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Near Real-Time Surveillance of U.S. Norovirus Outbreaks by the Norovirus Sentinel Testing and Tracking Network — United States, August 2009–July 2015

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Norovirus is the leading cause of endemic and epidemic acute gastroenteritis in the United States (*1*). New variant strains of norovirus GII.4 emerge every 2–4 years (*2–4*) and are often associated with increased disease and health care visits (*5–7*). Since 2009, CDC has obtained epidemiologic data on norovirus outbreaks from state health departments through the National Outbreak Reporting System (NORS) (*8*) and laboratory data through CaliciNet (*9*). NORS is a web-based platform for reporting waterborne, foodborne, and enteric disease outbreaks of all etiologies, including norovirus, to CDC. CaliciNet, a nationwide electronic surveillance system of local and state public health and regulatory agency laboratories, collects genetic sequences of norovirus strains associated with gastroenteritis outbreaks. Because these two independent reporting systems contain complementary data, integration of NORS and CaliciNet records could provide valuable public health information about norovirus outbreaks. However, reporting lags and inconsistent identification codes in NORS and CaliciNet records have been an obstacle to developing an integrated surveillance system.

In 2012, CDC launched Norovirus Sentinel Testing and Tracking (NoroSTAT), a collaborative network with selected state health departments that report specific epidemiologic and laboratory data on norovirus outbreaks to CDC via NORS and CaliciNet within 7 business days, and provide consistent identification codes for each outbreak (https://www.cdc.gov/norovirus/reporting/norostat/). The five states initially participating in NoroSTAT reduced reporting lag to NORS from a median of 22 to 2 days ($p<0.001$) and to CaliciNet from a median of 21 to 3 days ($p<0.001$). Nonparticipating states had no change in reporting lag to NORS, with a median of 26 days pre- and post-NoroSTAT implementation, and a reduction in reporting lag to CaliciNet from a median of 21 to 11 days ($p<0.001$). CaliciNet outbreaks that were linkable to NORS outbreaks increased from 86% to 95% ($p<0.001$) for NoroSTAT states, and from 29% to 33% ($p = 0.016$) for other states. NoroSTAT effectively integrates epidemiologic and laboratory surveillance data to provide near real-time monitoring of norovirus outbreak activity in the United States, thereby improving public health surveillance and guiding appropriate response.

Norovirus outbreak reports in NORS and CaliciNet from the five states that participated in the first 3 years of NoroSTAT (Minnesota, Ohio, Oregon, Tennessee, and Wisconsin) were compared with all other U.S. states, Washington, DC, and Puerto Rico. Only outbreaks reported with norovirus as the single confirmed or probable disease etiology were included. All transmission modes for norovirus (person-to-person, water, food, environment, and unknown) were included. The 3-year period after NoroSTAT introduction (August 2012–July 2015, "post-NoroSTAT") was compared with the preceding 3-year period (August 2009–July 2012, "pre-NoroSTAT").

Per capita reporting rates for each state were calculated by dividing the number of outbreaks reported to NORS and

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CaliciNet by U.S. Census intercensal yearly population estimates (*10*), and were expressed as outbreaks per 1,000,000 person-years. Report timeliness for NORS was assessed by determining the interval in days between the first report of an outbreak to a state health department and the date a NORS report was submitted. Report timeliness for CaliciNet was assessed as the difference in days between the date of receipt of a stool specimen at a public health laboratory and the date a CaliciNet report was submitted. The proportion of reports submitted within 7 business days was evaluated.

A complete NORS report was defined as a report that contained complete information for all fields required for NoroSTAT participation: date the first person in the outbreak became ill, primary transmission mode, exposure setting, and the number of ill persons. Linking ability was defined as the ability to link CaliciNet reports manually with a NORS report by user-submitted identification variables (automated linking was not possible during the period of analysis). The proportion of linked reports was assessed for NoroSTAT states and for other states. Norovirus genotypes reported to CaliciNet by NoroSTAT states and by other states were evaluated pre- and post-implementation of NoroSTAT. The primary transmission modes and outbreak settings reported to NORS by states participating in NoroSTAT were compared with other states and were similarly evaluated pre- and post-NoroSTAT implementation. CaliciNet-NORS linked reports were further analyzed to determine the distribution of reported transmission modes, outbreak settings, and norovirus genotypes from each reporting system. All analyses were completed using statistical software. Wilcoxon's signed-rank test was used for numerical comparisons of reporting lag and outbreak size, and chi-square tests or Fisher's exact tests were used for categorical comparisons, with a p-value <0.05 considered statistically significant.

The median outbreak reporting rates to NORS from NoroSTAT states before and after NoroSTAT introduction were similar (17.3 and 21.0 per 1,000,000 person-years, respectively) (Table 1). The median reporting rate to NORS from non-NoroSTAT states increased, from 3.0 per 1,000,000 person-years (pre-NoroSTAT) to 4.1 (post-NoroSTAT). The median reporting rate to CaliciNet from NoroSTAT states increased significantly from 4.9 (pre-NoroSTAT) to 9.0 (post-NoroSTAT). The median reporting rate to CaliciNet from non-NoroSTAT states was similar pre- (2.6) and post-NoroSTAT (2.1).

The median reporting interval to NORS significantly declined in NoroSTAT states from 22 to 2 days and to CaliciNet from 21 to 3 days (Table 1). No change in reporting interval to NORS occurred in non-NoroSTAT states (median = 26 days pre- and post-NoroSTAT); however, there was a significant decline in the median reporting interval to CaliciNet from 21 to 11 days. The percentage of NORS reports submitted within 7 business days increased significantly, from 26% to 95% among NoroSTAT states, and increased marginally in non-NoroSTAT states (from 12% to 13%). The percentage of CaliciNet reports submitted within 7 business days increased from 29% to 95% among NoroSTAT states;

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TABLE 1. Reporting indicators of norovirus outbreaks reported to the National Outbreak Reporting System (NORS) and CaliciNet — Norovirus Sentinel Testing and Tracking, United States,* August 2009–July 2015

Reporting indicators	NoroSTAT states (n = 5)			Other states (n = 47)		
	Pre-NoroSTAT Aug 2009–Jul 2012	Post-NoroSTAT Aug 2012–Jul 2015	p-value	Pre-NoroSTAT Aug 2009–Jul 2012	Post-NoroSTAT Aug 2012–Jul 2015	p-value
Total NORS reports	**1,357**	**1,981**	—	**2,843**	**3,738**	—
Median NORS reports per 1,000,000 p-y* (range)	17.3 (4.1–32.8)	21.0 (6.1–41.5)	0.16	3.0 (0.1–55.1)	4.1 (0.1–72.2)	0.045
Median reporting lag (days)	22	2	<0.001	26	26	0.29
No. (%) reported within 7 business days	359 (26)	1,888 (95)	<0.001	328 (12)	500 (13)	0.026
No. (%) with all required fields completed	1,183 (87)	1,979 (99.9)	<0.001	1,235 (43)	2,396 (64)	<0.001
Total CaliciNet reports	**657**	**1,077**	—	**1,885**	**2,174**	—
Median CaliciNet reports per 1,000,000 p-y (range)	4.9 (1.9–22.0)	9.0 (2.6–26.2)	0.036	2.6 (0.05–34.6)	2.1 (0.08–24.7)	0.63
Median reporting lag (days)	21	3	<0.001	21	11	<0.001
No. (%) reported within 7 business days	188 (29)	1,018 (95)	<0.001	196 (10)	651 (30)	<0.001
No. (%) linkable to NORS reports with reporter-supplied ID	564 (86)	1,027 (95)	<0.001	552 (29)	718 (33)	0.016

Abbreviations: NoroSTAT = Norovirus Sentinel Testing and Tracking; p-y = person-years.
* NoroSTAT-participating states during 2009–2015 were Minnesota, Ohio, Oregon, Tennessee and Wisconsin. Washington, DC and Puerto Rico are included with other states.

a more modest, but still significant increase (10% to 30%) occurred among non-NoroSTAT states.

NORS reports with all NoroSTAT-required fields completed increased significantly, from 87% to 99.9% among NoroSTAT states, and from 43% to 64% in non-NoroSTAT states. The percentage of CaliciNet reports that were linkable to NORS reports also increased significantly among both NoroSTAT states (from 86% to 95%) and all other states (from 29% to 33%). Over the entire 6-year period, 2,861 CaliciNet reports linked to NORS reports across all states, providing more complete data on the outbreaks than either system alone. The NORS reports provided the transmission mode for all 1,106 (100%) linked CaliciNet records without an identified transmission mode, and the outbreak setting for 669 (60%) CaliciNet records without an identified setting. In addition, CaliciNet reports provided the genotype for all 719 linked NORS records without a reported genotype.

The genotypes of norovirus outbreaks reported to CaliciNet by NoroSTAT states were similar to those reported from non-NoroSTAT states (Table 2). In the pre-NoroSTAT period, GII.4 New Orleans was the dominant genotype in both NoroSTAT and non-NoroSTAT states, accounting for 54% and 65% of outbreaks in these states, respectively. The dominant genotype shifted to GII.4 Sydney in the post-NoroSTAT period in both NoroSTAT and non-NoroSTAT states, accounting for 61% and 68% of outbreaks, respectively. Similarly, the transmission modes and outbreak settings reported to NORS by NoroSTAT states were representative of national data, both pre- and post-NoroSTAT implementation (Table 2). Person-to-person transmission was the predominant transmission mode, and long-term care facilities were the most common outbreak setting.

Discussion

Substantial improvements in norovirus outbreak reporting, measured by the volume, timeliness, and completeness of epidemiologic and laboratory reports have been observed since the introduction of NoroSTAT in participating states, likely because of stringent reporting requirements and enhanced communication between epidemiologists and laboratorians in both state health departments and at CDC. NoroSTAT participating states are providing near real-time norovirus outbreak surveillance data to CDC, with 95% of NORS and CaliciNet reports submitted by these states within 7 business days. States not participating in the NoroSTAT network saw more modest improvements in report timeliness and completeness, likely because of general improvements in the report submission user interface, and increased engagement of state health departments and laboratories with annual meetings, workshops, and newsletters.

Ninety-five percent of CaliciNet reports submitted by NoroSTAT states were linked to NORS reports, fostering better integration and coordination of epidemiologic and laboratory data. These linked reports provide more complete and accurate reporting of norovirus outbreaks, and their value is illustrated by the large proportion of reports for which data from one system supplement those from the other. Report linkages were completed manually and retrospectively during the period of this analysis; automated, prospective linking is currently being implemented.

The findings in this report are subject to at least two limitations. First, both NORS and CaliciNet collect data on norovirus outbreaks; because norovirus outbreaks are defined as two or more cases of illness with a common exposure, these results might not be generalizable to endemic norovirus illnesses. Second, variations in reporting practices among both

TABLE 2. Reported genotype, transmission mode, and outbreak setting of norovirus outbreaks before and after implementation of NoroSTAT surveillance in five states* — United States, August 2009–July 2015

Variables reported	Pre-NoroSTAT (August 2009–July 2012)		Post-NoroSTAT (August 2012–July 2015)	
	NoroSTAT states No. (%)	Other states No. (%)	NoroSTAT states No. (%)	Other states No. (%)
Genotype†	**657 (100)**	**1,885 (100)**	**1,077 (100)**	**2,174 (100)**
GII.4 Den Haag 2006	39 (6)	121 (6)	4 (0.4)	5 (0.2)
GII.4 Osaka 2007	5 (0.8)	5 (0.3)	0	0
GII.4 New Orleans 2009	357 (54)	1,233 (65)	24 (2.2)	54 (2.5)
GII.4 Sydney 2012	4 (0.6)	22 (1.2)	657 (61)	1,474 (68)
Other GII	155 (23)	347 (18)	226 (21)	319 (15)
All GI	97 (15)	157 (8)	166 (15)	322 (15)
Transmission mode§	**1,357 (100)**	**2,843 (100)**	**1,981 (100)**	**3,738 (100)**
Person-to-person	958 (71)	2,191 (77)	1,456 (73)	2,952 (79)
Foodborne	236 (17)	515 (18)	296 (15)	550 (15)
Environmental	7 (0.5)	9 (0.3)	7 (0.4)	12 (0.3)
Unknown	156 (11)	128 (4)	222 (11)	224 (6)
Outbreak setting†	995 (100)	1,129 (100)	1,674 (100)	2,330 (100)
Long term care facility	818 (82)	856 (76)	1,183 (71)	1,728 (74)
Restaurant	19 (2)	18 (2)	59 (4)	59 (3)
Hospital/Other health care setting	41 (4)	89 (8)	69 (4)	116 (5)
Child care center	21 (2)	22 (2)	57 (3)	47 (2)
Other	96 (10)	144 (13)	306 (18)	380 (16)

Abbreviation: NoroSTAT = Norovirus Sentinel Testing and Tracking.
* NoroSTAT-participating states during 2009–2015 are Minnesota, Ohio, Oregon, Tennessee and Wisconsin. Washington, DC and Puerto Rico are included with other states.
† Norovirus genotypes as reported to CaliciNet.
§ Transmission modes and outbreak settings as reported to National Outbreak Reporting System (NORS).

NoroSTAT and non-NoroSTAT states can affect the quality and internal comparability of surveillance data.

Despite these limitations, the NoroSTAT network was shown to be valuable in early identification and better characterization of norovirus outbreaks across the country. Near real-time surveillance data from NoroSTAT improved public health response and preparedness when the GII.4 Sydney variant emerged during 2012–2013. Early reporting of data from NoroSTAT states allowed a timely assessment showing no increase in norovirus outbreak activity in the United States associated with emergence of the GII.4 Sydney variant, in contrast to data from other countries (*4*). Similar strain-specific attribution analyses can be useful to rapidly detect the impact of the emergence of novel norovirus strains every few years.

The NoroSTAT network has built upon the initial success demonstrated by the first five states, expanding to seven states in August 2015 and to nine states in August 2016. The more rapid, complete, and integrated reporting by NoroSTAT-participating states demonstrates a key advancement in norovirus outbreak surveillance, providing near real-time monitoring of norovirus outbreak activity and emerging new strains.

Summary

What is already known about this topic?

Norovirus is the most common cause of acute gastroenteritis in the United States. Norovirus outbreaks are reported to CDC by state and territorial health departments. Reporting lags and incomplete reporting have been limitations to norovirus outbreak surveillance systems.

What is added by this report?

The initial five sentinel states that participated in the NoroSTAT network (Minnesota, Ohio, Oregon, Tennessee, and Wisconsin) during the first 3 years reduced the median reporting interval from 22 days to 2 days for epidemiologic data, and from 21 days to 3 days for laboratory data. These states also had more complete reports that better linked epidemiologic and laboratory data.

What are the implications for public health practice?

The NoroSTAT network provides near real-time surveillance of norovirus outbreak activity and emerging new strains. Data collected by NoroSTAT-participating states are representative of national trends and can help inform public health response.

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Continued Endemic Wild Poliovirus Transmission in Security-Compromised Areas — Nigeria, 2016

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On August 10, 2016, 2 years after the most recent wild poliovirus (WPV) case was reported in Nigeria (in July 2014) (*1*), two WPV cases were reported in the northeastern state of Borno, which has been severely affected by insurgency-related insecurity since 2013. On September 9 and 26, 2016, two additional WPV cases were reported in Borno in children whose families migrated from security-compromised, inaccessible areas of the state. All four cases were WPV serotype 1 (WPV1), with genetic differences indicating prolonged undetected transmission. A large-scale emergency response plan was developed and implemented. The plan initially called for vaccination of 815,791 children during August 15–18 in five local government areas (LGAs) in the immediate vicinity of the first two WPV cases. Subsequently, the plan was expanded to regionally synchronized supplementary immunization activities (SIAs), conducted during August 27–December 6 in five Lake Chad basin countries at increased risk for national and regional WPV1 transmission (Cameroon, Central African Republic, Chad, Niger, and Nigeria). In addition, retrospective searches for missed cases of acute flaccid paralysis (AFP), enhanced environmental surveillance for polioviruses, and polio surveillance system reviews were conducted. Prolonged undetected WPV1 transmission in Borno State is a consequence of low population immunity and severe surveillance limitations associated with insurgency-related insecurity and highlights the risk for local and international WPV spread (*2*). Increasing polio vaccination coverage and implementing high-quality polio surveillance, especially among populations in newly secured and difficult-to-access areas in Borno and other Lake Chad basin areas are urgently needed.

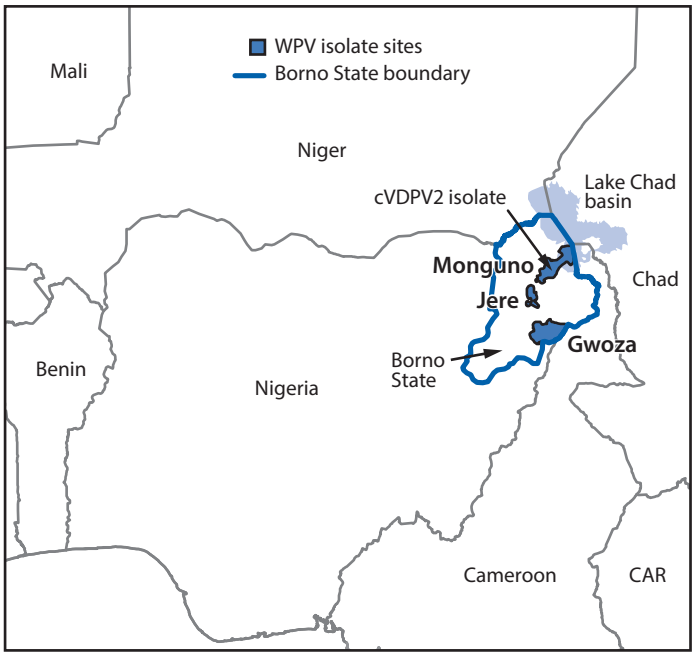
Security Situation

Borno shares boundaries with Adamawa, Gombe, and Yobe states in Nigeria, and international boundaries with Cameroon, Chad, and Niger (Figure 1). Years of armed insurgency in Borno has led to destruction of the health care delivery infrastructure, including nearly two thirds of health facilities in the state. During the last 2 years, approximately half of all settlements in the state were inaccessible for implementation of effective polio eradication activities, including high-quality surveillance and immunization activities. An estimated 2.1 million internally displaced persons (IDPs) have sought shelter in formal and informal camp settings, as well as in communities in Borno and other Nigerian states (*3*). In addition, conflict-driven insecurity has led to the forced displacement of 200,000 refugees across international boundaries. Because of the prevailing humanitarian situation in Borno and other northeastern Nigeria states, in August 2016, the World Health Organization (WHO) declared a Grade 3 emergency in the region, indicating a substantial public health event requiring a major international response (*4,5*). Efforts by the Nigeria military have resulted in improved accessibility in Borno during the last year, although assessments in November 2016 indicate that 39% of settlements are still inaccessible because of insurgency-related insecurity (Figure 2).

WPV Case Investigations and Response Plan

The first WPV case reported was in a child aged 23 months in Gwoza LGA, and the second was in a child aged 24 months from Jere LGA. Dates of paralysis onset were reported as July 4 and 13, 2016, respectively. The third and fourth cases were in two children aged 23 and 21 months from Monguno LGA, with respective dates of paralysis onset of August 6

FIGURE 1. Location of wild poliovirus (WPV) isolates and circulating vaccine-derived type 2 poliovirus (cVDPV2) isolate identified in the local government areas of Jere, Gwoza, and Monguno — Borno State, Nigeria, 2016



Abbreviation: CAR = Central African Republic.

and 21, 2016. Additional investigation identified an isolate of circulating vaccine-derived type 2 poliovirus (cVDPV2) in a healthy contact, aged 6 years, of one of the polio patients from Monguno LGA. cVDPVs are genetic variants of the oral vaccine virus that emerge and can cause paralysis indistinguishable from WPV disease in unimmunized or underimmunized populations (*6*). Laboratory analysis of the four WPV isolates showed limited genetic relationship among isolated viral strains; the closest known genetic link was to a virus last identified in Borno in 2013, indicating distinct and prolonged periods of undetected transmission (*7*). The cVDPV2 isolate was 37 nucleotides different from Sabin 2 and 25 nucleotides different from the closest match, also signifying prolonged undetected circulation. This was the second cVDPV2 isolate identified in Borno in 2016; the first isolate was from an environmental sample collected in March 2016 in Maiduguri LGA which had prompted SIAs with monovalent oral poliovirus vaccine type 2 (mOPV2) in May, June, and July (*2*).

In collaboration with Global Polio Eradication Initiative partners, health authorities in four other Lake Chad basin countries and staff members from the Nigeria Polio Emergency Operations Center planned and implemented a large-scale regional response during August–December 2016. The response included SIAs to vaccinate children against WPV1 and cVDPV2, intensified surveillance for AFP cases, and enhanced environmental surveillance (*8*). In addition, a review of polio surveillance activities in the region was conducted.

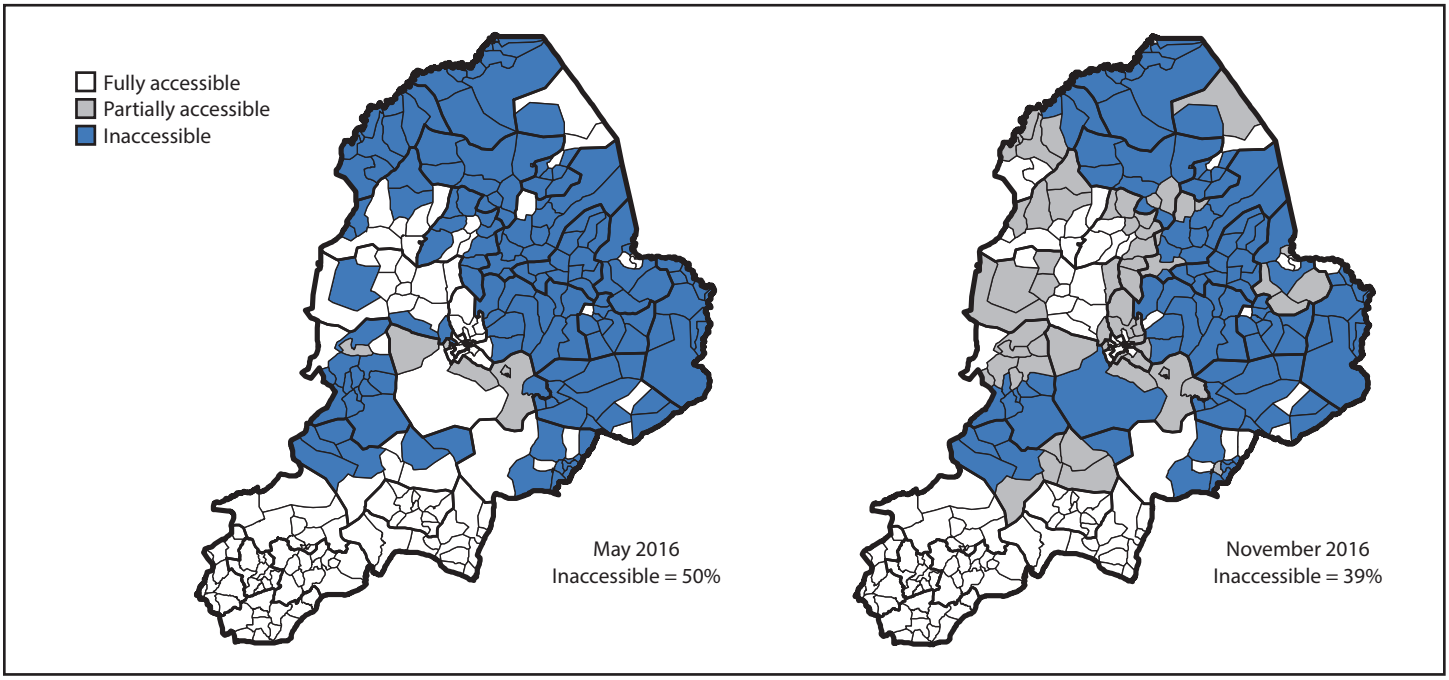
Supplementary Immunization Activities

Following notification of the first two WPV cases, outbreak response vaccination using bivalent oral poliovirus vaccine (bOPV) (containing types 1 and 3 OPV) were conducted during August 15–18, 2016, in Jere and Gwoza LGAs and in three additional LGAs with substantial IDP populations. Five rounds of regionally synchronized SIAs also were implemented, targeting children aged <5 years in five Lake Chad basin countries (Cameroon, Central African Republic, Chad, Niger, and Nigeria) at risk for poliovirus transmission because of large population movements. SIA quality was evaluated using lot quality assurance sampling (LQAS) methodology. Overall, approximately 30 million children in 18 Northern Nigeria states were vaccinated with bOPV. In addition, one dose of inactivated polio vaccine (IPV) was administered to children in Borno State to boost immunity (Table). A separate outbreak response to the cVDPV2 detected in Monguno LGA was conducted using mOPV2 during December 2016 and January 2017.

Poliovirus Surveillance

AFP surveillance. In 2016, a total of 614 AFP cases were reported in Borno State, a 73% increase from 354 reported cases in 2015. Improvements in AFP reporting in 2016 can be attributed to increased surveillance activity in the wake of the March 2016 cVDPV isolation, as well as improving access to populations in previously inaccessible areas of the state.

FIGURE 2. Security-related accessibility classifications within the 27 local government areas* — Borno State, Nigeria, May and November 2016



* Accessible population and settlement data for house-to-house and special vaccination teams.

TABLE. Polio outbreak response supplementary immunization activity dates, antigen types, target areas, number of children vaccinated, and reported lot quality assurance sampling (LQAS) results — Nigeria, August 2016–January 2017

Activity dates	Vaccine type	Target area	No. of children vaccinated	Percentage of LGAs achieving ≥90% on LQAS*
August 15–18, 2016	bOPV	Five Borno LGAs†	815,791	100
August 27–30, 2016	bOPV	Zone 1§	5,787,177	71
September, 17–20, 2016	bOPV	Zone 2¶	30,466,282	71
	IPV	Borno State	1,523,981	50
October 15–18, 2016	bOPV	Zone 2	31,422,237	86
November 12–15, 2016	bOPV	Zone 2	32,563,311	80
December 3–6, 2016	bOPV	Zone 2	32,449,576	85
December 16–19, 2016	mOPV-2	Zone 1 plus Bauchi and Sokoto states**	9,977,377	90
January 28–31, 2017	mOPV-2	Zone 2	Not available	Not available

Abbreviations: bOPV = bivalent (types 1 and 3) oral poliovirus vaccine; IPV = inactivated polio vaccine; LGA = local government area; mOPV-2 = monovalent (type 2) poliovirus vaccine.

* ≥90% coverage achievement pass mark on LQAS set by Nigeria polio Emergency Operations Center.

† Immediate outbreak response in the Borno LGAs of Bama, Gwoza, Jere, and Maiduguri Municipal Council, and one accessible ward in Mafa.

§ Zone 1 = Adamawa, Borno, Gombe, Taraba, and Yobe states.

¶ Zone 2 = Abuja Federal Capital Territory, Adamawa, Bauchi, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kwara, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara states.

** Bauchi and Sokoto states were included as target areas because of increased risk profiles.

Environmental surveillance. Following the reported WPV circulation in Borno, the number of environmental sampling sites in Borno was increased from four to six. In March 2016, the frequency of sample collection at existing sites in Maiduguri (the Borno State capital) was increased from monthly to weekly following the reported cVDPV2 isolation (*2*). No positive WPV or cVDPV isolate has been reported from any of the sites since April 2016.

Surveillance reviews. Two surveillance reviews were conducted as part of the response to assess and develop recommendations to improve weaknesses in surveillance that could account for the prolonged undetected transmission indicated by genetic sequence analyses of isolates from reported WPV1 cases. A key finding was the limited ability to conduct systematic high-quality surveillance in security-compromised areas of Borno State, which adversely affected case detection and reporting. In addition, serious surveillance performance limitations were identified, including inconsistent AFP case reporting in some fully accessible areas. Measures were recommended to strengthen surveillance activities at the national and subnational levels, including the development of protocols for improved identification of the location of cases among IDPs.

Discussion

The recent finding of prolonged undetected WPV circulation in Borno State highlights key challenges facing polio eradication efforts in Nigeria and globally. Although the large-scale outbreak response SIA and surveillance activities conducted in the Lake Chad basin region were considered successful, conflict-related inaccessibility might continue to limit surveillance and immunization activities, raising concerns about further undetected WPV and cVDPV transmission. To reduce the potential for persistent virus transmission, it is important to increase polio surveillance quality and vaccination coverage among cohorts of persons in unimmunized and underimmunized populations, prioritizing persons living in recently accessible areas, IDP camps, and refugee communities.

As has been observed in Afghanistan and Pakistan, the two other countries that have not yet interrupted endemic WPV transmission, insurgency-related insecurity can restrict access to populations in conflict settings, potentially imposing limits on implementation of polio eradication activities, including high-quality immunization and surveillance activities (*9*,*10*). In Borno State, the restriction of the implementation of polio eradication activities in insurgent-held areas has been absolute: no polio eradication activities occurred in those areas. Despite multiple SIA rounds conducted in accessible areas of Borno State prior to August 2016 for which all children were eligible, two of the four children with WPV had never received polio vaccine, and the other two did not complete the polio vaccination series. This finding validates longstanding concerns about WPV circulation among populations that have become susceptible because of the inability to reach and fully vaccinate children in security-compromised areas. Although recent gains made by the Nigerian military have led to an increase in the number of areas now accessible to polio eradication activities, approximately 40% of settlement communities in Borno State are still classified as fully inaccessible. Unless a substantial proportion of children in these settlement communities are reached and vaccinated, it will be difficult to interrupt WPV transmission in the inaccessible areas of Borno State.

Summary

What is already known about this topic?

In August 2015, 1 year after the last known case of wild poliovirus (WPV) infection was reported in Nigeria in July 2014, the World Health Organization removed Nigeria from the list of endemic countries because of the high likelihood that endemic WPV circulation had been interrupted in Nigeria. However, Borno State in northeastern Nigeria has experienced years of armed insurgency, which has hampered implementation of effective polio eradication activities.

What is added by this report?

During August and September 2016, four WPV cases and one circulating vaccine-derived poliovirus (cVDPV) isolate were reported in accessible areas of Borno State. Analysis of the WPV isolates showed limited genetic relationship, indicating prolonged undetected transmission. In response, regionally synchronized supplementary immunization activities were conducted in five Lake Chad basin countries, and >30 million children in 18 northern states in Nigeria were vaccinated. Additional measures to strengthen polio surveillance quality were implemented in accessible areas of Borno State. Ongoing conflict-related insecurity continues to restrict polio workers' access to populations in insurgent-held areas.

What are the implications for public health practice?

Although the areas that are insurgent-held have diminished over the last year, about 40% of communities in Borno State remain inaccessible. Response to the detection of WPV and cVDPV was highly successful in accessible areas. Increasing polio vaccination coverage and improving surveillance quality among cohorts of unimmunized and underimmunized populations is a critical public health need in Borno and the Lake Chad region.

Large population migration to and from refugee and IDP camps and communities has occurred across Nigeria and other Lake Chad basin countries (*3*), increasing the potential for WPV transmission in settings far removed from the conflict. For this reason, immediate steps were taken to increase polio vaccination coverage in large areas of the Lake Chad region. The risk for outbreaks among IDPs in camps and host communities across the region remains, because of the continued migration of potentially infected and underimmunized persons from the security-compromised areas of Borno State.

Armed conflict limits the implementation of high-quality surveillance activities. The current polio surveillance system in Borno State has identified WPV cases, but exclusively in accessible areas of the state. The continued insurgency-related access limitation in a number of subdistricts in Borno State means that the risk for undetected transmission in these communities might persist until secure access becomes feasible. In addition, the recent findings of prolonged undetected WPV circulation in Borno State, along with other deficiencies highlighted in recent surveillance reviews, underscore the need for improved surveillance in areas that have become accessible. Regular and rigorous supervision, evaluations, and reviews focused on surveillance performance at the subdistrict level are urgently needed.

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Notes from the Field

Francisella tularensis Type B Infection from a Fish Hook Injury — Minnesota, 2016

Tory Whitten, MPH[1]; Jenna Bjork, DVM[1]; Dave Neitzel, MS[1]; Kirk Smith, DVM[1]; Maureen Sullivan, MPH[2]; Joni Scheftel, DVM[1]

On June 27, 2016, the Minnesota Department of Health (MDH) Public Health Laboratory (PHL) was notified of a suspected *Francisella tularensis* isolate cultured at a hospital laboratory. The isolate was confirmed as *F. tularensis* type B at MDH PHL by reverse transcription–polymerase chain reaction, culture, and direct fluorescent antibody testing. *Francisella tularensis* subspecies *tularensis* (type A) and *holarctica* (type B) bacteria are the causative agents of tularemia.

MDH initiated an epidemiologic investigation to identify potential exposure sources and risks to additional persons. The case occurred in an immunocompetent white, non-Hispanic woman aged 67 years from Sherburne County, Minnesota. On June 18, she was fishing on a freshwater lake in northeastern South Dakota. While removing a hook from a fish, the hook penetrated the pulp of the patient's left middle finger. On June 21, she developed pain and swelling at the site of the puncture and was seen at an urgent care center where she received an injection of ceftriaxone and was prescribed oral cephalexin. The pain and swelling did not improve, and she was seen by her primary care provider the next day. Because of concern about a possible joint infection, the patient was referred to an orthopedic specialist, who saw her on June 23, at which time an enlarged, tender left axillary lymph node was noted. The orthopedist drained the finger wound, collected a swab of cloudy, nonpurulent fluid for culture, and changed the patient's antibiotic to ciprofloxacin. After MDH PHL confirmed tularemia on June 28, the patient was seen again by the orthopedist; by this time she had developed an eschar-like ulcer. An infectious disease consultation was obtained, ciprofloxacin was discontinued, and a treatment course of doxycycline was initiated and ultimately continued for 5 weeks. As of July 8, the lymphadenopathy had resolved and the ulcerated wound was improving. MDH epidemiologists shared exposure information with the South Dakota Department of Health; no other cases of tularemia were reported from this area of South Dakota in 2016 (South Dakota Department of Health, personal communication, January 4, 2017).

Tularemia can cause a wide range of symptoms in humans, depending upon the route of inoculation. The infection is often characterized by fever, lymphadenopathy, and an ulcer at the site of cutaneous inoculation. Type A is frequently associated with lagomorphs (hares, rabbits, and pikas), and type B is frequently associated with rodents and aquatic environments. Type A is often considered more virulent to humans than is type B, but subtypes exist that are associated with varying degrees of severity (*1*,*2*). Exposure routes include animal contact, arthropod (ticks and biting flies) bites, and exposure to natural waters (*1*–*5*). During 1994–2015, 10 tularemia cases were confirmed in Minnesota residents; five were caused by *F. tularensis* type B (MDH, unpublished data, 2009–2015) (*5*).

Although tularemia is rarely diagnosed in Minnesota, there has been one other culture-confirmed case of a tularemia type B wound infection that resulted after lake water exposure of a superficial cut, sustained while shaving (MDH, unpublished data, 2012). Inoculation by fish hook represents a novel exposure to *F. tularensis*. This and the previous Minnesota case highlight the significance of freshwater exposure in cases of tularemia, the importance of obtaining a thorough exposure history, and the importance of obtaining wound cultures, especially when wound infections do not respond to empiric antibiotic therapy. Prompt diagnosis and initiation of appropriate antibiotics, consistent with current practice guidelines, can prevent serious illness in tularemia cases (*6*).

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Announcement

World Birth Defects Day — March 3, 2017

Every year, approximately 3%–6% of infants worldwide are born with a serious birth defect (*1*–*5*). Birth defects can affect an infant regardless of birthplace, race, or ethnicity. In many countries, birth defects are among the leading causes of death for infants and young children (*6*). Those who survive and live with these conditions are at an increased risk for lifelong disabilities.

During the past year, birth defects have received increased attention, as researchers at CDC and worldwide have been studying the relationship between Zika virus disease and congenital Zika syndrome (*7*). The Zika virus disease outbreak and its effect on birth defects have highlighted the need for and benefits of international collaboration and communication about birth defects prevention.

To further raise awareness about birth defects, 33 countries joined to support World Birth Defects Day in 2016 (*8*). On March 3, 2016, social media presence of the hashtag #WorldBDDay reached nearly 4.8 million persons around the world.

For World Birth Defects Day 2017, the same group of partners has reconvened and invited others to join them to continue to bring attention to this global public health issue. The goals for 2017 are to raise awareness about birth defects, reduce stigma, and increase opportunities for prevention by 1) increasing the number of birth defects surveillance programs globally, 2) improving existing birth defects surveillance programs, 3) improving access to care, and 4) continuing research on the causes of birth defects.

CDC invites other organizations around the world to participate in World Birth Defects Day 2017 by sharing stories and information about birth defects using the hashtag #WorldBDDay.

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Errata

Vol. 66, No. SS-5

In the Surveillance Summary "Health-Related Behaviors by Urban-Rural County Classification — United States, 2013," errors occurred in Table 1 and Table 2. On page 5, in Table 1, under the Micropolitan column, the 95% CI values should have been **(75.7–77.3)** for the current nonsmoking row and **(29.8–31.4)** for the maintaining normal body weight row; under the Noncore column, the 95% CI values should have been **(74.0–75.9)** for the current nonsmoking row, **(28.0–29.8)** for the maintaining body weight row, and **(45.7–47.7)** for the meeting aerobic physical activity recommendations row. On page 6, in Table 2, errors occurred in footnotes and the table is reprinted below.

TABLE 2. Prevalence of reporting four or five health-related behaviors* among adults aged ≥18 years, by urban-rural status† and selected demographic characteristics§ — Behavioral Risk Factor Surveillance System, United States, 2013

Characteristic	Overall % (95% CI)	Large metropolitan center % (95% CI)	Large fringe metropolitan % (95% CI)	Medium metropolitan % (95% CI)	Small metropolitan % (95% CI)	Micropolitan % (95% CI)	Noncore % (95% CI)
Total	**30.4 (30.0–30.7)**	**31.7 (31.0–32.5)¶**	**30.2 (29.6–30.9)¶**	**30.5 (29.9–31.0)¶**	**29.5 (28.8–30.3)¶**	**28.8 (28.0–29.6)¶**	**27.0 (26.2–27.9)¶**
Sex							
Men	**27.3 (26.9–27.8)**	28.8 (27.8–29.8)¶	26.5 (25.6–27.3)¶	27.7 (26.9–28.5)¶	26.7 (25.6–27.8)¶	26.3 (25.2–27.4)	25.0 (23.8–26.2)
Women	**33.5 (33.0–33.9)**	34.8 (33.8–35.8)¶	34.0 (33.1–34.9)¶	33.3 (32.4–34.1)¶	32.6 (31.5–33.7)¶	31.5 (30.4–32.6)¶	29.2 (28.0–30.4)¶
Age (yrs)							
18–24	**28.2 (26.9–29.5)**	30.9 (28.2–33.8)	27.6 (25.0–30.4)	26.1 (23.7–28.6)	27.0 (23.9–30.4)	27.7 (24.7–31.0)	27.1 (23.3–31.3)
25–34	**25.5 (24.7–26.2)**	26.9 (25.4–28.6)¶	25.7 (24.2–27.3)¶	24.7 (23.4–26.1)¶	25.1 (23.2–27.1)¶	24.1 (22.3–26.1)	20.9 (18.9–23.0)
35–44	**27.1 (26.3–27.9)**	30.0 (28.2–31.8)¶	27.1 (25.7–28.6)¶	26.5 (25.1–27.9)¶	25.0 (23.2–26.9)¶	23.8 (22.1–25.6)	21.8 (20.0–23.8)
45–54	**26.4 (25.8–27.1)**	28.3 (26.7–29.9)¶	26.2 (25.1–27.4)¶	27.4 (26.3–28.6)¶	24.4 (22.9–26.0)	23.8 (22.3–25.4)	22.5 (20.9–24.2)
55–64	**29.9 (29.3–30.5)**	30.0 (28.4–31.6)¶	30.8 (29.6–32.0)¶	30.0 (28.9–31.1)¶	29.5 (28.1–31.0)	29.0 (27.6–30.4)	27.6 (26.2–29.1)
65–74	**38.0 (37.3–38.8)**	37.4 (35.5–39.4)	37.3 (35.9–38.8)	39.5 (38.2–40.8)¶	40.0 (38.3–41.7)¶	37.5 (35.8–39.1)	36.7 (35.0–38.3)
≥75	**47.9 (47.1–48.8)**	48.3 (46.0–50.6)	46.7 (44.9–48.4)	49.3 (47.9–50.8)	48.9 (47.0–50.8)	46.7 (44.6–48.8)	47.1 (44.9–49.3)
Race/Ethnicity							
White, non-Hispanic	**30.9 (30.6–31.3)**	33.6 (32.7–34.5)¶	30.4 (29.7–31.1)¶	31.3 (30.6–31.9)¶	30.2 (29.4–31.1)¶	29.2 (28.3–30.1)¶	27.6 (26.6–28.5)¶
Black, non-Hispanic	**23.4 (22.5–24.3)**	23.5 (21.9–25.3)	23.5 (21.7–25.3)	23.7 (21.9–25.6)	21.4 (18.9–24.3)	25.4 (22.2–28.9)	21.1 (18.2–24.4)
Hispanic	**28.4 (27.3–29.5)**	29.2 (27.4–31.1)¶	27.4 (25.2–29.8)¶	28.6 (26.8–30.5)¶	27.8 (24.7–31.1)¶	27.0 (24.0–30.3)	22.0 (18.3–26.2)
American Indian/ Alaska Native	**26.0 (23.4–28.9)**	31.1 (23.3–40.1)	24.1 (18.6–30.5)	24.4 (18.8–31.0)	27.6 (22.4–33.4)	23.3 (19.1–28.1)	25.4 (21.2–30.2)
Asian	**42.1 (39.7–44.4)**	39.8 (36.3–43.5)¶	45.7 (41.5–49.9)	42.1 (37.4–47.0)	45.4 (38.1–52.9)	42.0 (32.6–52.1)	58.2 (43.8–71.3)
Native Hawaiian/ Pacific Islander	**34.2 (27.4–41.6)**	38.2 (28.1–49.4)	40.5 (25.8–57.1)	22.5 (14.2–33.9)	35.5 (22.8–50.5)	21.9 (12.7–35.3)	—**
Multiracial, non-Hispanic	**24.5 (22.3–26.8)**	26.3 (21.3–32.1)	22.3 (18.4–26.7)	26.3 (22.8–30.2)	21.4 (17.8–25.5)	23.5 (19.5–28.0)	19.4 (15.2–24.4)
Other	**30.7 (28.7–32.8)**	33.6 (29.2–38.3)	29.5 (25.6–33.7)	32.0 (28.1–36.1)	28.5 (24.3–33.2)	25.6 (21.2–30.5)	27.1 (21.7–33.3)
Education (yrs)							
<12	**22.5 (21.5–23.7)**	24.9 (22.6–27.3)¶	21.6 (19.4–24.0)	22.2 (20.2–24.4)¶	19.8 (17.4–22.4)	21.1 (18.5–24.0)	18.7 (16.5–21.0)
12	**26.3 (25.8–26.9)**	27.8 (26.4–29.4)¶	25.7 (24.4–27.0)	26.6 (25.6–27.7)	25.8 (24.5–27.2)	24.8 (23.5–26.1)	25.0 (23.6–26.5)
>12	**33.9 (33.5–34.3)**	34.8 (3 3.9–35.7)¶	33.3 (32.6–34.1)¶	34.0 (33.2–34.7)¶	33.8 (32.8–34.8)¶	33.7 (32.7–34.7)¶	31.4 (30.3–32.6)¶

Abbreviation: CI = confidence interval.

* The five health-related behaviors are sufficient sleep, current nonsmoking, nondrinking or moderate drinking, maintaining normal body weight, and meeting aerobic leisure time physical activity recommendations.

† As defined in the National Center for Health Statistics 2013 Urban-Rural Classification Scheme for Counties.

§ Age adjusted to the 2000 U.S. standard population aged ≥18 years with the direct method, except for age groups.

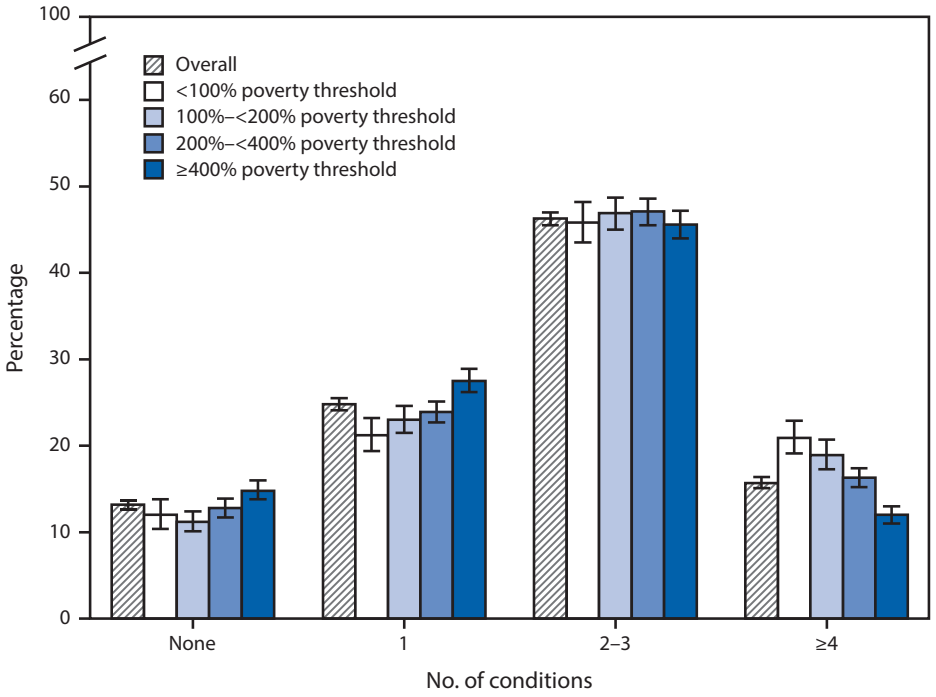
¶ t-test p<0.05 for significant difference between rural respondents and respondents in any other urban-rural classification group.

** Unreliable estimate if relative standard error ≥30% or n <50.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥65 Years,† by Number of 10 Selected Diagnosed Chronic Conditions§ and Poverty Status¶ — National Health Interview Survey, 2013–2015



* With error bars indicating 95% confidence intervals.

† Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population and are derived from the National Health Interview Survey Sample Adult component. Percentages were age-adjusted to the projected 2000 U.S. population as the standard population, using three age groups: 65–74, 75–84, and ≥85 years.

§ Respondents were asked about the following 10 selected chronic conditions: hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, chronic obstructive pulmonary disease (COPD), weak or failing kidneys during the past 12 months, and current asthma. COPD was defined as ever having COPD or emphysema or having chronic bronchitis during the past 12 months. Unless a time frame was noted, chronic conditions were based on the respondents reporting ever being told by a doctor or other health professional that they had the condition.

¶ Poverty status is based on family income and family size using the U.S. Census Bureau poverty thresholds. Family income was imputed where missing.

For the period 2013–2015, 13% of adults aged ≥65 years reported having none of 10 selected diagnosed chronic conditions; 25% had one, 46% had two or three, and 16% had four or more of the conditions. No differences by poverty status were observed among those who reported having two or three conditions, but those in the lowest income group (<100% of the poverty threshold) were less likely to have none or only one of the chronic conditions compared with those in the highest income group (≥400% of the poverty threshold). Those in the lowest income group also were more likely to have four or more conditions when compared with those in the highest income group (21% compared with 12%).

Source: National Health Interview Survey, 2013–2015. https://www.cdc.gov/nchs/nhis.htm.

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