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Cancer Screening Test Receipt — United States, 2018

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Screening for breast cancer, cervical cancer, and colorectal cancer (CRC) reduces mortality from these cancers.* However, screening test receipt has been below national targets with disparities observed in certain populations (*1*,*2*). National Health Interview Survey (NHIS) data from 2018 were analyzed to estimate percentages of adults up to date with U.S. Preventive Services Task Force (USPSTF) screening recommendations. Screening test receipt remained below national Healthy People 2020 (HP2020) targets, although CRC test receipt neared the target. Disparities were evident, with particularly low test receipt among persons who were uninsured or did not have usual sources of care. Continued monitoring helps assess progress toward targets and could inform efforts to promote screening and reduce barriers for underserved populations.

Data from the 2018 NHIS, an annual survey of a nationally representative sample of the civilian, noninstitutionalized U.S. population,† were used to examine up-to-date breast, cervical, and colorectal cancer screening test receipt per USPSTF recommendations. Information about tests was collected from one randomly selected adult per family (final sample adult response rate was 53.1%) (*3*). Respondents were asked whether they had ever received each test and when they received their most recent test. Respondents with a personal history of the cancer in question were excluded from analysis for that cancer type. Percentages with Korn-Graubard confidence intervals (*4*) are presented overall and by sociodemographic and health care access factors. Percentages of respondents who were up to date with screening were also age-standardized to the 2000 U.S. standard population, consistent with HP2020 cancer screening measures. NHIS-imputed income files were used. NHIS data from 2005, 2008, 2010, 2013, 2015, and 2018 were used to examine differences across years in percentages of persons who were up to date with screening, according to USPSTF recommendations in effect for each year. For 2018, "up-to-date" status was defined as receipt of the following: mammography within 2 years among women aged 50–74 years for breast cancer screening; Pap test within 3 years for women aged 21–65 years or Pap test plus human papillomavirus (HPV) test (co-testing) within 5 years for women aged 30–65 years for cervical cancer screening (among women without hysterectomy);

Continuing Education examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html

* https://uspreventiveservicestaskforce.org/uspstf/recommendation/breast-cancer-screening#bootstrap-panel--5; https://uspreventiveservicestaskforce.org/uspstf/recommendation/cervical-cancer-screening#bootstrap-panel--8; https://uspreventiveservicestaskforce.org/uspstf/recommendation/colorectal-cancer-screening#bootstrap-panel--5.

† https://www.cdc.gov/nchs/nhis/nhis_2018_data_release.htm.

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and home blood stool or fecal immunochemical test (FIT) within 1 year; colonoscopy within 10 years; computed tomography (CT) colonography, or sigmoidoscopy within 5 years; or FIT-DNA test within 3 years among adults aged 50–75 years for CRC screening.

In August 2018, USPSTF added HPV testing alone as a cervical cancer screening option for women aged 30–65 years[§]; however, because this analysis used data collected beginning January 2018 regarding screening in the preceding 3–5 years, this option was not included. Wald F tests were used to test for any differences across years (treated categorically) and groups. Sample adult weights and design variables were used to account for the complex sample design. Estimates not meeting National Center for Health Statistics data presentation standards for proportions were suppressed (*4*). All analyses were performed using SAS (version 9.4; SAS Institute) and SUDAAN (version 11.0.3; RTI International).

Among women aged 50–74 years, 72.4% were up to date with mammography (age-standardized 72.3%) (Table 1), which is below the HP2020 target (81.1%). Lower test receipt was associated with having lower educational attainment and income, not having a usual source of care, and being uninsured or having only public health insurance coverage. Approximately 30%–40% of women without a usual source of care or health insurance coverage were up to date. Although the percentage of women up to date with mammography has not varied substantially by year (Figure), the absolute number of women who received a mammogram has increased. The estimated number of women tested (numerator) was 4,097,142 in 2005 and 5,558,224 in 2018, reflecting growth in the population of women aged 50–74 years (denominator) age-eligible for testing.

Among women aged 21–65 years, 82.9% were up to date with cervical cancer screening (age-standardized 83.4%) (Table 1), which is below the HP2020 target (93.0%). Lower test receipt was associated with younger and older age groups, Asian race, lower educational attainment and income, shorter U.S. residence, gay or lesbian sexual orientation, no usual source of care, and being uninsured or having only public insurance coverage. Cervical cancer test receipt varied from 2005 to 2018 (Figure), with declines from 85.3% in 2005 to 80.5% in 2013, followed by an increase (82.9% in 2018).

Among adults aged 50–75 years, 66.9% were up to date with CRC testing (age-standardized 66.7%) (Table 2), nearing the HP2020 target (70.5%). Lower test receipt was associated with age 50–64 years, American Indian/Alaska Native or Asian race, Hispanic ethnicity, lower educational attainment or income, non-U.S. birthplace, no usual source of care, and non-military health insurance coverage or no insurance. Approximately 30% of those without a usual source of care or health insurance were up to date. Test receipt increased since 2005 (46.6%) (Figure).

[§] https://uspreventiveservicestaskforce.org/uspstf/recommendation/cervical-cancer-screening.

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TABLE 1. Percentage of U.S. women age-eligible for screening who were up to date with breast and cervical cancer screening, by sociodemographic and access-to-care factors — United States, 2018

Characteristic	Breast cancer screening*		Cervical cancer screening†	
	No.	%§ (95% CI)	No.	%§ (95% CI)
Overall	**5,311**	**72.4 (70.8–73.9)**	**7,732**	**82.9 (81.6–84.0)**
Age group, yrs¶				
21–30	—**	—**	1,717	75.8 (72.8–78.7)
31–40	—**	—**	1,989	90.1 (88.5–91.6)
41–50	—**	—**	1,590	87.9 (85.7–89.8)
51–65	—**	—**	2,436	79.5 (77.4–81.5)
50–64	3,229	71.5 (69.6–73.4)	—**	—**
65–74	2,082	74.3 (71.7–76.7)	—**	—**
P-value††	0.076		<0.001	
Race				
White	4,312	72.7 (71.0–74.3)	5,943	83.2 (81.9–84.5)
Black	625	72.9 (67.8–77.6)	1,038	87.1 (84.0–89.7)
AI/AN	52	—§§	102	73.6 (57.8–86.0)
Asian	210	70.5 (62.3–77.9)	460	75.8 (70.4–80.7)
Multiple race	108	65.3 (52.0–77.1)	173	77.5 (68.5–84.9)
P-value††	0.588		0.002	
Ethnicity¶¶				
Non-Hispanic	4,768	72.6 (71.0–74.2)	6,475	83.2 (81.9–84.5)
Hispanic	543	70.7 (65.5–75.6)	1,257	81.4 (78.0–84.4)
Puerto Rican	64	79.8 (67.9–88.8)	127	81.1 (72.0–88.3)
Mexican/Mexican American	283	70.3 (62.9–77.1)	739	78.4 (73.5–82.7)
Central/South American	101	73.0 (59.2–84.1)	217	86.9 (79.8–92.2)
Other Hispanic	95	63.9 (51.3–75.2)	174	87.3 (80.1–92.7)
P-value††	0.471		0.283	
Education				
Less than high school	597	63.0 (57.7–68.1)	686	72.1 (67.3–76.7)
High school/GED	1,311	68.6 (65.5–71.5)	1,490	78.4 (75.5–81.2)
Some college	1,686	71.6 (68.9–74.2)	2,344	82.3 (80.2–84.2)
College degree	1,694	80.4 (78.1–82.7)	3,188	88.2 (86.5–89.8)
P-value††	<0.001		<0.001	
Federal poverty threshold, %				
≤138	1,060	58.6 (54.5–62.6)	1,677	73.7 (70.4–76.8)
>138–250	980	66.7 (62.6–70.6)	1,401	78.4 (75.3–81.4)
>250–400	1,030	72.1 (68.5–75.5)	1,556	84.3 (81.8–86.5)
>400	2,240	79.5 (77.3–81.6)	3,098	88.2 (86.7–89.7)
P-value††	<0.001		<0.001	

See table footnotes on the next page.

Discussion

In 2018, receipt of screening tests for breast, cervical, and colorectal cancers was below national HP2020 targets. CRC test receipt increased after 2005 and neared the target in 2018, whereas breast and cervical cancer test receipt remained below targets with little change over this period. Test receipt varied across groups. As was also found in previous reports, testing for all three cancers decreased with decreasing educational attainment and income (*1*,*2*). Cervical cancer test receipt differed by sexual orientation, CRC test receipt varied by ethnicity, and both differed by age, race, and duration of U.S. residence. Information about lower test receipt in some groups might help inform targeted efforts to promote screening and reduce disparities. Lower test receipt in the youngest age groups for cervical cancer and CRC screening might, in part, reflect the transition of persons who previously did not meet screening criteria.

The lowest percentages of breast cancer and CRC screening test receipt were among respondents who lacked a usual source of care (32.0% and 29.4% for breast cancer and CRC screening, respectively) or health insurance coverage (39.5% and 30.2% for breast cancer and CRC screening, respectively); the largest disparities on the basis of these characteristics were for breast cancer and CRC screening. Most persons in these groups were not up to date with breast cancer or CRC tests. These large disparities have persisted for years (*1*,*2*,*5*,*6*). The number of persons without health insurance has declined in recent years (*7*). However, among those lacking insurance or a usual source of care, most were not up to date with USPSTF breast cancer and CRC screening recommendations. CDC's National Breast and Cervical Cancer Early Detection Program provides low-income, uninsured, and underinsured women access to breast and cervical cancer screening and diagnostic

TABLE 1. (*Continued*) Percentage of U.S. women age-eligible for screening who were up to date with breast and cervical cancer screening, by sociodemographic and access-to-care factors — United States, 2018

Characteristic	Breast cancer screening*		Cervical cancer screening†	
	No.	%§ (95% CI)	No.	%§ (95% CI)
Duration of U.S. residence, yrs¶				
≤10	51	—§§	303	65.0 (58.3–71.3)
>10	748	73.0 (68.4–77.2)	1,133	82.0 (78.9–84.8)
Born in United States	4,502	72.7 (71.1–74.3)	6,273	84.3 (83.0–85.5)
P-value††	0.028		<0.001	
Sexual orientation				
Gay or lesbian	63	—§§	124	64.7 (52.9–75.4)
Straight	5,118	72.6 (71.0–74.1)	7,288	83.4 (82.2–84.6)
Bisexual	24	—§§	171	79.0 (69.5–86.6)
Other	23	—§§	41	—§§
P-value††	0.304		0.007	
Usual source of care				
Yes	4,956	75.1 (73.6–76.6)	6,705	85.2 (84.0–86.4)
No	354	32.0 (26.1–38.4)	1,025	67.7 (63.9–71.3)
P-value††	<0.001		<0.001	
Insurance¶,***				
Private	3,305	77.2 (75.5–78.9)	5,302	86.4 (85.1–87.6)
Military	167	78.2 (70.2–85.0)	217	91.9 (86.6–95.6)
Public only	1,521	67.2 (64.2–70.2)	1,321	79.5 (76.4–82.4)
Uninsured	304	39.5 (32.8–46.5)	865	65.0 (60.6–69.1)
P-value††	<0.001		<0.001	

Source: National Center for Health Statistics, National Health Interview Survey, 2018.
Abbreviations: AI/AN = American Indian/Alaska Native; GED = General Educational Development certificate.
* Mammogram within preceding 2 years among women aged 50–74 years with no prior history of breast cancer.
† For women without hysterectomy and with no prior history of cervical cancer, either Pap test within 3 years for women aged 21–65, or Pap test plus human papillomavirus (HPV) test (co-testing) within 5 years for women aged 30–65 years.
§ Percentages are weighted using National Health Interview Survey sample adult weights that adjust for the probability of selection, nonresponse, and poststratification. Poststratification adjustments for 2018 use population estimates derived from the 2010 Census by the U.S. Census Bureau.
¶ As of time of survey.
** Not estimated.
†† P-values from Wald F tests.
§§ Estimates suppressed because they did not meet National Center for Health Statistics reliability standards.
¶¶ P-value testing for differences between Hispanic persons and non-Hispanic persons. Hispanic subgroups are self-reported.
*** Insurance categorized hierarchically in order of categories listed.

services.¶ The Colorectal Cancer Control Program supports implementation of evidence-based interventions and supporting strategies in health systems to increase screening use.** Even among those with health insurance coverage, some groups might be farther below targets than others. For example, approximately 77%–78% of women with private or military insurance were up to date with USPSTF breast cancer screening recommendations, nearing the HP2020 target of 81.1%, compared with 67% of women with only public insurance. Of note, HP2020 determined targets based on population totals rather than specific groups.

The findings reported reflect receipt of tests within recommended screening intervals. They do not reflect test overuse, screening quality, or adequacy of follow-up. For example, positive results on CRC screening stool tests need follow-up colonoscopy to complete evaluation, and problems in CRC screening quality exist (*8*,*9*).

¶ https://www.cdc.gov/cancer/nbccedp/.
** https://www.cdc.gov/cancer/crccp/about.htm.

Summary

What is already known about this topic?

Receipt of screening for breast cancer, cervical cancer, and colorectal cancer (CRC) is below national targets. Large population disparities in screening receipt exist.

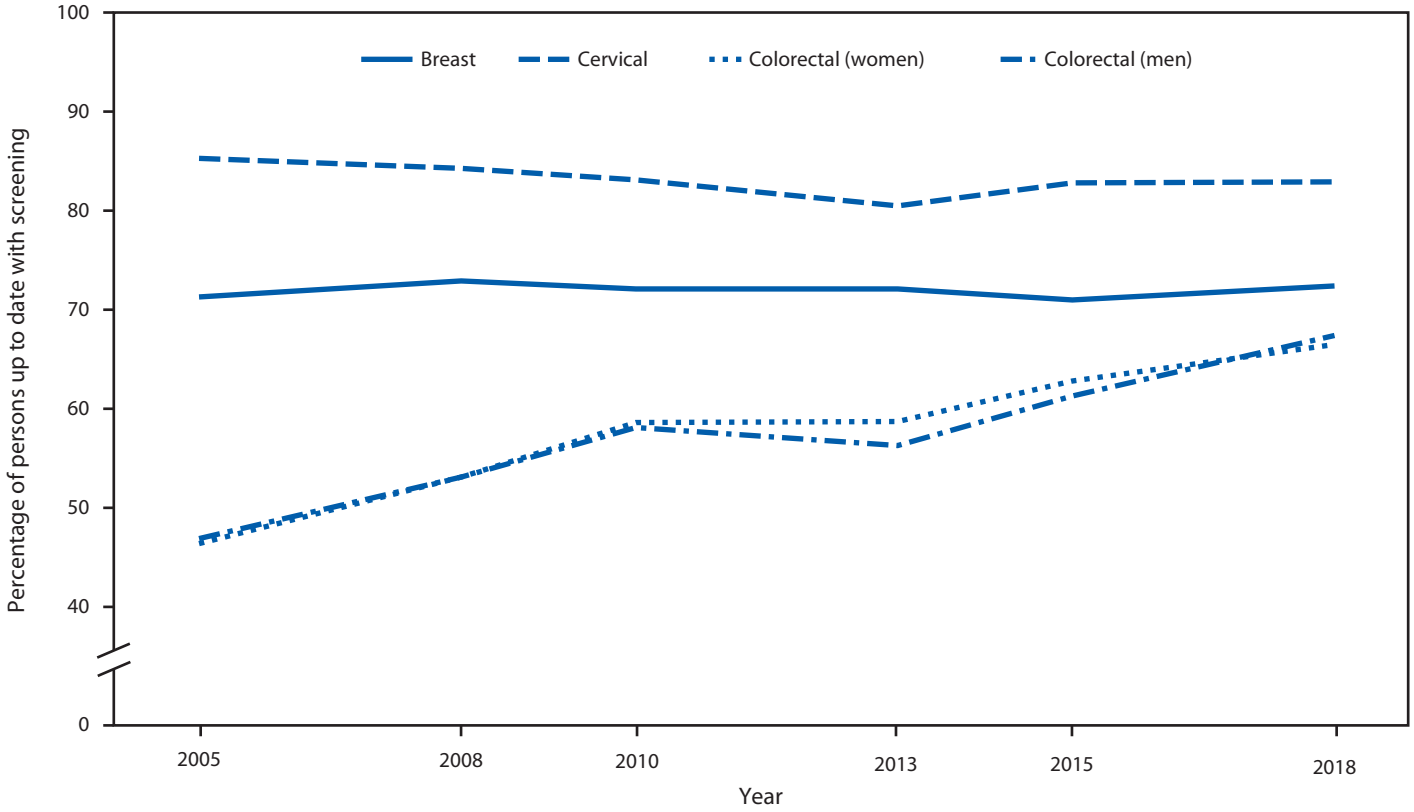
What is added by this report?

In 2018, receipt of screening tests for breast and cervical cancers remained below Healthy People 2020 targets, with little change since 2005. CRC screening receipt increased in recent years and has neared the target (70.5%). Screening test receipt was low among persons without health insurance coverage or a usual source of care.

What are the implications for public health practice?

Continued monitoring of screening rates can help assess whether national screening targets are achieved. Information about test receipt might help inform efforts that promote screening test use as recommended and reduce barriers for underserved populations to eliminate disparities.

FIGURE. Percentage of adults up to date* with screening for breast, cervical, and colorectal cancers, by cancer type, sex, and year — United States, 2005–2018



* Up to date with U.S. Preventive Services Task Force screening recommendations in effect for each year defined as breast cancer: mammography within 2 years among women aged 50–74 years (all survey years); cervical cancer 2015–2018: Pap test within 3 years among women aged 21–65 years without hysterectomy, or Pap test plus human papillomavirus (HPV) test (co-testing) within 5 years among women aged 30–65 years without hysterectomy; cervical cancer before 2015: Pap test within 3 years among women aged 21–65 years without hysterectomy; colorectal cancer (CRC) 2018: home blood stool test within 1 year, sigmoidoscopy or computed tomography (CT) colonography within 5 years, colonoscopy within 10 years, or fecal immunochemical test (FIT)–DNA test within 3 years among adults aged 50–75 years; CRC 2010–2015: home blood stool test within 1 year, colonoscopy within 10 years, or sigmoidoscopy within 5 years with home blood stool test within 3 years among adults aged 50–75 years; CRC 2005–2008: home blood stool test within 1 year, colonoscopy within 10 years, or sigmoidoscopy within 5 years among adults aged 50–75 years.

The findings in this report are subject to at least five limitations. First, data are self-reported and potentially subject to social desirability and recall bias. Second, survey questions about tests have changed over time. Third, the 2018 sample adult response rate was 53%, and nonresponse bias might exist despite survey weight adjustments; response rates for earlier years have been published (*3*). Fourth, because of limited sample sizes, estimates could not be generated for all groups. Finally, percentages might include tests performed for diagnostic purposes. NHIS data from 2018 include self-reported reasons for mammograms but not for cervical cancer tests or the CRC screening measure. Among women who received a mammogram within 2 years in the current analysis, 95% reported that it was part of a "routine exam." A study of CRC tests (*10*) also suggested that a majority of respondents reported that tests were performed for screening. Consistent with HP2020 measures[††] and previous reports (*1*,*2*,*5*,*6*,*10*), the current analysis included all tests because those receiving diagnostic tests might be considered screened in effect and therefore up to date with screening recommendations.

Continued monitoring can help assess whether national screening targets are achieved, and inform efforts that promote screening test receipt as recommended and reduce barriers for underserved populations to eliminate disparities. To promote screening for these three cancers, the Community Preventive Services Task Force recommends evidence-based interventions that increase client demand for, access to, and provider delivery of screening services.[§§] The Task Force noted that evidence-based interventions can be selected and adapted to meet the

[††] https://www.healthypeople.gov/2020/data-search/Search-the-Data#topic-area=3513.
[§§] https://www.thecommunityguide.org/.

TABLE 2. Percentage of U.S. adults aged 50–75 years who were up to date with colorectal cancer screening* — United States, 2018

Characteristic	Colorectal cancer screening	
	No.	%† (95% CI)
Overall	**10,595**	**66.9 (65.8–68.1)**
Age group, yrs§		
50–64	6,294	61.8 (60.2–63.3)
65–75	4,301	76.9 (75.4–78.4)
P-value¶	<0.001	
Sex		
Men	4,846	67.4 (65.8–69.0)
Women	5,749	66.5 (64.9–68.1)
P-value¶	0.437	
Race		
White	8,630	67.9 (66.6–69.2)
Black	1,197	65.3 (61.8–68.7)
AI/AN	116	54.7 (42.7–66.3)
Asian	432	58.1 (52.1–63.9)
Multiple race	201	66.9 (58.2–74.7)
P-value¶	0.007	
Ethnicity**		
Non-Hispanic	9,637	68.2 (67.0–69.4)
Hispanic	958	57.6 (53.4–61.7)
Puerto Rican	121	76.6 (67.2–84.4)
Mexican/Mexican American	513	52.3 (46.6–58.0)
Central/South American	173	57.7 (48.1–66.9)
Other Hispanic	151	63.4 (55.2–71.1)
P-value¶	<0.001	
Education		
Less than high school	1,132	54.2 (50.6–57.8)
High school/GED	2,704	63.5 (61.3–65.7)
Some college	3,218	67.7 (65.7–69.7)
College degree	3,499	73.5 (71.7–75.2)
P-value¶	<0.001	
Federal poverty threshold, %		
≤138	1,881	56.9 (53.9–60.0)
>138–250	1,924	59.7 (56.8–62.7)
>250–400	2,053	66.3 (63.4–69.0)
>400	4,737	72.7 (71.0–74.3)
P-value¶	<0.001	
Duration of U.S. residence¶		
≤10 yrs	81	32.8 (21.5–45.8)
>10 yrs	1,384	58.6 (55.3–61.8)
Born in U.S.	9,113	69.2 (68.0–70.4)
P-value¶	<0.001	
Sexual orientation		
Gay or lesbian	199	75.3 (67.2–82.3)
Straight	10,140	66.9 (65.8–68.1)
Bisexual	44	—††
Other	44	—††
P-value¶	0.118	
Usual source of care		
Yes	9,739	70.2 (69.0–71.3)
No	856	29.4 (25.5–33.5)
P-value¶	<0.001	
Insurance§,§§		
Private	6,488	69.0 (67.5–70.4)
Military	631	80.6 (76.7–84.1)
Public only	2,812	68.2 (66.1–70.4)
Uninsured	640	30.2 (25.5–35.1)
P-value¶	<0.001	

Source: National Center for Health Statistics, National Health Interview Survey, 2018.
Abbreviations: AI/AN = American Indian/Alaska Native; GED = General Educational Development.
* Among respondents aged 50–75 years with no prior history of colorectal cancer, home blood stool or fecal immunochemical test (FIT) within 1 year, colonoscopy in past 10 years, computed tomography (CT) colonography in past 5 years, sigmoidoscopy in past 5 years, or FIT-DNA test in past 3 years.
† Weighted using National Health Interview Survey sample adult weights that adjust for the probability of selection, nonresponse, and post-stratification. Post-stratification adjustments for 2018 use population estimates derived from the 2010 Census by the U.S. Census Bureau.
§ As of time of survey.
¶ P-values from Wald F tests.
** P-value testing for differences between Hispanic persons and non-Hispanic persons. Hispanic subgroups are self-reported.
†† Estimates suppressed because they did not meet National Center for Health Statistics reliability standards.
§§ Insurance categorized hierarchically in order of categories listed.

needs of communities and specific populations and can be combined to address multiple barriers, potentially at multiple levels. Resources are available to help identify, implement, and evaluate evidence-based approaches through The Community Guide, Evidence-Based Cancer Control Programs¶¶ and Cancer Control P.L.A.N.E.T. (Plan, Link, Act, Network with Evidence-based Tools).***

¶¶ https://ebccp.cancercontrol.cancer.gov/.
*** https://cancercontrolplanet.cancer.gov/planet/.

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CDC's Emergency Management Program Activities — Worldwide, 2013–2018

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CDC continually evaluates its Emergency Management Program (EMP) activities, including Incident Management System (IMS) activations, use of EMP functions (referred to as EMP utilizations), and exercises, to ensure that the agency is ready to respond to infectious disease outbreaks, disasters (human-made or natural), and security events. Such evaluation not only documents baseline preparedness and response activities during a selected analytical period, but also highlights significant EMP actions that can guide and inform future emergency operations. To characterize EMP activities that occurred during January 1, 2013–December 31, 2018, CDC conducted a retrospective analysis of operational activity logs. The results showed 253 domestic (U.S. states and territories) and international EMP activities, including 12 IMS activations, 147 EMP utilizations, and 94 exercises. Infectious diseases were the most common threat among both IMS activations (58%) and EMP utilizations (52%). CDC responded to the 2014 Ebola epidemic and the 2016 Zika outbreak; each response lasted approximately 2 years and required extended collaboration with domestic and international partners. Understanding the trends in EMP activities, including knowing the most common threats, aids CDC in allocating resources and focusing preparedness efforts. In 2013, CDC became the first federal agency to receive full agency-wide accreditation by the Emergency Management Accreditation Program (EMAP) in recognition of CDC's commitment to preparedness and its ability to respond to domestic and global public health threats. CDC received EMAP reaccreditation in December 2018 (*1*,*2*).

CDC first implemented the IMS in 2005 based on lessons learned from the Hurricane Katrina response and has since used the IMS as the standard for responding to public health threats (*3*,*4*). CDC activates an agency-level IMS when CDC leadership approves a recommendation from a Preliminary Assessment Team (PAT) comprising program and emergency response subject matter experts. PAT assesses the situation, determines that a program has exhausted available resources, and recommends an agency-level activation to provide enhanced coordination of operations and resources (e.g., staff members, deployment support, equipment, and systems) across the agency. During the period covered in this analysis, CDC IMS activations ranged from level 1, the highest level of activation, to level 3, the lowest level. In other instances, when an IMS activation was not needed but specific support was required, CDC used EMP utilizations by providing technical assistance, including use of the Emergency Operations Center, developing plans and situational reports, distributing emergency public health messages, assisting with data analysis, or providing deployment travel assistance for CDC staff members.

During January 1, 2013–December 31, 2018, CDC conducted a variety of exercises as part of preparedness efforts to ensure that plans and processes were operationally defined should a public health event occur. Exercise types included drills (testing a single response function), full-scale (deployment of resources mimicking a real emergency), functional (exercising a specific IMS element), and tabletop exercises (discussion of a scenario). To further characterize IMS activations, EMP utilizations, and exercises, CDC defined and categorized each event as one of the following: an adverse event (an event resulting in unexpected harm, injury, or illness caused by exposure to a medication, vaccine, or medical equipment or procedure); an infectious disease (an event involving a disease caused by the introduction of a pathogenic agent or microorganism into the body); a human-made event (an event caused directly or principally by human intent, error, or neglect); a mass gathering (an event with large social crowds); a natural disaster (an event related to an environmental cause such as weather or physical characteristics of an area); a national security event (a large gathering involving political and government leaders, delegates, or emissaries), a nuclear/radiological event (involving exposure to nuclear or radiological agents); substance abuse (involving the misuse of prescription drugs or illicit drugs); or other event (not related to defined categories).

During 2013–2018, CDC conducted 253 domestic and international EMP activities, including 12 IMS activations, 147 EMP utilizations, and 94 exercises (Table). IMS activations (58%) and EMP utilizations (52%) were prompted most frequently by infectious disease, followed by human-made events and natural disasters (both 17%) for IMS activations, and human-made events for EMP utilizations (29%). The majority of EMP activities occurred domestically (221, 87%), and EMP utilizations occurred most frequently (147, 58%). Among EMP utilizations, two involved substance-abuse threats; both included distribution of a Health Alert Network notice, a vital public health incident message. Among exercises, six (6%) were large functional exercises conducted to test CDC preparedness for threats such as infectious disease outbreaks including a pandemic influenza, human-made event, natural disaster, and a nuclear/radiological event.

TABLE. Number of Emergency Management Program activities (N = 253), by type, cause, and location — Emergency Management Program, CDC, 2013–2018

Activity type/cause (%)	Location			
	Domestic	International	Both	Total
IMS activations				
Adverse event (none)	—	—	—	—
Infectious disease (58)	1	3	3	**7**
Human-made event (17)	1	—	1	**2**
Mass gathering (none)	—	—	—	—
Natural disaster (17)	2	—	—	**2**
National security event (none)	—	—	—	—
Nuclear/Radiological (none)	—	—	—	—
Other (8)	1	—	—	**1**
Substance abuse (none)	—	—	—	—
Total	**5**	**3**	**4**	**12**
EMP utilizations				
Adverse event (7)	9	1	—	**10**
Infectious disease (52)	72	4	—	**76**
Human-made event (29)	25	17	—	**42**
Mass gathering (1)	2	—	—	**2**
Natural disaster (3)	2	2	—	**4**
National security event (5)	7	—	—	**7**
Nuclear/Radiological (<1)	1	—	—	**1**
Other (2%)	3	—	—	**3**
Substance abuse (1)	2	—	—	**2**
Total	**123**	**24**	—	**147**
Exercises				
Drills (82)	**77**	—	—	**77**
Full-scale (10)				
Infectious disease	1	1	—	**2**
Human-made event	1	—	—	**1**
Natural disaster	4	—	—	**4**
Nuclear/Radiological	2	—	—	**2**
Functional (6)				
Infectious disease	3	—	—	**3**
Human-made event	1	—	—	**1**
Natural disaster	1	—	—	**1**
Nuclear/Radiological	1	—	—	**1**
Tabletop (2)				
Natural disaster	1	—	—	**1**
Nuclear/Radiological	1	—	—	**1**
Total	**93**	**1**	—	**94**

Abbreviations: EMP = Emergency Management Program, IMS = Incident Management System.

Summary

What is already known about this topic?

CDC's Emergency Management Program (EMP) uses the Incident Management System (IMS) to respond to public health emergencies and provides technical assistance by applying emergency management principles to public health responses and exercises.

What is added by this report?

During 2013–2018, CDC conducted 12 IMS activations, 147 EMP utilizations, and 94 exercises, an increase from the previous 10 years. In 2018, CDC was reaccredited by the Emergency Management Accreditation Program, highlighting CDC's preparedness to respond to various hazards and global public health threats.

What are the implications for public health practice?

As more complex and novel public health emergencies occur, CDC, other agencies, and programs can use and adapt the IMS to respond to these events.

Incident Management System (IMS) Activations

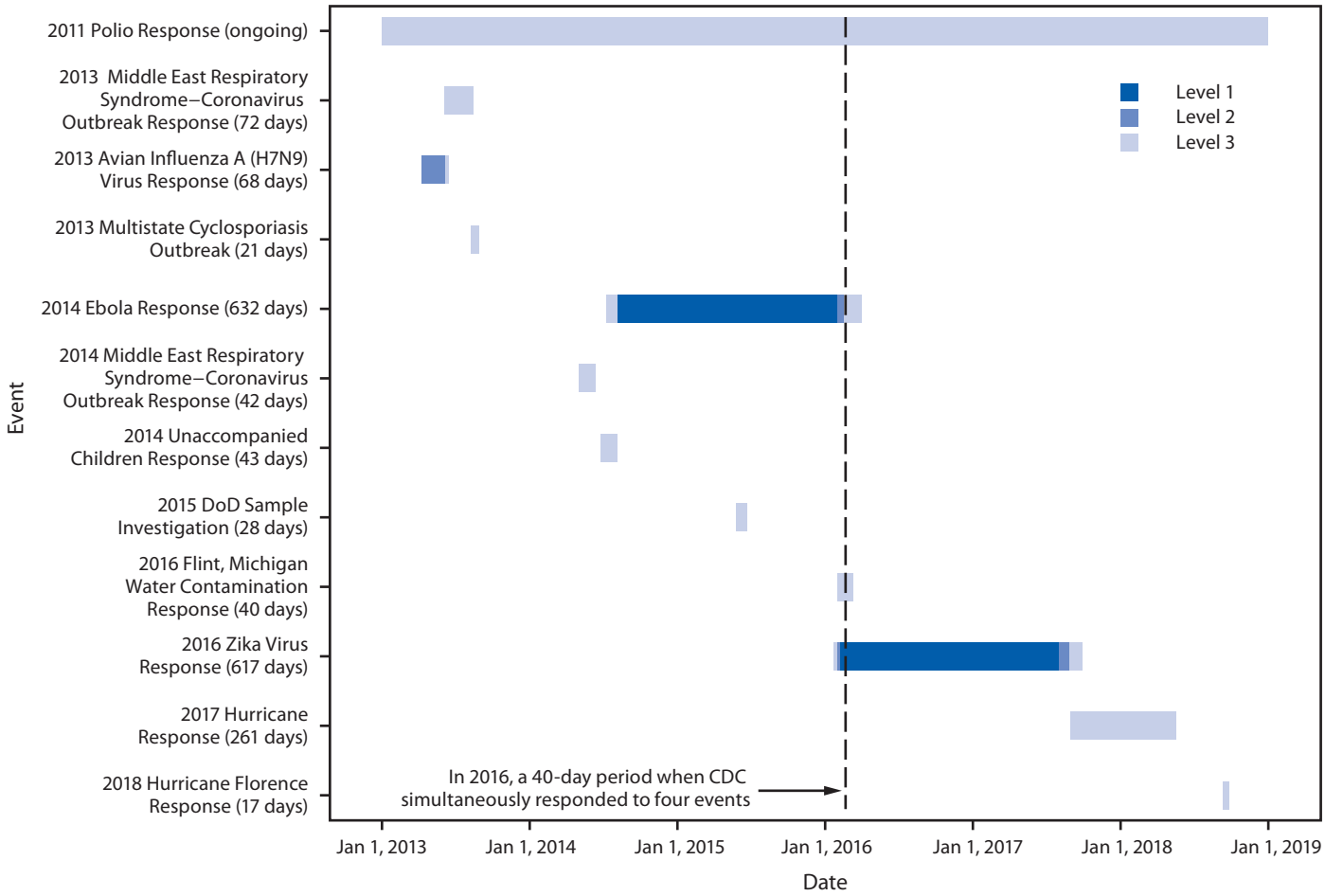
Although nine of the 12 IMS activations during 2013–2018 were wholly or partially domestic responses, an increase occurred in international responses and in those having both a domestic and international impact. The proportion of activations that included international involvement increased from 14 of 55 during 2003–2012 to seven of 12 during 2013–2018 (*3*). Nine IMS activations during 2013–2018 were conducted at a level 3, one at level 2, and two at level 1 (Figure). The level 1 events (the 2014 Ebola Response and the 2016 Zika Response) had an impact on public health systems domestically and internationally. As the responses intensified, the activation levels also increased; activation levels declined with response de-escalation. Apart from the Polio Response, which has been ongoing since 2011, the longest IMS activations during this timeframe were the 2014 Ebola Response (level 1, 632 days; 3,285 total domestic and international field deployments of CDC staff members) followed by the 2016 Zika Response (level 1, 617 days; 1,718 total domestic and international field deployments of CDC staff members). The shortest IMS activation was the 2018 Hurricane Florence Response, lasting 17 days at level 3. CDC also faced a new type of public health response in 2014, when a substantially higher-than-usual number of unaccompanied immigrant children crossed the southern border into the United States, prompting a level 3 IMS activation. During 2016, CDC responded to four events simultaneously through IMS activations: 2011 Polio, 2014 Ebola, 2016 Zika, and 2016 Flint Water Contamination Response (Figure).

Discussion

This analysis demonstrated an overall increase in CDC EMP activities (IMS activations, EMP utilizations, and exercises), from 194 during the 10-year period 2003–2012 to 253 during the 6-year period 2013–2018 (*3*). CDC's EMP has responded to more international activities in the last 6 years than previously reported (*3*). International events can be resource-intensive and require more extensive and expanded coordination within CDC (among CDC and field staff members), with other government entities, and with external partners, adding multiple layers of complexity.

This analysis highlighted two back-to-back international responses (2014 Ebola and 2016 Zika) lasting approximately 4 of the 6 years assessed. These events required simultaneous

FIGURE. Incident Management System (IMS) activations (N = 12),* by date, duration (in number of days), and activation level† — Emergency Management Program, CDC, 2013–2018



Abbreviations: DoD = Department of Defense; Ebola = Ebola virus disease; polio = poliovirus.

* Total duration of IMS activation (in days) denoted in parentheses. Year in response name indicates the year that the event was initiated.

† Level 1 is the highest level of activation, requiring a 24/7 agency-wide effort. Level 2 involves a large number of staff members from the relevant program areas and from the Emergency Operations Center (EOC), and time-sensitive tasks and needs might extend beyond core business hours. Level 3 is the lowest level of activation, in which CDC subject matter experts lead the response with their program staff members and assistance from the EOC.

response activities in multiple countries and rostering of staff members with a range of technical skills including the ability to speak languages other than English (*5*). Deploying staff members with technical expertise combined with foreign-language skills is critical in meeting response demands. International IMS activations present additional challenges, including limited infrastructures, weak health care systems, security threats, political instabilities, and cultural challenges in the affected countries. For example, security challenges in countries with endemic polio transmission have complicated deployment of CDC staff members (*6*).

Today, CDC continues simultaneous responses to several ongoing domestic and international public health emergencies and must be prepared to counter other novel or unconventional public health threats as they occur. Examination of how the agency has addressed such emerging hazards over the analysis period highlights both the increasing complexity of responses and several opportunities for applying lessons learned to current and future response operations. Although the 2016 Zika Response did not involve a novel virus, congenital microcephaly and newborn brain abnormalities associated with Zika virus infection during pregnancy were new, and the route of sexual transmission was previously unknown (*7*). CDC responded quickly to provide guidance to health care professionals and the public on the prevention of Zika virus infection and to issue guidance for laboratory testing. The 2014 Unaccompanied Children Response demonstrated that unconventional situations require CDC to adapt quickly and support other U.S. government entities (e.g., Department of Homeland Security, Administration for Children and Families,

and Assistant Secretary for Preparedness and Response) by providing public health technical assistance.

Although CDC responds to various public health events, preparedness efforts are equally important; conducting regular exercises and increasing preparedness planning are critical to mitigating risks and responding to threats. CDC conducts agency-wide exercises and participates in exercises led by other U.S. agencies to enhance CDC's role in providing public health expertise. As part of CDC's preparedness efforts, CDC received full agency-wide accreditation by EMAP in 2013, becoming the first federal public health agency to achieve this status and then received reaccreditation in 2018. This accreditation process not only serves as an external evaluation but also requires CDC to review its preparedness for responding to a prioritized list of public health threats in a structured way to implement standard processes and procedures. Understanding common threats and what is required to respond in addition to having standard processes and procedures has improved CDC's preparedness for responding to these threats. Furthermore, lessons learned from these events have enabled CDC to apply and adapt the IMS to unconventional or novel threats.

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Assessment of Neonatal Abstinence Syndrome Surveillance — Pennsylvania, 2019

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The incidence of neonatal abstinence syndrome (NAS), a withdrawal syndrome associated with prenatal opioid or other substance exposure (*1*), has increased as part of the U.S. opioid crisis (*2*). No national NAS surveillance system exists (*3*), and data about the accuracy of state-based surveillance are limited (*4*,*5*). In February 2018, the Pennsylvania Department of Health began surveillance for opioid-related NAS in birthing facilities and pediatric hospitals* (*6*). In March 2019, CDC helped the Pennsylvania Department of Health assess the accuracy of this reporting system at five Pennsylvania hospitals. Medical records of 445 infants who possibly had NAS were abstracted; these infants had either been reported by hospital providers as having NAS or assigned an *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) hospital discharge code potentially related to NAS.† Among these 445 infants, 241 were confirmed as having NAS. Pennsylvania's NAS surveillance identified 191 (sensitivity = 79%) of the confirmed cases. The proportion of infants with confirmed NAS who were assigned the ICD-10-CM code for neonatal withdrawal symptoms from maternal use of drugs of addiction (P96.1) was similar among infants reported to surveillance (71%) and those who were not (78%; p = 0.30). Infants with confirmed NAS who were not assigned code P96.1 typically had less severe signs and symptoms. Accurate NAS surveillance, which is necessary to monitor changes and regional differences in incidence and assist with planning for needed services, includes and is strengthened by a combination of diagnosis code assessment and focused medical record review.

Five Pennsylvania hospitals were selected to represent various sizes, geographic regions, and anticipated NAS incidence. A broad NAS case definition was used to identify infants who possibly had NAS under the a priori assumption that hospitals might not always assign an infant P96.1 or a clinical diagnosis of NAS, despite the presence of NAS symptoms. Infants who possibly had NAS were aged <28 days born during March 1–August 31, 2018, and either reported to NAS surveillance or assigned a hospital discharge ICD-10-CM code indicative of prenatal substance exposure or NAS symptom.§ Medical records of all infants who possibly had NAS were reviewed for demographic and birth characteristics, prenatal opioid and other substance exposure, infant and maternal toxicology results and NAS symptoms and treatment information. Infants were considered to have confirmed NAS if all of the following criteria were documented in the infant medical record: 1) at least one NAS symptom; 2) maternal history or toxicology results indicating prenatal opioid exposure; and 3) a clinical mention of NAS (i.e., NAS listed in the discharge diagnosis or problem list or use of a NAS scoring tool [e.g., Finnegan]). For infants with confirmed NAS, maternal prenatal and delivery records were abstracted to gather additional data on prenatal opioid or other substance exposure.

Sensitivity and positive predictive value (PPV) of the Pennsylvania NAS surveillance system were calculated, with corresponding 95% confidence intervals (CIs) estimated using an exact binomial distribution. Descriptive analyses compared infants with confirmed NAS by reporting status and by presence of ICD-10-CM code P96.1. Categorical variables were compared using chi-squared tests (or Fisher's exact tests for cell counts <5); continuous variables were compared using negative binomial regression. Statistical significance was assessed at $\alpha = 0.05$. All analyses were conducted using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

* As described in the Neonatal Abstinence Syndrome: 2018 Report released by the Pennsylvania Bureau of Epidemiology, the Pennsylvania NAS surveillance system was established through an emergency declaration that made NAS a reportable condition throughout the state. The Pennsylvania NAS surveillance case definition required health care providers at birthing facilities and pediatric hospitals to report infants born on or after January 10, 2018, to residents of Pennsylvania who received a diagnosis of NAS (based on prenatal exposure to opiate drugs anytime during pregnancy and the presence of at least one symptom of withdrawal) during the neonatal period (birth through 28 days of life). Reports were submitted through a web-based system.

† Included the following ICD-10 codes available as of October, 2018: F11.x; T40.0x–T40.4x, T40.6x, T50.7x; P96.1; P04.1x, P04.49, P04.89, P04.9; P04.2, P04.3, P04.41, P04.42, Q86.0; P90, R56.xx; P81.8, P81.9; R25.1, R25.8, R25.9; P94.1, P94.8, P94.9.

§ Signs and symptoms include tremors, breathing problems, blotchy skin, diarrhea, crying, fever, fussiness, gagging or retching, hiccups, hyperactive or exaggerated Moro reflex, frequent yawning, overactive reflexes, poor feeding, salivation, seizures, skin abrasions or excoriation, slow weight gain, sneezing, stuffy nose, suckling issues, sweating, vomiting, increased muscle tone, trouble sleeping, and any other symptom attributed to NAS by a clinician.

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

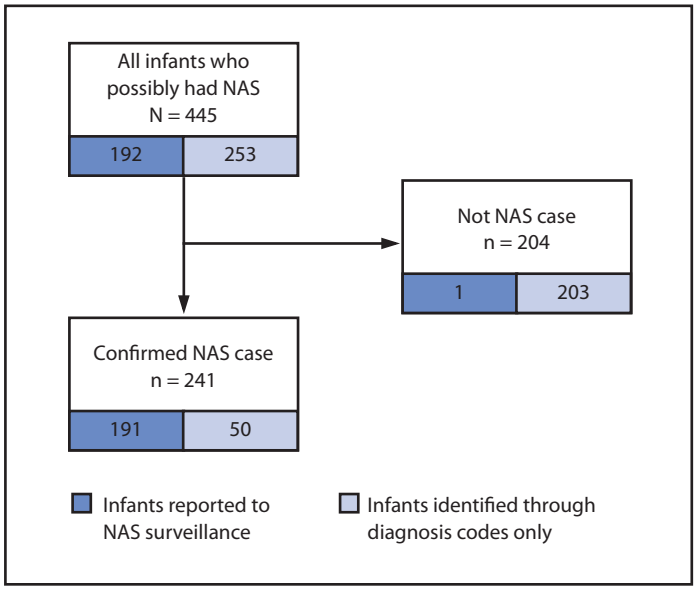
Overall, 445 infants who possibly had NAS were identified: 192 were reported to surveillance and 253 identified through diagnosis codes alone (Figure). Medical record review identified 241 infants with confirmed NAS, 191 of whom were reported to surveillance (sensitivity = 79% [191 of 241; 95% CI = 74%–84%]; PPV = 99% [191 of 192; 95% CI = 97%–100%]). Among the 241 infants with confirmed NAS, those reported to surveillance were significantly more likely than were those not reported to have documentation of neonatal (69% versus 50%) or maternal (55% versus 30%) toxicology evidence of prenatal opioid exposure in the infant record, maternal history of prenatal opioid exposure in the maternal record (98% versus 90%), and prenatal exposure to cannabis (30% versus 10%) in the infant or maternal record (Table 1). Notably, 71% of infants reported to surveillance were assigned ICD-10-CM code P96.1, which was not significantly different from infants not reported (78%).

Among infants with confirmed NAS, type and source of opioid exposure were similar in those who were and were not assigned P96.1 (Table 2). However, infants assigned P96.1 were more likely than were those not assigned P96.1 to have mothers enrolled in Medicaid (95% versus 88%), significantly longer lengths of stay (14 versus 9 days), older ages at first NAS score (2 versus 1 days), higher first NAS scores (4 versus 2), older ages at peak NAS score (5 versus 3 days), higher peak NAS scores (11 versus 9), more NAS symptoms (12 versus 9), more frequent pharmacologic treatment (61% versus 3%), and greater prenatal exposure to gabapentin in the infant or maternal record (12% versus 1%). Infants not assigned P96.1 were significantly more likely to be assigned ICD-10-CM code P04.49, "Newborn suspected to be affected by maternal use of other drugs of addiction" (60% versus 23%).

Discussion

Based on medical record review at five hospitals, Pennsylvania's NAS surveillance system had a PPV of 99% and sensitivity of 79%. Accurate NAS surveillance is necessary to monitor temporal and geographic changes in NAS incidence and to plan for needed services. Findings from this evaluation might inform NAS surveillance efforts in other states. First, ICD-10-CM code P96.1 was assigned to 71% of infants reported to Pennsylvania's NAS surveillance system, demonstrating the utility of using this code to efficiently identify NAS cases. However, 78% of infants not reported to the system were also assigned P96.1. Infants who are assigned P96.1 meet the Council of State and Territorial Epidemiologists (CSTE) 2019 Tier 2 confirmed NAS case definition (*1*), which was released after this investigation. CSTE's standardized definition might help clarify which infants should be reported for future surveillance efforts. Previous studies have found that use of P96.1 to identify infants with NAS can yield high PPV (*4*,*7*,*8*), and a combination of P96.1 or P04.49 improves sensitivity but decreases PPV (*5*). Second, in this investigation, infants with more severe signs and symptoms of NAS were more likely to be assigned P96.1. A recent review of surveillance practices highlighted the variability of NAS case definitions and use of ICD-10-CM codes across jurisdictions (*9*). Consistency in coding of infants with NAS could assist future surveillance efforts. Third, infants with toxicology evidence of prenatal opioid exposure were more likely to be reported to surveillance, but toxicology evidence was also frequently found among unreported cases. CSTE's Tier 1 NAS confirmed case

FIGURE. Identification of infants with confirmed neonatal abstinence syndrome (NAS) through medical record review of those reported to NAS surveillance and those identified by diagnosis codes — selected hospitals, Pennsylvania, 2018



Summary

What is already known about this topic?

Neonatal abstinence syndrome (NAS) has increased as part of the U.S. opioid crisis, but no national NAS surveillance system exists, and data about the accuracy of state-based surveillance are limited.

What is added by this report?

Among infants with confirmed NAS at five Pennsylvania hospitals, ICD-10-CM code P96.1 was assigned to 71% of those who were reported to the NAS surveillance system and 78% of those who were not reported to surveillance.

What are the implications for public health practice?

Accurate NAS surveillance, which is necessary to monitor changes and regional differences in incidence and assist with planning for needed services, includes a combination of diagnosis code assessment and focused medical record review.

TABLE 1. Characteristics of infants with confirmed neonatal abstinence syndrome (NAS) based on medical record review (N = 241) who were reported and not reported to surveillance — selected hospitals, Pennsylvania, 2018

Characteristic	No.* (%) or mean (range)			p-value†
	All infants with NAS (N = 241)	Infants reported to surveillance (N = 191)	Infants not reported to surveillance, identified through diagnosis codes only (N = 50)	
Maternal race				
White	211 (91)	171 (92)	40 (83)	
Other§	22 (9)	14 (8)	8 (17)	0.055
Maternal ethnicity				
Hispanic or Latina	2 (>1)	1 (1)	1 (2)	
Not Hispanic or Latina	223 (99)	179 (99)	44 (98)	0.361
Source of payment in maternal record				
Medicaid	216 (93)	174 (94)	42 (91)	0.530
Private/Other	16 (7)	12 (6)	4 (9)	
Maternal age, yrs	234¶; 29 (18–43)	184¶; 29 (18–43)	50¶; 30 (22–40)	0.112
Infant sex				
Male	118 (49)	97 (51)	21 (42)	
Female	123 (51)	94 (49)	29 (58)	0.269
Gestational age, wks	235¶; 38 (32–42)	187¶; 38 (32–41)	48¶; 37 (32–42)	0.417
Type of hospitalization				
Birth hospitalization	221 (92)	178 (93)	43 (88)	
Other type of admission	19 (8)	13 (7)	6 (12)	0.208
Length of stay, days	240¶; 13 (1–68)	190¶; 13 (2–68)	50¶; 12 (1–47)	0.596
NAS scores				
Age at first NAS score, days	234¶; 1 (0–19)	186¶; 1 (0–17)	48¶; 2 (0–19)	0.163
First NAS score**	239¶; 3 (0–19)	190¶; 3 (0–14)	49¶; 4 (0–19)	0.063
Age at highest NAS score, days	230¶; 5 (0–32)	182¶; 5 (0–32)	48¶; 4 (1–21)	0.275
Highest NAS score**	238¶; 10 (2–21)	189¶; 10 (2–21)	49¶; 10 (2–19)	0.659
Symptoms				
Total number of symptoms††	240¶; 11 (1–17)	191¶; 12 (1–17)	49¶; 11 (1–17)	0.147
Evidence of prenatal opioid exposure in the infant record§§				
Neonatal toxicology evidence	157 (65)	132 (69)	25 (50)	0.012
Maternal toxicology evidence	120 (50)	105 (55)	15 (30)	0.002
Maternal history	225 (93)	178 (93)	47 (94)	1.000
Evidence of prenatal opioid exposure in the maternal prenatal or delivery record§§				
Maternal toxicology evidence	56 (23)	44 (23)	12 (24)	0.886
Maternal history	233 (97)	188 (98)	45 (90)	0.011
Type of opioid exposure¶¶				
Buprenorphine	160 (66)	125 (65)	35 (70)	0.544
Methadone	68 (28)	58 (30)	10 (20)	0.147
Opiates, unspecified	69 (29)	57 (30)	12 (24)	0.416
Heroin	40 (17)	35 (18)	5 (10)	0.159
Oxycodone	30 (12)	22 (12)	8 (16)	0.393
Other opioids***	17 (7)	12 (6)	5 (10)	0.361

See table footnotes on the next page.

definition requires, in part, that infants have neonatal laboratory evidence of exposure (*1*); therefore, information on all infants with toxicologic evidence of exposure might warrant review when conducting NAS surveillance.

Although using P96.1 to trigger case review could have improved reporting to surveillance because it would have identified 78% of unreported NAS cases, using P96.1 as the sole criterion for reporting would have missed 29% of all infants reported with NAS. Medical record review was needed to identify infants with NAS who were less likely to have toxicology evidence of exposure (among infants not reported) and more likely to have less severe signs and symptoms of NAS (among infants not assigned P96.1). Therefore, these data suggest that using both diagnosis code assessment and focused medical record review as case-finding methods, though the latter might be labor intensive, would most accurately identify infants with NAS. Notably, in this investigation, this strategy relied on reviewing medical records of a selected group of infants with diagnosis codes indicative of prenatal substance exposure or a NAS symptom, and not only NAS diagnosis codes. Additional work is needed to identify the optimal subset of codes to identify possible infants with NAS (*5*,*7*,*8*).

TABLE 1. (*Continued*) Characteristics of infants with confirmed neonatal abstinence syndrome (NAS) based on medical record review (N = 241) who were reported and not reported to surveillance — selected hospitals, Pennsylvania, 2018

Characteristic	No.* (%) or mean (range)			
	All infants with NAS (N = 241)	Infants reported to surveillance (N = 191)	Infants not reported to surveillance, identified through diagnosis codes only (N = 50)	p-value†
Type of other exposure†††				
Tobacco	179 (74)	146 (76)	33 (66)	0.133
Cannabis	63 (26)	58 (30)	5 (10)	0.004
Cocaine	38 (16)	34 (18)	4 (8)	0.126
Antidepressants	35 (15)	25 (13)	10 (20)	0.217
Benzodiazepines	34 (14)	24 (13)	10 (20)	0.179
Amphetamine	27 (11)	23 (12)	4 (8)	0.614
Gabapentin	22 (9)	17 (9)	5 (10)	0.810
Infant receipt of pharmacologic treatment for NAS				
Yes	107 (44)	87 (46)	20 (42)	
No	129 (54)	101 (54)	28 (58)	0.567
ICD-10-CM discharge diagnosis codes§§§				
P96.1, Neonatal withdrawal symptoms from maternal use of drugs of addiction	174 (72)	135 (71)	39 (78)	0.304
P04.1, Newborn (suspected to be) affected by other maternal medication (2018 edition code)	8 (3)	5 (3)	3 (6)	0.368
P04.2, Newborn affected by maternal use of tobacco	10 (4)	7 (4)	3 (6)	0.437
P04.3, Newborn affected by maternal use of alcohol	1 (0)	0 (—)	1 (2)	0.207
P04.41, Newborn affected by maternal use of cocaine	5 (2)	4 (2)	1 (2)	1.000
P04.49, Newborn (suspected to be) affected by maternal use of other drugs of addiction	80 (33)	64 (34)	16 (32)	0.840

Abbreviations: ICD-10-CM = *International Classification of Diseases, Tenth Revision, Clinical Modification;* NAS = neonatal abstinence syndrome.

* Frequencies might not sum to total because of missing values. When data are not available for all members of a cohort, n is stated.

† P-values were calculated comparing infants reported to surveillance with infants not reported to surveillance using a negative binomial likelihood ratio test for continuous variables and chi-squared (or Fisher's exact test, if at least one cell count was <5) for categorical variables.

§ Other races included were Black, Asian, Native Hawaiian/Other Pacific Islander, American Indian/Alaska Native, not specified, or unknown. Given the small denominator in each category, all were collapsed into a single category.

¶ Data are not available for all members of this cohort.

** Includes all infants with a recorded score. All scores were Finnegan or modified Finnegan.

†† Signs and symptoms include tremors, breathing problems, blotchy skin, diarrhea, crying, fever, fussiness, gagging or retching, hiccups, hyperactive or exaggerated Moro reflex, frequent yawning, overactive reflexes, poor feeding, salivation, seizures, skin abrasions or excoriation, slow weight gain, sneezing, stuffy nose, suckling issues, sweating, vomiting, increased muscle tone, trouble sleeping, and any other symptom attributed to NAS by a clinician.

§§ Not mutually exclusive categories.

¶¶ As documented in the maternal record, infant record, or both.

*** Other opioids include codeine, fentanyl, hydrocodone, hydromorphone, kratom, morphine, and tramadol.

††† As documented in the maternal record, infant record, or both. Other substances with <20 infants exposed included alcohol, antipsychotics, barbiturates, bupropion, methamphetamine, phencyclidine, and other substances referred to directly, such as "methaqualone," or indirectly, such as "maternal polysubstance abuse."

§§§ No infants were assigned ICD-10-CM code P96.2, "Withdrawal symptoms from therapeutic use of drugs in newborn," or P04.40, "Newborn affected by maternal anesthesia and analgesia in pregnancy, labor and delivery."

CSTE released the first nationally standardized NAS case definition (*1*) after this investigation was completed; therefore, it could not be applied to these data. Differences include that the Pennsylvania NAS case definition included prenatal opioid exposure at any time during pregnancy, and the CSTE NAS definition includes not only exposure to opioids, but also benzodiazepines and barbiturates, and limits the exposure period to ≤4 weeks before delivery (*1*). Standardization of NAS reporting might improve with implementation of the CSTE definition.

The findings in this report are subject to at least three limitations. First, hospitals were selected to represent specific characteristics; these findings might not be representative of all hospitals in Pennsylvania or the United States. Second, in this investigation, NAS case status was determined based on infant charts alone, with maternal charts reviewed only among infants with confirmed NAS; findings might differ in investigations that can rely on both maternal and infant records to determine NAS case status. Finally, the estimate of the surveillance system's sensitivity might be biased because this investigation focused on infants who possibly had NAS and did not include chart review for a sample of all infants; this would be needed to estimate true sensitivity.

Throughout the United States, NAS surveillance is in a nascent stage; NAS surveillance can be strengthened by using a combination of diagnosis code assessment and focused medical record review. Further evaluation of NAS surveillance

TABLE 2. Characteristics of infants with confirmed neonatal abstinence syndrome (NAS) based on medical record review (N = 241), by presence of *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-CM-10) discharge diagnosis code P96.1: Neonatal withdrawal symptoms from maternal use of drugs of addiction — selected hospitals, Pennsylvania, 2018

Characteristic	No.* (%) or mean (range)		p-value§
	Infants with NAS assigned discharge diagnosis code P96.1 (N = 174)†	Infants with NAS not assigned discharge diagnosis code P96.1 (N = 67)	
Maternal race			
White	153 (92)	58 (88)	
Other¶	14 (8)	8 (12)	0.379
Maternal ethnicity			
Hispanic or Latina	1 (1)	1 (2)	
Not Hispanic or Latina	160 (99)	63 (98)	0.489
Source of payment in maternal record			
Medicaid	158 (95)	58 (88)	
Private/Other	8 (5)	8 (12)	0.048
Maternal age, yrs	169**; 29 (18–41)	65**; 29 (19–43)	0.711
Infant sex			
Male	84 (48)	34 (51)	
Female	90 (52)	33 (49)	0.731
Gestational age, wks	169**; 38 (33–42)	66**; 38 (32–41)	0.683
Type of hospitalization			
Birth hospitalization	156 (90)	65 (97)	0.109
Other type of admission	17 (10)	2 (3)	
Length of stay, days	173**; 14 (1–68)	67**; 9 (2–47)	<0.001
NAS scores			
Age at first NAS score, days	168**; 2 (0–19)	66**; 1 (0–6)	0.031
First NAS Score††	173**; 4 (0–19)	66**; 2 (0–8)	<0.001
Age at highest NAS score, days	166**; 5 (0–32)	64**; 3 (0–10)	<0.001
Highest NAS score††	173**; 11 (2–21)	65**; 9 (2–16)	<0.001
Symptoms			
Total number of symptoms§§	173**; 12 (1–17)	67**; 9 (1–16)	<0.001
Evidence of prenatal opioid exposure in the infant record¶¶			
Neonatal toxicology evidence	114 (66)	43 (64)	0.845
Maternal toxicology evidence	90 (52)	30 (45)	0.334
Maternal history	161 (93)	64 (96)	0.567
Evidence of prenatal opioid exposure in the maternal prenatal or delivery record¶¶			
Maternal toxicology evidence	40 (23)	16 (24)	0.883
Maternal history	168 (97)	65 (97)	1.000
Type of opioid exposure***			
Buprenorphine	116 (67)	44 (66)	0.884
Methadone	53 (30)	15 (22)	0.212
Opiates, unspecified	50 (29)	19 (28)	0.954
Heroin	30 (17)	10 (15)	0.665
Oxycodone	21 (12)	9 (13)	0.774
Other opioids†††	11 (6)	6 (9)	0.474

See table footnotes on the next page.

systems after implementation of the CSTE case definition will be useful. Accurate NAS surveillance is needed to identify changes in incidence and regional differences and to plan for needed services.

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TABLE 2. (*Continued*) Characteristics of infants with confirmed neonatal abstinence syndrome (NAS) based on medical record review (N = 241), by presence of *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-CM-10) discharge diagnosis code P96.1: Neonatal withdrawal symptoms from maternal use of drugs of addiction — selected hospitals, Pennsylvania, 2018

Characteristic	No.* (%) or mean (range)		p-value[§]
	Infants with NAS assigned discharge diagnosis code P96.1 (N = 174)[†]	Infants with NAS not assigned discharge diagnosis code P96.1 (N = 67)	
Type of other exposure[§§§]			
Tobacco	128 (74)	51 (76)	0.684
Cannabis	51 (29)	12 (18)	0.071
Cocaine	28 (16)	10 (15)	0.824
Antidepressants	30 (17)	5 (7)	0.054
Benzodiazepines	27 (16)	7 (10)	0.311
Amphetamine	23 (13)	4 (6)	0.169
Gabapentin	21 (12)	1 (1)	0.011
Infant receipt of pharmacologic treatment for NAS			
Yes	105 (61)	2 (3)	
No	66 (39)	63 (97)	<0.001
ICD-10-CM discharge diagnosis code[¶¶¶]			
P04.1, Newborn (suspected to be) affected by other maternal medication	7 (4)	1 (1)	0.449
P04.2, Newborn affected by maternal use of tobacco	5 (3)	5 (7)	0.110
P04.3, Newborn affected by maternal use of alcohol	0 (—)	1 (1)	0.278
P04.41, Newborn affected by maternal use of cocaine	3 (2)	2 (3)	0.620
P04.49, Newborn (suspected to be) affected by maternal use of other drugs of addiction	40 (23)	40 (60)	<0.001

Abbreviation: NAS = neonatal abstinence syndrome.

* Frequencies might not sum to total because of missing values.

† Includes 135 cases identified through surveillance and 39 cases identified through diagnosis code only who were assigned discharge diagnosis code P96.1.

§ P-values were calculated comparing infants assigned P96.1 with infants not assigned P96.1 using a negative binomial likelihood ratio test for continuous variables and chi squared (or Fisher's exact test, if at least one cell count was <5) used for categorical variables.

¶ Other races included were Black, Asian, Native Hawaiian/Other Pacific Islander, American Indian/Alaska Native, not specified, or unknown. Given the small denominator in each category, all were collapsed into a single category.

** Data are not available for all members of this cohort.

†† Includes all infants with a recorded score. All scores were Finnegan or modified Finnegan.

§§ Signs and symptoms include tremors, breathing problems, blotchy skin, diarrhea, crying, fever, fussiness, gagging or retching, hiccups, hyperactive or exaggerated Moro reflex, frequent yawning, overactive reflexes, poor feeding, salivation, seizures, skin abrasions or excoriation, slow weight gain, sneezing, stuffy nose, suckling issues, sweating, vomiting, increased muscle tone, trouble sleeping, and any other symptom attributed to NAS by a clinician.

¶¶ Not mutually exclusive categories.

*** As documented in the maternal record, infant record, or both.

††† Other opioids include codeine, fentanyl, hydrocodone, hydromorphone, kratom, morphine, and tramadol.

§§§ As documented in the maternal record, infant record, or both. Other substances with <20 infants exposed included alcohol, antipsychotics, barbiturates, bupropion, methamphetamine, phencyclidine, and other substances referred to directly, such as "methaqualone" or indirectly, such as "maternal polysubstance abuse."

¶¶¶ No infants were assigned ICD-10-CM code P96.2, "Withdrawal symptoms from therapeutic use of drugs in newborn," or P04.40, "Newborn affected by maternal anesthesia and analgesia in pregnancy, labor and delivery."

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Allergic Reactions Including Anaphylaxis After Receipt of the First Dose of Pfizer-BioNTech COVID-19 Vaccine — United States, December 14–23, 2020

CDC COVID-19 Response Team; Food and Drug Administration

On January 6, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

As of January 3, 2021, a total of 20,346,372 cases of coronavirus disease 2019 (COVID-19) and 349,246 associated deaths have been reported in the United States. Long-term sequalae of COVID-19 over the course of a lifetime currently are unknown; however, persistent symptoms and serious complications are being reported among COVID-19 survivors, including persons who initially experience a mild acute illness.* On December 11, 2020, the Food and Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for Pfizer-BioNTech COVID-19 vaccine to prevent COVID-19, administered as 2 doses separated by 21 days. On December 12, 2020, the Advisory Committee on Immunization Practices (ACIP) issued an interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine (*1*); initial doses were recommended for health care personnel and long-term care facility residents (*2*). As of December 23, 2020, a reported 1,893,360 first doses of Pfizer-BioNTech COVID-19 vaccine had been administered in the United States, and reports of 4,393 (0.2%) adverse events after receipt of Pfizer BioNTech COVID-19 vaccine had been submitted to the Vaccine Adverse Event Reporting System (VAERS). Among these, 175 case reports were identified for further review as possible cases of severe allergic reaction, including anaphylaxis. Anaphylaxis is a life-threatening allergic reaction that does occur rarely after vaccination, with onset typically within minutes to hours (*3*). Twenty-one cases were determined to be anaphylaxis (a rate of 11.1 per million doses administered), including 17 in persons with a documented history of allergies or allergic reactions, seven of whom had a history of anaphylaxis. The median interval from vaccine receipt to symptom onset was 13 minutes (range = 2–150 minutes). Among 20 persons with follow-up information available, all had recovered or been discharged home. Of the remaining case reports that were determined not to be anaphylaxis, 86 were judged to be nonanaphylaxis allergic reactions, and 61 were considered nonallergic adverse events. Seven case reports were still under investigation. This report summarizes the clinical and epidemiologic characteristics of case reports of allergic reactions, including anaphylaxis and nonanaphylaxis allergic reactions, after receipt of the first dose of Pfizer-BioNTech COVID-19 vaccine during December 14–23, 2020, in the United States. CDC has issued updated interim clinical considerations for use of mRNA COVID-19 vaccines currently authorized in the United States (*4*) and interim considerations for preparing for the potential management of anaphylaxis (*5*). In addition to screening for contraindications and precautions before administering COVID-19 vaccines, vaccine locations should have the necessary supplies available to manage anaphylaxis, should implement postvaccination observation periods, and should immediately treat persons experiencing anaphylaxis signs and symptoms with intramuscular injection of epinephrine (*4*,*5*).

CDC and FDA received notification of suspected anaphylaxis cases through multiple channels, including direct outreach by health care providers and public health officials and reports to VAERS, the national passive surveillance (spontaneous reporting) system for adverse events after immunization, which is jointly operated by CDC and FDA (*6*). All notifications of suspected anaphylaxis that came to the attention of CDC or FDA were also captured in VAERS. CDC physicians screened VAERS reports describing suspected severe allergic reactions and anaphylaxis and applied Brighton Collaboration case definition criteria (*7*), which use combinations of symptoms to define levels of diagnostic certainty to identify cases with sufficient evidence to warrant further assessment for anaphylaxis. Brighton level 1 represents the highest level of diagnostic certainty that a reported case is indeed a case of anaphylaxis; levels 2 and 3 represent successively lower levels of diagnostic certainty. Level 4 is a case reported as anaphylaxis but which does not meet the Brighton Collaboration case definition. Level 5 is a case that was neither reported as anaphylaxis nor meets the case definition. Reports with sufficient evidence to suggest anaphylaxis were followed up by direct outreach, including telephoning contacts listed in the VAERS report to gather additional clinical details (e.g., health care facilities and treating health care providers, and, in some cases, vaccine recipients) and collecting medical records. Physician reviewers also used their clinical judgment to categorize reports that were considered not anaphylaxis as nonanaphylaxis allergic reactions or nonallergic adverse events. Nonallergic adverse events, mostly vasovagal or anxiety-related, were excluded from the analysis. Anaphylaxis and nonanaphylaxis allergic reaction cases with symptom onset occurring later than the day after vaccination (i.e., outside of the 0–1-day risk window) were also excluded because of the difficulty in clearly attributing

* https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/late-sequelae.html.

Summary

What is already known about this topic?

Anaphylaxis is a severe, life-threatening allergic reaction that occurs rarely after vaccination.

What is added by this report?

During December 14–23, 2020, monitoring by the Vaccine Adverse Event Reporting System detected 21 cases of anaphylaxis after administration of a reported 1,893,360 first doses of the Pfizer-BioNTech COVID-19 vaccine (11.1 cases per million doses); 71% of these occurred within 15 minutes of vaccination.

What are the implications for public health practice?

Locations administering COVID-19 vaccines should adhere to CDC guidance for use of COVID-19 vaccines, including screening recipients for contraindications and precautions, having the necessary supplies available to manage anaphylaxis, implementing the recommended postvaccination observation periods, and immediately treating suspected cases of anaphylaxis with intramuscular injection of epinephrine.

allergic reactions with onset later than this to vaccination.[†] CDC and FDA conducted joint review sessions to discuss and adjudicate cases. Because the FDA EUA for the Moderna COVID-19 vaccine was received 1 week later than that for the Pfizer-BioNTech vaccine (i.e., on December 18, 2020), and the Moderna vaccine was only available beginning December 21, this report focuses on the Pfizer-BioNTech COVID-19 vaccine. An assessment of adverse events reported after receipt of the Moderna COVID-19 vaccine will be forthcoming.

During December 14–23, 2020, after administration of 1,893,360 first doses of Pfizer-BioNTech COVID-19 vaccine (1,177,527 doses in females, 648,327 doses in males, and 67,506 doses missing sex), reports of 4,393 (0.2%) adverse events after receipt of the vaccine had been submitted to VAERS. Among these, 175 case reports were identified for further review as possible cases of severe allergic reaction, including anaphylaxis, based on descriptions of signs and symptoms; 21 of these reports met the Brighton Collaboration case definition criteria for anaphylaxis, corresponding to an initial estimated rate of 11.1 cases per million doses administered. All reports were Brighton levels 1 or 2 (Table 1). The median age of persons with anaphylaxis was 40 years (range = 27–60 years), and 19 (90%) cases occurred in females. The median interval from vaccine receipt to symptom onset was 13 minutes (range = 2–150 minutes); 15 (71%) patients had onset within 15 minutes, three (14%) within 15 to 30 minutes, and three (14%) after 30 minutes (Figure). In 19 of 21 (90%) reports, patients were treated with epinephrine as part of therapy; one patient received subcutaneous epinephrine and the remaining 18 were confirmed or presumed to have received intramuscular epinephrine based on the report. Four (19%) patients were hospitalized (including three in intensive care), and 17 (81%) were treated in an emergency department; 20 (95%) are known to have been discharged home or had recovered at the time of report to VAERS. No deaths from anaphylaxis were reported after receipt of Pfizer-BioNTech COVID-19 vaccine. Seventeen (81%) of 21 patients with anaphylaxis had a documented history of allergies or allergic reactions, including to drugs or medical products, foods, and insect stings; seven (33%) patients had experienced an episode of anaphylaxis in the past, including one after receipt of a rabies vaccine and another after receipt of an influenza A(H1N1) vaccine (Table 2). No geographic clustering of anaphylaxis cases was observed, and the cases occurred after receipt of doses from multiple vaccine lots. At the time of this report, investigators have been unable to obtain sufficient information to confirm or rule out anaphylaxis in seven cases despite follow-up efforts; these cases remain under investigation.

During the same period, VAERS identified 83 cases of nonanaphylaxis allergic reaction after Pfizer-BioNTech COVID-19 vaccination with symptom onset within the 0–1-day risk window, 72 (87%) of which were classified as nonserious.[§] Commonly reported symptoms included pruritus, rash, itchy and scratchy sensations in the throat, and mild respiratory symptoms. The median patient age was 43 years (range = 18–65 years), and 75 (90%) reported reactions occurred in women. The median interval from vaccine receipt to symptom onset was 12 minutes (range = <1 minute–20 hours); in 61 (85%) cases, onset occurred within 30 minutes, in 11 cases, onset occurred after 30 minutes, and for 11 cases, time of onset was missing. For 56 (67%) case reports, a past history of allergies or allergic reactions was documented (Table 2) (Figure).

Discussion

Early safety monitoring of the Pfizer-BioNTech COVID-19 vaccine has detected 21 cases of anaphylaxis after reported administration of 1,893,360 first doses of Pfizer-BioNTech COVID-19 vaccine (11.1 cases per million vaccine doses administered) as well as cases of less severe nonanaphylaxis allergic reactions, based on U.S. data for December 14–23, 2020. Most (86%) anaphylaxis cases had symptom onset within 30 minutes of vaccination, and most persons with anaphylaxis

[†] Anaphylaxis and nonanaphylaxis allergic reaction cases with symptom onset occurring later than the day after vaccination (i.e., outside of the 0–1-day risk window) were excluded because of the difficulty in clearly attributing allergic reactions with onset outside this risk window to vaccination. Three of the initial 86 nonanaphylaxis allergic reactions were excluded from the final analysis.

[§] Based on the Code of Federal Regulations, a serious adverse event is defined if one of the following is reported: death, life-threatening illness, hospitalization or prolongation of hospitalization, permanent disability, congenital anomaly, or birth defect. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=312.32.

TABLE 1. Characteristics of reported cases of anaphylaxis (n = 21) after receipt of Pfizer-BioNTech COVID-19 vaccine — Vaccine Adverse Events Reporting System (VAERS), United States, December 14–23, 2020

Age (yrs)	Sex	Past history		Onset after receipt (mins)	Signs and symptoms	Treatment setting†	Epi received	Brighton level§	Outcome or disposition¶
		Allergies or allergic reactions*	Anaphylaxis						
27	F	Tropical fruit	No	2	Diffuse erythematous rash, sensation of throat closure	ED	Yes	2	Recovered at time of report
35	M	No	No	5	Diffuse erythematous rash, swollen tongue	ED	Yes	1	Discharged home
55	F	Rabies vaccine	Yes, rabies vaccine	5	Generalized urticaria, wheezing	Inpatient	Yes	1	Discharged home
52	F	Sulfa drugs	Yes, sulfa drugs	7	Wheezing, stridor, nausea	Inpatient	Yes	1	Discharged home
30	F	Bee sting	No	8	Generalized urticaria, wheezing	Inpatient	Yes	1	Recovered at time of report
32	F	No	No	10	Diffuse erythematous rash, difficulty breathing	Inpatient	Yes	2	Discharged home
60	F	Eggs, milk, sulfa drugs, jellyfish sting	Yes, jellyfish sting	10	Diffuse erythematous rash, hoarseness	ED	Yes	2	Recovered at time of report
29	F	Shellfish, eggs	No	10	Generalized urticaria, swollen lips and tongue	ED	Yes	1	Discharged home
52	F	Metoprolol, clarithromycin	No	10	Generalized urticaria, stridor, wheezing	ED	Yes	1	Recovered at time of report
49	F	Iodinated contrast media	No	13	Generalized urticaria, swollen throat	ED	Yes	1	Recovered at time of report
36	F	No	No	13	Generalized urticaria, nausea	ED	Yes	2	Not specified
40	F	Sulfa drugs, walnuts	Yes, walnuts	14	Generalized urticaria, nausea	ED	Yes	2	Discharged home
33	F	Wasp sting	No	15	Diffuse erythematous rash, swollen lip	ED	Yes	1	Recovered at time of report
41	F	Prochlorperazine	Yes, prochlorperazine	15	Diffuse erythematous rash, persistent dry cough	ED	No	2	Discharged home
57	F	Penicillin, azithromycin	Yes, unspecified	15	Diffuse pruritic rash, hoarseness	ED	Yes	2	Recovered at time of report
45	M	No	No	23	Generalized urticaria, swollen airway	ED	Yes	2	Discharged home
46	F	Hydrocodone, nuts	No	25	Diffuse erythematous rash, difficulty swallowing	ED	Yes	2	Discharged home
30	F	Cats, dogs	No	30	Generalized pruritis, wheezing	ED	No	2	Discharged home
44	F	Influenza A(H1N1) vaccine	Yes, influenza A(H1N1) vaccine	34	Generalized urticaria, swollen lips	ED	Yes	1	Discharged home
29	F	Sulfa drugs	No	54	Generalized urticaria, persistent cough	ED	Yes	2	Recovered at time of report
29	F	Steroids	No	150	Diffuse pruritic rash, swollen lip	ED	Yes	1	Discharged home

Abbreviations: COVID-19 = coronavirus disease 2019; ED = emergency department; epi = epinephrine; F = female; M = male.

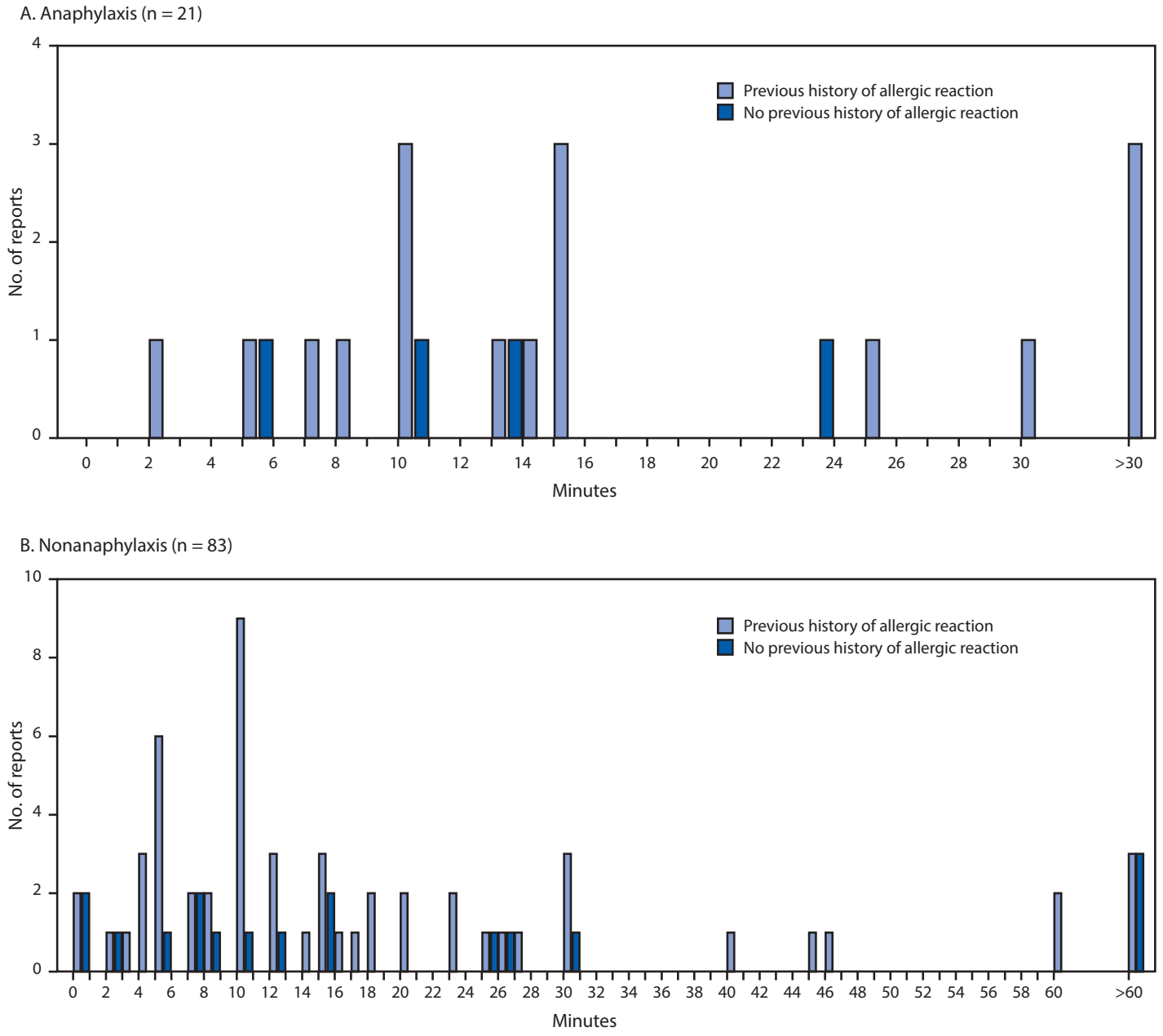
* As documented in the VAERS report or medical records, or through confirmation with the treating health care provider or the patients themselves.

† Inpatient = inpatient hospitalization.

§ The Brighton Collaboration case definition uses combinations of symptoms to define levels of diagnostic certainty. Brighton Level 1 represents the highest level of diagnostic certainty that a reported case is indeed a case of anaphylaxis; Levels 2 and 3 are successively lower levels of diagnostic certainty. Level 4 is a case reported as anaphylaxis but that does not meet the Brighton Collaboration case definition. Level 5 is a case that was neither reported as anaphylaxis nor meets the case definition (https://doi.org/10.1016/j.vaccine.2007.02.064).

¶ As documented in the description of the adverse event in the VAERS report in Box 18 or as document in recovery status in Box 20.

FIGURE. Interval (minutes) from vaccine receipt to onset of anaphylaxis (A)* and nonanaphylaxis allergic reactions (B)† after receipt of Pfizer-BioNTech COVID-19 vaccine — Vaccine Adverse Events Reporting System, United States, December 14–23, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

* The interval from vaccine receipt to symptom onset was >30 minutes for three anaphylaxis cases (34, 54, and 150 minutes).

† The interval from vaccine receipt to symptom onset was >60 minutes for three nonanaphylaxis patients who had a documented history of allergies or allergic reactions at 90, 96, and 180 minutes and for three who did not have a documented history of allergies or allergic reactions (105 minutes, 137 minutes, and 20 hours). Interval from vaccine receipt to symptom onset was missing for four patients with a history of allergies or allergic reactions and for seven without such history. Three cases of nonanaphylaxis allergic reactions with symptom onset occurring later than the day after vaccination (i.e., outside of the 0–1-day risk window) were excluded from the final analysis.

(81%) had a history of allergies or allergic reactions, including some with previous anaphylaxis events; up to 30% of persons in the general population might have some type of allergy or history of allergic reactions.¶ Most (90%) reported anaphylaxis cases after receipt of Pfizer-BioNTech COVID-19 vaccine occurred in women, although 64% of the vaccine doses administered with sex of recipient recorded were given in women. Whereas a female predominance has been previously observed in a review of immediate hypersensitivity reports to VAERS

¶ https://www.aaaai.org/about-aaaai/newsroom/allergy-statistics.

TABLE 2. Characteristics of patients with report of anaphylaxis and nonanaphylaxis allergic reactions after receipt of Pfizer-BioNTech COVID-19 vaccine — Vaccine Adverse Events Reporting System (VAERS), United States, December 14–23, 2020

Characteristic	Type of reported reaction, no. (%)	
	Anaphylaxis (n = 21)	Nonanaphylaxis allergic reactions (n = 83)*
Median age, yrs (range)	40 (27–60)	43 (18–65)
Female	19 (90)	75 (90)
Mins to symptom onset, median (range)	13 (2–150)	12 (<1–1,200 [20 hrs])
Symptom onset ≤15 mins	15 (71)	44 (61)†
Symptom onset ≤30 mins	18 (86)	61 (85)†
Documented history of allergies or allergic reactions	17 (81)§	56 (67)

Abbreviation: COVID-19 = coronavirus disease 2019.

* Three of the initial 86 nonanaphylaxis allergic reaction reports were excluded from the final analysis because symptom onset occurred later than the day after vaccination (i.e., outside of the 0–1-day risk window).

† Eleven reports were missing information on time of symptom onset; percentage calculated among 72 patients.

§ Seven anaphylaxis patients reported a history of a previous anaphylaxis episode, including one after receipt of rabies vaccine and one after receipt of influenza A(H1N1) vaccine.

after influenza A(H1N1) vaccine (*8*), the current finding could be impacted by the observation that more women than men had received a first dose of Pfizer-BioNTech COVID-19 vaccine during the analytic period. Anaphylaxis is potentially life-threatening and requires immediate treatment (*5*). Based on early safety monitoring, anaphylaxis after the Pfizer-BioNTech COVID-19 vaccine appears to be a rare event; however, comparisons of anaphylaxis risk with that associated with non-COVID-19 vaccines are constrained at this time by the limited data available this early in the COVID-19 vaccination program. CDC and FDA will continue enhanced monitoring for anaphylaxis among recipients of COVID-19 vaccines.

The findings in this report are subject to at least four limitations. First, the anaphylaxis and nonanaphylaxis allergic reaction case reports were gathered through passive surveillance based on spontaneous reports to VAERS. Spontaneous reporting is subject to reporting biases (including underreporting); however, the reporting efficiency to VAERS for clinically severe adverse events is believed to be high (*9*). A second potential source of bias arises from stimulated reporting related to increased public and health care provider awareness of a potential safety concern. Thus, it is possible that intense media attention around the national COVID-19 vaccination program and heightened awareness of reports of anaphylaxis have affected vaccine recipient and health care provider behavior and practices, including elevated concern and anxiety, higher index of suspicion for anaphylaxis, and lower threshold for early treatment of suspected cases, thereby resulting in an increase in diagnosis of suspected anaphylaxis and corresponding stimulated above-baseline reporting to VAERS. Third, it is possible that data lags and incomplete reporting of vaccine doses administered might underestimate the denominator (doses administered) relative to the numerator (anaphylaxis cases). If anaphylaxis cases after receipt of COVID-19 vaccine are identified and reported faster than vaccine doses administered are reported, the anaphylaxis rate associated with vaccination might be overestimated. Finally, the focus on the Pfizer-BioNTech COVID-19 vaccine is a function of the timing of product availability and doses administered. Data on the Moderna vaccine, which became available a week later, were limited. Vaccination with Moderna COVID-19 vaccine commenced on December 21, 2020, and through December 23, 2020, an estimated 224,322 first doses of the vaccine had been administered; one report that met the Brighton Collaboration case definition criteria for anaphylaxis had been submitted to VAERS.

Mortality from COVID-19 in populations at high risk is substantial (*10*), and treatment options are limited. Widespread vaccination against COVID-19 with highly effective vaccines represents an important tool in efforts to control the pandemic. CDC and FDA will continue to monitor for adverse events, including anaphylaxis, after receipt of COVID-19 vaccines and will regularly assess the benefits and risks of vaccination in the context of the evolving epidemiology of the pandemic. Continued monitoring in VAERS and additional monitoring in population-based surveillance systems, such as the CDC's Vaccine Safety Datalink (https://www.cdc.gov/vaccinesafety/ensuringsafety/monitoring/vsd/index.html), will help to further characterize the risk for anaphylaxis after administration of COVID-19 vaccines. CDC guidance on use of mRNA COVID-19 vaccines and management of anaphylaxis is available (*4*,*5*). Specifically, vaccination locations should 1) ensure that necessary supplies are available to manage anaphylaxis, especially sufficient quantities of epinephrine in prefilled syringes or autoinjectors; 2) screen potential vaccine recipients to identify persons with contraindications and precautions (*4*); 3) implement recommended postvaccination observation periods, either 15 or 30 minutes depending on each patient's previous history of allergic reactions; 4) ensure that health care providers can recognize the signs and symptoms of anaphylaxis early; and 5) immediately treat suspected anaphylaxis with intramuscular epinephrine; because of the acute,

life-threatening nature of anaphylaxis, there are no contraindications to epinephrine administration. Patients experiencing anaphylaxis should be transported to facilities where they can receive appropriate medical care (*5*). All patients should be instructed to seek immediate medical care if they develop signs or symptoms of an allergic reaction after their observation period ends and they have left the vaccination location. Health care providers can play an important role in vaccine safety by being vigilant in recognizing and reporting adverse events after immunization to VAERS at https://vaers.hhs.gov/reportevent.html.

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Rates of COVID-19 Among Residents and Staff Members in Nursing Homes — United States, May 25–November 22, 2020

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During the beginning of the coronavirus disease 2019 (COVID-19) pandemic, nursing homes were identified as congregate settings at high risk for outbreaks of COVID-19 (*1*,*2*). Their residents also are at higher risk than the general population for morbidity and mortality associated with infection with SARS-CoV-2, the virus that causes COVID-19, in light of the association of severe outcomes with older age and certain underlying medical conditions (*1*,*3*). CDC's National Healthcare Safety Network (NHSN) launched nationwide, facility-level COVID-19 nursing home surveillance on April 26, 2020. A federal mandate issued by the Centers for Medicare & Medicaid Services (CMS), required nursing homes to commence enrollment and routine reporting of COVID-19 cases among residents and staff members by May 25, 2020. This report uses the NHSN nursing home COVID-19 data reported during May 25–November 22, 2020, to describe COVID-19 rates among nursing home residents and staff members and compares these with rates in surrounding communities by corresponding U.S. Department of Health and Human Services (HHS) region.* COVID-19 cases among nursing home residents increased during June and July 2020, reaching 11.5 cases per 1,000 resident-weeks (calculated as the total number of occupied beds on the day that weekly data were reported) (week of July 26). By mid-September, rates had declined to 6.3 per 1,000 resident-weeks (week of September 13) before increasing again, reaching 23.2 cases per 1,000 resident-weeks by late November (week of November 22). COVID-19 cases among nursing home staff members also increased during June and July (week of July 26 = 10.9 cases per 1,000 resident-weeks) before declining during August–September (week of September 13 = 6.3 per 1,000 resident-weeks); rates increased by late November (week of November 22 = 21.3 cases per 1,000 resident-weeks). Rates of COVID-19 in the surrounding communities followed similar trends. Increases in community rates might be associated with increases in nursing home COVID-19 incidence, and nursing home mitigation strategies need to include a comprehensive plan to monitor local SARS-CoV-2 transmission and minimize high-risk exposures within facilities.

On May 25, 2020, CMS-certified nursing homes began reporting data to NHSN in response to a federal mandate (*4*). This reporting included data on the number of beds occupied and the number of COVID-19 cases among residents and staff members confirmed by antigen tests or laboratory-based viral nucleic acid test results (*5*). Nursing home staff members and facility personnel comprise all persons working or volunteering in the facility, including contractors, temporary staff members, resident caregivers, and staff members who might work at multiple facilities (*5*). Data on COVID-19 cases among residents and staff members reported during May 25–November 22, 2020 were analyzed for nursing homes in all U.S. states, the District of Columbia, Guam, and Puerto Rico. Facilities are expected to enter incident COVID-19 case counts on residents and staff members weekly. Facilities were excluded from the analysis for specific weeks if data on cases, occupied beds, or staffing were not reported. Data quality checks indicated that in some cases, facilities might have misinterpreted instructions and that cumulative case counts, rather than weekly case counts, were being entered. Based on the pattern of data entry, if it appeared that cumulative data were entered consecutively, data field values were reassigned to a weekly incident value. Outlier data points were derived using the distribution of facility-level resident and staff member case counts reported on a single collection date among reporting nursing homes over the entire cohort during the data collection period, and any value above the 99.9th percentile (i.e., >55 cases for residents and >37 cases for staff members) was truncated to the corresponding cut-point value. Case count data were aggregated weekly, and resident-weeks were calculated as the total number of occupied beds on the day data were reported. Because data on number of staff members employed is not collected, the proxy denominator of resident-weeks was used as a closest best estimate of the at-risk denominator for staff members. Weekly incidence was calculated for the weekly aggregated data at the end of each calendar week. Cases per 1,000 resident-week were calculated for residents and staff members using the number of COVID-19 cases reported in a week over the corresponding 1,000 resident-weeks. Community COVID-19 rates per 100,000 population were calculated for each of the ten HHS regions as the total number of cases reported in a week over the region's estimated population, using data available at

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

USAFacts.org (*6*). Calculations of cases per 100,000 population in Region 2 excluded cases reported from Puerto Rico and in HHS Region 9 excluded cases reported from Guam. Rates among residents and staff members and in the surrounding community were compared by HHS region. Analyses were conducted using SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.†

Among 15,404 nursing homes, 15,342 (99.6%) were included in the analysis. Overall, 13,185 (86%) nursing homes had ≥50 beds, 10,750 (70.1%) were for-profit, and 14,349 (93.5%) had dual Medicare and Medicaid certification (Table). Most nursing homes (8,688; 62.2%) were in HHS Regions 4, 5, 6, and 7.

During May 25–November 22, nursing homes reported 572,135 cases to NHSN, 296,762 (51.8%) of which occurred among residents and 275,373 (48.2%) among staff members. Among residents, cases per 1,000 resident-weeks increased during June and July, reaching 11.5 cases per 1,000 resident-weeks (week of July 26), and decreased during August–September (week of September 13 incidence = 6.3 per 1,000 resident-weeks). In November, rates increased again, reaching 23.2 cases per 1,000 resident-weeks (week of November 22) (Figure). Among staff members, cases per 1,000 resident-weeks also increased during June and July, reaching 10.9 cases per 1,000 resident-weeks (week of July 26); incidence then decreased during August and September (week of September 13, 2020 incidence = 6.3 per 1,000 resident-weeks). Incidence among staff members also increased in November, reaching 21.3 cases per 1,000 resident-weeks during the week of November 22 (Figure). Although incidence among residents (10.5 cases per 1,000 resident-weeks) was higher than that among staff members (8.9 per 1,000 resident-weeks) on May 31, during increases in July and November incidence among staff members closely matched that among residents, and trends were similar.

Nursing homes in HHS Regions 1 and 2 reported peak incidences of >10.0 cases per 1,000 resident-weeks among residents and staff members during May or June before rates subsequently declined to <6.0 cases per 1,000 resident-weeks during June–October (Supplementary Figure, https://stacks.cdc.gov/view/cdc/99807). During the July peak, rates among residents and staff members in HHS Regions 4, 6, and 9 ranged from 14 to 24 cases per 1,000 resident-weeks. In HHS Regions 5, 7, and 8, rates ranged from 2.5 to 15 cases per 1,000 resident-weeks during August–September and increased again in November, ranging from 32 to 44 cases per 1,000 resident-weeks during the week of November 22.

During May, population-level COVID-19 rates across the HHS regions ranged from 17 to 67 cases per 100,000 population, and during the July peak, increased to >178 cases per 100,000 in HHS Regions 4, 6, and 9. Rates declined in all HHS regions during August–September and began increasing again in October, with rates in HHS Region 5, 7, and 8 exceeding 615 cases per 100,000 during the week of November 22. For each HHS region, trends in nursing home incidence among residents and staff members were similar to population trends in the surrounding community.

TABLE. Characteristics of nursing homes reporting COVID-19 to the National Healthcare Safety Network (N = 15,342) — United States, May 25–November 22, 2020

Characteristic	No. (%)
Facility bed size*	
<50	2,126 (13.9)
50–99	5,533 (36.1)
100–199	6,764 (44.1)
>199	888 (5.8)
Unknown†	31 (0.2)
Facility ownership*	
Not-for-profit	3,678 (24.0)
For-profit	10,750 (70.1)
Government	883 (5.8)
Unknown†	31 (0.2)
Certification*	
Dual Medicare and Medicaid	14,349 (93.5)
Medicare only	652 (4.2)
Medicaid only	310 (2.0)
Unknown†	31 (0.2)
HHS regions§	
Region 1	836 (6.0)
Region 2	909 (6.5)
Region 3	1,225 (8.8)
Region 4	2,329 (16.7)
Region 5	3,108 (22.2)
Region 6	1,880 (13.5)
Region 7	1,371 (9.8)
Region 8	567 (4.1)
Region 9	1,334 (9.5)
Region 10	414 (3.0)

Abbreviations: COVID-19 = coronavirus disease 2019, HHS = U.S. Department of Health and Human Services.

* Data source: https://data.medicare.gov/Nursing-Home-Compare/Provider-Info/4pq5-n9py/data. Unknown category includes nursing homes where the information is not available.

† Unknown represents facilities without information on bed size, facility ownership, and certification

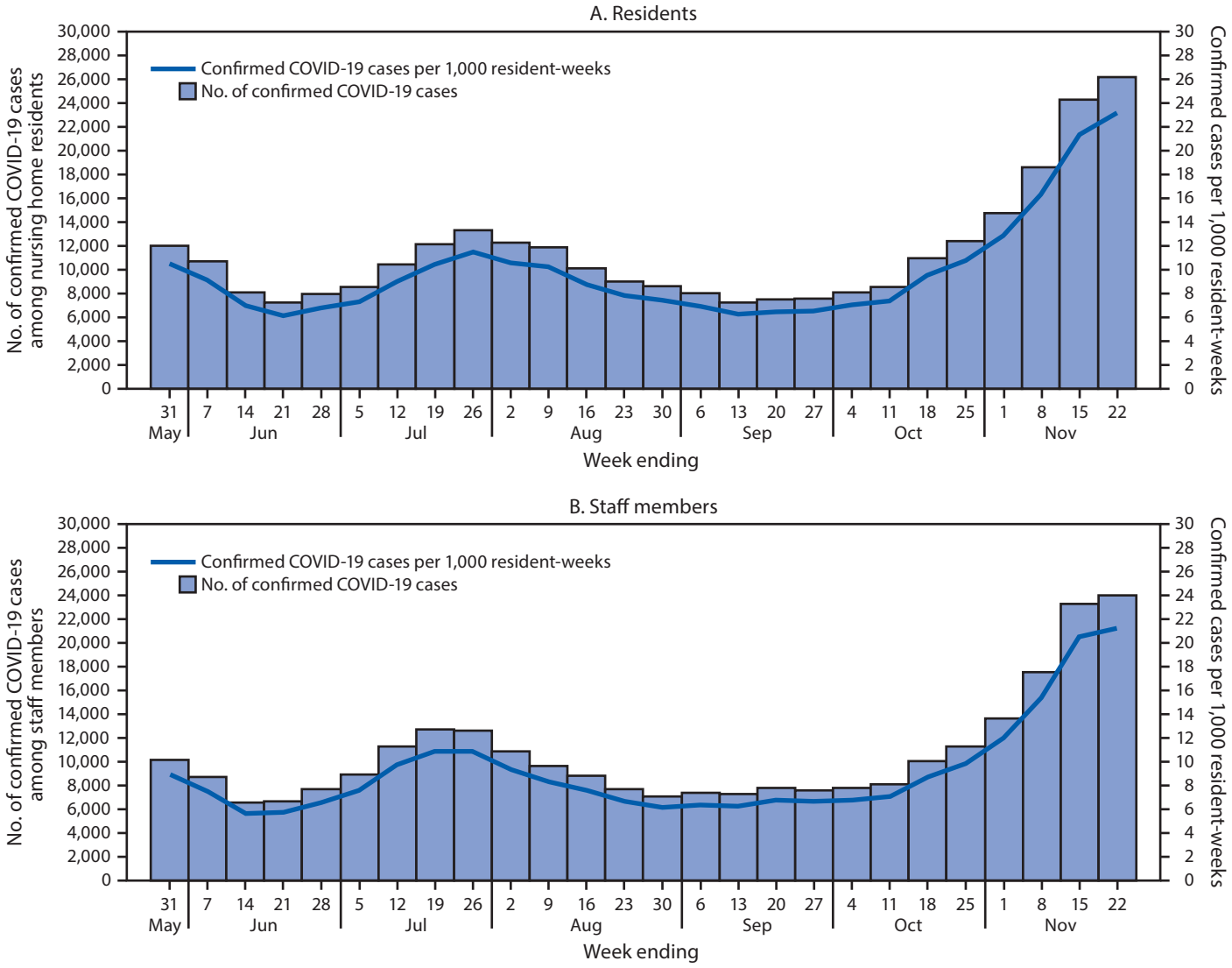
§ *Region 1:* Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2:* New Jersey, New York, and Puerto Rico; *Region 3:* Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4:* Alabama, Florida, Georgia, North Carolina, Kentucky, Mississippi, South Carolina, and Tennessee; *Region 5:* Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6:* Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7:* Iowa, Kansas, Missouri, and Nebraska; *Region 8:* Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9:* Arizona, California, Hawaii, Nevada, Guam; *Region 10:* Alaska, Idaho, Oregon, and Washington.

Discussion

There has been a substantial incidence of COVID-19 among nursing home residents and staff since May 2020. Rates of COVID-19 among residents and staff members in nursing

† 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE. COVID-19 cases* per 1,000 resident-weeks† among nursing home residents (A) and staff members (B) — United States, May 25–November 22, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.
* Confirmed COVID-19 cases were diagnosed by a positive SARS-CoV-2 viral nucleic acid or antigen test.
† Resident-weeks were calculated as the total number of occupied beds on the day data were reported.

homes fluctuated during weeks ending May 31–November 22, with regional and temporal variability; however, trends resembled those in the surrounding communities. These data suggest that increases in community rates might be associated with increases in nursing home COVID-19 incidence and that nursing home mitigation strategies need to include a comprehensive plan to monitor local SARS-CoV-2 transmission and minimize high-risk exposures within facilities. Increased COVID-19 incidence in communities with nursing homes increases the risk for introduction of SARS-CoV-2 by staff members. In Minnesota, ≥34% of high-risk exposures among health care staff members involved nonpatient contacts, including household and social contacts, indicating potential lapses in adherence to mask use and social distancing recommendations during social interactions (*7*). Addressing health care safety gaps calls for educating staff members about the risk for community exposure, encouraging consistent use of CDC guidance[§] in all settings, as well as ensuring adequate access and availability of personal protective equipment (*8*). In addition, nursing home adherence to the CMS requirement to conduct routine testing among all staff members and isolate newly admitted or readmitted residents with an unknown COVID-19 status can reduce the risk for SARS-CoV-2 introduction into nursing homes (*9*).

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

Summary

What is already known about this topic?

In the United States, COVID-19 among older adults living in nursing homes is associated with higher rates of severe illness and death.

What is added by this report?

Rates of COVID-19 among nursing home residents and staff members increased during June and July 2020, and again in November. Trends in reported COVID-19 cases among nursing home residents and staff members were similar to trends in incidence of COVID-19 in surrounding communities.

What are the implications for public health practice?

Increases in community rates might be associated with increases in nursing home COVID-19 incidence, and nursing home mitigation strategies need to include a comprehensive plan to monitor local SARS-CoV-2 transmission and minimize high-risk exposures within facilities.

The findings in this report are subject to at least four limitations. First, nursing homes reported aggregate weekly data to NHSN, preventing patient-level analysis. Second, reported data were not validated, and trends among nursing homes excluded because of missing data might have differed. Third, the sources of introduction and direction of transmission between residents and staff members could not be determined. Finally, these results might not be generalizable to residents and staff members of other long-term care facilities, such as those for the developmentally disabled and assisted living facilities because this analysis was restricted to nursing homes reporting COVID-19 data weekly, as required by CMS.

Nursing homes are high-risk, congregate settings that require a comprehensive infection prevention and control strategy to reduce SARS-CoV-2 entry into the facility and mitigate transmission to prevent severe outcomes. CDC's nursing home guidance provides tiered recommendations for different phases of a COVID-19 response and should be implemented in addition to CMS regulatory requirements (*9*). Prioritization of nursing home residents and staff members for SARS-CoV-2 vaccination, as recommended by the Advisory Committee on Immunization Practices, is an additional strategy to assist mitigation (*10*). Guidance and federal requirements could be further improved through assessing factors associated with the incidence of COVID-19 among nursing home staff members and residents, including factors associated with community-acquired infections leading to transmission within nursing homes.

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Candida auris Outbreak in a COVID-19 Specialty Care Unit — Florida, July–August 2020

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In July 2020, the Florida Department of Health was alerted to three *Candida auris* bloodstream infections and one urinary tract infection in four patients with coronavirus disease 2019 (COVID-19) who received care in the same dedicated COVID-19 unit of an acute care hospital (hospital A). *C. auris* is a multidrug-resistant yeast that can cause invasive infection. Its ability to colonize patients asymptomatically and persist on surfaces has contributed to previous *C. auris* outbreaks in health care settings (*1*–*7*). Since the first *C. auris* case was identified in Florida in 2017, aggressive measures have been implemented to limit spread, including contact tracing and screening upon detection of a new case. Before the COVID-19 pandemic, hospital A conducted admission screening for *C. auris* and admitted colonized patients to a separate dedicated ward.

Hospital A's COVID-19 unit spanned five wings on four floors, with 12–20 private, intensive care–capable rooms per wing. Only patients with positive test results for SARS-CoV-2, the virus that causes COVID-19, at the time of admission were admitted to this unit. After patient discharge, room turnover procedures included thorough cleaning of all surfaces and floor and ultraviolet disinfection. In response to the four clinical *C. auris* infections, unit-wide point prevalence surveys to identify additional hospitalized patients colonized with *C. auris* were conducted during August 4–18; patients on all four floors were screened sequentially and rescreened only if their initial result was indeterminate. Hospital A's infection prevention team, the Florida Department of Health, and CDC performed a joint investigation focused on infection prevention and control at hospital A that included observation of health care personnel (HCP) use of personal protective equipment (PPE), contact with and disinfection of shared medical equipment, hand hygiene, and supply storage. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.*

Among 67 patients admitted to the COVID-19 unit and screened during point prevalence surveys, 35 (52%) received positive test results. Mean age of colonized patients was 69 years (range = 38–101 years) and 60% were male. Six (17%) colonized patients later had clinical cultures that grew *C. auris*. Among patients screened who had available medical records (20), two (10%) were admitted directly from a long-term care facility and eight (40%) died within 30 days of screening, but whether *C. auris* contributed to death is unknown (Table).

HCP in the COVID-19 unit were observed wearing multiple layers of gowns and gloves during care of COVID-19 patients. HCP donned eye protection, an N95 respirator, a cloth isolation gown, gloves, a bouffant cap, and shoe covers on entry to the COVID-19 unit; these were worn during the entire shift. A second, disposable isolation gown and pair of gloves were donned before entering individual patient rooms, then doffed and discarded upon exit. Alcohol-based hand sanitizer was used on gloved hands after doffing outer gloves. HCP removed all PPE and performed hand hygiene before exiting the unit.

Investigators observed multiple opportunities for contamination of the base layer of gown and gloves during doffing and through direct contact with the patient care environment or potentially contaminated surfaces such as mobile computers. Mobile computers and medical equipment were not always disinfected between uses, medical supplies (e.g., oxygen tubing and gauze) were stored in open bins in hallways and accessed by HCP wearing the base PPE layer, and missed opportunities for performing hand hygiene were observed.

A combination of factors that included HCP using multiple gown and glove layers in the COVID-19 unit, extended use of the underlayer of PPE, lapses in cleaning and disinfection of shared medical equipment, and lapses in adherence to hand hygiene likely contributed to widespread *C. auris* transmission. After hospital A removed supplies from hallways, enhanced cleaning and disinfection practices, and ceased base PPE layer practices, no further *C. auris* transmission was detected on subsequent surveys.

The COVID-19 pandemic has prompted facilities to implement PPE conservation strategies during anticipated or existing shortages and to use PPE in ways that are not routine (e.g., extended wear and reuse) (*8*). Some health care facilities not experiencing shortages allow extra PPE layers because of the perception of increased protection for HCP. CDC does not recommend the use of more than one isolation gown or pair of gloves at a time when providing care to patients with suspected or confirmed SARS-CoV-2 infection (*9*,*10*). Such practices among HCP might be motivated by fear of becoming infected with SARS-CoV-2 but instead might increase risks for self-contamination when doffing

* 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. Demographic and clinical characteristics of patients colonized with *Candida auris* in a COVID-19 specialty care unit identified during screening at an acute care hospital (N = 35) — Florida, August 4–18, 2020

Characteristic (no. with available information)	No. (%)*
Sex (35)	
Female	14 (40)
Male	21 (60)
Mean age, yrs (range) (35)	69 (38–101)
Clinical culture with *C. auris* during admission† (35)	6 (17)
Mortality within 30 days of screening§ (20)	8 (40)
Admitted from long-term care facility (20)	2 (10)
Medical devices present at time of screening (20)	
Central venous catheter	16 (80)
Ventilator	11 (55)
Nasogastric/Gastric tube	11 (55)
Urinary catheter	11 (55)
Underlying conditions (20)	
Diabetes	12 (60)
Chronic wound/wound care	4 (20)
Malignancy	3 (15)
Chronic kidney disease	3 (15)
Chronic lung disease	1 (5)
Cardiac disease	1 (5)
No underlying conditions	4 (20)
Known multidrug-resistant organism before screening (20)	5 (25)
Vancomycin-resistant Enterococci	3 (15)
Extended-spectrum beta-lactamase–producing Enterobacteriaceae	2 (10)
Methicillin-resistant *Staphylococcus aureus*	2 (10)
Carbapenem-resistant Enterobacteriaceae	0 (—)
Candida auris	0 (—)

Abbreviation: COVID-19 = coronavirus disease 2019.
* Clinical information available for 20 (57%) of 35 patients. Medical records for other patients were not available. Clinical information on this subset might not be representative of all patients.
† Results of clinical cultures with *Candida auris* finalized after colonization was identified by screening during patients' current admission.
§ Contribution of *C. auris* to mortality is unknown.

and for transmission of other pathogens among patients and exacerbate PPE supply shortages. When managing SARS-CoV-2 patients in a dedicated ward, HCP should maintain standard practices (e.g., hand hygiene at indicated times and recommended cleaning and disinfection) intended to prevent transmission of other pathogens.[†,§] Outbreaks such as that described in this report highlight the importance of adhering to recommended infection control and PPE practices and continuing surveillance for novel pathogens like *C. auris*.

[†] https://www.cdc.gov/infectioncontrol/guidelines/index.html.
[§] https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control.html.

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Mitigation Policies and COVID-19–Associated Mortality — 37 European Countries, January 23–June 30, 2020

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On January 12, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

As cases and deaths from coronavirus disease 2019 (COVID-19) in Europe rose sharply in late March, most European countries implemented strict mitigation policies, including closure of nonessential businesses and mandatory stay-at-home orders. These policies were largely successful at curbing transmission of SARS-CoV-2, the virus that causes COVID-19 (*1*), but they came with social and economic costs, including increases in unemployment, interrupted education, social isolation, and related psychosocial outcomes (*2*,*3*). A better understanding of when and how these policies were effective is needed. Using data from 37 European countries, the impact of the timing of these mitigation policies on mortality from COVID-19 was evaluated. Linear regression was used to assess the association between policy stringency at an early time point and cumulative mortality per 100,000 persons on June 30. Implementation of policies earlier in the course of the outbreak was associated with lower COVID-19–associated mortality during the subsequent months. An increase by one standard deviation in policy stringency at an early timepoint was associated with 12.5 cumulative fewer deaths per 100,000 on June 30. Countries that implemented stringent policies earlier might have saved several thousand lives relative to those countries that implemented similar policies, but later. Earlier implementation of mitigation policies, even by just a few weeks, might be an important strategy to reduce the number of deaths from COVID-19.

Using data from 37 European countries, the impact of the timing and stringency of early mitigation policies on cumulative mortality from COVID-19 on June 30 was assessed. Countries with >250,000 inhabitants and for which relevant data were available were included. Mortality data were obtained from the World Health Organization (WHO) Coronavirus Disease Dashboard (*4*). Data on mitigation policies were obtained from the CDC COVID-19 International Taskforce global mitigation database accessible through WHO* (*5*) and the University of Oxford's Coronavirus Government Response Tracker (*6*), specifically the Oxford Stringency Index (OSI) (*6*), which is a composite index based on nine mitigation policies. These include cancellation of public events, school closures, gathering restrictions, workplace closures, border closures, internal movement restrictions, public transport closure, recommendations to stay at home, and stay-at-home orders; mask requirements are not included. The OSI ranges from 0 to 100 and increases over time if more stringent mitigation policies are implemented or decreases if policies are rescinded (Supplementary Figure, https://stacks.cdc.gov/view/cdc/100148); however, this index is also weighted on the strictness of each policy, which can vary among countries (*6*). For each country, the value of the OSI was extracted on the date that the country first reached a defined threshold of daily mortality from COVID-19 (mortality threshold). This report uses a threshold of a daily rate of 0.02 new COVID-19 deaths per 100,000 population (based on a 7-day moving average); several thresholds were explored,† all of which produced similar results. The mortality threshold is used to identify a common epidemiologic point early in the pandemic in each country to align countries by the progression of their epidemic, rather than by calendar date.

Linear regression was used to assess the association between the OSI on the day the country reached the mortality threshold and cumulative mortality per 100,000 at the end of June 2020. June 30, 2020 was chosen because at that time, the rate of new COVID-19 deaths per 100,000 had dropped to relatively low levels for nearly all 37 countries. The regression model controls for several covariates: the calendar date the mortality threshold was reached, because countries affected later might have had more time to prepare and less time before the fixed endpoint of June 30; hospital beds in the country per 1,000 population as a measure of baseline health care capacity; median age of the population, because age is an important risk factor for death from COVID-19; population density, because urbanization might lead to higher rates of contact; and gross domestic product per capita to account for differences in wealth. Controlling for other OSI metrics (e.g., the mean, median, and maximum OSI from January 1 to June 30) was explored, but none had a meaningful effect on the results. The

*Mitigation policies implemented by government authorities during January 1–June 30, 2020 were abstracted from media reports and government and United Nations websites and compiled by WHO. The CDC COVID-19 International Taskforce global mitigation database is a sub-set of the WHO public health and social measures database.

†The following potential mortality thresholds were explored: number of cumulative deaths (all values between one and 50 deaths), number of cumulative deaths per 100,000 population (all values between 0.01 and 0.5 deaths per 100,000), and the number of daily deaths per 100,000 population (all values between 0.001 and 0.05 deaths per 100,000).

Summary

What is already known about this topic?

Mitigation policies, including closure of nonessential businesses, restrictions on gatherings and movement, and stay-at-home orders, have been critical to controlling the COVID-19 pandemic in many countries, but they come with high social and economic costs.

What is added by this report?

European countries that implemented more stringent mitigation policies earlier in their outbreak response tended to report fewer COVID-19 deaths through the end of June 2020. These countries might have saved several thousand lives relative to countries that implemented similar policies, but later.

What are the implications for public health practice?

Earlier implementation of stringent mitigation policies, even by just a few weeks, appears to be important to prevent widespread COVID-19 transmission and reduce the number of deaths.

number of lives lost attributable to a lower OSI on the day the country reached the mortality threshold was calculated using the results from the linear regression. For each country whose OSI was <80 when reaching the mortality threshold, a counterfactual scenario was estimated by calculating the expected reduction in mortality had their OSI been 80.[§]

Among 37 European countries, the date the mortality threshold was reached ranged from March 2 (Italy) to April 18 (Ukraine), and the OSI on the date the mortality threshold was reached ranged from 16.7 (United Kingdom) to 100.0 (Serbia) (Table). The most common policies implemented in these countries by the time they reached the mortality threshold were cancellation of public events (35 countries; 95%), followed by school closures (33; 89%), restrictions on gatherings (31; 84%), workplace closures (31; 84%), border closures (27; 73%), restrictions on internal movement (25; 68%), and recommendations to stay at home (14; 38%). Several countries implemented more stringent policies including closure of public transportation (18; 49%) and stay-at-home orders (11; 30%). Countries with more policies in place generally had a higher OSI; however, several countries had a higher index with fewer policies in place. For example, Serbia (index = 100) and Hungary (index = 76.9) had similar types of policies in place, but Serbia had stricter policies such as restrictions on gatherings of ≥10 persons, compared with Hungary, which had restrictions on gatherings of >1,000 persons.

[§] The expected reduction in mortality was calculated as the product of three values: 1) the difference between the observed OSI when reaching the mortality threshold and 80, 2) the linear regression coefficient (–0.55), and 3) the population size (measured in 100,000 increments to account for the units of the regression coefficient). A value of 80 for the OSI was selected because it was the average maximum OSI values that countries reached before June 30, 2020.

Cumulative COVID-19–associated mortality on June 30 was lower in countries that had a higher OSI when reaching the mortality threshold (Figure). This association persisted after controlling for the calendar date the mortality threshold was reached, hospital beds per 1,000 population, median age of the population, population density, and gross domestic product per capita. For each 1-unit increase in the OSI when the mortality threshold was reached, the cumulative mortality as of June 30 decreased by 0.55 deaths per 100,000 (95% confidence interval [CI] = –0.82 to –0.27 deaths per 100,000). A 1-unit increase in the OSI standard deviation (22.9 unit increase in the OSI) was associated with a decrease of 12.5 deaths per 100,000.

Overall, the OSI was <80 when the mortality threshold was reached in 26 (70%) of 37 countries (Table). On the basis of the regression model, it was determined that if the OSI in each of those countries had been 80 when reaching the mortality threshold, 74,139 fewer deaths would have been expected across those 26 countries. Most of these potentially averted deaths would have been in the United Kingdom (22,776; 31% of all averted deaths), France (13,365; 18%), and Spain (9,346; 13%).

Discussion

European countries that implemented more stringent mitigation policies by the time they reached an early mortality threshold in spring 2020 tended to report fewer COVID-19–associated deaths through the end of June. Countries that implemented stringent policies earlier might have saved several thousand lives relative to those countries that implemented similar policies, but later. These findings suggest that earlier implementation, even by just a few weeks, might be important to preventing widespread transmission and large numbers of deaths.

Other research has highlighted the importance of the timing of control measures in mitigating the COVID-19 pandemic. One study of the 37 Organization of Economic Cooperation and Development member countries found that implementing school closures and gathering bans 1 week earlier could have reduced mortality by 44% (*7*). A modeling study highlighted a "window of opportunity" for implementing social distancing directives, suggesting that even small delays could lead to much higher incidence rates (*8*). An observational study of 43 U.S. states and 41 countries that implemented stay-at-home orders, found that jurisdictions that delayed those orders experienced more prolonged outbreaks (*9*). Another observational study of U.S. states and other countries found that several nonpharmaceutical interventions, including but not limited to cancelling small gatherings, airport restrictions, and closure of educational

TABLE. Mortality threshold date,* stringency index, and COVID-19 mitigation policies implemented, by Oxford Stringency Index (OSI) on date mortality threshold was reached — 37 European countries, March–April, 2020

Country	Date mortality threshold reached	OSI when mortality threshold reached	Cancellation of public events	School closures	Gathering restrictions	Workplace closures	Border closures	Internal movement restrictions	Public transport closure	Recommendations to stay at home	Stay-at-home orders
United Kingdom	Mar 16	16.7	N	N	N	Y	N	N	N	Y	N
Belarus	Apr 08	18.5	Y	Y	N	N	N	N	N	N	N
Luxembourg	Mar 11	22.2	Y	Y	N	N	N	N	N	N	N
Belgium	Mar 13	23.2	Y	N	N	N	N	N	N	N	N
Switzerland	Mar 10	25.0	Y	N	Y	N	N	N	N	N	N
Sweden	Mar 12	27.8	Y	N	Y	N	N	N	N	N	N
France	Mar 13	41.2	Y	Y	Y	Y	N	N	N	N	N
Spain	Mar 10	45.8	Y	Y	Y	Y	Y	Y	N	N	N
Ireland	Mar 24	48.2	Y	Y	Y	Y	N	N	N	N	N
Iceland	Mar 17	50.9	Y	Y	Y	Y	N	N	N	N	N
Cyprus	Mar 22	51.9	Y	Y	N	Y	Y	N	N	N	N
Netherlands	Mar 15	54.6	Y	Y	Y	Y	N	Y	N	Y	N
Norway	Mar 23	63.0	N	Y	Y	Y	Y	Y	Y	N	N
Finland	Mar 26	64.8	Y	Y	Y	N	Y	Y	N	Y	N
Germany	Mar 21	68.1	Y	Y	Y	Y	Y	Y	N	Y	N
Latvia	Apr 10	69.4	Y	Y	Y	Y	Y	N	Y	Y	N
Italy	Mar 02	69.9	Y	Y	Y	Y	Y	Y	N	Y	N
Bulgaria	Apr 01	71.3	Y	Y	Y	Y	Y	Y	N	Y	N
Denmark	Mar 18	72.2	Y	Y	Y	Y	Y	Y	Y	Y	N
Estonia	Mar 27	72.2	Y	Y	Y	Y	Y	Y	N	N	N
Greece	Mar 22	74.1	Y	Y	Y	Y	Y	Y	Y	N	N
Slovakia	Apr 16	75.0	Y	Y	Y	Y	Y	Y	Y	Y	N
Turkey	Mar 28	75.9	Y	Y	N	Y	Y	Y	Y	Y	N
Hungary†	Mar 31	76.9	Y	Y	Y	Y	Y	Y	Y	Y	Y
Romania	Mar 27	78.7	Y	Y	Y	Y	Y	Y	Y	N	Y
Slovenia	Mar 23	78.7	Y	Y	Y	Y	Y	N	Y	Y	N
Austria	Mar 20	81.5	Y	Y	Y	Y	Y	Y	Y	N	Y
Lithuania	Mar 23	81.5	Y	Y	Y	Y	Y	Y	Y	Y	N
Poland	Apr 01	81.5	Y	Y	Y	Y	Y	Y	N	N	Y
Czechia	Mar 27	82.4	Y	Y	Y	Y	Y	Y	N	N	Y
Portugal	Mar 21	82.4	Y	Y	Y	Y	Y	Y	Y	N	Y
Albania	Mar 24	84.3	Y	Y	Y	Y	Y	Y	Y	N	Y
Moldova	Mar 31	87.0	Y	Y	Y	Y	Y	Y	Y	N	Y
Ukraine	Apr 18	88.9	Y	Y	Y	Y	Y	Y	Y	Y	N
Bosnia and Herzegovina	Mar 27	89.8	Y	Y	Y	Y	Y	Y	Y	N	Y
Croatia	Mar 27	96.3	Y	Y	Y	Y	Y	Y	Y	N	Y
Serbia	Mar 27	100.0	Y	Y	Y	Y	Y	Y	Y	N	Y
Total countries	—	—	**35**	**33**	**31**	**31**	**27**	**25**	**18**	**14**	**11**

Abbreviations: COVID-19 = coronavirus disease 2019; N = no; Y = yes.

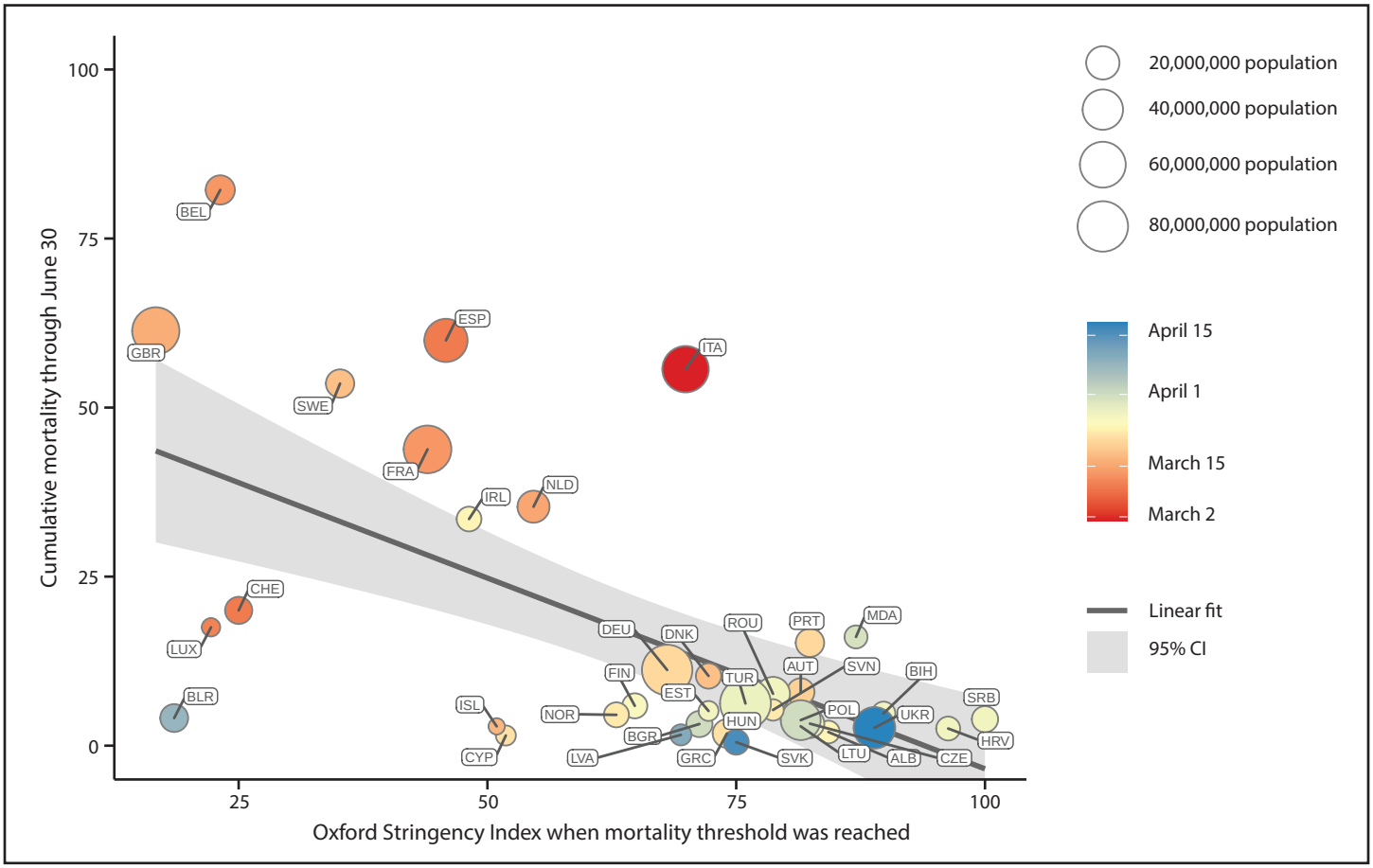
* The mortality threshold is the first date that each country reached a daily rate of 0.02 new COVID-19 deaths per 100,000 population based on a 7-day moving average of the daily death rate. "Yes" indicates that the policy was implemented before the date mortality threshold was reached, and "No" indicates that the policy had not been implemented. No country rescinded any policy before the mortality threshold was reached. Implementation of more policies in a country could result in a higher OSI; however, this index is also weighted on the strictness of each policy, which can vary among countries. For example, Serbia (index = 100) and Hungary (index = 76.9) had similar types of policies in place, but Serbia had more strict policies such as restrictions on gatherings of ≥10 persons compared with Hungary, which had restrictions on gatherings of >1,000 persons.

† Hungary implemented a stay-at-home order with exceptions for persons who commuted or had extraordinary situations; these persons were still under recommendations (but not requirements) to stay at home.

institutions, could lead to a larger reduction in transmission if implemented earlier rather than later (*10*).

The findings in this report are subject to at least four limitations. First, some COVID-19 deaths likely went undetected, especially during the early stages of the pandemic. This could impact both the date of reaching the mortality threshold and the cumulative mortality as of June 30. Second, the OSI does not capture all mitigation policies that countries might apply. For example, it does not include requirements for masks, though such requirements in Europe were rare during the early stages of the pandemic. Third, adherence to policies or recommendations was not accounted for and could explain some of the variability in the impact observed. Finally, many interventions were implemented simultaneously, making it difficult to determine which specific policies might have had the most impact.

FIGURE. Early policy stringency* and cumulative mortality† from COVID-19 — 37 European countries, January 23–June 30, 2020



Abbreviations: ALB = Albania; AUT = Austria; BEL = Belgium; BGR = Bulgaria; BIH = Bosnia and Herzegovina; BLR = Belarus; CHE = Switzerland; CI = confidence interval; COVID-19 = coronavirus disease 2019; CYP = Cyprus; CZE = Czechia; DEU = Germany; DNK = Denmark; ESP = Spain; EST = Estonia; FIN = Finland; FRA = France; GBR = United Kingdom; GRC = Greece; HRV = Croatia; HUN = Hungary; IRL = Ireland; ISL = Iceland; ITA = Italy; LTU = Lithuania; LUX = Luxembourg; LVA = Latvia; MDA = Moldova; NLD = Netherlands; NOR = Norway; POL = Poland; PRT = Portugal; ROU = Romania; SRB = Serbia; SVK = Slovakia; SVN = Slovenia; SWE = Sweden; TUR = Turkey; UKR = Ukraine.

* Based on the Oxford Stringency Index (OSI) on the date the country reached the mortality threshold. The OSI is a composite index ranging from 0–100, based on the following nine mitigation policies: 1) cancellation of public events, 2) school closures, 3) gathering restrictions, 4) workplace closures, 5) border closures, 6) internal movement restrictions, 7) public transport closure, 8) stay-at-home recommendations, and 9) stay-at-home orders. The mortality threshold is the first date that each country reached a daily rate of 0.02 new COVID-19 deaths per 100,000 population, based on a 7-day moving average of the daily death rate. The color gradient represents the calendar date that each country reached the mortality threshold.

† Deaths per 100,000 population.

This report quantifies the impact of earlier implementation of mitigation policies on COVID-19 mortality in Europe during the early stages of the pandemic. Further work should seek to identify optimal timing and duration of mitigation policies, evaluate the role of mask policies in relation to other mitigation policies, and assess which specific interventions are the most effective.

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Erratum

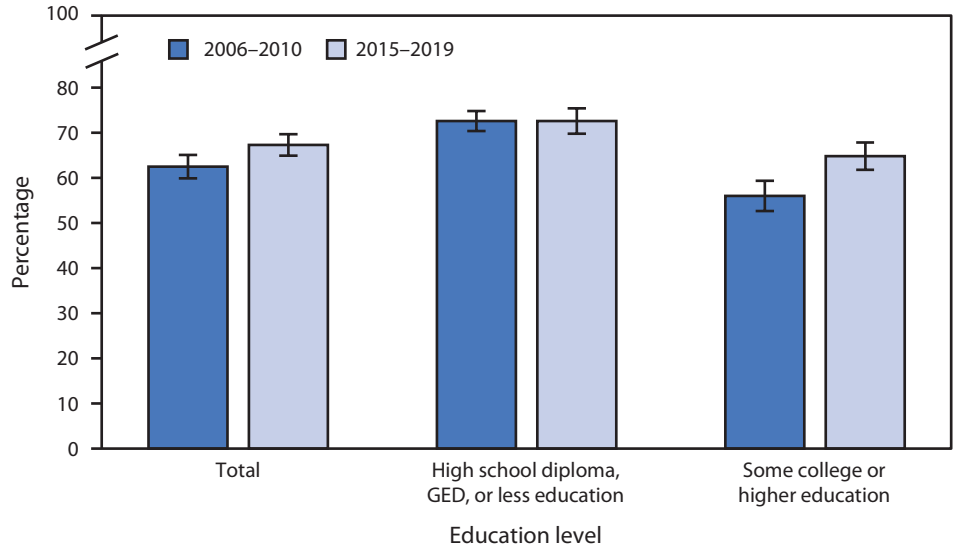
Vol. 69, No. 49

In the report "Trends in U.S. Emergency Department Visits Related to Suspected or Confirmed Child Abuse and Neglect Among Children and Adolescents Aged <18 Years Before and During the COVID-19 Pandemic — United States, January 2019-September 2020," on page 1842, the fourth sentence in the third complete paragraph should have read "The change in mean ED visits related to child abuse and neglect per week during the early pandemic period (**March 29–April 25, 2020**) and the comparison period (**March 31–April 27, 2019**) was calculated as the mean difference in total ED visits related to child abuse and neglect between the two 4-week periods."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Women Aged 22–44 Years Who Have Ever Cohabited with an Opposite-Sex Partner,† by Education§ — National Survey of Family Growth, United States, 2006–2010 and 2015–2019



Abbreviation: GED = General Educational Development certificate.
* Estimates are based on interviews of the U.S. household population for sample adults aged 22–44 years; 95% confidence intervals indicated with error bars.
† Ever cohabited with an opposite-sex partner refers to whether respondent ever lived with an opposite-sex partner before or outside of marriage in their lifetime.
§ Age and education of respondent are measured at time of interview.

Among women aged 22–44 years, during 2015–2019, 67.3% had ever cohabited with an opposite-sex partner compared with 62.5% during 2006–2010. Among women with a high school diploma, GED, or less education, the percentages of those who had ever cohabited with an opposite-sex partner were similar (72.6%) across the two periods; the percentage of women with some college or higher education who had ever cohabited was higher for 2015–2019 (64.8%) than for 2006–2010 (56.0%). In both periods, women with a high school diploma, GED, or less education were more likely to have ever cohabited with an opposite-sex partner than were women with some college or higher education.

Source: National Survey of Family Growth, 2006–2010 and 2015–2019. https://www.cdc.gov/nchs/nsfg/index.htm.

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