

Feedback from operational stakeholders who manage or respond to outbreaks is that they are often too busy to review literature or obtain relevant background information to assist them with acute response. Unlike a traditional analytical outbreak investigation report, **Watching Briefs** are intended as a rapid resource for public health or other first responders in the field on topical, serious or current outbreaks, and provide a digest of relevant information including key features of an outbreak, comparison with past outbreaks and a literature review. They can be completed by responders to an outbreak, or by anyone interested in or following an outbreak using public or open source data, including news reports.

Watching brief	
Title	Dream of Polio Free Pakistan - when will it become a reality?
Authors	S. Nandhini, Roopa Hariprasad, S. Vallikavitha, Reetika Malik Yadav
Date of first report of the outbreak	In June 2022, Pakistan was classified by the International Health Regulations (IHR) as a state infected with Wild Poliovirus type 1 (WPV1) and circulating Vaccine derived poliovirus type 2 (cVDPV2) with potential risk of international spread [1]. No cases of cVDPV2 were reported in 2022. After reporting a single wild poliovirus (WPV) type 1 (WPV1) case on 23rd January 2021 [2] the first report of a confirmed case of polio among all 20 cases reported from Pakistan in 2022 came on 22nd April 2022 [3] The case was confirmed by the Pakistan National Polio Laboratory at the National Institutes of Health, in addition to existence of the wild virus in environmental samples on April 5, 2022.
Disease or outbreak	Wild Poliovirus type 1 (WPV1) [4] and circulating Vaccine derived poliovirus type 2 (cVDPV2) [5].
Origin (country, city, region)	North Waziristan district of southern Khyber Pakhtunkhwa (KP) province in Pakistan.
Suspected Source (specify food source, zoonotic or human origin or other)	Fecal-oral transmission is the most common source of transmission of wild poliovirus in the developing countries, including Pakistan. In addition to the poor health and water sanitation infrastructure, the transmission of the virus is also heightened because of the high population density and climate conditions like excess rainfall which can promote sweeping of human waste into water bodies. For VDPV, strains from the attenuated oral poliovirus vaccine shed into water bodies that are used for activities of life (bathing, drinking and washing).

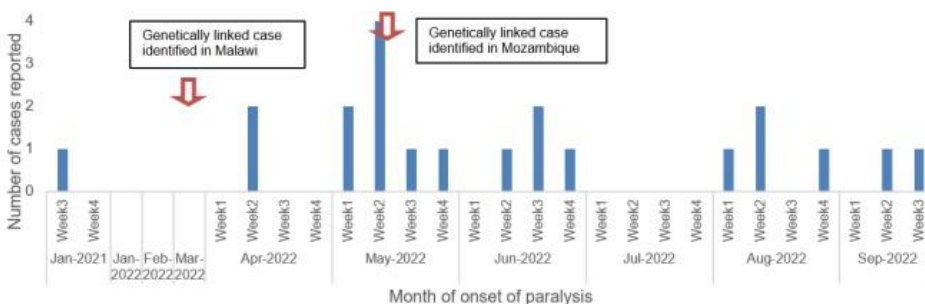
Date of outbreak beginning	The WPV1 case was reported from Khyber Pakhtunkhwa and confirmed on 9th and 22nd April 2022 [4] respectively; cVDPV2 case in Diamer district (Gilgit-Baltistan province) was reported on July 2019 [5].
Date outbreak declared over	The WPV1 outbreak is ongoing in December 2022. However, the cVDPV2 outbreak was declared over on 23 rd April 2021 [5].
Affected countries & regions	WPV1 cases had been reported from two districts in Khyber Pakhtunkhwa in 2022, including 18 (90%) from North Waziristan and 2 (10%) from Lakki Marwat. There were reports of two cases imported to Malawi and Mozambique which came from Pakistan/Afghanistan [6,7]. The genetic sequencing analyses of the two wild polioviruses indicate a single importation event into south-eastern Africa [1]. Of the cVDPV2 cases reported in the Morbidity and Mortality Weekly report (MMWR) by the U.S. Centers for Disease Control and Prevention, between 2019 and 2021, 59 (36%) were in Khyber Pakhtunkhwa, 47 (29%) in Sindh, 27 cases (16%) each in Punjab and Balochistan, four (2%) in Gilgit-Baltistan, and one (1%) in Islamabad.
Number of cases (specify at what date if ongoing)	It is an ongoing outbreak of WPV1 as in December 2022. There were 20 WPV1 cases reported in 2022 from Pakistan according to the Global Polio Eradication Initiative (GPEI) 26 October 2022(Figure 1, Table 1).  Figure1: Weekly incidence of WPV1 cases in Pakistan (Jan'21 - Oct'22)

Table 1: Line listing of WPV1 cases reported in Pakistan (Jan'2021 – Oct'2022)

No.	Age (in months)	Sex	Area of reporting	Date of onset of paralysis
P1-21	Not known	Not known	Killa Abdullah, Balochistan	21-01-2021
P1-22	15	1212	North Waziristan, Southern Khyber-Pakhtunkhwa	09-04-2022
P2-22	24	F		14-04-2022
P3-22	12	M		02-05-2022
P4-22	13	M		05-05-2022
P5-22	18	F		08-05-2022
P6-22	18	M		10-05-2022
P7-22	7	F		11-05-2022
P8-22	20	M		15-05-2022
P9-22	11	M		27-05-2022
P10-22	12	M		08-06-2022
P11-22	8	M		09-06-2022
P12-22	21	M		18-06-2022
P13-22	18	M	Lakki Marwat	20-06-2022
P14-22	8	F	North Waziristan, Southern Khyber-Pakhtunkhwa	30-06-2022
P15-22	17	M		01-08-2022
P16-22	192	M	Lakki Marwat	09-08-2022
P17-22	24	M	North Waziristan, Southern Khyber-Pakhtunkhwa	09-08-2022
P18-22	3	M		25-08-2022
P19-22	6	M		16-09-2022
P20-22	10	M		10-09-2022

Reported 14 cases during April 1–July 31, 2022, were clustered in North Waziristan district of southern Khyber Pakhtunkhwa (KP) province in Pakistan [8].

Pakistan reported 22, 135 and 8 cVDPV2 cases in 2019, 2020 and 2021 respectively.

Clinical features

The initial symptoms are fever, fatigue, headache, vomiting, stiffness of the neck and pain in the limbs. One in 200 infections leads to irreversible paralysis (usually in the legs). Polio mainly affects children under 5 years of age. However, anyone of any age who is unvaccinated can contract the disease. Symptoms in VDPV infection may range from asymptomatic excretion of VDPV in some vaccinated immunodeficient individuals (iVDPV) because of a prolonged period of intestinal replication to acute flaccid paralysis (AFP) as described above. AFP can result if the vaccine-virus is able to circulate uninterrupted in the community for a prolonged period of time, as it can mutate and, over the course of 12-18 months, and reacquire neurovirulence [9].

Mode of transmission (dominant mode and other documented modes)	Polio virus is transmitted mainly through the feco-oral route. It invades the nervous system and can cause total paralysis in a matter of hours. The virus is transmitted less frequently, by a common vehicle (for example, contaminated water or food) and multiplies in the intestine. Circulating vaccine derived polioviruses (cVDPVs) can result in outbreaks of polio in areas with low vaccine coverage. Sporadic cases of VDPV have also been reported, the common being cVDPV2 [10].
Demographics of cases	Pakistan is one of the two endemic countries for polio, reporting co-circulation of WPV1 and cVDPV2. Environmental surveillance conducted routinely from sewage samples revealed 13 (2%) of 748 samples positive for WPV1 in 2022, including eight from Khyber Pakhtunkhwa province, four from Punjab province, and one from Islamabad, thereby indicating circulation in these geographical areas. Ongoing cVDPV2 transmission in Pakistan has resulted in 165 cVDPV2 cases during July 2019–July 2021 (22 cases in 2019, 135 in 2020, and eight in 2021 to date), with the latest case reported on April 23, 2021 [11]. Ten cVDPV2 positive environmental samples have been reported to date. Of the 15 WPV1 cases reported during January 2021–July 2022, patients' ages ranged from 7 to 28 months (median = 15 months). The ages of the children with cVDPV2 cases ranged from 2 months to 12 years (median = 18 months) [10].
Case fatality rate	The case fatality ratio will be the same as for paralytic polio which is generally 2%–5% among children and up to 15%–30% among adolescents and adults. It increases to 25%–75% with bulbar involvement [12].
Complications	These are seen in neurovirulent form of disease and include paralysis, polio being a prominent differential diagnosis in case of acute flaccid paralysis. Among those paralyzed, 5–10% die when their breathing muscles become immobilized [13].
Available prevention	Use of inactivated polio vaccine (IPV) is an available prevention strategy for phased removal of OPV in routine immunization and has been introduced in all countries as of May 2019 to achieve and sustain a polio-free world [14]. In 2022, five national polio vaccination campaigns have been conducted in the months of January, February, August, October, and November [15–19] and subnational campaigns in the months of March and May [20].
Available treatment	Multiple drug candidates, including capsid inhibitors and protease inhibitors, have been screened and pocapavir identified as the lead candidate. The Global Polio Eradication Initiative (GPEI) is developing a combination pocapavir and another candidate (V-7404), a protease inhibitor which may prove to be useful for community outbreaks [21]. In a randomized controlled trial, 56% pocapavir-treated subjects cleared virus in median 5.5 days with no evidence of drug resistance [22].

Comparison with past outbreaks	Pakistan is still endemic for wild poliovirus transmission. Isolated Cases of cVDPV have been reported in Pakistan in 2015 and 2016. Two cases of cVDPV in 2015 which had continued transmission from cVDPV cases in 2014 [23]. In 2016, a new cVDPV2 AFP case was reported in the month of December from Quetta [24].
Unusual features	Among WPV1 cases reported in 2022 until July, 87% had never received OPV through essential immunization (zero-dose children) [25]. An unusual feature deterring polio eradication in Pakistan is non-acceptance of the vaccine [26-28]. A mix of fragile health systems, conflicts, other complex cultural and religious challenges make the country prone to repeated polio outbreaks. Pakistan has in the past, witnessed frequent attacks on polio teams including women, and policemen deployed to protect door-to-door vaccination campaigns, while K-P's North Waziristan district and areas near the Afghan border, falsely claim that vaccination campaigns are either a Western conspiracy to sterilize children or a cover for espionage. The cVDPV2 outbreak also poses increased risk of spread to neighbouring countries. If a population is seriously under-immunized, there are enough susceptible children for the excreted vaccine-derived polioviruses to begin circulating in the community. If the vaccine-virus is able to circulate for a prolonged period of time uninterrupted, it can mutate and, over the course of 12-18 months, reacquire neurovirulence.
Critical analysis	With the wild poliovirus eliminated from most of the world apart from Pakistan and Afghanistan, the threat to the Global Polio Eradication stems from reintroduction of the poliovirus and emergence of circulating vaccine derived poliovirus (cVDPV) in the polio-free countries. Pakistan is one of the few nations in the world where polio is still attacking infants despite the continuous and rigorous efforts of the government and its partners' organizations including the Bill & Melinda Gates Foundation, WHO, UNICEF, US CDC, and Rotary International. Pakistan reports both co-circulation of WPV1 and cVDPV2. Although Pakistan had completed one year of zero polio incidence [25] with no case reported between January 2021 and April 2022, the WPV1 outbreak and detection of the virus in environmental samples in the southern districts of KP and Balochistan in 2022 has placed the target of polio free Pakistan further away. With the ongoing WPV1 circulation in South KP, the risk to the rest of Pakistan has escalated though the current geographic transmission is limited to KP.

	Detection of genetically linked strains of WPV1 during this period in Malawi and Mozambique, two countries located in the WHO African Region, which were certified free of indigenous WPV1 transmission in September 2020, indicate an increased risk of spread to neighbouring countries [25]. Additionally, cVDPV2 also has been detected from Iran and Tajikistan. Of the 307 cVDPV2 cases reported in Afghanistan in 2020, 199 (65%) were genetically derived from the Pakistan- Gilgit-Baltistan -1 emergence which originated in Gilgit-Baltistan, Pakistan [29]. Hence, control of the WPV1 and cVDPV2 transmission in Pakistan is an international concern. Multiple reasons might be responsible for Pakistan lack of success in the eradication of polio including, governance issues, lack of health facilities, low routine immunization, or refusal of immunization [30], security threat to immunization staff, extensive public movement, and presence of polio reservoirs/zones in border regions with Afghanistan [31]. Pakistan's struggle against polio eradication was further exacerbated by the COVID-19 pandemic which brought a standstill to the routine immunizations [32]. Considering all the bottlenecks, the current priorities for Global Polio Eradication Initiative (GPEI) are to stop transmission of WPV1 in endemic countries and to stop persistent cVDPV2 outbreaks [33,34]. Important strategies for the same include high vaccine coverage with IPV and improved surveillance for VDPV [35,36].
Key questions	1. How to permanently interrupt all poliovirus transmission in the final WPV-endemic country like Pakistan? 2. How COVID-19 pandemic played a role in under-immunization of the community? 3. What strategies should be adopted to improve vaccination coverage at the community level in Pakistan? 4. How surveillance for VDPV can be improved in Pakistan? What is the current surveillance system in place for WPV and VDPV detection in Pakistan?
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