# Surveillance To Track Progress Toward Polio Eradication-Worldwide 2018-2023 : Literature Review

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**ABSTRACT**

The near-complete eradication of polio is one of humanity's greatest achievements, yet surveillance remains critical to detect and interrupt poliovirus transmission. This study aims to analyze polio eradication surveillance programs in 28 priority countries over a five-year period (2018–2023). The primary method of poliovirus detection is acute flaccid paralysis (AFP) surveillance, confirmed by stool specimen testing, complemented by environmental surveillance (ES) through systematic sewage sampling to detect circulating polioviruses without relying on paralytic cases. Using a literature review with the PICO method, this study examined AFP quality data across 28 priority countries. The analysis reveals that while significant progress has been made, persistent challenges require urgent attention. Strengthening subnational surveillance is crucial to prevent undetected cases. Countries with low stool adequacy rates must improve sample collection and transportation, particularly in remote and conflict-affected areas. Given its success in early virus detection, environmental surveillance should be further expanded, especially in high-risk regions with weak AFP surveillance. Achieving global polio eradication demands continued investment, robust surveillance systems, and targeted interventions in vulnerable areas.

**Keywords:** Polio, acute flaccid paralysis (AFP), vaccine-derived poliovirus (VDPV), wild poliovirus (WPV), Environmental Surveillance (ES)

## Introduction

An important first step in limiting the spread of the disease and lowering its burden was the creation of the polio vaccine in the 1950s and 1960s. US doctor Jonas Salk created the inactivated poliovirus vaccine (IPV), which contains a virus that has been killed by formalin, and it was approved for use in 1955. Soon after, Polish American microbiologist Albert Sabin created the oral poliovirus vaccine (OPV), it had live-attenuated poliovirus in it. Both IPV and OPV produce a potent humoral response that can shield the recipient, however, only the latter has been shown to support gut mucosal

immunity, which is crucial to preventing the spread of the virus and is therefore a vital instrument for its eradication. Although each vaccination type has an own set of benefits and drawbacks, they are both still crucial to the fight against polio today.

Only two nations have seen a 99.99% decrease in polio incidence since the Global Polio Eradication Initiative (GPEI) was launched in 1988, Afghanistan and Pakistan, have never prevented the spread of the wild polio virus (WPV). Increasing the effectiveness of routine immunization (RI), putting in place supplementary immunization actions (SIAs) at different scales for local emergences or major outbreaks, and quickly identifying and stopping transmission through environmental surveillance (ES) and clinical (acute flaccid paralysis, AFP) are all components of the GPEI strategy. The main method of detecting polioviruses is surveillance for acute flaccid paralysis (AFP), which is verified by examining stool specimens. By identifying poliovirus circulation independently of verified paralytic polio cases, environmental surveillance (ES), this improves AFP surveillance by systematically sampling sewage and doing poliovirus testing.

In the 1990s, WHO stopped releasing estimates of polio incidence and cases prevented that were based on simple linear models. due to unsuspecting presumptions and the inclusion or exclusion of intervention-related benefits, simple computations might yield helpful but occasionally inaccurate judgments. Accurate global illness models can provide as a foundation for evaluating the straightforward method and contextualizing the findings.

The benefit of the reversal events is that local surveillance was sensitive enough to identify and notify in a timely manner in the majority of these cases. The drawback is that the detection might only be the beginning. This hazard is highlighted by the discovery of vaccine-derived viruses in environmental samples in the USA, Canada, UK, and Israel during the past two years. Children everywhere are at risk from polio. Until we eradicate it, it will always be only a plane flight away. The endgame-post eradication link will become increasingly important if Pakistan and Afghanistan stop the spread of the wild poliovirus, the two remaining endemic nations.

Therefore, this research becomes increasingly important to provide deeper insights into the pattern of polio spread nationally and subnationally in 28 priority countries. With a data-based approach, advanced technologies such as Artificial Intelligence (AI), and collaboration between academics, policy makers, and the community (quadruple helix approach), It is anticipated that it can Maintaining achieving the global polio eradication goal requires efficient surveillance. Monitoring surveillance indicators is essential for identifying gaps and focusing efforts to expand surveillance, especially in countries with a high risk of poliovirus transmission.

**Material and Methods**

This study uses literature review as the main method to examine AFP quality data in 28 priority countries. The literature review process was carried out using the PICO method.

**P(Population) :** 28 priority countries including those in Southeast Asia, Africa, the Eastern

Mediterranean, and the Western Pacific are at high risk of spreading the poliovirus.

**I (Intervention) :** Acute flaccid paralysis (AFP) monitoring and environmental monitoring are used to find polioviruses.

**C (Comparison) :** No direct comparison group is mentioned in this article. However, the evaluation is based on AFP surveillance performance indicators and environmental surveillance.

**O (Outcome) :** According to a review of 2019–2020 AFP monitoring data from 42 countries at high risk for poliovirus transmission, stool specimen adequacy and national and subnational nonpolio In a number of priority nations, especially in the African Region, AFP rates decreased. This implies that surveillance is becoming less sensitive and of worse quality. 20 of the 28 priority nations (71.4%) achieved the national AFP monitoring objective in 2022–2023. However, significant gaps in AFP surveillance remain at both national and subnational levels.

## Results

### 1. Progress in Polio Eradication: Surveillance Findings from 2018–2019 and 2022–2023

Polio elimination has been a worldwide focus since the initiation of the Global Polio Eradication Initiative (GPEI) in 1988. In the last several decades, polio cases have dropped by over 99.9%, with wild poliovirus (WPV) serotypes 2 and 3 being officially declared eradicated. However, wild poliovirus type 1 (WPV1) continues to spread, especially in Afghanistan and Pakistan. In addition to WPV, vaccine-derived polioviruses (VDPVs) have posed a growing challenge in areas with low immunization coverage. Two recent surveillance reports covering the periods 2018–2019 and 2022–2023 provide valuable insights into the progress and challenges of polio eradication efforts worldwide.

### 2. Polio Surveillance Strategies

Effective polio surveillance relies on two primary methods: acute flaccid paralysis (AFP) surveillance and environmental surveillance (ES). AFP surveillance involves detecting cases of paralysis in children under 15 years old and testing stool specimens to confirm the presence of poliovirus. Environmental surveillance complements AFP monitoring by analyzing sewage samples for poliovirus, providing early warnings of virus circulation even in the absence of reported paralysis cases. Both methods are essential for tracking progress and identifying areas where polio continues to spread.

### 3. Findings from 2018–2019

During this period, 40 priority countries were identified based on the presence of WPV or VDPV outbreaks, as well as their risk of importation from neighboring countries. Surveillance data indicated that only 63% of these priority countries met AFP surveillance indicators at the national level, highlighting gaps in detection and response capabilities.

In the African Region (AFR), no new cases of WPV1 were reported; however, the number of VDPV outbreaks rose, resulting in an expansion of the list of priority countries. Subnational surveillance performance varied widely, revealing weaknesses in detection efforts in certain regions. In the Eastern Mediterranean Region (EMR), the number of WPV1 cases dramatically increased in Pakistan, rising by 1,125% from 2018 to 2019, while Afghanistan also saw an uptick in cases. The Western Pacific Region (WPR) faced challenges in meeting surveillance targets, with the Philippines and Malaysia detecting cVDPV cases. Meanwhile, In the South-East Asia Region (SEAR), Myanmar achieved both surveillance indicators, while Indonesia faced challenges due to subnational weaknesses.

Several recurring challenges were identified across all regions:
1. Subnational Surveillance Gaps : Many countries showed strong national surveillance performance but had weaknesses at the local level.
2. Stool Sample Collection Issues : Inadequate collection and transportation of stool samples hindered accurate poliovirus detection.
3. Increasing cVDPV Outbreaks : The number of cVDPV2 outbreaks rose sharply, particularly in Africa and the Eastern Mediterranean.
4. Security and Access Barriers : Conflict zones and remote areas posed difficulties for surveillance activities, particularly in Afghanistan, Pakistan, and parts of Africa.
5. Environmental Surveillance Limitations: While useful in detecting poliovirus circulation, environmental surveillance was inconsistent in some regions, reducing its effectiveness.

## 4. Findings from 2022–2023

The later surveillance report covering 2022–2023 showed some improvements, but significant challenges remained. A total of 28 priority countries were identified, focusing on areas at high risk of poliovirus transmission. The report indicated that 71.4% of these countries met AFP surveillance targets at the national level, marking an improvement from the 2018–2019 period.

One of the most significant developments was the detection of WPV1 importation into Malawi and Mozambique in 2021–2022. These cases were genetically linked to WPV1 strains from Pakistan, highlighting the risk of international spread. In response, polio immunization and surveillance efforts were intensified in affected countries. In 2023, WPV1 cases were only detected in Afghanistan and Pakistan, reinforcing the importance of targeted interventions in these endemic regions.

In the African Region, 18 of 21 priority countries met surveillance targets, and the number of cVDPV cases declined slightly compared to previous years. However, environmental

surveillance coverage decreased in some areas, and challenges in stool specimen collection persisted. The Eastern Mediterranean Region continued to report WPV1 cases, particularly in Afghanistan and Pakistan, while Sudan and Somalia experienced declines in surveillance performance.

Indonesia remained the only priority country in the South-East Asia Region. Although its AFP surveillance sensitivity improved, stool adequacy rates did not meet the target, indicating difficulties in timely specimen collection and transportation. In the Western Pacific Region, Papua New Guinea did not meet either AFP surveillance indicator, and no cases of polio were reported during the period.

Several recurring challenges were identified across all regions :

1. Subnational Surveillance Gaps: Despite improvements at the national level, many regions still struggled to meet surveillance targets, particularly in stool sample collection.
2. cVDPV Outbreaks: Although overall cases declined, cVDPV outbreaks remained widespread, affecting 42 countries globally.
3. Environmental Surveillance Inconsistencies: While some regions expanded ES coverage, others saw declines, affecting detection capacity.
4. Surveillance Lag and Data Reporting Issues: In some areas, delays in case reporting affected the accuracy of surveillance data, leading to potential underestimation of poliovirus circulation.
5. Political and Security Challenges: Conflicts in countries like Sudan, Yemen, Afghanistan, and parts of Africa limited access to vaccination and surveillance activities.

## 5. Comparison and Challenges

When comparing the findings from 2018–2019 and 2022–2023, some positive trends emerge, particularly in the expansion of environmental surveillance and the increase in the number of countries meeting national AFP surveillance targets. However, subnational gaps continue to pose a significant barrier to polio eradication. In both periods, issues such as delays in case reporting, low stool adequacy rates, and weak laboratory infrastructure were identified as major challenges.

Another key concern is the persistent circulation of cVDPVs, which have now been detected in 42 countries. These outbreaks take place in areas with inadequate vaccination coverage, highlighting the critical need to sustain high immunization rates to avoid the resurgence of poliovirus.

## Discussion

Efforts to eradicate polio have greatly diminished the global impact of poliovirus, with wild poliovirus cases dropping by more than 99.9% since the inception of the Global Polio Eradication Initiative in 1988. However, surveillance remains a critical component in ensuring that poliovirus circulation is detected and eliminated before it can cause new outbreaks. The two studies from 2018–2019 and 2022–2023 provide a comparative analysis of polio surveillance trends, challenges, and

progress across different regions. Despite advancements in surveillance systems and vaccination programs, several key issues continue to hinder eradication efforts, particularly in high-risk countries. The two studies highlight that while wild poliovirus type 1 cases have become more geographically restricted, circulating vaccine-derived polioviruses remain a significant threat, particularly in areas with low immunization coverage.

One of the key findings from these studies is the improvement in the number of priority countries meeting acute flaccid paralysis surveillance indicators at the national level. In the 2018–2019 period, only 63% of priority countries met the surveillance targets, whereas this improved to 71.4% in 2022–2023. This suggests that over time, countries have enhanced their surveillance efforts, allowing for better detection and response to poliovirus circulation. Another notable improvement was the expansion of environmental surveillance networks, particularly in the Eastern Mediterranean region, where the number of surveillance sites more than doubled from 244 in 2022 to 571 in 2023. This increase allows for early detection of poliovirus in wastewater, even in the absence of reported cases of paralysis.

In the African region, efforts to control polio have been particularly crucial, given that this region has historically faced the most significant outbreaks. The number of priority countries increased from 18 in 2018 to 30 in 2019, reflecting the growing concern over circulating vaccine-derived poliovirus outbreaks. However, by 2023, no new wild poliovirus cases were reported in Africa, marking a significant milestone.

Despite these improvements, several critical challenges remain, particularly in subnational surveillance. While national-level surveillance indicators have improved, many regions still struggle with weaknesses in acute flaccid paralysis case detection, stool sample collection, and laboratory testing. Many subnational regions continued to underperform, making it difficult to track and respond to poliovirus transmission effectively. One of the primary challenges noted in both periods was the low rate of stool adequacy, which is essential for accurate poliovirus detection. In 2022, Indonesia failed to meet stool adequacy standards, and in 2023, Sudan and Papua New Guinea also failed to meet the target.

Another significant challenge identified in both studies was the issue of surveillance lag and data reporting. In some regions, delays in data reporting affected the ability to track poliovirus circulation accurately. This was particularly evident in the 2022–2023 period, where some decreases in acute flaccid paralysis cases might have been due to reporting lags rather than actual reductions in cases. Political and security challenges also posed major obstacles to surveillance and immunization campaigns. Countries such as Afghanistan, Pakistan, Sudan, and parts of Africa have faced conflict and instability, which hindered access to communities and disrupted polio vaccination efforts.

One of the most concerning findings from both studies is the continued presence of circulating vaccine-derived polioviruses. These viruses emerge when the weakened poliovirus from the oral polio vaccine mutates and regains neurovirulence in areas with low immunization coverage. In 2018–

2019, the number of circulating vaccine-derived poliovirus outbreaks increased sharply, particularly in Africa and the Eastern Mediterranean, leading to a rise in the number of priority countries from 31 to 40. In 2022–2023, while wild poliovirus cases declined, circulating vaccine-derived poliovirus cases remained a major concern, with outbreaks reported in 42 countries. Nigeria, the Democratic Republic of the Congo, Chad, and Madagascar were among the most affected countries, reporting high numbers of circulating vaccine-derived poliovirus cases in 2023. These findings underscore the urgent need to strengthen routine immunization programs and ensure that all children receive inactivated polio vaccine to reduce the risk of vaccine-derived poliovirus emergence.

From the analysis of these two periods, it is evident that while significant progress has been made, persistent challenges require urgent attention to achieve global polio eradication. Strengthening subnational surveillance remains crucial to ensuring that no cases go undetected. Countries that struggle with low stool adequacy rates should implement better sample collection and transportation systems, particularly in remote and conflict-affected areas. Given its success in early virus detection, environmental surveillance should be further expanded, especially in high-risk areas with weak acute flaccid paralysis surveillance. Countries experiencing circulating vaccine-derived poliovirus outbreaks must implement rapid and well-coordinated outbreak response campaigns, including supplemental immunization activities. Governments and health organizations must also work with local leaders and communities to address vaccine hesitancy and security challenges that hinder vaccination efforts.

The findings from the 2018–2019 and 2022–2023 studies highlight both progress and ongoing challenges in polio eradication efforts. The reduction of wild poliovirus cases to only Afghanistan and Pakistan is a significant achievement, yet the persistence of circulating vaccine-derived poliovirus outbreaks remains a major concern. Stronger surveillance, enhanced immunization coverage, and improved outbreak response will be critical in ensuring that polio is eradicated once and for all. With coordinated global efforts, the goal of a polio-free world remains within reach, but continued vigilance and investment in surveillance and vaccination programs are essential to achieving this milestone.

Polio eradication efforts have significantly reduced the global burden of poliovirus, with the number of wild poliovirus cases decreasing by over 99.9% since the launch of the Global Polio Eradication Initiative in 1988. However, surveillance remains a critical component in ensuring that poliovirus circulation is detected and eliminated before it can cause new outbreaks. The two studies from 2018–2019 and 2022–2023 provide a comparative analysis of polio surveillance trends, challenges, and progress across different regions. Despite advancements in surveillance systems and vaccination programs, several key issues continue to hinder eradication efforts, particularly in high-risk countries. The two studies highlight that while wild poliovirus type 1 cases have become more geographically restricted, circulating vaccine-derived polioviruses remain a significant threat, particularly in areas with low immunization coverage.

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## Conclusion

Analysis of polio surveillance data from 2018–2019 and 2022–2023 shows significant progress, including a >99.9% decline in wild poliovirus cases and no new cases in Africa by 2023. National surveillance indicators improved from 63% to 71.4% of priority countries meeting targets. However, persistent challenges remain: subnational surveillance gaps, low stool adequacy rates (Indonesia, Sudan, Papua New Guinea), reporting delays, and political instability in conflict-affected countries. Most concerning is the continued circulation of vaccine-derived polioviruses (cVDPVs) in 42 countries, driven by low immunization coverage. To achieve global eradication, urgent action is needed to strengthen subnational surveillance, expand environmental surveillance, improve sample collection, and implement rapid outbreak responses while addressing vaccine hesitancy. With sustained investment and coordinated efforts, a polio-free world remains achievable.

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