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Polio eradication surveillance in Sri Lanka, 2019-2023

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ABSTRACT

Objective: To evaluate the polio laboratory surveillance carried out from January, 2019 to May, 2023 by the Polio Regional Reference Laboratory, Sri Lanka.

Methods: This retrospective study analyzed all stool samples received under the acute flaccid paralysis (AFP) and immunodeficient vaccine-derived poliovirus (VDPV) surveillance at Polio Regional Reference Laboratory, Sri Lanka from January, 2019 to May, 2023. The results of the testing methodologies were extracted from the laboratory data system, *i.e.*, poliovirus virus isolation, intra-typic differentiation/VDPV real time reverse transcriptase polymerase chain reaction (ITD/VDPV rRTPCR) and sequencing, along with the data on timing of reporting results, stool adequacy and socio-demographics. Data was analyzed using descriptive statistics.

Results: A total of 2 141 stool samples from 1 644 cases were received for AFP surveillance from Sri Lanka (93.61%), Maldives (1.52%), and immunodeficient VDPV (4.86%) surveillance. Both polioviruses (19/1 644, 1.15%) and non-polio enteroviruses (73/1 644, 4.44%) were isolated, while Sabin-like 3 virus was detected in majority (12/19, 63.15%) among the poliovirus isolated. Wild polioviruses or circulating VDPVs were not detected among the cases. During all years of the study, the non-polio AFP detection rate was >1/100 000 in children aged less than 15 years, whereas stool adequacy rate was >80%. All results were reported within 14 days of receipt, ensuring timely reporting as per global guidelines.

Conclusions: The Polio Regional Reference Laboratory, Sri Lanka plays a vital role in maintaining the polio-free status in the country through its robust laboratory surveillance, while adhering to the surveillance indicators. Non-detection of wild polioviruses and circulating VDPV during the study period reinforces the polio-free status in the country.

KEYWORDS: Poliovirus; Polio laboratory surveillance; Regional reference laboratory; Polio eradication

1. Introduction

Polio eradication has achieved several milestones during the past few decades since launching of the Global Polio Eradication

Significance

This study evaluated the laboratory surveillance carried out by the Polio Regional Reference Laboratory, Sri Lanka. Samples for acute flaccid paralysis surveillance from Sri Lanka and Maldives and immunodeficient vaccine derived polio virus surveillance from Sri Lanka were completely investigated at the laboratory during the study period, while adhering to surveillance indicators. Both polioviruses and nonpolio enteroviruses were isolated among the samples whereas Sabin-like (SL) 3, SL1 & 3 and SL1 were detected among the polioviruses isolated. No wild poliovirus and circulating vaccine derived poliovirus were detected during the study period, reinforcing the polio-free status in the country.

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Initiative in 1988[1,2]. The number of wild poliovirus (WPV) cases have decreased by over 99% since then, with five out of six World Health Organization (WHO) regions achieving the polio-free status by the year 2020[2]. The WHO South-East Asia Region (SEARO) which includes Sri Lanka was certified polio-free in March, 2014[3]. Currently, the circulation of WPVs have been limited to type 1, with type 2 and 3 been declared eradicated in September 2015 and October 2019, respectively. Further, the spread of WPV with type 1 is also limited to the two countries, Afghanistan and Pakistan[4].

Interruption of WPV transmission is achieved using a combination of routine and supplementary immunization activities and high-quality surveillance[5]. However, the risk of global resurgence of the disease persists with failure of complete eradication of the virus. Furthermore, the possibility of the oral polio vaccine (OPV) virus strains to reverse to their neurovirulent forms when circulated in underimmunized populations, leading to circulating vaccine derived polio virus (cVDPV) outbreaks, is a major concern during the eradication era. cVDPVs have been detected in areas where WPV PV transmission had long been eliminated[3,6].

Cessation of cVDPV transmission and prevention of outbreaks in non-endemic countries is one of the two main goals in the polio eradication strategy 2022–2026 and its objectives include enhanced detection and response through a sensitive surveillance[7,8]. Moreover, the Global polio surveillance action plan 2022–2024 emphasizes the importance of timely and sensitive acute flaccid paralysis AFP, environmental and immunodeficient vaccine derived poliovirus (iVDPV) surveillances[9]. Hence, it is evident that surveillance becomes even more important as the world moves closer to polio eradication[3].

Surveillance indicators are used to demonstrate the precision of the surveillance system. The sensitivity of the system is assessed by evaluating whether at least one case of non-polio AFP per 100 000 population is detected annually in children aged less than 15 years, and the laboratory performance is assessed by evaluating whether all AFP case specimens were processed in a World Health Organization-accredited laboratory within the Global Polio Laboratory Network. The investigation timeliness and the quality of the reverse cold chain mechanism employed for virus isolation, and there by the ability to detect the PVis assessed by evaluating the stool adequacy rate[7,8].

The Polio Regional Reference Laboratory of Sri Lanka is a WHO-accredited laboratory within the Global Polio Laboratory Network which is the premier center coordinating the laboratory surveillance of AFP and iVDPV for the country, while also acting as the polio laboratory for the Maldives. Thus, this study was aimed at evaluating the laboratory surveillance carried out at the Polio Regional Reference Laboratory, Sri Lanka to facilitate maintaining its' polio-free status.

2. Materials and methods

The study included laboratory test results of samples sent to the laboratory. However, no patient identification details or data were included in the study thus ethical approval was waived by local ethics committee.

This retrospective study analyzed all stool samples received for the AFP and iVDPV surveillance at the Polio Regional Reference Laboratory, Sri Lanka from January, 2019 to May, 2023. Results of the testing methodologies carried out at the Polio Regional Reference Laboratory were extracted from the laboratory data system, *i.e.*; viral inoculation in L20B and RD cell lines for virus detection and differentiation of PV and non-polio enteroviruses (NPEV), intra typical intratypic differentiation/VDPV polymerase chain reaction (ITD/VDPV PCR) for differentiation of sabin-like (SL) polio viruses and WPVs, and sequencing carried out at the polio reference center, India for samples that detected WPV or were not confirmed as SL polio viruses (*i.e.* VDPV discordant) by the ITD/VDPV PCR. Data on socio demographics, completeness of the samples received and timing of reporting results as per the global guidelines were also extracted from the laboratory data system. Data was analyzed using Microsoft office excel software. Descriptive statistics were used to show the characteristics of the study samples.

3. Results

A total of 2 141 stool samples from 1 644 cases were received during the study period. Majority (1 539/1 644, 93.61%) of cases were received for the AFP surveillance from Sri Lanka while 4.86% (80/1 644) and 1.52% (25/1 644) were for the iVDPV surveillance from Sri Lanka and AFP surveillance from Maldives, respectively (Table 1).

The highest number of cases (28.16%, 463/1 644) had been received during the year 2019, of which majority belonged to the AFP surveillance form Sri Lanka. 211 Cases have been received in year 2023, during a period of five months (Table 2).

3.1. Socio–demographic characteristics of the cases received for surveillance

Majority of the cases belonged to ages between more than 1 year to, equal or less than 5 years in the AFP surveillance from both Sri Lanka (34.30%, 528/1 539) and Maldives (40.00%, 10/25), while patients between more than 10 years to, equal or less than 15 years dominated in the iVDPV surveillance samples (51.25%, 41/80). Male patients dominated the study population in all groups (Table 3).

Samples from both cases with AFP (41.58%, 640/1 539) and contacts of the respective cases (58.41%, 899/1 539) were received for the AFP surveillance from Sri Lanka. Of the samples received for

Table 1. Number of cases received for surveillance during each year.

Year	AFP surveillance Sri Lanka (*n*=1 539)	AFP surveillance Maldives (*n*=25)	iVDPV surveillance(*n*=80)
2019	456 (29.62)	0 (0.00)	7 (8.75)
2020	292 (18.97)	3 (12.00)	29 (36.25)
2021	251 (16.30)	3 (12.00)	27 (33.75)
2022	342 (22.22)	11 (44.00)	12 (15.00)
2023 (January-May)	198 (12.86)	8 (32.00)	5 (6.25)

iVDPV: immunodeficient vaccine derived poliovirus.

Table 2. Sociodemographic distribution of the cases.

Characteristic	AFP surveillance Sri Lanka (*n*=1 539)	AFP surveillance Maldives (*n*=25)	iVDPV surveillance (*n*=80)
Age, years			
age≤1	42 (2.72)	2 (8.00)	6 (7.50)
1<age≤5	528 (34.30)	10 (40.00)	12 (15.00)
5<age≤10	482 (31.31)	8 (32.00)	18 (22.50)
10<age≤15	344 (22.35)	3 (12.00)	41 (51.25)
15<age	63 (4.09)	2 (8.00)	3 (3.75)
No data	80 (5.19)	-	-
Sex			
Male	753 (48.92)	15 (60.00)	48 (60.00)
Female	627 (40.74)	10 (40.00)	32 (40.00)
No data	159 (10.33)	-	-

-: not available.

Table 3. Results of virus isolation of the cases.

Year	Sri Lanka												Maldives			
	AFP surveillance				AFP surveillance for contacts				iVDPV surveillance				AFP surveillance			
	PV	NPEV	Negative	Total	PV	NPEV	Negative	Total	PV	NPEV	Negative	Total	PV	NPEV	Negative	Total
2019	3	18	155	176	2	14	264	280	-	-	7	7	-	-	-	-
2020	-	3	114	117	-	2	173	175	1	2	26	29	-	-	3	3
2021	12	-	136	148	-	2	101	103	-	1	26	27	-	1	2	3
2022	-	5	150	155	1	13	174	187	-	2	10	12	-	2	9	11
2023	-	2	42	44	-	5	149	154	-	-	5	5	-	1	7	8

-: not detected.

the iVDPV surveillance, 21.25% (17/80) were from patients with X linked agammaglobulinaemia while 7.50% (6/80) and 3.75% (3/80) were from patients with common variable immunodeficiency and hyper IgM syndrome, respectively. Data on the indication for testing was not available in the rest of the samples (67.50%, 54/80).

3.2. Testing methodologies

Samples of all the cases received have been inoculated on L20B and RD cell lines for virus detection, and differentiation of PV from NPEV. Of the cases received for AFP surveillance from Sri Lanka, PV was detected in 1.16% (18/1 539) while NPEV were detected in 4.15% (64/1 539). Most cases with PV isolation have been detected in 2021 and among AFP cases from Sri Lanka (Table 4). One case (1.25%) of PV was detected among the iVDPV cases, while NPEV was detected in 6.25% (*n*=5) among the iVDPV cases. Of the cases received for the AFP surveillance from Maldives (*n*=25), four samples (5% was tested positive for NPEV while none of the samples detected PV).

All samples that detected PV with virus isolation have been investigated with the ITD/VDPV rRTPCR testing. In the AFP surveillance from Sri Lanka, Sabin-like (SL) poliovirus 3 was detected in majority in all years of the study (*n*=10) with the highest number detected in 2019 (*n*=5) followed by 4 cases in 2021. SL1 &

3 (*n*=4) and SL1 (*n*=3) were the other PV types detected. One of the cases have yielded discordant results in the VDPV rRTPCR in year 2021; however, has been confirmed as SL3 following sequencing of the virus at the Polio reference center, India. SL3 was detected in the only PV positive case in the iVDPV surveillance was confiremed as SL3 with the ITD/VDPV rRTPCR testing.

3.3. Surveillance indicators

During all years of the study, the number of non-polio AFP cases detected annually among 100 000 children aged less than 15 years was more than 1, with highest been recorded in 2022 (3.11) and lowest in 2020 (2.28). The rates were 3.33 and 2.69 in years 2019 and 2021, respectively. The least rate of detection in year 2020 and 2021. The stool adequacy rate was more than 80.00% in all years with lowest in 2020 (80.19%) and highest in 2022 (94.83%). All samples that were tested for the AFP surveillance at the Polio Regional Reference Laboratory have reported results within 14 days of receiving the sample during each year of the study.

4. Discussion

During the study period, both polioviruses (*n*=19, 1.15%) and non-polio enteroviruses (*n*=73, 4.44%) were isolated, among the 2 141 stool samples that were received from 1 644 cases for AFP surveillance from Sri Lanka (93.61%), Maldives (1.52%), and immunodeficient VDPV (4.86%) surveillance. Sabin-like 3 virus was detected in majority (*n*=12, 63.15%) among the poliovirus isolated where as wild polioviruses or circulating VDPVs were not detected among the cases. During all years of the study, the non-polio AFP detection rate was >1/100 000 in children aged less than 15 years, while the stool adequacy rate was >80%. All results were reported within 14 days of receipt, ensuring timely reporting as per global guidelines.

The last case of WPV was detected in Sri Lanka in year 1993 and the country was certified polio-free in March, 2014 along with the other countries in the WHO SEARO region[2]. Thus, in line with the polio eradication strategy 2022-2026, and global polio surveillance action plan 2022-2024, Sri Lanka follows an enhanced detection and response system through a sensitive and timely surveillance, to maintain the polio free status in the country. In achieving this goal the Polio Regional Reference Laboratory Sri Lanka, plays a pivotal role by carrying out the laboratory virological surveillance for polio, following the recommendations of the global polio eradication initiative. Thus, in this study we evaluate the polio laboratory surveillance carried out by the Polio Regional Reference Laboratory, Sri Lanka with regard to maintaining a polio free status in the country.

Timely and sensitive AFP surveillance is the gold standard for detecting cases of poliomyelitis according to the Global polio eradication initiative[8]. The surveillance includes reporting children with AFP, transporting stool samples for analysis, isolating and identifying poliovirus in the laboratory and mapping the virus to determine the origin of the virus strain[8]. All patients aged under 15 years of age with a clinical diagnosis of AFP including Guillain-Barré syndrome or any person of any age with paralytic illness where poliomyelitis is suspected, should be investigated with two samples of stools collected at least 24 hours apart, within 14 days of onset of symptoms. Further, it is recommended to collect stool samples from 4-5 contacts of the AFP cases who are under 5 years of age and who have not received OPV for the last 30 days[10].

In addition, the WHO has supported several countries in implementing pilot projects for iVDPV surveillance, which includes Sri Lanka. This monitors laboratory-confirmed VDPV infection in persons of any age who have a primary immunodeficiency disorder (humoral or combined humoral and cellular) which is defined as iVDPV, and which may be present with persistent (>6 months) or chronic (>5 years) polio viral excretion[11].

The Polio Regional Reference Laboratory, Sri Lanka, receives all samples of suspected AFP cases and contacts from throughout the country to confirm/exclude PV infection, and samples from patients with primary immunodeficiencies to examine for prolonged excretion of the virus. Thus, the laboratory in collaboration with global polio laboratory network GPLN carries out the AFP surveillance as well as the iVDPV surveillance, ensuring rapid investigation of all cases providing timely and accurate virological information. The laboratory monitors the proper receipt of these samples including their condition and timing of collection and transport. The stool adequacy rate of the samples were more than 80% in all study years, thereby ensuring the investigation timeliness and the quality of the reverse cold chain mechanism employed for virus isolation, and the ability to detect the PV.

All samples received for the AFP and iVDPV surveillance undergo recommended laboratory testing methodologies with cell culture inoculation on the L20B and RD cell lines, which are permitted in the laboratory network. Combination of these cell lines provides greater diagnostic sensitivity and specificity and differentiates PV from the NPEV. Samples with positive viral culture for PV are differentiated into possible wild strains and vaccine-like strains with the utilization of the poliovirus ITD/VDPV rRT-PCR assay. Any samples which give rise to discordant results with the ITD/VDPV rRT-PCR assays without confirming the PV isolate to be Sabin like PV, are referred to specialized centres for genetic sequencing. The Polio Regional Reference Laboratory, Sri Lanka ensures completion of this diagnostic algorithm within 14 days of receipt[10]. This was confirmed through data extracted from the laboratory data system where all (100%) samples tested during the study period were reported within 14 days, ensuring timely reporting. Further, results of all samples are reported to the GPLN using the online data system, following their recommendations.

Moreover, the Polio Regional Reference Laboratory, Sri Lanka

extends its' role as the laboratory for region where it acts as the polio laboratory for Maldives. Samples have been received from Maldives during all years of study and timely reporting has been ensured, confirming its role as a regional laboratory.

The Polio Regional Reference Laboratory has taken several steps to confirm high quality in providing its services. The laboratory is accredited under the WHO, and there by fulfill a performance indicator for the AFP surveillance[8]. Furthermore, the laboratory undergoes external quality assurance programmes by-annually for poliovirus inoculation and ITD/VDPV rRT-PCR to ensure the high level of diagnostic performances and to maintain its' accreditation status.

Both PVs and NPEVs were isolated from AFP and VDPV surveillance samples during the study period. Throughout the study years, including during the COVID-19 pandemic, the non-polio AFP detection rate was more than 1/100 000 children aged less than 15 years of age annually, fulfilling the indicator for a sensitive surveillance. SL 3 virus was detected in the majority among the PVs isolated followed by SL1 & 3 and SL1 during the study period. WPVs or c-VDPV were not detected among the samples tested.

The study period included the SARS-CoV-2 pandemic that circulated in Sri Lanka, thus the numbers of samples investigated during that period could have been affected due to low reporting of cases.

In conclusion, Polio Regional Reference Laboratory, Sri Lanka plays a vital role in maintaining the polio-free status in the country through its robust laboratory surveillance, while adhering to the surveillance indicators. Non-detection of WPV and cVDPV during the study period reinforces the polio-free status in the country.

Conflict of interest statement

All authors would like to declare that there are no potential conflicts of interest.

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Authors' contributions

M.A.Y.F. conceptualized the study and got involved in formulating the methodology, validation, analysis and writing of the original draft. N.S.M., C.R. and N.W. participated in data curation and investigation. D.C.U.D.W. got involved in conceptualizing the study, reviewing & editing, supervision and project administration. J.I.A. conceptualized the study, formulated the methodology and participated in validation, formal analysis, review & editing, supervision, and project administration.

References

[1] World Health Organization. *History of polio vaccine*. [Online]. Available from: https://www.who.int/news-room/spotlight/history-of-vaccination/history-of-polio-vaccination. [Accessed on 9 August 2023].

[2] World Health Organization. *Poliomyelitis. WHO 2023.* [Online]. Available from: https://www.who.int/news-room/fact-sheets/detail/poliomyelitis [Accessed on 12 November 2023].

[3] World Health Organization. *Polio eradication initiative 2023*. [Online]. Available from: https://www.emro.who.int/polio-eradication/about-eradication/surveillance.html. [Accessed on 1 August 2023].

[4] Lee SE, Greene SA, Burns CC, Tallis G, Wassilak SGF, Bolu O, et al. Progress toward poliomyelitis eradication--worldwide, January 2021--March 2023. *MMWR Morb Mortal Wkly Rep* 2023; **72**(19): 517-522.

[5] World Health Organization. *Global polio eradication initiative strategic plan 2004–2008*. [Online]. Available from: https://www.who.int/publications/m/item/global-polio-eradication-initiative-strategic-plan-2004-2008. [Accessed on 3 August 2023].

[6] Bigouette JP, Henderson E, Traoré MA, Wassilak SGF, Jorba J, Mahoney F, et al. Update on vaccine-derived poliovirus outbreaks—Worldwide, January 2021–December 2022. *MMWR Morb Mortal Wkly Rep* 2023; **72**(14): 366-371.

[7] World Health Organization. *Polio eradication strategy 2022–2026: Delivering on a promise*. [Online]. Available from: https://polioeradication.org/wp-content/uploads/2022/06/Polio-Eradication-Strategy-2022-2026-Delivering-on-a-Promise.pdf. [Accessed on 8 August 2023].

[8] Polio Global Eradication Initiative. *Surveillance indicators*. [Online]. Available from: https://polioeradication.org/polio-today/polio-now/surveillance-indicators/. [Accessed on 6 August 2023].

[9] Polio Global Eradication Initiative. *Global polio surveillance action plan 2022–2024*. [Online]. Available from: https://polioeradication.org/wp-content/uploads/2022/05/GPSAP-2022-2024-EN.pdf. [Accessed on 1 August 2023].

[10] Centers for Disease Control and Prevention (CDC). *Polio, laboratory testing for poliovirus.* [Online]. Available from: https://www.cdc.gov/polio/php/laboratories/index.html [Accessed on 10.05.2024].

[11] Global Polio Eradication Initiative. *Guidelines for implementing poliovirus surveillance among patients with primary immunodeficiency disorders (PIDs). Geneva: Switzerland; 2019.* [Online]. Available from: https://polioeradication.org/wp-content/uploads/2022/06/Guidelines-for-Implementing-PID-Suveillance_EN.pdf. [Accessed on 13 August 2023].

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