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Medical Expenditures Attributed to Asthma and Chronic Obstructive Pulmonary Disease Among Workers — United States, 2011–2015

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Asthma and chronic obstructive pulmonary disease (COPD) are respiratory conditions associated with a significant economic cost among U.S. adults (*1*,*2*), and up to 44% of asthma and 50% of COPD cases among adults are associated with workplace exposures (*3*). CDC analyzed 2011–2015 Medical Expenditure Panel Survey (MEPS) data to determine the medical expenditures attributed to treatment of asthma and COPD among U.S. workers aged ≥18 years who were employed at any time during the survey year. During 2011–2015, among the estimated 166 million U.S. workers, 8 million had at least one asthma-related medical event,* and 7 million had at least one COPD-related medical event. The annualized total medical expenditures, in 2017 dollars, were $7 billion for asthma and $5 billion for COPD. Private health insurance paid for 61% of expenditures attributable to treatment of asthma and 59% related to COPD. By type of medical event, the highest annualized per-person asthma- and COPD-related expenditures were for inpatient visits: $8,238 for asthma and $27,597 for COPD. By industry group, the highest annualized per-person expenditures ($1,279 for asthma and $1,819 for COPD) were among workers in public administration. Early identification and reduction of risk factors, including workplace exposures, and implementation of proven interventions are needed to reduce the adverse health and economic impacts of asthma and COPD among workers.

MEPS is an annual household survey administered to a nationally representative sample of the noninstitutionalized civilian U.S. population through an in-person interview.† During the study period, 2011–2015, the years with the most recent available data, the annual survey response rates ranged from 54.9% in 2011 to 47.7% in 2015. To improve the precision and reliability of estimates, 2011–2015 data were combined.

Participants' self-reported information on medical conditions, the associated medical events, payments, source of payments, and employment status were collected during the MEPS interview. MEPS professional coders assigned a code to

* Hospital inpatient care, outpatient visits, emergency department visits, office-based visits, home health care, or purchase of prescribed medicines.

† https://meps.ahrq.gov/mepsweb/survey_comp/household.jsp.

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the medical condition or conditions associated with each medical event reported by the participant, using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM). Each medical event could be assigned one or more ICD-9-CM codes. Medical events associated with treated asthma were identified using ICD-9-CM code 493 and medical events associated with treated COPD were identified using ICD-9-CM codes 490, 491, 492, and 496.[§]

Expenditures were calculated from the sum of payments from Medicaid, Medicare, private insurance, out-of-pocket expenses, and other sources[¶] for each treated asthma- and COPD-associated medical event. The annualized, total and per-person unadjusted medical expenditures for workers with asthma and COPD were estimated by type of medical event and source of payments. Workers were those who were "currently employed," "had no job at the interview date but had a job to return to" or were employed at any time during the survey year. Information on participants' current industry was categorized into 15 industry groups.[**]

§ https://meps.ahrq.gov/data_stats/download_data/pufs/h180/h180doc.pdf.

¶ Veterans Administration/CHAMPVA, TRICARE, and other federal sources include Indian Health Service, military treatment facilities, and other care by the federal government. Other state and local sources include community and neighborhood clinics, state and local health departments, and state programs other than Medicaid, and workers' compensation. Other unclassified sources include sources such as automobile, homeowner's, and liability insurance and other miscellaneous or unknown sources.

** https://meps.ahrq.gov/data_stats/download_data/pufs/ind_occ/ind3.pdf.

Data were weighted to produce nationally representative estimates using sample weights adjusted for the 5-year data. Data were analyzed using SAS software (version 9.4; SAS Institute) to account for the complex survey design. Estimates with relative standard error (standard error of the estimate divided by the estimate) ≥30% are not reported. All expenditure values were expressed in 2017 U.S. dollars using the Medical Care Consumer Price Index.[††]

During 2011–2015, among the annual average estimated 166 million U.S. persons aged ≥18 years who were working at any time during the survey year, 8 million (5%) workers had at least one asthma-related medical event, and 7 million (4%) had at least one COPD-related medical event, which accounted for 21 million asthma-associated and 15 million COPD-related medical events (Table 1). The proportion of current smokers among workers who had an asthma event during the study period was 13%; 24% had a COPD event. Annualized average per-person medical expenditures attributable to treated asthma and COPD were $901 and $681, respectively. Highest annualized expenditures per person attributable to treated asthma and treated COPD were among non-Hispanic whites ($923 and $742, respectively), persons with health insurance ($914 and $705, respectively), and current nonsmokers ($936 and $692, respectively). By age group, annualized per-person expenditures

†† https://www.in2013dollars.com/Medical-care/price-inflation/2015-to-2017?amount.

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TABLE 1. Estimated number of workers with an asthma-related or chronic obstructive pulmonary disease–related medical event and annualized total and per-person expenditures,* by selected characteristics among workers aged ≥18 years — Medical Expenditure Panel Survey, United States, 2011–2015

		Asthma			Chronic obstructive pulmonary disease		
Characteristic†	No. of workers (x1,000)	No. of workers with an event (x1,000)	Total expenditures ($) in millions	Average expenditure ($) per person	No. of workers with an event (x1,000)	Total expenditures ($) in millions	Average expenditure ($) per person
Total	**166,347**	**7,920**	**7,137**	**901**	**7,371**	**5,021**	**681**
Age group (yrs)							
18–34	21,704	1,012	626	619	499	93	186
35–44	70,773	2,961	2,268	766	2,421	515	213
45–64	63,467	3,375	3,648	1,081	3,568	3,355	940
≥65	10,403	659	595	903	971	1,058	1,090
Sex							
Men	86,749	2,954	2,473	837	3,057	2,238	732
Women	79,598	5,053	4,663	923	4,403	2,783	632
Race/Ethnicity							
Hispanic	26,499	891	745	836	594	129	217
White, non-Hispanic	107,676	5,564	5,140	923	5,865	4,350	742
Black, non-Hispanic	18,712	1,037	879	847	613	375	611
Other	13,460	515	372	722	388	168	433
Household income							
<$35,000	39,521	1,794	1,520	847	1,810	1,091	603
$35,000–$74,999	53,373	2,486	2,112	850	2,579	2,113	819
≥$75,000	73,375	3,726	3,505	940	3,070	1,817	592
Education							
Less than high school	67,266	2,396	2,185	911	2,961	2,838	959
High school or more	98,269	5,607	4,951	883	4,468	2,170	486
Insurance coverage							
Yes	142,396	7,509	6,866	914	6,916	4,875	705
No	23,951	498	270	542	544	146	268
U.S. Census region§							
Northeast	29,696	1,851	1,787	965	1,281	984	768
Midwest	36,660	1,757	1,621	923	1,941	1,757	905
South	60,870	2,683	2,381	887	2,826	1,117	395
West	38,809	1,714	1,348	787	1,408	1,162	825
Current smoking status¶							
Smoker	24,820	955	664	695	1,636	1,024	626
Nonsmoker	125,570	6,514	6,097	936	5,220	3,612	692

* All medical expenditures expressed in 2017 U.S. dollars.
† Missing information on education for 812,000; on household income for 78,000; on region for 312,000; and on smoking status for 15,957,000 workers. Columns do not sum to totals because of rounding; those with missing values were excluded from the analysis.
§ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.
¶ Based on yes/no responses to the question "Do you currently smoke?"

for asthma and COPD were highest among persons aged 45–64 years ($1,081) ≥65 years ($1,090), respectively.

Prescription medication accounted for the highest number of events for asthma (15 million) and for COPD (8 million) (Table 2). The total annualized medical expenditures for treated asthma-related medical events among workers were $7 billion, and they were $5 billion for COPD. Derived using the pooled population-attributable fraction of 16% for asthma and 14% for COPD (*3*), annualized expenditures attributable to workplace exposures exceeded $1 billion for asthma and $700 million for COPD.

By type of medical event, prescription drugs for asthma ($5 billion) and inpatient visits for COPD ($2 billion) accounted for the highest total annualized expenditures. Annualized expenditures per person were highest for inpatient visits (excluding prescription medications): $8,238 for asthma and $27,597 for COPD. By source of payment, private health insurance paid for 61% ($4 billion) of expenditures attributable to treated asthma and 59% ($3 billion) of expenditures attributable to treated COPD. The highest annualized expenditures per person were paid by private insurance for asthma ($811) and Medicare for COPD ($983).

Among industry groups, the annualized expenditures per person for treated asthma were highest among public administration workers ($1,279), followed by transportation and utilities workers ($1,222) (Table 3). The annualized expenditures

TABLE 2. Estimated number of workers with asthma-related or chronic obstructive pulmonary disease–related medical event and annualized total and per-person expenditures,* by type of event and source of payment — Medical Expenditure Panel Survey, United States, 2011–2015

	Asthma				Chronic obstructive pulmonary disease			
Event/Source of payment[†]	Total no. of events	No. of workers with an event (x1,000)	Total expenditures ($) in millions	Average expenditure ($) per person	Total no. of events	No. of workers with an event (x1,000)	Total expenditures ($) in millions	Average expenditure ($) per person
Total[§]	**21,206**	**7,920**	**7,137**	**901**	**14,540**	**7,371**	**5,021**	**681**
Type of event								
Prescription drugs	15,008	5,361	5,216	973	8,421	3,733	1,627	436
Office based visits	5,503	2,117	921	435	5,262	3,064	1,041	340
Inpatient visits	66	63	519	8,238	71	62	1,711	27,597
Emergency department visits	412	332	372	1,121	441	375	442	1,178
Outpatient visits	210	126	106	841	293	205	166	810
Home health visits	8	8	3	375	52	21	35	1,667
Source of payment								
Private insurance	16,917	5,331	4,326	811	9,235	4,173	2,949	707
Out of pocket[¶]	22,907	6,673	1,370	205	14,489	5,993	664	111
Medicaid	3,011	977	681	697	1,859	647	391	604
Medicare	2,473	635	446	702	2,399	775	761	983
Other**	2,109	583	314	556	1,437	592	256	432

* All medical expenditures expressed in 2017 U.S. dollars.
† More than one type of medical event and source of payment could be reported per person.
§ Columns do not sum to totals because of rounding.
¶ Portion of total payments made by persons or families for services received during the year, including deductibles, coinsurance, and copayments for covered services plus all expenditures for services not covered by the insurance.
** Includes payments from the Department of Veterans Affairs (excluding TRICARE); other federal sources (Indian Health Service, military treatment facilities, and other care provided by the Federal Government); various state and local sources (community and neighborhood clinics, state and local health departments, and State programs other than Medicaid); payments from Workers' Compensation; and, other unclassified sources (e.g., automobile, homeowner's, or liability insurance, and other miscellaneous or unknown sources). It also includes private insurance payments reported for persons without private health insurance coverage during the year, as defined in the Medical Expenditure Panel Survey, and Medicaid payments reported for persons who were not enrolled in the Medicaid program at any time during the year (https://meps.ahrq.gov/mepstrends/hc_cond/).

per person for treated COPD were highest among public administration workers ($1,819), followed by construction workers ($1,198).

Discussion

COPD and asthma combined were among the top five most costly medical conditions among U.S. adults in 2012 (*4*). Among workers, the total medical expenditures attributable to the treatment of asthma and COPD were substantial ($7 billion for asthma and $5 billion for COPD) and varied by sociodemographic characteristics and industry. Workers in the public administration industry (e.g., police officers, correctional officers, jailers, firefighters, and secretaries and administrative assistants)[§§] had the highest annualized per-person expenditures for both asthma and COPD. In the public administration industry, an estimated 7.4% of workers have asthma, and 3.5% of workers have COPD.[¶¶] Variation in expenditures by industry might reflect the differences in prevalences, health insurance status, and access to medical care. Overall, workers with no health insurance had lower medical expenditures for asthma and for COPD than did those who had health insurance, suggesting that the uninsured population might have sought services through free clinics or might have limited their care-seeking (*1*,*3*). Based on the 2019 pooled population attributable fraction estimates of 16% for asthma and 14% for COPD, the estimated expenditures attributable to workplace exposures among workers exceeded $1 billion for asthma and $700 million for COPD.

Among workers, prescription medications accounted for the highest proportion of total medical expenditures attributable to the treatment of asthma, as did inpatient visits for the treatment of COPD, similar to previous findings among all U.S. adults (*1*,*5*). Inpatient visits accounted for the highest per-person expenditure for treated asthma and COPD. Higher expenditures related to inpatient visits have been highly correlated with asthma and COPD exacerbation severity (*5*,*6*). An estimated 67% of total asthma-attributable medical expenditures were

§§ https://datausa.io/profile/naics/92/.
¶¶ https://wwwn.cdc.gov/eWorld/Set/Work-Related_Respiratory_Diseases/88; https://www.cdc.gov/mmwr/volumes/67/wr/mm6713a1.htm.

TABLE 3. Estimated number of workers with an asthma-related or chronic obstructive pulmonary disease–related medical event and annualized total and per-person expenditures,* by industry groups among workers aged ≥18 years payment — Medical Expenditure Panel Survey, United States, 2011–2015

Industry group	No. of workers (x1,000)	Asthma: No. of workers with an event (x1,000)	Asthma: Total expenditures ($) in millions	Asthma: Average expenditure ($) per person	Chronic obstructive pulmonary disease: No. of workers with an event (x1,000)	Chronic obstructive pulmonary disease: Total expenditures ($) in millions	Chronic obstructive pulmonary disease: Average expenditure ($) per person
Natural resources	2,320	57	47	825	96	36	375
Mining	792	40	46	1,150	—†	—	—
Construction	10,500	221	214	968	344	412	1,198
Manufacturing	16,354	658	733	1,114	874	614	703
Wholesale and retail trade	21,400	1,005	940	935	821	404	492
Transportation and utilities	7,771	284	347	1,222	349	155	444
Information	3,306	155	136	877	137	76	555
Financial activities	10,142	435	363	834	416	180	433
Professional and business services	19,592	957	773	808	806	327	406
Education health and social services§	38,507	2,421	2,250	929	2,004	1,435	716
Leisure and hospitality	14,492	691	555	803	552	383	694
Other services¶	8,515	363	324	893	398	199	500
Public administration§	8,247	535	684	1,279	469	853	1,819
Military	355	—	—	—	—	—	—
Unclassifiable/Missing	4,054	—	—	—	—	—	—

* All medical expenditures expressed in 2017 U.S. dollars.
† Unreliable estimates (relative standard error (RSE) >30; standard error of the estimate divided by the estimate), data suppressed.
§ Includes education services workers and ambulatory healthcare services workers, hospitals, nursing and residential care facility workers and social assistance.
§ https://datausa.io/profile/naics/92.
¶ Other services industries include repair and maintenance, personal and laundry services, religious, grantmaking, civic, professional services, and private households and similar organizations.

Summary

What is already known about this topic?

Asthma and chronic obstructive pulmonary disease (COPD) are associated with substantial economic and health costs among U.S. workers.

What is added by this report?

During 2011–2015, total annualized medical expenditures among U.S. workers were $7 billion ($901 per person) for asthma and $5 billion ($681 per person) for COPD. Inpatient visits were associated with the highest average per-person expenditures for both conditions. Insured workers incurred higher expenditures than did uninsured workers.

What are the implications for public health practice?

Early identification and reduction of risk factors, including workplace exposures (e.g., vapors, gas, dusts, and fumes), and implementation of proven interventions are needed to reduce the adverse health and economic impacts of asthma and COPD among workers.

associated with prescription medications, which is higher than the 51% observed previously among all U.S. adults (*1*). The higher prescription medication expenditures might be associated with new and more costly treatment options or could be a result of inflation adjustments (*1*,*7*,*8*). Moreover, workers are more likely to have health insurance than are nonworkers (*9*); therefore, they might have fewer financial barriers to purchasing prescription medications, which might also partially explain the higher expenditures among workers.

The findings in this report are subject to at least four limitations. First, the number of medical events and expenditures associated with asthma and COPD were self-reported by respondents and might be subject to recall bias. However, self-reported medical events and expenditure data, including office-based visits, emergency department visits, and hospitalizations, have been shown to correspond well with health care utilization data (*10*). Second, workers could have been treated for comorbidities during their asthma- or COPD-related medical encounter; therefore, a portion of medical expenditures might not be directly associated with asthma or COPD. Third, workers might have changed employment from the industry in which they were employed at the time of their asthma- or COPD-related medical events; therefore, medical expenditures by industry group might not reflect the actual industry the worker was employed in when the expenditure was incurred. Finally, small sample sizes for some groups resulted in unreliable estimates.

Annualized overall and per-person medical expenditures attributable to treated asthma and treated COPD among workers were substantial. Early identification and reduction of risk factors, including workplace exposures (e.g., vapors dusts gas and fumes), and implementation of proven interventions are needed to reduce the adverse health and economic impacts of asthma and COPD among workers. Prioritizing intervention efforts aimed at preventing asthma and COPD among workers, especially among those with higher medical costs, by supporting workplace programs and policies (e.g., smoke-free workplace policies, smoking cessation programs, and workplace exposure control measures) can reduce the impact of disease and improve worker health.*** Continued surveillance is important to identify workers with high prevalences of asthma or COPD and less consistent access to health care.

*** https://goldcopd.org/wp-content/uploads/2018/11/GOLD-2019-v1.7-FINAL-14Nov2018-WMS.pdf; https://ginasthma.org/wp-content/uploads/2019/06/GINA-2019-main-report-June-2019-wms.pdf.

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Salmonellosis Outbreak Detected by Automated Spatiotemporal Analysis — New York City, May–June 2019

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In May 2019, the New York City Department of Health and Mental Hygiene (NYCDOHMH) detected an unusual cluster of five salmonellosis patients via automated spatiotemporal analysis of notifiable diseases using free SaTScan software (*1*). Within 1 day of cluster detection, graduate student interviewers determined that three of the patients had eaten prepared food from the same grocery store (establishment A) located inside the cluster area. NYCDOHMH initiated an investigation to identify additional cases, establish the cause, and provide control recommendations. Overall, 15 New York City (NYC) residents with laboratory-diagnosed salmonellosis who reported eating food from establishment A were identified. The most commonly consumed food item was chicken, reported by 10 patients. All 11 clinical isolates available were serotyped as *Salmonella* Blockley, sequenced, and analyzed by core genome multilocus sequence typing; isolates had a median difference of zero alleles. Environmental assessments revealed food not held at the proper temperature, food not cooled properly, and potential cross-contamination during chicken preparation. Elevated fecal coliform counts were found in two of four ready-to-eat food samples collected from establishment A, and *Bacillus cereus* was detected in three. The outbreak strain of *Salmonella* was isolated from one patient's leftover chicken. Establishing automated spatiotemporal cluster detection analyses for salmonellosis and other reportable diseases could aid in the detection of geographically focused, community-acquired outbreaks even before laboratory subtyping results become available.

Investigation and Results

On May 21, 2019, NYCDOHMH detected a spatiotemporal cluster of five salmonellosis patients reported through passive surveillance by electronic laboratory reporting (*2*). These patients resided within a 0.3-mile (0.48-km) radius and had "event dates" (illness onset dates if available, otherwise specimen collection dates) during May 11–17. The cluster's recurrence interval (*3*) was 2.3 years, indicating that one would expect to see one cluster of that magnitude in any 2.3-year period. This cluster was detected because each weekday, using SaTScan, NYCDOHMH applies the prospective space-time permutation scan statistic (*4*,*5*) to scan for recent increases (parameter settings included maximum temporal cluster size of 60 days and maximum spatial size of 50% of observed events during a 1.5 year-study period) in the occurrence of salmonellosis cases based on patients' event dates and geocoded home addresses.[†]

At NYCDOHMH, CDC FoodCORE–funded graduate student interns attempt to interview all reported salmonellosis patients as soon as feasible after initial report to collect possible exposure information with minimal recall bias (*6*); median time from report of salmonellosis to completion of interview is generally 2 days. At the time of cluster detection on May 21, interviews had not yet been completed with any cluster patients. The cluster notification prompted interviewers to be vigilant for any common food, grocery store, or restaurant exposures. Once interviews of patients in the initial cluster were completed, student interns immediately compared interviews to look for any common exposures. On May 22, interviewers determined that three of the five patients had eaten prepared food from establishment A.

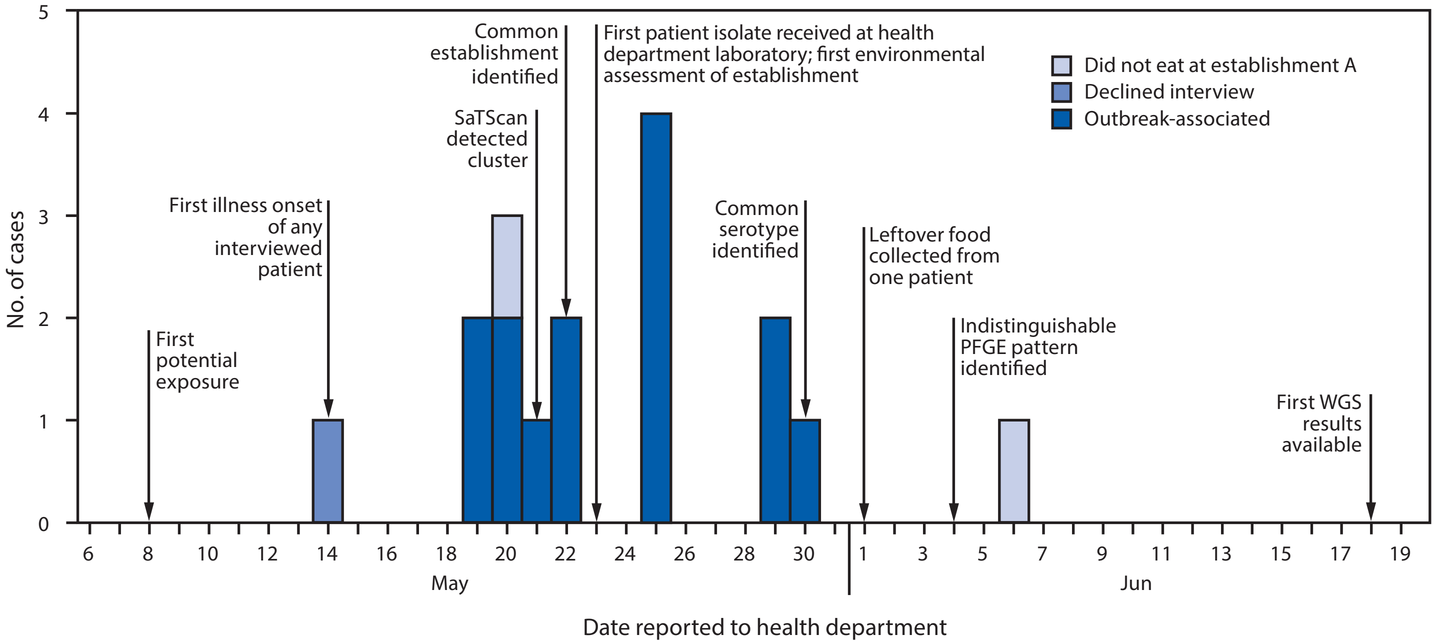
On May 23, the New York State Department of Agriculture and Markets inspected establishment A to assess food handling practices. On the same day, the NYCDOHMH Office of Environmental Investigations distributed stool collection kits for *Salmonella* testing to 18 food handlers involved in food preparation at establishment A; the first food handler specimen was collected on May 25.

An outbreak-associated case was defined as a laboratory diagnosis of *Salmonella* infection in a NYC resident who reported eating food from establishment A in the 7 days preceding illness onset. Among 17 salmonellosis patients included in the SaTScan cluster during May 21–June 19, interviews were completed with 16 patients, 14 of whom had illnesses meeting the outbreak case definition (Figure). In addition, one food handler not included in the SaTScan cluster also had an illness that met the outbreak case definition but did not cause the outbreak, based on 10 outbreak patients having had symptom onset prior to the food handler. The 15 patients with outbreak-associated cases (14 patrons of establishment A and one food handler) reported eating food from establishment A during May 8–20 and had illness onset during May 14–21. None of the patients resided in the same household. Nine patients were female, and the median age was 42 years (range = 26–61 years). The most common food item consumed, reported by 10 patients, was chicken (rotisserie chicken, chicken salad, or chicken soup).

* These authors contributed equally to this report.

[†] https://github.com/CityOfNewYork/communicable-disease-surveillance-nycdohmh.

FIGURE. Cases of salmonellosis (N = 17) included in a SaTScan* spatiotemporal cluster, by date reported to health department — New York City, May–June 2019



Abbreviations: PFGE = pulsed-field gel electrophoresis; WGS = whole genome sequencing.
* https://www.satscan.org/.

Outbreak-associated patient isolates were subtyped at the NYCDOHMH Public Health Laboratory and the New York State Department of Health Wadsworth Center. Eleven of the 15 patients had isolates available for subtyping. All were serotyped as *S*. Blockley, with a median difference by whole genome sequencing (WGS) of zero alleles (range = 0–1 alleles). Pulsed-field gel electrophoresis (PFGE) was performed on nine clinical isolates; all were indistinguishable from each other.

One patient had leftover rotisserie chicken from establishment A, which had not been handled after illness onset and was held under refrigeration until collected by NYCDOHMH on June 1 for testing. *S.* Blockley with an indistinguishable PFGE pattern and 0–1 alleles difference by WGS from the clinical isolates was isolated from the leftover chicken.

On June 5, a second environmental assessment of establishment A was conducted by the New York State Department of Agriculture and Markets jointly with the NYCDOHMH Office of Environmental Investigations. The establishment was immediately notified of violations revealed by this assessment, including ambient temperature of a walk-in refrigerator of 51°F (10.6°C) instead of ≤40°F (4.4°C); opportunities for potential cross-contamination, such as preparing raw chicken in the walk-in cooler and using gloved hands to open walk-in doors during food preparation; using an inadequately calibrated food thermometer; improper hot- and cold-holding of cooked foods; and inadequate cooling of cooked foods. Eight environmental sponge swabs and four ready-to-eat food samples were also collected for testing at NYCDOHMH Public Health Laboratory. The eight environmental swabs tested negative for *Salmonella*, but two ready-to-eat food samples had elevated fecal coliform counts (>1,100 most probable number/gram), and three food samples tested positive for *Bacillus cereus* (range per sample = 70–670 colony-forming units [CFU]/gram), although below the threshold required to cause illness (10^5–10^6 CFU/gram) (*7*); these findings were consistent with identified deficiencies in holding temperatures that could allow bacterial proliferation.

To evaluate whether spatiotemporal cluster detection analyses might have contributed to reducing typical delays in taking public health action, the investigation timeline of this outbreak was compared with timelines of previous investigations conducted by NYCDOHMH meeting the following three criteria: 1) the outbreak included at least three patients with a positive laboratory test result for *Salmonella* reported through passive surveillance, such that the outbreak might have been possible to detect via an automated analysis using SaTScan or another method; 2) the investigation occurred during September 2009–May 2019 when graduate student interviewers were in place, such that staffing levels were sufficient to feasibly collect and assess exposures reported by patients (*6*); and 3) the public health response included an environmental assessment of a restaurant or grocery store.

The outbreak described in this report was detected within 2 days of the third case being reported through passive surveillance, compared with a median of 13 days (range = 6–57 days) for five previous outbreaks (Table). An environmental

TABLE. Characteristics of selected* salmonellosis outbreaks — New York City, September 2009–May 2019

Month/ Year OB detected	Method by which OB came to attention of NYCDOHMH	Days from third NYC case reported to OB detection	Days from OB detection to first NYC environmental assessment	No. of NYC residents meeting OB case definition	Median age/yrs (range)	% Female	*Salmonella* serotype(s)	Source	Environmental findings
07/2011	Another health dept. notified NYCDOHMH of increase in *S.* Heidelberg among persons in the Orthodox Jewish population	57	111	73	16 (<1–90)	44	Heidelberg	Broiled chicken livers†	Chicken livers appeared to be ready-to-eat and were not cooked to appropriate internal temperature; outbreak strain isolated from product samples
02/2012	NYCDOHMH applied historical limits method§ to serotyping results	6	21	23	28 (11–74)	57	Bareilly/ Nchanga	Frozen chopped tuna¶	Gloves not worn by cooks; product samples collected and tested negative for *Salmonella*
08/2015	PHL identified patient cluster with indistinguishable PFGE patterns	8	21	8	22 (<1–56)	38	Oranienburg	Not determined, but common restaurant	No critical violations noted
03/2018	PHL identified patient cluster with indistinguishable PFGE patterns	22	8	6	28.5 (13–32)	83	Saintpaul	Not determined, but common restaurant	No critical violations noted; product samples collected and tested negative for *Salmonella*
03/2019	Another health dept. notified NYCDOHMH of two NYC cases with PFGE patterns indistinguishable to cases in nearby states	13	48	16	24.5 (3–87)	38	Typhimurium	Not determined, but common restaurant	No critical violations noted
03/2019	NYCDOHMH automated alert for any newly reported *S.* Concord cases following a recent multistate cluster associated with tahini	−30**	21	4	15.5 (<1–30)	50	Concord	Tahini††	No critical violations noted; outbreak strain isolated from product samples
05/2019	NYCDOHMH automated spatiotemporal analysis using SaTScan	2	2	15	42 (26–61)	60	Blockley	Chicken at a common grocery store	Improper hot- and cold-holding; potential cross-contamination between raw chicken and ready-to-eat foods; use of poorly calibrated food thermometer; inadequate cooling of cooked foods; elevated fecal coliform counts (two product samples); *Bacillus cereus* detected (three product samples); OB strain isolated from patient's leftover food

Abbreviations: NYC = New York City; NYCDOHMH = New York City Department of Health and Mental Hygiene; OB = outbreak; PFGE = pulsed-field gel electrophoresis; PHL = NYCDOHMH Public Health Laboratory.

* Outbreaks with three or more patients with a positive laboratory test result for *Salmonella* reported through passive surveillance during a period when graduate student interns routinely attempted interviews with all reported salmonellosis patients, and the public health response included an environmental assessment of a restaurant or grocery store.

† Hanson H, et al. Creating student sleuths: how a team of graduate students helped solve an outbreak of *Salmonella* Heidelberg infections associated with kosher broiled chicken livers. J Food Prot 2014;77:1390–3.

§ Stroup DF, et al. Evaluation of a method for detecting aberrations in public health surveillance data. Am J Epidemiol 1993;137:373–80.

¶ https://www.cdc.gov/salmonella/bareilly-04-12/index.html.

** Ultimately, four patients were included in this cluster, but investigation began after notification of the first patient, given a recently investigated multistate cluster of the same serotype (https://www.cdc.gov/salmonella/concord-11-18/index.html); this cluster was distinct from the previously investigated cluster based on molecular subtyping. This finding was excluded from the summary calculation in the text.

†† https://www.cdc.gov/salmonella/concord-05-19/index.html.

assessment was performed within 2 days of outbreak detection, compared with a median of 21 days (range = 8–111 days) for six previous outbreaks.

Discussion

This investigation illustrates the utility of integrating automated spatiotemporal cluster detection analyses into applied public health practice. In a jurisdiction with approximately 1,000 salmonellosis cases diagnosed each year,[§] a focal cluster consisting initially of just five cases was detected by NYCDOHMH before any patient interviews were completed, patient isolates were received at a public health laboratory, or laboratory subtyping results were available. Rapid detection, coupled with interviews conducted by experienced investigators, facilitated food handler testing, environmental assessments highlighting food handling deficiencies, prioritization of patient isolates for molecular subtyping, and collection of patient leftovers for testing before they were discarded. This local investigation, which confirmed chicken as the outbreak source, was later incorporated into a multistate investigation of *S.* Blockley associated with chicken.

It is uncommon for NYCDOHMH to detect a salmonellosis outbreak in the absence of any laboratory subtyping data (*8*) or any single report of multiple ill patients. As of July 15, 2019, CDC PulseNet transitioned its primary molecular subtyping tool from PFGE to WGS, which will improve foodborne outbreak detection through detailed pathogen characterization (*9*,*10*). However, the additional time required for WGS testing could result in a lag in identifying some outbreaks; and some outbreaks might be missed if isolates for subtyping are unavailable with use of culture-independent diagnostic tests, or if not all isolates can be tested, given public health laboratory capacity limitations. In February 2019, ahead of PulseNet's transition to WGS, NYCDOHMH set up automated analyses using SaTScan to detect salmonellosis clusters without regard to laboratory subtyping results.

Rapid detection of this focal, community-based outbreak relied on critical public health infrastructure and informatics, including automated and timely electronic laboratory reporting, transfer of disease reports to a disease surveillance database, geocoding of patients' residences, and analyses using SaTScan. Once detected, the rapid outbreak response relied on adequately resourced student interviewers, epidemiologists, environmental health inspectors, and laboratory personnel. Establishing automated spatiotemporal cluster detection analyses for salmonellosis and other reportable diseases could aid in the detection of geographically focused, community-acquired outbreaks.

[§] https://a816-health.nyc.gov/hdi/epiquery/.

Summary

What is already known about this topic?

Whole genome sequencing (WGS) improves detection of foodborne outbreaks caused by contaminated products. However, detecting geographically focal outbreaks can be delayed pending WGS results, and public health laboratory capacity limitations might preclude sequencing of all *Salmonella* isolates.

What is added by this report?

Through daily automated spatiotemporal analysis of notifiable diseases, a salmonellosis outbreak in New York City was detected 9 days before availability of serotyping results. Early detection primed investigators to look for common exposures and facilitated rapid environmental assessments, leftover food collection, and prioritization of isolates for subtyping.

What are the implications for public health practice?

Along with laboratory subtyping results, public health officials can use spatiotemporal cluster detection analyses to prioritize investigations.

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Use of Molecular Epidemiology to Inform Response to a Hepatitis A Outbreak — Los Angeles County, California, October 2018–April 2019

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Los Angeles County comprises 4,058 square miles and is home to approximately 10 million residents (*1*), an estimated 59,000 (0.6%) of whom experience homelessness on a given night (*2*). In late 2018, Los Angeles County Department of Public Health (LAC DPH) was notified of a case of hepatitis A virus (HAV) infection in a person experiencing homelessness. LAC DPH conducted an investigation to determine the source of infection, identify additional cases, and identify contacts for postexposure prophylaxis (PEP). Over the next week, LAC DPH identified two additional hepatitis A cases in persons experiencing homelessness who knew one another socially and were known to congregate at a specific street intersection. To identify and respond rapidly to additional outbreak-associated cases, LAC DPH implemented enhanced surveillance procedures, including immediately obtaining specimens for molecular testing from all patients with suspected hepatitis A in the same geographic area. Enhanced surveillance identified four additional cases in persons linked to a senior living campus within two blocks of the intersection where the initial three patients reported congregating. These four cases were linked to the cluster in persons experiencing homelessness through HAV genotyping. Overall, DPH identified seven outbreak-associated hepatitis A cases during October 2018–January 2019. The DPH response to this community hepatitis A outbreak included conducting vaccination outreach to persons at risk, conducting environmental health outreach to restaurants in the outbreak area, and issuing health care provider alerts about the increased occurrence of hepatitis A. Implementation of near real-time molecular testing can improve hepatitis A outbreak responses by confirming HAV infections, linking additional cases to the outbreak, and informing the targeting of prevention efforts.

Investigation and Results

Health care providers and clinical laboratories are mandated to report hepatitis A cases within one working day of identification.* DPH staff members investigate reported hepatitis A cases to determine whether they meet the national surveillance acute hepatitis A case definition. In 2018, a confirmed case of acute HAV infection was defined as illness occurring in a person with 1) a discrete onset of hepatitis symptoms, 2) jaundice or elevated alanine aminotransferase (ALT) or aspartate aminotransferase (AST), and 3) reactive anti-HAV immunoglobulin (Ig) M antibody (*3*). Patients with confirmed HAV infection are interviewed using a standard questionnaire to assess risk factors and to identify contacts who can be offered PEP.

On November 10, 2018, an acute hepatitis A case was reported to DPH in a person experiencing homelessness who used methamphetamines (patient A) (Table) (Figure). Medical records review indicated that patient A was transported to the emergency department of hospital A by ambulance from intersection X but left the hospital against medical advice and could not be located by DPH for interview. Patient A did not report nausea, vomiting, or abdominal pain but did have left flank pain, fever, an elevated ALT and a positive anti-HAV IgM test result. Another person experiencing homelessness who reported methamphetamine use (patient B) was evaluated 3 days later at hospital B with a 3-day history of nausea and abdominal pain. The patient received a diagnosis of HAV infection, and the diagnosis was reported to DPH on November 14, 2018.

Upon DPH interview, patient B reported using public restrooms located in restaurants and stores at intersection X and named patient A as a contact who was ill. Patient B also named an acquaintance (patient C) with acute hepatitis A who had been reported to DPH 1 month earlier and could not be interviewed when originally reported. Patient B stated that patient C also frequented intersection X, lived unsheltered nearby, and had shared drug equipment with patient A. Serum from patients A and B were sent to the California Department of Public Health (CDPH) Viral and Rickettsial Disease Laboratory for sequence-based genotyping targeting a segment of the VP1-P2B genomic region (*4*). A genotype IB sequence (CA Cluster [Cls] A) matching a recent outbreak strain, USA/2017/V17S07250 (GenBank accession number MH577310), was detected in both specimens.

After identifying hepatitis A cases in three epidemiologically linked persons, DPH implemented enhanced surveillance procedures to rapidly detect and respond to any secondary cases. Enhanced surveillance was conducted within a 50-square mile area bounded by four major freeways, on the assumption that movement of persons might be constrained by these roadways. DPH immediately attempted to obtain and hold all anti-HAV IgM-positive serum specimens from patients residing within the outbreak area; serum specimens from persons who met

* Per Title 17 of the California Code of Regulations. Cal. Code Regs. tit. 17, sect. 2500, sect. 2505 (2020).

TABLE. Demographic and clinical characteristics of patients with suspected outbreak-associated hepatitis A virus (HAV) infection — Los Angeles County, California, October 2018–April 2019*

Characteristic	Patient											
	A	B	C	D†	E	F†	G	H	I†	J	K†	L†
Report date§	Nov 11, 2018	Nov 14, 2018	Oct 18, 2018	Nov 20, 2018	Dec 5, 2018	Dec 9, 2018	Dec 11, 2018	Dec 21, 2018	Jan 7, 2019	Jan 13, 2019	Feb 5, 2019	Mar 6, 2019
Age group (yrs)	35–44	35–44	35–44	18–34	55–64	35–44	≥75	18–34	65–74	≥75	18–34	45–54
Jaundice	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Symptoms¶	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Hospitalized	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
HAV IgM+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ALT >200	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
TBil ≥3.0	No	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Genotype	IB	IB	Unknown	Unknown	IB	Unknown	Unknown	IB	IA	IB	IB	Unknown
Strain	CA Cls A	CA Cls A	Unknown	Unknown	CA Cls A	Unknown	Unknown	CA Cls A	Unique	CA Cls A	A16MI Cls 2	Unknown
Homeless	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	No
Illegal drug use**	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes	No
Linked to senior living campus	No	No	No	No	Yes (visitor)	No	Yes (resident)	Yes (staff member)	No	Yes (resident)	No	No
Epi-link to outbreak case	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No
Met surveillance case definition††	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Met outbreak case definition§§	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No

Abbreviations: ALT = alanine amino transferase; CA = California; Cls = cluster; Epi-link = epidemiologic link; HAV IgM+ = positive immunoglobulin M antibody against HAV; TBil = total bilirubin.

* Los Angeles County Department of Public Health declared the outbreak over after 100 days without additional outbreak-associated hepatitis A cases (representing two HAV infection incubation periods)

† Not outbreak-associated.

§ Dates have been shifted to preserve patient confidentiality.

¶ Symptoms compatible with acute HAV infection, including fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain.

** Includes illegal drug use in the state of California, including use of methamphetamines, cocaine, heroin, and prescription opioids that have not been prescribed to the user. Does not include marijuana use.

†† National surveillance acute hepatitis A case definition in 2018: acute illness with discrete onset of symptoms consistent with acute viral hepatitis, jaundice or elevated ALT or aspartate aminotransferase, and IgM antibody to hepatitis A virus (anti-HAV) positive.

§§ Hepatitis A infections in persons residing or spending time in outbreak area and infection caused by HAV genotype IB, CA Cls A, or if no genotype available, epidemiologic link to outbreak case.

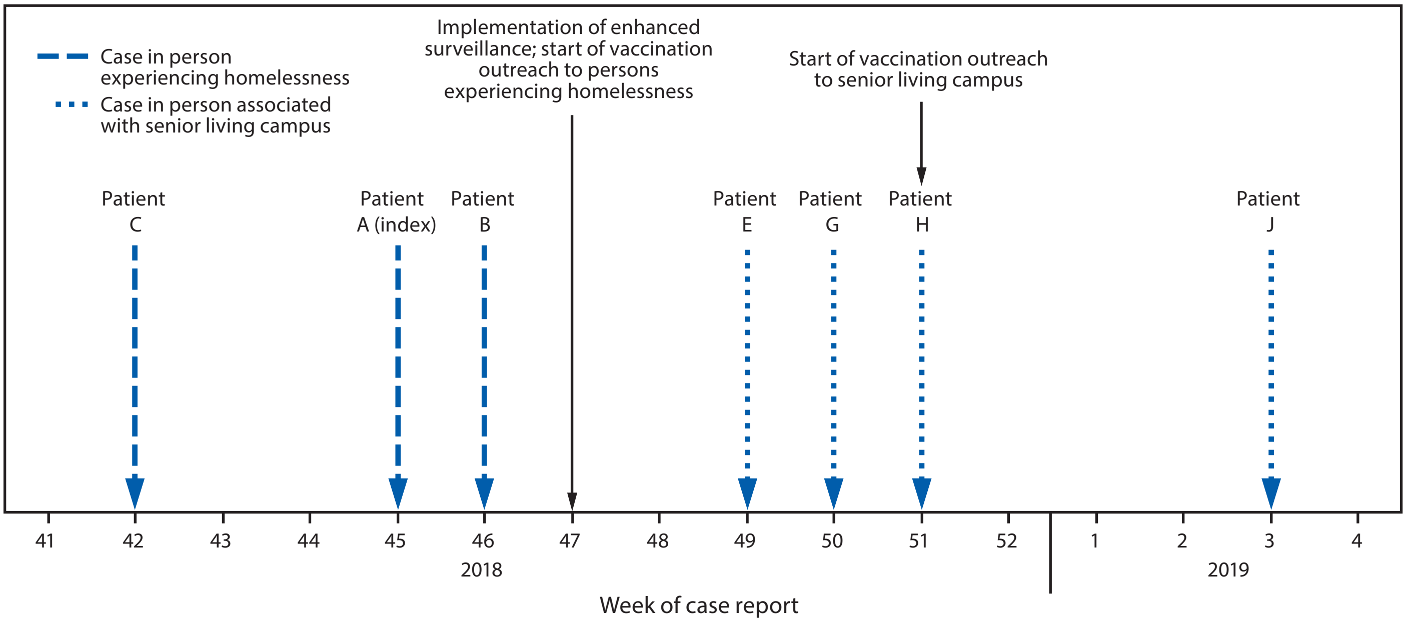
the national surveillance acute hepatitis A case definition or were epidemiologically linked to a confirmed case were sent to CDPH for molecular testing. These procedures were maintained until 100 days had elapsed without additional outbreak-associated hepatitis A cases (representing twice the HAV infection incubation period).

Outbreak-associated cases were defined as HAV infections occurring in persons who 1) resided or spent time in the outbreak area during October 15, 2018–April 29, 2019 and 2) either had infections caused by the HAV genotype IB CA Cls A strain or were epidemiologically linked to a person infected with the outbreak strain. DPH staff members interviewed persons linked to the outbreak with a supplementary outbreak-specific questionnaire to 1) assess any additional sources of HAV exposure, 2) identify potentially ill persons who might not have sought medical care, and 3) identify areas where ill persons congregated during the infectious period to guide prevention outreach efforts.

Among the 19 anti-HAV IgM-positive cases reported to DPH during November 10, 2018–April 29, 2019, from the outbreak area, 10 did not meet the national surveillance acute hepatitis A case definition (surveillance case definition) or outbreak hepatitis A case definition (outbreak case definition). Five patients (D, F, I, K, and L) did meet the surveillance case definition but did not meet the outbreak case definition (Table), two (E and H) met both the surveillance and outbreak case definitions, and two (G and J) met the outbreak case definition only. Patient K's illness was initially classified as an outbreak-associated case because the patient reported both homelessness and methamphetamine use and resided near intersection X during the incubation period. However, genotyping subsequently revealed that patient K was infected with a different HAV strain, so the case was reclassified as not outbreak-associated.

The four outbreak-associated cases (in patients E, G, H, and J) identified after the initial three (in patients A, B, and C) occurred in persons who did not report homelessness or illegal drug use (Table) (Figure). These four cases were linked to a senior living campus as either residents (two), a staff member (one), or a visitor (one). Serum for molecular testing was available for

FIGURE. Timeline of confirmed outbreak-associated* hepatitis A virus (HAV) cases and public health response — Los Angeles County, California, October 2018–January 2019†,§



* Outbreak cases were defined as HAV infections occurring in persons who 1) resided or spent time in the outbreak area and 2) either had infections caused by HAV genotype IB CA cluster A strain or were epidemiologically linked to a person infected with the outbreak strain.

† Dates have been shifted to preserve patient confidentiality.

§ Enhanced surveillance continued until the outbreak was declared over in April 2019. Los Angeles County Department of Public Health declared the outbreak over after 100 days without additional outbreak-associated HAV cases (representing two HAV infection incubation periods).

patients E, H, and J; all were HAV genotype IB, CA Cls A. Patients G and J did not meet the surveillance case definition because they did not have symptoms compatible with acute hepatitis. Patient J, however, had an infection caused by the outbreak strain and patient G was epidemiologically linked to patient E, who was infected with the outbreak strain. All four patients were interviewed to assess potential common exposures to patients A, B, and C. Patients G and H reported patronizing businesses in intersection X.

DPH maintained enhanced surveillance for 100 days following the last day of patient J's infectious period and identified no additional outbreak cases. Five of the seven persons with outbreak-associated HAV infection were hospitalized (Table); none died. DPH declared the outbreak over on April 29, 2019.

Public Health Response

After identification of cases of HAV infection in persons experiencing homelessness, DPH sent a health alert to Los Angeles County health care personnel advising them to remain vigilant for hepatitis A in persons experiencing homelessness or using drugs and to immediately notify DPH of any suspected hepatitis A cases.

Based on responses of patients with outbreak-associated cases to the outbreak-specific questionnaire, DPH targeted hepatitis A vaccination efforts to reach persons with similar risk factors in the geographic area where patients A, B, and C had dwelt beginning November 22 (week 47) (*5*). After identification of a confirmed outbreak-associated case in a visitor to the senior living campus (patient E) and a suspected case in the resident visited by patient E (and before identification of the other two outbreak-associated cases), hepatitis A vaccination clinics were held for residents and staff members beginning the week of December 17 (week 51) (Figure). In total, 857 hepatitis A vaccine doses were provided at the senior living campus, drug treatment centers, food pantries, and homeless shelters during November 22, 2018–March 13, 2019.

Environmental health staff members visited 22 restaurants near intersection X and the senior living campus to assess sanitation and hygiene procedures and provide education. They also sent an email with information about hepatitis A and sanitation to all restaurants within the two ZIP codes where patients A, B, and C spent time during their infectious periods.

Discussion

A hepatitis A outbreak occurred in Los Angeles County among persons with a history of homelessness and illegal drug use and among persons residing in the same geographic area who had no identifiable hepatitis A risk factors (*6*,*7*). Since

Summary

What is already known about this topic?

Sequence-based genotyping has been valuable for retrospectively characterizing and identifying the potential sources of hepatitis A outbreaks.

What is added by this report?

After identification of a case of hepatitis A in a person experiencing homelessness, Los Angeles County implemented enhanced surveillance and near real-time molecular testing, which identified two additional cases in homeless persons and four cases in a senior living campus; genotyping results linked the two clusters and informed the outbreak response.

What are the implications for public health practice?

Conducting sequence-based genotyping of hepatitis A virus strains, especially early in an outbreak when there are few cases, can result in targeted and timelier implementation of effective prevention and control efforts.

2016, multiple large and ongoing hepatitis A outbreaks have occurred in the United States, disproportionately affecting persons with a history of homelessness or drug use (*7*,*8*). Genotyping has been used to retrospectively characterize the HAV strains causing the outbreaks (*8*). This report describes the use of rapid molecular testing in LAC to guide an ongoing community hepatitis A outbreak response by confirming infection, linking cases to the outbreak, and informing prevention outreach efforts.

Genotyping improved outbreak characterization and response in several ways. First, genotyping helped to narrow the scope of LAC DPH response activities by excluding cases identified as having a nonmatching strain. For example, patient K would have been considered part of the outbreak based on epidemiologic factors alone. Because patient K's HAV strain did not match the outbreak strain, DPH was able to reduce the period of enhanced surveillance by approximately 3 weeks and redirect efforts toward investigating an independent chain of transmission. Second, the identification of matching strains helped to link cases that did not have any other apparent epidemiologic connections, leading DPH to hypothesize that transmission occurred through exposure to common community spaces (such as public restrooms) and conduct outreach to local businesses to encourage enhanced environmental sanitation procedures. Finally, molecular testing confirmed infections in persons who did not meet the national surveillance acute hepatitis A case definition. Confirming these additional cases provided LAC DPH with an opportunity to implement timely control measures and potentially prevented additional cases.

Obtaining specimens for HAV genotyping is challenging. Serum intended for sequencing must be appropriately processed and frozen within 72 hours of collection, which commercial laboratories typically only do upon request. The routine hepatitis A surveillance case reporting and investigation process can take >72 hours, so often serum is no longer available by the time a case is confirmed. Therefore, as part of the enhanced surveillance efforts, DPH immediately contacted laboratories to obtain any anti-HAV IgM-positive serum within the outbreak area while investigating to determine if the specimen met criteria for molecular testing. The increased resource requirement for the expanded effort (in terms of staff member time and shipping costs) was manageable because it was limited to a defined period and within a specific geographic area. However, in the setting of widespread community transmission, such an approach might not be feasible.

The findings in the report are subject to at least three limitations. First, the CA Cls A strain is a commonly identified cause of many national hepatitis A outbreaks, indicating that it might be an endemic strain (*4*). Therefore, it is possible that the outbreak-associated cases linked to the senior living campus represent a chain of transmission distinct from the cases among persons experiencing homelessness or using drugs. Second, HAV strain results must be interpreted in the context of the epidemiologic information. The interpretation of genotyping results from this investigation might have been limited by patients' not disclosing certain risk factors or exposures. Finally, the sensitivity of molecular testing for confirming hepatitis A can be reduced by improper specimen handling or if specimens are obtained after a substantial time has elapsed since symptom onset. Thus, it is possible that some anti-HAV IgM-positive cases were misclassified as false-positive case reports.

This outbreak response illustrates the value of using rapid HAV molecular testing to characterize an outbreak and guide the public health response to contain the outbreak. HAV genotyping can be helpful in identifying and interrupting the chain of transmission early in an outbreak when there are few cases. HAV genotyping in other contexts might provide additional insights into its optimal use for outbreak prevention and control.

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Screening for SARS-CoV-2 Infection Within a Psychiatric Hospital and Considerations for Limiting Transmission Within Residential Psychiatric Facilities — Wyoming, 2020

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In the United States, approximately 180,000 patients receive mental health services each day at approximately 4,000 inpatient and residential psychiatric facilities (*1*). SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), can spread rapidly within congregate residential settings (*2*–*4*), including psychiatric facilities. On April 13, 2020, two patients were transferred to Wyoming's state psychiatric hospital from a private psychiatric hospital that had confirmed COVID-19 cases among its residents and staff members (*5*). Although both patients were asymptomatic at the time of transfer and one had a negative test result for SARS-CoV-2 at the originating facility, they were both isolated and received testing upon arrival at the state facility. On April 16, 2020, the test results indicated that both patients had SARS-CoV-2 infection. In response, the state hospital implemented expanded COVID-19 infection prevention and control (IPC) procedures (e.g., enhanced screening, testing, and management of new patient admissions) and adapted some standard IPC measures to facilitate implementation within the psychiatric patient population (e.g., use of modified face coverings). To assess the likely effectiveness of these procedures and determine SARS-CoV-2 infection prevalence among patients and health care personnel (HCP) (*6*) at the state hospital, a point prevalence survey was conducted. On May 1, 2020, 18 days after the patients' arrival, 46 (61%) of 76 patients and 171 (61%) of 282 HCP had nasopharyngeal swabs collected and tested for SARS-CoV-2 RNA by reverse transcription–polymerase chain reaction. All patients and HCP who received testing had negative test results, suggesting that the hospital's expanded IPC strategies might have been effective in preventing the introduction and spread of SARS-CoV-2 infection within the facility. In congregate residential settings, prompt identification of COVID-19 cases and application of strong IPC procedures are critical to ensuring the protection of other patients and staff members. Although standard guidance exists for other congregate facilities (*7*) and for HCP in general (*8*), modifications and nonstandard solutions might be needed to account for the specific needs of psychiatric facilities, their patients, and staff members.

Wyoming's state psychiatric hospital is a complex residential facility comprising three very different units: Adult Psychiatric Services, Medical Geriatric Psychiatric Services, and Criminal Justice Services. Each unit presents its own multifaceted challenges in terms of patient populations, the level of care required, and the risks to HCP posed by patient behaviors, which are not typically encountered in other residential settings. Patients at the state hospital are all aged ≥19 years, and admissions come from other health care, group residential, and correctional facilities within the state. Approximately 300 staff members are employed at the hospital, mostly HCP who provide varying levels of patient care. The hospital currently has a 104-bed capacity, with approximately 65% of beds in double occupancy rooms.

The state hospital had no known COVID-19 cases among patients or staff members before the transfer of two patients from a private psychiatric hospital on April 13, 2020. In late March, the state hospital had started some testing of new admissions and patients with COVID-19–like symptoms, and staff members had been advised to seek testing through their primary care providers if they had symptoms suggestive of COVID-19, but no cases had been identified. In early April, the originating private hospital had performed SARS-CoV-2 testing for one of the transferred patients when planning for transfer to an alternative facility and received a negative result on April 3, 2020; no testing was performed for the second patient before transfer to the state hospital. Because of the reported COVID-19 outbreak at the private facility (*5*), both patients were tested at the time of admission to the state hospital. While awaiting test results, both patients were isolated in separate rooms as a precautionary measure, and any staff members with exposure to the two patients during transport or admission while not wearing all recommended personal protective equipment (PPE) (*8*) were asked to self-quarantine.

When both patients received positive laboratory test results, the state hospital immediately implemented enhanced measures to prevent further transmission, including 1) the screening and testing of all new patients by a dedicated admissions team, 2) immediate isolation of new patients in separate rooms until receipt of test results, and 3) isolation and management of new patients with positive SARS-CoV-2 test results in a separate ward (supported by eight dedicated nurses who provided clinical care and housekeeping services) for 2 weeks or until receipt of two negative SARS-CoV-2 results from nasopharyngeal swab specimens collected 24 hours apart.* These same procedures were also to be followed if symptoms were identified in any patients already at the state hospital. In addition, standard IPC procedures already in place were reinforced, based on long-term care facility guidelines (*7*), including 1) universal cloth face coverings for compliant patients and face masks for HCP at all times within the facility, 2) frequent disinfection of spaces accessed by patients with COVID-19 and all communal spaces, 3) cancellation of group dining or increase of space between patients at dining tables, 4) reduction in the number of persons participating in group therapy sessions, 5) limitation of all nonessential visitors and services, and 6) daily symptom screening and temperature checks of all patients and staff members (*7*). Some standard IPC measures were modified to facilitate implementation in the psychiatric patient population, such as adapting face coverings for patients to avoid elastic and metal components that could be used for self-harm or violent purposes (e.g., socks, a preapproved item, were modified for use as face coverings).

On May 1, 2020, the state hospital, with support from the Wyoming Department of Health and CDC, conducted a point prevalence survey to determine the prevalence of SARS-CoV-2 infection among patients and HCP and to assess the effectiveness of the newly implemented enhanced patient admission, isolation, and IPC procedures. All state psychiatric hospital patients and HCP (*6*) were invited to participate in the survey. Two-person survey teams were located in each of the hospital's three units. Participants provided oral consent for survey participation; per hospital policy, hospital staff members obtained guardian consent before the survey for any patients with legal guardians. Survey team members administered a questionnaire to patients and HCP that elicited information about demographic characteristics, patient's unit, symptoms, and HCP duties and work locations in the past 2 weeks. Survey team members also collected one nasopharyngeal swab specimen from each participant. Specimens were tested at the Wyoming State Public Health Laboratory using the CDC 2019 Novel Coronavirus (2019-nCoV) Real-Time Reverse Transcriptase (RT)–PCR Diagnostic Panel (*9*). This survey was conducted by a public health authority to provide timely situational awareness and priority setting during the COVID-19 pandemic, and as such, was considered nonresearch public health surveillance as outlined in 45 CFR 46.102(l)(2).†

* https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-hospitalized-patients.html.

† https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/.

Overall, 46 (61%) of 76 patients and 171 (61%) of 282 HCP participated in the survey and had nasopharyngeal swab specimens collected and tested (Table 1) (one clinical care staff member was excluded because their sample was received at the laboratory without a label). Included among the 76 patients were 21 (68%) of 31 in the Adult Psychiatric Services unit, 16 (76%) of 21 in the Medical Geriatric Psychiatric Services unit, and nine (38%) of 24 patients in the Criminal Justice Services unit. Included among the 171 HCP were 137 (58%) of 238 in clinical care, 14 (88%) of 16 in housekeeping, and 20 (74%) of 27 in transportation and security. Median length of patient stay was 150 days (interquartile range = 86–381 days). Among the 171 participating HCP, 151 (88%) reported providing direct care to the patients, eight (5%) reported working within another health care facility, and 98 (57%) reported working across multiple units at the state hospital within the previous 2 weeks. Responses to survey questions regarding COVID-19–like symptoms were inconsistent and incomplete because patients and staff members would often mention non-COVID-19–like symptoms or attribute symptoms to existing comorbidities; therefore, these responses were not included in the analysis. All patients and HCP had negative test results for SARS-CoV-2 infection.

Based on observations and discussions at the state psychiatric hospital and review of reports from other facilities in Wyoming, various unique concerns were identified related to preventing and managing SARS-CoV-2 transmission in psychiatric facilities (Table 2). In the rapidly evolving early days of the COVID-19 pandemic, the psychiatric facilities in Wyoming were faced with the task of adapting standard IPC procedures to their specific settings, given the needs of their patient population, the specific risks for their staff members, and the limitations of their physical facilities. These concerns were tabulated and organized in terms of provider group and processes, and possible solutions were proposed. The issues faced ranged from the ability to cohort infected patients when it was also necessary to segregate patients by age, gender, and treatment needs, to the ability to continue essential mental health services when physical distancing or isolation had to be maintained.

Discussion

SARS-CoV-2 can spread rapidly within congregate residential settings (*2*–*4*), especially complex residential settings such as psychiatric hospitals. Psychiatric facilities often serve several functions concurrently, including long-term care, acute care, detention for psychiatric reasons, memory and addiction treatment, as well as social and behavioral services (*10*). Psychiatric facilities also are often linked to a network of other sites which have an elevated risk of SARS-CoV-2 transmission,

TABLE 1. Characteristics of patients and health care personnel (HCP) who participated in the point prevalence survey at a state psychiatric hospital — Wyoming, May 1, 2020

	Hospital service unit or role			
Patient characteristic	**Adult psychiatric**	**Medical geriatric psychiatric**	**Criminal justice**	**Total patients**
No. participating/Total no.	**21/31**	**16/21**	**9/24**	**46/76**
Male, no. (%)	8 (38)	4 (25)	6 (67)	18 (39)
Median age, yrs (IQR)	48 (38–61)	62 (57–66)	42 (32–59)	57 (41–63)
Median length of admission, days (IQR)	107 (76–176)	320 (121–735)	150 (73–228)	150 (86–381)
HCP characteristic	**Clinical care**	**Housekeeping**	**Transport/Security**	**Total HCP**
No. participating/Total no.	**137/238**	**14/16**	**20/27**	**171/282***
Male, no. (%)	37 (27)	0 (0)	13 (65)	50 (29)
Median age, yrs (IQR)	41 (32–54)	55 (43–57)	46 (34–53)	43 (32–55)
Provided direct patient care, no. (%)[†]	132 (96)	2 (14)	18 (90)	151 (88)
Worked at other health care facilities within previous 2 weeks, no. (%)	7 (5)	0 (0)	1 (5)	8 (5)
Worked on multiple units at the state hospital within previous 2 weeks, no. (%)	72 (53)	10 (71)	17 (85)	98 (57)

Abbreviations: HCP = health care personnel; IQR = interquartile range.
* One HCP staff member was excluded because the nasopharyngeal sample arrived at the testing laboratory without a label.
† As reported by HCP; at times housekeeping, transportation, and security staff members might provide nonclinical direct patient care, such as assisting the patients to move around the facility or intervening if a patient becomes violent.

including homeless shelters (*3*), group homes, and correctional facilities (*4*). In an outbreak, the interconnectedness of these facilities and the vulnerable populations they serve increase the likelihood of transmission of SARS-CoV-2 between facilities through the admission and discharge of patients and through critical personnel who might work across several facilities.

Following admission of two patients with SARS-CoV-2 infection on April 13, 2020, in the absence of specific guidance on prevention and management of COVID-19 in psychiatric facilities, the state hospital implemented expanded admission screening and IPC procedures. The results of the point prevalence survey, indicating no further transmission among patients and HCP almost 3 weeks after admission of the two SARS-CoV-2-positive patients, suggested that the expanded procedures might have been effective.

Although most health care facilities encounter challenges within an emergency or outbreak context, psychiatric facilities can face unforeseen or compounded issues because of the patient population they serve, their unique workforce, and the constraints of the physical facilities. Psychiatric facilities could possibly reduce the risk of introduction of SARS-CoV-2 by closing or deferring new patient admissions, but these actions would contradict their mandate and result in a backlog of patients at acute care hospitals and other facilities. Therefore, psychiatric facilities need to consider the various IPC, staffing, and structural limitations associated with preventing SARS-CoV-2 transmission in these facilities and plan accordingly. In addition, broader planning at the state and county could be useful in limiting transmission between high-risk facilities, including considerations of an integrated testing strategy, expanded screening protocols, and a community surveillance plan that supports the needs of all high-risk facilities.

The findings in this report are subject to at least four limitations. First, the survey was conducted on one single day; thus, results represent SARS-CoV-2 infection prevalence at a single point in time and recent infections among patients and staff members might not have been detected. Second, SARS-CoV-2 infections might have been missed among the 39% of patients and HCP who did not participate in the survey. Not all patients were willing or able to participate because of their mental or physical states on the day of the survey. In addition, although all HCP were invited to participate, some who were not working on the survey day might not have participated to avoid traveling a long distance to the hospital on a nonwork day. If positive cases were missed among the patients and HCP not tested, true prevalence was higher than indicated by the survey results. Third, answers to survey questions might have been limited by cognitive disabilities or recall bias. Finally, confirmation that the enhanced IPC procedures were responsible for lack of detection of secondary transmission was not possible.

In congregate residential settings, prompt identification of COVID-19 cases and application of strong IPC procedures are critical to ensuring protection of other patients and staff members. Information obtained from this investigation was useful in demonstrating the likely effectiveness of the enhanced, and often resourceful, modified IPC strategies implemented by the state psychiatric hospital. Point prevalence surveys can be useful to monitor outcomes of implementation of IPC measures and to identify cases of COVID-19, including potential asymptomatic cases missed through traditional screening procedures.

TABLE 2. Infection prevention, control, and other considerations based on observations at psychiatric facilities during the COVID-19 pandemic — Wyoming, May 2020

Group/Process	Challenges to effective COVID-19 prevention and control	Possible solutions
Patients		
Admissions	Admissions from facilities at higher risk for SARS-CoV-2 transmission (e.g., homeless shelters, group homes, and correctional facilities)	Test newly admitted patients to identify any persons with asymptomatic infection and defer integration to regular wards until results are received. If result is positive, keep patient isolated; if result is negative, conduct routine symptom screening on regular ward
Screening	Uncooperative/violent behavior when patients are being screened for symptoms or tested for SARS-CoV-2 infection	Educate patients to raise awareness of the need for screening and testing, and to avoid misinformation and fear
Cohorting	Logistical challenge to segregate according to age, gender, treatment needs, and potential for violence in addition to cohorting based on COVID-19 case status	Implement rigorous measures to prevent transmission into and within the facility to avoid the need for patient cohorting in addition to the normal necessary segregation of patients. If transmission occurs, isolate patients in single rooms, or in rooms with other COVID-19 patients as segregation of patients allows, within quarantined areas to limit interaction
Social distancing	Psychiatric treatment often requires close interaction and cannot be canceled or delayed	Conduct smaller group sessions or one-on-one therapy, with 6-foot distancing, universal use of face coverings, and more frequent decontamination of surfaces
Use of face coverings for source control	Face coverings unsuitable for patient use or patient noncompliant with use	Consider modified face coverings, modified methods of securing face coverings, or the use of facility-approved items as face coverings when possible and accepted by the patient
Exposure to cleaning products and disinfectants	Risks associated with patient behaviors (e.g., licking surfaces, attempts to ingest products if accessible)	Have staff members follow instructions on product labels for safe use, including securing products from unauthorized persons such as patients; have staff members dispense individual portions of hand sanitizer directly to patients as needed
Close connections with other high-risk facilities	Regular transfers from facilities at higher risk for SARS-CoV-2 transmission (e.g., homeless shelters, group homes, and correctional facilities)	Develop county and state level plans that support the needs of all higher-risk facilities and address issues such as integrated testing strategies, expanded screening approaches, and community surveillance
Staff members		
Physical strain	Time-consuming, frequent wellbeing checks; need for physical restraint of violent/uncooperative patients	Plan for additional or surge workforce capacity; consider flexible leave policies to account for added strain; make provisions for any staff member at higher risk of severe outcomes from COVID-19
Emotional strain	Possible high HCP turnover; potential stigma of working in a psychiatric facility with active SARS-CoV-2 transmission	Plan for additional or surge workforce capacity; develop a communications plan to address stigma
Risk of exposure for clinical care staff members	Patient behavior might increase risk of SARS-CoV-2 exposure (e.g., spitting, licking, thrashing, or intentionally dislodging PPE)	Use modified PPE to allow unrestricted movement and reduce risk of exposure for clinical care staff members working with violent and nonviolent patients (e.g., goggles instead of glasses or face shields, respirators instead of surgical masks, or Tyvek suits instead of gowns)
Risk of exposure for nonclinical care staff members	Security staff members, constantly present on some wards, might be first to respond to a patient issue/violent situation, increasing potential for high-risk exposure; similar risks for transportation staff members who interact with patients during transfer	Use modified PPE to allow unrestricted movement and provide access to utility belts when needed for all nonclinical care staff members (e.g., goggles instead of glasses or face shields, respirators instead of surgical masks, or Tyvek suits instead of gowns)
Buildings/Wards		
Social distancing	Open patient wards and rooms to facilitate patient observation; many spaces (including bathrooms) are communal	Control and monitor access to communal areas by symptomatic patients; implement enhanced disinfection practices
Cohorting	Converting single rooms to double occupancy or moving patients to different wards for disease cohorting purposes might be impossible given patients' different psychiatric needs	Utilize other available structures or facilities when possible
Clinical case management	Units and patient rooms often not set up to provide multifaceted clinical care; for safety reasons, rooms often do not include electric outlets to run medical equipment	Plan for transfer of patients to acute care hospitals as needed

Abbreviations: COVID-19 = coronavirus disease 2019; HCP = health care personnel; PPE = personal protective equipment.

Summary

What is already known about this topic?

SARS-CoV-2 can spread rapidly within residential, congregate settings. Psychiatric facilities are at risk for outbreaks because of patient transfers from other high-risk residential settings and face unique challenges in implementing standard infection prevention and control (IPC) measures because of complex patient needs.

What is added by this report?

After admitting two patients with SARS-CoV-2 infection, a psychiatric facility responded by implementing modified and expanded IPC procedures. A point prevalence survey found no evidence of further SARS-CoV-2 transmission within the facility.

What are the implications for public health practice?

Adaption of standard IPC strategies in psychiatric facilities to meet patient and facility needs might prevent SARS-CoV-2 transmission, and point prevalence surveys can be useful to assess the likely effectiveness of any adapted IPC measures.

Successful implementation of this survey suggests that similar surveys would be feasible as an outbreak response activity in this or other psychiatric facilities in the future. For psychiatric facilities in the United States, strong COVID-19 surveillance and response readiness are essential. However, the range of patient behavioral needs makes implementing any universal, uniform measures difficult. Although standard guidance exists for other congregate facilities (*7*) and for HCP in general (*8*), modifications and nonstandard solutions might be required to account for the specific needs of psychiatric facilities, their patients, and staff members. Prevention of transmission in psychiatric facilities will require consideration of the unique risk factors in this population, and approaches might need to be amended to best fit the context of other psychiatric facilities.

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COVID-19 Outbreak Among College Students After a Spring Break Trip to Mexico — Austin, Texas, March 26–April 5, 2020

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On March 27, 2020, a University of Texas at Austin student with cough, sore throat, and shortness of breath had a positive test result for SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). On March 28, two more symptomatic students had positive test results, alerting the COVID-19 Center at the University of Texas Health Austin (UTHA) to a potential outbreak; the center initiated an outbreak investigation the same day. UTHA conducted contact tracing, which linked the students' infections to a spring break trip to Cabo San Lucas, Mexico, during March 14–19. Among 231 persons tested for SARS-CoV-2 in this investigation, 64 (28%) had positive test results, including 60 (33%) of 183 Cabo San Lucas travelers, one of 13 (8%) household contacts of Cabo San Lucas travelers, and three (9%) of 35 community contacts of Cabo San Lucas travelers. Approximately one fifth of persons with positive test results were asymptomatic; no persons needed hospitalization, and none died. This COVID-19 outbreak among a young, healthy population with no or mild symptoms was controlled with a coordinated public health response that included rapid contact tracing and testing of all exposed persons. A coordinated response with contact tracing and testing of all contacts, including those who are asymptomatic, is important in controlling future COVID-19 outbreaks that might occur as schools and universities consider reopening.

Investigation and Results

During March 27–28, three symptomatic University of Texas students had positive test results for SARS-CoV-2. All three had traveled to Cabo San Lucas, Mexico, during March 14–19 and became symptomatic after returning (March 22–25). On March 28, the UTHA COVID-19 Center, a multidisciplinary team established in early March to conduct testing, contact tracing, and monitoring for the University of Texas community with authority delegated from Austin Public Health, initiated an investigation. Additional travelers were identified through contact tracing interviews and review of flight manifests gathered with assistance from Austin Public Health. Travelers on chartered or private flights were traced by UTHA and any potential commercial flight exposures were escalated through Austin Public Health to the Texas Department of State Health Services. Travelers and contacts of any travelers with a positive SARS-CoV-2 test result were classified into one of three categories: Cabo San Lucas travelers (i.e., persons who traveled to Cabo San Lucas), household contacts (i.e., persons who did not travel to Cabo San Lucas, but who lived with a Cabo San Lucas traveler who had a positive test result), or community contacts (i.e., persons who did not travel to Cabo San Lucas, but who had close contact in a community setting to a Cabo San Lucas traveler who had a positive test result). A case was defined as a positive SARS-CoV-2 reverse transcription–polymerase chain reaction (RT-PCR) test result in any traveler to Cabo San Lucas during March 14–19 or any of the travelers' household or community contacts identified during March 19–April 2.

With oversight from a university epidemiologist and infectious diseases physician, UTHA trained medical students, public health students, and clinical and research staff members to trace contacts. UTHA contact tracers communicated with travelers and contacts by telephone, first texting an initial message about the potential exposure and then attempting to call each traveler and contact up to three times. Through interviews with travelers and contacts, the date and method of return travel (i.e., commercial or charter flight and flight number for those who traveled to Cabo San Lucas), date of last exposure to a patient with known COVID-19, presence of symptoms, symptom onset date, and current address were collected and recorded. For those travelers and contacts without symptoms, the date of testing was used as a proxy for symptom onset date to estimate an infectious period. During the telephone call, contact tracers advised asymptomatic travelers and contacts to self-quarantine and self-monitor for symptoms for 14 days from the last potential exposure date. Symptomatic travelers and contacts were offered a SARS-CoV-2 test and asked to self-isolate until either a negative test result was obtained or, following CDC recommendations at the time, until 7 days after symptom onset, including 3 days with no fever and no worsening of symptoms. Following CDC guidance at the time,* persons were considered symptomatic if they had a documented temperature of ≥100.0°F (37.8°C) or reported subjective fever, acute cough, shortness of breath, sore throat, chills, muscle aches, runny nose, headache, nausea, vomiting, diarrhea, or loss of sense of smell or taste. In addition, travelers

* https://emergency.cdc.gov/han/2020/HAN00429.asp.

and contacts were offered the opportunity to enroll in a home-monitoring program developed by UTHA in partnership with Sentinel Healthcare.[†] During the contact tracing interview, data were recorded and stored in a secure, online drive.

If testing was recommended, UTHA nurses used a person-under-investigation (PUI) form to collect information on symptom status, any underlying medical conditions, and smoking status[§] before scheduling a test. Nasopharyngeal swab specimens were collected at UTHA's drive-through testing site. A private reference laboratory in Austin, Texas, conducted RT-PCR testing on collected samples using a cobas SARS-CoV-2 qualitative assay (Roche Molecular Systems, Inc.), which was given emergency use authorization by the Food and Drug Administration.[¶] For those who were not residing in Austin but were recommended for testing, Austin Public Health passed on their information to the appropriate public health jurisdiction. Once a traveler or contact had a positive test result, further identification of contacts was conducted. Because of the limited number of tests available at the time, travelers and contacts were only tested once.

By March 30, nine of the first 19 travelers and contacts tested had a positive test result. Because approximately one half of persons identified and tested had a positive test result 2 days into the investigation, testing criteria were broadened to include any traveler to Cabo San Lucas, regardless of symptom status, but only symptomatic contacts continued to qualify for testing. Based on the SARS-CoV-2 incubation period of 14 days from date of exposure (*1*), the presumptive incubation period that began on March 19 when travelers returned from Cabo San Lucas ended on April 2. Therefore, after April 2, testing was only performed for exposed, symptomatic travelers and contacts. The investigation ended on April 5 when the last symptomatic contacts received negative test results.

Descriptive statistics and bivariate analyses were performed using Stata (version 16; StataCorp). Unadjusted logistic regression models were used to calculate odds ratios (ORs) and 95% confidence intervals (CIs), which were used to evaluate differences in symptoms and smoking status between persons who did and did not have positive SARS-CoV-2 test results. Because seven contacts and travelers had testing for SARS-CoV-2 performed at other sites and PUI forms were incomplete for 26, data on symptoms and underlying medical conditions are missing for 33 (14%) persons.

Among 298 persons identified during the investigation, 289 (97%) were interviewed. Contact tracing interviews revealed that Cabo San Lucas travelers used a variety of commercial, charter, and private flights to return to the United States. Although the index patient whose illness started the investigation was not symptomatic until after arriving home (March 22), other travelers experienced symptoms during March 15–19 while in Cabo San Lucas (Figure). Further, many Cabo San Lucas travelers reported prolonged exposure and reexposure to multiple other travelers because they shared hotel rooms in Mexico and apartments or other shared living spaces upon return to Austin.

Among the 231 (80%) persons tested, 183 (79%) were Cabo San Lucas travelers, and 48 (21%) were contacts of travelers with diagnosed COVID-19, including 13 (6%) household contacts and 35 (15%) community contacts (Table 1). Among all persons tested, 110 (55%) were male, and the median age was 22 years (range = 19–62 years); 179 (89%) were non-Hispanic white. The prevalence of underlying medical conditions was low (15; 8%), but nearly a quarter (45; 24%) were current smokers. Overall, 64 (28%) persons had a positive test result, including 60 (33%) of 183 Cabo San Lucas travelers, one (8%) of 13 household contacts, and three (9%) of 35 community contacts. Persons for whom testing was performed reported a median of four contacts (range = 0–15) from the 2 days preceding symptom onset (or date of testing, if asymptomatic) through their date of self-isolation. No persons were hospitalized, and none died.

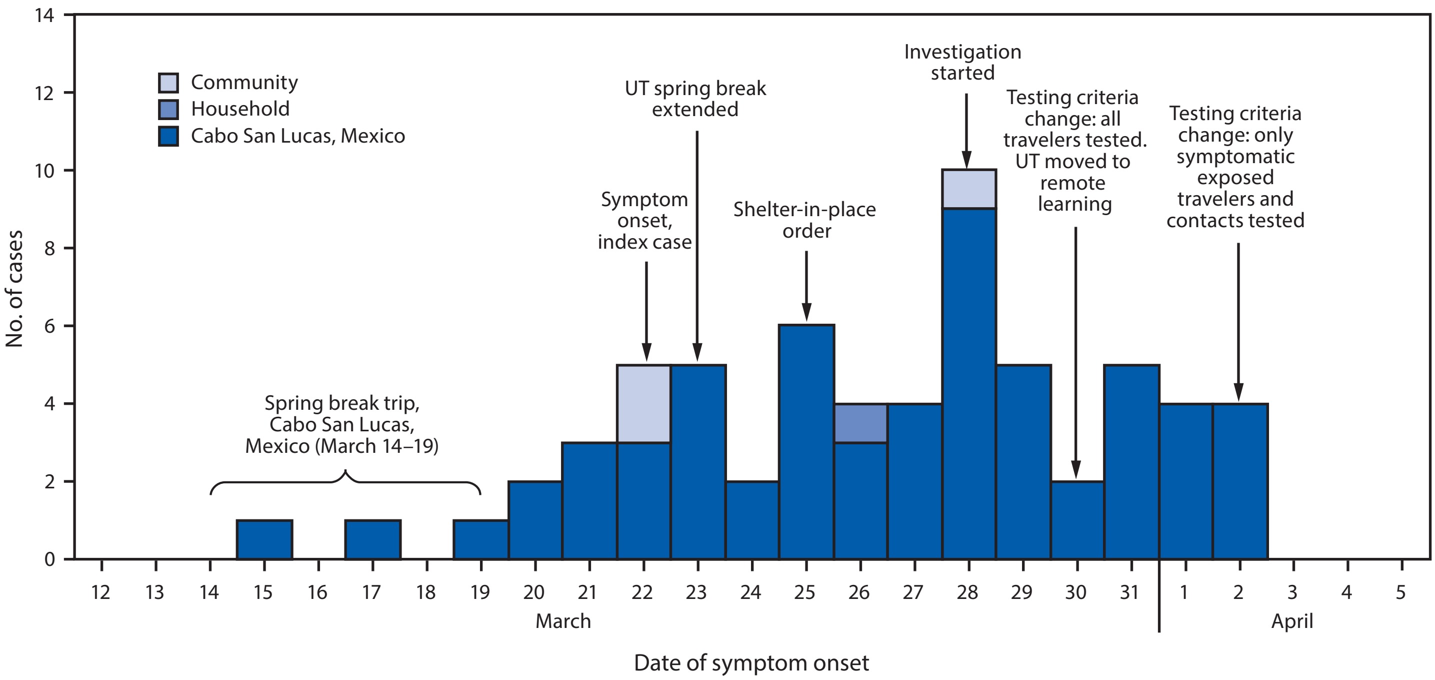
Among the 64 persons with positive SARS-CoV-2 RT-PCR test results, 14 (22%) were asymptomatic and 50 (78%) were symptomatic at the time of testing (Table 2). Among those who had a positive test result, the most commonly reported symptoms were cough (21; 38%), sore throat (18; 32%), headache (14; 25%), and loss of sense of smell or taste (15; 25%); only six (11%) reported fever. Among persons with negative test results, 84 (50.3%) reported symptoms; the most commonly reported symptoms were cough (58; 41%), sore throat (46; 32%), headache (29; 20%), and loss of sense of smell or taste (22; 14%); 13 (9%) reported fever. The odds of having a positive test result were significantly higher among those who were symptomatic than among those who were asymptomatic (OR = 3.5; 95% CI = 1.8–7.4). There were no significant differences in the types of symptoms reported among persons with positive and negative test results, nor were there any significant differences in smoking status among persons with positive and negative test results.

† https://sentinel.healthcare/2020/04/07/sentinel-healthcare-announces-partnership-with-ut-health-austin-to-launch-quarantine-management-platform-for-novel-coronavirus/.

§ Smoking status includes reported use of either combustible cigarettes, e-cigarettes, or both.

¶ The clinical diagnostic sensitivity investigations are ongoing, but analytical sensitivity studies that compare the cobas SARS-CoV-2 qualitative assay against an authorized RT-PCR test using a symptomatic patient's SARS-CoV-2 virus specimen demonstrate a sensitivity of 95% at concentrations as low as 46 virus copies/mL. https://www.fda.gov/media/136049/download.

FIGURE. COVID-19 cases (n = 64) following a spring break trip to Cabo San Lucas, Mexico, by exposure source and date of symptom onset,* and public health investigation — Austin, Texas, March 12–April 5, 2020



Abbreviations: COVID-19 = coronavirus disease 2019; UT = University of Texas.
* For asymptomatic cases, date of testing is used as a proxy for date of symptom onset.

Public Health Response

The UTHA COVID-19 Center, a novel university–public health partnership established with the local public health entity, Austin Public Health, led the outbreak response. During the early stage of the pandemic in March, resources among institutions were pooled to improve the capacity to identify and interview a large number of travelers and contacts, to facilitate testing, and to follow travelers and contacts. University Health Services coordinated additional support for students' housing, food, and other needs during isolation and quarantine.

In addition, concurrent actions at the university level and across Austin aimed at limiting COVID-19 spread in the community were undertaken, including rapid contact tracing, a municipal shelter-in-place order on March 25 (Figure), the university's extension of spring break by a week, and a transition to remote learning when operations resumed on March 30. Austin Public Health and University of Texas Austin publicized the ongoing investigation on March 31 and April 3, respectively, and encouraged community members to avoid nonessential travel and seek testing if they had symptoms. UTHA also provided updates about the ongoing investigation to the UTHA community through email.

Discussion

Investigation of an outbreak of COVID-19 among a group of college-aged travelers and their contacts demonstrated that 28% had positive SARS-CoV-2 RT-PCR test results, approximately one fifth of whom were asymptomatic when tested. Asymptomatic transmission has been documented in multiple settings and has led to large outbreaks (*2*–*6*). Asymptomatic persons or those with mild symptoms likely play an important role in sustaining SARS-CoV-2 transmission during outbreaks, especially in younger populations, such as the one described here. The high prevalence of asymptomatic persons underscores the importance of testing both symptomatic and asymptomatic persons after a known COVID-19 exposure.

No constellation of symptoms was diagnostic of COVID-19 in this population. Similar proportions of fever, cough, sore throat, and headache occurred among persons with positive test results and those with negative results. Because testing supplies were limited, only symptomatic persons were tested during March 28–30. Some persons might have reported symptoms as a means to get tested during that time. A possibility also exists that a separate, concomitant respiratory illness occurred among travelers and contacts in March that might explain the similarities in symptoms between those who had positive test results and those who had negative results. Although persons

TABLE 1. Demographic characteristics and symptoms of persons who received SARS-CoV-2 virus reverse transcription–polymerase chain reaction testing (n = 231), by contact type — Austin, Texas, March 26–April 5, 2020

	No. (%)			
Characteristic	**Total n = 231 (100)**	**Cabo San Lucas travelers n = 183 (79)**	**Household contacts n = 13 (6)**	**Community contacts n = 35 (15)**
Age, yrs, median (range)	**22 (19–62)**	21 (19–22)	22 (22–52)	22 (20–23)
Gender* (n = 202)				
Male	**110 (54.5)**	81 (52.3)	10 (76.9)	19 (55.9)
Female	**92 (45.5)**	74 (47.7)	3 (23.1)	15 (44.1)
Race/Ethnicity* (n = 202)				
White, non-Hispanic	**179 (88.6)**	140 (90.3)	11 (84.6)	28 (82.4)
Black, non-Hispanic	**0 (0.0)**	0 (0.0)	0 (0.0)	0 (0.0)
Hispanic	**17 (8.4)**	10 (6.5)	2 (15.4)	5 (14.7)
Other	**6 (3.0)**	5 (3.2)	0 (0.0)	1 (2.9)
Positive SARS-CoV-2 test result	**64 (27.7)**	60 (32.8)	1 (7.7)	3 (8.6)
Symptomatic	**134 (58.0)**	89 (48.6)	13 (100)	32 (91.4)
Signs and Symptoms† (n = 198)				
Cough	**79 (39.9)**	44 (29.1)	9 (69.2)	26 (76.5)
Sore throat	**64 (32.3)**	44 (29.1)	5 (38.5)	15 (44.1)
Headache	**43 (21.7)**	25 (16.6)	5 (38.5)	13 (38.2)
Loss of smell or taste (n = 215)	**37 (17.2)**	26 (14.8)	3 (27.3)	8 (28.6)
Shortness of breath	**28 (14.1)**	13 (8.6)	4 (30.8)	11 (32.4)
Muscle aches	**27 (13.6)**	15 (9.9)	3 (23.1)	9 (26.5)
Diarrhea	**25 (12.6)**	20 (13.3)	1 (7.7)	4 (11.8)
Chills	**18 (9.1)**	12 (8.0)	0 (0.0)	6 (17.7)
Fever	**19 (9.6)**	10 (6.6)	1 (7.7)	8 (23.5)
Abdominal pain	**9 (4.6)**	5 (3.3)	1 (7.7)	3 (8.8)
Vomiting	**4 (2.0)**	3 (2.0)	0 (0.0)	1 (2.9)
Other	**38 (19.2)**	21 (13.9)	5 (38.5)	12 (35.3)
Underlying medical conditions§ (n = 192)				
Chronic lung disease	**9 (4.7)**	6 (4.0)	1 (8.3)	2 (6.5)
Immunocompromised	**4 (2.1)**	2 (1.3)	1 (8.3)	1 (3.2)
Hypertension	**2 (1.0)**	1 (0.7)	1 (8.3)	0 (0.0)
Cardiovascular disease	**2 (1.0)**	1 (0.7)	0 (0.0)	1 (3.2)
Diabetes	**0 (0.0)**	0 (0.0)	0 (0.0)	0 (0.0)
Chronic kidney disease	**0 (0.0)**	0 (0.0)	0 (0.0)	0 (0.0)
Chronic liver disease	**0 (0.0)**	0 (0.0)	0 (0.0)	0 (0.0)
Pregnancy	**0 (0.0)**	0 (0.0)	0 (0.0)	0 (0.0)
Smoking status¶ (n = 191)				
Current smoker	**45 (23.6)**	31 (20.9)	6 (50.0)	8 (25.8)
Former smoker	**20 (10.5)**	13 (8.8)	1 (8.3)	6 (19.4)
Never smoked	**126 (66.0)**	104 (70.3)	5 (41.7)	17 (54.8)

* The number of available responses for gender and race/ethnicity is 202 (12.6% missing), with 155 (15.3% missing) for Cabo San Lucas travelers, 13 (0.0% missing) for Household contacts, and 34 (2.9% missing) for Community contacts.

† The number of available responses for signs and symptoms, with the exception of loss of sense of taste and smell, is 198 (14.3% missing), with 151 (17.5% missing) for Cabo San Lucas travelers, 13 (0.0% missing) for Household contacts, and 34 (2.9% missing) for Community contacts. Loss of sense of taste or smell was evaluated by both contact tracers and triage nurses, resulting in 215 available evaluations (6.9% missing), with 176 (3.8% missing) for Cabo San Lucas travelers, 28 (20% missing) for Community contacts, and 11 (6.9% missing) for Household contacts.

§ The number of missing responses for underlying medical conditions is 39 (16.9% missing), with 149 (18.6% missing) for Cabo San Lucas travelers, 12 (7.7% missing) for Household contacts (7.7%), and 31 (11.4% missing) for Community contacts.

¶ The number of available responses for smoking status is 191 (17.3% missing), with 148 (19.1% missing) for Cabo San Lucas travelers, 12 (7.7% missing) for Household contacts, and 31 (11.4% missing) for Community contacts.

with negative SARS-CoV-2 test results in this analysis were not tested for influenza or other respiratory illnesses, widespread transmission of influenza was reported by the U.S. Department of Health and Human Services during March 8–March 21.** Recent studies have demonstrated variability in symptoms such that strict implementation of guidance that emphasizes a symptom-based approach to COVID-19 testing could result in missing a diagnosis of COVID-19 in a sizeable proportion of cases (*7*,*8*).

During contact tracing interviews, Cabo San Lucas travelers reported sharing housing in both Mexico and upon return to Austin. The proximity created by this shared housing likely contributed to transmission through ongoing exposure and reexposure to SARS-CoV-2. This pattern of social interaction, in which residents gather frequently to socialize and share facilities, is common among many college-aged persons and might lead

** https://www.dshs.state.tx.us/idcu/disease/influenza/surveillance/2019-2020.aspx.

TABLE 2. Association of symptom status and symptoms reported among persons who received SARS-CoV-2 virus reverse transcription–polymerase chain reaction testing (n = 231) — Austin, Texas, March 26–April 5, 2020

Characteristic	No. (%)		
	Positive test (n = 64)	Negative test (n = 167)	Unadjusted odds ratio (95% CI)
Symptom status			
Asymptomatic	14 (21.9)	83 (49.7)	Ref
Symptomatic	50 (78.1)	84 (50.3)	3.53 (1.75–7.42)
Symptoms (n = 198)*			
Cough	21 (37.5)	58 (40.9)	0.87 (0.46–1.64)
Sore Throat	18 (32.1)	46 (32.4)	0.99 (0.51–1.92)
Headache	14 (25.0)	29 (20.4)	1.30 (0.63–2.70)
Loss of smell or taste (n = 215)	15 (24.6)	22 (14.3)	1.96 (0.94–4.09)
Chills	8 (14.3)	10 (7.0)	2.20 (0.82–5.90)
Diarrhea	8 (14.3)	17 (12.0)	1.23 (0.50–3.03)
Fever	6 (10.7)	13 (9.2)	1.19 (0.43–3.31)
Shortness of breath	4 (7.1)	24 (16.9)	0.38 (0.12–1.14)

* The number of available responses for symptoms, except for loss of smell or taste, is 198 (14.3% missing), with 56 (12.5% missing) for positive test results and 142 (15.0% missing) for negative test results. Loss of sense of taste or smell was evaluated by both contact tracers and triage nurses, resulting in 215 available evaluations (6.9% missing), with 61 (4.7% missing) for positive test results and 154 (7.8%) for negative test results. The reference group for the logistic regressions that examined the association of specific symptoms with test results is those persons who tested negative.

to propagated spread, similar to the continued person-to-person transmission observed in long-term care facilities (*5*). The prevalence of shared housing and prolonged exposure experienced by the college-aged Cabo San Lucas travelers highlights the importance of universities and schools considering how to align students' living arrangements with CDC recommendations for living in shared housing[††] as they plan to reopen.

The findings in this report are subject to at least five limitations. First, the majority of students were only tested for SARS-CoV-2 once because of limited test availability at the time; therefore, some asymptomatic or presymptomatic cases might have been missed. Second, seven travelers and contacts did not reside in Austin and were tested elsewhere. For these seven, investigators relied upon self-reported test results, and information on demographic characteristics and symptoms was not available. Third, a number of PUI forms had missing information regarding demographic characteristics, symptoms, or underlying health conditions. Although it is possible that the missing information regarding symptoms and underlying health conditions could influence the prevalence of symptoms seen in this investigation, the variability of reported signs and symptoms is consistent with what has been published in recent literature (*7*,*8*). Fourth, the diagnostic sensitivity of the RT-PCR test used is not yet known. Although this particular RT-PCR test demonstrates an analytic sensitivity of 95% at concentrations of 46 copies of virus/mL, the first systematic reviews suggest that similar RT-PCR tests are demonstrating a false-negative rate of 2%–29%[§§] (*9*). Finally, the significant overlap between students who went on the trip together and those who shared living quarters after returning to Austin made it difficult to estimate accurate primary and secondary infection rates.

As schools and universities make decisions about reopening, it is important that they plan for isolating and testing persons with suspected COVID-19, quarantining their contacts, and implementing suggestions described in CDC's Considerations for Institutes of Higher Education.[¶¶] Coordination between educational institutions and health authorities can facilitate rapid identification of cases, contact tracing, active surveillance, and identification of clusters. Contact tracing and testing of close contacts, regardless of symptoms, is important in limiting spread, especially in young and healthy populations living in shared housing and in controlling future COVID-19 outbreaks that might occur as schools and universities consider reopening.

Summary

What is already known about this topic?

COVID-19 can cause asymptomatic and mild illness, particularly among young, healthy populations.

What is added by this report?

Transmission of SARS-CoV-2 during and after a college spring break trip (March 14–19) led to 64 cases, including 60 among 183 vacation travelers, one among 13 household contacts, and three among 35 community contacts. Prompt epidemiologic investigation, with effective contact tracing and cooperation between a university and a public health department, contributed to outbreak control.

What are the implications for public health practice?

A coordinated response with contact tracing and testing of all contacts, including those who are asymptomatic, is important in controlling future COVID-19 outbreaks that might occur as schools and universities consider reopening.

†† https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/shared-housing/index.html.

§§ https://www.medrxiv.org/content/10.1101/2020.04.16.20066787v1.

¶¶ https://www.cdc.gov/coronavirus/2019-ncov/community/colleges-universities/considerations.html.

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Serial Laboratory Testing for SARS-CoV-2 Infection Among Incarcerated and Detained Persons in a Correctional and Detention Facility — Louisiana, April–May 2020

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Transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), by asymptomatic and presymptomatic persons poses important challenges to controlling spread of the disease, particularly in congregate settings such as correctional and detention facilities (*1*). On March 29, 2020, a staff member in a correctional and detention facility in Louisiana developed symptoms[†] and later had a positive test result for SARS-CoV-2. During April 2–May 7, two additional cases were detected among staff members, and 36 cases were detected among incarcerated and detained persons at the facility; these persons were removed from dormitories and isolated, and the five dormitories that they had resided in before diagnosis were quarantined. On May 7, CDC and the Louisiana Department of Health initiated an investigation to assess the prevalence of SARS-CoV-2 infection among incarcerated and detained persons residing in quarantined dormitories. Goals of this investigation included evaluating COVID-19 symptoms in this setting and assessing the effectiveness of serial testing to identify additional persons with SARS-CoV-2 infection as part of efforts to mitigate transmission. During May 7–21, testing of 98 incarcerated and detained persons residing in the five quarantined dormitories (A–E) identified an additional 71 cases of SARS-CoV-2 infection; 32 (45%) were among persons who reported no symptoms at the time of testing, including three who were presymptomatic. Eighteen cases (25%) were identified in persons who had received negative test results during previous testing rounds. Serial testing of contacts from shared living quarters identified persons with SARS-CoV-2 infection who would not have been detected by symptom screening alone or by testing at a single time point. Prompt identification and isolation of infected persons is important to reduce further transmission in congregate settings such as correctional and detention facilities and the communities to which persons return when released.

On March 29, a staff member working in a correctional and detention facility in Louisiana reported symptoms of COVID-19 and later had a positive test result for SARS-CoV-2. Two additional cases among staff members were identified on April 2 and April 10. The facility housed approximately 700 incarcerated and detained persons in 15 dormitories. On April 7, the first case of COVID-19 in an incarcerated person was detected after the patient reported symptoms. During April 8–May 7, through daily active monitoring with temperature screening and oxygen saturation measurements, an additional 35 laboratory-confirmed symptomatic cases were identified among incarcerated and detained persons in five dormitories, resulting in three hospitalizations. Upon identification, all COVID-19 patients were immediately transferred to another facility for medical isolation and care.

During May 7–21, the Louisiana Department of Health and CDC, as part of a public health outbreak response, conducted an investigation to assess the prevalence of infection with SARS-CoV-2 among incarcerated and detained persons residing in quarantined dormitories, and to evaluate symptoms and assess the feasibility of using serial testing with nasopharyngeal swabs to identify additional persons with SARS-CoV-2 infection. Demographic information, medical history, and symptom data were collected for persons in the five affected dormitories using standardized questionnaires. Serial SARS-CoV-2 testing and COVID-19 symptom assessments were conducted on 3 days: May 7 (day 1), May 11, (day 4), and May 21 (day 14). To detect any additional cases before symptom onset, persons who had negative test results on day 1 were retested and completed another symptom assessment on day 4. Those who had negative test results a second time were retested on day 14, the end of the initial quarantine period. On day 14, symptom data were collected again from all persons. The Louisiana Office of Public Health Laboratory tested nasopharyngeal swabs for SARS-CoV-2 using the CDC 2019 reverse transcription–polymerase chain reaction (RT-PCR) panel (*2*), and results were received within 24 hours of testing. Depending on their test results, persons were cohorted by being moved to medical isolation or remaining in quarantined dormitories. Symptom data from all 3 test days were analyzed to classify cases as asymptomatic, presymptomatic, or symptomatic. To identify

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† COVID-19–related signs and symptoms include subjective fever, cough, shortness of breath, chills, muscle aches, headache, sore throat, loss of taste, or loss of smell. https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.

potential previous illness, outbreak investigators also recorded symptoms reported >2 weeks before testing. Persons were classified as presymptomatic if they reported onset of symptoms after the date of collection of a specimen that had a positive test result; persons were classified as asymptomatic if they had a positive SARS-CoV-2 test result but did not report any symptoms during the previous 2 months or during the 14-day testing period. Attack rates during May 7–21 were stratified by participants' dormitory assignments on day 1. Analyses were conducted using R (version 3.6.0; The R Foundation). This investigation was determined by CDC to be public health surveillance.[§] Persons provided voluntary oral consent for testing and questionnaire administration, consistent with the policies of the facility.

At the time of investigation 98 incarcerated and detained persons were in the five quarantined dormitories. All 98 persons were interviewed and tested for SARS-CoV-2 on day 1. The median age was 33 years (interquartile range [IQR] = 29–42 years) (Table 1). The majority of persons tested were male (91, 93%), 65 (66%) were non-Hispanic black, 31 (32%) were non-Hispanic white, one (1%) was non-Hispanic Asian, and one (1%) was Hispanic. Overall, 39 (40%) had an underlying health condition, and 23 (23%) had a body mass index >30 kg/m^2.

Seventy-one additional cases of SARS-CoV-2 infection were detected in the five dormitories. Among 98 persons tested on day 1, 53 (54%) had positive SARS-CoV-2 test results (Table 2). Among the remaining 45 who had negative test results on day 1, 16 (36%) had positive test results on day 4. Two (7%) of 29 persons who had negative test results on days 1 and 4 had a positive test result on day 14. Of the 71 cases, three (4%) occurred in persons who were presymptomatic at the time of specimen collection, 29 (41%) were in persons who were asymptomatic, and two (3%) were in persons who had had unknown symptom histories. Among the 37 patients who reported COVID-19 symptoms before testing, 11 (30%) reported symptom onset ≤2 weeks before testing, and 19 (51%) experienced symptom onset >2 weeks before testing. Among 27 persons testing negative, 18 (67%) reported COVID-19–compatible symptoms in the previous 2 months, including eight (30%) reporting loss of smell and seven (26%) reporting loss of taste. Among the 98 persons who were tested, 55 (56%) reported at least one COVID-19 symptom during the 2 months before testing, including 37 (52%) who had positive test results and 18 (67%) who had negative test results. Headache (27, 38%) and loss of smell (25, 35%) were the most commonly reported symptoms. During the public health outbreak investigation period, none of the COVID-19 patients identified through serial testing developed severe illness requiring hospitalization.

The attack rate by dormitory ranged from 57% in dormitory A to 82% in dormitory C. The number of days between the first identified COVID-19 case in each dormitory and day 1 testing ranged from 14–30 days. Dormitory A, which had the lowest attack rate, also had the shortest interval from day of first COVID-19 case to day 1 testing.

Discussion

High COVID-19 attack rates can occur in correctional and detention facilities (*3*). During May 7–21, among 98 incarcerated and detained persons who were quarantined because of exposure to the virus, 71 (72%) had laboratory-confirmed SARS-CoV-2 infection identified through serial testing. Among those with positive test results, approximately one fourth had positive test results after one or two negative tests at previous time points in quarantine, and 45% did not report any symptoms at the time of testing. These findings suggest ongoing transmission among quarantined persons living in congregate settings; therefore, serial testing of contacts of persons with COVID-19 in correctional and detention facilities can identify asymptomatic and presymptomatic persons who would be missed through symptom screening alone.

Increased detection of SARS-CoV-2 cases by serial testing has been observed in other congregate settings, including homeless shelters and long-term care facilities (*1,4*). The high attack rate within these five dormitories and the large proportion of asymptomatic persons with SARS-CoV-2 infection suggest that serial testing of close contacts, including those in congregate settings, should begin immediately after identification of a case to limit further transmission. Some persons infected with SARS-CoV-2 were likely not detected until weeks after they had been infected, which could have contributed to rapid transmission within the quarantined dormitories. Among 71 persons with SARS-CoV-2 identified through serial testing, 27% reported symptom onset 2–8 weeks before testing. Dormitory A, which had the most recent known SARS-CoV-2 introduction among the dormitories, also had the lowest cumulative attack rate, with no additional persons with SARS-CoV-2 infection identified through testing on day 4 or day 14.

CDC's Interim Guidance on Management of COVID-19 in Correctional and Detention Facilities (*5*), released on March 23, 2020, recommended prompt isolation of COVID-19 patients, quarantine and twice daily symptom-monitoring of exposed persons, and intensified cleaning and disinfection procedures. In these facilities, quarantine is often accomplished by cohorting exposed persons in shared dormitories. It is possible that

[§] https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=83cd09e1c0f5c6937cd9d7513160fc3f&pitd=20180719&n=pt45.1.46&r=PART&ty=HTML.

TABLE 1. Characteristics of incarcerated and detained persons tested for SARS-CoV-2 in a correctional and detention facility, by dormitory — Louisiana, May 7–21, 2020

Characteristic	Dormitory, no. of residents					
	Dormitory A, 7	Dormitory B, 37	Dormitory C, 11	Dormitory D, 23	Dormitory E, 20	Total, 98
Age, median (IQR)	37 (29–47)	31 (29–39)	45 (35–52)	31 (29–36)	37 (29–47)	**33 (29–42)**
Sex, no. (%)						
Male	0 (—)	37 (100)	11 (100)	23 (100)	20 (100)	**91 (93)**
Female	7 (100)	0 (—)	0 (—)	0 (—)	0 (—)	**7 (7)**
Race/Ethnicity, no. (%)						
White, non-Hispanic	2 (29)	5 (14)	7 (64)	6 (26)	10 (50)	**31 (32)**
Black, non-Hispanic	5 (71)	30 (81)	4 (36)	16 (70)	10 (50)	**65 (66)**
Asian, non-Hispanic	0 (—)	1 (3)	0 (—)	0 (—)	0 (—)	**1 (1)**
Hispanic	0 (—)	1 (3)	0 (—)	0 (—)	0 (—)	**1 (1)**
Underlying health condition, no. (%)						
Any	3 (43)	14 (38)	7 (64)	7 (30)	8 (40)	**39 (40)**
Respiratory disease	1 (14)	5 (14)	3 (27)	3 (13)	3 (15)	**15 (15)**
Diabetes	2 (29)	0 (—)	3 (27)	0 (—)	1 (5)	**6 (6)**
Hypertension	2 (29)	7 (19)	5 (45)	3 (13)	3 (15)	**20 (20)**
Other cardiovascular disease	0 (0)	2 (5)	0 (—)	1 (4)	0 (—)	**3 (3)**
Other*	0 (—)	2 (5)	1 (9)	2 (8)	4 (15)	**9 (8)**
Body mass index >30 kg/m^2, no. (%)	2 (29)	7 (19)	1 (9)	7 (30)	6 (30)	**23 (23)**
Interval from identification of first case to day 1 (May 7), days†	14	20	28	28	30	—
SARS-CoV-2 positive, no. (%)						
Day 1	4 (57)	20 (54)	6 (55)	10 (43)	13 (65)	**53 (54)**
Day 4	0 (—)	7 (19)	3 (27)	4 (17)	2 (10)	**16 (16)**
Day 14	0 (—)	0 (—)	0 (—)	2 (9)	0 (—)	**2 (2)**
Overall	4 (57)	27 (73)	9 (82)	16 (69)	15 (75)	**71 (72)**

Abbreviation: IQR = interquartile range.
* Includes liver disease, immunosuppressive disorder, and neurologic disease.
† Number of days from the identification of the first known COVID-19 case in the dormitory to the first day of serial testing (day 1).

TABLE 2. Reported symptoms* among incarcerated and detained persons (N = 98) in five dormitories in a single correctional and detention facility, by SARS-CoV-2 test results — Louisiana, May 7–21, 2020

Persons in all five dormitories	Subtotal, by symptom, no. (%)	Test day, no. tested, no. (%) with positive results				All negative, no. (%)
		Day 1, 98	Day 4, 45	Day 14, 29	Total all 3 days, 98	
Total	—	**53 (54)**	**16 (36)**	**2 (7)**	**71 (72)**	**27 (27)**
Symptom status						
Asymptomatic†	37 (39)	19 (36)	9 (56)	1 (50)	29 (41)	8 (30)
Presymptomatic§	3 (3)	3 (6)	0 (—)	0 (—)	3 (4)	0 (—)
Symptomatic	55 (56)	29 (55)	7 (43)	1 (50)	37 (52)	18 (67)
Onset in past 2 wks	13 (13)	10 (19)	1 (6)	0 (—)	11 (15)	2 (7)
Onset >2 wks ago	30 (31)	12 (23)	6 (38)	1 (50)	19 (27)	11 (41)
Onset unknown	12 (12)	7 (13)	0 (—)	0 (—)	7 (10)	5 (19)
Specific symptoms*						
Subjective fever	21 (21)	11 (21)	4 (25)	0 (—)	15 (21)	6 (22)
Cough	14 (14)	8 (15)	3 (19)	0 (—)	11 (15)	3 (11)
Shortness of breath	11 (11)	5 (9)	1 (6)	0 (—)	6 (8)	5 (18)
Chills	23 (23)	13 (25)	3 (19)	0 (—)	16 (23)	7 (26)
Muscle aches	24 (24)	15 (28)	3 (19)	1 (50)	19 (27)	5 (19)
Headache	39 (40)	20 (37)	6 (38)	1 (50)	27 (38)	12 (44)
Sore throat	10 (10)	6 (11)	1 (6)	0 (—)	7 (10)	3 (11)
Loss of taste	26 (27)	15 (28)	4 (25)	0 (—)	19 (27)	7 (26)
Loss of smell	33 (34)	20 (38)	5 (31)	0 (—)	25 (35)	8 (30)
Unknown	3 (3)	2 (4)	0 (—)	0 (—)	2 (3)	1 (4)

* During the 2 months preceding the date of data collection.
† During the 2 months preceding testing and during the 14-day testing period. The person who was asymptomatic and had a positive test result on day 14 had not developed symptoms at follow-up 1 week later.
§ Persons who reported onset of symptoms after the date of specimen collection, which resulted in a positive test.

incarcerated and detained persons experience incentives or disincentives to reporting illness, thereby compromising the effectiveness of symptom screening (*6*,*7*). In addition, asymptomatic or presymptomatic persons infected with SARS-CoV-2 can be missed by symptom screening and transmit the infection (*1*). On June 13, 2020, CDC recommended testing for all close contacts (including those without symptoms) and consideration of broader testing strategies, including the option of widespread and weekly testing of asymptomatic persons, to control transmission in special high-risk settings that have potential for rapid and widespread dissemination of SARS-CoV-2 infection (*8*).

Implementation of symptom screening and serial testing in correctional and detention facilities can be challenging and requires skilled personnel. No single symptom was reported by the majority of persons with COVID-19, and common symptoms such as headache are nonspecific and might not prompt testing. Serial testing is dependent on laboratory capacity and test availability. Delayed receipt of test results inhibits prompt cohorting to reduce transmission from asymptomatic or presymptomatic persons within dormitories. To address these potential challenges, facility staff members should work with their local health department and partners to determine the feasibility of implementing a serial testing strategy. In the future, rapid point of care tests might address some of these challenges.

The findings in this report are subject to at least four limitations. First, serial testing was initiated 2–4 weeks after identification of the first COVID-19 case in an incarcerated person in the dormitories, which likely resulted in substantial transmission before this investigation. Approximately one third of persons with negative test results reported experiencing COVID-19 compatible symptoms >2 weeks before testing and might have already recovered from COVID-19. Second, systematic testing was limited to the five dormitories with known cases among incarcerated and detained persons; staff members were not systematically tested. Exposure to ill staff members might have contributed to transmission. Third, symptom ascertainment might be incomplete, especially for symptoms experienced >2 weeks before testing. Likewise, some persons were unable to provide symptom onset dates. Persons might have underreported symptoms, leading to an overestimate of the prevalence of asymptomatic infection. Finally, this investigation was conducted within five dormitories in one facility; therefore, findings are not generalizable to all correctional and detention facilities.

Approximately 10 million persons are admitted to jails each year, and approximately 55% of detainees return to their community each week.[¶] Likewise, correctional and detention facility staff members reside in local communities. Thus, high rates of COVID-19 transmission in correctional and detention facilities also have the potential to influence broader community transmission. Because SARS-CoV-2 infection might spread rapidly in correctional and detention facilities (*3*), prevention measures are needed to reduce SARS-CoV-2 introduction and transmission. Mitigation measures should include the quarantine and symptom screening of incarcerated and detained persons upon intake, proper infection prevention and control measures, including the use of appropriate personal protective equipment or cloth face covering[**] for both staff members and incarcerated and detained persons, regular monitoring of staff members, and encouraging them not to work if they become symptomatic (*5*). Early identification of persons with COVID-19 facilitates their transfer to medical isolation where they can receive timely medical care. Prompt detection and isolation of cases through serial testing might reduce further exposure within the congregate living environment and outside community. Cohorting of incarcerated and detained persons by infection status is essential to slow the transmission of the virus in the facility. Serial testing, particularly in congregate settings is important for identification of persons with SARS-CoV-2 infection and prompt public health response. Reducing transmission in correctional and detention facilities potentially also reduces transmission in communities where staff members live and where detained persons return when released.

Summary

What is already known about this topic?

Correctional and detention facilities face unique challenges in detecting and mitigating transmission of SARS-CoV-2 infection.

What is added by this report?

Testing among quarantined contacts of patients with COVID-19 in a correctional and detention facility identified a high proportion of asymptomatic and presymptomatic cases that were not identified through symptom screening alone. Approximately one fourth of cases were found through serial testing during quarantine.

What are the implications for public health practice?

Early detection and isolation of persons with COVID-19, along with testing of close contacts, can slow the transmission of SARS-CoV-2 in correctional and detention facilities. Serial testing, particularly for close contacts of patients, is important for complete identification of cases and prompt public health response in congregate settings.

[¶] https://www.bjs.gov/content/pub/pdf/ji16.pdf.

[**] A person who has trouble breathing, is unconscious, incapacitated, or otherwise unable to remove the mask without assistance should not use a cloth face covering.

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Characteristics of Adult Outpatients and Inpatients with COVID-19 — 11 Academic Medical Centers, United States, March–May 2020

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Descriptions of coronavirus disease 2019 (COVID-19) in the United States have focused primarily on hospitalized patients. Reports documenting exposures to SARS-CoV-2, the virus that causes COVID-19, have generally been described within congregate settings, such as meat and poultry processing plants (*1*) and long-term care facilities (*2*). Understanding individual behaviors and demographic characteristics of patients with COVID-19 and risks for severe illness requiring hospitalization can inform efforts to reduce transmission. During April 15–May 24, 2020, telephone interviews were conducted with a random sample of adults aged ≥18 years who had positive reverse transcription–polymerase chain reaction (RT-PCR) test results for SARS-CoV-2 in outpatient and inpatient settings at 11 U.S. academic medical centers in nine states. Respondents were contacted 14–21 days after SARS-CoV-2 testing and asked about their demographic characteristics, underlying chronic conditions, symptoms experienced on the date of testing, and potential exposures to SARS-CoV-2 during the 2 weeks before illness onset (or the date of testing among those who did not report symptoms at the time of testing). Among 350 interviewed patients (271 [77%] outpatients and 79 [23%] inpatients), inpatients were older, more likely to be Hispanic and to report dyspnea than outpatients. Fewer inpatients (39%, 20 of 51) reported a return to baseline level of health at 14–21 days than did outpatients (64%, 150 of 233) (p = 0.001). Overall, approximately one half (46%) of patients reported known close contact with someone with COVID-19 during the preceding 2 weeks. This was most commonly a family member (45%) or a work colleague (34%). Approximately two thirds (64%, 212 of 333) of participants were employed; only 35 of 209 (17%) were able to telework. These findings highlight the need for screening, case investigation, contact tracing, and isolation of infected persons to control transmission of SARS-CoV-2 infection during periods of community transmission. The need for enhanced measures to ensure workplace safety, including ensuring social distancing and more widespread use of cloth face coverings, are warranted (*3*).

The Influenza Vaccine Effectiveness in the Critically Ill (IVY) Network is a collaboration of U.S. medical centers conducting research on vaccine effectiveness for and epidemiologic studies of influenza, and recently started conducting epidemiologic studies on COVID-19. To explore the spectrum of illness across health care settings and potential community SARS-CoV-2 exposures after issuance of national social distancing guidelines on March 16, 2020 (*4*), 11 academic medical centers in nine states conducted telephone-based surveys of a sample of patients with positive SARS-COV-2 test results during April 15–May 24, 2020 (testing dates = March 31–May 10, 2020). Medical centers submitted lists of persons with SARS-CoV-2 infection to Vanderbilt University and identified location of testing (intensive care unit [ICU], non-ICU hospital admission, emergency department [ED] without admission during the encounter, and other outpatient settings). To achieve a broadly representative cohort, selection of patients was made using site-specific stratified random sampling by location of testing. The median proportions sampled were 67% of inpatients and 53% of outpatients. Personnel from CDC telephoned patients during intervals of 14–21 days (97%) or 28–35 days (3%) after testing; up to seven call attempts were made per patient for each period. Interviews were conducted in English, Spanish, French, Creole, Portuguese, Arabic, Burmese, and Somali. Respondents or their proxies were asked to provide patient demographic and socioeconomic information, clinical signs and symptoms on the date of testing, underlying chronic conditions, and potential exposures to SARS-CoV-2 during the 2 weeks preceding illness onset (or 2 weeks before test date in patients who did not report symptoms). This 14-day exposure period was selected to encompass the estimated COVID-19 incubation period for most persons (*5*). Patients who responded at 28–35 days were asked the same questions, with the exception of signs or symptoms at the time of testing because the delay between symptom onset and interview date increased the potential for introducing recall bias.

To compare responses among patients who received inpatient and outpatient testing, descriptive statistics were analyzed, using Wilcoxon rank-sum testing for continuous variables and chi-squared or Fisher's exact test for categorical variables. Patients with proxy respondents or who had died were excluded

Summary

What is already known about this topic?

Exposures to SARS-CoV-2 have commonly been described in congregate settings rather than broader community settings.

What is added by this report?

In a multistate telephone survey of 350 adult inpatients and outpatients who tested positive for SARS-CoV-2 infection, only 46% reported recent contact with a COVID-19 patient. Most participants' contacts were a family member (45%) or a work colleague (34%). Two thirds of participants were employed; only 17% were able to telework.

What are the implications for public health practice?

Case investigation, contact tracing, and isolation of infected persons are needed to prevent ongoing community transmission, given the frequent lack of a known contact. Enhanced measures to ensure workplace safety, including social distancing and more widespread use of cloth face coverings, are warranted.

because details about symptoms, medical conditions, and exposure histories were frequently unknown. Statistical analyses were conducted using Stata software (version 16; StataCorp).

At least one telephone call was attempted for 798 randomly selected patients 309 inpatients [98 ICU and 211 non-ICU] and 489 outpatients [144 ED and 345 non-ED]) across the 11 sites. Among these, 544 (68%) answered calls, and 398 (50%) completed interviews. Sixty-seven (8%) patients or proxies refused, 37 (5%) were unable to complete the interview because of a language barrier, 42 (5%) requested a callback but could not be reached on further call attempts; 20 (3%) were reported to have died within 21 days of testing (nine proxy respondents interviewed and 11 refused). A total of 48 proxy interviews were excluded, leaving 350 of 398 for analysis.*

Among the 350 respondents with completed interviews, 271 (77%) were tested as outpatients (70 ED and 201 non-ED) and 79 (23%) as inpatients (17 ICU and 62 non-ICU) (Table 1). The median number of patient respondents by site was 20 (interquartile range = 11–46). The median respondent age was 43 years; 185 (53%) were female, 116 (33%) white, 73 (21%) non-Hispanic black (black), 43 (12%) non-Hispanic of another race, and 116 (33%) Hispanic. Nineteen patients reported another positive SARS-CoV-2 test result before the test date applicable to this study. Among outpatients, 8% (22 of 271) were later admitted to the hospital after having outpatient testing.

* Patients with a proxy respondent were more likely to have been hospitalized (83% versus 23%) and to be older (median age = 67 versus 43 years) than were patients who responded for themselves.

Demographic and Baseline Health Characteristics

Compared with outpatients, inpatients were older (median age = 54 versus 42 years; p<0.001) and differed by race/ethnicity (p = 0.008) and annual household income (p = 0.003). Inpatients were less likely to be white (19% versus 37%) and more likely to have annual household income <$25,000 (28% versus 13%). Inpatients also had more underlying chronic conditions (median = two) than did outpatients (median = one) (p<0.001), including cardiovascular conditions, chronic respiratory disease, and diabetes.

Reported Symptoms

Among 316 (90%) respondents who answered questions on symptoms and did not report a previous positive SARS-CoV-2 test result,† 292 (92%) reported one or more symptoms on the date of SARS-CoV-2 testing (Table 2), including 238 (96%) of 248 outpatients and 54 (79%) of 68 inpatients. Both inpatients and outpatients reported a similar number of symptoms, but inpatients were more likely to describe dyspnea (72% versus 32%; p<0.001) and less likely to report loss of smell or taste (43% versus 59%; p = 0.030). Fewer symptomatic inpatients (39%, 20 of 51) reported a return to baseline level of health at 14–21 days than did symptomatic outpatients (64%, 150 of 233) (p = 0.001).

Exposures

Among 339 (97%) participants who provided exposure histories, 46% (153 of 332) reported a close case contact, defined as being within 6 feet of someone with a diagnosis of COVID-19, during the 2 weeks preceding illness onset or the date of testing for asymptomatic patients (Table 3). This was most commonly a family member (45%, 69 of 153) or a work colleague (34%, 52 of 153). Seven of the 339 participants were missing data in their case contact histories.

Approximately two thirds (64%, 212 of 333) of participants were employed; however, only 35 of 209 (17%) were able to telework. Outpatients were more likely to report being employed than were inpatients (70% versus 42%; p<0.001) and interacted with persons outside the home more frequently (p<0.001). Among employed participants, 53 (25%) reported working in health care.

Discussion

Few studies have systematically collected data on COVID-19 patients from varied health care settings in the United States. In this multistate telephone-based survey of 350 U.S. COVID-19

† Symptoms were asked in reference to the date of SARS-CoV-2 testing. Given uncertainty in reference date for patients with a previous positive SARS-CoV-2 RT-PCR test result, symptoms were not reported for these patients.

TABLE 1. Self-reported demographic and baseline clinical characteristics of outpatients (N = 271) and inpatients (N = 79) with SARS-CoV-2 RT-PCR–positive test results at 14–21 days or 28–35 days after testing — academic medical centers,* United States, March–May 2020

	No. (%)			
Characteristic	Total (350)	Outpatients (271)	Inpatients (79)	P-value
Median age, yrs, (IQR)	**43 (32–57)**	42 (31–54)	54 (36–68)	<0.001
Female sex	**185 (53)**	144 (53)	41 (52)	0.85
Race/Ethnicity[†]				0.008
White, non-Hispanic	**116 (33)**	101 (37)	15 (19)	
Black, non-Hispanic	**73 (21)**	51 (19)	22 (28)	
Hispanic	**116 (33)**	82 (30)	34 (43)	
Other, non-Hispanic	**43 (12)**	35 (13)	8 (10)	
Unknown	**2 (1)**	2 (1)	0 (0)	
Medical Insurance				0.85
Yes	**289 (83)**	222 (82)	67 (85)	
No	**45 (13)**	34 (13)	11 (14)	
Unknown	**16 (5)**	15 (6)	1 (1)	
Education level				0.83
Less than college	**177 (51)**	135 (50)	42 (53)	
Some college or more	**154 (44)**	119 (44)	35 (44)	
Unknown	**19 (5)**	17 (6)	2 (3)	
Annual household income				0.003
<$25,000	**56 (16)**	34 (13)	22 (28)	
$25,000–$49,000	**92 (26)**	77 (28)	15 (19)	
$50,000–$74,000	**33 (9)**	27 (10)	6 (8)	
>$74,000	**57 (16)**	49 (18)	8 (10)	
Unknown/Refused to answer	**112 (32)**	84 (31)	28 (35)	
Underlying medical condition (334)[§]				
Number, median (IQR)	**1 (0–2)**	1 (0–2)	2 (1–3)	<0.001
Any cardiac disease	**100 (30)**	69 (27)	31 (41)	0.019
Hypertension	**97 (29)**	67 (26)	30 (39)	0.023
Coronary artery disease	**10 (3)**	5 (2)	5 (7)	0.037
Congestive heart failure	**9 (3)**	3 (1)	6 (8)	0.005
Any respiratory disease	**65 (20)**	40 (16)	25 (33)	0.001
Asthma	**55 (16)**	36 (14)	19 (25)	0.022
COPD	**18 (5)**	6 (2)	12 (16)	<0.001
Diabetes	**51 (15)**	28 (11)	23 (30)	<0.001
Obesity (BMI ≥30 kg/m2)	**67 (20)**	47 (18)	20 (26)	0.13
Chronic kidney disease	**14 (4)**	8 (3)	6 (8)	0.067
Chronic liver disease	**11 (3)**	5 (2)	6 (8)	0.011
Immunosuppressive condition	**22 (7)**	16 (6)	6 (8)	0.60
Rheumatologic/Autoimmune condition	**28 (8)**	20 (8)	8 (11)	0.45
Neurologic condition	**16 (5)**	9 (4)	7 (9)	0.041
Blood disorder	**12 (4)**	7 (3)	5 (7)	0.11
Psychiatric disorder	**69 (21)**	52 (20)	17 (23)	0.65
Ever used tobacco[¶]	**104 (31)**	77 (30)	27 (36)	0.36
Current tobacco use (among ever users)	**17 (17)**	15 (20)	2 (7)	0.23
Current alcohol use**	**112 (34)**	89 (35)	23 (30)	0.45

Abbreviations: BMI = body mass index; COPD = chronic obstructive pulmonary disease; IQR = interquartile range; RT-PCR = reverse transcription–polymerase chain reaction.

* Patients were sampled from 11 academic medical centers in nine states (University of Washington [Washington], Oregon Health and Sciences University [Oregon], University of California Los Angeles and Stanford University [California], Hennepin County Medical Center [Minnesota], Vanderbilt University [Tennessee], The Ohio State University [Ohio], Wake Forest University [North Carolina], Montefiore Medical Center [New York], Beth Israel Deaconess Medical Center and Baystate Medical Center [Massachusetts]).

† Other non-Hispanic included two persons who reported being American Indian/Alaska Native, 25 Asian, three Native Hawaiian/Other Pacific Islander, and 18 Other; five reported both Asian and Other for race. Other race group combined because of comparatively low numbers in these groups compared with other race/ethnicity groups.

§ Excluding 16 (5%) patients who did not answer questions about underlying medical conditions; for those who answered questions about underlying conditions, some respondents were missing data on congestive heart failure (one), obesity (three), rheumatologic/autoimmune conditions (one), neurologic conditions (one), and psychiatric conditions (two); denominators used to calculate proportions of respondents with individual underlying medical conditions excluded patients who have missing data for the condition.

¶ Unknown for 17 (14 outpatients and three inpatients); among those who had ever used tobacco products, one did not state whether they were a current tobacco user.

** Unknown for 19 (16 outpatients and three inpatients).

TABLE 2. Symptoms reported on the date of SARS-CoV-2 test in outpatients and inpatients who tested positive for SARS-CoV-2 (N = 316) at 14–21 days or 28–35 days after testing — 11 academic medical centers,* United States, March–May 2020

	No. (%)			
Characteristic†	**All (316)**	**Outpatients (248)**	**Inpatients (68)**	**P-value**
Reported any symptom§	**292 (92%)**	238 (96%)	54 (79%)	N/A
Symptoms reported¶				
Median no. of symptoms (IQR)	**7 (4–10)**	7 (4–10)	8 (4–10)	0.18
Fever	**167 (57)**	131 (55)	36 (68)	0.086
Shortness of breath	**114 (39)**	76 (32)	38 (72)	<0.001
Cough	**182 (63)**	147 (62)	35 (69)	0.36
Productive	**91 (50)**	72 (49)	19 (54)	0.57
Bloody	**16 (9)**	10 (7)	6 (17)	0.054
Chest pain	**82 (28)**	60 (25)	22 (42)	0.014
Pleuritic pain	**61 (76)**	43 (74)	18 (82)	0.47
Abdominal pain	**55 (19)**	42 (18)	13 (25)	0.20
Nausea	**93 (32)**	73 (31)	20 (38)	0.28
Vomiting	**35 (12)**	24 (10)	11 (21)	0.027
Diarrhea	**109 (38)**	91 (38)	18 (35)	0.61
Chills	**156 (54)**	124 (52)	32 (60)	0.29
Body aches	**167 (58)**	138 (58)	29 (56)	0.72
Headache	**171 (60)**	146 (62)	25 (48)	0.062
Confusion	**41 (14)**	35 (15)	6 (12)	0.53
Fatigue	**198 (69)**	164 (70)	34 (65)	0.54
Congestion	**110 (38)**	91 (39)	19 (37)	0.77
Sore throat	**89 (31)**	73 (31)	16 (31)	0.97
Loss of smell	**140 (49)**	122 (52)	18 (35)	0.031
Loss of taste	**143 (50)**	122 (52)	21 (41)	0.16
Loss of smell, taste, or both	**163 (56)**	140 (59)	23 (43)	0.030
Returned to baseline health by interview date**	**170 (60)**	150 (64)	20 (39)	0.001

Abbreviations: IQR = interquartile range; N/A = not applicable.

* Patients were sampled from 11 academic medical centers in nine states (University of Washington [Washington], Oregon Health and Sciences University [Oregon], University of California Los Angeles and Stanford University [California], Hennepin County Medical Center [Minnesota], Vanderbilt University [Tennessee], The Ohio State University [Ohio], Wake Forest University [North Carolina], Montefiore Medical Center [New York], Beth Israel Deaconess Medical Center and Baystate Medical Center [Massachusetts]).

† Among 350 patients who had positive test results for SARS-CoV-2 and responded, 19 (5%) who reported a previous positive SARS-CoV-2 test result before the current test (10 outpatients and nine inpatients) were excluded. An additional 15 (4%) were excluded who did not answer symptom questions during the call 14–21 days after testing (five) or who only responded to the follow-up call at 28-35 days after testing, which did not include symptom questions (10).

§ Four percent (10 of 250) of outpatients reporting no symptoms were tested because of a job requirement (four), being a close contact of a COVID-19 patient (three), requirement before a scheduled surgery (two), and voluntarily tested because of advanced age and underlying medical conditions (one); 21% (14 of 66) of inpatients reporting no symptoms were tested while hospitalized for unrelated reasons, including six pregnant women hospitalized for delivery and eight for other reasons.

¶ Among 292 respondents who reported one or more symptoms, some respondents were missing data on individual symptoms: fever (one), shortness of breath (one), cough (three), chest pain (three), abdominal pain (four), nausea (three), vomiting (three), diarrhea (three), chills (two), body aches (four), headache (five), confusion (six), fatigue (five), congestion (five), sore throat (five), loss of smell (six), loss of taste (seven); denominators used to calculate proportions of respondents with individual symptoms excluded patients who had missing data for the symptom.

** Eight responses on return to baseline health were missing.

outpatients and inpatients, inpatients were typically older and had more underlying chronic conditions, findings that have been previously observed with both COVID-19 and influenza patients (*6*–*8*). Compared with outpatients, inpatients reported lower household incomes and were less likely to be white. Differences by race/ethnicity are consistent with those reported previously (*9*) (e.g., 43% of inpatients were Hispanic, and 28% were black), although in this descriptive analysis no adjustment for other factors was made to evaluate any independent association between race/ethnicity and COVID-19 severity.

Approximately one third of symptomatic outpatients reported that they had not returned to baseline health by the interview date 14–21 days after testing positive for SARS-CoV-2 infection. In comparison, almost all outpatient working adults with laboratory-confirmed influenza reported returning to normal activities within 14 days of illness onset during the 2012–13 influenza season (*10*).

Fewer than one half of patients were aware of recent close contact with someone with COVID-19, highlighting a need for increased screening, case investigation, contact tracing, and isolation of infected persons during periods of community transmission. This finding suggests that ensuring social distancing and more widespread use of cloth face coverings are warranted (*3*). A majority of COVID-19 patients reported working during the 2 weeks preceding illness, and few had the ability to telework, underscoring the need for enhanced measures to ensure workplace safety.

The findings in this report are subject to at least six limitations. First, given that the survey was telephone-based, some nonresponse bias is possible. Patients with more severe illnesses might

TABLE 3. Exposures and behaviors in the 2 weeks preceding illness onset in outpatients and inpatients who had positive test results for SARS-CoV-2 (N = 339) at 14–21 days or 28–35 days after testing — 11 academic medical centers,* United States, March–May 2020†

Characteristic§	No. (%)			
	All (339)	**Outpatients (262)**	**Inpatients (77)**	**P-value**
Contact (≤6 feet) with COVID-19 patient [might have multiple]	**153 (46)**	129 (50)	24 (32)	0.004
Contact				
Family member	**69 (45)**	56 (43)	13 (54)	
Work colleague	**52 (34)**	47 (36)	5 (21)	
Friend	**15 (10)**	14 (11)	1 (4)	
Other¶	**29 (19)**	22 (17)	7 (29)	
Type of residence				<0.001
Single family home	**211 (62)**	176 (67)	35 (45)	
Apartment	**94 (28)**	66 (25)	28 (36)	
Long-term care facility	**4 (1)**	0 (0)	4 (5)	
Group home	**1 (<1)**	0 (0)	1 (1)	
Other	**29 (9)**	20 (8)	9 (12)	
Lives with others	**303 (89)**	232 (89)	71 (92)	0.36
No. of other household members, median (IQR)	**3 (1–4)**	3 (1.5–4)	2 (1–4)	0.49
Employed	**212 (64)**	180 (70)	32 (42)	<0.001
If employed, worked outside home within last 2 wks				0.49
Every day	**118 (59)**	102 (60)	16 (52)	
2–3 times per wk	**38 (19)**	31 (18)	7 (23)	
Once per wk	**6 (3)**	6 (4)	0 (0)	
Never	**39 (19)**	31 (18)	8 (26)	
If employed, ability to telework	**35 (17)**	32 (18)	3 (10)	0.25
If employed, worked in health care facility	**53 (25)**	46 (26)	7 (23)	0.72
Total number of daily contacts, median (IQR)	**5 (2–10)**	5 (3–13)	3 (1–10)	0.013
Frequency of interaction with others outside of home				<0.001
Every day	**130 (41)**	113 (47)	17 (23)	
2–3 times per wk	**65 (21)**	47 (19)	18 (24)	
Once per wk	**38 (12)**	32 (13)	6 (8)	
Never	**83 (26)**	50 (21)	33 (45)	
Days going out for groceries				0.071
Every day	**7 (2)**	4 (2)	3 (4)	
2–3 times per wk	**85 (27)**	65 (27)	20 (27)	
Once per wk	**120 (38)**	100 (41)	20 (27)	
Never	**107 (34)**	75 (31)	32 (43)	
Attended gathering with >10 persons	**28 (8)**	21 (8)	7 (9)	0.77
Used public transportation	**23 (7)**	12 (5)	11 (15)	0.003

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

* Patients were sampled from 11 academic medical centers in nine states (University of Washington [Washington], Oregon Health and Sciences University [Oregon], University of California Los Angeles and Stanford University [California], Hennepin County Medical Center [Minnesota], Vanderbilt University [Tennessee], The Ohio State University [Ohio], Wake Forest University [North Carolina], Montefiore Medical Center [New York], Beth Israel Deaconess Medical Center and Baystate Medical Center [Massachusetts]).

† Exposures were elicited in 2 weeks preceding illness onset or 2 weeks preceding testing for asymptomatic patients.

§ Of 350 patient respondents, 339 were included; 11 (3%) were excluded for not answering any of the exposure-related questions; for individual exposures in 339 included respondents, some respondents were missing data on close contact with a person with a COVID-19 case (seven), being employed (six), working outside the home (11), ability to telework (three), working at a health care facility (one), average number of daily contacts outside the home (15), frequency of interaction with others outside the home (23), days going out for groceries (20), attendance at gathering with ≥10 persons (six), and use of public transportation (six); denominators used to calculate proportions of respondents with individual exposures or behaviors exclude patients with missing data for the exposure or behavior.

¶ Other included exposures within health care settings (18), assisted living facilities (six), neighbors (two), clients at work (one), exposure at a correctional facility (one), and roommate at long-term care facility (one); among 24 exposures in health care settings or assisted living facilities, 22 were reported among persons who worked in a health care facility.

have still been hospitalized at the time of the survey or might have died, resulting in a higher proportion of nonrespondents among patients with more severe illness. Estimates of the frequency of clinical characteristics should therefore be interpreted with caution. Second, patients were sampled from academic medical centers with differing numbers of respondents; therefore, patients in this study are not representative of cases nationwide. With limited testing capacity, some groups (e.g., health care and other essential workers) might also have been preferentially tested. Third, data were obtained by self-report and might be subject to recall bias. Fourth, this survey documented a cross-section of symptoms reported on the date of testing, and symptoms might have changed during the course of illness. In addition, a few patients reported an earlier positive test result, which might have led to misclassification of test setting; however, this was infrequent (5%). Fifth, no adjustment for other factors to determine whether variables were independently associated with illness severity was made. Finally, a small proportion of respondents were asymptomatic at the time of testing. However, comparisons including demographics and exposure histories were similar when the analysis was restricted to only patients who reported symptoms.

This study provides insights into epidemiologic characteristics of patients with laboratory-confirmed COVID-19 during March–May 2020, documenting differences between patients with medically attended outpatient and inpatient illness regarding demographic characteristics, baseline underlying chronic conditions, symptoms, and exposures that could be used to target public health interventions. In addition, among symptomatic respondents, inpatients and outpatients with COVID-19 reported similar numbers of symptoms, but different types of symptoms as previously described.[§] Thus, a range of symptoms should prompt testing for SARS-CoV-2. The wide range of symptoms reported, and the lack of known COVID-19 contact in 54% of patients, underscores the need for isolation of infected persons, contact tracing and testing during ongoing community transmission, and prevention measures including social distancing and use of cloth face coverings.

[§] https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.

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Exposures Before Issuance of Stay-at-Home Orders Among Persons with Laboratory-Confirmed COVID-19 — Colorado, March 2020

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On March 26, 2020, Colorado instituted stay-at-home orders to reduce community transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). To inform public health messaging and measures that could be used after reopening, persons with laboratory-confirmed COVID-19 during March 9–26 from nine Colorado counties comprising approximately 80% of the state's population[†] (Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, and Weld) were asked about possible exposures to SARS-CoV-2 before implementation of stay-at-home orders. Among 1,738 persons meeting the inclusion criteria[§] in the Colorado Electronic Disease Surveillance System, 600 were randomly selected and interviewed using a standardized questionnaire by telephone. Data collection during April 10–30 included information about demographic characteristics, occupations, and selected activities in the 2 weeks preceding symptom onset. During the period examined, SARS-CoV-2 molecular testing was widely available in Colorado; community transmission was documented before implementation of the stay-at-home order. At least three attempts were made to contact all selected patients or their proxy (for deceased patients, minors, and persons unable to be interviewed [e.g., those with dementia]) on at least 2 separate days, at different times of day. Data were entered into a Research Electronic Data Capture (version 9.5.13; Vanderbilt University) database, and descriptive analyses used R statistical software (version 3.6.3; The R Foundation).

Among the 600 randomly selected COVID-19 patients, 133 (22%) were unreachable, 57 (10%) declined to participate, and 46 (8%) were ineligible (e.g., the onset date was too early or the patient was asymptomatic), leaving 364 (61%) participants. The median age of participants was 50 years (interquartile range = 34–64 years), and 187 (51%) were male. Overall, 206 (57%) participants identified as non-Hispanic white and 75 (21%) as Hispanic. Among all participants, 345 (95%) reported having health insurance, 128 (35%) were hospitalized and 18 (5%) died. Occupations reported by the 264 (73%) working participants were most frequently categorized into the following workplace settings[¶]: health care (99; 38%), professional or office setting (46; 17%), public administration or armed forces (18; 7%), and manufacturing (including meatpacking) (15; 6%).

Among all participants, 99 (27%) reported known contact with at least one person with laboratory-confirmed COVID-19 (Figure); the most commonly reported relationships to potential source patients were a family member (27; 27%) and a coworker (25; 25%). Approximately three quarters of participants reported that their exposure to a known COVID-19 contact occurred in the workplace (47; 47%) or the household (24; 24%). Among the 47 participants who reported workplace exposure, most were health care personnel (28; 60%), followed by workers in public administration or the armed forces (six; 13%), and those working in a manufacturing setting (five; 11%).

Among the 265 (73%) participants without known contact with a laboratory-confirmed COVID-19 patient, 30% (79 of 265) reported contact with a person they knew who had fever or respiratory symptoms. The most commonly reported activities in the 2 weeks before becoming ill included attending gatherings of >10 persons (116; 44%), traveling domestically (76; 29%), working in a health care setting (75; 28%), visiting a health care setting not as a health care worker (61; 23%), and using public transportation (57; 22%).

These findings highlight the need for anyone with COVID-19–compatible symptoms to avoid public settings and isolate from other persons, even within their own household, when possible (*1*,*2*). Because workplaces are common locations of potential exposure to persons with COVID-19, it is important that company officials and managers refer to CDC's guidance for workplaces during the COVID-19 pandemic to minimize risk for exposure for their employees and customers (*3*). To protect their employees, patients, and other persons who enter their facilities, managers and staff members of health care facilities are encouraged to continue to follow CDC infection prevention and control practices (*4*). Because approximately one half of participants did not report contact with either a confirmed COVID-19 case or someone they knew with fever

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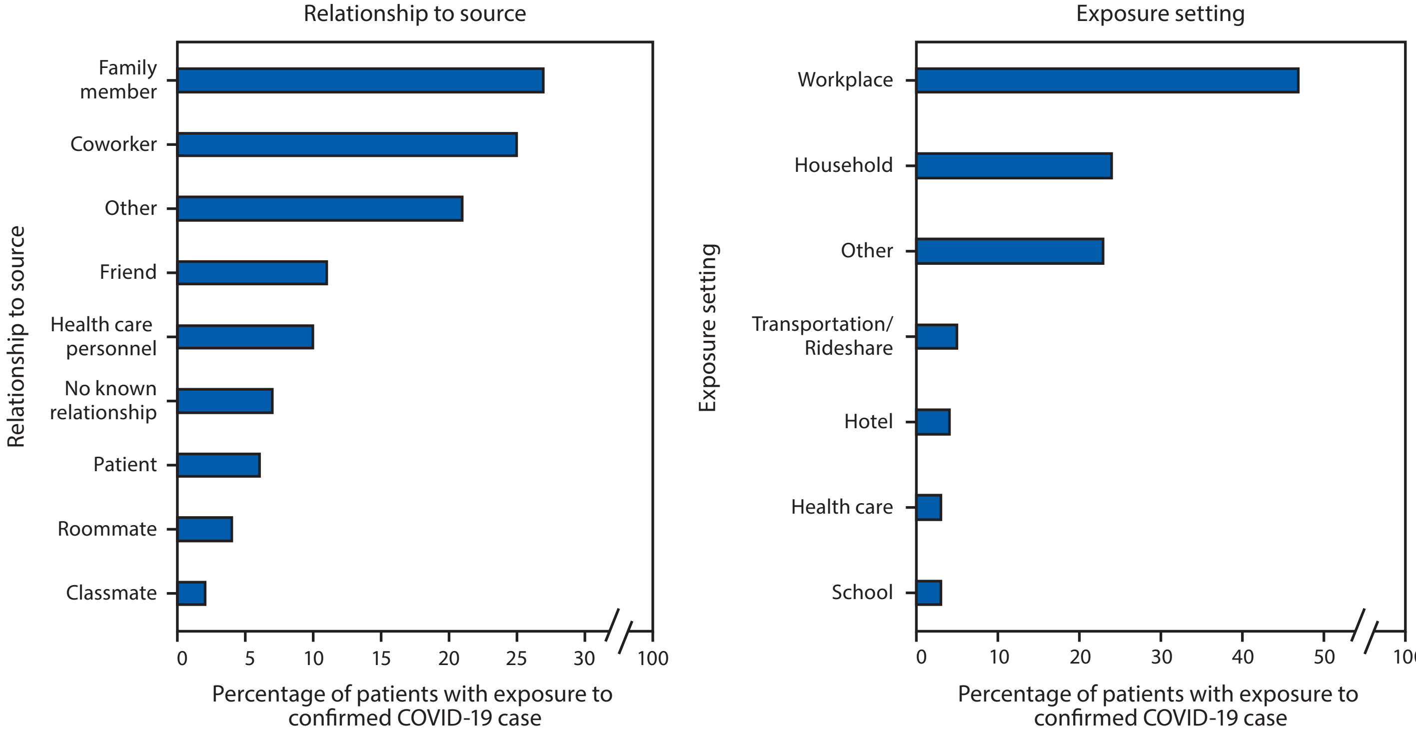
† https://demography.dola.colorado.gov/population/population-totals-counties/.

§ Inclusion criteria consisted of laboratory-confirmed SARS-CoV-2 infection, presence of ≥1 symptom to establish illness onset date, and known hospitalization status.

¶ Occupations were coded using the Census Industry and Occupation Classification System (https://www.cdc.gov/niosh/topics/coding/code.html and https://wwwn.cdc.gov/nioccs3/Default.aspx).

FIGURE. Reported relationships* and settings† of exposure to persons with laboratory-confirmed COVID-19 among persons (N = 99) infected before institution of stay-at-home orders§ — Colorado, March 2020



Abbreviation: COVID-19 = coronavirus disease 2019.
* Responses to exposure relationship and setting were not mutually exclusive. Family members include spouse (14%) and parent, child, or other family member (13%).
† Health care personnel reporting exposure at work were classified as having workplace exposure.
§ March 26, 2020.

or respiratory symptoms, hand hygiene, social distancing, and wearing face coverings remain important strategies to practice while SARS-CoV-2 continues to circulate (*5*).

The findings in this report are subject to at least three limitations. First, this analysis did not include a comparison group of persons without COVID-19; thus, these findings are descriptive. Second, these findings are likely not generalizable to other populations because of potential response bias and differences in age distribution, disease severity, testing practices, or socioeconomic status between participants in this investigation and other populations. Finally, other community mitigation interventions, such as restrictions on gatherings of ≥50 persons, had been implemented before the stay-at-home orders were issued in Colorado, which likely also affected reported activities and potential exposure locations.

Depending on local guidance and circumstances, health departments should consider prioritizing case investigation and contact tracing to ensure prompt notification of exposed contacts. As jurisdictions continue reopening, mitigation strategies will need to be reviewed and potentially augmented to reduce the spread of SARS-CoV-2.

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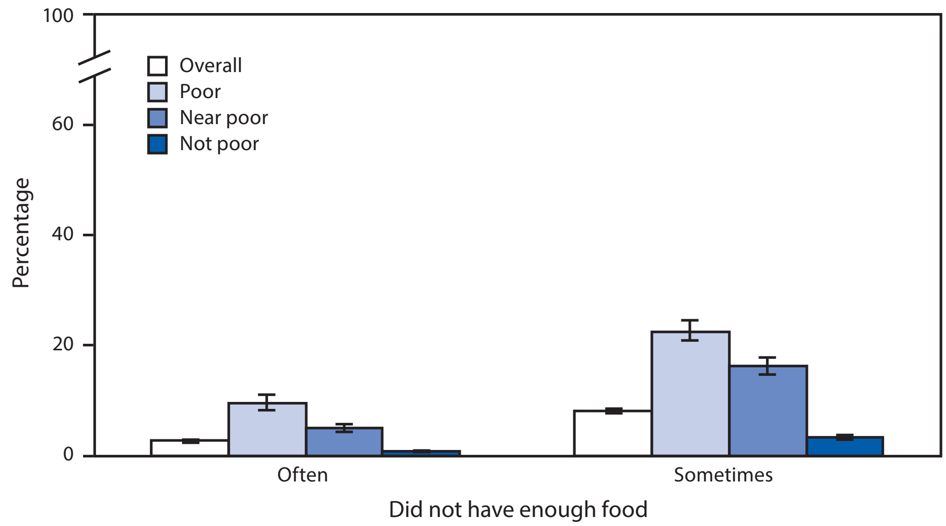
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Families That Often or Sometimes Did Not Have Enough Food To Last 30 Days and Did Not Have Enough Money to Buy More,† by Poverty Status§ — National Health Interview Survey, United States, 2018



* With 95% confidence intervals shown by error bars.

† Household interviews of a sample of the civilian, noninstitutionalized U.S. population were conducted using the National Health Interview Survey Family component. Estimates were derived from answers to the question "The food that I/we bought just didn't last, and I/we didn't have money to get more. Was that often true, sometimes true, or never true for your family in the last 30 days?" The percentages who responded "often true" or "sometimes true" are presented in the QuickStats.

§ Poverty status was based on family income and family size, using the U.S. Census Bureau's poverty thresholds. "Poor" families are defined as those with incomes below the poverty threshold; "near poor" families have incomes of 100% to less than 200% of the poverty threshold; and "not poor" families have incomes of 200% of the poverty threshold or greater.

During 2018, 2.7% of U.S. families often did not have enough food and did not have enough money to buy more to last 30 days. Poor families (9.6%) were more likely than near-poor families (4.9%) and not-poor families (0.8%) to often lack food. An estimated 8.2% of families sometimes did not have enough food or the money to buy more, and the percentage varied by poverty status: poor families (22.6%), near-poor families (16.2%), and not-poor families (3.4%).

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

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