Original Article

# Evaluation of WHO indicators for surveillance of acute flaccid paralysis in children: The case of Kenitra province, Morocco; from 1994 to 2018

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## ABSTRACT

### Background

Polio has not been detected in Morocco since 1989. The aim of this study was to examine the surveillance system for acute flaccid paralysis (AFP) in the province of Kenitra, assess its strengths and weaknesses, and suggest ways to improve it.

### Method & materials

A qualitative and quantitative evaluation was carried out within the Kenitra Provincial Epidemiology Unit. The AFP case database was analyzed using the standards for evaluation of public health surveillance systems defined by the Centers for Disease Control and Prevention (CDC) in 2001 and WHO indicators. The surveillance system was found to be flexible and effective.

### Result

The sensitivity of the system reached 50%, with an average notification rate of 3.04 cases. More than 40% of patients were reported within 7 days of onset of paralysis. Investigation time was approximately 70% within 48 hours of notification. 80% of stool samples were sent to the laboratory within 72 hours of collection. ***Conclusion:*** The AFP surveillance system in Kenitra is effective, adaptable and highly vigilant, allowing a rapid response. Maintaining AFP surveillance is essential until polio is eradicated worldwide.

## Keywords

WHO indicators; Acute Flaccid Paralysis;Evaluation; Poliovirus

## INTRODUCTION

The number of polio cases worldwide has fallen by 99.99% since the start of the Global Polio Eradication Initiative (GPEI) in 1988. However, it's important to note that transmission of the

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wild poliovirus (WPV) persists in only two countries: Afghanistan and Pakistan.[1,2]. Surveillance for acute flaccid paralysis (AFP) in children aged 15 years is the most commonly utilized method for detecting poliovirus circulation, with stool specimens tested for WPV and vaccine-derived polioviruses (VDPVs) (genetically reverted strains of the vaccine virus that regain neurovirulence) in World Health Organization (WHO)-accredited laboratories[3].

Eradicating the poliovirus is feasible due to its sole reservoir being humans, and because polio patients can only transmit the virus briefly, leading to its limited survival in the environment. This is the reason why poliovirus can be eradicated. The polio virus usually infects the throat and mouth without causing any symptoms. In some cases, the virus travels to the intestines and can cause mild illness such as fever or muscle aches. More seriously, in cases of intestinal infection, the virus invades the nervous system and causes permanent paralysis, known as paralytic polio, the virus is shed in feces. It can be spread from person to person where there is poor hygiene or sanitation.[4] **(Figure 1)**.

Vaccination remains the best protection against this potentially devastating disease. It stops the spread of infection by creating herd immunity[5].To eradicate this disease, which is particularly easily transmitted and virulent, the vaccination strategies were proposed by the WHO[6].

Another essential strategy for eradication is to report all polio cases. Cases of Acute Flaccid Paralysis (AFP) often manifest similar symptoms and signs to those of poliomyelitis. Consequently, in 1996, the WHO expanded surveillance to encompass all cases of AFP. This Surveillance should be carried out in each country according to the performance of the required indicators. Virological diagnosis, conducted by the international network of WHO reference laboratories, identifies the viruses involved in the onset of AF[3,6].

For immediate public health response, sensitive AFP surveillance can identify all instances of poliomyelitis. Moreover, it serves as an effective means of continually evaluating the absence of transmission in areas that have been certified as polio-free[5,7].As a result, a high-quality AFP surveillance system is required to demonstrate and maintain the successful interruption of WPV[8].

Morocco is part of Eastern Mediterranean Regional Office (EMRO), which includes Pakistan and Afghanistan, poliovirus endemic states. Despite having eliminate polio in 1989, Morocco consistently monitors the disease within its public health system[9].Poliovirus Surveillance is carried out through AFP Surveillance, which involves promptly notifying and investigating any polio suspicion or any AFP in children less than 15 years old[10,11].

In Morocco, an evaluation of the AFP Surveillance system is essential to know how the system performs, its goals, and objectives to offer recommendations for improving its quality, efficiency, and usefulness.

The Atlanta Centers for Diseases Control and Prevention (CDC) has developed a guide to help evaluate public health Surveillance systems using a method that includes a system description and analysis performance based on these attributes (qualitative, quantitative, utility and costs involved). This methodology makes it possible to identify any weaknesses in the system and to propose recommendations favoring the strengthening of surveillance actions for the studied disease[13].The objective of this work consists on a rapid evaluation of the surveillance system based on the CDC guide, and the WHO tools to identify structural weaknesses and priority actions to be implemented.

The study's strength lies in its combination of a rigorous methodological approach, a unique geographical and epidemiological context, and a public health perspective. It will make a significant contribution to our knowledge of AFP and to improving disease surveillance in the province of Kenitra and beyond. The assessment of WHO indicators for AFP surveillance in Kenitra province is a significant and innovative study that will enhance disease surveillance and safeguard public health[14].

## MATERIALS AND METHODS

### Study area

Our study focuses on the province of Kenitra, located in the northwest of Morocco and part of the Rabat Salé Kenitra (RSK) region. It is one of the largest cities in Morocco and provides a unique geographical and epidemiological context for the study of AFP. The region is densely populated and close to other North African countries, which may influence the circulation of AFP viruses (Figure 2) [9]

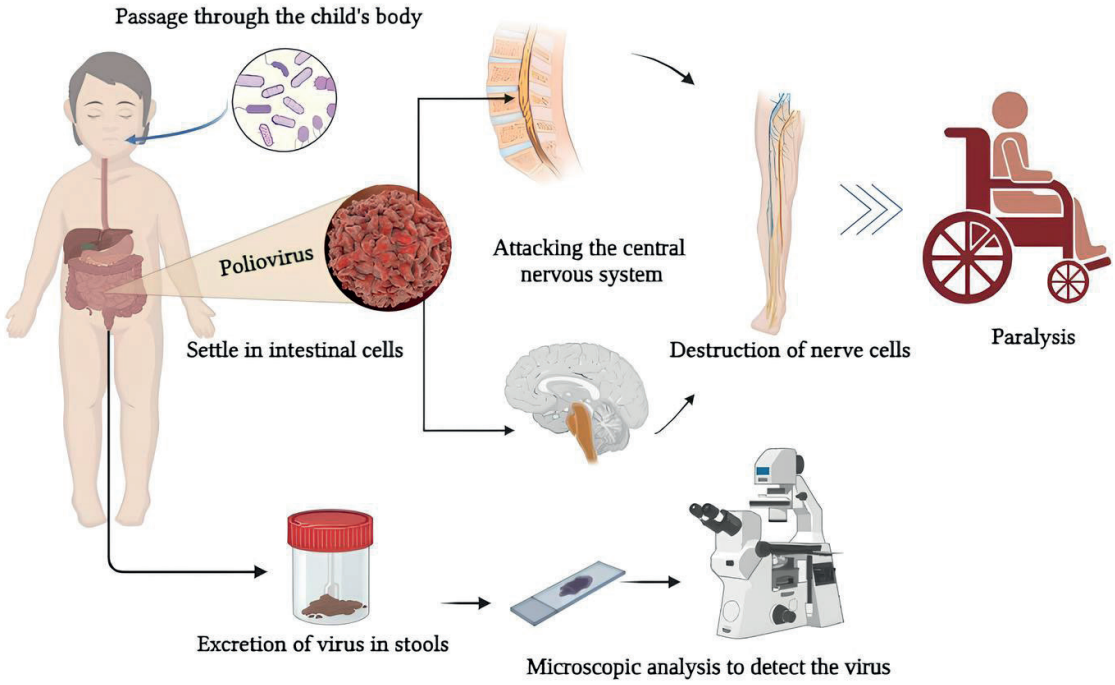



**Figure 1:** Poliovirus transmission

### System description

AFP surveillance effectively began in 1994 and improved in 1995.The indicative level of good performance, is tow cases for 100 000 children under 15 years of age. The National Polio Laboratory has been designated by the Ministry of Health since 1994, and accredited by WHO in 2001 and since then has improved its indicators with respect to proficiency testing, enterovirus isolation and turn-around time[12].

AFP surveillance in Morocco plays a vital role in polio prevention and control, based on 4 main objectives (Figure 3)

Surveillance of AFP in Morocco improves case detection and contributes to polio eradication, based on two complementary pillars passive and active surveillance (Figure 4). Passive surveillance is based on the systematic reporting of all cases of acute flaccid paralysis (AFP) by doctors and other healthcare professionals. Although important, this approach may not be sufficient because it does not detect all cases, particularly asymptomatic cases, and it is difficult to maintain high quality active surveillance over time.

### AFP case

A case of poliomyelitis is defined as any child under the age of 15 presenting AFP symptoms[10].

All AFP cases that meet the WHO definition will be consistently managed, including treating them as polio cases until final classification, even if it is evident from the outset that the condition is Guillain-Barré syndrome or another form of non-polio AFP[10].

## METHODS

This study is a retrospective and descriptive analysis of active and passive AFP surveillance over a 25-year period, from 1994 to 2018, in the province of Kenitra.

To evaluate the AFP surveillance system in the province of Kenitra, we used the updated and revised-2001 version of the Guidelines for Evaluating Public Health Surveillance Systems (CDC) (Table 1) and the WHO AFP surveillance performance indicators (Table 2)[10,13]. The performance of the CDC system was assessed on the basis of qualitative analysis attributes such as simplicity and flexibility, and quantitative attributes such as sensitivity, relevance, representativeness and stability.

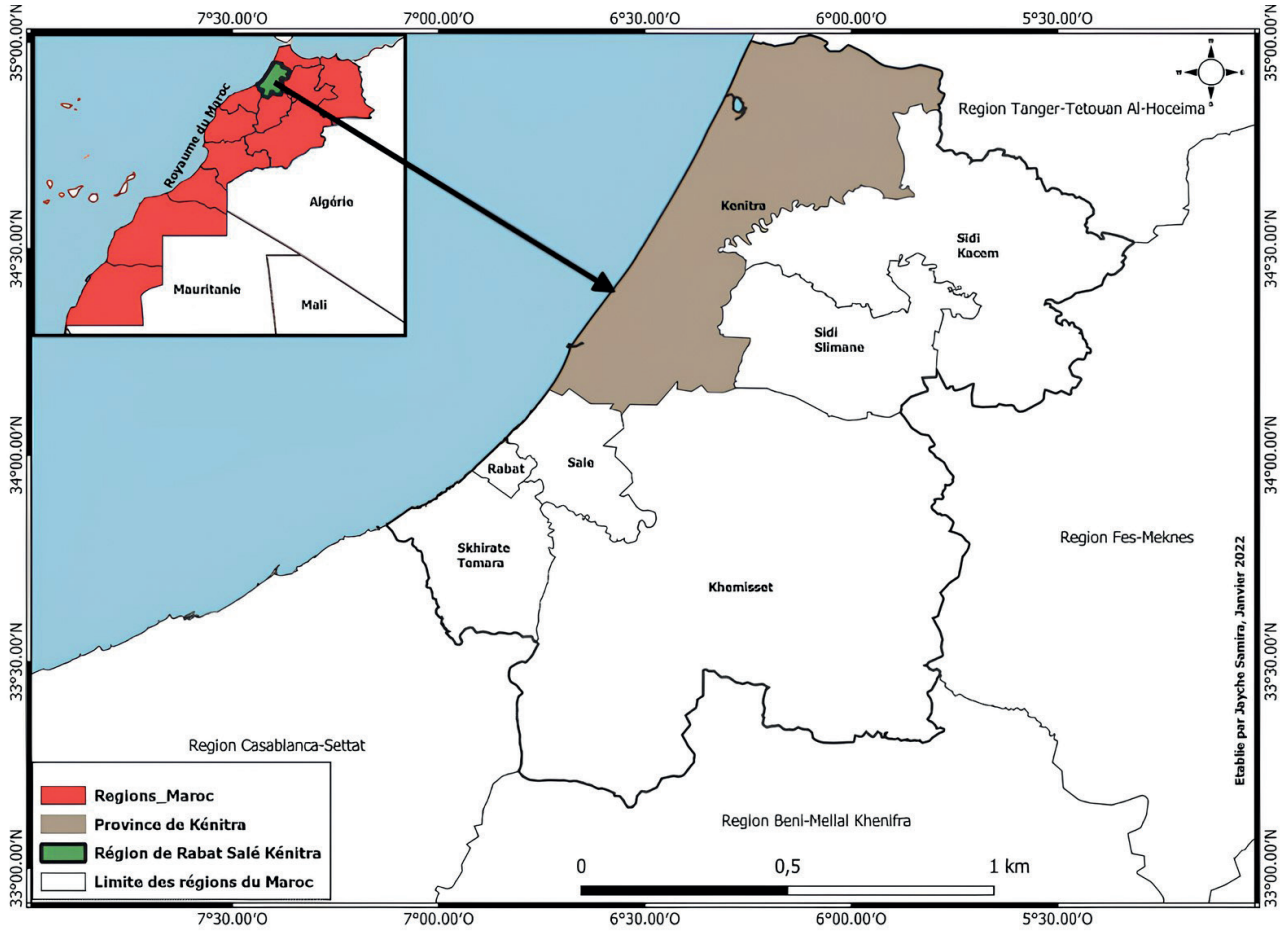



**Figure 2:** Geographical Location of Kenitra Province (Jayche et al., 2023)

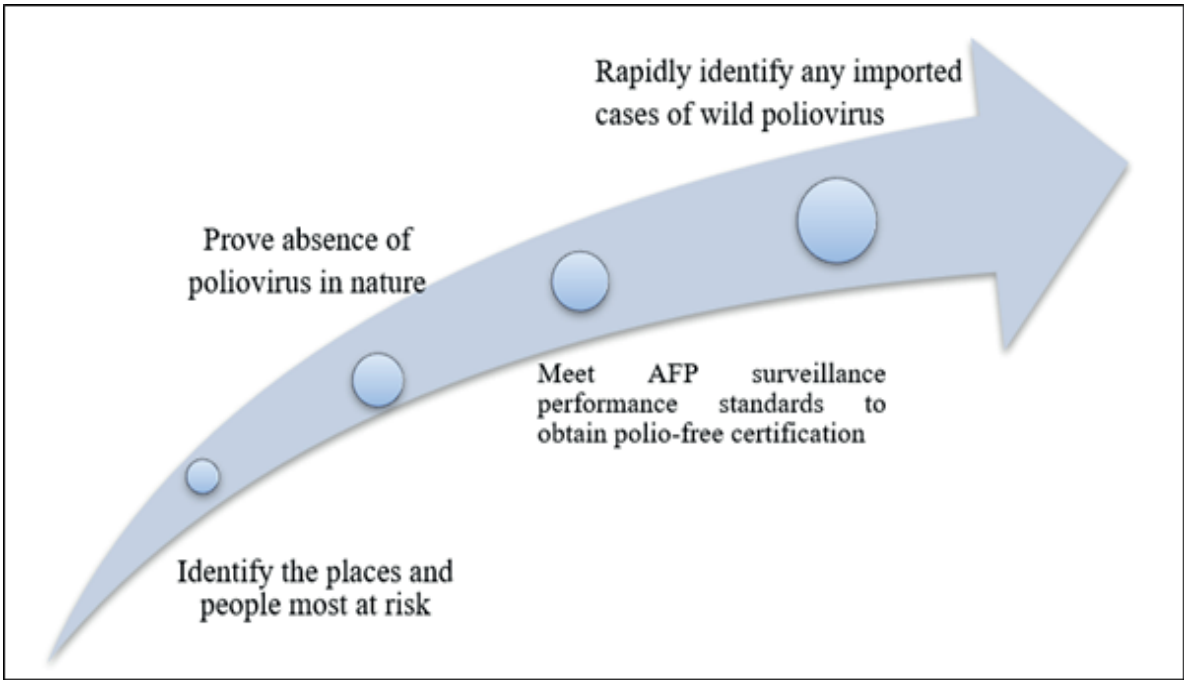
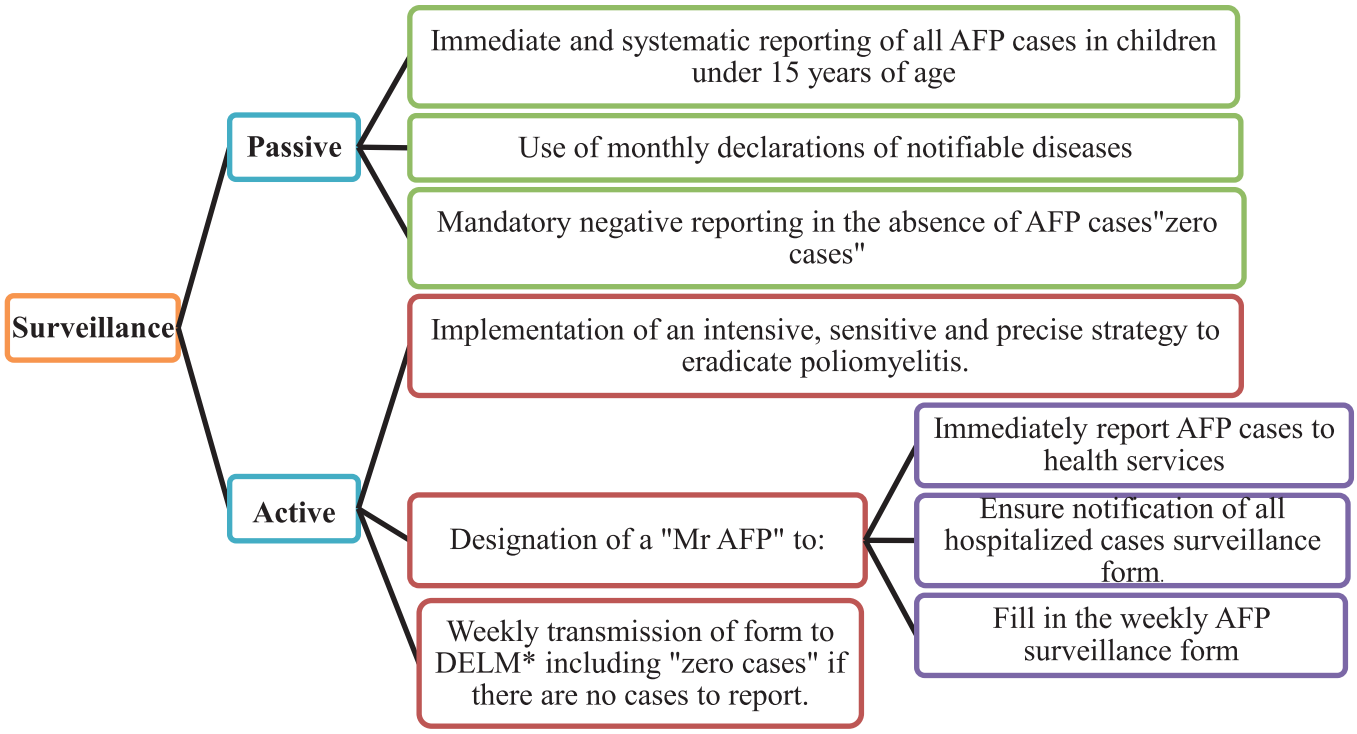



**Figure 3:** Goals of AFP monitoring




**DELM : Directorate of Epidémiologie and fight against diseases (Directipn d'Epidémiologie de Lutte contre les Maladies)*

**Figure 4:** Active and passive polio surveillance plan in Morocco to ensure optimal detection for AFP eradication

**Table 1:** Summary of AFP monitoring system attributes goals and performance indicators according to CDC standards

| Attribute | Goal | Example of Performance Indicator |
|---|---|---|
| **Simplicity** | Easy to implement and use | Amount and type of data needed for case confirmation |
| **Flexibility** | Adaptable to changing needs | Retrospective assessment of adaptation to new demands |
| **Data Quality** | Accurate and complete data | Percentage of missing or unknown responses for key variables |
| **Acceptability** | Willingness to participate | Completeness of reporting forms |
| **Sensitivity** | Detects most cases | Percentage of cases detected in the target population |
| **Positive Predictive Value** | Few false positives | Proportion of "false positives" identified by surveillance |
| **Representativeness** | Accurately reflects disease burden | Comparison of reported cases' characteristics (age, sex, location) to actual cases |

**Table 2:** Performance Indicators of AFP Surveillance according to WHO

| Indicators | Objective |
|---|---|
| **Completeness of weekly sheets** | ≥90% |
| **AFP-NP Ratio** | ≥1 |
| **Adequate specimens** | ≥80% |
| **Stool condition** | ≥80% |
| **Samplesshippedin 72 hours** | ≥80% |
| **Non-polio enterovirus isolation** | ≥10% |
| **Collection within 14 days** | ≥80% |
| **Follow-up exams performed in 60 days** | 100% |
| **Notification in health system ≤7 Days** | ≥80% |
| **Health system investigation in 48-hour** | ≥ 80% |


**Figure 5:** Moroccan AFP surveillance key indicator

WHO performance indicators for AFP surveillance were determined based on the criteria outlined in Figure 5; Reporting time is measured by the percentage of AFP cases reported within 7 days of onset of paralysis. This is a crucial measure to assess the effectiveness and timeliness of the disease surveillance system. Investigation time is defined as the percentage of AFP cases for which an investigation was initiated within 48 hours of notification. This is to ensure a rapid and appropriate response to suspected AFP cases, thereby limiting their spread and identifying potential causes. Finally, stool collection is an essential aspect of AFP surveillance. The percentage of cases where two stool samples were collected and sent to the laboratory within 72 hours of collection of the samples is used as an indicator of the quality and timeliness of collection and testing procedures. This calculation is carried out on a national scale to ensure exhaustive and consistent surveillance of the disease.

## ETHICAL CONSIDERATION

The ethical committee of the university Ibn Tofail University –Morocco revised and approved this study

## RESULTS

### Qualitative attributes

### Simplicity

The polio surveillance system is based on five different case definitions, underscoring the need for a multidimensional approach to polio eradication. Confirmation and eradication of polio rely on rigorous laboratory surveillance, including timely stool collection and wild poliovirus testing. This surveillance requires close collaboration between different sectors and services, with healthcare, epidemiological surveillance and the environment.

The system relies on the expertise of specialists with specific knowledge of virology and neurology. Clinical diagnosis requires two separate neurological examinations, one in the acute phase and one at a follow-up visit. Complex additional tests, as well as less invasive examinations such as lumbar puncture, are also required for a complete analysis.

### Flexibility

The polio surveillance and control system in Morocco has evolved considerably over time (Figure 6). Royal Decree no. 554-65 (1967) and Ministry of Public Health Order no. 683-95 (1995) constitute the legal bases for compulsory AFP surveillance.

To improve poliomyelitis surveillance in Morocco, the Department of Epidemiology and Disease Control (DEDC) of the Ministry of Health set up an active AFP surveillance system in 1995 (Ministerial Circular No. 2 / DE / 02 of 25 March 1994), which was implemented at the national level. Each PSU has a manager (Mr AFP) who plays an important role in the active search for AFP cases in hospital wards. The head of the PSU ensures that clinical samples and epidemiological data are rapidly collected and sent to the DEDC and the National Institute of hygien (NIH). The National Polio Laboratory (NPL) has been a reference laboratory since 1994 and was certified in 2001. Its role is to assess all cases of AFP reported in Morocco for poliovirus or other non-polio enteroviruses responsible for AFP observed in children under 15 years of age, as well as the family of the case, if the AFP case was not collected within 14 days of the onset of paralysis. The information and results are sent to the DEDC, which forwards them to the WHO.

## QUANTITATIVE ATTRIBUTES

### Sensitivity

The sensitivity of an AFP surveillance system is its ability to detect each case of disease. It is calculated by

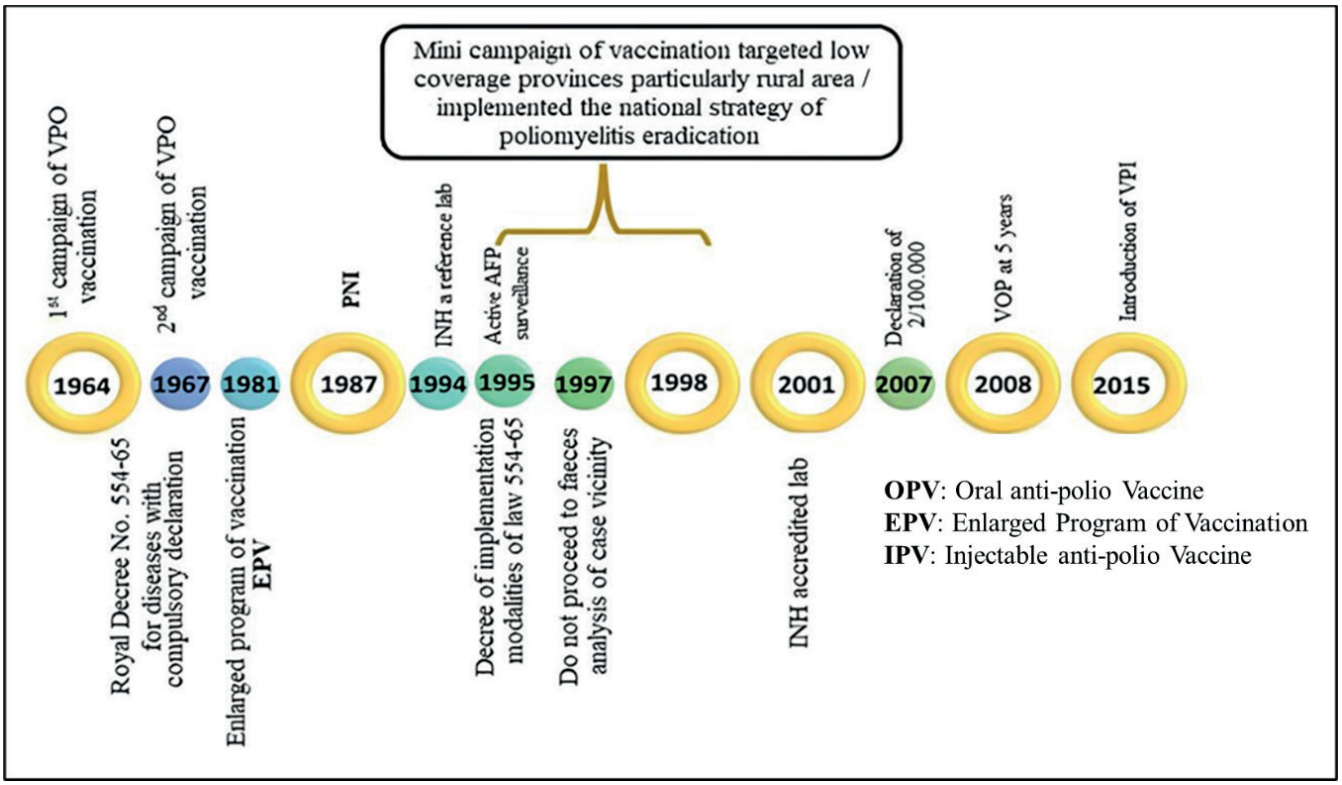



**Figure6.** Important events that marked the AFP Surveillance history in Morocco

dividing the number of anticipated cases by the number of actual cases. This value is crucial for a system with limited resources, as it allows it to determine in real time whether a population has an abnormal predisposition to a disease.

The average reporting rate was 3.46 cases per year. Since the start of AFP surveillance in Morocco in 1994, the WHO has recommended reporting at least 1 case of AFP per 100,000 children under 15 years of age, i.e. 3 minimum notifications for the province of Kenitra. It was only from 2007 onwards that it became necessary to record 2 cases of AFP per 100,000 children, corresponding to 6 cases per year. On the other hand, from 2011, we should notify 5 cases per year as Sidi Slimane is no longer part of the province of Kenitra, which has reduced the number of the population and therefore the number of cases to be declared in 100,000 children (Figure 7).

In the province the threshold has not always been reached, with the exception of the years 1995, 1996, 1997, 2001, 2002, 2017, 2018 and where we reached or exceeded the number of expected cases.

In this case, the sensitivity of the AFP surveillance system in Kenitra can be considered satisfactory.

## Representativeness

Acute flaccid paralysis (AFP) mainly affects young children and rural areas (Figure 8). More than half of AFP cases (51%) occur in children under 5 years of age, highlighting the need to pay special attention to this age group. Children aged 11–15 years also account for a significant proportion of cases (21%), and one case was diagnosed in a 3-month-old baby, indicating that the disease can affect very young children. There is also a geographical disparity, with 77% of AFP notifications coming from rural areas,this suggests a lack of access to healthcare and low awareness of the disease in these regions. In addition, AFP affects more boys (59% of cases) than girls. This difference may be due to gender-specific risk factors, which need to be investigated further.

The commune of Kenitra (provincial capital) stands out as the area most affected by AFPover the last 25 years. Of the 76 cases recorded in the province, 15 were from the commune of Kenitra, an alarming 20%. Ben Mansour

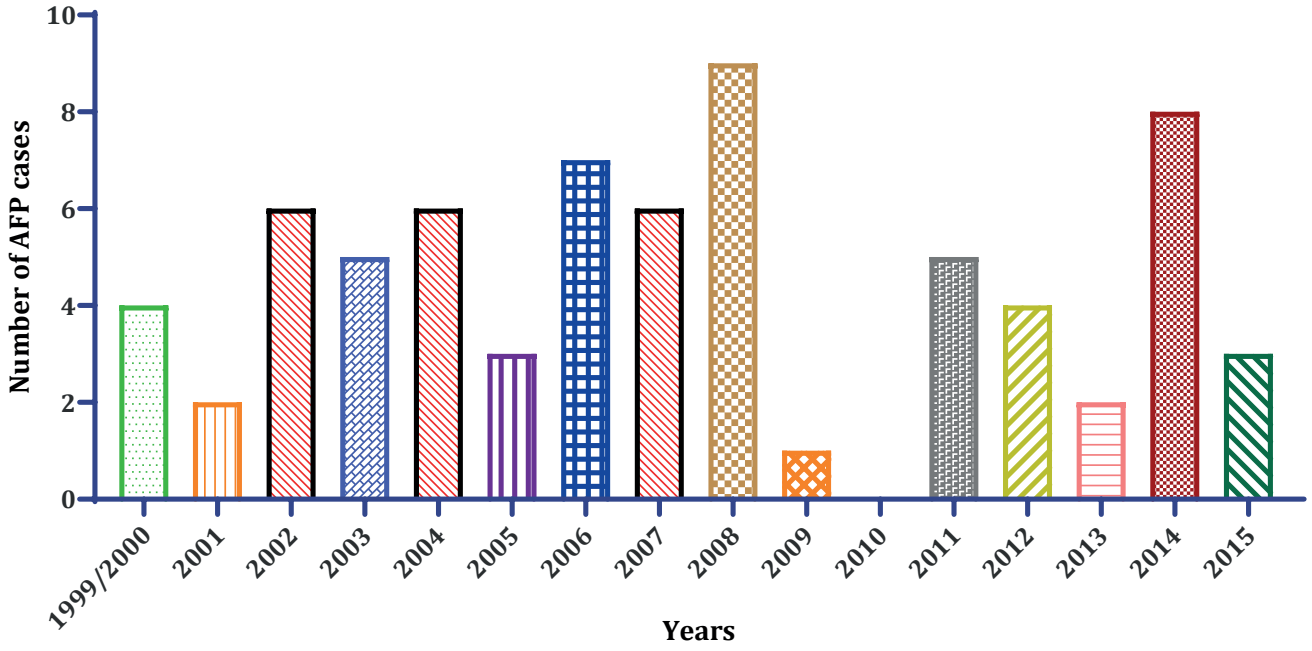



**Figure 7.** Sensitivity of AFP surveillance system in the province of Kenitra(1999/2000 to 2015)

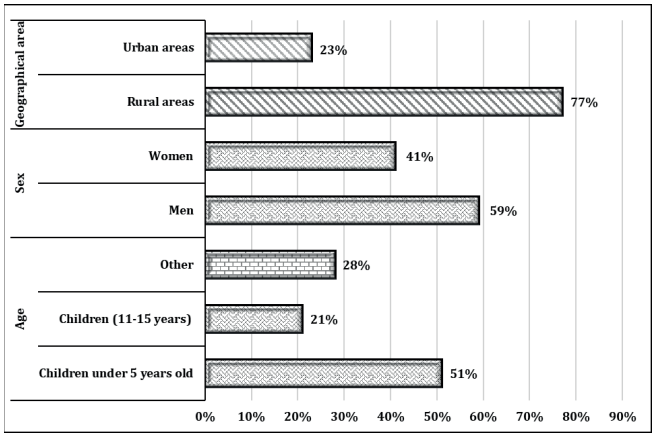



**Figure 8.** Distribution of AFP cases analysed by age, sex and geographical region.

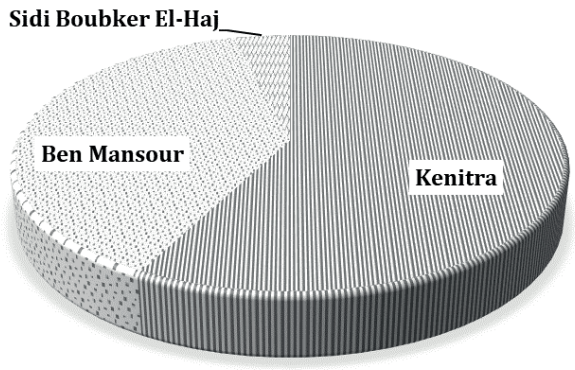



**Figure 9.** AFP incidence in the province of Kenitra (last 25 years)

followed with 10 cases (13%), while SidiBoubker El-Haj recorded only one case (1%) (Figure 9).

### Acceptability: Completeness and Timeliness of case investigation and stool arriving lab on time

The assessment of the completeness and timeliness of investigation sheets serves as a key quantitative indicator to assess the effectiveness and acceptability of public health surveillance systems. This metric reflects the level of staff involvement and participation in the surveillance system. The following completeness metrics are proposed for the purpose of AFP surveillance (Table 3):

**Completeness and timeliness of reports:** In Kenitra Province, over 90% of the expected routine monitoring reports (especially weekly zero reports) were submitted on time.

**Completeness and timelines of the survey:** A comprehensive examination was conducted to assess the clinical and virological aspects of all documented cases of AFP, with the majority occurring within a timeframe of less than 7 days. Approximately 80% of stool samples are collected and sent within less than 72 hours.

**Completeness and timeliness of follow-up:** A post-onset assessment of residual paralysis was completed within 60 days in 64% of AFP patients.

**Table 3:** Notification, investigation, and sampling times of AFP in Kenitra (1994-2018)

| Attributes | n | % |
|---|---|---|
| **Notification Deadline** | | |
| **≤ 7 Days** | **31** | **40** |
| > 7 Days | 38 | 50 |
| Not Specified | 7 | 9.1 |
| **Investigation Deadline** | | |
| **≤ 48 h** | **54** | **71** |
| > 48 h | 4 | 5 |
| Not Specified | 18 | 24 |
| **Deadline for Stool Sampling and Delivery** | | |
| **≤ 72 h** | **61** | **80** |
| > 72 h | 1 | 1 |
| Not Specified | 14 | 19 |

## DISCUSSION

The last endemic case of polio in Morocco was recorded in. The current goal is to eradicate the disease from the planet, both in terms of cases and the virus itself[5].

Surveillance of AFP cases is the most effective way to control the spread of wild poliovirus (WPV)[5,10]. To achieve the goal of eradication, it is essential that all detection, investigation and surveillance procedures are continuously implemented and maintained[14]. In addition, the collection, safeguarding and results of the database are critical.

The analysis revealed that the AFP monitoring system studied was overly complex, in line with the findings of other academic studies in Europe (Italy, Serbia, Bosnia-Herzegovina, Montenegro, Bulgaria, Kosovo, Albania, North Macedonia, Malta and Greece) and Africa (Zimbabwe)[14-17]. Nevertheless, the system has been found to be flexible and adaptable with efforts in training, recruitment, communication and updating of teaching materials[17-22].

This study also highlighted a lack of sensitivity in the AFP monitoring system, confirming previous observations[16,17,23.24,25].This sensitivity can be attributed to the geographical extent of the province of Kenitra and the under declaration.

The AFP surveillance system in Kenitra can be considered representative of the whole city, as patients came from many different municipalities in the province. This observation is similar to those made in South America [27] and Africa (Nigeria and Sudan)[18,28,29]. Kenitra is the municipality with the highest number of cases (15), or 20% of the total. This disparity may be explained by the high population density of the city.

At the national level, a disparity in case reporting between different regions was also observed, which is a common phenomenon in many African and Asian countries[7,29,23].

The data collected confirm the results of previous studies [31-35] and highlight some important trends.

The age group most affected by AFP is children between 1 and 5 years of age, representing 51% of cases. This is followed by a predominance of males, accounting for 59% of AFP cases[35-37]. There is also a correlation with rural areas, with 77% of patients coming from these areas[35,38].

Over 90% of AFP cases are reported more than a week after the onset of paralysis, although the completeness of zero reporting remains over ninety percent. This delay may be explained by a lack of awareness among healthcare staff of the need to report AFP cases immediately. This delays the implementation of control measures and the collection of adequate samples. The investigation rate stands at 70%, indicating that investigations are launched once a case is identified and reported[25,39].

During the evaluation period, more than half of suspected cases were investigated within 48 hours of receipt of notification. In contrast, during the same period, virtually all suspected cases were investigated within 48 hours of receipt of notification[39,40].

The speed at which samples were processed by the laboratory consistently exceeded the minimum requirements, allowing the desired level of coverage to be achieved. However, the time between the onset

of symptoms in the first reported polio case and the confirmation of an outbreak can be prolonged by delays in sending stool samples to laboratories and the time required for testing. In addition, many countries do not routinely provide sufficient stool samples to identify poliovirus[41]. According to our survey results, about 80% of stool samples are collected and sent within 72 hours according to WHO standards, although this is not the case in several African countries[40,41].

The accuracy of stool sampling for polio surveillance depends on the ability of the field investigator to obtain the precise date of onset of paralysis[8,41]. Typically, residual paralysis is assessed 60 days after the onset of acute flaccid paralysis (AFP), either at the patient's home or during a hospital visit[44,45].

## CONCLUSION

The results of this research project suggest that careful surveillance of non-polio **AFP** has helped to prevent the spread of the disease. In fact, the predicted minimum reporting rate for each year (1.0 cases per 100,000 children under 15) was achieved in 2002, 2004, 2007 and 2015. These results could have a significant impact on the health of the population. The fact that the percentage of acceptable stool samples is higher than the target of 80% is very encouraging.

The surveillance system has achieved its goals, including maintaining polio surveillance after wild poliovirus elimination in Morocco. This conclusion was taken after the system was judged to be effective in achieving its goals.

### Recommendations

- Increase the level of awareness among health providers and make the notification of AFP cases a priority.
- Make sure everyone in the health network is aware of the AFP Surveillance program.
- Immediately report and examine any suspected instances of AFP in children or adolescents under the age of 15 so that appropriate preventative measures can be taken.
- Conduct an exhaustive search throughout the reference hospitals and clinics, as well as review the patient records of children under the age of 15 who were hospitalized with a diagnosis that led to AFP.
- Expand the number of reliable notification sources.
- Involving the for-profit health care industry in the process of reporting incidents of AFP

Finally, effective AFP surveillance is essential for the prevention and control of diseases with epidemic potential. By following these recommendations, we can improve the detection, reporting and response to AFP cases, thereby helping to protect public health.

## DECLARATIONS

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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## AUTHOR'S CONTRIBUTION

Conceptualization, writing the original draft: Samira Jayche, Ahmed Idrissi, Fatima Zahra Talbi, Asmae Baghouz, SanaeSendaoui. Formal analysis, investigations, funding acquisition, resources, Sendaoui, Amr Loutfi, Badreddine Dahou, Mohamed Lahmam Mohamed Najy, Ahmed Omar Thouhami Ahami, Aouane Elmahjoub

## FUNDING

### This work has received no external funding

### Data Availability

All data generated or analysed during this study are included in this published article

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