Evaluation of Acute Flaccid Paralysis Surveillance indicators in Sokoto State, Nigeria, 2012-2019: A secondary data analysis

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Abstract

Background: Nigeria and indeed, entire Africa has been certified free of Wild Polio Virus (WPV) in 2020. However, the continent is still at risk of importation of WPV, especially in states like Sokoto in Nigeria, which has an international border. Furthermore, due to low immunity in some communities in Sokoto, outbreaks of the circulating Vaccine Derived Polio Virus (cVDPV) occur. Therefore, this paper evaluates the Acute Flaccid Paralysis (AFP) surveillance indicators in Sokoto state, Nigeria.

Methods: This retrospective study was an analysis of routinely collected AFP surveillance data between 2012 and 2019 by the Sokoto state surveillance network. We assessed the Sokoto state AFP surveillance system using the AFP surveillance performance indicators. We performed all analyses using Microsoft Excel 2019.

Results: Cumulatively, 3001 Acute Flaccid Paralysis (AFP) cases were reported over the evaluation period, out of which 1692 (56.4%) were males, and 2478 (82.4%) were below five years. More than half, 1773 (59.1%) had a fever at the beginning of the disease, and 1911 (63.7%) had asymmetric paralysis. The non-polio AFP rate (9.1 to 23.5%) and stool adequacy rate (92.5 to 100%) indicate high sensitivity. The proportion of cases that had stool samples collected early, timely transported to the laboratory and arrived at the laboratory in optimal condition were all above the World Health Organization (WHO) minimum standard of 80%. There was inadequate profile documentation of some suspected cases.

Conclusions: Sokoto State has exceeded the WHO minimum standards in most of the AFP surveillance indicators. The performance of the system is sufficient enough to detect any reintroduction of WPV into the state. However, there is a need for improvement in data quality.

Introduction

Wild Polio Virus (WPV) is a highly contagious viral disease that leads to poliomyelitis which mainly affects children below five years [1]. It transmitted human to human, mainly via the orofaecal route [2]. Out of 200 cases of poliovirus infection, one would lead to irreversible floppiness a limb (usually the lower extremities). Among those paralyzed, up to 10% die as a result of the failure of the respiratory muscles [1].

Following the introduction of the Global Polio Eradication Initiative in 1988, the proportion of new cases of paralysis due to WPV infection has dropped to less than one per cent [1, 3].

The polio searchlight of the world is now on Pakistan and Afghanistan, as Nigeria was recently declared free of poliomyelitis [4]. Eliminating the poliovirus in the remaining endemic countries would have led to the biggest-ever internationally-coordinated open wellbeing exertion in history [1].

Poliomyelitis is of public health importance because it is among the few diseases that can be eradicated with cheap and effective vaccines [1]. To eradicate polio, every child must receive the polio vaccine. The

vaccination should include those living in remote and underserved areas and in conflict zones like Borno state in Nigeria (where the last case in Nigeria was reported in 2016) [1]. The presence of just a child with poliovirus puts children worldwide at risk of contracting the virus. The continuous endemicity of poliovirus in certain countries may result in as numerous as 200 thousand new WPV cases each year and if unchecked may affect every continent within ten years [5]. Worse of all, once poliovirus causes paralysis, there is no cure [5].

Acute Flaccid Paralysis (AFP) cases present with similar symptoms and signs with poliomyelitis; hence, AFP surveillance is used worldwide as an approach for monitoring and evaluating the achievements of polio eradication initiative [6]. Sensitive AFP surveillance is able to detect all cases of poliomyelitis for immediate public health action. In countries that have been certified polio-free, effective AFP surveillance is a strategy to continually evaluate the absence of transmission [7, 8]. In countries that are not yet declared polio-free, surveillance plays a central role in the eradication process [9]. Therefore, high-quality AFP surveillance system is needed in proving and maintain the successful interruption of WPV [10].

Nigeria and indeed, entire Africa has been certified free of WPV [4]. However, the continent is still at risk of importation of WPV from Pakistan and Afghanistan, especially in states like Sokoto, which has international borders. Furthermore, the rare form of the poliovirus, the circulating Vaccine Derived Polio Virus (cVDPV) is affecting communities in Africa that are under-immunized, especially among hard to reach communities, migrant population, and those in conflict zones [9]. This is the case in Sokoto state where in the last one year, the state has recorded 6 cases of cvDPV2 from different sources – an indication of low population immunity and favourable factors for the transmission of cVPDVs [11]. Therefore, it is essential to continuously ensure that the AFP surveillance in Sokoto state is reliable enough to guide public health response towards the eradication of cVDPV in the context of the polio endgame strategic plan 2019 to 2023 [12].

Therefore, this study describes the findings from an eight-year AFP surveillance in Sokoto State and assesses the performance of the system with respect to the World Health Organization (WHO) surveillance indicators besides identifying the aspects that need improvement.

Methods

Study setting and design

Sokoto state is located in Northwest Nigeria, covering about 27,825 km^2 [13]. It shares a border with the Niger Republic to the North – making it prone to cross border importation of poliovirus[14], Zamfara state to the south and east, and Kebbi state to the west and south. The state has 23 Local Government Areas (LGAs) out of which four are metropolitan. The projected population of Sokoto state for the year 2019 using a growth rate of 3.01% from the 2006 national census [13] was 5,475,895, with children under-five and under-15 years having a projected population of 114,069 and 268,1364 respectively. The state has a substantial nomadic population who are polio high-risk group [14].

Description Of The Afp Surveillance System In Sokoto State

The mode of operation of the Sokoto state AFP surveillance system is similar to the other 35 states and the Federal Capital Territory, and it is part of the broader AFP surveillance system in Nigeria (Fig. 1). In the surveillance system, an AFP case is defined as "Any child under 15 years of age with the acute (sudden) onset of weakness or floppiness of one or more limbs or any person of any age with paralytic illness in whom a clinician suspects poliomyelitis" [15].

The primary purpose of the AFP surveillance system in Sokoto state is to detect and document the presence or absence of Wild Polio Virus in the state. The objectives of the AFP surveillance system in Sokoto state include:

1. To provide data-driven evidence that guides the advancement of strategies that lead to polio eradication.
2. To identify areas of cVDPV in Sokoto state.
3. To investigate all detected AFP cases and demonstrate the non-transmission of WPV in Sokoto state.
4. To assess the effect of Routine Immunization Activities (RIAs) and Supplementary Immunization Activities (SIAs) against polio.

The flow of data in the AFP surveillance in Sokoto state begins with the notification of every case by community informants (such as traditional bone setters) or the health facility focal persons to their respective LGA Disease Surveillance and Notification Officers (DSNOs). The DSNOs are responsible for ensuring that adequate stool samples are collected from suspected cases. They are also responsible for ensuring that the samples get to the national polio laboratory in Ibadan, Oyo state in optimal temperature accompanied with correctly filled AFP Case Investigation Forms (CIFs). The LGA DSNO has an assistant DSNO, and he is also supported by an LGA facilitator who is on the WHO payroll. The LGA DSNO is responsible for giving regular feedback to the reporting facilities, focal persons and communities.

The state epidemiologist and the state DSNO facilitate and oversee the activities of the LGA DSNO. The WHO cluster consultants assigned to different LGAs are responsible for verifying the suspected cases and conducting 60-day follow-up for cases that were not investigated within 14 days of onset of paralysis. The state epidemiologist gives feedback to the LGAs and reports to the Nigeria Center for Disease Control (NCDC), National Primary Health Care Development Agency (NPHCDA), Federal Ministry of Health (FMoH); and the state DSNO gives feedback to the LGAs on laboratory results (Fig. 1).

The funding of AFP surveillance System in Sokoto State is by the federal government, Sokoto state government, and LGAs with robust technical and financial support by development partners notably, WHO and Centers for Disease Control and Prevention (CDC) / Africa Field Epidemiology Network (AFENET). WHO sponsors the active case finding visits by DSNOs to AFP reporting sites. Additionally, the organization supports the DSNOs with transportation allowances to attend the monthly surveillance meetings at the states' capital. CDC/AFENET provides technical and human resource support to all the LGAs to complement Government resources.

Study Design

We conducted a retrospective descriptive analyses of AFP surveillance data in Sokoto state from January 2012 to December 2019. We included AFP cases reported in all the LGAs within the period in this study. We evaluated the AFP performance using the WHO indicators for assessing the AFP surveillance system [16].

Data Collection And Analysis

We sieved out information on age, gender, Oral Polio vaccine (OPV) doses, fever at the onset, asymmetry of paralysis, the progression of paralysis in 3 days and classification as true AFP. All analyses were done using Microsoft Excel version 2019. We conducted descriptive analyses and generated core performance indicators and other indicators recommended by the WHO for assessing the AFP surveillance system [16].

Results

In total, 3001 AFP cases were identified and reported by the AFP surveillance system in Sokoto between January 2012 and December 2019. Out of these, more than half, 1692 (56.4) were males, and more than three-quarters, 2478 (82.4%) were less than five years old. Almost all, 2959 (98.6%) had taken three or more OPV doses. More than half, 1773 (59.1%) had a fever at the onset of the disease, and many 1911 (63.7%) had asymmetric paralysis. More than one-third, 1178 (39.3) of cases had a progression of paralysis in 3 days (Table 1). Illela LGA had the highest proportion of cases cases, 251 (8.4%); while Tureta LGA had the least number of cases, 72 (2.4%) over the evaluation period (Fig. 2).

Cumulatively, the Sokoto State annualized non-polio AFP detection rate was 16.7 AFP cases per 100,0000 population below 15 years, indicating a sensitive AFP surveillance. Over the evaluation period, the annualized non-polio AFP rate was consistently above the minimum target of ≥ 2/100,000 in the state. (Table 2). Disaggregating the state cumulative non-polio AFP rate by LGAs showed that all the LGAs consistently surpassed the WHO minimum of 2 AFP cases per 100, 000 population of children below 15 years during the 8 years evaluation period (Fig. 3).

There was a consistent increase in the proportion of AFP cases with adequate stools from 92.5% in 2012 to 100% in 2016 and a drop to 96% in 2018 and 2019. Over the evaluation period, the stool adequacy performance was above the minimum target of 80% for the state (Table 2). Disaggregated by LGAs, all the LGAs met the minimum standard except, Kware, 67% in 2012; Yabo, 71% in 2018 and Tangaza, 75% in 2019 (Fig. 4).

All stool samples arrived at the laboratory within 72 hours of being sent during the evaluation period (Table 2). The laboratory performance indicator, Non-polio Enterovirus (NPENT) rate, was above the minimum level required over the 8-year evaluation period. (Table 2).

Table 1
Profile of the AFP cases reported in Sokoto state, Nigeria, 2012–2019

Profile	Number of AFP cases (n = 3001)	Percent
Age group (years)		
≤ 5	2478	82.5
6–10	383	12.8
11–15	17	0.6
> 15	91	3.0
Unknown age status	32	1.1
Gender		
Male	1692	56.4
Female	1309	43.6
OPV doses		
< 3	42	1.4
≥3	2959	98.6
Fever at onset		
Yes	1773	59.1
No	78	2.6
Missing	1150	38.3
Asymmetry		
Yes	1911	63.7
No	415	18.3
Missing	541	18.0
Progression in 3 days		
Yes	1178	39.3
No	52	1.7
Missing	1771	59.0
Classified as true AFP		

Profile	Number of AFP cases (n = 3001)	Percent
Yes	1187	39.6
No	31	1.0
Missing	1783	59.4

Table 2

AFP performance indicators for Sokoto State, Nigeria, 2012–2019

Performance indicator	Target	State performance							
		2012	2013	2014	2015	2016	2017	2018	2019
Annualized non-polio AFP rate /100,000 < 15 years population	≥ 3	13.5	15	20.1	23.5	19.1	21.7	11.8	9.1
Proportion of AFP cases with two adequate stool specimens	≥ 80%	92.5	97	99.3	100	100	99.7	96.7	96.1
Timeliness of monthly reporting	≥ 80%	100	100	89	100	96	100	100	96
completeness of monthly reporting	≥ 90%	100	100	99	100	97	100	100	97
Proportion of AFP cases investigated within 48 hours of notification	≥ 80%	98.3	100	100	99.4	100	100	100	100
Reported AFP cases with follow-up exam at least 60 days after paralysis onset.	≥ 80%	80.8	100	100	100	100	100	100	100
The proportion of specimens that arrived at a WHO accredited laboratory < 3 days of being sent	≥ 80%	100	100	100	100	100	100	100	100
Proportion of stool specimens arriving at the laboratory in good condition	≥ 80%	99.3	99.5	100	99.8	99	99	100	100
Proportion of stool specimens from which non-polio enterovirus was isolated NPENT	≥ 10%	14.9	11.1	11.4	9.5	14	13	14	13
AFP surveillance index	≥ 1.6	12.5	14.6	20.0	23.5	19.1	21.6	11.4	8.7

Discussion

This study involved a state-wide analysis of AFP surveillance data in Sokoto State and reports the findings of the evaluation of APF surveillance indicators from 2012–2019. Over the evaluation period, we found that children below five years were most affected, with over 80% of the cases. This finding

corroborates what has been stated by WHO that under-five children are most affected [17]. The finding indicates that the AFP surveillance system is identifying the primary age group affected. The finding in this study is comparable to what was reported in the evaluation of surveillance system in Ibadan (74.3%) [18] and in Akwa Ibom (82.5%)[19] states in Nigeria and Ghana(76.3%) [20]. However, a surveillance system evaluation in Zambia showed that 63% of cases were in the age group 10–15 years [21]; although a significant proportion of the cases did not have their age documented in the study which could have been responsible for their finding. More than half (56.7%) of the AFP cases observed in this evaluation were males. This finding is similar to what was reported in Ghana (55.8%)[20] and South Africa (54.3%) [8].

Almost all the AFP cases have had at least three doses of OPV through RIAs and SIAs activities. This is encouraging because it is an indication that Sokoto State is implementing the global polio eradication strategies. A similar finding was reported in the surveillance system evaluation in Ghana [20]. Worthy of note in the surveillance data was that some characteristics of the AFP cases were not documented. For example, 38.3% of the cases did not have documentation presence of fever at the onset of paralysis, and 59% did not have documentation on the progression of paralysis. This information is essential in determining whether a case is a "hot" case or not [15, 22]. Therefore, this poor quality of data can affect the performance of the surveillance system.

Maintaining a sensitive surveillance system that can detect WPV is critical in the eradication of poliomyelitis by enabling early response to importations and in certifying the complete interruption of transmission [12]. A well-performing AFP surveillance system should be able to pick a minimum of two AFP cases per 100,00 children younger than 15 years [23]. This is used as a proxy of the sensitivity of AFP surveillance system. This indicator measures the capacity of the surveillance system to detect AFP cases due to other causes than polio [15]. In this study, we found the AFP surveillance system in Sokoto to be sensitive. The minimum standard for non-polio AFP rate was surpassed throughout the period under review. It is crucial to monitor LGA performance because, state-level indicators may mask wide variation in LGA performance,[15] therefore, we disaggregated the data by LGA, and we found that all LGAs performed above the minimum standard. This finding is encouraging as Nigeria is no more an endemic country for polio transmission [4]; therefore, any reintroduction can be picked by the sensitive AFP surveillance system. This finding is especially important because Sokoto State has an international border. A similar finding was reported in Zambia, where the AFP detection rate was consistently above the national target for over five years of surveillance evaluation [21]. The finding our study is contrary to what was reported in a surveillance evaluation in Zimbabwe, where it was found not to be sensitive [24]. In South Africa, an increasing trend in the sensitivity of the AFP surveillance system was observed over five years – between 2005 and 2009; however, the target was only met in 2008 [8].

A stool specimen is adequate if collected 24–48 hours apart and within two weeks of the onset of paralysis and arriving at the laboratory in good condition [23]. The results from this surveillance evaluation showed that the proportion of stool samples adequately collected throughout the evaluation period was consistently above the minimum standard of 80%. After disaggregating, all LGAs performed

well, except 3 LGAs (Kware in 2012, Yabo in 2018 and Tangaza in 2019). This finding could be an indication that the community and parents are aware of the AFP surveillance system, leading to early detection and reporting. The finding could also be an indication that there are minimal causes of delays such as lack of involvement of health workers or inadequate logistics such as stock-out of kit sand transport.

The non-polio AFP rate and the stool adequacy rate are used as the standard for assessing the quality of AFP surveillance [22]. These two indicators can be combined into a single indicator of AFP surveillance quality, the surveillance index, which can be used to compare progress over time and or geographic differences [15, 22]. In this surveillance evaluation, the surveillance index for the state was greater than 2.5, indicating a robust AFP surveillance on average [15]. Using this index in maps helps in identifying areas of risk. Fortunately, in Sokoto State, no area of risk was identified using this index. The success in the surveillance index could be due to the regular capacity building and financial support provided by the WHO to the LGA DSNOs.

In addition to finding AFP cases, timeliness, and the quality of investigation of suspected cases are also vital in achieving the objectives of an AFP surveillance system. Stool samples were collected from almost all the suspected cases within 48 hours of notification. This could be attributed to proper training and supervision from WHO cluster consultants in the various LGAs in the state.

Laboratory investigation is fundamental to the confirmation of WPV; therefore, the integrity of the faecal samples arriving the laboratory should be good enough for laboratory confirmation of the presence or absence of the virus with a reasonable level of certainty. No WPV was isolated in Sokoto State during the evaluation period; therefore, with the high stool adequacy rate, any form of poliovirus transmission will be most likely picked by the AFP surveillance in Sokoto state. The finding in this study defers from what was reported in the evaluation done in North Korea, where stool adequacy was consistently lower than the WHO recommended standard of 80% [25].

To maximize the opportunity to isolate the poliovirus, with the highest probability occurring within the first 14 days, some indicators of AFP surveillance assess the timeliness of certain surveillance activities [22]. A minimum of 80% of faecal samples should reach the laboratory within three days of sample collection. [23]. The result from this evaluation revealed that in Sokoto State, all the stool samples were received in the laboratory within three days during the evaluation period. This positive finding could be a result of the stipend given to any surveillance officers who transport the samples to the laboratory. A contrary finding was reported in South Africa were the WHO minimum target was not met with regards to the timeliness of transportation of samples to the laboratory [8]. The finding could be because, in South Africa, courier services were used, which could experience some delays; however, in Nigeria, Sokoto State inclusive, the LGA DSNOs are responsible for the immediate transportation of the sample to the laboratory.

Very pivotal in the detection of poliovirus is the arrival of the stool samples in the laboratory within three days and samples being in good condition. These indicators also assess the timeliness of surveillance activities [22]. In this evaluation, at least 99 per cent of samples reached the designated laboratory in

perfect condition, and all samples arrived at the laboratory within three days. This finding gives a high degree of confidence that whatever findings in the laboratory reflect the actual situation. This positive finding could be attributed to the frequent sponsored training on polio surveillance activities by WHO in the state, close monitoring of surveillance activities by cluster consultants and provision of stipends for surveillance officers. The AFP surveillance system met the target for timeliness of monthly reporting over the evaluation period. This finding is important because this allows the state to take all necessary early actions to ensure polio certification.

The NPENT rate to assesses how the AFP surveillance system can maintain the reverse cold chain. It also to assesses the performance of the laboratories in the routine isolation of enteroviruses [15]. Sokoto state has performed well in this indicator over the evaluation period by exceeding the minimum value of 10%. This finding is important, especially in the post-polio era in Sokoto state, which still reports cVDPVs. It has been established that cVDPVs have the potential to combine and recombine with other enteroviruses, which can give rise to new strains of pathogenic [26]. Therefore, adequate NPENT surveillance will help detect and control any outbreak. Similar NPENT rates were recorded in the neighbouring Kebbi state between 2010 and 2015 [27].

An area of deficiency observed in this secondary data analysis is that the surveillance data obtained had no information on the timeliness of specimen processing. So we could not assess if stool sample results were sent back within 28 days of receipt of samples in the laboratory. It is essential to document this information as this will allow for assessment of the feedback channel.

Overall, the AFP surveillance indicators are meeting-up with the minimum targets. However, this should not create a state of complacency as it was observed in Jigawa state in 2011 where all the minimum standard for certification were surpassed, but following analyses of environmental samples, WPV and cVDPV were detected, indicating that certain chains of transmission had been missed [22]. Therefore, surpassing most of the surveillance indicator targets should not allow lowering of surveillance guards.

Conclusion

The AFP Surveillance system in Sokoto State has performed well over the past eight years by exceeding the minimum WHO targets both at the state and LGA levels. The system is sensitive enough to detect any importation of new cases into the polio-free Sokoto. However, there is inadequate documentation of laboratory results and some profile information on the suspected cases. We recommend that the state ministry of health should ensure that data managers document whether laboratory results return within 28 days of receiving the samples in the laboratory.

Abbreviations

AFENET	**Africa Field Epidemiology Network**
AFP	Acute Flaccid Paralysis
CDC	Centres for Disease Control and Prevention
CIFs	Case Investigation Forms
cVDPV	circulating Vaccine Derived Polio Virus
DSNOs	Disease Surveillance and Notification Officers
FMoH	Federal Ministry of Health
LGAs	Local Government Areas
NCDC	Nigeria Center for Disease Control
NPENT	Non-polio Enterovirus
NPHCDA	National Primary Health Care Development Agency
OPV	Oral Polio vaccine
RIAs	Immunization Activities
SIAs	Supplementary Immunization Activities
WPV	Wild Polio Virus

Declarations

Ethics approval and consent to participate: We sought ethical approval from Sokoto State Ministry of Health Research Ethics Committee before the commencement of the study. We protected the confidentiality of patients by using special codes. We expunged all personal identifying information from the data used. Data security was maintained using a password-protected computer.

Consent for publication: Not applicable

Availability of data and materials: The datasets generated analyzed during the current study are not publicly available because it is the property of Sokoto state Ministry of Health; however, the data but are available from the corresponding author on reasonable request.

Competing interests

Dr Chukwuma David Umeokonkwo, one of the authors of this manuscript is a member of the BMC Public Health editorial board member.

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Authors' contributions

IAR participated in conceptualization, analyses, writing original draft, and review and editing. AAU was involved in conceptualization, analyses and interpretation of data, review and editing Abdulrahman participated in data acquisition, analyses and interpretation of data. BBL contributed to conceptualization, analyses and interpretation of data, review and editing. CDU was involved in methodology, review and editing. AAO contributed to methodology, review and editing. SG was involved in conceptualization, methodology and review and editing. MB supervised the manuscript writing, review & editing. All authors read and approved the final manuscript.

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Figures

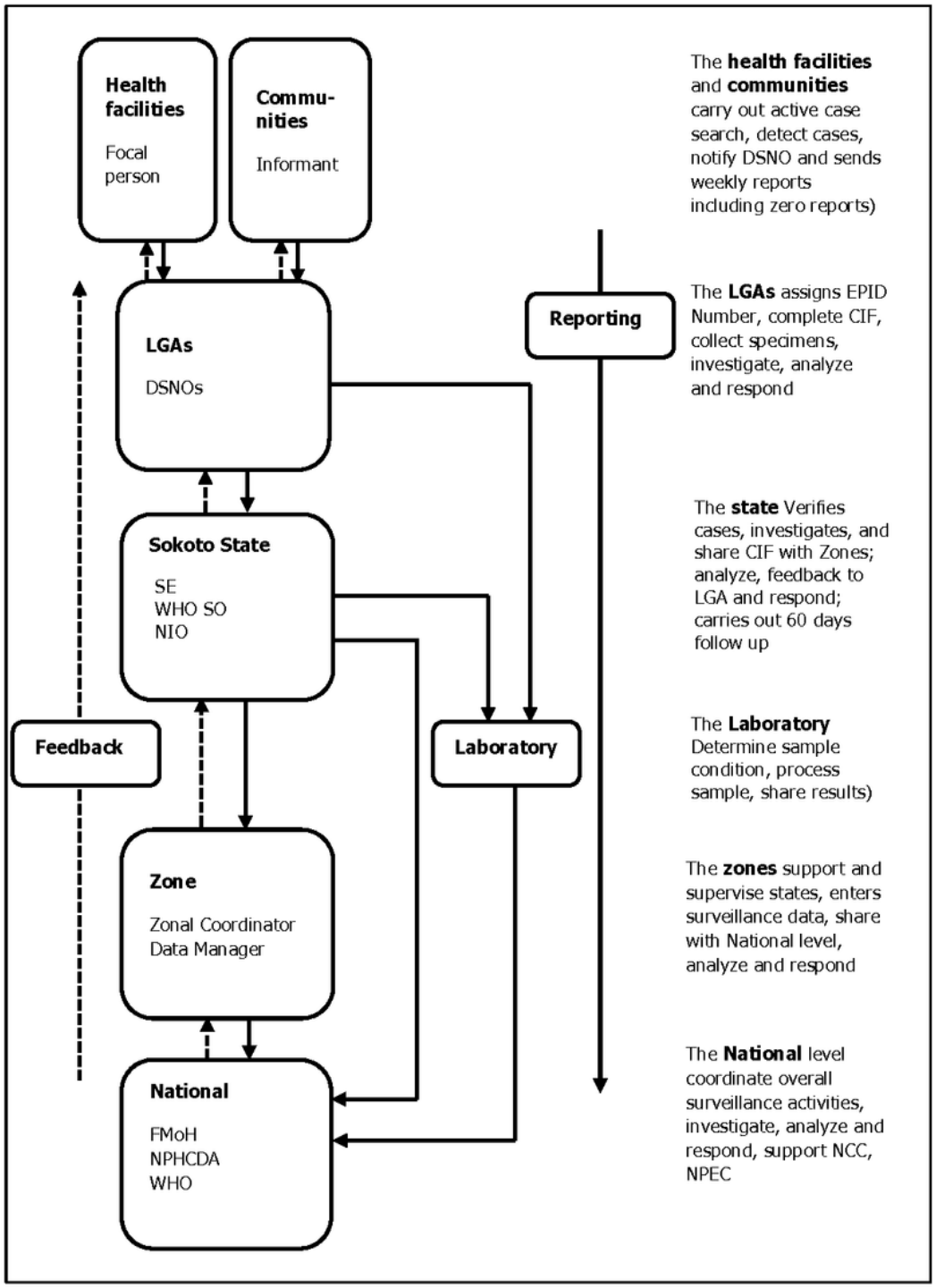

Figure 1

Flow chart of AFP surveillance system. CIF - Case Investigation Form, DSNO - Disease Surveillance and Notification Officer, FMoH - Federal Ministry of Health, NPHCDA - National Primary Health Care Development Agency, NIO - National Immunization Officer, NPEC: National Polio Expert Review Committee, SE: State Epidemiologist, WHO SO - World Health Organization Surveillance Officer

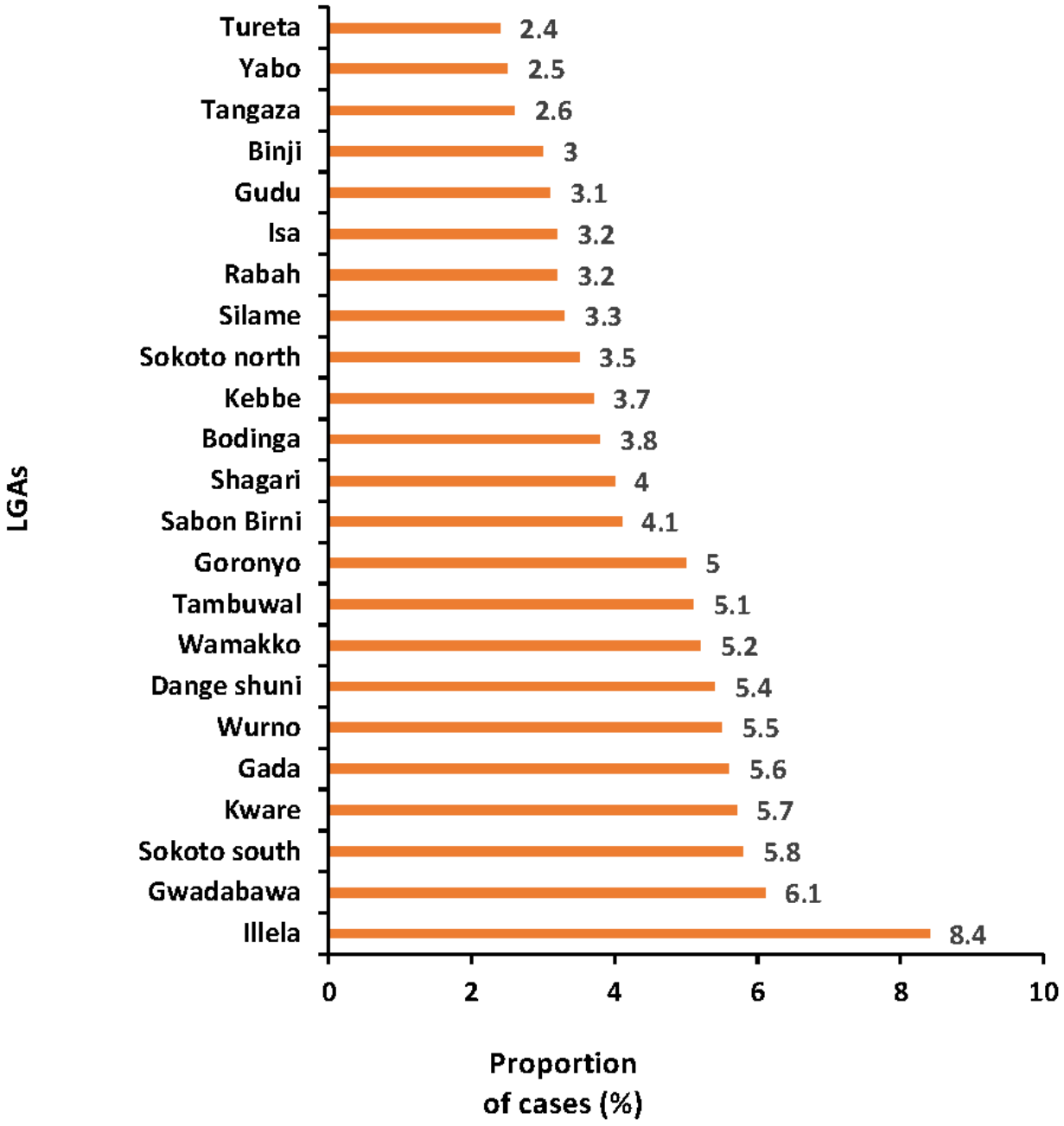

Figure 2

Proportion of cases seen in the LGAs in Sokoto state, 2012-2019

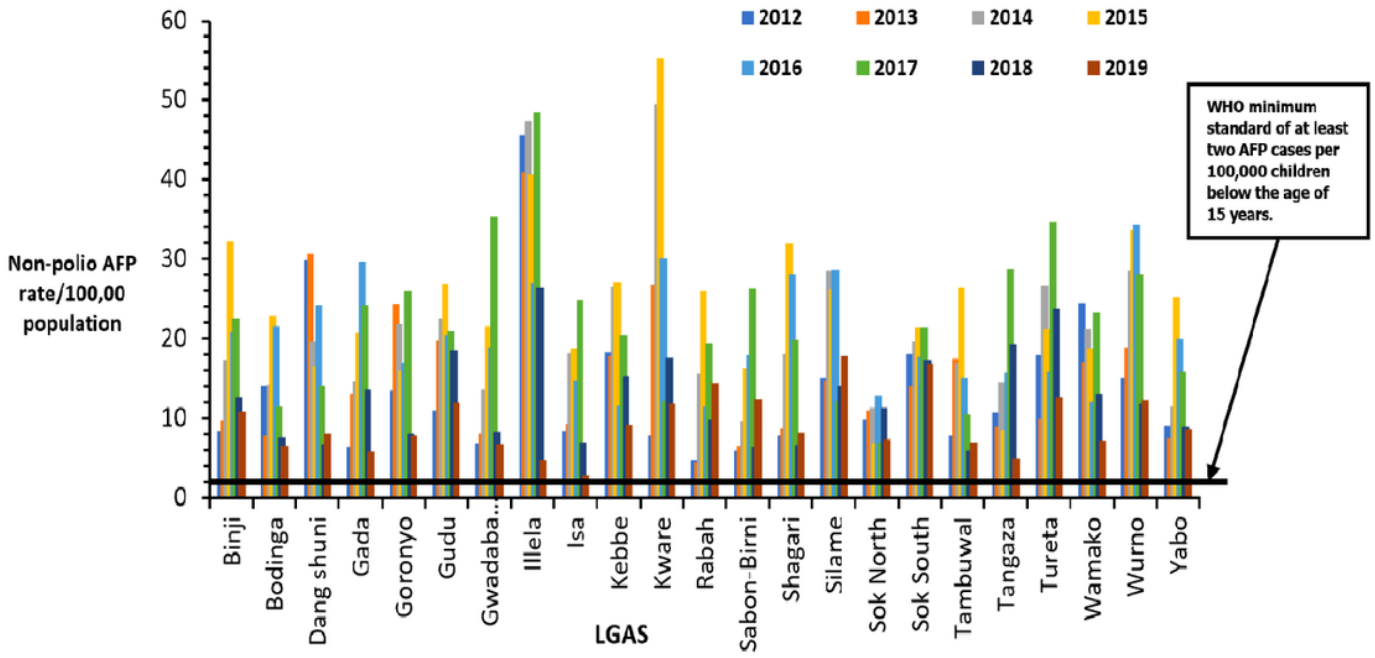

Figure 3

Annualised non-polio AFP rate by LGA for each year in Sokoto state, 2012-2019

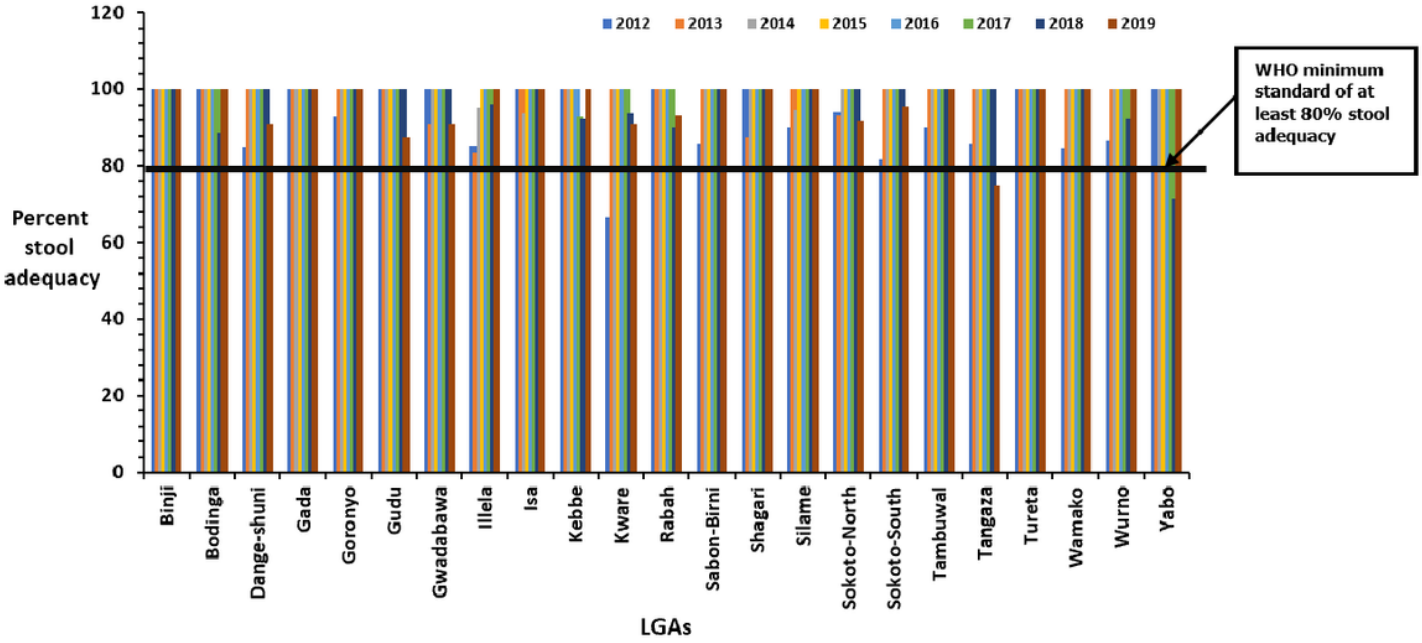

Figure 4

Stool adequacy rate by LGA for each year in Sokoto state, 2012-2019