Original Article

An Epidemiological Evaluation of Acute Flaccid Paralysis Surveillance Performance in Ondo State, Nigeria from 2016 to 2020

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Abstract

Background: The last case of the indigenous Wild Polio Virus in Ondo state was in 2008, and the last Polio compatible case was in 2010. Poliovirus transmission was interrupted through the adherence to the World Health Organization's (WHO) guidelines, which included acute flaccid paralysis (AFP) surveillance. We wanted to describe the state's AFP surveillance performance during the last five years, from 2016 to 2020, using WHO-recommended indicators and find areas where it could improve.

Methods: Between January 2016 and December 2020, AFP case-based surveillance data was used to undertake a retrospective review of records. Microsoft Excel was used for data analysis, and Quantum Geographic Information System was used for mapping (GIS).

Results: From 2016 to 2020, a total of 1,096 AFP cases were reported, none of which were confirmed as Poliomyelitis. The majority of the cases (77.2 percent) were found in children under the age of five. Males made up more than half of the cases (53.4%). More than 89 percent of reported cases received three or more OPV doses. Between 2016 and 2020, there was a 79 percent decline in reported cases. Between 2016 and 2020, the average Non-Polio AFP rate was 11.2 per 100,000, with a stool adequacy of 98.4%.

Conclusion: AFP surveillance in Ondo state met the minimum WHO targets during the study period, according to the findings. However, because of the possibility of poliovirus being imported from endemic countries, which might threaten Nigeria's polio-free status, the sensitization of all surveillance actors and active case search should be strengthened, particularly in underperforming local government areas (LGAs).

Keywords: Acute Flaccid Paralysis, (AFP), Surveillance, Indicators, WHO, Nigeria

Introduction

The World Health Organization (WHO) is in charge of coordinating global efforts to eradicate polio, which is a major public health initiative (1). Poliomyelitis has a variety of symptoms, ranging from non-specific illnesses to severe flaccid paralysis with permanent disability (1-2). There are three serotypes of the Wild Polio Virus (WPV): types 1, 2, and 3. Poliovirus types 2 and 3 have been eradicated worldwide. In November 2012, the last case of poliovirus type 3 in Nigeria was recorded (2).

Poliomyelitis primarily affects children under the age of five, and it is known to cause permanent paralysis in 1 in 200 to 1 in 1,000 cases (4). Feco-oral transmission is the most typical mode of transmission (1). Children with no or insufficient vaccination history with potent Polio vaccines, as well as those living in locations with low sanitation and sanitary conditions, are particularly vulnerable to infection (2,3). Only 2% of infected cases are known to experience virus replication in the central nervous system, which could lead to irreversible neuronal paralysis and damage.

WHO suggested that countries institute Acute Flaccid Paralysis (AFP) surveillance systems to detect new cases of AFP and WPV imports in order to eradicate polio (1). Following the 41st World Health Assembly (WHA) in Geneva, Switzerland in May 1988, a breakthrough in the implementation of the Global Polio Eradication Initiative (GPEI) occurred. Spearheaded by government of nations with strong partnerships with WHO, the Bill and Melinda Gates Foundation (BMGF), the Rotary Foundation, the United Nations Children's Fund (UNICEF), and the United States Center for Disease Control (US CDC), this program was launched (5-7).

GPEI's goal was to eliminate polio worldwide by the year 2000, using four key strategies: High routine OPV vaccination coverage; quality National Immunization Days (NIDs); and effective surveillance and mop-up actions. (8–10).

WPV cases have decreased by more than 99 percent globally, from around 350,000 in 125 countries in 1988 to only 33 cases by the end of 2018, and 139 by 2020. (9). The entire GPEI depends on the sensitivity of the AFP surveillance system. Gullian-Barre Syndrome, transverse myelitis, traumatic neuritis, acute hemiparesis, tuberculosis (TB) of the spine, upper motor lesion, acute hemiplegia, Coxsackie virus, and other non-polio enteroviruses (NPEVs) infections are differential diagnosis for AFP. All AFP cases should be notified and investigated as probable polio cases, with two stool samples collected within 24 to 48 hours of the onset of paralysis and within 14 days of the onset of paralysis, to guarantee optimal sensitivity of the surveillance system to quickly discover any imported case (12-13).

In 1978, Nigeria launched the Expanded Program on Immunization (EPI) (14). The polio immunization schedule for children includes four doses of live attenuated oral polio vaccine (OPV) administered at birth, six weeks, ten weeks, and fourteen weeks of age. In Nigeria, the inactivated polio vaccine (IPV) was launched in 2015 and is administered every 14 weeks. In July 2021, a second dose of IPV (IPV 2) was introduced. As a result, the IPV schedule was changed to incorporate IPV1 at 6 weeks and IPV2 at 14 weeks. A 21-month-old girl from Kumaila Ward, Monguno, Borno State, was the last indigenous case of wild Polio virus in Nigeria (15). The onset of paralysis occurred on August 21st, 2016. In Ondo State, the last indigenous WPV-transmitted polio case occurred in Ese Odo Local Government Area (LGA) in 2008, with an onset date of September 26, 2008. The patient was a 20-month-old female who had never been vaccinated.

The transmission of poliovirus has been interrupted, with no record of a case of WPV, due to the implementation of WHO guidelines in ensuring the sensitivity of AFP surveillance and high coverage of OPV vaccinations. The African Regional Commission on Certification (ARCC) declared Nigeria polio-free on June 18, 2020. Following Nigeria's polio-free status, WPV elimination in the AFRO area was declared on August 25th, 2020. (16). Ondo state must maintain high-quality and sensitive AFP surveillance to detect any WPV importation promptly, as well as boost routine immunization coverage, to sustain the advances in polio-free certification. This is because WPV is still endemic in countries like Pakistan and Afghanistan, as well as the high number of cases of circulating Vaccine Derived Polio Virus type 2 (cVDPV2) in African nations including Nigeria.

The AFP continuous epidemiological data collection, as well as routine coordination meetings with surveillance officers at all levels for feedback and review of surveillance performance, are crucial in finding system gaps and ways to improve the AFP surveillance system. The purpose of this study was to use the WHO AFP surveillance performance indicators to evaluate the State's AFP surveillance indicators and describe AFP case data from 2016 to 2020, highlighting progress made and identifying areas for improvement.

Methods

Study Setting

Ondo State is located in Nigeria's southwest zone. It is divided into 18 LGAs with a total of 203 wards. Basedon the 3.0 percent growth factor from the 2006 national population census, the total estimated population of Ondo state for 2020 was 5,204,858. The population of children under the age of one year is 208,194, and the population of children under the age of 15 is 2,477,512. (17).

Study design

AFP case-based surveillance data was used in this retrospective study, which took place between January 2016 and December 2020. The study included all cases of AFP reported to the disease surveillance department throughout the time period from all 18 LGAs in the state.

AFP surveillance

A child under the age of 15 who has sudden onset of paralysis of the limbs or muscle weakness, regardless of the cause, or anyone in whom a clinician suspects poliomyelitis, is classified as an AFP case (18, 19). A hot AFP case is one that contains at least three of the following characteristics and is highly likely to be WPV: 1. being under the age of five years; 2. being clinically compatible (asymmetric paralysis, fever at onset, and rapid progression of paralysis); 3. having received less than three doses of OPV vaccine; 4. belonging to a high-risk group (migrants, nomads, contacts of confirmed polio cases, living in security-compromised areas); 5. occurring in polio-free states (18).

A country's estimated surveillance detection rate is 3 per 100,000 under-15-year-olds (18–20). All of the state's LGAs have focal reporting and non-reporting sites. In Nigeria, the AFP surveillance system is both health facility-based and community-based. Both public and private health facilities are included in the focal reporting sites. Traditional bone setters, traditional birth attendants, patent medicine vendors, traditional healers, and other key influential people in the communities, such as traditional leaders, community leaders, and market leaders, among others, are part of a community informant network that conducts community-based surveillance (21, 22). These networks can be found in all of the state's wards and LGAs. Ondo State has 2,030 community informants, with 10 per ward across the state's 203 wards. There are 193 focal reporting sites in the state; 43 high priority, 79 medium priority, and 71 low priority focal sites and 429 non-focal reporting sites. There are 203 surveillance focal persons at the health facility (HF) level. All cases of AFP should be reported to the LGA Disease Surveillance Notification

Officers (DSNOs) within 24 hours by health facility surveillance focal individuals, other health care personnel, and surveillance actors. Hot AFP cases, on the other hand, must be reported as soon as possible via the fastest available method. Within 24 to 48 hours of receiving notification from DSNOs, a case investigation should begin. Two stool samples should be taken within 24 to 48 hours of each other and kept in a reverse cold chain on investigation as a "true" AFP case. The stool samples are delivered to a WHO-accredited laboratory in Ibadan for poliovirus isolation, PV identification to confirm WPV cases, serotype differentiation of WPV serotypes, and intra-typic differentiation of Sabin-like polioviruses and vaccine-derived polioviruses (VPDVs) (21).

A paper-based case investigation form (CIF) is filled out during an AFP case investigation by LGA DSNOs or Assistant DSNOs (ADSNOs) to capture demographic characteristics of cases, clinical history, Polio vaccination history, date of sample collection, and laboratory results following laboratory investigations. In addition, in 2010, Nigeria implemented an AFP case verification system to improve the quality of AFP surveillance, the quality of information in the national AFP database, the process of AFP case investigation, and the DSNOs' and verifiers' AFP surveillance capacities. A state surveillance officer visits an AFP case that has already been investigated by a DSNO to determine if the case satisfies the AFP case definition and whether the case investigation procedure was completed according to approved recommendations. The verifier conducts an interview with the AFP case's parent or caregiver, examines the case physically, and fills out a case verification form on the open data kit (ODK) server. The location of case verification (often the AFP case's residence) is also recorded. This details the high-risk areas (21-23).

An AFP contact sample is taken to optimize the process even more. It's the process of collecting stool samples from contacts on an index AFP case that has inadequate stool samples. "A contact is a healthy child aged below 5 years who was in direct contact with the index AFP case (household, close family, neighbor and playmate), 7 days prior to the onset of paralysis and/or within 14 days after the onset of paralysis." If poliovirus is in circulation, the goal of AFP contact sampling is to maximize the chances of identification and confirmation (22, 24).

Cases of AFP are reported to the nearest focal reporting sites or directly to the LGA DSNO by community informants. Surveillance activities are managed at the state level by the state epidemiologist and the state DSNO. They coordinate monthly review meetings with LGA DSNOs, quarterly meetings with

LGA DSNOs and Assistant DSNOs (ADSNOs), and provide LGA/HFs with supportive supervision, conduct outbreak investigations, training, and sensitizations. LGA DSNOs, ADSNOs, the state surveillance team, WHO, and other partners also conduct active surveillance to HFs and community informants. (21, 22).

AFP surveillance Indicators

The WHO has developed a set of surveillance performance indicators to ensure that the sensitivity and quality of AFP surveillance is maintained. We used WHO criteria for minimum performance standards to assess the quality of the AFP surveillance system in Ondo state.

In this investigation, the following criteria were used:

1. **Annualized non-polio AFP rate:** This shows how sensitive an AFP surveillance system is. At least three cases of AFP per 100,000 people under the age of 15 should be detected by a sensitive surveillance system. Cases of non-polio AFP are those that haven't been confirmed as WPV, cVDPV, or Polio-compatible. This rate is based on the notion that in the absence of WPV, other causes of AFP, such as transverse myelitis, Guillain-Barre syndrome, and so on, will continue to occur.
2. **Two samples adequate in time and condition (Stool adequacy):** This is defined as two stool samples taken from an AFP case within 14 days of paralysis onset and separated by at least 24 hours. The goal is to achieve a stool adequacy rate of at least 80%.
3. **LGAs meeting two key indicators:** This is a combination of NPAFP and a stool adequacy proportion. At least 80% target must be met.
4. **Samples arriving at national laboratory in good condition:** At least 90% of stool specimens should arrive in "good condition" at the WHO-accredited laboratory. A stool specimen is deemed to be in good condition if there is proof that the reverse cold chain was maintained, it is of sufficient volume (8-10 grams), has suitable documentation, no leaking, and no desiccation when it arrives at the laboratory.
5. **Samples arriving timely at national laboratory**: Within 72 hours of collecting the second sample, at least 90% of stool samples taken from AFP cases should arrive to a WHO-accredited Polio isolation laboratory.
6. **Non-polio enterovirus isolation rate**: This is a measure of the reverse cold chain's quality during sample collection, storage, and transportation to the laboratory. Rather than cases, this is based on the quantity of samples. At least 10% of all samples must meet the criteria.
7. **60-day follow up examination:** All AFP patients that need to be followed up on should be seen 60 days following the onset of paralysis. This follow-up is done for inadequate cases and to see whether there is any residual paralysis. (18, 22).

Data collection and analysis

For this study, the AFP surveillance electronic database was utilised. Microsoft (MS) Excel was used to enter demographic data from case investigation forms. Microsoft Excel was used for statistical analysis: frequency tables. Quantum GIS (Version 3.20.0) was used for spatial analysis. Based on the WHO recommended performance indicators, descriptive analyses were done to summarize the epidemiology of all reported cases in Ondo state during the study period. The distribution of AFP cases and surveillance performance by geographical location were visualized using mapping.

Results

Demographic characteristics and clinical history

Between 2016 and 2020, 1,096 cases of AFP were reported in children under the age of 15. In the WHO-accredited laboratory in Ibadan, stool samples collected from all 1,096 AFP cases, and 47 contacts were processed. Within the study period, at least one case of AFP with stool samples was documented in each of the 18 LGAs. The majority of the cases (76.1 percent) involved children under the age of five, and the average age of the children was 4.8 years. The ratio of males to females was 1:1.1. (Table 1). There were no AFP cases found that were classified as poliomyelitis or poliomyelitis-compatible.

Table 1 shows that 91.3 percent of reported cases had received three or more doses of OPV, 8.5 percent had received one to two doses of OPV, and just 0.2 percent had gotten no doses of OPV. 986 (90%) of the AFP cases had a fever at the time of paralysis onset, 993 (90.6%) had maximal paralysis progression within 3 days, and 891 (81.3%) had asymmetric paralysis. A total of 1012 (92.3%) AFP cases had a sudden onset of paralysis, with 756 (69%) having a history of injection and only 153 (4%) having ascending paralysis.

AFP surveillance performance indicators

Between 2016 and 2020, the average NP-AFP rate for under-15-year population was 11.2 per 100,000. However, between 2016 and 2020, the NP-AFP rate declined significantly, from 16.8 per 100,000 in 2016 to 3.1 per 100,000 in 2020. (Table 2). Within the last five years, every LGA in the state has recorded at least one incidence of AFP, with Okitipupa LGA reporting the most cases and Ifedore LGA reporting the least. Despite the fact that Ondo's overall performance met the WHO objective of 3 per 100,000 children under the age of 15 years for the NP-AFP rate, five LGAs (Ifedore, Akure South, Owo, Odigbo, and Ilaje) failed to meet the target from 2016 to 2020. (Figure 1). Between 2016 and 2020, there was a 79 percent decrease in the number of AFP cases detected.

The average annual state performance for AFP cases with adequate stools was 98.4 percent, which was higher than the aim of 80 percent. The number of AFP cases with adequate stools has consistently exceeded the minimum target, with 100% in 2016, 99 percent in 2017, 97 percent in 2018, 93 percent in 2019, and 90% in 2020. During the study period, all 18 LGAs met the goal (Figure 2).

The average proportion of LGAs fulfilling the two key indicators of NP-AFP rate and stool adequacy was 77.6% across the state, falling short of the WHO objective of 80%. From 100% in 2016 to 67 percent in 2020, the proportion of LGAs satisfying the two core indicators has decreased significantly (33 percent) (Figure 4). However, when looking at the state as a whole, the majority of the LGAs (72.2 percent) met their combined AFP key surveillance performance indicators (NP-AFP rate and stool adequacy) targets (Figure 3). Six Local Government Areas (LGAs) (Akoko South-West, Akure South, Ifedore, Ondo East, Ondo West, and Owo) failed to meet the two key indicators by 2020.

From 100% in 2016 to only 37% in 2020, the proportion of stool samples reaching the lab within 3 days (72 hours) has decreased significantly. The proportion of stool samples that arrived in the lab within 72 hours was 87.4 percent on average. The state fell short of the minimal goal of 90%. (Table 2). According to our findings, the state's average NPENT rate between 2016 and 2020 was 10.8%. The annual NPENT rate in Ondo State stayed above 10% from 2016 to 2019, but dipped below the target (6.6%) in 2020.

Discussion

The results of a five-year period, from 2016 to 2020, based on the WHO recommended performance indicators for AFP surveillance, are reported in this paper, which describes the AFP surveillance system in Ondo state. During the study period, no cases of indigenous Wild Polio Virus or circulating vaccine-derived Polio virus were reported in the state.

The bulk of AFP cases, 77.2 percent, were under the age of 5 years (0–59 months), according to the age distribution of AFP cases. This is in line with research from Ibadan, Ghana, and Iran (6,25-26), which found 74.3 percent and 74.4 percent of AFP cases in children under the age of five, respectively, but higher than those from Italy (37 percent) (27). With 90 percent and 82.5 percent of cases under five years of age, respectively, the proportion of cases under five years of age was lower than in India and Borno State, Nigeria (28,29). When comparing males and females, our findings found a higher number of males (53.4%) compared to women (46.6%). This finding is consistent with research from Kenya, Ghana, Italy, and Ethiopia (26,27,30,31). It was clear that a large percentage of the reported cases had fever at the onset of paralysis, with paralysis asymmetrically and maximal progression within three days. These findings were likewise similar to those found in Ghana and Kenya (26) but differed from those seen in Turkey (30) where only 15% of AFP cases had a fever at the time of paralysis onset. Our research further supports the differentials of AFP cases based on injection history. The majority of AFP cases (92.3 percent) had a history of injection prior to the onset of paralysis.

Immunization coverage with three or more doses of OPV was 89.2 percent among AFP cases reported. This is in line with prior research (26, 30, 38). Bosch-Capblanch (33) conducted another investigation that yielded varying results. Due to recall bias from parents or caregivers of children where vaccination cards could not be obtained and vaccine doses were taken by history, the number of vaccine doses received may be over or underestimated (38). High-quality Supplemental Immunization Activities (SIAs) were done for 11 rounds from 2016 to 2020 to complement the routine vaccination (RI) program. High-risk and underserved populations were given more attention. Herd immunity is achieved through the RI program and SIAs, which provide high immunization coverage with OPV (Table 3). In addition, poliovirus transmission and circulation are disrupted (34–36). Reduced immunization coverage in OPV-using countries may cause negative impact by the occurrence of wild or circulating poliovirus viruses (37,38).

Table 1. Demographic characteristics, clinical and vaccination history of AFP cases, Ondo State 2016-2020

Characteristics	Year				
	2016 N (%)	2017 N (%)	2018 N (%)	2019 N (%)	2020 N (%)
Age					
Less than 5 years	276 (74.6%)	286 (76.5%)	142 (84.0%)	76 (71.7%)	54 (70.1%)
5-15 years	94 (25.4%)	88 (23.5%)	27 (16.0%)	29 (27.4%)	23 (29.9%)
>15 years	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.9%)	0 (0.0%)
Sex					
Male	219 (59.2%)	201 (53.7%)	92 (54.4%)	49 (46.2%)	47 (61.0%)
Female	151 (40.8%)	173 (46.3%)	77 (45.6%)	57 (53.8%)	30 (39.0%)
Vaccination history					
Zero dose	0 (0.0%)	0 (0.0%)	2 (1.2%)	0 (0.0%)	0 (0.0%)
1-2 doses	20 (5.4%)	37 (9.9%)	26 (15.4%)	7 (6.6%)	3 (3.9%)
3+ doses	350 (94.6%)	337 (90.1%)	141 (83.4%)	99 (93.4%)	74 (96.1%)
Clinical history					
Fever at onset of paralysis	308 (92.8%)	336 (89.8%)	145 (85.8%)	101 (95.3%)	71 (92.2%)
Maximal progression of paralysis within 3 days	321 (96.7%)	365 (97.6%)	142 (84.0%)	103 (97.2%)	74 (96.1%)
Asymmetrical paralysis	292 (88%)	333 (89%)	125 (74.0%)	89 (84.0%)	72 (93.5%)
Sudden onset of paralysis	331 (99.7%)	337 (90.1%)	144 (85.2%)	106 (100%)	75 (97.4%)
History of injection	102 (30.7%)	169 (45.2%)	126 (74.6%)	63 (59.4%)	54 (70.1%)
Ascending paralysis	72 (21.7%)	17 (4.5%)	3 (1.8%)	4 (3.8%)	7 (9.1%)

Table 2. AFP surveillance performance indicators, Ondo State, 2016-2020

Indicators	Year				
	2016	**2017**	**2018**	**2019**	**2020**
Number of AFP cases investigated	370	374	169	106	77
% of stool specimens arriving lab within 72hrs	100%	100%	100%	100%	37%
% of stool specimens arriving lab in good condition	99%	99%	99%	99%	99%
% of stool specimens from which NPENT was isolated	12%	11.5%	13.4%	10.7%	6.6%
% of LGAs meeting 2 key indicators	100%	94%	83%	67%	44%

Table 3. Summary of Polio immunization activities in Ondo State 2016-2020

Year	NIPDs/OBR	Date conducted	<5 yrs. target	<5 yrs. vaccinated	% Coverage	Routine Immunization coverage (%)
2016	OBR	16th-19th Jan	924,890	1,080,763	117	99
2016	NIPDs	27th Feb-1st Mar	924,890	1,082,920	117	99
2016	NIPDS	2nd-5th April	924,890	1,086,820	118	99
2017	NIPDS	25th-28th March	952,636	1,057,351	111	112
2017	NIPDS	22nd-25th April	952,636	1,082,267	114	112
2018	NIPDS	7th-10th April	701,856	872,635	124	79
2018	NIPDS	30th June-3rd July	871,521	950,373	109	79
2019	OBR	18th-21st May	875,939	881,384	101	81
2019	OBR	22nd-25th June	875,939	902,156	103	81
2019	OBR	20-23/07/2019	875,939	936,299	107	81
2020	NID	15-18/02/2020	902,292	954,877	106	91

Figure 1. Mean NPAFP Rate by LGA, Ondo State 2016-2020

Figure 2. Mean stool adequacy by LGA, Ondo State 2016-2020
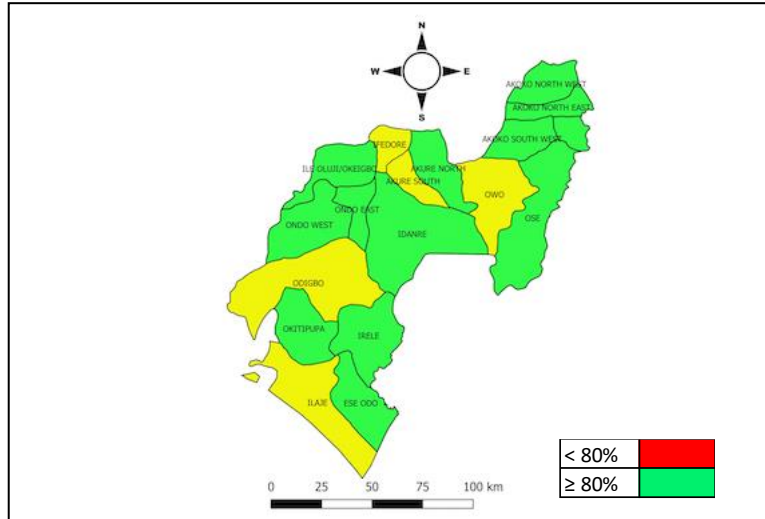
Figure 3. Mean combined NPAFP rate and Stool adequacy; 2 key indicators by LGA, Ondo State 2016-2020
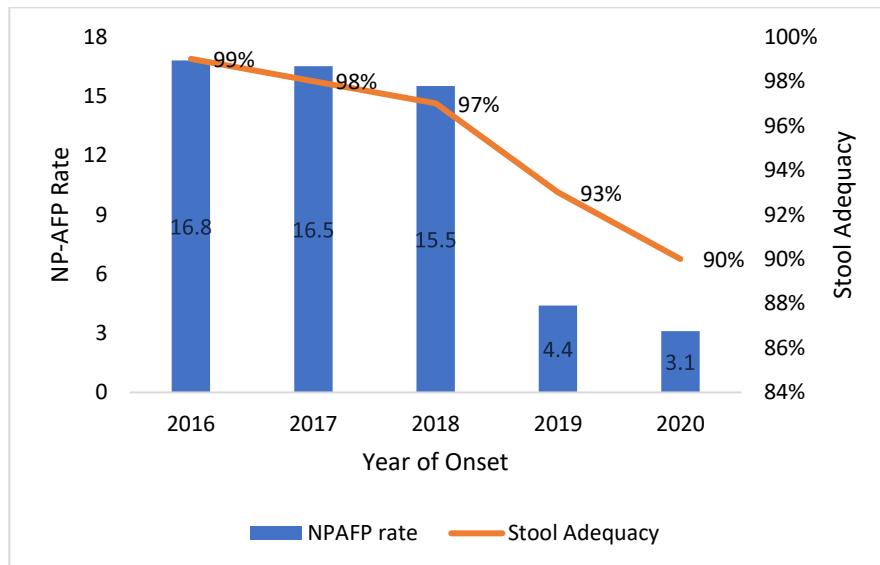

Fig 4. NPAFP Rate and Stool adequacy, Ondo State 2016-2020

The oral polio vaccine (OPV), which is given orally, and the inactivated polio vaccine (IPV), which is given by injection, are the two types of polio vaccine used in polio eradication. Sabin produced the OPV, which is a live but weakened virus. The major vaccine used in polio eradication is OPV (39,40). The attenuated virus replicates in the intestines before entering the bloodstream, where it triggers a protective immune response. Some vaccine-viruses may mutate genetically from its weakened strain which was its original form during virus replication and become virulent. The Vaccine-Derived Poliovirus (VDPV) is a neurovirulent virus with the capability to cause paralysis. When it is able to circulate in a community, it is known as a circulating vaccine-derived poliovirus (cVDPV) (6). The inactivated polio vaccine, which has already been "killed," has no potential of retaining its virulence after being given to a child. IPV should not be a replacement for OPV to protect children against poliovirus serotype 2; rather, it should be used in conjunction with OPV to protect children against poliovirus serotype 2. (41).

Our research found that Ondo State met critical AFP surveillance indicators over the course of the five-year study period and is sensitive to detecting and reporting Poliovirus transmission. Even though the state met minimum requirements, the COVID-19 pandemic may have had a significant impact on AFP monitoring performance in 2020 compared to 2016 through 2019. The national and state governments' imposition of inter- and intra-state lockdowns and movement restrictions to combat the spread of the COVID-19 virus among populations may have affected the seeking of essential health services. Fears of contracting COVID-19 may have also contributed to the decline in 2020.

Minimum targets for NP-AFP rates and stool adequacy were met for all five years of the evaluation. An in-depth assessment of LGA performance over time revealed significant variances. Irele, Akoko South-East, Okitipupa, and Akure North were among the LGAs that outperformed others. Ifedore, Odigbo, Akure South, Owo, and Ilaje were the least-performing LGAs, with a mean NP-AFP rate of less than 3 per 100,000 children under the age of 15. The proportion adequate stools were consistently higher than the WHO target of 80% from 2016 to 2020 at state level. From analysis by LGA, all 18 LGAs had a mean stool adequacy of more than 80%. The Akoko North-East, Akoko North-West, Akoko South-East, Ese Odo, Ilaje, Irele, Ondo West, and Ose LGAs had 100% stool adequacy during the five-year study period. Stool adequacy—stool specimens collected within 14 days of onset of paralysis and within 24-48 hours apart is a significant surveillance and laboratory indicator. Stool samples are preferred because they are simple to obtain, the virus titre is highest in feces, and the virus sheds intermittently. Because it determines the isolation and confirmation of poliovirus in the stool material, this laboratory indicator is just as important as the detection rate. Despite the fact that the mean proportion of stool adequacy was higher than the WHO minimum target at both the state and LGA levels in 2020, there was a noticeable decline in stool adequacy. In 2020, stool adequacy in Akure South, Akoko South-West, and Ondo East was less than 80%. The majority of the inadequate samples in these LGAs were the result of case investigations and sample collection that took place after 14 days of paralysis. This dismal performance was partly attributable to the restriction of intra-state migration in 2020 owing to the COVID-19 pandemic. Another reason for late case detection was likely due to parents and caregivers' fear of becoming infected with COVID-19, which prevented them from seeking medical help.

Another key WHO indicator for AFP surveillance is the timeliness of stool samples transported to a certified laboratory. Within three days (72 hours) of the date of the second stool sample collection, at least 90% of all stool specimens should arrive at the polio laboratory. Ondo State exceeded this goal, with an average of 87.4 percent of stool specimens arriving at the laboratory within 72 hours. The results revealed that the state did exceedingly well (100 percent) from 2016 to 2019, but then declined to 37 percent in 2020. This was partly due to the implementation of lockdown measures both within the state and across the country. Due to the restrictions of movement inside and outside the state, transportation of AFP stool samples collected during this time was delayed. As a result, a contingency plan and specific preparations were devised to avoid lengthy delays in the delivery of specimen samples to the Polio laboratory. AFP stool specimens arriving in the state from LGAs were kept at -20 degrees Celsius, batched, and transported to the Polio laboratory weekly.

Isolation of the non-polio enterovirus (NPENT) is also critical. This indicator refers to the viability and reliability of stool samples sent to the lab. It's expected that at least 10% of all stool samples sent to the polio lab will yield NPENT. During case investigation, the DSNOs also educated mothers and caregivers about the importance of maintaining reverse cold chain temperature by limiting the number of times the Geostyles that were given to them for stool sample storage were opened. The DSNOs or ADSNOs change the baked ice packs in the Geostyle after the first sample is collected to keep the stool specimens viable. The State government had installed working

freezer in all LGAs for the sole purpose of baking ice packs for case investigation and maintaining a reverse cold chain throughout sample transportation to the Polio lab. The state's usage of laminated cardboard papers provided to parents or caregivers was a noteworthy innovation. All parents and caregivers are educated on how to use these cardboard papers during case investigation, by the LGA DSNOs and ADSNOs. To reduce contamination, the AFP case defecates directly on the laminated paper, following which the stool specimen is scooped into the stool sample bottles with a specialized spoon or spatula.

According to the WHO virological classification, no AFP case was classified as Poliomyelitis, and no inadequate AFP case was classed as Poliomyelitis compatible. Despite the fact that the ARCC has declared Nigeria polio-free, there is a need to increase AFP surveillance in the state due to the risk of wild poliovirus and circulating vaccine-derived polio virus importation from endemic countries due to general human movement and the influx of displaced persons from security-compromised areas. It is critical to continue sensitizing DSNOs, ADSNOs, clinicians, surveillance focal persons in both focal reporting and non-reporting sites, and community informants. The active case search for AFP cases in health facilities and communities should be enhanced.

Conclusion

Over the five years of study, Ondo State's AFP surveillance performance has met the WHO AFP surveillance indicators' suggested minimum standards. The annualized non-polio AFP detection rates, stool adequacy, and stool specimens arriving the lab in good condition are all strengths of the AFP surveillance system. Between 2016 and 2020, there was a significant decline in case detection rates. To maintain the advances of Polio-free certification, AFP surveillance indicators must be improved, particularly in underperforming LGAs like Ifedore, Ilaje, and Owo. This is due to the possibility of poliovirus being imported from endemic countries. Routine surveillance review meetings, active case search in health facilities and communities, as well as the sensitization of all important surveillance actors should all be reinforced as part of the AFP surveillance program.

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