Evaluation of Acute Flaccid Paralysis (AFP) surveillance system, Kebbi State, Nigeria, 2013-2018

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Abstract

Background: Since 1988, the incidence of polio has reduced by more than 99 percent, worldwide, according to the WHO. Each year, more than 350,000 children were paralyzed, in more than 125 endemic countries. Today, only two countries are still having transmission of polio: Pakistan and Afghanistan. No wild poliovirus has been reported anywhere in Africa since 2016. A good and effective Acute Flaccid Paralysis (AFP) surveillance system is necessary to detect any suspected case of polio to interrupt the transmission of polio within any country. We evaluated the AFP surveillance system to identify gaps in its operations.

Methods: We used the updated CDC guidelines for evaluating public health surveillance systems and the WHO performance standards to assess the system. We also interviewed stakeholders using an adapted questionnaire, and a key informant interview. We also reviewed AFP surveillance data from 2013-2018. We summarized data using means, frequencies, and proportion.

Results: A total of 49 respondents were interviewed. Of these, 47 (98%) reported case definitions as being easy to use, and case investigation forms as being easy to fill, 46 (97%) reported data tools could easily accommodate changes, and all the surveillance officers understand the case definition of AFP. All respondents were willing to continue with the system. The non-polio AFP rate (24.6-55.2), stool adequacy (95-99.7%), timeliness, and completeness of reporting were found to be consistently above the WHO minimum standard.

Conclusion: The AFP surveillance system in Kebbi State was found to be useful, simple, flexible, acceptable, sensitive, representative, timely, and stable, though donor-driven. The absence of data on 60-day follow up and feedback from the laboratory was a major problem with the system.

Background

Poliomyelitis is a highly contagious viral disease caused by infection with the poliovirus (serotypes m1, 2, and 3) ¹. In about 0.5 percent of cases, it moves from the gut to affect the [central nervous system](#) and there is [muscle weakness](#) resulting in a [flaccid paralysis](#).² This can occur over a few hours to a few days.^{2,3} The weakness most often involves the legs, but may less commonly involve the muscles of the head, neck, and [diaphragm](#).² Many people fully recover.² In those with muscle weakness, about 2 to 5 percent of children and 15 to 30 percent of adults die.^[1] For all those infected, in up to 70 percent of infections, [there are no symptoms](#).² Another 25 percent of people have minor symptoms such as fever and a sore throat, and up to 5 percent have [headache](#), neck stiffness and pains in the arms and legs.^{2,3} These people are usually back to normal within one or two weeks.² Years after recovery, [post-polio syndrome](#) may occur, with a slow development of muscle weakness similar to that which the person had during the initial infection ^{1,2}

One of the measures in controlling polio is through vaccination of children. There is the orally administered, live attenuated polio vaccines (OPV) as well as the inactivated polio vaccines (IPV) for intramuscular (or subcutaneous) injection that are used internationally. OPV has been the vaccine of choice for controlling poliomyelitis in many countries, and for the global polio eradication initiative, because of the ease of oral administration, its superiority in conferring intestinal immunity in immunologically naive individuals, and its low cost. The only very rare adverse event associated with OPV use is vaccine-associated paralytic poliomyelitis (VAPP), which may occur in vaccine recipients or their contacts.^{5,6} CDC recommends that children get four doses of polio vaccine. They should get one dose at each of the following ages: 2 months old, 4 months old, 6 through 18 months old, and 4 through 6 years old.⁵

The primary series consisting of 3 OPV doses plus 1 IPV dose can be initiated from the age of 6 weeks with a minimum interval of 4 weeks between the OPV doses. If only 1 dose of IPV is used in the schedule, it should be given from 14 weeks of age (when maternal antibodies have diminished and immunogenicity is significantly higher) and can be co-administered with an OPV dose. Countries may have alternative schedules based on local epidemiology, including the documented risk of VAPP before 4 months of age.⁶

Routine vaccination with IPV alone should be used only in countries with high immunization coverage (> 90%) and at low risk of wild poliovirus importation and spread. A primary series of three IPV doses should be administered, beginning at 2 months of age. If the primary series begins earlier (e.g. with a 6-, 10- and 14-week schedule), a booster dose should be administered after at least 6 months (four-dose IPV schedule). Some such countries may use a sequential schedule of IPV followed by OPV.⁶

Before traveling to areas with active poliovirus transmission, travellers from polio-free countries should ensure that they have completed the age-appropriate polio vaccine series, according to their respective national immunization schedule. Adult travellers to polio- infected areas who have previously received three or more doses of OPV or IPV should also be given another one-time booster dose of polio vaccine. Travelers to polio-infected areas who have not received any polio vaccine previously should complete a primary schedule of polio vaccination before departure.⁶

Acute Flaccid Paralysis (AFP) is a clinical syndrome characterized by a sudden onset of weakness of a limb, described as flaccid (reduced tone) in a child below 15 years of age⁷. Many conditions are presenting in the form of AFP, apart from poliomyelitis, such as Guillain Barre Syndrome. therefore, AFP surveillance was adopted globally as a strategy for monitoring the progress of the polio eradication initiative (3,4). A good AFP surveillance system is a sensitive instrument for detecting potential poliomyelitis cases, therefore, alerting surveillance officers and clinicians to timely institute appropriate intervention measures to interrupt any poliovirus transmission. Effective AFP surveillance is essential for verifying the absence of wild poliovirus circulation in countries that no longer report any cases of poliomyelitis^(2,5).

There are three strains of wild poliovirus – type 1, type 2, and type 3. Type 2 wild poliovirus was declared eradicated in September 2015, with the last virus detected in India in 1999. Type 3 wild poliovirus was

declared eradicated in October 2019. It was last detected in November 2012.¹⁰ Only type 1 wild poliovirus remains. There are two vaccines used to protect against polio disease, oral polio vaccine and inactivated poliovirus vaccine.¹⁰ Wild poliovirus type 2 was eradicated in 1999 and no case of wild poliovirus type 3 has been found since the last reported case in Nigeria in November 2016.¹¹

Nigeria has put in place a surveillance system which has been adjudged to be very successful, as areas of high virus transmission are now better known due to quality surveillance data.¹²

With the support of WHO and partners like Rotary International, UNICEF, USAID, CDC and other bilateral and multilateral organizations, each state in the federation has at least one Surveillance Officer. Logistics support, including a vehicle, computers and accessories as well as communication facilities have also been provided.¹²

Relevant State Ministries of Health and Local Government staff are being supported to carry out surveillance of priority diseases including AFP in their various domains. The two National Polio Laboratories in Ibadan and Maiduguri have also received substantial financial and logistics support for their operations.¹²

Nigeria is one of the six polio-endemic countries in the WHO Africa Region. Others are Niger Republic, Angola, Sierra Leone, Mauritania, and Ethiopia. The countries and the world in general are expected to stop transmission of wild poliovirus by the end of this year and be certified polio-free by 2005. Three years are needed in-between the time of stopping the transmission of the virus and certification.¹²

The presence of wild poliovirus in Nigeria, despite many rounds of National Immunization Days (NIDs) carried out since 1997, may indicate poor quality of the exercise among other things. There is therefore need to ensure that appropriate measures are taken to ensure that Nigeria joins the rest of the world in being certified polio-free by 2005.¹²

The purpose of evaluating public health surveillance systems is to ensure that problems of public health importance are being monitored efficiently and effectively¹³. Additionally, evaluation helps to determine if a system is meeting the set objectives and whether the attributes are efficient to achieve these objectives. We described the operations of the Kebbi State AFP surveillance system, assess its key attributes and performance of the system in line with its set objectives¹⁴.

Methods

Kebbi is a state in the north-western part of Nigeria. The 2019 projected population of Kebbi State was 4,671,594 while the under-five population was 2,223, 679. It has 21 Local Government Areas (LGAs), 225 political wards, and 122 districts spread over four emirate councils namely Argungu, Gwandu, Yauri, and Zuru. Seventy percent of the people live in rural communities, where the predominant economic activities are fishing, farming, and trading. There are 22 general hospitals, 225 primary health care centres, a

Federal Medical centre, and a Specialist Hospital. In total, there are 203 focal sites for AFP which include all the secondary and tertiary public health facilities. And all the facilities offering routine immunization (RI) services offer free RI services.

Study tools and data management

i. Qualitative study

A structured self-administered questionnaire, adapted from previous similar studies and adapted for this study was used to obtain information from respondents (these are some of the respondents; State Epidemiologist, State DSNO, Assistant State DSNO, LGA DSNOs/ADSNOs). This is to assess their views on some of the surveillance system attributes (such as the simplicity, flexibility, representativeness, stability, usefulness, and acceptability of the system) ^{4,15–20}.

ii. Quantitative study

A KII was conducted among some Key informants which include the SE, State DSNO, and some randomly selected three Medical officers from the State general hospitals as well as the WHO surveillance focal person in the State. These were to obtain more information regarding acceptability, stability, representativeness, and challenges faced.

iii. Review of documents

We also used the WHO standard guidelines for AFP performance standards to assess some of the attributes such as the sensitivity, timeliness, data quality, of the system. Some of these WHO from the data obtained on AFP surveillance in Kebbi State within the review period. The WHO guidelines are:

Indicators of AFP surveillance performance

- Percentage of all expected monthly reports that were received: target $\geq 90\%$
- - Annualized non-polio AFP rate per 100 000 children under 15 years of age: target $\geq 1/100\ 000$
- Percentage of AFP cases investigated within 48 hours: target $\geq 80\%$
- Percentage of AFP cases with two adequate stool specimens collected 24-48 hours apart and ≤ 14 days after onset: **Target = $\geq 80\%$**
- Percentage of specimens arriving at the laboratory in good condition: target $\geq 80\%$
- Percentage of specimens arriving at a WHO-accredited laboratory within three days of being sent: **Target $\geq 80\%$**
- Percentage of specimens for which laboratory results sent within 28 days of receipt of specimens: **Target $\geq 80\%$** ⁷

Data analysis

- We cleaned, coded, and analysed the quantitative data we obtained from the self-administered questionnaires. Using IBM SPSS version 25
- We used Microsoft excel to co conduct a secondary data analysis of the AFP surveillance data between January 2013 to December 2018.
- For the qualitative data obtained we conducted a thematic analysis.

Table 1: Summarizing AFP key indicator surveillance data

Surveillance Attributes	Key indicators	Source of information
Data Quality	Timeliness and completeness of reporting	$\geq 90\%$; all reports should be at least 90% complete and at least 90% should reach the State on time (WHO target)
Sensitivity	1. Annualized NP-AFPR 2. Stool adequacy	NP-AFPR should be $\geq 1/100,000/\text{year}$ of under 15 Stool adequacy: $> 80\%$ of stool samples must be adequate (WHO target)
Simplicity	1. Simplicity of case definition 2. Ease of filling the CIF	From staff interviews
Flexibility	1. How easily the system integrates into IDSR 2. How easily the system can accommodate changes	From staff interviews
Acceptability	The willingness of the surveillance officers/stakeholders to continue to with the surveillance as well as the acceptance by the communities involved	From staff interviews
Stability	Presence of dedicated staff to carry out AFP surveillance, presence of structure as well as funding of the system	From staff interview
Representativeness	The ability of the system to be carried out in all parts of the State, touching all communities (urban and rural), both males and females	From the data review
Timeliness	1. Timeliness of case investigation of reported AFP cases 2. Timeliness of stool sample arriving the lab	1. All reported cases should be investigated within 24-48 hours
		2. All stools samples should arrive laboratory within 72 hours of collection (WHO criteria)

A key informant interview (KII) guide also adopted from similar studies (22), was used to gather information from relevant stakeholders (State epidemiologist, Medical officers, and Monitoring & Evaluation officers) to also gather information on stability representativeness, funding, and other challenges facing the system. Those selected for KII include: Kebbi state Epidemiologist, Deputy State DSNO, Chief Medical Officers in General Hospital Zauru and General Hospital Zuru.

A retrospective record review of the AFP surveillance data from 2013-2018 was carried out. We used the data to determine the sensitivity, timeliness, representativeness of the system. We assessed data quality, by determining the timeliness and completeness of reporting. Completeness was assessed by estimating the proportion of complete weekly reports that got to the State by close of work (4.00 pm) of Tuesday of the reporting week. Representativeness was calculated by determining the proportion of all the health facilities that report.

AFP notified cases aged <15 years old between January 2013 and December 2018 were analysed. The analysis was performed using Microsoft Excel version 2016. Evidence regarding performances were assessed using system attributes according to the CDC updated guidelines to describe the attributes of the surveillance system.

Ethical consideration

Permission was obtained from the Kebbi State Ministry of Health Ethics Committee. The participants (stakeholders) were interviewed privately and confidentiality of data was maintained. A written permission was also obtained from the Public Health Department of the Kebbi State Ministry of Health (doc no; MOH/STA/PER/6007/205751). Written consent was also obtained from the study participants as indicated in the questionnaire.

Results

Four thousand five hundred and thirteen cases (4513) of AFP were reported between January 2013 to December 2018, from all LGAs. Fakai and Ngaski LGAs reported 362 (8%) cases, while Bagudo reported 45 (1%). Non-polio AFP rate (NP-AFPR) for Ngaski and Fakai LGAs were 71.5/100,000 & 73.8/100,000 respectively, while Wasagu/Danko had NP-AFP rate of 20.1/100,000.

Data quality

The data is also valid because the surveillance system aims to detect AFP cases and the system has been consistently and effectively reporting AFP cases throughout the review period. Ninety-seven percent of data fields used were complete.

Timeliness and completeness of reporting

In the years under review, the timeliness of monthly reporting was consistently above 90% (Fig 1)

In the above figure, the least attained percentage by the surveillance system was 98% (in 2013 and 2018). The WHO cut off mark is 90%.

Simplicity

All the respondents knew that polio is a disease caused by a virus. 47 (97.6%) responded that the AFP case definition is easy to understand. The majority of the respondents 45 (97%) felt the case investigation form CIF is easy to fill, however, 33 (70%) believed there is a need for regular training and retraining.

Flexibility

The AFP surveillance is well integrated into the integrated disease surveillance and response (IDSR) system. The AFP surveillance system uses the minimum data collection recommended by the WHO which are few. It can easily accommodate new specific variables as needed. Though 50% of the respondents feel that any change in the surveillance system process can be accommodated by the data collection forms.

Acceptability

The system was generally found to be acceptable by the surveillance officers. All of them were willing to continue to participate in the AFP surveillance in the state. Interview with some focal persons in some health care facilities showed that they are willing to continue with AFP surveillance despite their busy schedules. Community informants were always willing to participate in reporting of suspected cases. Nonetheless, some private health care facilities were not fully reporting.

However, despite their willingness to continue with the current system as it is, 62% of the respondents said they have made contributions or suggestions on areas where they think the system can be improved. Among the suggestions were, the surveillance officers should be supported especially with means of transportation to improve active case search, to increase the number of focal sites, or to completely change the reporting system to electronic format. The majority, 74% of the respondents said their suggestions were considered and some were even implemented (e.g. they were supported with motorcycles, android phones, and the number of focal sites were increased).

Stability

There are dedicated surveillance officers from the State Ministry of Health (i.e. The State Epidemiologist, State DSNO, and his Deputy), from the Local Government Authorities (LGAs) (i.e. LGA DSNOs and their Deputies), Health Facility surveillance focal persons, Community Informants, etc. The State is also supported by The WHO Cluster Consultants, WHO LGA facilitators, Field Volunteers, etc. therefore, the AFP surveillance system in Kebbi State is stable. However, the system is donor-driven. The WHO provides all the logistic support, laboratory reagents and consumables, sample collection bottles, and transportation

of samples to the reference laboratories. Therefore, the system will be unstable the moment the donors withdraw their support.

Representativeness

The AFP surveillance system in the State is representative because the surveillance data analysed showed that the system is ongoing in all the LGAs in the State. Both males and females were represented in the data. Though there were more males (53%) than females (47%). It cuts across individuals from different ethnic backgrounds within the State, suspected cases cuts across individuals from different socioeconomic backgrounds, and all from both urban and rural settlements. The data is also obtained from both public and private health facilities.

The above figure is the map of Kebbi State, showing all the Local Governments involved in AFP surveillance. The map depicts that all the 21 LGAs were reporting throughout the review.

Sensitivity of AFP surveillance system in Kebbi State, 2013-2018

The Annualized non-polio AFP rate per 100 000 children under 15 years of age, target of $\geq 1/100\ 000$ has been consistently achieved by the studied surveillance system throughout the review.

The stool adequacy of ≥ 80 as prescribed by the WHO has been achieved throughout the review by the AFP surveillance system in the State.

The Because the minimum non-polio AFP rate ($\geq 1/100,000/\text{year}$ of under 15) and stool adequacy rate ($> 80\%$ stool samples must be adequate) were consistently above the WHO minimum standard, as depicted in the figures 3 and 4 respectively, the system is, therefore, sensitive.

Timeliness of AFP surveillance in Kebbi State (2013-2018)

Timeliness of case investigation & stool arriving lab on time

All AFP cases should be investigated within 24-48 hours of reporting and two stool samples should be collected 24 hours apart, and each should be adequate. Furthermore, all collected stool samples should reach the WHO accredited laboratory in good condition and on time (48-72 hours of collection)

At least 80% of cases of AFP reported, must be investigated within 24-48 hours of notification, as prescribed by the WHO. This has been consistently achieved in all the period of review. The least percentage attained was 98% (2014)

The minimum cut off mark for stool samples arriving at the laboratoty on time (72 hours after collection), is also 80%. This has also been achieved consistently by the AFP surveillance system in Kebbi State.

The proportion of AFP cases investigated within 48 hours of notification as well as the proportion of stool samples arriving at the lab on time (i.e. 72 hours from of being sent to the lab), between January 2013

and December 2018. Both results were consistently above the WHO minimum standard of 80%. The minimum level obtained was 98% (for timeliness of case investigation), and 99% (for timeliness of sample arriving at the laboratory on time).

The stool sample must arrive at the laboratory in good condition; this simply means that the stool:

- Must arrive at the designated laboratory on time (48-72 hours of collection),
- the quantity of stool collected must be at least 8g, not desiccated, the container and Case investigation form well labelled, the container well sealed and at a good temperature of 2-8⁰C (reverse cold chain).

Figures 5 and 6 above show the system met the minimum criteria set by the WHO, therefore, timely.

Discussion

AFP surveillance system in Kebbi State was found to meet some of the attributes of a good surveillance system. The state-level surveillance officers (State Epidemiologist, State disease surveillance and notification officer) and LGA-level health workers (DSNOs) attested to the ease of operation of the system which is well structured and flexible to changes. The ease of operation of the system was due to the simplicity of the data tools and case definition. These findings were similar to some studies conducted in Oyo State Nigeria and another survey in Ghana and Pakistan ^(12, 21-23) where the AFP system was found to be simple and flexible. However, it is in contrast to a study in Zimbabwe, where a good number of respondents found it difficult to fill the case investigation forms ¹⁷.

The Kebbi State surveillance system is majorly donor-funded. The WHO is the major funder, which provides logistic support for transportation during active case search, transportation of samples to the designated laboratories, provision of some laboratory reagents and consumables. And the surveillance officers; mainly the DSNOs are under the State's payroll. Even though, their transportation and other stipends come from the WHO. This is possibly the reason why almost all the surveillance system's attributes were achieved throughout the review period. The implication of these is, if the donors withdraw their funding today, the surveillance system may not stand on its feet. Previous studies in Oyo State, Nigeria showed the majority of funding was also from partner agencies.²² With this tremendous support from the WHO, the surveillance has been going on smoothly. The surveillance officers are incentivized by the donors on sample collection and transportation. However, if the donors chose to withdraw their support, the surveillance system will face a major setback.

In terms of data quality, the timeliness, and completeness of reporting, the system in Kebbi State has surpassed the 80% target by the WHO, throughout the review. Similar findings were seen in Oyo state²² but contrary to findings in other similar studies, wherein some cases, the reporting was not complete and not timely.¹⁷ This was due to bad roads and lack of dedicated mobility and resources to conduct active case search and transportation of samples to the laboratory on time.

We found out that the system was generally acceptable to the surveillance officers. All the respondents were willing to continue with the AFP surveillance. This is in line with several similar studies.^(25,23,12) This is probably because of incentivization and intensification of support by the WHO towards the eradication of polio. In yet another study, the AFP surveillance system was found to be less acceptable²³. This was because about 4% of respondents felt it wasn't their duty to fill the case investigation forms, though about 96% were willing to continue filling the forms.²³

The system was also representative. This is because the data collected were from all the tertiary and secondary health facilities across the State. From both urban and rural areas and includes all the focal primary health facilities both public and private. This is similarly found in other studies where the AFP surveillance system is representative^{14,21,24}. However, in another study, the system was found not to be representative. This is because data from private clinics and hospitals were not available.²³

Throughout the review (2013-2018), the AFP surveillance system in Kebbi State was found to be sensitive. The non-polio AFP rate and the stool adequacy were consistently above the WHO minimum standards. Similar results were found in other surveys.^{4,15,16,25} In other studies, the system was found not to be sensitive.^{17,21} An uninvestigated Case was found in a hospital in one of the studies¹⁸, and in another study, the insensitivity of the system was due to a failure to report a case as a result of lack of resources to conduct active case search, and transport stool specimens on time.¹⁷

Conclusion

The performance of the AFP surveillance system in Kebbi State was excellent. Most of the major stakeholders found the surveillance system to be useful and acceptable as it was able to detect cases. The surveillance system also played an important role in assessing the effectiveness of the current AFP control strategies. However, the system was discovered to be highly donor-dependent for funding and technical support.

Recommendation

Private healthcare facilities currently not reporting should be encouraged to report. Finally, Kebbi State should take complete ownership of the AFP surveillance system and ensure its sustainability by providing funding and logistic support.

Abbreviations

Acute Flaccid Paralysis (AFP)

Assistant state disease surveillance and notification officer (ADSNO)

Case investigation form (CIF)

Centre for disease control (CDC)

Disease surveillance and notification officer (DSNO)

Disease surveillance and notification officers (DSNOs)

Inactivated Polio Vaccine (IPV)

Key informant interview (KII)

Local Government Authorities (LGAs)

Ministry of Health (MOH)

Non-polio AFP rate (NP-AFPR)

Oral Polio Vaccine (OPV)

Routine immunization (RI)

Vaccine-associated paralytic poliomyelitis (VAPP)

Wild Polio Virus (WPV)

World Health Organization (WHO)

Declarations

Ethics approval and consent to participate

Ethics approval for this research work was granted by the Ethics and research committee of the Kebbi State Ministry of Health. Participants were adequately informed about the study, verbally. Confidentiality of their responses was assured; no personal identifiers were used on questionnaires.

Consent to publish

Not applicable

Availability of data and materials

The data for this study are available at the hands of the corresponding author, and the data are not shared with any third party. The six-year AFP data reviewed for this study was obtained from the Epidemiology Unit of the Kebbi State Ministry of Health. Other information obtained was from the use of a self-administered questionnaires, as well as KIIs.

Competing interests

The authors declared that they have no competing interests.

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Authors' Contributions

HAB (Principal author): proposed, designed, and implemented the study, did the analysis and writing up of the manuscript. YM and BN made significant contributions to the conception and design of the proposal, analysis, and interpretation of data. They also critically edit and approved the final manuscript. LS and PUO participated greatly in the cleaning and analysis of data, QGIS design.

All authors read and approved the final manuscript.

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Figures

Figure 1

Showing the percentage of all monthly reports received In the above figure, the least attained percentage by the surveillance system was 98% (in 2013 and 2018). The WHO cut off mark is 90%.

Figure 2

Map of Kebbi State showing all the LGAs where AFP surveillance is ongoing The above figure is the map of Kebbi State, showing all the Local Governments involved in AFP surveillance. The map depicts that all the 21 LGAs were reporting throughout the review.

Figure 3

Distribution of Non-polio AFP rate between 2013 and 2018 in Kebbi State

Figure 4

Stool adequacy of AFP cases reported in Kebbi State, 2013-2018

Figure 5

Timeliness of case investigation of reported AFP cases between 2013-2018

Figure 6

Timeliness of stool sample arriving the lab on time, Kebbi State, 2013-2018

Supplementary Files

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- [Appendix1.pdf](#)