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Evaluation of Acute Flaccid Paralysis Surveillance System in Afghanistan during 2020: A Retrospective Secondary Data Analysis

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ABSTRACT

Background: We aimed to evaluate the acute flaccid paralysis (AFP) surveillance system focusing on indicators reflecting the performance of the system in Afghanistan.
Methods: This retrospective study was a secondary analysis of routinely collected AFP surveillance data during 2020 in Afghanistan. The standard WHO indicators were used to evaluate the AFP surveillance.
Results: Afghanistan reported 3972 AFP cases during 2020; of them 2228 (56%) were male while 2835 (71%) were children aged under five years. Of all AFP-reported cases, 56 were wild polio cases and almost half (n= 28, 50%) of them were reported among children aged 12–24 months. Almost 348 (8.8%) had taken zero doses of the vaccine both in routine and supplementary immunization activities (SIA). Approximately 83% (n=3290) had fever at the onset of the disease while 50.4% (n=2001) had asymmetric paralysis. Two southern provinces, i.e., Kandahar and Helmand, reported 30 (54%) wild polio cases. In 2020, the non-polio AFP rate was 17/100,000 in children below 15 years of age. Meanwhile 42 (75%) of wild polio cases patients received zero oral polio vaccine (OPV) through routine immunization while 24 (43%) wild polio cases received zero OPV through NID campaigns. All other indicators met the expected target except that 851 (21.4%) specimens arrived at the laboratory within 3 days and 180 (41.3%) were followed up after onset of paralysis in 60 days.
Conclusion: The AFP surveillance performed well in 2020. However, timely investigation of AFP cases and reaching the specimen to the lab should be improved.

Keywords: Afghanistan; Acute flaccid paralysis (AFP); Poliomyelitis (Polio); Eradication; Surveillance; Evaluation

Introduction

Poliomyelitis (Polio) is a viral disease caused by an RNA enterovirus with three subtypes of PV1, PV2, and PV3; however, heterotypic immunity between these serotypes is minimal. The virus enters the body through the mouth and then replicates in the oropharynx, intestine, and local lymphatic system. Later, it enters the bloodstream, which spreads to the central nervous system, i.e., the spinal cord and brain. The possible outcome after introduction is the resolution of infection without symptoms, mild disease, and paralysis (1). Polio is near to be eradicated

from the world, and only Afghanistan and Pakistan are two remaining endemic countries where cases still exist and have active circulation.

When the Global Polio Eradication Initiative (GPEI) was established in 1988, an estimated 350,000 poliomyelitis cases were reported worldwide. In 2020, 140 wild poliovirus (WPV) cases were confirmed, representing a 99.99% reduction since 1988. WPV type 1 transmission remains endemic in only two countries (Pakistan and Afghanistan), but outbreaks of circulating vaccine-derived poliovirus (cVDPV) occurred in 33 countries during 2019–2020 (2,3). While today there are only two endemic countries, the world is closer than ever to eradicating another disabling and life-threatening disease. As of Oct 2024, 23 polio confirmed cases have been reported from Afghanistan and 41 cases from Pakistan (4).

Globally, there were 140 wild poliovirus (WPV) and 932 cVDPV2 cases in 2020. Afghanistan reported 56 WPV and 306 cVDPV2 cases. Cros- border transmission of cases is common between Afghanistan and Pakistan because of having shared borders of 39 districts in 10 provinces of the south, southeast, and eastern regions of Afghanistan. Their shared borders are recognized as one polio epidemiological block to coordinate efforts to stop wild virus circulation (3).

The Polio Eradication Initiative (PEI) has taken vast steps using the key strategies including improving routine immunization coverage with polio and other recommended vaccines, supplementary immunization activities (SIAs) consisting of national and subnational immunization days (NIDs), surveillance for acute flaccid paralysis (AFP) (5). Therefore, the AFP surveillance is one of the four cornerstone strategies of the PEI focusing on being very sensitive by casting a wide net and collecting any case with even a possibility of being polio, and then using culture to confirm the presence of the virus. While it is difficult to diagnose polio cases clinically, it is easy for all levels of health workers to understand the AFP. The main purposes of AFP Surveillance are to detect the presence of circulating wild-type poliovirus as a measure of progress toward eradication and using information to plan preventive and response measures. AFP surveillance is also the main source for virus isolates and timely genetic sequencing to refine the microepidemiology of viruses. Finally, AFP surveillance provides the main documentation for the country's certification that it is free of polio (6). Because of these critical roles played by AFP surveillance, it is essential that the system must be thorough, timely, and accurate. Furthermore, the AFP surveillance system is launched to ensure that cases of AFP in less than 15-year-old children are detected and monitored efficiently and effectively. Therefore, to ensure that the system is on track and achieving its objectives, it should be evaluated periodically, and the evaluation should include recommendations for improving quality, efficiency, and usefulness (7).

In Afghanistan, the AFP surveillance was reviewed in 2015 and 2016 to know a few indicators including quality, sensitivity, and timeliness of the system. The evaluation in 2016 found that the system is geographically well-distributed, representative, and sensitive to identify and detect the AFP cases. In practice, the system is active surveillance with focal points in sentinel sites which need to be more systematic. The awareness and knowledge of health workers about the system was good. Data analysis and reporting were complete and meticulous maintenance of case records and other surveillance documents were maintained (8). Later, a comprehensive review was conducted by the WHO and reported that Afghanistan’s surveillance system is achieving all sensitivity targets, and the likelihood of undetected poliovirus transmission is low (9). Hence, AFP surveillance system structure is well

developed and functional in the country, which includes a network of reporting community volunteers, focal points in health facilities, provincial polio officers, provincial management team of expanded program for immunization (PEMT), regional management team for EPI (REMT), and national emergency operation center for polio (NEOC) in Kabul (10).
As regularly said evaluation of surveillance systems is required to know its effectiveness and efficiency. Given that field epidemiology training program (FETP) has enrolled group of technical staff from polio and EPI section who are learning the epidemiology, biostatistics and public health surveillance and evaluation of any public health surveillance system is part of their assignments. Therefore, we aimed to assess the various attributes of AFP surveillance system in Afghanistan which will identify the strengths and weaknesses and formulate recommendations for its improvement.

Materials and Methods

We conducted a retrospective descriptive analyses and assessment of AFP surveillance data in Afghanistan which included data from Jan–Dec 2020. The standard WHO indicators were used to evaluate the AFP surveillance (11). The indicators and the targets mostly used in assessments are as below:

- Non-polio AFP rate per 100,000 in less than 15–year–old children (target >2/100 000 population).
- Reported AFP cases with 2 stool specimens within 14 d of onset of paralysis (target >80%).
- Notification of AFP cases within 7 d (7-10) of onset of paralysis (target >80%).
- Reported AFP cases investigated within 48 h of notification (target >80%).
- Timeliness of weekly reporting (target >80%).
- Completeness of weekly reporting (target >90%).
- Stool specimens reaching a WHO accredited laboratory within 72 h (target >80%).
- Stool specimens reaching laboratory in good condition (target >80%).
- Stool specimens with a turnaround time <28 d (target >80%).
- Stool specimens from which non-polio enteroviruses were isolated (target >10%).

The WHO was approached and data for AFP surveillance was obtained for 2020. Then, after transfer of data to Epi Info version 7, descriptive data analysis and calculation of indicators was performed. The protocol of the study was submitted, and approval was granted by Institutional Review Board (IRB) of Afghanistan National Public Health Institute (ANPHI) at Ministry of Public Health, Kabul Afghanistan.

Ethical Approval

This study was submitted to Institutional Review Board (IRB) Ministry of Public Health Afghanistan. The protocol was approved by email of IRB secretariat on 17 July 2021. Data and samples from AFP cases were collected and analyzed anonymously within the national AFP Surveillance system as part of secondary analysis.

Results

During 2020, a total of 3972 cases of AFP were detected, reported, and analyzed. Out of them, 2228 (56%) were males and 2835 (71%) children aged under five years. The mean age of cases was 50 months, with standard deviation (SD) of 41.6 months. Among these cases, 348 (8.8%) had taken zero doses of vaccine both in routine and supplementary immunization activities while 105 (2.6%), 163 (4.1%), 173 (4.4%),

189 (4.8%), 204 (5.1%), 177 (4.5%), and 2613 (65.8%) had taken one, two, three, four, five, six, and seven or more doses of OPV either in routine or SIA programs, respectively. Approximately 83% (3290) of the children had fever at the onset of the disease and 2001 (50.4%) had asymmetric paralysis. After analysis of notification data from each province, it was found that two southern provinces, Kandahar and Helmand, reported 30 (54%) wild polio cases. Almost 75% (42) of wild polio cases received zero OPV through routine immunization, while 24 (43%) wild polio cases received zero OPV through NID campaigns (Table 1). Furthermore, just 192 (4.8%) of all AFP cases had received no vaccination either from routine or supplementary activities.

Table 1: Characteristics of cases of acute flaccid paralysis (AFP) in Afghanistan during 2020 (N=3972).

Characteristics	***Subcategories***	***Frequency***	***Percentage***
Age group in months	≤ 5	90	2.27
	6 to 11	380	9.57
	12 to 23	837	21.07
	24 to 59	1414	35.60
	≥ 60	1251	31.50
Regions	Badakhshan	83	2.09
	Central	734	18.48
	East	543	13.67
	North	337	8.48
	Northeast	429	10.80
	South	798	20.09
	Southeast	426	10.73
	West	622	15.66
Sex	Female	1744	43.91
	Male	2228	56.09
Oral Polio Vaccine (OPV) doses	0	192	4.83
	1	110	2.77
	2	108	2.72
	3	100	2.52
	4	113	2.84
	5	134	3.37
	6	130	3.27
	≥7	3085	77.67
Fever at onset (N=3937)	Yes	3297	83.01
	No	640	16.11
Asymmetry of Paralysis (N=3970)	Yes	2001	50.38
	No	1969	49.57

Totally the highest proportion of AFP cases was reported from the south region (n=798, 20.1%) while the central, west, east, northeast, southeast, north and Badakhshan regions reported 734 (18.5%), 622 (15.7%), 543 (13.7%), 429 (10.8%), 426 (10.7%), 337 (8.5%) and 83 (2.1%) cases, respectively. Furthermore, the frequently encountered final diagnosis for AFP was Guillain Barre Syndrome, which constituted 1207 (42%) of the reported cases, followed by meningitis or meningoencephalitis 356 (12.6%), 176 (6.3%) traumatic neuritis, and the rest other relevant diagnosis. However, the spelling errors of complications with some data were observed when the datasets were reviewed and analyzed.

Nonpolio AFP Rate

For the sensitivity of the surveillance system, the nonpolio AFP rate was determined and practiced for the AFP surveillance system. According to target, annually at least two cases of nonpolio AFP should be reported for every 100,000 children aged under 15 years. The average nonpolio AFP rate during the 2020 by AFP surveillance system was 17/100,000, which is surpassing the target. During the evaluation period, the annualized non-polio AFP rate was consistently above the minimum target of ≥2/100,000 in all provinces. Disaggregating the cumulative non-polio AFP rate by geography showed that all the provinces consistently surpassed the WHO minimum of 2 AFP cases per 100,000 population of children under 15 years (Table 2). The population used for this calculation was the one used in the polio eradication program estimated by UN agencies.

Table 2: Nonpolio acute flaccid paralysis (AFP) rate in Afghanistan, 2020

Provinces	*Population*	*Less than 15 years*	*All AFP Cases*	*Polio related AFP*	*Nonpolio AFP*	*Nonpolio AFP Rate*
Bamyan	504947	227226	82	0	82	36.09
Farah	1017533	457890	179	21	158	34.51
Kunar	784440	352998	120	10	110	31.16
Paktia	789398	355229	115	6	109	30.68
Zabul	741200	333540	112	15	97	29.08
Parwan	817913	368061	84	1	83	22.55
Baghlan	1510851	679883	151	1	150	22.06
Nangarhar	2948640	1326888	336	46	290	21.86
Panjshir	144929	65218	14	0	14	21.47
Samangan	542184	243983	52	1	51	20.90
Wardak	804404	361982	79	5	74	20.44
Kandahar	2653578	1194110	332	90	242	20.27
Badghis	827542	372394	87	12	75	20.14
Ghor	1062402	478081	93	1	92	19.24
Nuristan	222800	100260	21	2	19	18.95
Paktika	902949	406327	82	5	77	18.95
Takhar	2042733	919230	162	1	161	17.51
Khost	1138976	512539	111	22	89	17.36
Jawzjan	791640	356238	65	4	61	17.12
Herat	3379609	1520824	263	4	259	17.03
Urozgan	769564	346304	77	19	58	16.75
Sar-e Pol	741744	333785	52	1	51	15.28
Laghman	765807	344613	66	15	51	14.8
Nimruz	406713	183021	31	4	27	14.75
Kunduz	1714944	771725	116	3	113	14.64
Kapisa	773082	347887	49	0	49	14.09
Ghazni	1851427	833142	118	8	110	13.2
Badakhshan	1382669	622201	83	2	81	13.02
Logar	678729	305428	43	4	39	12.77
Kabul	6216269	2797321	343	8	335	11.98
Helmand	3547193	1596237	246	56	190	11.9
Daikundi	751073	337983	40	1	39	11.54
Balkh	2184044	982820	105	3	102	10.38
Faryab	1538947	692526	63	1	62	8.95
Total	46950876	21127894	3972	372	3600	17.04

Therefore, the table shows all provinces and national indicator for nonpolio AFP rate have crossed the target of either one or two per 100,000 population of less than 15 years, and all cases fully detected the estimated cases. Furthermore, 13 (38.2%) of provinces achieved a proportion of 20 AFP cases, 9 (26.4%) provinces achieved a proportion of 15 to 20 cases, and 12 (35.3%) achieved a proportion of 9 to15 cases of AFP per 100,000 population of under 15 years.

Notification and Investigation

Based on the definitions of the AFP, cases should be notified within 7–10 d after onset and should also be investigated within 48 h after being notified. Out of all cases, 3339 (84.1%) were notified within ≤ seven days, while 355 (8.9%) within 8–10 d and 277 (7%) within ≥11 d. The date of notification for one case was missing. Furthermore, 3941 (99.9%) were investigated within ≤48 h after notification, and just 29 (0.7%) were investigated in ≥3 d. For two cases, the date of investigation was missing. So, in both indicators, the target of 80% was met by the surveillance system.

Stool Collection

The percentage of AFP cases with two adequate stool specimens collected 24–48 h apart and ≤14 d after onset is an important indicator for the surveillance system. After analysis of data, in 3273 (93.7%) cases, the specimens were collected in ≤14 d after investigation. While in 209 (5.3%) of cases, it was collected in >14 d. In about 40 (1%) of cases, the date for collection of sample or date of onset was missing. In addition, in 2698 (65.7%) cases the two specimens were collected within 24 h, in 1111 (28%) the two specimens were collected within 48 h apart while in 253 (6.4%) of the cases two specimens were collected within 72 h apart. Therefore, both targets met the 80% which were set for the program.

Specimen Transportation

According to the program, after collection of specimens, it should reach the WHO accredited laboratory within 3 d. Then the result of laboratory should be distributed to stakeholders in <28 d after receiving the specimens. In 2020, 851 (21.4%) specimens arrived at laboratory within 3 d while 3077 (77.5%) reached to the laboratory in >3 d. For the rest of the samples, the date for collection or reaching the laboratory was missing. Transportation of samples to the laboratory was not timely and did not reach the target of 80%. Furthermore, 2134 (53.7%) reached the laboratory in >5 d and 1295 (32.6%) arrived at the laboratory in ≥7 d which was later than the time determined by the program. The number of days when the specimens for which laboratory results were out and sent within 28 d of receipt of specimens 114 (2.9%) was difficult to measure from current data. However, the result was out after obtaining the samples of 114 (2.9%) in less than 5 d, in 831 (20.9%) samples in 6–10 d, in 2977 (74.9%) of samples in 11–15 d and in 41(1%) of cases the result was out. There is a need to know when the sample was collected, how long it takes to be transported, and the result was reached to first-level sample collectors.

Non polio enterovirus (NPEV) Isolation

To ensure the quality of the reverse cold chain, there is an indicator to isolate NPEV in at least 10% of stool specimens submitted to the laboratory. This indicator also reflects the efficiency of the laboratory in performing routine isolation of the enterovirus.

Overall, 709 (17.8%) of the cases of enterovirus were isolated by cell culture from the stool samples of AFP cases. This indicator varied from 7/21 (33%) in Nuristan Province to 8/71 (10.1%) in Wardak Province. However, the average of this indicator was almost 18% which is crossing the target of 10% determined for the program. Nevertheless, the results of 40

(1%) AFP cases were pending at the end of year 2020.

Stool Adequacy

According to AFP surveillance system supported by the WHO, two stool samples must be collected at least 24 h apart, both within 14 d of the onset of paralysis. Sample shipment should be done under cold chain to be received in good condition at the reference laboratory. Good condition implies that upon arrival there is ice or a temperature indicator showing <8 C in the container, the specimen volume is adequate (> 8 gr), there is no evidence of leakage or desiccation. Anyway, the system has set the target that at least 80% of the cases must have two adequate stool samples. The general proportion of adequacy rate of stool was 3678 (92.6%). However, it differed geographically in provinces. For instance, the proportion of AFP cases with adequate stools varied from 61/77 (79.22%) in Urozgan to 14/14, 43/43 and 79/79 (100%) in Panjshir, Logar, and Wardak provinces, respectively. Disaggregated by provinces, all localities met the minimum standards (Figure 1).

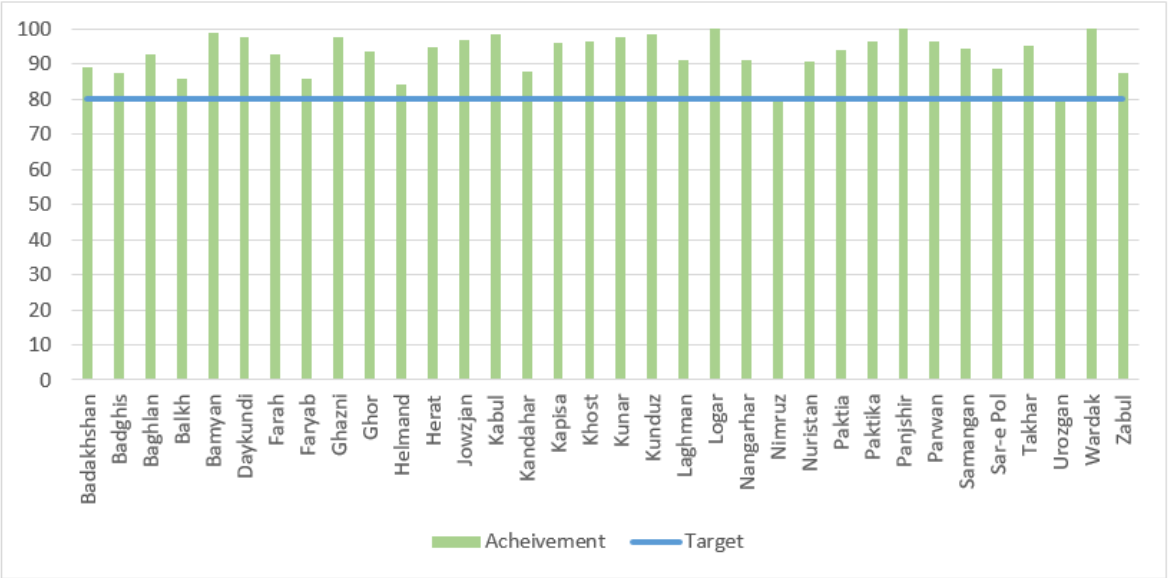

Figure 1: Adequacy of stool samples (by percentages) collected and tested for AFP cases in 34 provinces of Afghanistan in 2020.

Following-up of cases

The percentage of AFP cases requiring a follow-up examination that were examined at 60 d after the onset of paralysis was another indicator of the surveillance system required to be conducted and considered in evaluations. In this analysis, there were 435 cases that required to be followed for 60 d. Out of them 65 (1.6%) died, 14 (0.4%) lost to follow up, 122 (3.1%) had no weakness, and 234 (5.9%) still had the weakness. Furthermore, 180 (41.3%) were followed up after onset of analysis in 60 d.

Discussion

Based on the assessment of performance indicators, the evaluation of the AFP surveillance system in Afghanistan is well established with good quality. The system has the highest sensitivity as this study showed that non-polio AFP cases were more detected by this system compared to the target which is set of 2 cases per 100,000 children under 15 years of age. Therefore, it is sensitive enough to detect any polio cases reported in the country. Similar findings of the high sensitivity of

the AFP surveillance system were reported from Sudan (12), Pakistan (13), and Yemen (14) while the current study findings were higher than the neighboring country Iran (15). These findings were not only meeting the indicator but also in agreement in all the provinces of Afghanistan. Majority of AFP cases were notified and investigated timely as determined by the system. The proportion of AFP cases with two adequate specimens taken in ≤14 d in 24–48 h apart was also surpassing the target. It means stool samples adequately collected during 2020 and was beyond the minimum standard of 80%. The findings were similar with robust AFP surveillance system reporting their evaluation of surveillance system in literature (16).

Timeliness in shipment of samples from site of sample collection to provincial level and then to the reference laboratory and final the circulation of results was an issue. This was probably due to some problems the specimens were kept at provincial level, central level, and other levels as it was not tested within the country and required to be shipped to national institute of health (NIH) in Pakistan. These delays could be due to insufficient time for transportation or inadequate attention to transport the sample on time which require more in-depth investigation. Detection of non-polio enterovirus was also meeting minimum standard of 10% showing the system was collecting the right specimen at right time. This indicator reflected the performance of laboratory which was being above the minimum level in other countries (17,18). Furthermore, adequate specimens were collected in good condition and reached the laboratory with proportion of more than 80% of the cases. This finding was consistent with reports of other countries with AFP surveillance system (19,20). In addition, the 60 day follow up of the cases were conducted by the system and the data were recorded in AFP surveillance system.

The analysis of dataset for AFP surveillance system were not restricted by legal values in data entry. Therefore, the spelling errors were common in the system. The age of records should not go beyond 15 years or 180 months but some records surpassing the age entry cut off point. Although most of indicators met the targets set by the system, but still we could not ignore the issues related to security and hard-to-access populations that might affect AFP surveillance and limit interpretation of surveillance indicators. Additionally, high NPAFP rates do not necessarily indicate highly sensitive surveillance because not all reported AFP cases might meet the case definition. Some actual AFP cases might go undetected and background NPAFP rates might vary.

Conclusion

High-quality surveillance is critical to reaching the milestone of global polio eradication and includes timely and effective AFP case detection, notification, and investigation; specimen transport; and laboratory testing. Frequent monitoring of surveillance indicators could help identify gaps, guide improvements, and enhance the overall sensitivity and timelines of poliovirus detection to successfully achieve polio eradication.

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Conflict of interest

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial

interest in or financial conflict with the subject matter or materials discussed in the manuscript.

References

1. What is polio? [Internet]. Centers for Disease Control and Prevention; 2022 [cited 2024 Mar 22]. Available from: https://www.cdc.gov/polio/what-is-polio/index.htm
2. Chard AN, Datta SD, Tallis G, et al. Progress toward polio eradication—worldwide, January 2018–March 2020. MMWR Morb Mortal Wkly Rep. 2020; 69:784–9.
3. Alleman MM, Jorba J, Greene SA, et al. Update on vaccine-derived poliovirus outbreaks—worldwide, July 2019–February 2020. MMWR Morb Mortal Wkly Rep. 2020;69:489–95.
4. GPEI weekly surveillance report. [https://polioeradication.org/this-week/30]
5. Banerjee K, Sahu S, Sarkar S. Strategies for eradication of poliomyelitis--the Indian experience. Indian J Public Health. 2000 Jan-Mar;44(1):5-14.
6. Surveillance to track progress toward polio eradication - worldwide, 2020–2021 [Internet]. Centers for Disease Control and Prevention; 2022 [cited 2024 Mar 22]. Available from: https://www.cdc.gov/mmwr/volumes/71/wr/mm7115a2.htm
7. Centers for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group. MMWR Recomm Rep. 2001 Jul 27;50(13):1-35.
8. External Review of Acute Flaccid Paralysis Surveillance. Summary Report June, 2016. https://polioeradication.org/wp-content/uploads/2017/04/AFG_Ext.AFPSurveillanceReviewRep_JUN2016.pdf
9. Afghanistan completes largest ever review of polio surveillance system [Internet]. World Health Organization; 2022 [cited 2024 Mar 22]. Available from: https://www.emro.who.int/afg/afghanistan-news/afghanistan-completes-largest-ever-review-of-polio-surveillance-system.html
10. Polio Eradication Initiative Afghanistan. National Emergency Action Plan 2022. National Emergency Operations Centre, Afghanistan. https://polioeradication.org/wp-content/uploads/2023/02/Afghanistan-NEAP-2022.pdf
11. World Health Organization. Recommended Surveillance standards for vaccine-preventable diseases. 2. Geneva: World Health Organization; 2018.
12. Ali AS, Allzain H, Ahmed OM, Mahgoub E, Bashir MB, Gorish BM. Evaluation of acute flaccid paralysis surveillance system in the River Nile State-Northern Sudan, 2021. BMC Public Health. 2023 Jan 18;23(1):125.
13. Nadeem-ur-Rehman S, Hafeez U, Khan MA, Bukhari MA. Acute Flaccid Paralysis Surveillance System: Current Status in Azad Jammu& Kashmir-2018. Pak J Public Health. 2019 Dec 9;9(2):54-6.
14. Almoayed KA, Break AB, Al-Qassimi M, Assabri A, Khader Y. The acute flaccid paralysis (AFP) surveillance system in Yemen, 2010-2015: descriptive study based on secondary data analysis. JMIR Public Health and Surveillance. 2019 Dec 6;5(4):e14413.
15. Davarpanah MA, Bakhtiari H, Mehrbani D, Khadem AF. A 12-years surveillance of poliomyelitis and acute flaccid paralysis in Fars Province, Southern Iran. Iran Red Cres Med J. 2024; 10:1-6.
16. Raji IA, Abubakar AU, Ahmad A, Gidado S, Olorukooba AA, Lawal BB, Umeokonkwo CD, Balogun M. Evaluation of acute flaccid paralysis surveillance indicators in Sokoto state, Nigeria, 2012–2019: a secondary data analysis. BMC Public Health. 2021 Dec;21:1-9.
17. Raji IA, Abubakar AU, Ahmad A, Gidado S, Olorukooba AA, Lawal BB, Umeokonkwo CD, Balogun M. Evaluation of acute flaccid paralysis surveillance indicators in Sokoto state, Nigeria, 2012–2019: a secondary data analysis. BMC Public Health. 2021 Dec;21:1-9.
18. Olaoye I, Fatiregun A, Opeyemi E, Adeleke D, Jacdonmi T, Fagbemi S, et al. An Epidemiological evaluation of Acute Flaccid Paralysis surveillance performance in Ondo State; Nigeria, 2016-2020. Int J Epidemiol Health Sci, 2021;

2(Continuous): -. doi: 10.51757/IJEHS.2.12.2021.246984

19. Amodan BO, Kisakye A, Okumu PT, Ahirirwe SR, Kadobera D, Driwale A, Ario AR. Trends of key surveillance performance indicators of acute flaccid paralysis: a descriptive analysis, Uganda, 2015–2020. BMC Public Health. 2022 Sep 7;22(1):1694.

20. Hamisu AW, Etapelong SG, Ayodeji I, Richard B, Fiona B, Gidado S, Abbott SL, Edukugho AA, Bolu O, Adeyelu A, Mawashi KY. Experience and findings from surveillance peer review in Nigeria, August 2017-May 2019. The Pan Afr Med J. 2023;45(Suppl 2).