

PARALYSIS SURVEILLANCE FOR POLIO, SOUTH AFRICA, AND OTHER AFRICAN COUNTRIES, 2020

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Summary

From January 2020 to December 2020, the South African national non-polio acute flaccid paralysis rate was 2.6/100 000 children under 15 years compared to 3.5/100 000 children in 2019. The country reached the World Health Organization target of 2.0/100 000 population under the age of 15, but did not reach the country's target of 4.0/100 000. Receipt of samples in the laboratory within 72 hours of collection was 36%, below the World Health Organization's target of 80%. No wild-type poliovirus nor vaccine-derived poliovirus was detected in South Africa. Sabin poliovirus type 2 and circulating vaccine-derived poliovirus type 2 (cVDPV2) were detected from 13 African countries, namely Burkina Faso, Angola, Malawi, Ethiopia, Senegal, Côte d'Ivoire Niger, the Democratic Republic of the Congo, Republic of South Sudan, Zambia, Guinea, Sierra Leone and Mali. Sabin 2 and cVDPV2 were the most prevalent poliovirus strains in the African region. The performance of AFP surveillance in 2020 has declined despite the fact that South Africa has achieved the WHO target. There is an urgent need for more African countries to use novel oral poliovirus 2 vaccines to prevent cVDPV2 outbreaks. The percentage of South African samples arriving at

the laboratory within 72 hours was below the WHO target. There is also an urgent need to improve the logistics of sample transportation to the laboratory within the required time. As the Global Polio Eradication Initiative winds down and devolves to regional WHO initiatives, incorporation of national AFP surveillance targets into integrated disease surveillance will require attention.

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, namely Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia and Swaziland. The NICD additionally serves as the regional reference centre for the polio laboratory network of the World Health Organization (WHO) and conducts molecular characterization of poliovirus isolates from within the African Region.

In 1988, when the Global Polio Eradication Initiative (GPEI) was established, there were an estimated 350 000 cases of wild poliovirus (WPV) types 1, 2, and 3 in more than 125 endemic countries.¹ The global incidence of polio has decreased by 99.9% since then. Two of three wild poliovirus strains are declared globally eradicated: wild poliovirus type 2 in September 2015 and wild poliovirus type 3 in October 2019. In 2020, the African region was declared and certified free of wild poliovirus, a key milestone.² Afghanistan and Pakistan are the only two remaining polio-endemic countries in the world, recording 140 wild polioviruses type 1 in 2020.³ In South Africa, the last wild poliovirus case occurred in 1989.

Many African countries are faced with circulating vaccine-derived poliovirus type 2 (cVDPV2) outbreaks, possibly arising from the emergency use of monovalent oral polio vaccine serotype 2 (mOPV2) during outbreak responses in populations with low coverage of inactivated polio vaccine (IPV). In November 2020, the WHO received an Emergency Use Listing for the use of novel oral polio vaccine serotype 2 (nOPV2) to halt the spread of cVDPV2. The switch from mOPV2 to nOPV2 will significantly reduce the risk of cVDPV2. The nOPV2 vaccine is a modified version of the existing mOPV2, providing comparable protection against poliovirus while being more genetically stable and less likely to revert into a form that can cause paralysis in low immunity settings.⁴

In December 2019, the novel SARS-CoV-2 coronavirus caused a global COVID-19 pandemic. South Africa reported the first COVID-19 case on 05 March 2020 followed by a national lockdown on 27 March 2020. The national lockdown restricted movement that had a notable impact on AFP surveillance.

The aim of this surveillance project was to report the performance of acute flaccid paralysis and environmental surveillance conducted at the National Institute for Communicable Diseases, Johannesburg in 2020.

Methods

Surveillance indicators

AFP case-based surveillance is conducted nationally in South Africa. An AFP case is defined as acute weakness or paralysis with reduced muscle tone, including Guillain-Barré syndrome, in a person under 15 years of age for any reason other than severe trauma, or paralytic illness in a person of any age in which polio is suspected. AFP Surveillance comprises field and laboratory components.

Field surveillance

Cases of AFP from all health facilities were notified to the NICD with samples collected for investigation and completion of case investigation forms. An adequately investigated case required the collection of two stool specimens from an AFP case within 14 days of onset of paralysis. The stool samples should be collected 24-48 hours apart and transported on ice to arrive at the NICD laboratory within 72 hours of collection. AFP cases were detected through active field surveillance, selecting children under the age of 15 years. The WHO non-polio AFP target detection rate for 2020 was 2.0/100 000, while the South African target was 4.0/100 000. For inadequately investigated AFP cases, the National Polio Expert Committee (NPEC) met quarterly for final classification of cases using clinical case notes (Table 1).

Laboratory methods

Virus isolation was performed by inoculation of clarified faecal material into cell cultures, followed by microscopic examination of the cells for cytopathic effect, which indicates the presence of suspected poliovirus/es. Intratypic differentiation (ITD) by polymerase chain reaction (PCR) was conducted on suspected poliovirus isolates. Poliovirus type 2 or discordant Sabin-like polioviruses were sequenced to classify them as either WPV, Sabin or VDPV.

Environmental surveillance

Environmental surveillance, a supplement to AFP surveillance, was initiated in South Africa in July 2019. In 2020, South Africa expanded polio environmental surveillance to include two sites from each of the eight metropolitan districts, totalling sixteen sites in South Africa. All sites collected sewage samples once a month, meeting the minimum WHO requirements.⁵ Results for environmental surveillance are shown in figure 1.

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 a stool sample of a case or one of the
	Confirmed (vaccine-associated)	B1	Vaccine-type poliovirus found in a stool sample of the 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 no other medical reason is evident.
	Discarded	D1	No residual paralysis and no wild polio were 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	NPEC 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

From 477 AFP cases, 946 stool samples were received for polio isolation, of which 36% were received within 72 hours of collection. Non-polio enteroviruses (NPEVs) were identified in thirty-three samples with a detection rate of 3.5%. Ninety-nine percent of the samples were received on ice, and 94% had results within 14 days.

Samples from four children tested positive for polioviruses. Sabin poliovirus type 1 and/or Sabin poliovirus type 3 were confirmed using Sanger sequencing. Sabin poliovirus type 3 was detected in one case each from Gauteng province, Mpumalanga province and Eastern Cape province, while a fourth child from KwaZulu-Natal Province shed both poliovirus serotypes 1 and 3. No wild-type poliovirus strains nor VDPV were detected in South African samples. Sequencing was performed to determine mutations in the five prime untranslated region of the detected Sabin polioviruses. In three cases, the five prime untranslated region of the detected Sabin poliovirus type 3 had a mutation at position 472 (T472C), a mutation associated with neurovirulence. In one case an additional mutation at position 682 (C682T) was identified in the five prime untranslated region of Sabin poliovirus type 3. One sample was not sequenced at the five prime untranslated region because it had a mixture of poliovirus strains. No children were classified by the NPEC as vaccine-associated paralytic poliomyelitis (VAPP). A summary of the 2020 AFP case classification is listed in Table 2.

Table 2. Final classification of South African Acute Flaccid Paralysis (AFP) cases for 2020.

Classification	Number	Percentage of total (%)
Compatible	5	1.05
Discarded	452	94.76
Denotified (Not AFP)	20	4.19
Total	477	100

African countries supported by NICD

In 2020, 2102 stool specimens were processed from African countries other than South Africa. From Angola, there were 69 samples (37 cases) in which VDPV2 was identified and 21 samples (11 cases) in which Sabin poliovirus type 2 was detected. One sample from Mozambique tested positive for Sabin

poliovirus type 2. No wild-type poliovirus was detected. The number of samples sequenced from each country is shown in table 4.

Surveillance indicators

South Africa's non-polio AFP rate was 2.6/100 000 children under the age of 15 years. This detection rate was above the WHO target; however, it was below the country's target. Free State Province managed to reach both the country and WHO detection rate targets, while Eastern Cape Province, Gauteng Province, Mpumalanga Province and Western Cape Province met only the WHO target. Provinces that performed below the WHO target were Limpopo, KwaZulu-Natal, Northern Cape and North West (Table 3). This was an unusual year for communicable diseases, with many diseases detected at a lower frequency than previous years, including influenza⁶, febrile rash (NICD unpublished data) and hepatitis A.⁷ The lower non-polio AFP detection rate than previous years may have been due to fewer circulating non-polio enteroviruses or other infectious causes of AFP due to COVID-19 lockdown restrictions as well as reduced health-seeking behaviour. The national stool adequacy rate was 87.5% and above the required 80% target, similar to the previous year.

Table 3. South African Acute Flaccid Paralysis (AFP) surveillance indicators for 2020 by province and health district.

AFP SUMMARY-WEEK 1-52 OF 2020								
Key indicators								
Province	District	Total population	Under 15 years	Target AFP Case	Total AFP Cases Under 15 years	Non Polio Detection Rate per 100,000 individuals Under 15 years	Stool Adequacy (%)	Proportion of samples arriving to the lab within 72 hrs from collection (%)
Eastern Cape	A Nzo DM	887,061	339,805	14	2	0.6	100.0	0.0
Eastern Cape	Amathole DM	985,602	357,846	14	6	1.7	83.3	33.3
Eastern Cape	Buffalo City MM	893,598	278,715	11	1	0.4	100.0	100.0
Eastern Cape	C Hani DM	826,472	272,114	11	11	4.0	72.7	9.1
Eastern Cape	Joe Gqabi DM	379,019	125,683	5	1	0.8	100.0	0.0
Eastern Cape	N Mandela Bay MM	1,333,124	393,304	16	10	2.5	80.0	20.0
Eastern Cape	O Tambo DM	1,525,948	577,804	23	20	3.8	72.7	13.6
Eastern Cape	Sarah Baartman DM	537,461	164,195	7	6	3.7	83.3	33.3
Eastern Cape		7,368,285	2,509,466	101	57	2.3	80.7	26
Free State	Fezile Dabi DM	509,520	138,718	6	32	26.0	83.3	38.9
Free State	Lejweleputswa DM	677,535	185,327	7	13	9.2	64.7	52.9
Free State	Mangaung MM	820,955	219,122	9	27	13.7	66.7	43.3
Free State	T Mofutsanyana DM	800,201	240,587	10	13	5.8	78.6	50.0
Free State	Xhariep DM	130,469	33,680	1	1	3.0	100.0	100.0
Free State		2,938,680	817,434	33	86	10.5	84.9	57
Gauteng	Ekurhuleni MM	3,643,679	885,634	35	10	1.1	90.0	70.0
Gauteng	Johannesburg MM	5,401,173	1,320,187	53	38	3.0	87.2	74.4

AFP SUMMARY-WEEK 1-52 OF 2020

Key indicators

Province	District	Total population	Under 15 years	Target AFP Case	Total AFP Cases Under 15 years	Non Polio Detection Rate per 100,000 individuals Under 15 years	Stool Adequacy (%)	Proportion of samples arriving to the lab within 72 hrs from collection (%)
Gauteng	Sedibeng DM	1,003,535	264,894	11	11	4.5	83.3	58.3
Gauteng	Tshwane MM	3,606,241	916,948	37	13	1.7	75.0	50.0
Gauteng	West Rand DM	896,159	231,470	9	5	2.2	100.0	60.0
Gauteng		14,550,787	3,619,133	145	77	2.1	90.9	63
KwaZulu-Natal	Amajuba DM	595,573	220,570	9	7	3.2	71.4	14.3
KwaZulu-Natal	eThekweni MM	3,848,515	1,113,002	45	22	2.0	95.5	13.6
KwaZulu-Natal	Harry Gwala DM	526,956	206,957	8	1	0.5	100.0	0.0
KwaZulu-Natal	iLembe DM	724,200	237,541	10	3	1.3	100.0	33.3
KwaZulu-Natal	King Cetshwayo DM	1,016,001	396,218	16	8	2.3	66.7	11.1
KwaZulu-Natal	Ugu DM	799,522	284,563	11	3	1.1	66.7	33.3
KwaZulu-Natal	uMgungundlovu DM	1,191,332	384,977	15	5	1.3	100.0	40.0
KwaZulu-Natal	Umkhanyakude DM	711,176	276,408	11	9	3.6	90.0	30.0
KwaZulu-Natal	Umzinyathi DM	586,402	222,916	9	6	2.7	83.3	16.7
KwaZulu-Natal	Uthukela DM	773,120	304,090	12	11	3.6	90.9	18.2
KwaZulu-Natal	Zululand DM	904,345	337,369	13	2	0.6	100.0	50.0
KwaZulu-Natal		11,677,142	3,984,611	159	77	1.9	89.6	24
Limpopo	Capricorn DM	1,358,841	419,721	17	14	3.3	92.9	21.4
Limpopo	Mopani DM	1,247,693	392,541	16	9	2.3	100.0	55.6
Limpopo	Sekhukhune DM	1,266,928	431,488	17	6	1.4	83.3	33.3

AFP SUMMARY-WEEK 1-52 OF 2020

Key indicators

Province	District	Total population	Under 15 years	Target AFP Case	Total AFP Cases Under 15 years	Non Polio Detection Rate per 100,000 individuals Under 15 years	Stool Adequacy (%)	Proportion of samples arriving to the lab within 72 hrs from collection (%)
Limpopo	Vhembe DM	1,493,306	502,816	20	3	0.6	66.7	0.0
Limpopo	Waterberg DM	733,144	215,671	9	6	2.8	83.3	33.3
Limpopo		6,099,912	1,962,237	79	38	1.9	89.5	29
Mpumalanga	Ehlanzeni DM	1,749,011	570,679	23	17	3.0	76.5	58.8
Mpumalanga	G Sibande DM	1,229,321	347,111	14	15	4.3	93.3	53.3
Mpumalanga	Nkangala DM	1,585,460	415,084	17	16	3.9	100.0	37.5
Mpumalanga		4,563,792	1,332,874	54	48	3.6	89.6	50
North West	Bojanala Platinum DM	1,779,141	500,932	20	5	1.0	60.0	40.0
North West	Dr K Kaunda DM	780,166	225,511	9	3	1.3	100.0	66.7
North West	Ngaka Modiri Molema DM	977,227	295,675	12	9	3.0	100.0	55.6
North West	Ruth Segomotsi Mompoti DM	481,907	174,840	7	0	0.6	0.0	0.0
North West		4,018,441	1,196,958	48	17	1.4	88.2	41
Northern Cape	Frances Baard DM	381,764	99,455	4	1	2.0	50.0	0.0
Northern Cape	J T Gaetsewe DM	248,423	77,079	3	0			0.0
Northern Cape	Namakwa DM	113,317	28,069	1	1	3.6	0.0	0.0
Northern Cape	Pixley ka Seme DM	213,607	56,335	2	0	1.8	0.0	0.0
Northern Cape	ZF Mgcawu DM	269,163	63,450	3	1	1.6	100.0	0.0
Northern Cape		1,226,274	324,388	13	3	0.9	66.7	0
Western Cape	Cape Town MM	4,233,412	998,210	40	27	2.7	85.2	40.7

AFP SUMMARY-WEEK 1-52 OF 2020								
Key indicators								
Province	District	Total population	Under 15 years	Target AFP Case	Total AFP Cases Under 15 years	Non Polio Detection Rate per 100,000 individuals Under 15 years	Stool Adequacy (%)	Proportion of samples arriving to the lab within 72 hrs from collection (%)
Western Cape	Cape Winelands DM	946,248	243,238	10	3	1.2	100.0	66.7
Western Cape	Central Karoo DM	78,205	21,624	1	0			0.0
Western Cape	Garden Route DM	641,957	158,642	6	8	5.0	100.0	25.0
Western Cape	Overberg DM	303,441	72,112	3	3	4.2	66.7	33.3
Western Cape	West Coast DM	478,050	122,832	5	3	2.4	100.0	66.7
Western Cape		6,681,313	1,616,658	65	44	2.7	88.6	39
South Africa		59,124,626	17,363,759	697	447	2.6	87.5	36

Non-Polio detection rate: red (0-1.99), yellow (2-3.99), green (4+), and blue (no cases reported).

Stool adequacy: red (<80), green (>80), and blue (no cases reported).

Proportion of samples arriving to the lab within 72 hours from collection: red (<50), yellow (50-79.99), green (80+).

DM = District Municipality; MM = Metro Municipality

Table 4. Polioviruses sequenced from acute flaccid paralysis cases and contacts from the Southern African region, 2020.

Country	Sample Received	Sabin 2	VDPV 2
Eswatini	0	0	0
Mozambique	6	0	0
Burkina Faso	104	22	75
Angola	37	11	19
Guinea	44	2	25
Lesotho	0	0	0
Malawi	3	0	0
Chad	6	0	0
Ethiopia	59	21	30
Senegal	0	0	0
Cote d'Ivoire	131	33	86
Sierra Leone	3	0	3
Mali	47	0	38
Niger	41	14	11
Democratic Republic of the Congo	325	110	195
Madagascar	0	0	0
Namibia	1	0	0
Republic of Sudan	60	5	55
Zambia	17	17	0

Environmental surveillance

A total of 101 South African environmental sewage samples was received in 2020. Four samples tested positive for Sabin poliovirus strains (Table 5). The NPEV isolation rate for environmental surveillance was 46% in 202

Table 5. Distribution of environmental samples confirmed to be positive for Sabin 1 and Sabin 3, by province, South Africa, 2020.

Province	District	Site	Poliovirus strains	Number of samples
Gauteng	Tshwane	Daspoort	Sabin 1	1
Free State	Mangaung	Sterkwater	Sabin 3	1
Gauteng	Johannesburg	Northern	Sabin 3	2

2020																																																										
Site Name	Epidemiological Week 2020																																																									
Province - Gauteng	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						
Northern Wastewater Treatment																																																										
Daspoort Wastewater Treatment																																																										
Hartebeesfontein Water Works																																																										
Rooiwal waterwaste																																																										
Erwat vlakplaats Wastewater Treatment																																																										
Goudkoppies Wastewater Treatment																																																										
Site Name	Epidemiological Week 2020																																																									
Province - Western Cape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						
Borcheds Quarry Wastewater																																																										
Zandvleit Wastewater																																																										
Site Name	Epidemiological Week 2020																																																									
Province - Free State	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						
Bloemspruit Wastewater																																																										
Sterkwater Wastewater																																																										
Site Name	Epidemiological Week 2020																																																									
Province - Kwazulu Natal	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						
Central Wastewater Treatment Works																																																										
Northern Wastewater Treatment Works																																																										
Site Name	Epidemiological Week 2020																																																									
Province - Eastern Cape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52						
Kwanobuhle Wastewater Treatment																																																										
Brickfield Pretreatment plant																																																										
East Bank Wastewater treatment work																																																										
Mdantsane Wastewater Treatment																																																										

Figure 1. Dashboard of poliovirus environmental surveillance conducted in Gauteng, Western Cape, Free State, KwaZulu Natal, and Eastern Cape provinces in 2020. Light green represents Sabin strains, brown represents scheduled but not collected, blue represents non-polio enterovirus, dark green represents negative, black represents non-enterovirus, green with black lines represents Sabin and non-polio enterovirus.

Angola (Figure 2) and Mozambique (Figure 3) sent environmental sewage samples to NICD for poliovirus screening in 2020. In Angola, circulating VDPV2, Sabin poliovirus type 2 and Sabin poliovirus type 3 were detected in weeks 7, 9 and 51, respectively. In Mozambique, five environmental samples tested positive for Sabin polioviruses, three for Sabin poliovirus type 3, and two for Sabin poliovirus type 1.

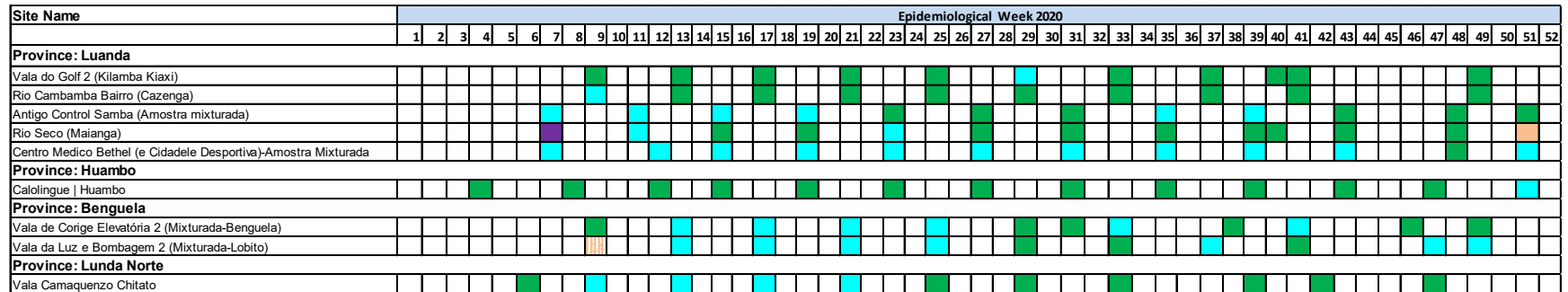


Figure 2. Dashboard of poliovirus environmental surveillance conducted in Angola in 2020. Light green represents Sabin, brown represents scheduled but not collected, blue represents non-polio enterovirus, dark green represents negative, purple represents circulating vaccine derived poliovirus type 2, white represents not scheduled, and white with brown lines represents Sabin 2.

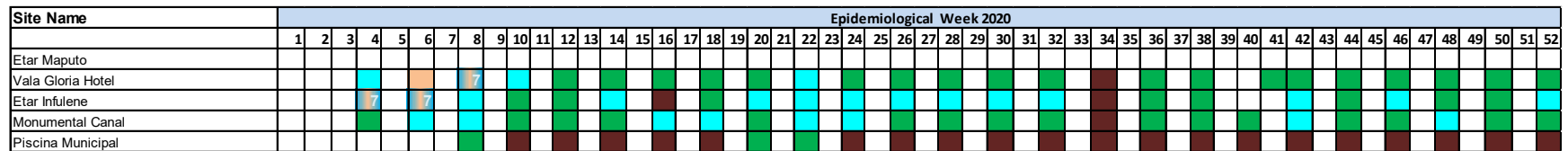


Figure 3. Dashboard of poliovirus environmental surveillance conducted in Mozambique in 2020. Light green represents Sabin, brown represents scheduled but not collected, blue represents non-polio enterovirus, dark green represents negative, blue and a brown line represents non-polio enterovirus and Sabin-like, light brown represents Sabin-like, white represents not scheduled.