

Evaluation of the Measles Surveillance System Performance in the Mbandaka Health Zone, Équateur Province, Democratic Republic of Congo: January to December 2025

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ABSTRACT

Background: Measles remains a major public health problem in the Democratic Republic of Congo, particularly in the city of Mbandaka, where outbreaks are regularly reported despite the availability of an effective vaccine. The evaluation of surveillance systems is essential to determine their capacity to detect cases early, report alerts, and implement appropriate control measures.

Objective: This study aimed to evaluate the measles surveillance system in the Mbandaka Health Zone, Équateur Province, to assess its performance and propose evidence-based recommendations for strengthening epidemic preparedness and response.

Methods: A descriptive cross-sectional study was conducted from January to December 2025, following the Centers for Disease Control and Prevention (CDC) guidelines for surveillance system evaluation. Data were collected from 15 health facilities, the Provincial Health Division, the Expanded Program on Immunization (EPI) office, and 22 healthcare providers involved in measles surveillance. A standardized questionnaire was administered, and surveillance records were reviewed. Key attributes analyzed included usefulness, simplicity, sensitivity, specificity, representativeness, timeliness, data quality, acceptability, and stability.

Results: The surveillance system demonstrated high usefulness (100%) and specificity (100%), with all health facilities reporting suspected cases. However, important gaps were identified. Simplicity was rated at 71%, with some providers reporting difficulties in completing notification forms. Sensitivity was 64%, indicating under-detection of community cases. Acceptability was 72%, limited by lack of financial motivation and feedback. Stability was very low (14%) due to frequent stockouts of surveillance materials and dependence on external funding. Data quality was poor (27% completeness). Timeliness showed that 78% of cases met the 72-hour notification-to-analysis target. Among 127 suspected cases, 56% were laboratory-confirmed, and 70% of samples met quality standards for collection and transport.

Conclusion: The measles surveillance system in the Mbandaka Health Zone is useful and functional but faces significant challenges in stability, data quality, sensitivity, and timeliness. Strengthening provider training, ensuring adequate logistics, improving feedback mechanisms, and securing sustainable financing are essential to enhance system performance and progress toward measles elimination goals.

Keywords: Measles, surveillance system evaluation, Mbandaka Health Zone, Democratic Republic of Congo, IDSR, public health.

1. INTRODUCTION

1.1 Background

Measles remains one of the most contagious infectious diseases and continues to be a major public health problem, particularly in developing countries. According to the World Health Organization (WHO, 2023), measles is still an important cause of morbidity and mortality among children despite the availability of a safe and effective vaccine. The disease is caused by a virus of the genus *Morbillivirus* in the family *Paramyxoviridae* and is transmitted primarily through respiratory droplets. A single infected person can transmit the virus to 12-18 non-immune individuals (Centers for Disease Control and Prevention [CDC], 2022).

The clinical presentation of measles includes high fever, cough, coryza, conjunctivitis, and a generalized maculopapular rash. Complications can be severe, including pneumonia (the leading cause of death), acute encephalitis, severe diarrhea with dehydration, malnutrition, and subacute sclerosing panencephalitis (SSPE), a rare but fatal late complication (WHO, 2023).

Globally, despite progress in vaccination, measles has resurged in several regions since 2018 due to declining vaccine coverage and health system disruptions. In 2019, more than 869,000 cases were recorded worldwide, marking a significant increase from previous years (WHO, 2023).

Sub-Saharan Africa remains the most affected region, with recurrent outbreaks linked to insufficient vaccination coverage (below 80% in some areas), weak surveillance systems, and population displacement due to conflicts (CDC Africa, 2022).

1.2 The Congolese Context

The Democratic Republic of Congo (DRC) ranks among the most affected countries by measles. Several major epidemics were reported between 2018 and 2023, with thousands of deaths, primarily among unvaccinated children. The Ministry of Health indicates that aggravating factors include low vaccination coverage, logistical difficulties, and insufficient integrated disease surveillance and response (IDSR) systems (Ministry of Public Health, 2022).

Équateur Province, located in northwestern DRC, is regularly confronted with measles outbreaks. This province is one of the areas where vaccination coverage remains insufficient, facilitating virus circulation. Health data indicate that measles is responsible for numerous epidemics affecting mainly children under five years of age. In 2019, a major epidemic struck several health zones in the province, causing hundreds of child deaths (Radio Okapi, 2019). More recently, in 2023, the province again faced a resurgence of cases, leading to emergency vaccination campaigns in Mbandaka and other affected areas (ACP, 2023).

The Mbandaka Health Zone, an urban health zone and the capital of Équateur Province, constitutes one of the main foci of measles in the province. Local studies have shown regular resurgence of cases, particularly among children aged 6 to 59 months. Research indicates that the

health zone faces underreporting of cases, insufficient vaccination coverage, and difficulties in rapid response, which favor the persistence of epidemics (IJSSASS, 2024; IJSSASS, 2025).

1.3 Problem Statement and Rationale

According to WHO guidelines, a vaccination coverage of at least 95% is necessary to interrupt measles virus transmission (WHO, 2023). However, in the Mbandaka Health Zone, this target remains far from being achieved. The persistence of recurrent epidemics despite routine vaccination and response campaigns suggests serious shortcomings in the surveillance system.

Epidemiological surveillance is an essential component in the fight against epidemic-prone diseases. According to the IDSR framework implemented by WHO in Africa, an effective surveillance system must enable rapid detection of suspected cases, laboratory confirmation, and rapid decision-making to control outbreaks (WHO, 2019). However, in several health zones in the DRC, this system faces challenges related to lack of qualified human resources, poor data quality, and underreporting of cases.

Given this context, evaluating the measles surveillance system in the Mbandaka Health Zone is essential to identify its strengths and weaknesses and to propose context-appropriate improvements.

1.4 Study Objectives

General objective: To evaluate the measles surveillance system in the Mbandaka Health Zone, Équateur Province, to analyze its effectiveness and propose improvement strategies.

Specific objectives:

1. Describe the organization and functioning of the measles surveillance system in the Mbandaka Health Zone
2. Evaluate the quality of measles data notification and collection
3. Analyze the capacity for early detection and response to measles cases
4. Identify the strengths and weaknesses of the existing surveillance system

5. Propose recommendations to improve surveillance system performance

1.5 Research Question and Hypotheses

Main research question: How is the measles surveillance system structured and functioning in the Mbandaka Health Zone, and to what extent is it effective in ensuring early detection and response to cases?

Main hypothesis: The measles surveillance system in the Mbandaka Health Zone has deficiencies that limit its effectiveness in early detection and rapid response to cases.

Specific hypotheses:

1. Low notification of suspected measles cases contributes to underestimation of the epidemiological situation
2. Insufficient human and material resources affect the quality of the surveillance system
3. Delays in data transmission limit the speed of outbreak response
4. Low vaccination coverage favors the persistence of measles epidemics

2. METHODS

2.1 Study Design

This was a descriptive cross-sectional study with analytical aims. The study followed the CDC guidelines for evaluating public health surveillance systems (CDC, 2001).

2.2 Study Setting

The study was conducted in the Mbandaka Health Zone, located in Équateur Province, northwestern Democratic Republic of Congo. The province covers approximately 130,000 km² and comprises 18 health zones, distributed among urban, semi-urban, and predominantly rural

areas. The health zone is characterized by equatorial vegetation, high biodiversity, and deep forest zones.

According to recent projections from the Provincial Health Division and the National Health Program, the province has approximately 2 to 2.5 million inhabitants, with a high proportion of young people. Access to healthcare is limited, with often under-equipped health facilities. The epidemiological surveillance system relies primarily on the Integrated Disease Surveillance and Response (IDSR) system, weekly notification, and community alerts.

2.3 Study Period

The study covered a one-year period from January 1 to December 31, 2025.

2.4 Study Population and Sampling

The study population comprised all personnel working in selected health structures in Équateur Province, including the Mbandaka Health Zone central office, health facilities, the EPI office, and the health information office at the Provincial Health Division.

A convenience sampling method was used. Personnel from 15 health facilities, the Health Zone central office, the EPI office, and the Provincial Health Division health information office were considered for the study. The final sample included 22 healthcare providers from 14 health facilities who met the inclusion criteria and consented to participate.

Inclusion criteria: Healthcare workers involved in priority disease surveillance in the Mbandaka Health Zone, the EPI office, or the health information office.

Exclusion criteria: Healthcare workers not involved in priority disease surveillance or working in other health facilities not included in the study.

2.5 Data Sources

Data sources included:

- Health facility records (notification forms, line lists, investigation forms)
- Health Zone central office records
- EPI office records (sample transport and laboratory results)
- Provincial Health Division health information office records
- Questionnaires administered to surveillance personnel

2.6 Data Collection

Data were collected using a pre-tested standardized questionnaire, structured interviews, and document review. The questionnaire assessed:

- Essential surveillance functions (detection, notification, analysis, preparation for response, response)
- Support functions (training, supervision, coordination)
- Surveillance attributes (usefulness, simplicity, sensitivity, specificity, representativeness, timeliness, data quality, acceptability, stability, flexibility)

A pre-test of the questionnaire was conducted at the Health Zone central office and at Mama Balako Health Center in the Wangata Health Zone to assess clarity, feasibility, and validity.

2.7 Variables Studied

Essential functions:

- Detection: Use of standardized case definitions
- Notification: Timeliness of data transmission
- Analysis and interpretation: Existence of up-to-date dashboards
- Preparation for response: Proportion of notified cases investigated
- Response: Implementation of control measures

Support functions:

- Training: Proportion of staff trained in IDSR and measles surveillance

- Supervision: Regularity of supervisory visits
- Coordination: Existence of coordination meetings

Surveillance attributes:

- Usefulness: Ability to use data for program management
- Simplicity: Ease of system operation
- Sensitivity: Ability to detect all real cases
- Specificity: Ability to exclude false cases
- Representativeness: Geographic and population coverage
- Timeliness: Speed between case occurrence and notification/response
- Data quality: Completeness and accuracy of reported data
- Acceptability: Willingness of stakeholders to participate
- Stability: Continuity of system operation
- Flexibility: Ability to adapt to changes

2.8 Data Analysis

Data were compiled in Microsoft Excel and analyzed using SPSS version 27. Descriptive statistics (frequencies, proportions, means) were calculated. Quantitative attributes were assessed using standard surveillance indicators. Data quality was evaluated based on completeness of notification forms (demographic, clinical, and epidemiological data).

2.9 Ethical Considerations

The research protocol was approved by the ISTM ethics committee. Administrative authorizations were obtained from the Provincial Health Division of Équateur, the EPI office, and the Medical Chief of the Mbandaka Health Zone. Individual identifiers were not included in the results presentation to ensure confidentiality. Informed consent was obtained from each participant before data collection. Participants were informed of their right to withdraw from the study at any time.

3. RESULTS

3.1 Characteristics of Study Participants

Table 1. Participant Characteristics (N=22)

Characteristic	n	%
Sex		
Male	16	72.7
Female	6	27.3
Professional category		
Head Nurse (IT)	11	50.0
Assistant Head Nurse (ITA)	2	9.1
Supervisor (IS)	2	9.1
Director of Nursing (DN)	1	4.5
EPI staff (MCA/Log)	2	9.1
Physician	2	9.1
Health information staff	2	9.1
Years of experience		
1-5 years	2	9.1
6-10 years	9	40.9
>10 years	11	50.0

The majority of participants were male (72.7%), head nurses (50.0%), and had more than 10 years of experience (50.0%). A total of 15 health facilities were visited.

3.2 Essential Surveillance Functions

Table 2. Availability of Surveillance Tools in Health Facilities (N=12)

Surveillance tool	Available n (%)	Not available n (%)
Investigation forms	10 (83.3)	2 (16.7)
Up-to-date line list	1 (8.3)	11 (91.7)
Response plan	1 (8.3)	11 (91.7)
Up-to-date dashboard	4 (33.3)	8 (66.7)
Up-to-date graphs	3 (25.0)	9 (75.0)
Information bulletins	1 (8.3)	11 (91.7)

Most health facilities had investigation forms (83.3%), but very few had up-to-date line lists (8.3%), response plans (8.3%), or information bulletins (8.3%). Information bulletins were produced only at the provincial level.

3.3 Investigation and Laboratory Capacity

Table 3. Investigation and Laboratory Performance (N=14 health facilities)

Indicator	Yes n (%)	No n (%)
Investigation forms archived case-by-case	0 (0.0)	14 (100.0)
Samples arrived at lab within 72 hours	0 (0.0)	14 (100.0)
Results received at health facility within 48 hours	0 (0.0)	14 (100.0)

Indicator	Yes n (%)	No n (%)
Sufficient measles sample collection kits	8 (57.1)	6 (42.9)
Mastery of sample conservation/transport	10 (71.4)	4 (28.6)
Availability of investigation forms	12 (85.7)	2 (14.3)
Mastery of sample collection technique	14 (100.0)	0 (0.0)
Rapid response kits available	0 (0.0)	14 (100.0)

All health facilities (100%) mastered the sample collection technique, and 71.4% mastered sample conservation and transport. However, none had archived investigation forms, none had samples arriving at the laboratory within 72 hours, and none had rapid response kits available.

3.4 Support Functions for Surveillance and Response

Table 4. Training and Support Functions (N=22 providers unless indicated)

Indicator	Yes n (%)	No n (%)
Trained in IDSR (3rd edition)	16 (72.7)	6 (27.3)
Trained in measles surveillance/response	16 (72.7)	6 (27.3)
Presence of coordination teams (N=12 facilities)	12 (100.0)	0 (0.0)
Trained in biosafety	12 (54.5)	10 (45.5)
Trained in sample management	10 (45.5)	12 (54.5)

Indicator	Yes n (%)	No n (%)
Trained in database management	8 (36.4)	14 (63.6)
Trained in measles vaccination	9 (40.9)	13 (59.1)

Most providers (72.7%) had received training in IDSR and measles surveillance/response. All health facilities had well-organized coordination teams. However, training in sample management (45.5%) and database management (36.4%) was less common.

3.5 Surveillance System Attributes

3.5.1 Quantitative Attributes

Table 5. Quantitative Attributes of the Measles Surveillance System

Attribute	Cases expected	Cases found	%	Interpretation
Positive predictive value (lab-confirmed)	127	71	56	Moderate
Sample adequacy (quality standards)	127	89	70	Moderate
Timeliness (72-hour target)	127	99	78	Moderate
Data quality (completeness)	127	34	27	Poor

Among 127 suspected measles cases notified during the study period, 56% were laboratory-confirmed. Seventy percent of samples met quality standards for collection, conservation, and transport. Timeliness—defined as the interval between symptom onset, notification, and laboratory analysis within 72 hours—was achieved for 78% of cases. Data quality, measured by completeness and accuracy of notification forms (clinical, demographic, and epidemiological data), was very low at 27%.

3.5.2 Qualitative Attributes

Table 6. Qualitative Attributes of the Measles Surveillance System

Attribute	n/N	%	Interpretation
Usefulness	14/14	100	Excellent
Specificity	14/14	100	Excellent
Simplicity	10/14	71	Moderate
Acceptability	13/18	72	Moderate
Sensitivity	9/14	64	Moderate
Stability	2/14	14	Very poor

The surveillance system demonstrated excellent usefulness (100%) and specificity (100%). Simplicity was rated at 71%, with some providers reporting difficulties in completing notification forms. Acceptability was 72%, limited by lack of financial motivation and feedback. Sensitivity was 64%, indicating under-detection of community cases. Stability was very low (14%) due to frequent stockouts of surveillance materials and dependence on external funding.

3.6 Summary of Key Findings

1. **Usefulness:** All health facilities (100%) found the surveillance system useful for case detection and outbreak control.
2. **Specificity:** The system was highly specific (100%), effectively excluding non-measles cases.
3. **Sensitivity:** Only 64% of expected cases were detected, indicating significant underreporting.
4. **Data quality:** Only 27% of notification forms were complete and accurate.
5. **Timeliness:** 78% of cases met the 72-hour notification-to-analysis target.
6. **Stability:** Only 14% of facilities reported stable system functioning due to frequent supply shortages.
7. **Training gaps:** Only 36.4% of providers were trained in database management, and 45.5% in sample management.

8. **Laboratory capacity:** No samples arrived at the laboratory within 72 hours, and no results were received within 48 hours.
9. **Response preparedness:** No health facility had rapid response kits available.

4. DISCUSSION

4.1 Interpretation of Findings

This evaluation of the measles surveillance system in the Mbandaka Health Zone reveals a system that is useful and functional but faces significant operational constraints that limit its effectiveness in early detection and outbreak response.

The high usefulness (100%) and specificity (100%) of the system indicate that when cases are reported, they are correctly identified as measles, and the data are used for program management. This aligns with WHO guidelines, which consider surveillance an indispensable tool for the prevention and control of vaccine-preventable diseases (WHO, 2018).

However, the low sensitivity (64%) is concerning. This indicates that approximately one-third of actual measles cases in the community are not being detected by the surveillance system. This finding is consistent with studies in other sub-Saharan African countries, where underreporting of measles cases is frequent due to low diagnostic capacity, lack of training, and health worker overload (Graiss et al., 2006; Nsubuga et al., 2010). The risk of underreporting is particularly high in remote or difficult-to-access health areas, which may explain the observed gap.

The very low stability of the system (14%) is a major concern. Frequent stockouts of surveillance tools, insufficient funding, communication problems, and dependence on technical and financial partners limit the continuity of surveillance activities. This financial dependence has been described in several African studies on integrated disease surveillance systems (WHO-AFRO, 2019). The fact that only 14% of facilities reported stable system functioning indicates a critical fragility that could compromise the system's ability to detect and respond to outbreaks in a timely manner.

Data quality was also very poor (27% completeness). Some forms contained incomplete or inconsistent data, which can compromise the reliability of epidemiological analyses and decision-making. According to CDC recommendations, data quality is an essential element for ensuring the performance of an effective surveillance system (CDC, 2001).

4.2 Comparison with Existing Literature

The findings of this study are comparable to those reported in other African settings. Nsubuga et al. (2010) demonstrated that insufficient training of personnel negatively affects surveillance data quality in sub-Saharan Africa. Similarly, a study conducted in Nigeria by Braka et al. (2012) reported that lack of resources and supervision limited active provider participation in the measles surveillance system.

Ademe et al. (2019), in a study in Ethiopia, observed similar difficulties in completeness and representativeness of measles surveillance data, with 78% of districts meeting timeliness targets—a figure almost identical to the 78% found in our study. The same study reported data quality issues comparable to our findings, with completeness of forms ranging from 25-30%.

In the DRC, Mupenda et al. (2021) evaluated the measles surveillance system and found that logistical difficulties, transport problems, and insufficient feedback from the central to peripheral levels significantly reduced system performance. Muyembe and Nachega (2020) noted that weak laboratory capacity and delays in sample transport remain major challenges for measles surveillance in the country.

The positive predictive value of 56% in our study is consistent with findings from other resource-limited settings, where laboratory confirmation is often delayed or unavailable, leading to reliance on clinical diagnosis (WHO, 2021). The timeliness of 78% is slightly below the WHO-recommended target of 80% for outbreak detection (WHO-AFRO, 2019).

4.3 Strengths and Weaknesses

Strengths:

- The system demonstrated high usefulness and specificity
- All health facilities had coordination teams
- Most providers were trained in IDSR and measles surveillance
- The system successfully detected and notified suspected cases

Weaknesses:

- Very low stability (14%)
- Poor data quality (27% completeness)
- Moderate sensitivity (64%)
- No rapid response kits available
- No samples arrived at laboratories within 72 hours
- Insufficient training in database management and sample management

4.4 Limitations

Several limitations should be acknowledged. First, the cross-sectional nature of the study does not allow for assessment of temporal trends in surveillance performance. Second, the evaluation was based primarily on provider reports and document review, which may introduce recall and reporting bias. Third, the sample size (22 providers) and number of health facilities (15) may limit the generalizability of findings to other health zones in Équateur Province. Fourth, the study period of one year may not capture seasonal variations in surveillance performance. Despite these limitations, this study provides important baseline data on measles surveillance performance in a typical Congolese health zone.

5. CONCLUSION

5.1 Summary of Findings

This evaluation of the measles surveillance system in the Mbandaka Health Zone demonstrated that the system is useful (100%) and specific (100%), playing an essential role in early case detection and outbreak response. However, significant gaps were identified:

1. **Low stability (14%):** Frequent stockouts of surveillance materials and dependence on external funding threaten system continuity.
2. **Poor data quality (27%):** Incomplete and inconsistent data compromise the reliability of epidemiological analyses.
3. **Moderate sensitivity (64%):** Significant underreporting of community cases, particularly in remote areas.
4. **Moderate timeliness (78%):** Delays in sample transport and laboratory confirmation limit rapid response.
5. **Insufficient training:** Gaps in database management, sample management, and biosafety training affect data quality and safety.
6. **No rapid response capacity:** Absence of rapid response kits in all health facilities delays outbreak control.

5.2 Verification of Hypotheses

Hypothesis	Result
H1: Low notification contributes to underestimation	Confirmed (sensitivity 64%)
H2: Insufficient resources affect system quality	Confirmed (stability 14%)
H3: Delays in data transmission limit response	Confirmed (78% timeliness, no rapid response kits)
H4: Low vaccination coverage favors epidemic persistence	Not directly measured (but contextual evidence supports)

5.3 Recommendations

At the national level (Ministry of Health):

- Strengthen the national epidemiological surveillance policy

- Ensure sustainable financing for surveillance systems
- Decentralize diagnostic capacities to provincial laboratories
- Implement digital data transmission systems

At the provincial level (Équateur Province):

- Reduce confirmation delays by improving sample transport logistics
- Implement a digital surveillance system
- Strengthen supervision of health facilities
- Establish regular feedback mechanisms

At the health facility level:

- Train personnel on correct completion of notification forms
- Improve rapid case notification
- Strengthen data archiving
- Ensure availability of sample collection kits

At the community level:

- Intensify awareness campaigns on measles
- Strengthen community health worker networks
- Combat vaccine hesitancy and stigma

For partners and donors:

- Support digitalization of the surveillance system
- Strengthen technical and logistical capacities
- Promote sustainability of interventions

5.4 Final Conclusion

This study demonstrates that despite the efforts already made in measles control in the Mbandaka Health Zone, significant challenges persist. The surveillance system is useful and functional but

requires urgent strengthening in stability, data quality, sensitivity, and timeliness. The very low stability (14%) and poor data quality (27%) are particularly concerning and require immediate attention from health authorities and partners.

Strengthening the epidemiological surveillance system is an indispensable priority for reducing measles-related morbidity and mortality and contributing to the improvement of public health in Équateur Province and the Democratic Republic of Congo as a whole. Without sustainable investment in training, logistics, infrastructure, and governance, the goal of measles elimination will remain elusive.

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