ACUTE FLACCID PARALYSIS SURVEILLANCE FOR POLIO, SOUTH AFRICA AND OTHER AFRICAN COUNTRIES, 2019

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Summary

The adequacy of acute flaccid paralysis (AFP) surveillance, the poliovirus surveillance system recommended by the World Health Organisation (WHO), is measured against international benchmarks. For January to December 2019, the South African national non-polio AFP detection rate was 3.5/100 000 children under 15 years, compared to 2.9/100 000 children under 15 years in 2018. The national average non-polio AFP detection rate exceeded the WHO's target of 2.0/100 000 population under 15 but did not reach the country's target of 4.0/100 000. Seven of the 52 districts in South Africa (SA) (13.5%) did not reach 2.0/100 000. Stool adequacy of less than 80% was reported in one of South Africa's nine provinces. Transport time between sample collection and receipt at the laboratory exceeded three days in 58% of samples. Therefore, AFP surveillance in SA has aspects still requiring strengthening.

Introduction

In 1988, when the Global Polio Eradication Initiative (GPEI) was established[1], there was an estimated 350 000 cases of wild poliovirus (WPV) types 1, 2 and 3 in more than 125 endemic countries. Since then, the global incidence has decreased to 175 reported cases of WPV type 1 in 2019 in the two endemic countries that remain affected. The last case of WPV type 2 was reported in 1999, leading to declaration of eradication of WPV type 2 in 2015. WPV type 3 has not been detected since November 2012 and was declared eradicated in October 2019. In South Africa, the last wild poliovirus case occurred in 1989.

Globally, two types of polio vaccines are used routinely, inactivated polio vaccine (IPV) to prevent symptomatic polio, and oral polio vaccine (OPV) to prevent both symptomatic polio and polio transmission. IPV is an injectable vaccine consisting of all three poliovirus serotypes. OPV is composed of live attenuated polioviruses and can be monovalent (mOPV, type specific) or bivalent (bOPV, types 1 and 3). The type 2 Sabin strain was globally withdrawn from OPV in April 2016. The polio vaccination schedule for South Africa comprises bivalent

OPV at birth and 6 weeks, and IPV as part of a hexavalent vaccine at 6, 10 and 14 weeks, followed by a booster at 18 months. Globally it has been shown that in geographic areas with low vaccination coverage, and therefore low herd immunity to polio transmission, Sabin strains can circulate in the environment for prolonged periods, resulting in mutation and circulation of vaccine-derived poliovirus (cVDPV) - posing a challenge to the GPEI.

The National Institute for Communicable Diseases (NICD) serves as the national polio reference laboratory for AFP surveillance in South Africa and other southern African countries, including Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Seychelles and Swaziland. The NICD additionally serves as the regional reference centre for the polio laboratory network of the WHO African region, and conducts molecular characterization of poliovirus isolates from the national laboratories of the Democratic Republic of Congo (DRC), Ethiopia, Niger, Uganda, Cameroon, Central African Republic and Zambia.

There were 313 AFP cases caused by cVDPV2 within the WHO African region in 2019. These cases included samples analysed at NICD and reported here. These cVDPV2 cases were from Nigeria, DRC, Niger, Zambia, Chad, Angola, Benin, Ethiopia, Togo, Central African Republic, Burkina Faso and Ghana. Outside of the African region, China had 1 cVDPV2 case in 2019, and Myanmar and Malaysia reported outbreaks of cVDPV1, where Philippines had cases of cVDPV1 and cVDPV2. Somalia also reported 3 cases of cVDPV2 (www.polioeradication.org[1]).

Methods

Nationwide, case-based surveillance for AFP was conducted in South Africa in 2019. Surveillance comprises field and laboratory components.

Field Surveillance

Cases of AFP from all health facilities were notified to the Provincial and National Departments of Health with samples collected for investigation and case investigation forms forwarded to the NICD. An adequately investigated case requires the collection of two stool specimens from the AFP case within 14 days of onset of paralysis. The stool samples should be collected 24-48 hours apart, transported on ice and should arrive at the NICD laboratory within 72 hours of collection. Field surveillance, conducted through active case detection by retrospective record review targeting children under 15 years was conducted periodically throughout the year, targeting high priority sites. In 2019, the South African operational non-polio AFP target detection rate was 4.0/100 000, while the WHO target detection rate remained at 2.0/100 000. The National Polio Expert Committee (NPEC) met quarterly to determine the final classification of all inadequately investigated AFP cases (Table 1).

Laboratory methods

Viral Isolation was performed by inoculation of clarified faecal material into cell culture, followed by microscopic examination of the cells for cytopathic effect, which indicates the presence of suspected poliovirus. Intratypic differentiation (ITD) by polymerase chain reaction (PCR) was conducted on suspected poliovirus isolates.[2] Polioviruses were then sequenced to classify them as either WPV, Sabin or VDPV. Sequencing helps to monitor

poliovirus transmission pathways and transmission links. South African polioviruses were sequenced at the VP1 region and 5' untranslated region (UTR).

Table 1. Polio case classification system used by South Africa's National Polio Expert Committee (NPEC).

Status	Classification	Code	Reason
Final	Confirmed (wild-type)	A1	Wild-type poliovirus found in stool sample of case or one of the contacts
	Confirmed (vaccine-associated)	B1	Vaccine-type poliovirus found in stool sample of case, which has residual paralysis at 60-day follow-up; is confirmed clinically
	Compatible	C1	AFP[a] case lost to follow-up at 60 days
		C2	Death related to the illness within 60 days
		C3	Residual paralysis for which no other medical reason is evident
	Discarded	D1	No residual paralysis and no wild polio found in stool samples
		D2	Confirmed alternative diagnosis
		D3	Non-Polio Enterovirus isolated
		D4	No virological investigation and a clinical picture incompatible with polio
		D5	Two adequate negative stool specimens within 14 days of onset of paralysis
	Denotified	E1	Not an AFP[a] case
Pending	Inadequate information	F1	NPEC[b] is unable to make a decision due to the lack of information. The investigating team is given 30 days from the committee meeting to find further details. The final decision is taken at the next NPEC[b] meeting.
	60-day follow-up not yet done	F2	Final decision is referred to the next NPEC[b] meeting for final decision

[a]Acute Flaccid Paralysis
[b]National Polio Expert Committee

Results

South Africa

A total of 1268 samples was received from 636 cases with date of onset of paralysis between 1 January and 31 December 2019. No wild-type strains were detected. Sabin Poliovirus type 1 was detected in two cases, one each in Eastern Cape and Limpopo provinces, and Sabin Poliovirus type 3 was detected in two cases from Gauteng. Detection of Sabin virus from stool is usually a coincidental finding in countries using OPV; no case was classified by the NPEC as vaccine-associated paralytic poliomyelitis (VAPP). The 2019 NPEC final classification of 2019 AFP cases is listed in table 2.

Table 2. Final classifications of acute flaccid paralysis (AFP) cases in South Africa, 2019 (courtesy of the National Department of Health).

Classification	Number	Percentage of total cases
Compatible	2	0.3
Discarded	594	93.4
Denotified (not an AFP)	29	4.6
Pending	11	1.7
Total	636	100

Surveillance Indicators:

The NP AFP detection rate measures the sensitivity of the surveillance program and is calculated at a district, province and country level (Table 3). The 2019 AFP detection rate for South Africa was 3.5/100 000 children under the age of 15 years, compared to the 2018 rate of 2.9/100 000. While the rate was below the country's target of 4.0/100 000, it exceeded the WHO's target of 2.0/100 000. Free State, Limpopo, Northern Cape and Mpumalanga provinces exceeded the 4.0/100 000 country target; Eastern Cape, Gauteng, Kwazulu-Natal, North West and Western Cape provinces reached the WHO target but not the country target; no provinces had a detection rate below 2.0/100 000 and there were no silent districts.

The national stool adequacy rate was 88%, above the required target of 80% and an improvement from 59% in 2018.

Table 3. South African Acute Flaccid Paralysis (AFP) surveillance indicators for 2019 by province and health district.

AFP Summary-week 52 of 2019 (Updated)																	
			Key indicators												Additional indicators	
Province	District	Year	Total_ population	Under15 _years	Target_ AFP_ Case	Total_AFP_ Cases_ Under15	Denotified	Total_True_ AFP_Cases_ Under15	Adequately_ investigated _cases	Not_Adequately _investigated_ cases	NP_ Detection _Rate	Stool_ Adequacy	Compatible _Cases	Unclassified >90days	Average number days from onset to notification	% of samples arriving to the lab within 72 hrs from collection
Eastern Cape	A Nzo DM	2019	876,698	338,017	14	5	0	5	5	0	1.5	100.0	0	0	6	40.0
Eastern Cape	Amathole DM	2019	978,795	356,827	14	8	1	7	6	1	2.0	85.7	0	0	15	42.9
Eastern Cape	Buffalo City MM	2019	884,058	279,514	11	6	2	4	3	1	1.4	75.0	0	0	1	50.0
Eastern Cape	C Hani DM	2019	823,046	274,625	11	15	0	15	15	0	5.5	100.0	0	0	1	40.0
Eastern Cape	Joe Gqabi DM	2019	375,077	124,771	5	4	0	4	4	0	3.2	100.0	0	0	6	25.0
Eastern Cape	N Mandela Bay MM	2019	1,316,391	395,391	16	7	1	6	5	1	1.5	83.3	0	0	2	50.0
Eastern Cape	O Tambo DM	2019	1,508,419	571,203	23	25	0	25	21	4	4.4	84.0	1	0	5	16.0
Eastern Cape	Sarah Baartman DM	2019	530,252	164,541	7	4	0	4	4	0	2.4	100.0	0	0	0	25.0
Eastern Cape			**7,292,736**	**2,504,889**	**101**	**74**	**4**	**70**	**63**	**7**	**2.8**	**90.0**	**1**	**0**	**4**	**36.1**
Free State	Fezile Dabi DM	2019	506,856	138,314	6	23	9	14	10	4	10.1	71.4	0	0	1	28.6
Free State	Lejweleputswa DM	2019	673,104	185,516	7	17	0	17	14	3	9.2	82.4	0	0	3	23.5
Free State	Mangaung MM	2019	814,680	218,461	9	12	0	12	10	2	5.5	83.3	0	0	6	66.7
Free State	T Mofutsanyana DM	2019	795,927	239,641	10	11	0	11	8	3	4.6	72.7	0	0	5	36.4
Free State	Xhariep DM	2019	129,882	33,750	1	3	0	3	3	0	8.9	100.0	0	0	0	33.3
Free State			**2,920,449**	**815,682**	**33**	**66**	**9**	**57**	**45**	**12**	**7.0**	**78.9**	**0**	**0**	**3**	**38**
Gauteng	Ekurhuleni MM	2019	3,597,781	882,680	35	16	1	15	11	4	1.7	73.3	1	0	1	73.3
Gauteng	Johannesburg MM	2019	5,287,887	1,303,779	52	31	2	29	25	4	2.2	86.2	0	0	3	69.0
Gauteng	Sedibeng DM	2019	993,044	263,408	11	18	1	17	15	2	6.5	88.2	0	0	2	82.4
Gauteng	Tshwane MM	2019	3,531,230	904,748	36	27	2	25	22	3	2.8	88.0	0	0	1	52.0
Gauteng	West Rand DM	2019	888,265	230,502	9	11	1	10	10	0	4.3	100.0	0	0	3	90.0
Gauteng			**14,298,207**	**3,585,117**	**143**	**103**	**7**	**96**	**83**	**13**	**2.7**	**86.5**	**1**	**0**	**2**	**73**
KwaZulu-Natal	Amajuba DM	2019	585,389	218,295	9	6	0	6	5	1	2.7	83.3	0	0	2	0.0
KwaZulu-Natal	eThekwini MM	2019	3,804,794	1,112,677	45	29	0	29	24	5	2.6	82.8	0	0	2	24.1
KwaZulu-Natal	Harry Gwala DM	2019	520,188	204,447	8	7	0	7	5	2	3.4	71.4	0	0	3	14.3
KwaZulu-Natal	iLembe DM	2019	713,189	236,458	9	9	0	9	8	1	3.8	88.9	0	0	1	22.2
KwaZulu-Natal	King Cetshwayo DM	2019	1,005,822	395,129	16	8	0	8	8	0	2.0	100.0	0	0	4	0.0
KwaZulu-Natal	Ugu DM	2019	790,154	283,413	11	11	2	9	6	3	3.2	66.7	0	0	2	33.3
KwaZulu-Natal	uMgungundlovu DM	2019	1,172,768	384,930	15	11	0	11	8	3	2.9	72.7	0	0	5	36.4
KwaZulu-Natal	Umkhanyakude DM	2019	702,470	274,637	11	9	0	9	7	2	3.3	77.8	0	0	3	22.2
KwaZulu-Natal	Umzinyathi DM	2019	578,835	220,003	9	10	0	10	10	0	4.5	100.0	0	0	3	20.0
KwaZulu-Natal	Uthukela DM	2019	764,548	303,350	12	9	0	9	8	1	3.0	88.9	0	0	3	0.0
KwaZulu-Natal	Zululand DM	2019	890,722	332,577	13	11	0	11	11	0	3.3	100.0	0	0	5	9.1
KwaZulu-Natal			**11,528,879**	**3,965,916**	**158**	**120**	**2**	**118**	**100**	**18**	**3.0**	**84.7**	**0**	**0**	**3**	**17**
Limpopo	Capricorn DM	2019	1,347,201	416,213	17	17	0	17	16	1	4.1	94.1	0	0	1	52.9
Limpopo	Mopani DM	2019	1,235,297	391,114	16	24	0	24	24	0	6.1	100.0	0	0	2	20.8
Limpopo	Sekhukhune DM	2019	1,247,984	425,687	17	16	0	16	16	0	3.8	100.0	0	0	2	25.0
Limpopo	Vhembe DM	2019	1,472,489	498,451	20	20	2	18	17	1	3.6	94.4	0	0	4	50.0
Limpopo	Waterberg DM	2019	722,916	213,886	9	19	2	17	17	0	7.9	100.0	0	0	3	70.6
Limpopo			**6,025,887**	**1,945,351**	**78**	**96**	**4**	**92**	**90**	**2**	**4.7**	**97.8**	**0**	**0**	**2**	**44**
Mpumalanga	Ehlanzeni DM	2019	1,741,232	573,491	23	29	0	29	28	1	5.1	96.6	0	0	3	55.2
Mpumalanga	G Sibande DM	2019	1,210,593	346,526	14	23	1	22	22	0	6.3	100.0	0	0	2	54.5
Mpumalanga	Nkangala DM	2019	1,554,418	409,484	16	20	0	20	18	2	4.9	90.0	0	0	2	25.0
Mpumalanga			**4,506,243**	**1,329,501**	**53**	**72**	**1**	**71**	**68**	**3**	**5.3**	**95.8**	**0**	**0**	**3**	**45**
North West	Bojanala Platinum DM	2019	1,745,419	493,065	20	12	0	12	9	3	2.4	75.0	0	0	6	33.3
North West	Dr K Kaunda DM	2019	769,700	224,358	9	5	0	5	4	1	2.2	80.0	0	0	2	40.0
North West	Ngaka Modiri Molema DM	2019	965,968	295,060	12	11	0	11	11	0	3.7	100.0	0	0	2	27.3
North West	Ruth Segomotsi Mompati DM	2019	480,611	175,817	7	7	0	7	6	1	4.0	85.7	0	0	4	71.4
North West			**3,961,698**	**1,188,300**	**48**	**35**	**0**	**35**	**30**	**5**	**2.9**	**85.7**	**0**	**0**	**4**	**43**
Northern Cape	Frances Baard DM	2019	381,570	100,828	4	7	0	7	7	0	6.9	100.0	0	0	2	71.4
Northern Cape	J T Gaetsewe DM	2019	245,820	77,502	3	2	1	1	1	0	1.3	100.0	0	0	1	0.0
Northern Cape	Namakwa DM	2019	113,474	28,265	1	1	0	1	1	0	3.5	100.0	0	0	1	100.0
Northern Cape	Pixley ka Seme DM	2019	211,431	56,355	2	2	0	2	2	0	3.5	100.0	0	0	0	50.0
Northern Cape	ZF Mgcawu DM	2019	265,867	63,461	3	1	0	1	1	0	1.6	100.0	0	0	0	100.0
Northern Cape			**1,218,162**	**326,411**	**13**	**13**	**1**	**12**	**12**	**0**	**4.0**	**100.0**	**0**	**0**	**1**	**64**
Western Cape	Cape Town MM	2019	4,181,107	994,010	40	39	1	38	32	6	3.8	84.2	0	0	3	44.7
Western Cape	Cape Winelands DM	2019	929,218	240,760	10	8	0	8	6	2	3.3	75.0	0	0	2	37.5
Western Cape	Central Karoo DM	2019	77,411	21,431	1	1	0	1	1	0	4.7	100.0	0	0	1	100.0
Western Cape	Garden Route DM	2019	634,437	157,258	6	7	0	7	4	3	4.5	57.1	0	0	3	71.4
Western Cape	Overberg DM	2019	297,792	71,249	3	3	0	3	3	0	4.2	100.0	0	0	3	100.0
Western Cape	West Coast DM	2019	467,528	120,343	5	3	0	3	3	0	2.5	100.0	0	0	1	33.3
Western Cape			**6,587,493**	**1,605,051**	**65**	**61**	**1**	**60**	**49**	**11**	**3.7**	**81.7**	**0**	**0**	**2**	**64**
South Africa			**58,339,754**	**17,266,218**	**692**	**640**	**29**	**611**	**540**	**71**	**3.5**	**88.4**	**2**	**0**	**3**	**47**
Detection Rate					**0-1.99**	**2-3.99**	**4+**	**Silent**								
Stool Adequacy					**<80**	**80+**	**Silent**									
Proportion of samples arriving to the lab with 72 hrs from					**80+**	**50-79.99**	**<50**									

Laboratory Indicators

On arrival at the laboratory, 1304 of 1328 (98%) of samples were appropriately received on ice and 42% were received within three days of sample collection.

Laboratory surveillance indicators showed that 94% of samples were reported within 14 days of receipt, above the target of 80%. The Non-Polio Enterovirus (NPEV) isolation rate was 9%, below the target of 10% as stipulated by the WHO (https://apps.who.int/iris/handle/10665/68762[2]). The NPEV rate may be a useful indicator of laboratory performance, however, the rate can be influenced by a number of factors, including the season of the year, elevation, or population hygienic levels.

Southern African countries supported by NICD

A total of 3110 stool samples were received from other Southern African countries. Of these, 94% were received in good condition and 89% were processed within 14 days of receipt. The NPEV isolation rate was 17%. No WPV was detected. There were 8 cases of cVDPV2 detected from Mozambique, 2 cases of cVDPV2 from Malawi, and 129 cases of cVDPV2 from Angola from several outbreaks.

The broader African Region

A total of 548 samples from cases and contacts of cases in Central African Republic, Chad, Ethiopia, Niger, Democratic Republic of Congo (DRC), Zambia, Cameroon and South Sudan were received for molecular characterization. VDPV type 2 was detected in Central African Republic (21 cases), DRC (88 cases), Zambia (3 cases and 2 contacts), Chad (3 cases and 3 contacts), Ethiopia (3 cases and 10 contacts) and Niger (2 cases and 9 contacts). One case from South Sudan was Sabin 1. Sabin 2 was identified in 279 samples, with cases and contacts of cases from Cameroon, Chad, Ethiopia, Niger and DRC.

Environmental surveillance in South Africa

Environmental surveillance, a supplement to AFP surveillance, was initiated in South Africa in July 2019. A total of 32 samples was received from 3 sites in Gauteng Province. The NPEV isolation rate was 87% and Sabin-like virus was detected at 2 sites - an anticipated finding in a country using live oral polio vaccine.

Environmental surveillance for the African region

The NICD performed viral isolation on 98 samples from 9 sites in Angola, 76 samples from 4 sites in Mozambique and 253 samples from 10 sites in Zambia. The NPEV isolation rate was 44% in Angola, 41% in Mozambique and 29% in Zambia (Figure 1). Notably, cVDPV2 was detected in 7 of the 9 sites in Angola.

Molecular testing was conducted for environmental samples from Cameroon, Ethiopia, Cote d'Ivoire, Uganda and Madagascar. cVDPV2 was detected from environmental sites in Cameroon, Ethiopia and Cote d'Ivoire.

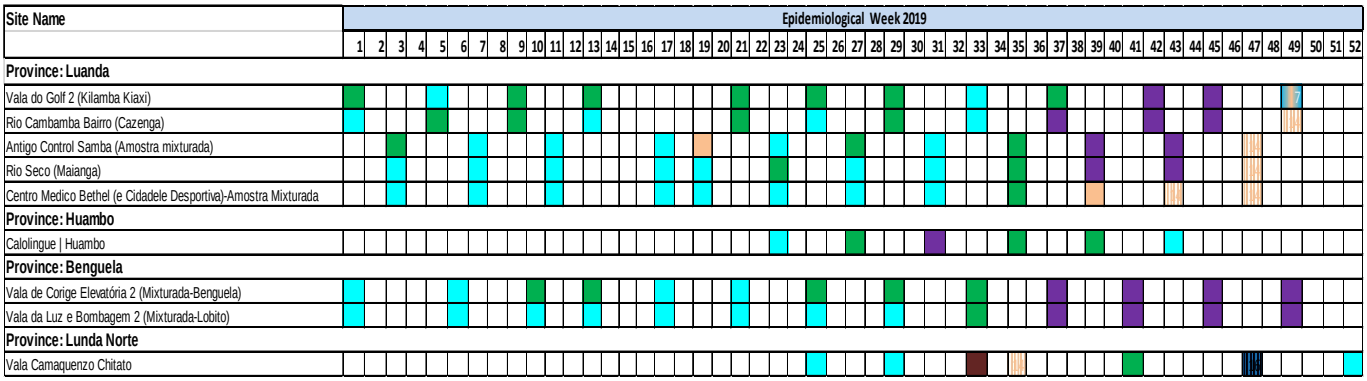

Figure 1a. Results from environmental sampling sites in Angola, 2019.

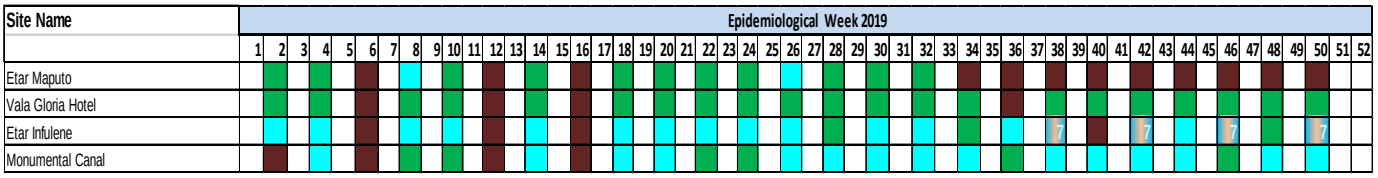

Figure 1b. Results from environmental sampling sites in Mozambique, 2019.

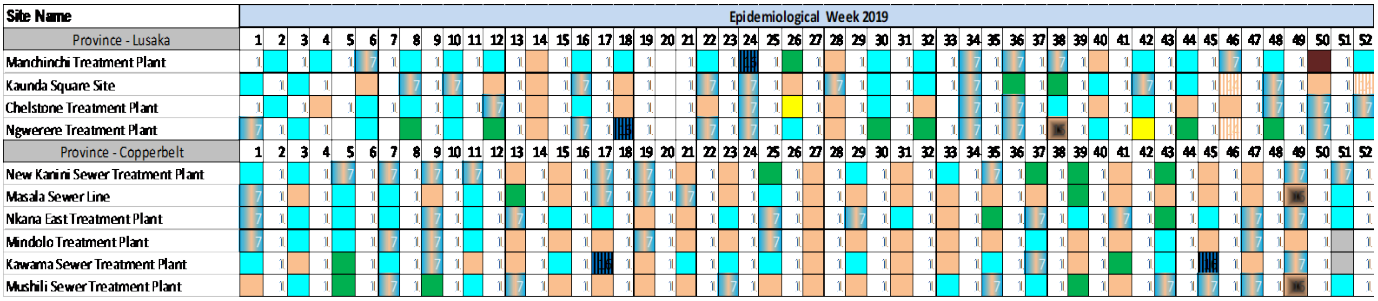

Figure 1c. Results from environmental sampling in Zambia, 2019.

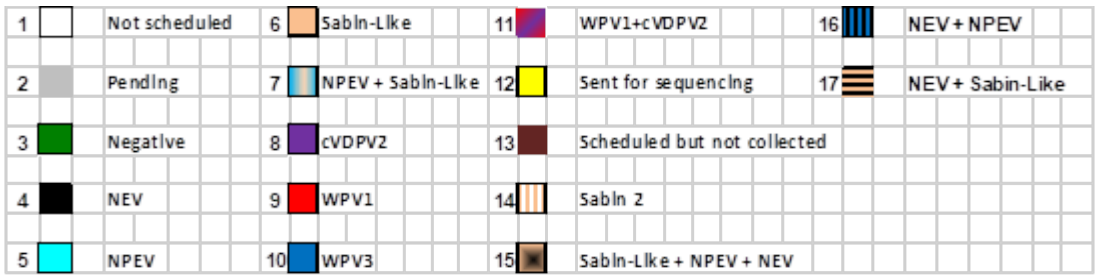

Figure 1. Matrices showing sampling frequency and viral isolation results of environmental samples processed at the National Institute for Communicable Diseases, South Africa, for Angola (figure 1a), Mozambique (figure 1b) and Zambia (figure 1c) in 2019.
NPEV = non polio enterovirus, NEV = non enterovirus.

Discussion

The global effort to eradicate polio is one of the largest health initiatives in history. The AFP surveillance network needs to be highly sensitive, enabling the immediate detection of polioviruses and ensuring that the polio eradication mission is successful. Although the last WPV case in South Africa occurred in 1989, deficiencies in the country's routine immunization coverage and surveillance systems resulted in South Africa's polio-free status being revoked by the African Regional Certification Commission in 2017. In response, a number of measures were put in place to address the identified weaknesses. The Department of Health set the target for South Africa to find four cases of AFP per 100 000 children and investigate them for polio. Following the African Regional Certification Commission's visit to South Africa and resubmission of certification documentation, the country was once again declared polio-free on 17 September 2019.

These data show that stool adequacy and AFP reporting rates have improved since 2018. However, the transport time for samples to reach the laboratory remains a challenge. Improvements are needed in terms of transport logistics to ensure samples reach the laboratory within the required timeframe. Continued training of healthcare workers is needed to ensure that the correct samples are collected, the correct test is requested, and samples are being sent to the laboratory without delay.

The NICD has supported the African region by molecular characterization of polioviruses of international public health concern. Additionally, the NICD implemented environmental polio surveillance in South Africa which has potential to supplement AFP surveillance as an early warning system, although its extent is limited by the need for labour-intensive viral culture prior to molecular confirmatory assays. The utility of environmental surveillance is demonstrated by detection of cVDPV strains through environmental surveillance for Angola.

The Sabin type 2 polioviruses detected in the African region were most likely due to mop-up campaigns using monovalent OPV type 2 to restrict VDPV type 2 circulation in those countries where it had been detected. Updated data is available on the GPEI website: www.polioeradication.org.[1]

The GPEI has developed a comprehensive new strategy to stop the spread of cVDPV2 outbreaks currently affecting mainly countries in Africa. The strategy aims to accelerate the development of a new vaccine-novel OPV2 (nOPV2) as a potential alternative for outbreak response and, ultimately, as a replacement for mOPV2. nOPV2 is a modification of the existing Sabin OPV type 2 and is specifically designed to improve the genetic stability of the vaccine. The nOPV2 has been given a WHO Emergency Use Listing (EUL) recommendation and should be available to address cVDPV2.[3]

Conclusion

The international spread of poliovirus remains a Public Health Emergency of International concern (PHEIC) as demonstrated by the widespread outbreaks of cVDPV2 in the African region. Countries need to strengthen their surveillance efforts and increase routine immunization efforts particularly with IPV to give protection against type 2 cVDPV.

Acknowledgements

Special thanks to staff of the Centre for Vaccines and Immunology, National Institute for Communicable Diseases, National Polio Expert Committee, South Africa, the Expanded Programme on Immunization, National Department of Health, Pretoria, Expanded Programme on Immunization, World Health Organization and clinicians who notified cases.

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