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پولیو در افغانستان: چالش‌های کنونی و مسیرهای ریشه‌کن‌سازی

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چکیده

پیش‌زمینه: ابتکار جهانی ریشه‌کنی فلج اطفال، آغاز شده در سال ۱۹۸۸، بروز جهانی فلج اطفال را بیش از ۹۹٫۹٪ کاهش داده و نوع‌های ۲ و ۳ ویروس وحشی فلج اطفال را ریشه‌کن کرده است. افغانستان و پاکستان آخرین ذخایر ویروس وحشی فلج اطفال نوع ۱ باقی مانده‌اند، با انتقال ادامه‌دار به دلیل ناامنی، محدودیت‌های واکسیناسیون خانه‌به‌خانه، تردید در مورد واکسن و ضعف زیرساخت‌های بهداشتی.

روش‌ها: ما در پایگاه‌های داده اسکاپوس، پاب‌مد و گوگل اسکالر جستجو کردیم و از کلیدواژه‌هایی مانند «ریشه‌کنی فلج اطفال در افغانستان»، «ویروس وحشی فلج اطفال نوع ۱»، «تردید در مورد واکسن» و «واکسیناسیون خانه‌به‌خانه» استفاده نمودیم. منابع بررسی شده شامل مقالات مرور شده و گزارش‌های خاکستری، از جمله گزارش‌های سازمان جهانی صحت و یونیسف بود.

یافته‌ها: جستجو، ۳۴ منبع مرتبط شامل مقالات علمی، گزارش‌ها و ادبیات خاکستری را شناسایی کرد. یافته‌ها نشان می‌دهد انتقال ویروس وحشی فلج اطفال نوع ۱ به دلیل ناامنی، محدودیت‌های واکسیناسیون و حرکت‌های جمعیتی ادامه دارد. پایش محیطی و ژنتیکی، هماهنگی فرامرزی و درس‌هایی از هند و نیجریه اهمیت ترکیب واکسیناسیون با خدمات بهداشتی گسترده‌تر، استفاده از ابزارهای دیجیتال مانند سیستم‌های اطلاعات جغرافیایی و هوش مصنوعی و تقویت اعتماد جامعه از طریق رهبران محلی را نشان می‌دهند.

نتیجه‌گیری: ریشه‌کنی فلج اطفال در افغانستان نیازمند راهبرد چندجانبه است که واکسیناسیون را با خدمات بهداشتی گسترده‌تر پیوند دهد، از پایش دیجیتال و مشارکت جامعه بهره گیرد، حمایت سیاسی پایدار داشته باشد و هماهنگی قوی با پاکستان برقرار شود.

واژه‌گانِ کلیدی: ریشه‌کنی پولیو، ویروس پولیوی وحشی نوع اول (WPV1)، استراتیژی‌های واکسینشن، افغانستان، صحت جهانی

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Polio in Afghanistan: Current Challenges and Pathways to Eradication

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Abstract

Background: The Global Polio Eradication Initiative (GPEI), launched in 1988, has reduced global polio incidence by over 99.9% and eradicated wild poliovirus types 2 and 3. Afghanistan and Pakistan remain the last reservoirs of wild poliovirus type 1 (WPV1), with transmission hindered by insecurity, restrictions on house-to-house vaccination, vaccine hesitancy, and fragile health infrastructure.

Methods: We searched Scopus, PubMed, and Google Scholar using keywords such as "Afghanistan polio eradication," "WPV1," "vaccine hesitancy," and "house-to-house vaccination." Both peer-reviewed and grey literature, including WHO and UNICEF reports, were included.

Results: The search identified 34 relevant sources. Findings highlight persistent WPV1 transmission due to insecurity, vaccination restrictions, and population movements. Environmental and genetic surveillance, cross-border coordination, and lessons from India and Nigeria emphasize integrating vaccination with broader health services, using digital tools like Geographic Information Systems (GIS) and Artificial Intelligence (AI), and strengthening community trust through local leaders.

Conclusion: Eradication in Afghanistan requires multi-faceted strategies linking vaccination to broader health services, digital surveillance, community engagement, and sustained political commitment, alongside strong coordination with Pakistan.

Key words: Polio eradication, Wild poliovirus type 1 (WPV1), Vaccination strategies, Afghanistan, Global health.

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Introduction

The Global Polio Eradication Initiative (GPEI), launched in 1988, has driven a remarkable reduction of over 99.9% in global polio cases and led to the eradication of two of the three wild poliovirus types (WPV2 and WPV3). However, the final push toward a polio-free world is stalled by the persistent circulation of WPV1 in a single, interconnected epidemiological bloc: Afghanistan and Pakistan [1,2]. The historical context of polio in Afghanistan is one of profound vulnerability, marked by prolonged conflict, political instability, and humanitarian crises that have consistently undermined public health efforts. Historically, the nation has struggled to achieve high vaccination coverage due to a combination of internal conflicts and fragmented governance. Eradicating the virus from this region is both a public health goal and a matter of global health security. Circulating WPV1 threatens polio-free countries with importation and outbreaks, risking reversal of decades of progress [3]. The GPEI's mission has shifted from vaccination campaigns to a multi-layered effort requiring diplomacy, community trust, and technological innovation to eliminate the last reservoirs of the virus[1]. GPEI has had a long and complex history in Afghanistan [4].

In the early 1990s, despite civil war, the polio program achieved success by negotiating local cease-fires and creating safe corridors that allowed vaccination teams to reach children on both sides of the conflict [5,6]. This period demonstrated that even in the most challenging security environments, sustained political will and persistent diplomacy could yield real gains [7]. As a result, polio cases dropped significantly; by the mid-2000s Afghanistan was nearing polio-free status, with annual case numbers falling into the single digits [8]. However, this progress was not sustained. The mid-2010s saw a sharp resurgence in polio cases, driven by escalating conflict, the rise of new insurgent groups, and renewed restrictions on house-to-house vaccination campaigns [9,10]. A turning point was the exposure of a CIA-run (Central Intelligence Agency) fake vaccination program in neighboring Pakistan, which sowed deep mistrust in vaccination campaigns. Militants came to view vaccination teams as instruments of intelligence gathering, leading to widespread bans on immunization and heightened resistance, particularly in southern Afghanistan, the stronghold of insurgent groups [9].

After the Taliban takeover, restrictions were imposed on house to house vaccination campaigns, particularly in the southern and southeastern regions, as well as on broader supplementary immunization activities (SIAs) [11]. Beginning in 2022, however, Afghanistan gradually reintroduced nationwide house to house campaigns, a globally recognized standard that proved far more effective than fixed posts. In early 2024, the program expanded efforts by supporting hard to reach children and strengthening community engagement. With nationwide access restored, 99 percent of children were vaccinated during the June and July SIAs, and coverage improved across all regions. Yet in August authorities unexpectedly reversed this decision, and September SIA was postponed to revise fixed site strategies. Monitoring data showed that non house to house modalities consistently achieved low coverage, especially in the South, the epicenter of ongoing transmission. [12]. The historical pattern of rapid advances followed by sharp setbacks demonstrates that progress in polio control is fragile and can be easily reversed without sustained political commitment and strong community trust [9]. This review aims to critically examine the current challenges to polio eradication in Afghanistan and to outline potential pathways for achieving a polio-free future.

Epidemiology of Polio in Afghanistan

In 2023, Afghanistan reported six wild poliovirus type 1 (WPV1) cases [13,14]. This rose dramatically in 2024 (25 cases), and by early 2025 an additional 1 case had been reported. Environmental surveillance in 2024 detected WPV1 in ten Afghan provinces (e.g., Kandahar, Helmand, Uruzgan, Nangarhar, Laghman, Kunar, Kabul, Ghazni, Herat, Paktia), indicating widespread silent circulation as shown in Table 1 [15]. The WHO Emergency Committee noted that the virus had spread to new provinces in 2024 and emphasized that transmission remained most intense in the southern cross-border corridor linking the Quetta Block (Pakistan) and southern Afghanistan. It also warned that the persistence of WPV1 transmission despite ongoing campaigns highlights gaps in immunization quality, and that transmission during the low season could worsen without consistently high-quality campaigns [16]. The GPEI's strategy continues to target interrupting WPV1 transmission by the end of 2025 [17].

Genetic sequencing of poliovirus isolates has become a key tool for tracing outbreaks, helping to confirm virus sources, establish links between cases, and track transmission pathways. For example, one study that characterized WPV1 strains from 2010–2012 found a close genetic link between isolates of Cluster C1 [18]. Likewise, WHO reports from 2023–2024 show that most WPV1 cases in Pakistan and Afghanistan belong to interlinked genetic clusters (e.g., YB3A and YB3C), reflecting frequent virus flow across the porous border. These genetic data confirm that polio routinely crosses the Afghan Pakistani border, underscoring the need for synchronized, high-quality vaccination campaigns on both sides [13,18].

Many infections remain silent (non-paralytic), so weak surveillance can mask ongoing circulation. Pakistan's data illustrate this: sewage samples showed a spike in WPV1 despite few detected cases, due to gaps in local AFP (acute flaccid paralysis) reporting [19]. In short, subnational AFP surveillance has been uneven, allowing hidden transmission. A robust surveillance system including environmental sampling and genetic analysis is therefore critical to detect and respond to these hidden chains [18,19].

Table 1. WPV 1 Cases and Environmental Detections in Afghanistan and Pakistan (2024-2025) [20,21]

Year	Country	Total WPV1 Cases	Total WPV1 Environmental Samples	Key Affected Regions/Provinces
2024	Afghanistan	25	113	South Region
2024	Pakistan	74	628	Khyber Pakhtunkhwa, Sindh, Balochistan, Karachi, South KP, Central Pakistan
2025 (as of June 4)	Afghanistan	1	30	South Region, Badghis province
2025 (as of June 4)	Pakistan	8	245	Quetta Block, Karachi, South KP, Central Pakistan

Note: The southern cross-border epidemiological corridor, encompassing Afghanistan's South Region and Pakistan's Quetta Block, experiences the most intense WPV1 transmission [20].

Key Challenges to Polio Eradication: A Critical Discussion

Security and Access

Ongoing conflict and distrust have severely curtailed vaccination access. Since May 2018, the Islamic Emirate of Afghanistan has intermittently prohibited house-to-house vaccination campaigns, with repeated on-and-off restrictions. These interruptions have resulted in approximately 3.4 million children being missed in each national immunization round. Currently, the ban remains in effect [22]. This mirrors Nigeria's experience, where political bans created huge immunity gaps. Afghanistan's switch to site-to-site delivery has partly adapted, but WHO warns that site-to-site campaigns often fail to reach all children particularly younger children and girls [23]. In practice, this means many toddlers and girls slip through the cracks, keeping the virus alive.

Violence against vaccinators compounds these problems. Over the past decade dozens of polio workers (most of them being female vaccinators) have been assassinated, creating a climate of terror. A UNICEF polio official noted that after three vaccinators were killed, officials considered security escorts for women workers [24]. Such attacks, whether carried out by militant groups or unidentified gunmen, discourage new recruits and leave rural areas unvaccinated.

Vaccine Hesitancy and Community Resistance

Distrust of polio campaigns in Afghanistan is deeply rooted in history. Many communities recall past abuse. For example, in 2011 the CIA used a fake vaccination campaign to collect DNA during the search for Bin Laden, which severely damaged confidence in immunization programs. Since then, rumors have spread that vaccines are a foreign plot or cause infertility. One field report noted families refusing polio drops, believing vaccination would 'compromise their children's fertility. For locals, these fears are not irrational but reflect long-standing suspicion of outside actors. Misinformation and cultural beliefs continue to fuel hesitancy, with caregivers in conflict zones often reporting distrust of health workers and negative attitudes toward vaccination[25]. Specific myths continue to circulate, such as claims that the vaccine causes infertility or that it is un-Islamic, especially in the South. Experts emphasize that top-down messages alone are not enough. Eradication requires community-led strategies, with trusted local leaders and religious figures addressing rumors directly [22,25].

Logistical and Infrastructure Barriers

Afghanistan's health system is extremely fragile. Many high-risk districts have no permanent clinics, so polio vaccination remains campaign-based rather than integrated into routine care. One consequence is an unreliable cold chain. Keeping OPV (Oral Polio Virus) doses cold in remote villages with no electricity is a major hurdle. To meet this need, GPEI has deployed solar-powered refrigerators, cold boxes and temperature monitors technologies proven to keep vaccines viable. These solar refrigerators can run for days without grid power, extending the program's reach in some of the most difficult yet critical areas [26]. Still, summers in Afghanistan are scorching, and bad roads mean frequent breaks in the chain. WHO inspectors found in 2017

that many vaccinators did not know about vaccine management, often failing to keep doses properly cold [25]. As a result, vaccine wastage remains high and thousands of doses spoil before use.

Without strong infrastructure, vaccination campaigns cannot simply become routine. The lack of fixed facilities prevents integration of polio shots into standard child health visits. This is a long-term gap and experts agree that only by building clinics and routine immunization can Afghanistan close the immunity gap sustainably [25,26]. Until then, every campaign must bring its own cold chain equipment into rugged terrain, which is costly and logistically complex.

Political Will and Cross-Border Coordination

Regional politics heavily influence eradication. Pakistan and Afghanistan have tense relations, but polio transcends borders. WHO notes that both countries continue to implement an intensive and mostly synchronized campaign schedule focused on shared reservoir areas [23]. This alignment of vaccinating mobile and refugee populations on both sides is essential. However, diplomatic spats and distrust can still undermine cooperation. For example, failure to share surveillance data promptly or clashes at the border could allow the virus to slip through in either country. Mass population movements amplify risk [23]. In 2023–24, Pakistan returned hundreds of thousands of Afghans through both forced and voluntary movements. According to IOM and UNHCR, over 600,000 returnees have been officially recorded, with estimates suggesting that up to 1.7 million people have been affected. These returns, combined with seasonal movements within and between the two countries, have further compounded the challenges faced.[13]. Many of these returnees left the poliovirus reservoirs of Pakistan (e.g., Karachi and Quetta) and re-entered Afghan provinces. This continued return of undocumented migrants has compounded the challenges of eradication [23]. It heightens the chance that undetected WPV1 cases seed new outbreaks in previously polio-free districts. Both countries are responding by vaccinating at transit points and updating local micro-plans, but lasting success requires high-level commitment to keep campaigns truly synchronized [13,23].

Strategies and Pathways to Eradication: Innovative Proposals

To address the deeply rooted challenges of eradication, Afghanistan requires not only persistence but also a more innovative and policy-focused approach. Lessons from the success stories of other countries, particularly India and Nigeria, provide crucial insights into strategies that can be adapted for the Afghan context.

India's achievement, despite a massive and diverse population and immense logistical barriers, was built on unwavering political will, extensive community mobilization, and rigorous surveillance [27,28]. The Pulse Polio Initiative relied on National Immunization Days (NIDs) and a house-to-house strategy to ensure every child was reached. A vast network of community health workers and volunteers including women and young students was mobilized to go door-to-door, dispel myths, and build trust. Surveillance was equally robust, with monitoring of AFP and environmental testing of sewage ensuring that no virus circulation went undetected. Emergency Operations Centers (EOCs) further strengthened the effort by serving as central hubs for real-time data analysis and problem-solving, a model that has since been adopted by other countries [29]

Nigeria's path to eradication was marked by insecurity and widespread vaccine boycotts, yet its eventual success came through a multi-pronged and highly adaptive approach. Central to this was the use of high-tech EOCs for real-time data analysis and decision-making [30]. Equally important was the strategic engagement of influential religious and traditional leaders, who played a decisive role in rebuilding community trust and countering misinformation. In areas of high insecurity, health camps and alternative vaccine delivery methods including the use of Inactivated Polio Vaccine (IPV) were deployed to provide at least partial protection. Nigeria also strengthened its appeal to communities by integrating polio vaccination with other essential services, such as vitamin A supplementation and basic health screenings, making the program not only more effective but also more beneficial in the eyes of families[31] [32].

Applying the lessons of India and Nigeria to Afghanistan requires innovative strategies that adapt to the country's unique challenges while strengthening long-term health systems. One critical step is the integration of polio vaccination into broader public health services. The current push to link vaccination with routine immunization and essential health interventions such as vitamin A supplementation represents a crucial move toward building a resilient and sustainable system that can outlast the GPEI's campaign-based model [33]. By offering tangible benefits beyond polio, this approach also enhances community trust and addresses some of the root causes of resistance.

Leveraging innovative technologies can also reshape surveillance and microplanning. Artificial intelligence (AI) and Geographic Information Systems (GIS) have the potential to revolutionize how vaccination gaps are identified and addressed. AI algorithms can rapidly analyze data from diverse sources

including news reports, social media, and environmental sampling to detect emerging hotspots and predict outbreaks faster than traditional surveillance [34]. Tools such as RapidPro enable real-time data collection via mobile devices, allowing campaign strategies to be adjusted dynamically. GIS-based microplanning further strengthens accountability, as vaccination teams can be tracked with detailed, real-time maps showing covered and missed households. This structured use of GIS, pioneered by the GPEI in Africa, ensures that previously unreached communities are not overlooked [35].

Sustained progress also depends on international diplomacy. Cross-border collaboration requires more than synchronized vaccination campaigns; it relies on political will and shared responsibility between Afghanistan and Pakistan. The mobility of nomadic groups and refugees makes joint surveillance, shared data, and coordinated response plans indispensable. In this context, "polio diplomacy" is not only a technical necessity but also an opportunity to build broader cooperation between the two nations. Given recent diplomatic tensions and the mass return of refugees from Pakistan, achieving this form of collaboration is more urgent than ever [36].

Global Health and Policy Implications

The persistence of WPV1 in Afghanistan and Pakistan carries critical global health implications. These two countries remain the only reservoirs of endemic wild poliovirus, and failure to stop transmission there could trigger a global resurgence of the disease [2]. Although over 99.9% of cases have been eliminated worldwide, even a single WPV1 case remains a serious global public health threat [15]. The virus can be carried by travelers, migrants, or displaced populations into previously polio-free regions, sparking outbreaks where immunity has waned [2,37]. This "last fraction of a percent" of cases underscores the fragility of eradication efforts, demanding sustained vigilance through surveillance and vaccination until all transmission is interrupted [2].

Afghanistan shows how hard disease control can be in conflict-affected areas. Decades of war, political instability, and bans on house-to-house vaccination campaigns, especially the Taliban restrictions from 2018 to 2021, have created major access barriers and increased mistrust of vaccines. WHO reports that immunization gaps linked to vaccine hesitancy remain especially pronounced in the southern and southeastern provinces [38].

In this environment, eradication has required more than biomedical tools; it has depended on high-level diplomacy and negotiation. The resumption of door-to-door campaigns in late 2021 followed direct engagement with Taliban leaders and local elders, who provided security guarantees and logistical support [39].

The Technical Advisory Group (TAG) has similarly emphasized the need for full involvement of provincial and district authorities, health leaders, and religious figures to create an enabling environment for vaccination [40]. At the same time, historical episodes such as the CIA's use of a fake vaccination campaign in Pakistan have further undermined public trust, illustrating how political events shape health interventions [41].

The collapse of foreign aid following the 2021 regime change has further strained Afghanistan's fragile health system. Human Rights Watch documented that donor governments cut most development funding, including health programs, resulting in clinic closures and medicine shortages [42]. In this context, the polio program has provided vital infrastructure. It maintains a nationwide surveillance network for AFP and environmental sampling [43] and has preserved cold-chain systems even as routine immunization services declined. Comparative studies show that eradication funding has financed cold-chain upgrades that also strengthened routine vaccine delivery [44]. During the 2023 nationwide measles campaign, WHO reported that the polio program leveraged its operational capacity to recruit vaccinators, organize sites, and manage logistics transporting both measles and oral polio vaccines under strict cold chain conditions across all provinces [45]. These examples highlight how vertical programs like polio eradication can enhance health-system resilience and support the control of other vaccine-preventable diseases [2,44].

For long-term sustainability, polio eradication must be integrated into broader health systems. Afghanistan's polio campaigns have often operated parallel to routine services, risking fragmentation. Evidence shows that combining polio vaccination with child health interventions, such as vitamin A supplementation, has improved both health outcomes and community trust [2,31]. More broadly, positioning polio eradication within Afghanistan's progress toward universal health coverage (UHC) and the Sustainable Development Goals (SDGs) is essential. Embedding polio staff and assets into routine primary care rather than maintaining siloed, polio-only teams will help sustain population immunity and protect progress against political or financial shocks [2,44].

Finally, the polio eradication endgame has produced tools and innovations now central to global health security. Environmental surveillance of wastewater, rapid genomic sequencing, GIS-based microplanning, and the establishment of EOCs were pioneered for polio and have since been adapted for outbreaks of Ebola and COVID-19 [46,47]. In Nigeria, repurposed polio EOCs proved critical for Ebola and COVID-19 response, strengthening local outbreak preparedness and response capacity [47]. Policymakers should therefore view the polio program not only as a vertical eradication effort but also as a platform for international health security. Continued funding, community engagement, and cross-border coordination remain indispensable until polio is certified eradicated and its legacy infrastructure fully transitioned to broader health priorities.

Conclusion

Polio eradication in Afghanistan is at a critical point. Despite decades of progress, the continued presence of WPV1 shows how easily gains can be lost when political instability, mistrust, and weak infrastructure come together. Current epidemiological patterns marked by silent circulation and cross-border linkages show that vaccination campaigns alone are insufficient. Success will require integrating polio services into routine healthcare, enhancing surveillance, addressing vaccine hesitancy with culturally grounded approaches, and ensuring synchronized cross-border action. Lessons from India and Nigeria demonstrate that eradication is possible when political commitment, community trust, and technological innovation align. For Afghanistan, the polio program must be recognized not only as a public health emergency but as a strategic investment in health system resilience. Failure to interrupt transmission risks undermining global eradication and forfeiting the chance to transform polio assets into a foundation for universal health coverage and preparedness for future outbreaks.

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