ACUTE FLACCID PARALYSIS SURVEILLANCE FOR POLIO, SOUTH AFRICA AND OTHER AFRICAN COUNTRIES, 2018

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Summary

Acute flaccid paralysis (AFP) surveillance is used as the standard indicator for the potential incidence of polio. For January to December 2018, the South African national non-polio AFP rate was 2.9/100 000 in children under 15 years, compared to 2.3/100 00 children in 2017. The detection rate reached the World Health Organization's (WHO) target of 2.0/100 000 but did not reach the country's target of 4.0/100 000. Surveillance still needs to be strengthened because two of South Africa's provinces (North West and Western Cape) and seven districts did not reach 2.0/100 000. Stool adequacy of less than 80% was reported in six of South Africa's nine provinces. An immunodeficiency-associated vaccine-derived poliovirus (VDPV) was detected in October 2018. This prompted a co-ordinated response from all stakeholders, showing that despite its shortcomings, the surveillance network can identify and respond to poliovirus events.

Introduction

The National Institute for Communicable Diseases (NICD) serves as the national polio reference laboratory for acute flaccid paralysis (AFP) surveillance in South Africa and other southern African countries including Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia and Swaziland. The NICD additionally serves as the regional reference centre for the polio laboratory network of the

African region, and conducts molecular characterization of poliovirus isolates from the national laboratories of the Democratic Republic of Congo (DRC), Ethiopia, Niger, Uganda and Zambia.

The Global Polio Eradication Initiative uses two types of vaccines; 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 polio vaccination schedule for South Africa comprises bivalent OPV at birth and 6 weeks, and IPV as part of hexavalent vaccine at 6, 10, and 14 weeks, followed by a booster at 18 months. It should be noted that if OPV circulates in the environment for many months in areas of low vaccine coverage, it can mutate resulting in the circulation of vaccine-derived poliovirus (cVDPV).

Since the establishment of the Global Polio Eradication Initiative in 1988, the global incidence of wild poliovirus has decreased to 33 reported cases in 2018, from an estimated 350 000 cases in more than 125 endemic countries. The lowest number of cases ever reported was 21 in 2017, thus showing that incidence increased in 2018. This increase highlights the need to enhance effective surveillance and immunization programmes. The three countries that remain endemic for the transmission of wild poliovirus type 1 are Afghanistan, Pakistan and Nigeria. The last case of wild poliovirus type 2 was reported in 1999, and this type was declared eradicated in 2015. Wild poliovirus type 3 has not been detected since November 2012. In South Africa, the last wild poliovirus case occurred in 1989.

Within the WHO African (AFRO) region in 2018, there were 71 AFP cases caused by circulating vaccine-derived poliovirus type 2 (cVDPV2). These were from Nigeria, DRC, Niger, Somalia and Mozambique. This is likely because mOPV2 vaccine was used as part of their mop-up campaigns to end polio transmission. In Somalia, seven cases of vaccine-derived poliovirus type 3 (cVDPV3) were detected in 2018. Outside of the African region, Indonesia and Papua New Guinea reported cVDPV1 outbreaks in late 2018 (www.polioeradication.org).[1]

Methods

Nationwide, case-based surveillance for AFP with laboratory confirmation of poliovirus from stool specimens was conducted in South Africa in 2018.

Field Surveillance

Cases of AFP from all health facilities were notified to the Provincial and National Departments of Health, together with samples for investigation and associated case investigation forms. (An adequately investigated case requires the collection of two stool specimens from the suspected AFP case within 14 days of onset of paralysis. The stool samples should be collected 24-48 hours apart. Stool samples are to be transported on ice and should arrive at the NICD laboratory within 72 hours of collection). Field surveillance was also conducted through active case detection, targeting children under 15 years. In 2018, the South African operational AFP target detection rate was 4.0/100 000 (double the 2015 target of 2.0/100 000), while the WHO target detection rate was 2.0/100 000. The National Polio Expert Committee (NPEC) performed the final classification for all inadequately investigated AFP cases quarterly (Table 1).

Laboratory methods

Viral isolation was performed by inoculation of faecal material into cell culture, followed by microscopic examination of the cells for cytopathic effect, which indicates the presence of suspected poliovirus. Intratypic differentiation by polymerase chain reaction (PCR) was conducted on suspected poliovirus isolates. Polioviruses were then sequenced to classify them as either wild poliovirus (WPV), Sabin or VDPV. Sequencing helps to monitor poliovirus transmission pathways and transmission links. All 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; and is confirmed clinically.
	Compatible	C1	AFP case lost to follow-up at 60 days.
		C2	Death related to the illness within 60 days.
		C3	Residual paralysis for which other no 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 with 14 days of onset of paralysis
	Denotified	E1	Not an AFP case
Pending	Inadequate Information	F1	PEC 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 meeting.
	60-day follow-up not yet done	F2	Final decision is referred to the next NPEC meeting for final decision.

Results

South Africa

A total of 1026 faecal samples was received from 505 AFP cases with dates of onset of paralysis between 1 January and 31 December 2018. No wild-type strains were detected. Sabin poliovirus type 1 was detected in two cases (Gauteng & Mpumalanga provinces). 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 2018 NPEC final classification of 2018 AFP cases is listed in Table 2.

Table 2. Final classifications of acute flaccid paralysis (AFP) cases in South Africa, 2018, as at 30 September 2019 (courtesy of the National Department of Health).

Classification	Number	Percentage
Compatible	7	1.25
Discarded	516	91.81
Denotified (not an AFP)	20	3.56
iVDPV (immune deficient vaccine-derived Poliovirus)	1	0.18
Pending	18	3.2
Total	562	100

In October 2018, VDPV type 3 was detected in a 10-month-old child who presented with AFP in Johannesburg. Following recognition of the case, several activities were conducted as part of a multi-stakeholder public health response. These activities included 1) case investigation; 2) household and community contact investigation; 3) a vaccine coverage survey; and 4) active case finding. Case investigation revealed a rare immunodeficiency disorder, MHC class II deficiency (known as bare lymphocyte syndrome), with complete absence of HLA-DR expression on lymphocytes. The child completed the course of pocapavir treatment but with no improvement. The child subsequently died in March 2019.[2]

Of the 112 contacts tested, Sabin 1 and Sabin 3 polioviruses were isolated from two. Non-polio enteroviruses were isolated from seven of the contacts. Preliminary findings of the vaccination coverage survey revealed that 43% (67/156) of households had at least one child aged <5 years. Within these 67 households, 97 children were surveyed and Road to Health Booklets were available for review by healthcare workers in 69% of cases (n=67). Of these, 93% (62/67) had received age-appropriate vaccines as per their Road to Health Booklets.

Active case detection identified 14 missed AFP cases from 33 hospitals visited, which were reported to NPEC. For those without Road to Health Booklets, it was difficult to accurately determine their vaccination status.

Surveillance indicators:

The AFP detection rate measures the sensitivity of the surveillance program and is calculated on a district, provincial and country level (Table 3). The 2018 AFP detection rate for South Africa was 2.9/100 000 children under the age of 15 years, an improvement compared to the 2017 rate of 2.6/100 000. While the rate was below the country's target of 4.0/100 000, it exceeded the World Health Organization's target rate of 2.0/100 000. Mpumalanga, Free State and Limpopo provinces exceeded the 4.0/100 000 target; Eastern Cape, Gauteng, KwaZulu-Natal, Northern Cape and Western Cape provinces reached the WHO target but not the country target; North West and Western Cape provinces had a detection rate below 2.0/100 000. The North West provincial government was a site of political instability in 2018, with various departments under administration, including the North West Department of Health. Western Cape Province experienced challenges as a result of drought, devastating fires and financial constraints. There were two silent districts in Northern Cape Province, Namakwa DM and ZF Mgcawu DM, that should have reported at least one and five AFP cases respectively as per the WHO target rate of 2.0/100 000. These districts have small populations and low targets, which may explain why no cases were identified.

The national stool adequacy rate was 59% in 2018, below the required target of at least 80%. Table 4 indicates reasons for low stool adequacy.

Table 3. Field surveillance adequacy for acute flaccid paralysis (AFP) by district, South Africa, January – December 2018 (case-based data, courtesy of National Department of Health).

2018 AFP Summary

Province	District	Year	Total_population	Under15_years	Target_AFP_Case	Total NP AFP Cases in DB	Adequately_investigated_cases	Not_Adequately_investigated_cases	NP_Detection_Rate	Stool_Adequacy
Eastern Cape	A Nzo DM	2018	866,646	335,787	13	7	4	3	2.1	57.1
Eastern Cape	Amathole DM	2018	972,188	355,095	14	9	0	9	2.5	0.0
Eastern Cape	Buffalo City MM	2018	874,199	279,545	11	4	3	1	1.4	75.0
Eastern Cape	C Hani DM	2018	818,915	276,284	11	11	6	5	4.0	54.5
Eastern Cape	Joe Gqabi DM	2018	371,240	123,699	5	4	1	3	3.2	25.0
Eastern Cape	N Mandela Bay MM	2018	1,298,412	395,779	16	6	1	5	1.5	16.7
Eastern Cape	O Tambo DM	2018	1,492,014	564,261	23	21	7	14	3.7	33.3
Eastern Cape	Sarah Baartman DM	2018	522,720	164,358	7	1	1	0	0.6	100.0
Eastern Cape		**2018**	**7,216,334**	**2,494,808**	**100**	**63**	**23**	**40**	**2.5**	**36.5**
Free State	Fezile Dabi DM	2018	504,058	137,694	6	6	0	6	4.4	0.0
Free State	Lejweleputswa DM	2018	668,413	185,399	7	6	4	2	3.2	66.7
Free State	Mangaung MM	2018	808,251	217,613	9	7	4	3	3.2	57.1
Free State	T Mofutsanyana DM	2018	791,490	238,268	10	12	9	3	5.0	75.0
Free State	Xhariep DM	2018	129,309	33,828	1	2	1	1	5.9	50.0
Free State		**2018**	**2,901,521**	**812,802**	**33**	**33**	**18**	**15**	**4.1**	**54.5**
Gauteng	Ekurhuleni MM	2018	3,550,039	879,044	35	24	16	8	2.7	66.7
Gauteng	Johannesburg MM	2018	5,172,937	1,285,502	51	37	18	19	2.9	48.6
Gauteng	Sedibeng DM	2018	982,061	261,456	10	17	14	3	6.5	82.4
Gauteng	Tshwane MM	2018	3,454,751	890,907	36	18	11	7	2.0	61.1
Gauteng	West Rand DM	2018	879,799	229,236	9	13	6	7	5.7	46.2
Gauteng		**2018**	**14,039,587**	**3,546,145**	**142**	**109**	**65**	**44**	**3.1**	**59.6**
KwaZulu-Natal	Amajuba DM	2018	575,265	215,673	9	7	5	2	3.2	71.4
KwaZulu-Natal	eThekwini MM	2018	3,760,409	1,110,278	44	23	12	11	2.1	52.2
KwaZulu-Natal	Harry Gwala DM	2018	513,362	201,474	8	5	2	3	2.5	40.0
KwaZulu-Natal	iLembe DM	2018	702,222	234,902	9	6	6	0	2.6	100.0
KwaZulu-Natal	King Cetshwayo DM	2018	995,462	393,024	16	8	3	5	2.0	37.5
KwaZulu-Natal	Ugu DM	2018	780,676	281,537	11	12	7	5	4.3	58.3
KwaZulu-Natal	uMgungundlovu DM	2018	1,153,896	383,596	15	10	9	1	2.6	90.0
KwaZulu-Natal	Umkhanyakude DM	2018	693,899	272,439	11	7	3	4	2.6	42.9
KwaZulu-Natal	Umzinyathi DM	2018	571,650	217,031	9	6	1	5	2.8	16.7
KwaZulu-Natal	Uthukela DM	2018	755,749	301,890	12	10	8	2	3.3	80.0
KwaZulu-Natal	Zululand DM	2018	877,285	327,254	13	2	0	2	0.6	0.0
KwaZulu-Natal		**2018**	**11,379,875**	**3,939,098**	**158**	**96**	**56**	**40**	**2.4**	**58.3**
Limpopo	Capricorn DM	2018	1,335,951	412,584	17	20	13	7	4.8	65.0
Limpopo	Mopani DM	2018	1,222,202	388,636	16	19	13	6	4.9	68.4
Limpopo	Sekhukhune DM	2018	1,229,286	419,277	17	16	16	0	3.8	100.0
Limpopo	Vhembe DM	2018	1,451,836	493,193	20	20	19	1	4.1	95.0
Limpopo	Waterberg DM	2018	712,724	211,839	8	5	4	1	2.4	80.0
Limpopo		**2018**	**5,951,999**	**1,925,529**	**77**	**80**	**65**	**15**	**4.2**	**81.3**
Mpumalanga	Ehlanzeni DM	2018	1,732,249	575,055	23	32	28	4	5.6	87.5
Mpumalanga	G Sibande DM	2018	1,191,707	345,627	14	13	11	2	3.8	84.6
Mpumalanga	Nkangala DM	2018	1,523,787	404,108	16	20	14	6	4.9	70.0
Mpumalanga		**2018**	**4,447,743**	**1,324,790**	**53**	**65**	**53**	**12**	**4.9**	**81.5**
North West	Bojanala Platinum DM	2018	1,712,216	484,894	19	9	0	9	1.9	0.0
North West	Dr K Kaunda DM	2018	758,963	222,701	9	3	2	1	1.3	66.7
North West	Ngaka Modiri Molema DM	2018	954,615	294,050	12	3	2	1	1.0	66.7
North West	Ruth Segomotsi Mompati DM	2018	478,895	176,182	7	5	2	3	2.8	40.0
North West		**2018**	**3,904,689**	**1,177,827**	**47**	**20**	**6**	**14**	**1.7**	**30.0**
Northern Cape	Frances Baard DM	2018	381,046	102,053	4	3	1	2	2.9	33.3
Northern Cape	J T Gaetsewe DM	2018	243,123	77,817	3	2	2	0	2.6	100.0
Northern Cape	Pixley ka Seme DM	2018	209,241	56,412	2	5	5	0	8.9	100.0
Northern Cape	Namakwa DM	2018	113,585	28,508	1	0	0	0		
Northern Cape	ZF Mgcawu DM	2018	262,574	63,528	3	0	0	0		
Northern Cape		**2018**	**1,209,569**	**328,318**	**13**	**10**	**8**	**2**	**3.0**	**80.0**
Western Cape	Cape Town MM	2018	4,127,040	988,323	40	37	26	11	3.7	70.3
Western Cape	Cape Winelands DM	2018	912,107	238,105	10	7	4	3	2.9	57.1
Western Cape	Central Karoo DM	2018	76,634	21,252	1	1	0	1	4.7	0.0
Western Cape	Eden DM	2018	626,685	155,773	6	9	5	4	5.8	55.6
Western Cape	Overberg DM	2018	292,077	70,312	3	2	2	0	2.8	100.0
Western Cape	West Coast DM	2018	457,068	117,873	5	3	2	1	2.5	66.7
Western Cape		**2018**	**6,491,611**	**1,591,638**	**24**	**22**	**13**	**9**	**1.4**	**59.1**
South Africa		**2018**	**57,542,928**	**17,140,955**	**646**	**498**	**307**	**191**	**2.9**	**61.6**

Legend colour	Non-Polio AFP detection rate	Stool adequacy (%)
🟥	1-1.99/100 000	<80
🟨	2.00-3.99/100 000	
🟩	>=4.0/100 000	>=80
🟦	Silent district/zero-reporting	Silent district/zero-reporting

DM = district municipality, MM = metropolitan municipality, NP = Non-polio, DB = Database

Table 4. Reasons for low stool adequacy by province, acute flaccid paralysis (AFP) surveillance, South Africa, 2018 (courtesy of the WHO, South Africa).

Province	Reasons for Inadequately investigated cases						Total (Percentages shown represent totals)
	2nd stool not collected	Interval between stool is 0 days	Interval between stool is more than 48hrs	No Stool collected	Specimen not collected within 14 days of onset	Stool not on ice	
Eastern Cape	11	0	10	13	4	2	**40**
	(22.4%)	(0.0%)	(16.4%)	(41.9%)	(8.7%)	(18.2%)	**(19.1%)**
Free State	4	1	6	0	0	4	**15**
	(8.2%)	(9.1%)	(9.8%)	(0.0%)	(0.0%)	(36.4 %)	**(7.2%)**
Gauteng	14	3	16	9	5	0	**47**
	(28.6%)	(27.3%)	(26.2%)	(29.0%)	(10.9%)	(0.0%)	**(22.5%)**
KwaZulu-Natal	5	2	11	4	19	3	**44**
	(10.2%)	(18.2%)	(18.0%)	(12.9%)	(41.3%)	(27.3%)	**(21.1%)**
Limpopo	2	3	2	0	8	1	**16**
	(4.1%)	(27.3%)	(3.3%)	(0.0%)	(17.4%)	(9.1%)	**(7.7%)**
Mpumalanga	4	1	1	1	3	0	**10**
	(8.2%)	(9.1%)	(1.6%)	(3.2%)	(6.5%)	(0.0%)	**(4.8%)**
North West	7	1	3	2	1	0	**14**
	(14.3%)	(9.1%)	(4.9%)	(6.5%)	(2.2%)	(0.0%)	**(6.7%)**
Northern Cape	1	0	2	0	1	0	**4**
	(2.0%)	(0.0%)	(3.3%)	(0.0%)	(2.2%)	(0.0%)	**(1.9%)**
Western Cape	1	0	10	2	5	1	**19**
	(2.0%)	(0.0%)	(16.4%)	(6.5%)	(10.9%)	(9.1%)	**(9.1%)**
Total	49	11	61	31	46	11	**209**

Laboratory indicators: Reverse cold-chain should be observed in the transport of stool specimens to the laboratory. On arrival at the laboratory, 98.3% of the samples were received on ice. The interval between stool collection and arrival at the laboratory should be within 72 hours. In 2018, only 47.2% were received within three days or had two samples collected adequately. The stipulated target is that >80% of stool samples should reach the laboratory within three days of collection. 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.

Laboratory surveillance indicators showed that 96.5% of samples were reported within fourteen days of receipt, above the target of 80%. The non-polio enterovirus isolation rate was 12.3%, (target 10%), showing that laboratory systems are adequate to detect enterovirus.

Southern African countries supported by NICD

A total of 1858 stool samples was sent to the NICD's Polio Reference Laboratory from other southern African countries in 2018. Of these, 1856 were received in good condition and 95% were processed within 14 days of receipt. The non-polio isolation rate was 17%, implying that the sensitivity of the testing was adequate to detect polioviruses. No wild polioviruses were detected. One case of circulating VDPV type 2 (cVDPV2) was detected from Mozambique.

The broader African region

In 2018, 329 samples from cases and contacts of cases in Ethiopia, Niger and Democratic Republic of Congo were sent to the NICD for molecular analysis. VDPV type 2 was detected in 35 samples from Niger and Democratic Republic of Congo, owing to the circulating VDPV type 2 outbreak in these two countries. One case from Niger was Sabin 1. 288 samples were Sabin 2, with cases and contacts of cases from Ethiopia, Niger and Democratic Republic of Congo. The Sabin 2 polioviruses detected 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 Global Polio Eradication Initiative website: www.polioeradication.org.[1]

Environmental surveillance for the African Region

The Polio Reference Laboratory supported the WHO by testing environmental samples as a supplement to AFP surveillance. From January to December 2018, the NICD received 98 samples from eight sites in Angola, 82 samples from four sites in Mozambique, 24 samples from four sites in Republic of South Sudan and 120 samples from eight sites in Zambia, with 44%, 56.1%, 33.3% and 52.5% of samples with non-polio enteroviruses detected respectively. Furthermore, 1.6% non-enteroviruses were detected from Zambia.

Molecular testing involved environmental samples from Uganda, Ethiopia and DRC. VDPV type 2 and Sabin 2 were detected from DRC. Sabin 3 was detected from Uganda and Ethiopia. Sabin 1, Sabin 2 and Sabin 3 were detected in samples from Mozambique and Zambia.

Conclusion

The global effort to eradicate polio is one of the largest public 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. In South Africa, North West and Western Cape provinces did not reach the WHO non-polio AFP detection rate target of 2.0 cases per 100 000, most likely due to a range of challenges experienced in 2018. Additionally, seven districts fell short of the target of 2.0 cases per 100 000. Also of concern is low overall stool sample adequacy. The surveillance system, however, was effective as it was able to detect and respond to a poliovirus event i.e. detection of a case of immune-deficiency associated VDPV in South Africa.

Acknowledgements

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