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Preliminary Incidence and Trends of Infections with Pathogens Transmitted Commonly Through Food — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 2016–2019

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To evaluate progress toward prevention of enteric illnesses, the Foodborne Diseases Active Surveillance Network (FoodNet) of CDC's Emerging Infections Program monitors the incidence of laboratory-diagnosed infections caused by eight pathogens transmitted commonly through food at 10 U.S. sites.* This report summarizes preliminary 2019 data and describes changes in incidence compared with that during 2016–2018. The incidence of enteric infections caused by these eight pathogens reported by FoodNet sites in 2019 continued to increase or remained unchanged, indicating progress in controlling major foodborne pathogens in the United States has stalled. *Campylobacter* and *Salmonella* caused the largest proportion of illnesses; trends in incidence varied by *Salmonella* serotype. Widespread adoption of whole genome sequencing (WGS) of bacteria has improved the ability to identify outbreaks, emerging strains, and sources of pathogens. To maximize the potential of WGS to link illnesses to particular sources, testing of isolates by clinical and public health laboratories is needed. Reductions in *Salmonella* serotype Typhimurium suggest that targeted interventions (e.g., vaccinating chickens and other food animals) might decrease human infections. Reducing contamination during food production, processing, and preparation will require more widespread implementation of known prevention measures and of new strategies that target particular pathogens and serotypes.

Members of FoodNet conduct active, population-based surveillance for laboratory-diagnosed infections caused by *Campylobacter, Cyclospora, Listeria, Salmonella,* Shiga toxin-producing *Escherichia coli* (STEC), *Shigella, Vibrio,* and *Yersinia* at 10 sites covering approximately 15% of the U.S. population (an estimated 49 million persons in 2018). FoodNet is a collaboration of CDC, 10 state health departments, the U.S. Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS), and the Food and Drug Administration (FDA). Bacterial infections are defined as isolation of the bacteria from a clinical specimen by culture or detection of pathogen antigen, nucleic acid sequences, or, for STEC,† Shiga toxin or Shiga toxin genes, by a culture-independent diagnostic test (CIDT).§ A CIDT-positive–only

* Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York (https://www.cdc.gov/foodnet).

† STEC infections are defined as identification of Shiga toxin or its genes by any laboratory.

§ A CIDT detects the presence of a specific antibody or antigen or the DNA of an organism.

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bacterial infection is a positive CIDT result not confirmed by culture.¶ *Listeria* infections are defined as isolation of *L. monocytogenes* or detection of its nucleic acid sequences from a normally sterile site, or from placental or fetal tissue in the instance of miscarriage or stillbirth. *Cyclospora* infections are defined as detection of the parasite by microscopy using ultraviolet fluorescence or specific stains or by polymerase chain reaction. Cases with no documentation of international travel or unknown travel are considered domestically acquired infections.** The patient's disposition at hospital discharge, or 7 days after specimen collection if not hospitalized, is attributed to the infection.

Incidence per 100,000 population was calculated by dividing the number of infections in 2019 by the U.S. Census estimates of the surveillance area population for 2018. Incidence measures include all laboratory-diagnosed infections. A negative binomial model with 95% confidence intervals (CIs) was used to estimate change in incidence during 2019 compared with that during 2016–2018, adjusting for changes in the population over time; CIs not including zero were considered statistically significant. Analyses were performed using SAS statistical software (version 9.4; SAS Institute).

Surveillance for physician-diagnosed post-diarrheal hemolytic uremic syndrome (HUS), a complication of STEC infection characterized by renal failure, thrombocytopenia, and microangiopathic anemia, is conducted by reviewing hospital discharge data and by working with a network of nephrologists and infection preventionists. This report includes HUS data for children for 2018, the most recent year for which data are available.

¶ Serogroup or serotype is only available for infections confirmed by culture.

** No international travel or not known if international travel occurred within 30 days before illness onset for *Listeria, Salmonella* serotypes Typhi and Paratyphi, 15 days for *Cyclospora*, and 7 days for all other pathogens.

Cases of Infection, Incidence, and Trends

During 2019, FoodNet identified 25,866 cases of infection, 6,164 hospitalizations, and 122 deaths (Table 1). The overall incidence per 100,000 population was highest for *Campylobacter* (19.5), followed by *Salmonella* (17.1), STEC (6.3), *Shigella* (4.8), *Cyclospora* (1.5), *Yersinia* (1.4), *Vibrio* (0.9), and *Listeria* (0.3). The respective incidences were slightly lower for domestically acquired infections (Table 2). Eighty-six percent of infections were acquired domestically, ranging from 77% for *Shigella* to 96% for *Listeria*.

Compared with 2016–2018, the incidence in 2019 increased significantly for *Cyclospora* (1,209%), *Yersinia* (153%), *Vibrio* (79%), STEC (34%), and *Campylobacter* (13%) (Table 1). The number of bacterial infections diagnosed using a CIDT increased 32%, ranging from 18% for STEC to 253% for *Listeria*. The percentage of infections diagnosed only by CIDT, including specimens that were culture-negative and those not tested by culture, was highest for *Yersinia* (57%), followed by STEC (45%), *Campylobacter* (42%), *Vibrio* (41%), *Shigella* (40%), *Salmonella* (13%), and *Listeria* (1%).

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TABLE 1. Number of laboratory-diagnosed bacterial and parasitic infections, hospitalizations, and deaths, incidence and percentage change compared with 2016–2018 average annual incidence rate, by pathogen —10 U.S. sites, Foodborne Diseases Active Surveillance Network,* 2016–2019†

Pathogen	2019				% Change in incidence from 2016–2018 to 2019 (95% CI)¶
	No. of infections	No. of hospitalizations (%)	No. of deaths (%)	Incidence§	
Bacteria					
Campylobacter	9,731	1,988 (20)	26 (0.3)	19.5	13 (5 to 21)
Salmonella	8,556	2,430 (28)	46 (0.5)	17.1	5 (-1 to 12)
STEC	3,127	660 (21)	10 (0.3)	6.3	34 (14 to 58)
Shigella	2,416	644 (27)	3 (0.1)	4.8	7 (-17 to 37)
Yersinia	681	142 (21)	4 (0.6)	1.4	153 (102 to 217)
Vibrio	466	131 (28)	12 (2.6)	0.9	79 (47 to 117)
Listeria	134	131 (98)	21 (16)	0.3	1 (-19 to 27)
Parasite					
Cyclospora	755	38 (5)	0 (0)	1.5	1,209 (708 to 2,020)
Total	**25,866**	**6,164 (24)**	**122 (0.5)**	**N/A**	**N/A**

Abbreviations: CI = confidence interval; N/A = not applicable; STEC = Shiga toxin-producing *Escherichia coli*.
* Data collected from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.
† Data are preliminary.
§ Cases per 100,000 population.
¶ Percentage change reported as increase or decrease. CIs not including zero are statistically significant.

Overall, culture was attempted on 75% of positive bacterial CIDT results, ranging from 63% for *Campylobacter* to 100% for *Listeria* (Figure).

Among 6,656 (90%) fully serotyped *Salmonella* isolates, the six most common serotypes were Enteritidis (2.6 per 100,000 population); Newport (1.4); Typhimurium (1.3); Javiana (1.1); I 4,[5],12:i:- (0.7); and Infantis (0.5). Compared with 2016–2018, incidence was significantly lower for Typhimurium (13% decrease; 95% CI = 1–24) and I 4,[5],12:i:- (28% decrease; 95% CI = 8–44); Infantis was significantly higher (69% increase; 95% CI = 31–118).

Among 1,725 STEC isolates, most (397; 23%) were O157, followed by O103 (305; 18%), O26 (254; 15%), and O111 (175; 10%). The incidence of STEC O157 infections (0.8 per 100,000) decreased by 20% (95% CI = 3–34), compared with that during 2016–2018; the incidence of non-O157 STEC infections (2.7) increased by 35% (95% CI = 18–56).

FoodNet identified 62 cases of post-diarrheal HUS in children (0.6 cases per 100,000) during 2018; 31 (50%) cases occurred in children aged <5 years (1.1 cases per 100,000). These rates were not significantly different from those during 2015–2017.

Discussion

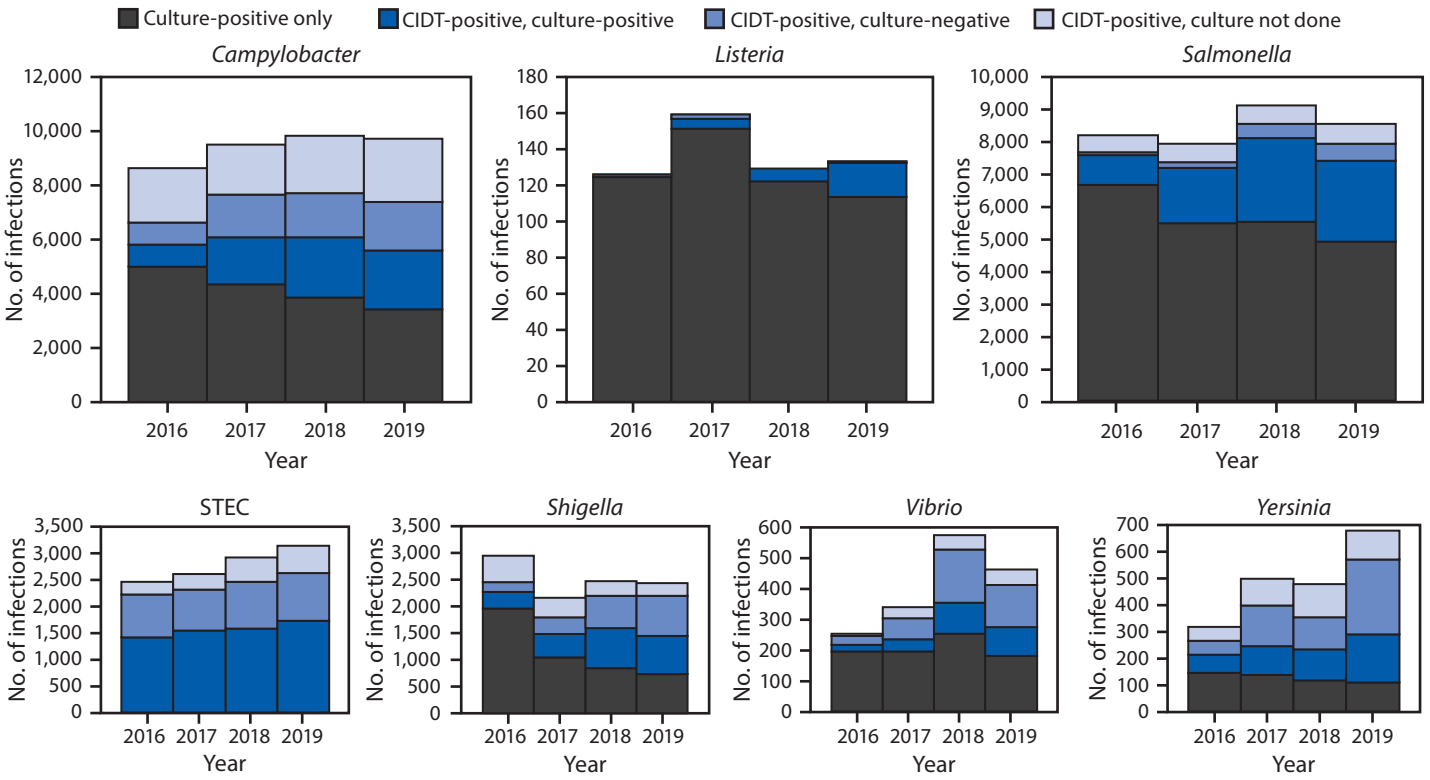
In 2019, compared with the previous 3 years, the incidence of infections caused by pathogens transmitted commonly through food increased (for *Campylobacter*, *Cyclospora*, STEC, *Vibrio*, *Yersinia*) or remained unchanged (for *Listeria, Salmonella,*

TABLE 2. Number, percentage of all cases, and incidence of domestically acquired* laboratory-diagnosed bacterial and parasitic infections in 2019, by pathogen — 10 U.S. sites, Foodborne Diseases Active Surveillance Network,† 2019§

Pathogen	Domestically acquired cases	
	No. (% of all cases)¶	Incidence**
Bacteria		
Campylobacter	8,264 (85)	16.5
Salmonella	7,677 (90)	15.4
STEC	2,514 (80)	5.0
Shigella	1,860 (77)	3.7
Yersinia	646 (95)	1.3
Vibrio	420 (90)	0.8
Listeria	129 (96)	0.3
Parasite		
Cyclospora	646 (86)	1.3
Total	**22,156 (86)**	**N/A**

Abbreviations: N/A = not applicable; STEC = Shiga toxin-producing *Escherichia coli*.
* Includes patients who did not have international travel in the 30 days before illness onset for *Listeria* and *Salmonella* serotypes Typhi and Paratyphi; 15 days for *Cyclospora*; and 7 days for all other pathogens and patients for whom information on international travel was not available. Information on international travel was available for 79%–89% of patients with *Campylobacter, Listeria, Salmonella, Shigella, Vibrio,* and *Yersinia* infections, and for 90% or more of patients with *Cyclospora* and STEC infection.
† Data collected from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.
§ Data are preliminary.
¶ Denominator is all cases, including those for which information on international travel was not available. Among patients with travel information available, the percentages of domestically acquired cases were as follows: *Campylobacter* (81%), *Cyclospora* (84%), *Listeria* (95%), *Salmonella* (87%), *Shigella* (72%), STEC (78%), *Vibrio* (89%), and *Yersinia* (94%).
** Cases per 100,000 population.

FIGURE. Number of infections diagnosed by culture or culture-independent diagnostic tests (CIDTs), by pathogen, year, and culture status — 10 U.S. sites, Foodborne Diseases Active Surveillance Network,* 2016–2019†



Abbreviation: STEC = Shiga toxin-producing *Escherichia coli*.

* Data collected from laboratories in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

† Data for 2019 are preliminary.

Shigella). These data indicate that *Healthy People 2020* targets for reducing foodborne illness will not be met. The identification of infections that might not have been detected before adoption of CIDTs cannot explain this overall lack of progress. Better implementation of known prevention approaches and new strategies is needed to overcome the continued challenges to reducing foodborne illnesses.

Serotype Enteritidis has been the most common cause of *Salmonella* infections at FoodNet sites since 2007 and incidence has not decreased. Eggs were the major source of Enteritidis infections in the 1980s (*1*). Chicken was recognized as another important source during the late 1990s (*2*,*3*). Infantis moved from the ninth most common *Salmonella* serotype among infected persons during 1996–1998 to the sixth most common in 2019. Many infections are now caused by a new, highly resistant strain found in chicken (*4*,*5*). The incidence of some serotypes has declined. Typhimurium moved from the most common serotype during 1996–1998 to the third most common in 2019. Heidelberg, the third most common serotype during 1996–1998, is no longer among the top 20. These decreases might be partly related to the widespread practice of vaccinating chickens against Typhimurium, which shares antigens with Heidelberg (*6*). This observation, combined with a marked decline in Enteritidis infections in the United Kingdom after implementation of widespread chicken vaccination and improved farm hygiene (*7*), suggests that targeting other serotypes through poultry vaccination could be one way to reduce human illnesses in the United States.

Laboratory-diagnosed non-O157 STEC infections continue to increase. Although STEC O157 infections appear to be decreasing, outbreaks linked to leafy greens continue (*8*). Produce is also an important source for *Cyclospora*, *Listeria,* and *Salmonella* (*9*,*10*). Although adoption of syndromic panels†† could be contributing to the large increase in *Cyclospora*, increased exposure to this pathogen cannot be excluded. Continued implementation of FDA's Produce Safety Rule§§ (e.g., expanded surveillance inspections of foreign

†† Syndromic panels are commercial CIDTs that simultaneously detect multiple pathogens associated with clinical syndromes, such as diarrheal illness.

§§ https://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm.

Summary

What is already known about this topic?

The incidence of most infections transmitted commonly through food has not declined for many years.

What is added by this report?

Incidence of infections caused by *Listeria*, *Salmonella*, and *Shigella* remained unchanged, and those caused by all other pathogens reported to FoodNet increased during 2019. Infections caused by *Salmonella* serotype Enteritidis, did not decline; however, serotype Typhimurium infections continued to decline.

What are the implications for public health practice?

New strategies that target particular serotypes and more widespread implementation of known prevention measures are needed to reduce *Salmonella* illnesses. Reductions in *Salmonella* serotype Typhimurium suggest that targeted interventions (e.g., vaccinating chickens and other food animals) might decrease human infections. Isolates are needed to subtype bacteria so that sources of illnesses can be determined.

and domestically grown produce) is needed, as are innovative approaches for preventing contamination.

Advances in laboratory science continue to revolutionize enteric disease clinical diagnostics and surveillance. Many laboratories now use CIDTs to detect infections that would have previously been undiagnosed. In 2019, public health laboratories fully transitioned the standard subtyping method for clinical bacterial isolates from pulsed-field gel electrophoresis to WGS. WGS provides detailed information to more effectively recognize outbreaks, determine resistance patterns, and investigate reoccurring, emerging, and persisting strains. However, because CIDTs do not yield isolates needed to perform WGS, the full potential of these new technologies can only be realized when laboratories are fully able to culture CIDT-positive specimens.

The findings in this report are subject to at least three limitations. First, part of the observed increase in incidence is likely due to increased use of CIDTs that identify previously unrecognized infections. Changes in clinicians' ordering practices and varying test sensitivities and specificities might also contribute to this observation. Second, changes in health care–seeking behavior, access to health services, or other population characteristics might have changed. Finally, year-to-year changes in incidence might not reflect sustained trends.

The landscape of foodborne disease continues to change, as do the methods to determine the incidence and sources of these infections. FoodNet surveillance data indicate that progress in controlling major foodborne pathogens in the United States has stalled. To better protect the public and achieve forthcoming Healthy People 2030 foodborne disease reduction goals, more widespread implementation of known prevention measures and new strategies that target particular pathogens and serotypes are needed.

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Progress Toward Maternal and Neonatal Tetanus Elimination — Worldwide, 2000–2018

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Maternal and neonatal tetanus* (MNT) remains a major public health problem, with an 80%–100% case-fatality rate among neonates, especially in areas with poor immunization coverage and limited access to clean deliveries (i.e., delivery in a health facility or assisted by medically trained attendants in sanitary conditions) and umbilical cord care (*1*). In 1989, the World Health Assembly endorsed the elimination† of neonatal tetanus (NT), and in 1999, the initiative was relaunched and renamed the MNT elimination§ initiative, targeting 59¶ priority countries (*1*). Elimination strategies include 1) achieving ≥80% coverage with ≥2 doses of tetanus toxoid-containing vaccine (TTCV) among women of reproductive age through routine immunization of pregnant women and supplementary immunization activities (SIAs)** in high-risk areas and districts††; 2) achieving care at ≥70% of deliveries by a skilled birth attendant (SBA)§§; and 3) enhancing surveillance for NT cases (*1*). This report summarizes progress toward achieving MNT elimination during 2000–2018. Coverage with ≥2 doses of TTCV (2 doses of tetanus toxoid [TT2+] or 2 doses of tetanus-diphtheria toxoid [Td2+]) among women of reproductive age increased by 16%, from 62% in 2000 to 72% in 2018. By December 2018, 52 (88%) of 59 priority countries had conducted TTCV SIAs, vaccinating 154 million (77%) of 201 million targeted women of reproductive age with TT2+/Td2+. Globally, the percentage of deliveries assisted by SBAs increased from 62% during 2000–2005 to 81% during 2013–2018, and estimated neonatal tetanus deaths decreased by 85%, from 170,829 in 2000 to 25,000 in 2018. By December 2018, 45 (76%) of 59 priority countries were validated by WHO as having achieved MNT elimination. To achieve elimination in the remaining 14 countries and sustain elimination in countries that have achieved it, implementation of MNT elimination strategies needs to be maintained and strengthened, and TTCV booster doses need to be included in country immunization schedules as recommended by the World Health Organization (WHO) (*2*). In addition, integration of maternal, newborn, and child health services with vaccination services is needed, as well as innovative approaches to target hard-to-reach areas for tetanus vaccination and community engagement to strengthen surveillance.

Immunization Activities

To estimate TT2+/Td2+ vaccination coverage delivered through routine immunization services and the number of neonates protected at birth (PAB)¶¶ from neonatal tetanus, WHO and the United Nations Children's Fund (UNICEF) use data from administrative records and vaccination coverage surveys reported annually by member countries (*3*). WHO and UNICEF also receive summaries of the number of women of reproductive age receiving TTCV during SIAs (*4*). During 2000–2018, coverage worldwide of women of reproductive age with TT2+/Td2+ increased by 16%, from 62% to 72% (*3*). In 2018, 17 (29%) of 59 priority countries achieved TT2+/Td2+ coverage ≥80%; in 39 of 48 (81%) priority countries where data were available,*** TT2+/Td2+ coverage increased compared with that in 2000. In 2018, the percentage of infants who were PAB was ≥80% in 46 (78%) of 59 priority countries (Table).

By the end of 2018, 52 (88%) of 59 priority countries had conducted TTCV SIAs, and 154 million (77%) of the

* Maternal tetanus is defined as tetanus occurring during pregnancy or within 6 weeks of the end of pregnancy (birth, miscarriage, or abortion). Maternal tetanus infection occurs during abortion, miscarriages, or unhygienic delivery. Neonatal tetanus occurs during the first 28 days of life; neonatal tetanus infection occurs following cutting the umbilical cord under nonsterile conditions or applying nonsterile traditional remedies to the umbilical stump in an infant without passively (transplacentally) acquired maternal antibodies.

† Neonatal tetanus (NT) elimination is defined as the occurrence of less than one NT case per 1,000 live births per year in every district in every country.

§ NT elimination is considered a proxy for maternal tetanus elimination, and both share the same strategies for elimination.

¶ Initially, the total number of priority countries was 57. The creation of Timor-Leste in 2002 and South Sudan in 2011 increased the number of priority countries to 59.

** SIAs are mass vaccination campaigns that aim to administer doses of tetanus-containing vaccines to women of childbearing age.

†† High-risk areas and districts are defined as those in which the estimated NT case rate exceeds 1 per 1,000 live births, clean delivery coverage is less than 70%, and coverage with at least 3 tetanus toxoid-containing vaccine (TTCV) doses among pregnant women or women of reproductive age is less than 80% during the past 5 years.

§§ A skilled birth attendant is defined as a midwife, trained nurse, doctor, or a health extension or community health worker.

¶¶ Protected at birth (PAB) is defined as the status of an infant born to a mother who received 2 doses of tetanus toxoid or tetanus-diphtheria toxoid (TT/Td) during the last birth; 2 or more TT/Td doses, with the last dose received ≤3 years before the last delivery; 3 or more doses with the last dose received ≤5 years earlier; 4 or more doses with the last dose received ≤10 years earlier; or receipt of 5 or more previous doses.

*** Angola, Burkina Faso, China, Egypt, Guinea Bissau, Haiti, Mauritania, Nigeria, Rwanda, Timor-Leste, South Africa, and South Sudan had missing TT2+/Td2+ coverage data for the year 2000 or 2018.

TABLE. Estimated coverage with ≥2 doses of tetanus toxoid-containing vaccine (TTCV) among women of reproductive age (WRA) administered through routine immunization services, estimated percentage of newborns protected at birth (PAB), number of WRA vaccinated with TTCV during supplementary immunization activities (SIAs), percentage of deliveries attended by a skilled birth attendant (SBA), and number of reported neonatal tetanus cases — 59 priority countries, 2000–2018

MNT elimination priority countries	WRA TT2+/Td2+ coverage (%)			Newborns PAB (%)			WRA vaccinated during TTCV SIAs*		SBA attendance at delivery (%)			No. of neonatal tetanus cases		
	Year		Change 2000–2018 (%)	Year		Change 2000–2018 (%)	No. of TT2+/Td2+ doses received	% vaccinated	Year†		Change 2000–2018 (%)	Year		Change 2000–2018 (%)
	2000	2018		2000	2018				2000	2018		2000	2018	
Validated for MNT elimination by end–2018														
Bangladesh	89	97	9	89	98	10	1,438,374	47	12	68	467	376	84	−78
Benin	81	69	−15	87	85	−2	1,399,461	97	66	78	18	52	13	−75
Burkina Faso	NA	92	NA	57	92	61	2,306,835	91	38	80	111	22	3	−86
Burma	81	89	10	79	90	14	8,170,763	87	57	60	5	41	22	−46
Burundi	28	90	221	51	90	76	679,222	55	25	85	240	16	0	−100
Cambodia	40	75	88	58	93	60	2,099,471	79	32	89	178	295	14	−95
Cameroon	40	66	65	54	85	57	2,687,461	85	56	65	16	279	27	−90
China	NA	NA	NA	NA	NA	NA	NA	NA	97	100	3	3230	83	−97
Comoros	40	78	95	57	85	49	160,767	55	62	NA	NA	NA	1	NA
Congo	39	83	113	67	85	27	273,003	91	83	91	10	2	0	−100
Côte d'Ivoire	78	85	9	76	85	12	5,924,527	85	63	74	17	30	17	−43
Egypt	71	NA	NA	80	86	7	2,518,802	87	61	92	51	321	2	−99
Equatorial Guinea	30	41	37	61	70	15	26,466	9	65	NA	NA	NA	6	NA
Eritrea	25	65	160	80	99	24	NA	NA	28	NA	NA	4	0	−100
Ethiopia	32	87	172	54	93	72	13,210,107	84	6	16	167	20	14	−30
Gabon	16	50	213	39	85	118	79,343	90	86	NA	NA	8	0	−100
Ghana	73	64	−12	69	89	29	1,666,666	87	47	78	66	80	9	−89
Guinea Bissau	NA	NA	NA	49	83	69	312,669	98	32	45	41	NA	0	NA
Haiti	NA	NA	NA	41	81	98	2,785,588	88	24	42	75	40	3	−93
India	80	81	1	85	90	6	7,643,440	94	43	81	88	3287	129	−96
Indonesia	81	47	−42	82	85	4	1,442,264	50	66	94	42	466	14	−97
Iraq	55	49	−11	75	75	0	111,721	96	65	96	48	37	3	−92
Kenya	51	61	20	68	88	29	4,463,695	67	42	62	48	1278	NA	NA
Laos	45	37	−18	58	90	55	968,323	90	17	64	276	21	16	−24
Liberia	25	74	196	51	89	75	288,984	57	51	61	20	152	14	−91
Madagascar	40	51	28	58	78	34	2,705,588	72	47	44	−6	13	30	131
Malawi	61	67	10	84	89	6	NA	NA	56	87	55	12	9	−25
Mauritania	NA	31	NA	44	80	82	586,277	76	53	69	30	NA	0	NA
Mozambique	61	85	39	75	86	15	605,640	79	48	73	52	42	160	281
Namibia	60	76	27	74	88	19	NA	NA	76	88	16	10	0	−100
Nepal	60	75	25	67	89	33	4,537,864	86	12	58	383	134	2	−99
Niger	31	94	203	63	81	29	2,184,277	92	16	40	150	55	9	−84
Philippines	58	48	−17	55	90	64	1,034,080	78	58	84	45	281	54	−81
Rwanda	NA	90	NA	81	95	17	NA	NA	31	91	194	5	2	−60
Senegal	45	65	44	62	95	53	359,845	92	58	68	17	0	6	NA
Sierra Leone	20	90	350	53	90	70	1,704,814	102	37	69	86	36	36	0
South Africa	65	NA	NA	68	90	32	NA	NA	91	97	7	11	0	−100
Tanzania	77	94	22	79	90	14	987,575	71	43	64	49	48	0	−100
Timor-Leste	NA	68	NA	NA	83	NA	24,141	53	18	57	217	NA	1	NA
Togo	47	76	62	63	83	32	262,130	87	35	45	29	33	14	−58
Turkey	36	55	53	50	95	90	1,242,674	58	83	98	18	26	0	−100
Uganda	42	66	57	70	85	21	2,448,527	86	39	74	90	470	78	−83
Vietnam	90	88	−2	86	94	9	367,842	69	59	94	59	142	37	−74
Zambia	61	76	25	78	85	9	330,030	81	42	63	50	130	71	−45
Zimbabwe	60	75	25	76	87	14	NA	NA	NA	78	NA	16	0	−100

See table footnotes on the next page.

targeted 201 million women of reproductive age received at least 2 doses of TTCV (*4*). In 2018, 49 million women remain unreached by TTCV SIAs (Figure 1). Among the 52 countries that conducted TTCV SIAs, 29 (56%) vaccinated ≥80% of the targeted women with ≥2 doses of TTCV (Table). Among the 45 countries that achieved MNT elimination by the end of 2018, 38 (84%) had conducted TTCV SIAs. Among the seven countries that achieved elimination by the end of 2018 but did not conduct SIAs, six (China, Eritrea, Namibia, Rwanda, South Africa, and Zimbabwe) achieved MNT elimination through strengthening of routine immunization and reproductive health services; one country (Malawi) achieved elimination

TABLE. (*Continued*) Estimated coverage with ≥2 doses of tetanus toxoid-containing vaccine (TTCV) among women of reproductive age (WRA) administered through routine immunization services, estimated percentage of newborns protected at birth (PAB), number of WRA vaccinated with TTCV during supplementary immunization activities (SIAs), percentage of deliveries attended by a skilled birth attendant (SBA), and number of reported neonatal tetanus cases — 59 priority countries, 2000–2018

MNT elimination priority countries	WRA TT2+/Td2+ coverage (%)			Newborns PAB (%)			WRA vaccinated during TTCV SIAs*		SBA attendance at delivery (%)			No. of neonatal tetanus cases		
	Year		Change 2000–2018 (%)	Year		Change 2000–2018 (%)	No. of TT2+/Td2+ doses received	% vaccinated	Year†		Change 2000–2018 (%)	Year		Change 2000–2018 (%)
	2000	2018		2000	2018				2000	2018		2000	2018	
Not validated for MNT elimination by the end of 2018														
Afghanistan	20	85	325	32	68	113	5,211,872	46	14	59	321	139	53	−62
Angola	NA	66	NA	60	78	30	7,097,552	84	NA	47	NA	131	86	−34
Central African Republic	20	89	345	36	60	67	804,984	78	32	NA	NA	37	39	5
Chad§	12	69	475	39	78	100	3,222,840	84	14	20	43	142	189	33
Democratic Republic of the Congo§	25	96	284	45	85	89	10,342,937	92	61	80	31	77	47	−39
Guinea	43	70	63	79	80	1	3,545,105	91	49	55	12	245	107	−56
Mali	62	60	−3	50	85	70	4,086,957	49	41	67	63	73	10	−86
Nigeria	NA	62	NA	57	60	5	4,986,353	84	34	43	26	1643	130	−92
Pakistan	51	60	18	71	85	20	21,143,148	87	23	69	200	1380	0	−100
Papua New Guinea	10	30	200	24	70	192	450,739	15	39	NA	NA	138	0	−100
Somalia	22	59	168	47	67	43	497,561	27	25	NA	NA	NA	NA	NA
South Sudan	NA	44	NA	NA	NA	NA	5,223,306	65	NA	NA	NA	NA	NA	NA
Sudan	34	51	50	NA	80	NA	4,780,345	89	NA	78	NA	88	NA	NA
Yemen	31	22	−29	54	70	30	3,043,456	52	27	45	67	174	116	−33
All 59 priority countries	—	—	—	—	—	—	**154,476,411**	—	—	—	—	**16,754**	**1,760**	—

Abbreviations: MNT = maternal and neonatal tetanus; NA = not available; Td2+ = 2 or more doses of tetanus and diphtheria toxoid-containing vaccine; TT2+ = 2 or more doses of TTCV.
* Includes first-year SIA conducted in Bangladesh in 1999 and first- and second-year SIAs conducted in Ethiopia in 1999.
† Includes SBA attendance surveys conducted within 5 years for year 2000 and year 2018.
§ Validated for MNT elimination in 2019.

because women of reproductive age are targeted for vaccination during pregnancy, and 5 TTCV doses are provided in the routine vaccination schedule for children and adolescents.[†††]

Surveillance Activities

Reported NT cases and incidence. WHO recommends nationwide case-based surveillance for NT, including zero-case reporting (submission of reports even if no NT cases are seen), active surveillance through regular site visits, and retrospective record review at major health facilities at least once a year (*2*). During 2000–2018, the number of reported NT cases worldwide (i.e., including nonpriority countries) decreased by 90% from 17,935 to 1,803 (*3*). In 2018, 13 (22%) of 59 priority countries reported zero NT cases (Table). The number of NT cases reported annually is likely to represent <11% of the actual number of NT cases occurring worldwide annually, because NT tends to occur in remote areas and cases might not be seen by health care workers (*5*).

NT mortality estimates. Because most NT deaths occur in the community and are not reported to WHO, NT deaths are usually estimated using mathematical models (*6*). During 2000–2018, the estimated number of NT deaths decreased by 85% from 170,829 to 25,000 (Figure 2). In 2018, neonatal tetanus accounted for 1% of major causes of neonatal deaths, a significant decrease compared with a 7% contribution to all-cause neonatal mortality in 2000.[§§§]

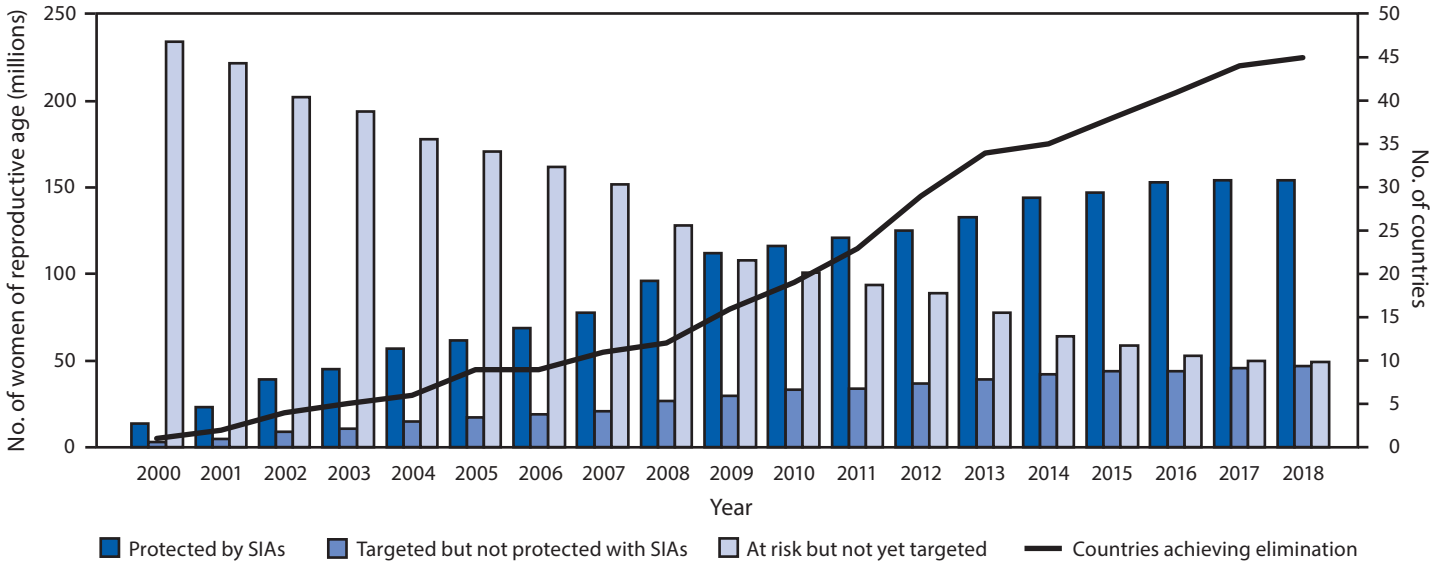
Deliveries Assisted by Skilled Birth Attendants

WHO and UNICEF estimate the percentage of births attended by an SBA from health facility reports and coverage survey estimates shared by countries (*7*). During 2000–2018, the percentage of deliveries attended by an SBA increased by 31% from 62% during 2000–2005 to 81% during 2013–2018 (*7*). In 2018, among 51 priority countries with available data, ≥70% of deliveries were attended by an SBA in 24 (47%) countries (Table).

[†††] https://cdn1.sph.harvard.edu/wp-content/uploads/sites/2413/2015/12/Nina-Schwalbe-1.pdf; https://apps.who.int/iris/bitstream/handle/10665/232360/WER7901_02_2-6.PDF?sequence=1&isAllowed=y.

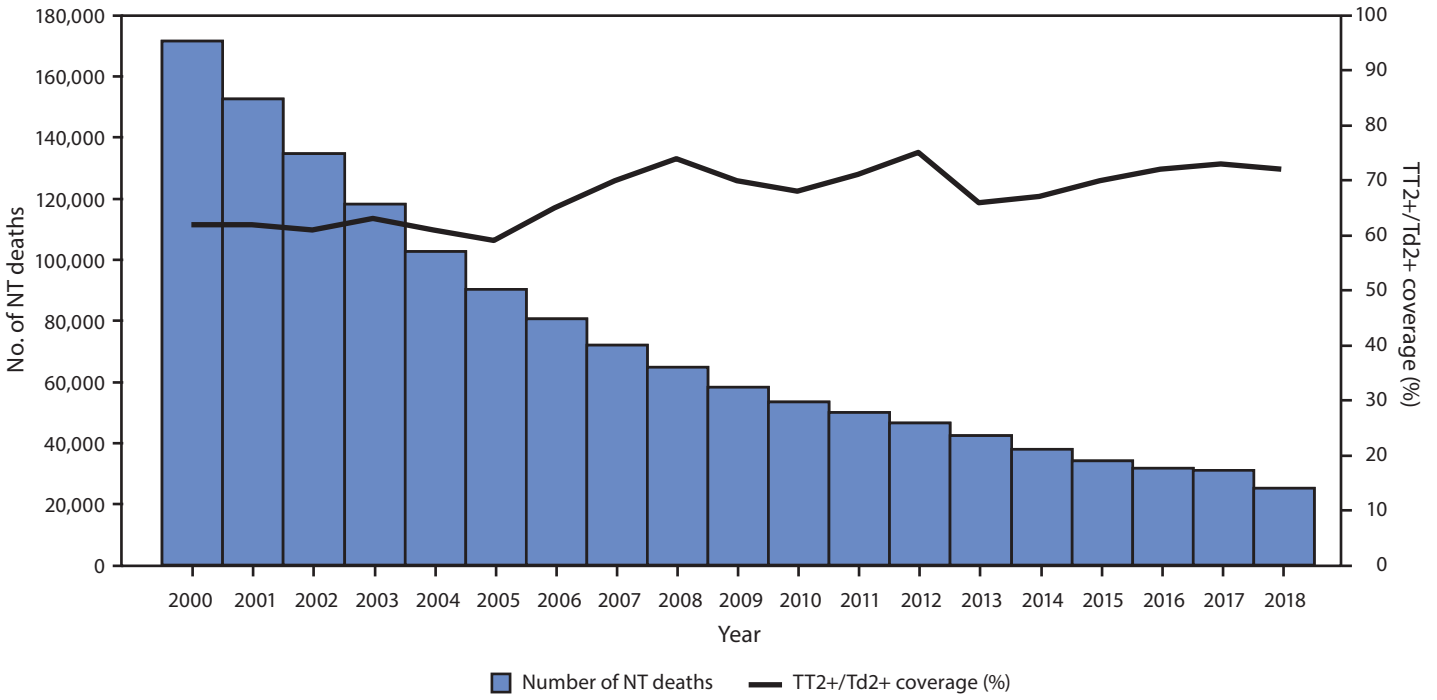
[§§§] https://www.unicef.org/media/60561/file/UN-IGME-child-mortality-report-2019.pdf.

FIGURE 1. Number of women of reproductive age protected by TTCV* received during SIAs, number targeted but not yet vaccinated, number not yet targeted, and number of priority countries achieving maternal and neonatal tetanus elimination — worldwide, 2000–2018



Abbreviations: SIAs = supplementary immunization activities; TTCV = tetanus toxoid–containing vaccine.
* 2 doses of tetanus toxoid (TT) or 2 doses of tetanus and diphtheria toxoids (Td).

FIGURE 2. Estimated number of neonatal tetanus (NT) deaths and estimated coverage with ≥2 doses of tetanus toxoid (TT) or tetanus and diphtheria toxoids (Td)–containing vaccine (TT2+/Td2+) among women of reproductive age — worldwide, 2000–2018



Validation of Maternal and Neonatal Tetanus Elimination

WHO recommends the validation of MNT elimination when countries complete the implementation of planned elimination activities (*8*). The validation process involves a review of district-level core indicators, including reported NT cases per 1,000 live births, percentage of deliveries by SBA, TT2+/Td2+ coverage, and supplementary indicators,

including TTCV SIA coverage, antenatal care coverage,¶¶¶ infant coverage with 3 doses of diphtheria-tetanus-pertussis vaccine, socioeconomic indices, urban versus rural status, field visits to assess the performance of the health system, validation surveys of districts with the most poorly performing MNT elimination indicators, and assessment of long-term plans for sustaining elimination (*9*). During 2000–2018, 45 (76%) of 59 priority countries were validated to have achieved MNT elimination, and 14**** remain to be validated (Table) (Figure 1). In addition, by 2018, three countries were validated to have achieved elimination in some regions: Pakistan (Punjab province), Mali (Southern regions), and Nigeria (South East zone).

Summary

What is already known about this topic?

In 1999, the maternal and neonatal tetanus (MNT) elimination initiative was relaunched to focus on 59 priority countries that were still at risk for neonatal tetanus (NT).

What is added by this report?

During 2000–2018, 45 countries achieved MNT elimination, reported NT cases decreased 90%, and estimated deaths declined 85%. Despite this progress, some countries that achieved elimination are still struggling to sustain performance indicators; war and insecurity pose challenges in countries that have not achieved MNT elimination.

What are the implications for public health practice?

To maintain MNT elimination and to achieve it in remaining priority countries, sustained efforts are needed to enhance routine vaccination, embrace life-course vaccination, and develop innovative strategies for reaching underserved populations.

Discussion

There has been significant progress globally to eliminate MNT, and approximately 75% of the 59 priority countries were validated to have achieved MNT elimination by the end of 2018. The intensive targeting of "high-risk areas and districts" reached an estimated 154 million women of reproductive age with at least 2 doses of TTCV through SIAs, resulting in an 85% decline in the number of NT deaths annually during 2000–2018. Critical factors contributing to success include improvement in women's access to education, country commitment to the implementation of recommended elimination strategies, timely availability of resources, good planning for SIAs, community engagement in elimination activities, strong monitoring and supervision of MNT elimination activities, and integrated delivery of antenatal care and tetanus vaccination services. Once countries are validated to have achieved MNT elimination, efforts to sustain elimination and broader tetanus control should continue, because tetanus cannot be eradicated from the environment.

MNT elimination validation assessments conducted in Cameroon and Timor-Leste, as well as Algeria and Djibouti (both validated before the 1999 relaunch of the initiative), showed that elimination was sustained; however, access to SBAs needed to be improved in Cameroon and Timor-Leste. Critical strategies for sustaining MNT elimination include strengthening routine immunization services for children and adolescents to receive a 3-dose primary TTCV series, and 3 TTCV booster doses at ages 12–23 months, 4–7 years, and 9–15 years to ensure long-term protection; antenatal screening of pregnant women for tetanus vaccination to ensure protection of neonates at birth; increased access to SBAs and clean delivery and cord care practices; strong tetanus surveillance; and periodic review of data to identify districts that are at risk for reemergence of MNT (*2*).

The findings in this report are subject to at least two limitations. First, TT2+/Td2+ coverage can underestimate true protection from tetanus, especially in countries with well-established vaccination programs, because it excludes women who were unvaccinated during pregnancy but were already protected through previous vaccination or had undocumented previous doses (*10*). Therefore, the percentage of PAB needs to be assessed, especially in countries that have achieved MNT elimination. Second, the number of neonatal tetanus cases and deaths are an underestimate of the actual number of NT cases because the majority of deaths occur in communities in areas underserved by the health care system (*5*).

Despite the progress made, the MNT elimination initiative still faces numerous challenges. Approximately 47 million women and their babies remain unprotected against tetanus, and 49 million women remain unreached by TTCV SIAs. Low TT2+/Td2+ coverage in these countries can be attributed to weak health systems, including conflict and security issues that limit access to vaccination services, competing priorities that limit the implementation of planned MNT elimination activities, and withdrawal of donor funding. Promoting institutional deliveries and ensuring the availability of clean delivery kits†††† for every home delivery would help MNT elimination and efforts to achieve the United Nations' Sustainable Development Goal 3 to reduce maternal and neonatal mortality (https://www.un.org/sustainabledevelopment/health/). Innovative approaches to reach remote and unsafe areas could include

¶¶¶ Antenatal care coverage is the percentage of women aged 15–49 years with a live birth who had received antenatal care provided by skilled health personnel (doctor, nurse, or midwife) at least once during the pregnancy.

**** Chad and the Democratic Republic of the Congo were validated in 2019, leaving 12 countries not validated by December 2019.

†††† https://www.unfpa.org/sites/default/files/resource-pdf/RH%20kits%20manual_EN_0.pdf.

the use of compact, prefilled autodisable devices; integration of reproductive, maternal, newborn, and child health services with vaccination services to optimize maternal immunization; and integration of TTCV SIAs with other SIAs, such as serogroup A meningococcal vaccine (MenA), measles-rubella, yellow fever, and polio campaigns. Efforts to strengthen NT surveillance through community engagement could serve as a platform for creating community-based surveillance systems for other diseases, and case-based surveillance for NT could be integrated with polio and measles case-based surveillance.[§§§§]

[§§§§] https://www.who.int/immunization/monitoring_surveillance/burden/vpd/WHO_SurveillanceVaccinePreventable_14_NeonatalTetanus_R1.pdf.

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Assessment of SARS-CoV-2 Infection Prevalence in Homeless Shelters — Four U.S. Cities, March 27–April 15, 2020

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In the United States, approximately 1.4 million persons access emergency shelter or transitional housing each year (*1*). These settings can pose risks for communicable disease spread. In late March and early April 2020, public health teams responded to clusters (two or more cases in the preceding 2 weeks) of coronavirus disease 2019 (COVID-19) in residents and staff members from five homeless shelters in Boston, Massachusetts (one shelter); San Francisco, California (one); and Seattle, Washington (three). The investigations were performed in coordination with academic partners, health care providers, and homeless service providers. Investigations included reverse transcription–polymerase chain reaction testing at commercial and public health laboratories for SARS-CoV-2, the virus that causes COVID-19, over approximately 1–2 weeks for residents and staff members at the five shelters. During the same period, the team in Seattle, Washington, also tested residents and staff members at 12 shelters where a single case in each had been identified. In Atlanta, Georgia, a team proactively tested residents and staff members at two shelters with no known COVID-19 cases in the preceding 2 weeks. In each city, the objective was to test all shelter residents and staff members at each assessed facility, irrespective of symptoms. Persons who tested positive were transported to hospitals or predesignated community isolation areas.

Overall, 1,192 residents and 313 staff members were tested in 19 homeless shelters (Table). When testing followed identification of a cluster, high proportions of residents and staff members had positive test results for SARS-CoV-2 in Seattle (17% of residents; 17% of staff members), Boston (36%; 30%), and San Francisco (66%; 16%). Testing in Seattle shelters where only one previous case had been identified in each shelter found a low prevalence of infection (5% of residents; 1% of staff members). Among shelters in Atlanta where no cases had been reported, a low prevalence of infection was also identified (4% of residents; 2% of staff members). Community incidence in the four cities (the average number of reported cases in the county per 100,000 persons per day during the testing period) varied, with the highest (14.4) in Boston and the lowest (5.7) in San Francisco (*2*).

The findings in this report are subject to at least three limitations. First, testing represented a single time point. Second, although testing all residents and staff members at each shelter was the objective, some were not available or declined (e.g., in San Francisco 143 of an estimated 255 residents at risk were tested). Finally, symptom information for persons tested was not consistently available and thus not included, although symptom information from Boston is available elsewhere.*

Homelessness poses multiple challenges that can exacerbate and amplify the spread of COVID-19. Homeless shelters are often crowded, making social distancing difficult. Many persons experiencing homelessness are older or have underlying medical conditions (*1*,*3*), placing them at higher risk for severe COVID-19–associated illness (*4*).

To protect homeless shelter residents and staff members, CDC recommends that homeless service providers implement recommended infection control practices, apply social distancing measures including ensuring residents' heads are at least 6 feet (2 meters) apart while sleeping, and promote use of cloth face coverings among all residents.† These measures become especially important once ongoing COVID-19 transmission is identified within communities where shelters are located. Given the high proportion of positive tests in the shelters with identified clusters and evidence for presymptomatic and asymptomatic transmission of SARS-CoV-2 (*5*), testing of all residents and staff members regardless of symptoms at shelters where clusters have been detected should be considered. If testing is easily accessible, regular testing in shelters before identifying clusters should also be considered. Testing all persons can facilitate isolation of those who are infected to minimize ongoing transmission in these settings.

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* https://www.medrxiv.org/content/10.1101/2020.04.12.20059618v1.
† https://www.cdc.gov/coronavirus/2019-ncov/community/homeless-shelters/plan-prepare-respond.html.

TABLE. SARS-CoV-2 testing among residents and staff members at 19 homeless shelters in four U.S. cities with community transmission of COVID-19, March 27–April 15, 2020

City	No. of shelters assessed	Date of testing	Residents		Staff members	
			No. tested	No. (%) positive	No. tested	No. (%) positive
Shelters reporting ≥2 cases in 2 weeks preceding testing						
Seattle	3	Mar 30–Apr 8	179	31 (17)	35	6 (17)
Boston	1	Apr 2–3	408	147 (36)	50	15 (30)
San Francisco	1	Apr 4–15	143	95 (66)	63	10 (16)
Subtotal	5	March 30–Apr 15	730	273 (37)	148	31 (21)
Shelters reporting 1 case in 2 weeks preceding testing						
Seattle	12	Mar 27–Apr 15	213	10 (5)	106	1 (1)
Shelters reporting no cases in 2 weeks preceding testing						
Atlanta	2	Apr 8–9	249	10 (4)	59	1 (2)
Total	**19**	**Mar 27–Apr 15**	**1,192**	**293 (25)**	**313**	**33 (11)**

Abbreviation: COVID-19 = coronavirus disease 2019.

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COVID-19 Outbreak Among Three Affiliated Homeless Service Sites — King County, Washington, 2020

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On April 22, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

On March 30, 2020, Public Health – Seattle and King County (PHSKC) was notified of a confirmed case of coronavirus disease 2019 (COVID-19) in a resident of a homeless shelter and day center (shelter A). Residents from two other homeless shelters (B and C) used shelter A's day center services. Testing for SARS-CoV-2, the virus that causes COVID-19, was offered to available residents and staff members at the three shelters during March 30–April 1, 2020. Among the 181 persons tested, 19 (10.5%) had positive test results (15 residents and four staff members). On April 1, PHSKC and CDC collaborated to conduct site assessments and symptom screening, isolate ill residents and staff members, reinforce infection prevention and control practices, provide face masks, and advise on sheltering-in-place. Repeat testing was offered April 7–8 to all residents and staff members who were not tested initially or who had negative test results. Among the 118 persons tested in the second round of testing, 18 (15.3%) had positive test results (16 residents and two staff members). In addition to the 31 residents and six staff members identified through testing at the shelters, two additional cases in residents were identified during separate symptom screening events, and four were identified after two residents and two staff members independently sought health care. In total, COVID-19 was diagnosed in 35 of 195 (18%) residents and eight of 38 (21%) staff members who received testing at the shelter or were evaluated elsewhere. COVID-19 can spread quickly in homeless shelters; rapid interventions including testing and isolation to identify cases and minimize transmission are necessary. CDC recommends that homeless service providers implement appropriate infection control practices, apply physical distancing measures including ensuring resident's heads are at least 6 feet (2 meters) apart while sleeping, and promote use of cloth face coverings among all residents (*1*).

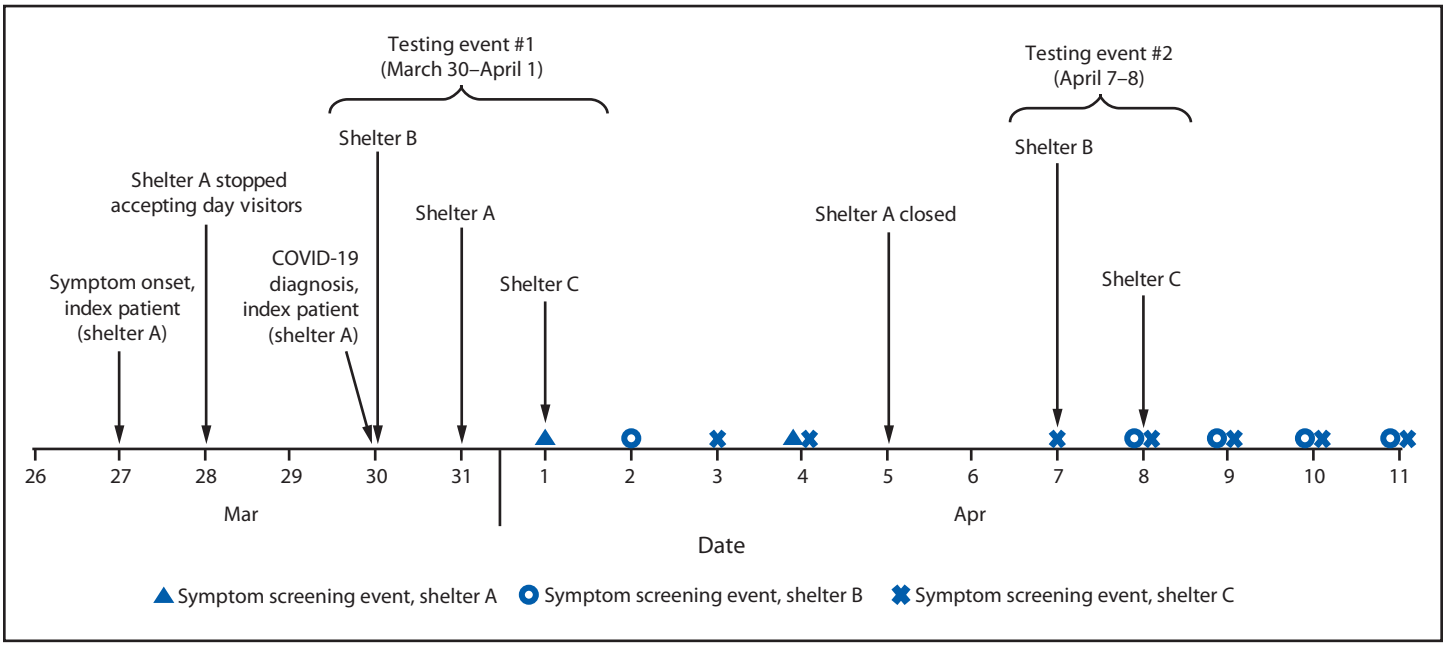
The first COVID-19 case in the United States was confirmed in Snohomish County, Washington, on January 20, 2020. The governor of Washington issued stay-at-home orders on March 23; by March 28, a total of 2,307 confirmed COVID-19 cases had been reported in nearby King County (*2*,*3*). On March 30, PHSKC was notified that a resident of homeless shelter A had positive test results for SARS-CoV-2 (Figure). The resident, a man aged 67 years with underlying medical conditions, was hospitalized on March 29 for acute encephalopathy. He reported 2 days of cough, shortness of breath, fever, sore throat, and runny nose. A nasopharyngeal swab collected on admission was positive for SARS-CoV-2 by real-time reverse transcription–polymerase chain reaction testing. The patient remained clinically stable without the need for intensive care unit support and was discharged after 5 days to isolation housing (i.e., an individual room with clinical support) provided by the King County Department of Community and Human Services.

During March 30–April 1, SARS-CoV-2 testing was offered to all available residents and staff members at shelter A, as well as those at shelters B and C, which used shelter A's day services (testing event 1). Overall, 62.8% of residents who spent the previous night at each shelter were tested. Residents and staff members were not screened for symptoms before testing. At shelter A, seven of 43 residents and four of 15 staff members had positive test results (Table 1). Two of 74 residents at shelter B and six of 37 residents at shelter C had positive test results. None of the staff members tested from shelters B and C had positive test results. Twelve residents with confirmed SARS-CoV-2 infection identified by testing event 1 were transported to isolation housing, and three were hospitalized; staff members with confirmed infection self-isolated at home.

A CDC team arrived April 1 to support PHSKC rapid response teams. The teams assessed 122 residents and staff members over 3 days to identify COVID-19–like illness (i.e., new or worsening cough, dyspnea, or subjective or measured fever [temperature ≥100.4°F (38°C)]), conducted site assessments at each shelter, and provided recommendations to limit transmission at the three shelters.

Shelter A is a 24-hour shelter that served up to 40 men and 10 women; sleeping mats (not assigned to individual residents) were arranged in two rooms during the night and stacked during the day. Shelter B housed up to 110 men in two main rooms; shelter C housed up to 100 men in two main rooms. To reduce crowding and COVID-19 transmission risk, approximately half of the residents of shelter B had been transferred to shelter C on March 13. Sleeping mats and

FIGURE. Testing events and changes in practices in response to a COVID-19 outbreak at three affiliated homeless shelters — King County, Washington, March 27–April 11, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

locations in shelters B and C were assigned to individual residents and remained in place all day. Shelters B and C became 24-hour shelters on March 13 and 26, respectively. All shelters had onsite indoor bathrooms with sinks and soap. All shelters served persons aged ≥50 years and were located approximately 2–5 miles (3–8 kilometers) from each other.

Site assessments identified multiple areas for improvement in sheltering-in-place and infection prevention and control practices. Staff members rotated among the three shelters. Residents were able to leave the shelters if they returned by curfew. Sleeping mats in each of the shelters were spaced ≤3 feet apart. Shelter C did not have alcohol-based hand sanitizer or on-site showers; residents used shelter shuttles or public transportation to access public showers. Staff members intermittently wore cloth face coverings or face masks; however, these were not provided to residents.

Following the assessment, recommendations to decrease the risk for COVID-19 transmission were implemented. On April 5, to address staffing shortages, PHSKC recommended closing shelter A and relocating women residents of shelter A to isolation housing with individual rooms and relocating men to shelter C, where PHSKC provided thermometers for temperature screening and arranged for portable showers to prevent the need for public shower facility use (Figure). For all shelters, the rapid response teams provided recommendations to limit staff member rotations, encourage physical distancing, limit movement in and out of the shelter, train staff members on cleaning and disinfection, and move sleeping mats so that residents' heads are ≥6 feet (≥2 meters) apart. Disposable face masks were provided to all residents and staff to aid in source control.

PHSKC coordinated active case finding and during April 7–8 conducted repeat SARS-CoV-2 testing (testing event 2) of all available residents and staff members who had negative test results or were unavailable for the first testing. This testing event identified additional confirmed COVID-19 cases among 16 of 103 (15.5%) residents and two of 15 (13.3%) staff members (Table 1). During April 1–11, PHSKC also conducted 14 symptom screening events among residents and staff members across all three shelters. Persons with COVID-19–like illness were connected to testing, which identified two additional cases among residents. Two staff members and two residents each sought health care independently and had positive test results for SARS-CoV-2.

By April 11, 2020, testing confirmed COVID-19 among 35 residents and eight staff members. Among these 43 confirmed cases, 37 (86%) were identified through testing offered to everyone at the shelter, two (5%) through symptom screening, and four (9%) after persons independently sought health care (Table 2). Among residents with confirmed COVID-19, the median age was 61 years (range = 50–73 years) and among staff members was 39 years (range = 28–57 years). Overall, 187 of 195 (96%) residents tested were men; among residents who had positive test results for COVID-19, 31 (89%) were

TABLE 1. Number of residents and staff members tested for SARS-CoV-2 and number and percentage who had positive test results at two testing events — three affiliated shelters, Seattle, Washington, March 30–April 8, 2020

	Testing event 1 (March 30–April 1, 2020)					Testing event 2 (April 7–8, 2020)*				
	Residents			Staff members		Residents			Staff members	
Shelter	No. eligible†	No. tested	No. (%) positive	No. tested§	No. (%) positive	No. eligible*	No. tested	No. (%) positive	No. tested	No. (%) positive
Shelter A	43	43	7 (16.3)	15	4 (26.7)	7¶	7	2 (28.6)	N/A**	N/A**
Shelter B	109	74	2 (2.7)	2	0 (—)	87	52	4 (7.7)	8	1 (12.5)
Shelter C	93	37	6 (16.2)	10	0 (—)	79	44	10 (22.7)	7	1 (14.3)
Total	**245**	**154**	**15 (9.7)**	**27**	**4 (14.8)**	**173**	**103**	**16 (15.5)**	**15**	**2 (13.3)**

Abbreviation: N/A = not applicable.
* Residents and staff members who had negative test results or were not available in testing event 1 were tested in event 2.
† Residents were eligible for testing if they spent the previous night at the shelter.
§ Total number of staff members working the day of testing was not available.
¶ Female residents from shelter A who were tested at isolation housing after shelter A closed on April 5, 2020.
** Shelter closed.

men. Seven residents (20%) were hospitalized; none has died to date. No staff members were hospitalized or died.

Discussion

This COVID-19 outbreak involved transmission among residents and staff members of three affiliated homeless shelters in Seattle, Washington. Conditions that might have contributed to SARS-CoV-2 transmission in these sites include 1) the mobile nature of the community and use of multiple homeless service sites among residents; 2) crowding and use of congregate sleeping arrangements; 3) challenges enforcing physical distancing; 4) possible asymptomatic transmission; and 5) unavailability of face coverings for residents before public health intervention.

PHSKC, the King County Department of Community and Human Services, and homeless service site leadership implemented rapid public health interventions to minimize transmission by proactively testing all residents and staff members and promptly transporting symptomatic and residents with confirmed disease to isolation housing. Additional measures included limiting movement into and out of the shelter (e.g., by providing on-site showers), encouraging physical distancing, and making infection prevention and control recommendations. Response coordination required resource investment and collaboration between local health and community service departments, staff members at homeless shelter sites, community health care providers, and federal partners.

The findings in this report are subject to at least four limitations. First, not all residents were present during the site visits; thus, residents with SARS-CoV-2 infection could have been missed during the testing events or symptom screening. Multiple testing and screening events were conducted to assess as many residents as possible. Second, these public health interventions were resource-intensive, which might not be sustainable long term. Third, symptom screening and testing were conducted independently of each other, which did not allow for simple linkage of symptom and test result information. Finally, the effectiveness of the interventions could not be assessed during the period of the investigation and response.

TABLE 2. Number and percentage of shelter residents and staff members with COVID-19 diagnosed by testing, symptom screening, or independent health care evaluation — Seattle, Washington, March 30–April 11, 2020

	No. (%) with COVID-19 diagnosis	
Method of diagnosis	Residents assessed (N = 195)	Staff members assessed (N = 38)
Testing event 1	15 (8)	4 (11)
Testing event 2	16 (8)	2 (5)
Symptom screening	2 (1)	—
Evaluated elsewhere	2 (1)	2 (5)
Total	**35 (18)**	**8 (21)**

Abbreviation: COVID-19 = coronavirus disease 2019.

Homeless service sites are densely populated environments, similar to long-term care facilities, which can amplify infectious disease outbreaks, including COVID-19 (*4*). Common methods to control COVID-19 spread (e.g., testing, contact tracing, physical distancing, and restricting movement) are difficult to implement among persons who are experiencing homelessness (*5*,*6*), and stay-at-home orders are impractical. CDC has published interim guidance for homeless service providers to plan and respond to COVID-19. CDC recommends that homeless service providers implement appropriate infection control practices, apply physical distancing measures including ensuring resident's heads are at least 6 feet apart while sleeping, and promote use of cloth face coverings among all residents (*1*). Assistance with enforcement of shelter-in-place orders might be necessary for persons experiencing homelessness during spread of COVID-19. At shelters experiencing COVID-19 outbreaks, transferring infected residents and those with underlying health conditions or of advanced age (*7*,*8*) into individual housing units should be prioritized.

Summary

What is already known about this topic?

COVID-19 can spread rapidly within and between congregate housing facilities, such as homeless shelters. COVID-19 in homeless shelters, however, has not been well described.

What is added by this report?

On April 1, 2020, a COVID-19 outbreak was detected at three affiliated homeless shelters. Testing for SARS-CoV-2 immediately offered to all residents and staff members identified additional unrecognized COVID-19 cases. Enhanced surveillance and repeat testing identified and confirmed COVID-19 in 43 persons at these sites.

What are the implications for public health practice?

Interrupting COVID-19 transmission in homeless shelters is challenging. In settings with known COVID-19 outbreaks, assistance with enforcement of shelter-in-place orders, testing of residents and staff members, and prompt isolation of symptomatic or residents with confirmed disease are needed to prevent further transmission in homeless shelters.

In this outbreak, testing events for everyone in the shelter identified a high proportion (86%) of COVID-19 cases and allowed for prompt transfer to isolation housing. Evidence exists for presymptomatic and asymptomatic transmission of SARS-CoV-2 (*9*); the testing of all available residents and staff members regardless of symptoms performed during this investigation potentially identified more infectious cases than symptomatic screening would have. Prompt implementation of public health interventions to identify COVID-19 cases early can mitigate further transmission in jurisdictions at high risk for community transmission.

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Notes from the Field

Cholera Outbreak — Zimbabwe, September 2018–March 2019

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During September 5–6, 2018, a total of 52 patients in Harare, Zimbabwe, were hospitalized with suspected cholera, an acute bacterial infection characterized by watery diarrhea. Rapid diagnostic testing was positive for *Vibrio cholerae* O1, and on September 6, Zimbabwe's Ministry of Health and Child Care (MOHCC) declared an outbreak of cholera. From September 4, 2018, (date of the first reported cases) through March 12, 2019, a total of 10,730 cases and 69 (0.64%) deaths were reported nationally from nine of Zimbabwe's 10 provinces (Figure). Most cases (94%) were reported from Harare Province, the country's largest province, with a population of approximately 2 million.

Cholera outbreak response efforts were led by MOHCC in partnership with the City of Harare, the World Health Organization (WHO),* and many local and international organizations. Zimbabwe's MOHCC activated its Inter-Agency Coordinating Committee on Health, which met regularly to coordinate response activities. Enhanced surveillance and reporting were encouraged nationally, and in Harare Province, supplementary surveillance trainings were provided by CDC to frontline medical staff members. In addition, approximately 200 health care workers received Integrated Disease Surveillance and Response training established by Zimbabwe, a comprehensive strategy for strengthening public health surveillance and response systems adopted by WHO African Region in 1998. This training-of-trainers effort was supported by MOHCC, WHO, and Africa Centres for Disease Control and Prevention. Cholera treatment centers were set up in affected areas in collaboration with Médecins Sans Frontières, and on-site case management trainings were conducted.

Laboratory testing at Zimbabwe's National Microbiology Reference Laboratory confirmed *V. cholerae* O1 serotype Ogawa as the causative agent. Multiple organizations worked with the laboratory to provide supplies and training to enhance national and regional laboratory capacity. Antimicrobial susceptibility testing was confirmed at the National Institute for Communicable Diseases in South Africa.

MOHCC's National Coordination Unit, with support from the United Nations Children's Fund (UNICEF), initiated community-wide water, sanitation, and hygiene (WASH) interventions, including distributions of household water treatment products and water quality monitoring, within 1 week of the outbreak declaration. In late October, following the decrease in cases, more targeted interventions were introduced, including the use of integrated City of Harare and nongovernmental environmental health response teams that conducted case investigations, provided health education, distributed soap and household water treatment products to the index and surrounding households, and implemented point-of-collection chlorination at priority water points.

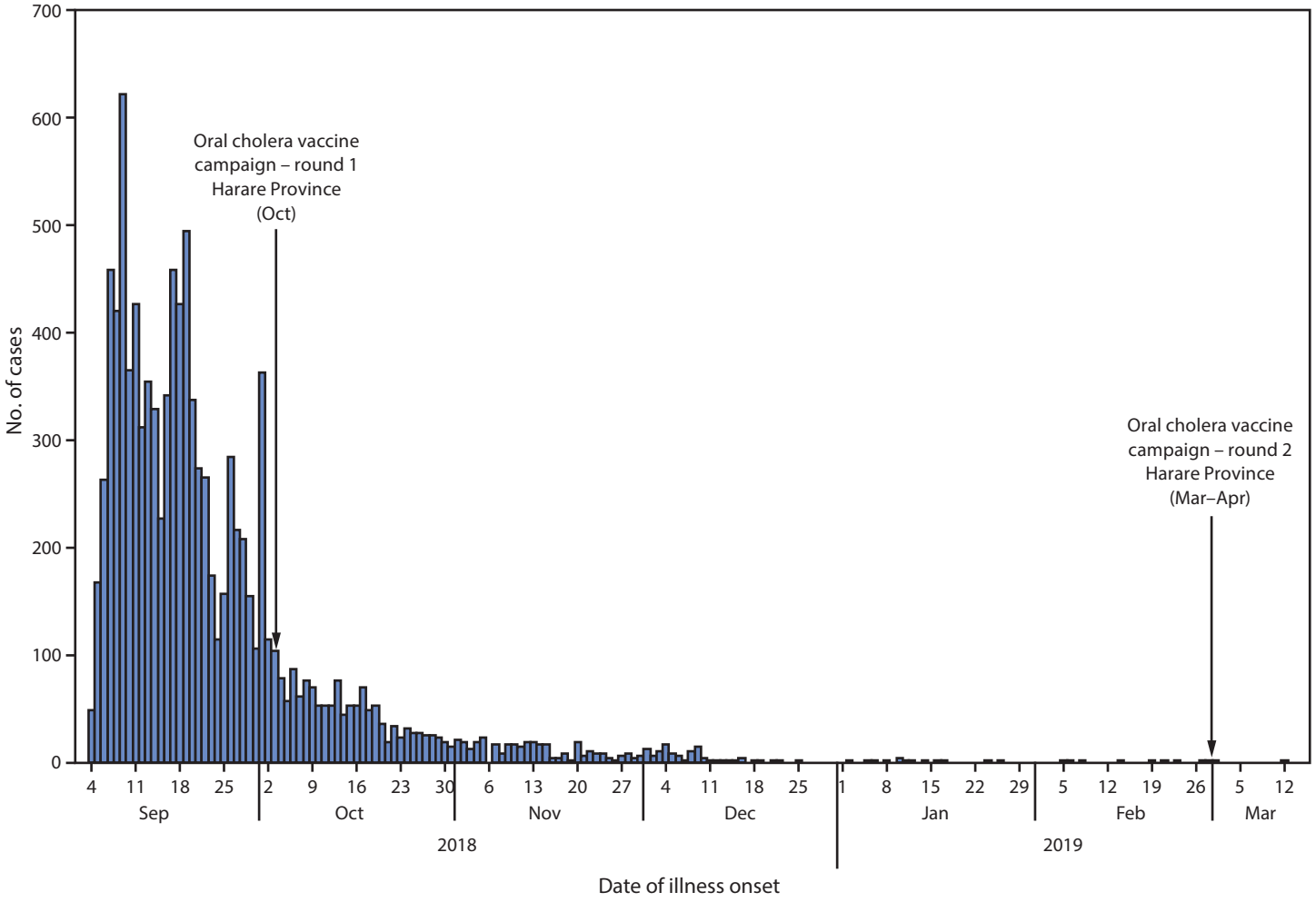
A 2-dose oral cholera vaccination campaign was conducted in Harare, beginning on October 3, 2018. Approximately 1.2 million doses administered by 1,750 health care workers completed the first round (administrative coverage = 86%) (Figure). During March–April 2019, a second round was conducted, with approximately 1.4 million doses administered by 1,900 health care workers (administrative coverage = 95%). The last reported cholera case occurred on March 12, 2019.

The first reported cholera case in Zimbabwe occurred in 1972, and in recent years, outbreaks have been reported almost annually. The largest outbreak recorded in Zimbabwe (and one of the largest ever in Africa) occurred during 2008–2009; 98,592 cases were reported, with 4,288 (4.3%) deaths (*1*). WHO advises that, with proper treatment, cholera case fatality should remain <1% (*2*); during the 2018–2019 outbreak, the case fatality rate was 0.64%, including deaths occurring within communities and at health facilities.

The timely declaration of this outbreak proved crucial to early response activities and resource mobilization. Prevention through improved WASH, community engagement, and cholera vaccination, as well as timely, integrated cholera outbreak detection and response activities are important to reducing the impact of cholera. Effective cholera outbreak response relies on collaboration among partners to systematically address the critical response pillars, including WASH, surveillance, laboratory testing, social mobilization, case management, and vaccination. Building local capacity through training remains a vital component of global health security, necessary to prevent, detect, and respond to infectious disease threats.

* WHO country office in Zimbabwe, supported with additional staffing and expertise by the WHO Regional Office for Africa and WHO headquarters in Geneva, Switzerland.

FIGURE. Suspected and confirmed cholera cases — Zimbabwe, September 2018–March 2019



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

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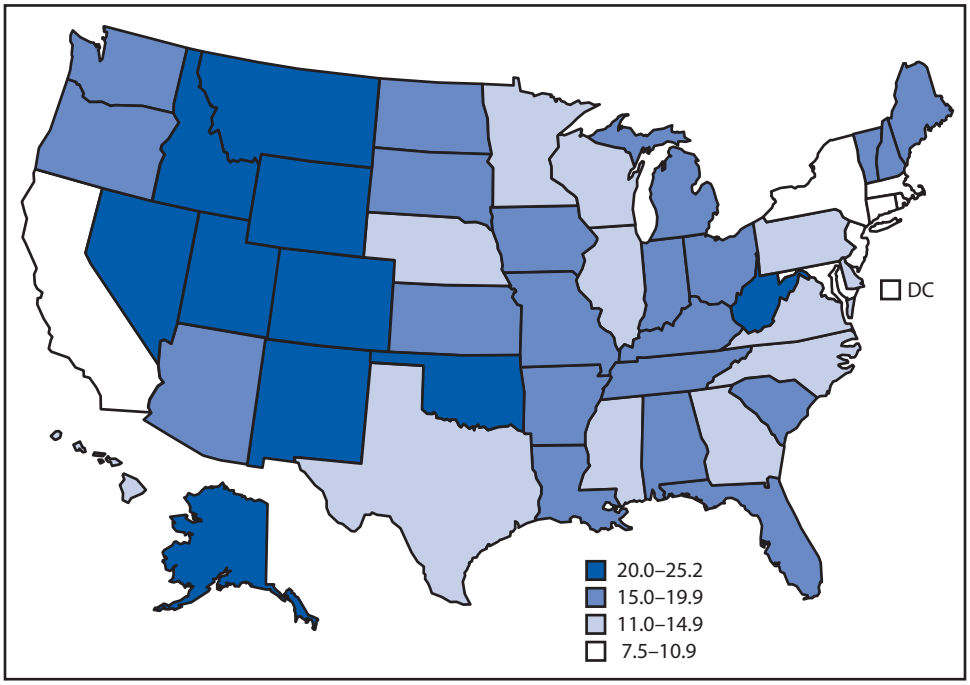
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Suicide Rates,*,† by State — National Vital Statistics System, United States, 2018



* Deaths per 100,000 population are age-adjusted to the 2000 U.S. standard population.
† As underlying cause of death, suicide is identified with *International Classification of Diseases, Tenth Revision* codes X60–X84, Y87.0, and also code U03.

In 2018, the U.S. suicide rate was 14.2 per 100,000 standard population, with rates varying by state. The five states with the highest age-adjusted suicide rates were Wyoming (25.2), New Mexico (25.0), Montana (24.9), Alaska (24.6), and Idaho (23.9). The five jurisdictions with the lowest suicide rates were the District of Columbia (7.5), New Jersey (8.3), New York (8.3), Rhode Island (9.5), and Massachusetts (9.9).

Source: National Vital Statistics System. Underlying cause of death data, 1999–2018. https://wonder.cdc.gov/ucd-icd10.html.

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/violenceprevention/suicide/index.html.

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