

# Improving Acute Flaccid Paralysis (AFP) Surveillance Performance in South Sudan: The Contribution of Open Data Kit Mobile Data Collection Technology

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**Abstract Background:** Of all the mobile platforms used for data collection, the Open Data kit application has been the most reliable and most effective especially for polio surveillance. ODK was introduced to the polio surveillance system in South Sudan in 2017. This study highlights the contribution of ODK mobile data collection to improving EPI activities, monitoring, and performance in South Sudan. **Methods:** A descriptive retrospective study of supportive supervision data collected under the ODK platform from October 2017 to October 2018. ODK is a free and open-source data tool that provides an out-of-the-box solution for users enabling them to create data collection forms or surveys. **Results:** In 2016, all 323 AFP cases reported in South Sudan had no geocode location. However, in 2017 and 2018, 36% of the 385 AFP cases and 56% of the 178 reported AFP cases respectively had geocode location with the use of ODK. Cases with geocodes were highest in Western Bahr El Ghazal State for both 2017 and 2018. In 2016, evidence from the Zero reporting summary form showed a total of 17538 visits by surveillance officers to priority sites. Whereas, visits to priority sites as documented by ODK showed that surveillance officers made a total 567 visits in 2017 with the priority sites in Western Bahr El Ghazal being the most visited while those in Unity State were the least. **Conclusion:** Supportive Supervision and AFP Case verification using ODK has contributed to producing real-time data, the actual location of health facilities and cases, prompt program implementation and health interventions. All these have helped strengthen the country's AFP surveillance system.

**Keywords:** Open Data Kit (ODK), supportive supervision, AFP surveillance

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## 1. Introduction

The goal of the Global Polio Eradication Initiative (GPEI) is to ensure that no child suffers from paralysis due to poliomyelitis. [1,2] Tremendous progress has been made towards polio eradication since the inception of the GPEI in 1988 with a 99% decrease in the number of cases due to poliomyelitis worldwide. [3,4] Currently, the global health community is pushing to ensure the eradication of the remaining 1% of polio cases and mobile data collection is paramount to validating and ensuring the success of this important work. [5,6]

Information Technology (IT) has penetrated the domain of public health in many countries and the potential of harnessing IT for surveillance is unlimited. [7,8] The use of mobile phone technology to address health needs have

been documented in many African countries. For instance, Short Message Services (SMS) was used for case reporting in a surveillance system in Madagascar, [9] thousands of household data in Ethiopia was collected using Android-based electronic data collection and management system to conduct a survey for Neglected Tropical Diseases. [10] Indeed, the use of IT has ensured that several countries have standardized data collection tools for real-time independent monitoring and surveillance and this has helped improve decision making for planning and response purposes.

Of all the mobile platforms used for data collection, the Open Data kit application for Android phones have been the most reliable and most effective not just for polio surveillance but also other public health programs such as tropical diseases, integrated management of childhood illness and community epidemiology [11]. In 2010, a pilot survey was implemented in Nigeria using ODK for

monitoring polio eradication activities where data was transferred directly from the field to the server in real-time. [12] This technology facilitated the availability of data before the paper form of the survey was submitted for review and analysis. The result of such electronic feedback is that it allows health managers and epidemiologist to overcome the challenges of the paper form, delayed results and have data analyzed for an immediate corrective response.

ODK was introduced to the polio surveillance system in South Sudan in 2017. This study highlights the contribution of ODK mobile data collection to improving EPI activities, monitoring, and performance in South Sudan.

## 2. Methods

### 2.1. Study Location

This study location is South Sudan, a landlocked country in East-Central Africa. The country is predominantly rural with an estimated population of 12 million people.

### 2.2. Study Design

We analyzed supportive supervision findings collected by mobile phones under open data kit (ODK) platform from October 2017 to October 2018. ODK is a free and open-source set of tools. ODK provides an out-of-the-box solution for users to build a data collection form or survey, collect the data on a mobile device, send it to a server, aggregate the collected data on a server, analyze the data and extract it in useful formats. [5]

### 2.3. Data Collection Tools and Techniques

The checklist for Routine Immunization (RI) supportive supervision and AFP Cases Verification Checklist was uploaded to the mobile phones of the World Health Organization (WHO) officers [6]. The officers used the Integrated Supportive Supervision checklist to supervise health facilities conducting RI while AFP Verification Checklist was used for verification of AFP after samples are collected. The system replaced a paper-based data collection method [6]. After data had been collected at the field level, it was transferred to the central server. The

data was then downloaded from the server at the national level in real time [6]. The ODK platform has inbuilt data analysis for prompt feedback.

## 2.4. Data Analysis

We measured the Number of AFP cases that have geo-coordinates from 2016 - 2018; Supportive Supervision to AFP Focal Sites and Number of Supportive Supervision conducted to Health Facilities conducting RI. A GPS coordinate was captured at the beginning and end of supportive supervision to measure the actual geolocation of the facilities visited. We also performed a trend analysis of the collected information on surveillance and routine immunization over the study period.

## 3. Results

Table 1 shows the proportion of AFP cases with geocodes by states from 2016-2018 in South Sudan. In 2016, 323 AFP cases were reported in South Sudan. None of these cases had geocoded locations. In 2017 however, 36% of the 385 AFP cases reported had geocoded location. Cases with geocodes were highest in Western Bahr El Ghazal State and were lowest in Lakes.

In 2018, 56% of the 178 reported AFP cases in the country had geocode locations. Highest cases with geocodes came from Northern Bahr El Ghazal State (90.3%) and the least from Unity State (8%).

Table 2 shows the improvement in evidence of surveillance priority sites visits from 2016-2018. Nationally, the total number of priority sites for AFP surveillance in 2018 was 1076.

In 2016, evidence from the Zero reporting summary form showed a total of 17538 visits by surveillance officers. Whereas, visits to priority sites as documented by ODK showed that surveillance officers made a total 567 visits in 2017 with the priority sites in Western Bahr El Ghazal being the most visited while those in Unity State were the least visited.

In 2018 however, surveillance visits to priority sites rose to 4214 visits with priority sites in Lakes being the most visited while those in Warrap were the least visited. This gave a National Percentage increase of 76.3% in Surveillance Sites Visit with evidence from 2017 – 2018.

Table 1. Proportion of AFP cases with geocodes by states from 2016-2018

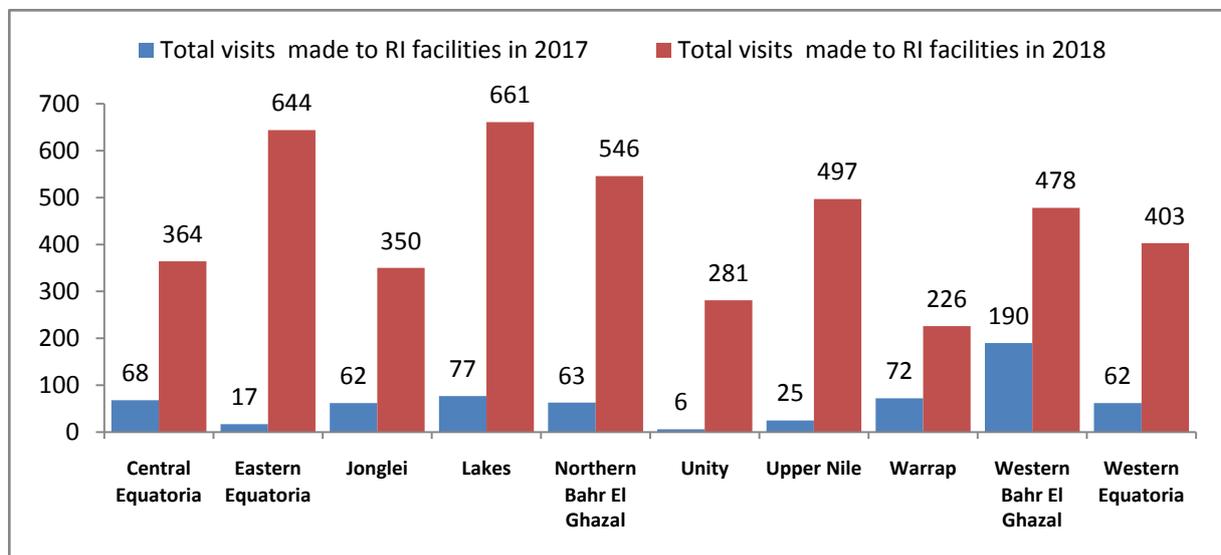
State/Province	Total AFP case reported 2016	Number of cases with geocodes 2016 (%)	Total AFP case reported 2017	Number of cases with geocodes 2017 (%)	Total AFP case reported in 2018	Number of cases with geocode 2018 (%)
Central Equatoria	14	0 (0)	12	8 (67)	22	15 (68)
Eastern Equatoria	39	0 (0)	47	9 (19)	32	24 (75)
Jonglei	34	0 (0)	35	6 (17)	32	11 (34)
Lakes	57	0 (0)	59	5 (9)	46	34 (74)
Northern Bahr El Ghazal	30	0 (0)	48	37 (77)	31	28 (90)
Unity	12	0 (0)	36	5 (14)	25	2 (8)
Upper Nile	27	0 (0)	30	10 (33)	36	8 (22)
Warrap	47	0 (0)	52	20 (39)	47	31 (66)
Western Bahr El Ghazal	17	0 (0)	19	21 (111)	16	5 (31)
Western Equatoria	46	0 (0)	47	16 (34)	30	20 (67)
<b>National/ Total</b>	<b>323</b>	<b>0 (0)</b>	<b>385</b>	<b>137 (36)</b>	<b>317</b>	<b>178 (56)</b>

\*As at October 2018.

**Table 2. Improvement in evidence of surveillance priority sites visits 2016-2018**

State/Province	Total number of Priority Sites	Total priority sites visit from zero reporting summary form in 2016	Total Priority site visits using ODK in 2017	Total Priority site visits using ODK in 2018	(%) Increase in Surveillance sites visits with evidence from 2017-2018
Central Equatoria	43	1318	64	320	66.7
Eastern Equatoria	163	2854	14	615	95.5
Jonglei	49	222	62	337	68.9
Lakes	84	892	59	627	82.8
Northern Bahr El Ghazal	236	779	61	507	78.5
Unity	93	642	6	279	95.8
Upper Nile	75	3668	25	479	90.1
Warrap	79	3332	62	217	55.6
Western Bahr El Ghazal	65	1251	178	468	44.9
Western Equatoria	189	2580	36	365	82.0
National	1076	17538	567	4214	76.3

\*As at October 2018.



**Figure 1.** Summary of Supportive Supervisory visits to routine Immunization Health facilities using ODK 2017-2018

Figure 1 shows the Summary of Supportive Supervisory visits to routine Immunization Health facilities using ODK 2017-2018. In 2017, supportive supervisory visits to Routine Immunization Health Facilities as documented by ODK were particularly low. Facilities in Unity were visited least (6 visits with ODK) while those in Western Bahr El Ghazal State (190 visits the captured on ODK) were most visited. However, in 2018, there was a significant increase of Visit conducted with the use of ODK across the nation with the highest from Lakes state and the least from Unity State.

#### 4. Discussion

AFP surveillance continues to meet the certification standard performances globally and with the introduction of the ODK collect application to the AFP surveillance in South-Sudan, surveillance gaps related to the mode of data collection, data quality and accountability are being bridged. This study highlights the contribution of ODK mobile data collection to improving EPI activities, monitoring, and performance in South Sudan.

The importance of collecting geocode locations in AFP surveillance is to be able to specifically determine the location of AFP cases, clustering of such cases and provide the appropriate intervention. Prior to 2017, spot maps for AFP cases were randomly generated. The same thing was applicable to Ethiopia and Somalia. [13,14] However, with the introduction of ODK, 35.6% and 56% of the AFP cases in 2017 and 2018 respectively had geocoded locations giving a true reflection of AFP cases by place.

Priority sites in AFP surveillance refer to areas with a dense population of target children (0-15years of age). These are priority sites because children therein would be most susceptible to the poliovirus without routine surveillance an immunization. Surveillance officers are supposed to visit these areas routinely to sensitize, carry out supportive supervision for both AFP and RI and conduct active AFP case search all in a bid to make sure that AFP cases are not missed and ensure the surveillance system remains sensitive. However, field supervisors in past conducted active case search for AFP, Measles and Neonatal tetanus and summarized these visits in figures which had no means of verification to authenticate that

active surveillance for the said case-based surveillance diseases/conditions occurred. For example, in 2016, field officers visited all priority sites in the country 17,538 times without proof. It is important that these visits are authenticated and verified because it serves not just as a means of monitoring the progress of AFP surveillance but also as a way to make surveillance officers accountable for the clusters, which they have been assigned to work.

Since the introduction of ODK, the needed evidence of health staff who actually visit their priority sites frequently as expected with active case search conducted on a weekly basis are now being provided.

The discoveries made on the surveillance system from using the ODK platform since 2017 have been used for decision-making and feedback to health staff and health facilities. Such discoveries have also afforded the EPI/PEI program the opportunity to revise the AFP Surveillance guidelines to address the existing challenges in the field; developing terms of reference for surveillance focal persons and training of all staff involved in surveillance, replacement of old surveillance posters and the provision of posters and guidelines to all health facilities. This platform to a large extent also guided National and state EPI/PEI teams in the identification of weak health facilities and staff in need of frequent support. The same level of progress was reported in Jordan following the introduction of ODK to its surveillance system. [15]

Since the introduction of ODK, supportive supervisory work has been conducted using a structured checklist which covers areas such as planning and implementation of immunizations, defaulter tracing, cold chain, temperature monitoring, and vaccine stock management, Adverse events following immunization, wastage management, data recording and documentation and funding of immunizations. Data is obtained in near real time despite the internet and mobile phone challenges encountered from time to time.

Some of the gains from conducting supervisory visits through the ODK platforms include the introduction and distribution of standardized immunization monitoring charts to health facilities in which hitherto were not available in most health facilities visited, prompt intervention on issues pertaining to cold chain such as unavailability of vaccine refrigerator due to vandalism or technical faults, poor temperature recording, no or faulty thermometers, and on the job coaching of health staff in health facilities visited in areas pertaining to AFP surveillance and RI. Other areas of improvement include the quality and consistency of reporting supervisory visits to facilities and investigation of AFP cases. All these have helped improve the surveillance system in the country.

However, there are some challenges with using ODK especially in a security-challenged country like South Sudan. These include delay in uploading field data to the servers in areas without phone networks, charging the phones due to poor power and the seizures of the ODK mobile phones by the security agents in the country who believe that the phones may be used to spy on the government or for espionage in the IO-held areas.

Supportive supervision and AFP case verification using ODK have contributed to producing real-time data, the actual location of health facilities and cases, prompt program implementation and health interventions. All

these have helped strengthen the country's AFP surveillance system.

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## Authors' Contributions

SM, BEB, BG, AU, KA contributed to the study design, interpretation of results, and manuscript conceptualization and preparation. SM, and BEB prepared the manuscript. All authors read and approved the final manuscript.

## Ethics Approval and Consent to Participate

The consultation of an ethics committee and consent to participate is not required for analyses based solely on secondary data.

## Consent for Publication

Not applicable.

## Competing Interests

The authors declare that they have no competing interests.

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