**The Recent Polio cVDPV2 Outbreak in Gaza – Challenges and Opportunities**

**Background**

The global effort to eradicate polio faces a complex web of challenges as it enters its final stages. Despite significant progress, wild virus transmission persists in Afghanistan and Pakistan. These endemic countries grapple with security issues and inaccessibility in certain regions, hindering vaccination efforts. . Compounding this problem is the emergence of vaccine-derived poliovirus type 2 (cVDPV2) outbreaks in previously polio-free areas, including in Israel and Gaza [1]. The current, major conflict has led to a humanitarian crisis and the displacement of over people in both Gaza and Israel, rsulting in . This has also resulted in a reduction of polio vaccination coverage.

**Global Epidemiology of cVDPV2**

Unvaccinated groups in regions with poor water, sanitation, hygienic conditions, fragile health systems, and ongoing wars and conflicts are at heightened risk for circulating vaccine-derived poliovirus (cVDPV). In recent years, cVDPV2 has emerged as a significant global public health concern, particularly among populations with low immunization coverage.

The global success in eradicating the wild poliovirus type 2 (WPV2) in 1999 led to the cessation of the type 2 component of OPV in 2016. However, the continued circulation cVDPV in countries with inadequate vaccination coverage with eIPV, allows for the attenuated vaccine-derived virus to circulate and further mutate, increasing the risk of cVDPV2 outbreaks. As of 2024, cVDPV1 has been reported in two countries, while cVDPV2 in 15 countries in multiple regions, with Africa being most affected, due to poor vaccination coverage, wars, and conflicts, displacement, poor water, sanitation and hygiene, and healthcare access barriers, [13].

In the WHO Eastern Mediterranean region, cVDPV2 has been detected in countries such as Afghanistan and Pakistan, which also remain endemic for wild poliovirus type 1 (WPV1), complicating eradication efforts. Additionally, cVDPV2 has been detected in environmental samples in countries like Iran and Somalia, indicating ongoing transmission, including import from other countries and highlighting the need for continued vigilance [14]. The WHO Western Pacific region has also reported cases of cVDPV2, particularly in Indonesia, where outbreaks in recent years have prompted emergency vaccination campaigns. In Europe, Tajikistan has experienced outbreaks linked to cVDPV2 strains originating from Pakistan, illustrating the virus’s potential for cross-border spread [14].

The resurgence of cVDPV2 emphasizes the need for sustained immunization efforts, particularly in high-risk regions. The introduction of the novel oral polio vaccine type 2 (nOPV2), designed to be more genetically stable and less likely to revert to virulence, represents a critical tool in combating these outbreaks [14]. However, the ongoing challenge of ensuring high vaccination coverage, especially in conflict-affected and underserved areas, remains a significant barrier to global polio eradication efforts [15].

Thanks to global vaccination efforts, the polio cases originating from the wild poliovirus are down from hundreds of thousands annually in the 1980s to 27 cases globally today - 14 cases of WPV1 in Afghanistan and 13 cases of WPV1 in Pakistan as of October 2024 [16]. The world is close to making polio the second human disease to be eradicated. However, this “polio end-game” phase exposes the world to the challenges of the residuals of the cVDPVs. Therefore, there is a need to ensure that all children are immunized against all strains of the virus using eIPV 1, 2, 3, combined with simultaneous administration of bOPV 1, 3 in areas with poor sanitation and hygiene. In cases of cVDPV2 outbreaks, the nOPV (type 2) is recommended as the first-line vaccine, aiming to stop the circulation of the virus rapidly and widely, side by side with the eIPV. Regional polio vaccination strategies should be tailored to address a whole-of-community approach that stops the spread of poliomyelitis, as borders do not confine hazards and microbes. The Israel-Gaza polio situation illustrates this need.

**Polio in Israel and Gaza**

In 1977-78, Gaza experienced a severe polio outbreak, with over 70 cases occurring annually, even among partially vaccinated children. Simultaneous outbreaks of enteric diseases and measles further exacerbated this crisis. In a remarkable display of collaboration, Israeli and Palestinian health officials, alongside the World Health Organization (WHO), took decisive action. They implemented a new polio control strategy based on advice from a WHO consultant, Dr Melnick: combining the oral polio vaccine (OPV) with two doses of the inactivated polio vaccine (IPV). This strategic approach, known as "the Gaza system," received full support from the Israeli Coordinator of Government Activities in the Territories (COGAT), marking a significant milestone in the fight against polio [2]. Due to its successful impact, the “Melnick Plan” was adopted by other countries in the Mediterranean region.

In 1988, Israel experienced a significant poliomyelitis outbreak, marking the largest occurrence of paralytic poliomyelitis in the country since 1979. This outbreak, caused by wild poliovirus type 1 (WPV1), resulted in 15 confirmed cases of paralytic poliomyelitis between July and October of that year. The outbreak also saw the co-identification of a clinical case in the West Bank, alongside the detection of WPV1 in sewage samples from Gaza. Most cases (12 out of 15) were concentrated in the Hadera subdistrict, an area where enhanced inactivated poliovirus vaccine (eIPV) had been exclusively used for infant immunization since 1982 [3]. In response to the outbreak, the Israeli Ministry of Health launched a mass vaccination campaign, targeting all individuals under the age of 40 with OPV, which led to the elimination of the virus. The outbreak led to the implementation of combined eIPV and OPV vaccination schedule in Israel [4].

Following the 1988 outbreak, a collaborative early warning system was established in and included routine sewage monitoring for Israel, the West Bank, and Gaza at the Central Virus Laboratory of Israel's Ministry of Health [5].

WHO declared Israel, the West Bank and Gaza polio-free in 2002 and 2010, respectively [5,6]. In 2004, Israel discontinued the use of OPV in line with the WHO European Region. However, Gaza has continued using the ״Melnick Plan״.

In May 2013, a silent outbreak of wild poliovirus type 1 (WPV1) was identified through sewage monitoring in southern Israel [7]. The same virus was previously detected in sewage samples in Cairo, Egypt. Genetic analyses linked the virus to strains circulating in Pakistan, indicating its spread from south Asia to the Middle East [8]. Later in 2013, the virus spread silently across the country, evidenced by environmental surveillance without clinical cases [9]. The outbreak further extended with WPV1 identified in sewage samples from both the West Bank and Gaza [10]. In response to the widespread detection of WPV1, Israel, along with the Palestinian territories, initiated a coordinated public health response that included a mass immunization campaign using bivalent oral polio vaccine (bOPV). Moreover, due to the ongoing threat posed by the virus, Israel made the strategic decision to re-include bOPV in its national vaccination schedule, a move aimed at ensuring sustained immunity and preventing future outbreaks [11]. The epidemiological interpretation was that without the deployment of the oral polio vaccine (OPV), it is doubtful that the polio outbreak could have been effectively contained and eradicated during this period [12].

**Latest cVDPV2 epidemiology in Israel**

In 2022, Israel reported a Vaccine-Associated Paralytic Poliomyelitis (VAPP) linked to circulating vaccine-derived poliovirus type 2 (cVDPV2), marking a significant public health event for the country. In addition to the VAPP case, cVDPV2 was detected in environmental samples, specifically in sewage, underscoring the silent circulation of the virus within the population. This was part of a broader pattern observed globally, as cVDPV2 was also identified in sewage in the United Kingdom and the United States during the same period, highlighting the virus’s potential for re-emergence even in polio-free regions. The Israeli Ministry of Health responded by intensifying surveillance and reassessing vaccination strategies, to increase vaccination coverage with the eIPV vaccine. The situation underscored the importance of continuous vigilance and adaptability in public health strategies to prevent the re-emergence of poliovirus in any form.

**Current Polio Outbreak in Gaza**

The routine vaccination in Gaza and the West Bank includes five dosages of OPV 1,3 and two of IPV1, 2, 3. The vaccination coverage until mid-2023 was high. However, since October 2024, with Gaza’s fragile healthcare infrastructure, exacerbated by prolonged conflict, displacement, crowded shelters, limited access to routine immunization services, and poor water, sanitation, and hygiene conditions, many of the infants have not been vaccinated routinely. (Palestinian Ministry of Health) In June 2024, Gaza faced a new polio threat with the detection of circulating vaccine-derived poliovirus type 2 (cVDPV2) in six environmental samples, followed by a verified case of cVDPV2 in a 10-month-old girl with poliomyelitis. The outbreak marks a significant public health emergency in Gaza and the region. The virus is genetically linked to cVDPV2 strains circulating in Egypt, reflecting the regional interconnectedness of poliovirus transmission [17].

In response to this outbreak, a critical polio vaccination campaign using nOPV2 was launched on September 1, 2024, targeting over 640,000 children under ten years of age. This campaign was successful with vaccination of 560,000 vaccinated between September 1-12, 2024. The round of the vaccination campaign in Gaza will start on October 14, 2024, using a similar scheme that was used for the first round, with local 'tactical pauses' in fighting during the working hours of the campaign [18].

The recent situation of polio spread in the Middle East is an example of how local context must be taken into consideration within the current global effort to eradicate polio. In the years ahead, we must also consider the post-COVID pandemic influences: vaccine hesitancy and misinformation pose significant obstacles, particularly in areas with low literacy rates where conspiracy theories can spread rapidly. This skepticism undermines efforts to achieve high immunization coverage. Additionally, logistical challenges, such as maintaining vaccine efficacy during storage and transportation in remote areas, further complicate the eradication campaign.

The Gaza case is presents another major challenge. The safety of healthcare workers remains a grave concern, with targeted attacks on polio vaccination teams threatening both the lives of workers and the success of immunization campaigns. Ensuring local ceasefires is crucial. On top of these considerations, population movement increases the risk of virus spread across borders. Weak routine immunization in high-risk environments and among populations-in-risk leaves children vulnerable to infection, while competing health priorities and disease outbreaks strain resources and attention away from polio eradication efforts.

Funding gaps continue to be a significant challenge, as sustained financial support is crucial for maintaining eradication efforts. Additionally, increased detection of poliovirus in environmental samples, such as sewage, indicates ongoing transmission risks that must be addressed to achieve global eradication.

The Gaza outbreak, combined with the previously detected cVDPV2 in Israel, underscores the need for coordinated regional efforts and sustained vaccination campaigns to prevent further. virus spread. Recent events both in Israel and Gaza are showing new challenges, not only for the region but also for the global eradication campaign, bringing forward the importance of circulating vaccine-derived poliovirus and the best ways to deal with this with the current existing vaccines available, gaps between different countries healthcare systems and existing military and political conflicts.

The complex situation in the Middle East can potentially drive the emergence and reemergence of infectious diseases across the region, making it essential for countries to collaborate and implement cross-border responses. There are successful precedents for such cooperation, including the establishment of the Middle East Consortium on Infectious Disease Surveillance (MECIDS) [19], as well as joint efforts during the 2009 H1N1 pandemic [20] and the 2013 silent WPV1 outbreak [10].

The current situation of cVDPV2 in the area,may require an expanded vaccination campaign with nOPV2 [21] and urges the creation of similar initiatives, in partnership with international bodies and organizations, to coordinate responses to the current polio outbreak in Gaza and address other infectious disease threats which can be attributed to the public health crisis related to the conflict in the Middle East.

**Conclusion**

The recent cVDPV2 outbreak in Gaza underscores the fragility of global polio eradication efforts and the critical importance of maintaining high vaccination coverage, especially in conflict zones. This situation highlights the interconnectedness of public health across borders and the need for coordinated regional responses. The successful implementation of vaccination campaigns amidst conflict demonstrates the challenges and possibilities of crises. Developing and deploying more stable vaccines, such targeted nOPV2 campaigns, while ensuring comprehensive coverage with IPV, offer hope in preventing future outbreaks. However, the ultimate success of polio eradication will depend on sustained political will, international cooperation, and innovative strategies to reach every child with life-saving vaccines. As we navigate the complexities of the "polio endgame," the lessons learned from the Gaza outbreak will be invaluable in shaping global health policies and preparedness for future infectious disease challenges.

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