International Journal of Public Health Science (IJPHS)
Vol. 15, No. 2, June 2026, pp. 583~592
ISSN: 2252-8806, DOI: 10.11591/ijphs.v15i2.26936

Assessing the effectiveness of a semi-annual monitoring model for data analysis and use in routine immunisation in Benin

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Article Info

Article history:

Received Dec 10, 2025
Revised May 10, 2026
Accepted May 22, 2026

Keywords:

Analysis
Benin
Data
Monitoring
Semi-annual
Use
Vaccination

ABSTRACT

Routine immunisation programmes generate large volumes of data, yet their effective analysis and use for decision-making remain limited at the operational level. For over three decades, Benin has institutionalized a semi-annual monitoring system to assess effectiveness, quality, and develop problem resolution plans (PRPs). This study evaluated its effectiveness in fostering data analysis and use within vaccination services. A descriptive cross-sectional study using mixed methods was conducted from January to June 2025 in eleven health centers across four departments. Data collected via direct observation, semi-structured interviews (n = 38), and document review underwent descriptive and qualitative analysis. Input availability and service accessibility remained optimal (100%). Variability persisted in utilisation, continuity, and quality, with recurrent over-coverage rates. During self-monitoring, technical tasks were frequently performed, whereas in-depth analysis and PRP development were limited (9.09%). Although 90.9% of centers had PRPs, their quality was mostly acceptable, with low innovation and weak follow-up mechanisms. Community participation was irregular. Nevertheless, 81.82% of managers perceived PRPs as contributing to improved vaccination performance. Semi-annual monitoring remains functional and relevant; however, strengthening analytical capacity, digital tools, follow-up mechanisms, and community engagement is essential to institutionalise a sustainable culture of data use for decision-making.

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1. INTRODUCTION

The digital transformation of health systems has significantly increased the volume of available data, particularly in the field of vaccination, providing unprecedented opportunities to enhance decision-making and health outcomes [1]. However, a persistent challenge lies in converting these data into actionable information, especially at operational levels of health systems where analytical and data-use capacities are often limited [2]. This gap in decision-making data use, shaped by organisational, human, and technical factors, undermines programme effectiveness and hinders progress towards the goals of the Immunisation Agenda 2030, which aims for "a world where everyone, everywhere, fully benefits from vaccines" [3].

Recent studies emphasise that strengthening data analysis skills, establishing feedback loops, and promoting a culture of continuous improvement are critical to enhancing the use of routine data within healthcare facilities [4], [5]. Moreover, continuous quality improvement approaches such as Plan–Do–Study–Act (PDSA) cycles provide relevant operational frameworks that link indicators, decision-making, and follow-up at the implementation level [5], [6]. Recognising these challenges, Gavi, the Vaccine Alliance, has prioritised investment in innovative models for data analysis and use as a strategic lever to reinforce routine immunisation in supported countries [7]. In this context, Benin offers a particular case study with its semi-annual monitoring model for primary health services, implemented for over three decades.

Introduced in 1988 under the Bamako Initiative, semi-annual monitoring is a periodic mechanism for assessing health facility performance. Based on the Tanahashi model, it sequentially analyses availability, accessibility, utilisation, continuity, and quality for health services such as vaccination. Primary data are collected directly to identify bottlenecks and develop a problem resolution plan (PRP). Originally conducted by an external team from the departmental health directorate or health zone supervisory team, self-monitoring by health center staff, followed by zone-level validation, was introduced two decades ago.

Semi-annual monitoring is a cornerstone of the expanded programme on immunisation (EPI) at first-line facilities [8]. However, questions remain regarding the model's effectiveness and its contribution to the practical analysis and use of data for improving vaccine performance. The forthcoming guideline update offers an opportunity to examine this model, document its strengths and limitations, and draw transferable lessons. This article presents the findings of the study assessing the effectiveness and achievements of this model of data analysis and use within Benin's health services.

2. METHOD

2.1. Study setting and site selection

The study was conducted in eleven health centers purposively selected. The sites, located across four departments and six health zones, represent geographical and organisational diversity that enables an assessment of variations in the monitoring process (Figure 1). All selected health facilities provide routine immunisation through both fixed and outreach strategies and possess at least basic functional infrastructure (dispensary or maternity unit).

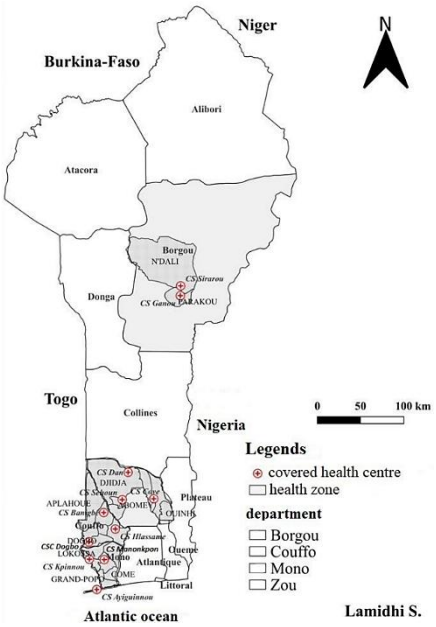

Figure 1. Map of Benin showing the health zones and health centers covered by the study in 2025

2.2. Study design and period

This was a descriptive cross-sectional study, using a mixed-methods approach (quantitative and qualitative). The study was conducted from January to June 2025. This design allowed exploration of both performance levels and the dynamics of the semi-annual monitoring process.

2.3. Study population, targets, and eligibility criteria

The study population comprised stakeholders involved in at least one phase of the monitoring process: self-monitoring, data validation, results dissemination, and follow-up of the problem resolution plan (PRP).

i) Inclusion criteria:
   - Sites: purposive selection based on territorial representativeness (north–center–south), accessibility, and feasibility of observing all phases of the monitoring process.
   - Participants: direct involvement in at least one stage of monitoring during the semester under review.

ii) Exclusion criteria: Persistent unavailability of respondents despite rescheduling attempts.

2.4. Description of the semi-annual monitoring system and research question

Semi-annual monitoring is conducted during the first fortnight of the month following the end of each semester. It is initiated by the health zone medical coordinator, who organizes the arrangements necessary for its implementation. The services to be covered, the tools to be used, and the guiding principles and procedures are defined or recalled prior to commencement. The essential phases of semi-annual monitoring include preparation, self-monitoring, validation, reporting, and feedback.

Participation of community representatives and health center staff is required at all stages, particularly during the preparatory and self-monitoring phases, for which they bear primary responsibility. Each monitoring cycle produces a performance assessment of the targeted services, identifies bottlenecks, and results in a problem resolution plan, thereby ensuring stakeholder engagement in a continuous service improvement process. Despite its longevity, questions remain regarding procedural adherence, analytical rigour, and the effective use of findings. Research question: "Does the semi-annual monitoring of vaccination activities foster a culture of analysis and effective use of reliable data to support decision-making at the operational level?"

2.5. Data collection techniques, tools, and variables

Four main techniques were used:

i) Direct observation: this covered the preparation and implementation of self-monitoring, data validation, and internal and health zone–level dissemination of results. A digitalized observation checklist was used to assess the effectiveness, availability, and quality of tools, production of required documentation, and analytical dynamics.
ii) Semi-structured interviews: conducted using adapted interview guides and audio recorders, these aimed to document perceptions, practices, and challenges related to monitoring.
iii) Document review: this included examination of PRPs, attendance sheets, monitoring reports, and other documents produced within the previous two years.
iv) Key variables collected: Availability of preparatory documents; conduct of monitoring sessions; presence and quality of required tools; calculation and verification of key indicators; identification of bottlenecks; development or updating of the micro-plan; existence of follow-up mechanisms.

2.6. Indicators and assessment criteria

Performance was assessed using the following components:

i) Monitoring process and quality
   - Effectiveness: completion of sessions and availability of monitoring reports.
   - Participation: high (all expected actors present); moderate (at least one representative per category); low (other situations).
   - Content relevance: analysis of indicators; identification of bottlenecks; PRP developed; follow-up mechanisms in place.

     High relevance: ≥ 5 criteria; moderate: ≥ 3; low: < 3.

ii) Quality and use of PRPs
   - Availability/display of the PRP.
   - PRP quality, assessed through: causal analysis (A), innovation of proposed actions (B), and realism/feasibility (C).

     High quality: A, B, C > 80%; low: < 50%; acceptable: intermediate values.

   - Implementation level of PRP actions: 80% = high; 50–80% = moderate; < 50% = low.

2.7. Data management and analysis

Methodological rigour was ensured through digitalisation of data collection tools, daily cross-checks by supervisors, and systematic verification of consistency across sources.

- Quantitative analysis: performed using Excel and Stata 15 to generate descriptive statistics and interannual comparisons.
- Qualitative analysis: manual using thematic analysis, with coding following an inductive and deductive approach; themes were identified through iterative reading and triangulated across sources to ensure rigour.

2.8. Ethical considerations

The study adhered to ethical principles for health research. The protocol was approved by the institutional committee of scientists and research ethics experts at IRSP. Administrative authorisations were obtained from the Ministry of Health and participating health zones. Informed consent was obtained from all participants. Anonymity and confidentiality were ensured through de-identification and secure data storage.

2.9. Study limitations and mitigation measures

Limitations included incomplete access to archives, perceived length of interview guides, and intermittent unavailability of key actors. Mitigation measures comprised rescheduling of sessions, maximal use of available documentation, triangulation of data sources, and documentation of uncertainties during analysis. These limitations were taken into account in the interpretation of findings.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Characteristics of the health facilities and respondents included

A total of eleven health centers were observed across four departments. These facilities comprised centers with at least a dispensary or maternity unit, all offering universal routine vaccination through fixed and outreach strategies. The presence of qualified staff (physicians, nurses, midwives) in varying numbers was confirmed in each health facility. In 2025, these centers covered a population of 229,276 inhabitants, corresponding to a cumulative semi-annual vaccination target of 3,659 children.

Concerning the 38 respondents included in the study, they are distributed almost equally across the four departments. The average age was 41.47 ± 9.57 years. The age group 46 years and above was predominant (42.11%), followed by the 23–35-year age group (31.58%). Male participants were more represented (55.26%). Most respondents had received a briefing on monitoring (84.21%), and the distribution of professional roles was balanced (21.05% in each category).

3.1.2. Progression of monitoring indicators (2023–2024)

In 2024, the availability of inputs and accessibility to services remained generally optimal (100%), with only two centers reporting availability levels between 94% and 96%. Compared with 2023, performance was almost identical, reflecting continued control of the supply chain, an essential factor for sustaining performance dynamics. Utilization in 2024 showed marked overperformance (‘super rate’, >>100%) in several centers, representing an improvement over 2023, particularly in four centers where service uptake far exceeded expected levels. These 2024 results indicate an increased use of services by the population.

Service continuity reached high levels in five centers in 2024, with improvements over 2023 in centers such as Health Center 1 and Health Center 6. The quality of vaccination services also tended to improve across several centers in 2024, with high or very high levels observed in five centers and overperformance in two. Compared with 2023, these results suggest a gradual readjustment and strengthening of quality practices.

3.1.3. Conduct of the semi-annual monitoring

i) Preparation and conduct of self-monitoring

- Preparation

Preparation was characterised by the transmission of an official information note from the health zone office to health centers specifying the schedule (81.81%) at least one week before the activity (63.64%). Stakeholder involvement during preparation was effective in 54.55% of health centers.

> *“Not all team members get involved… I have to do everything myself to prepare for the monitoring.” (Health center head)*

Indicators of interest for data analysis and use assessed at this stage varied: availability of monthly staff meeting reports (72.73%) and monitoring reports.

- Self-monitoring

Overall, the execution levels of self-monitoring tasks contrasted with the self-assessment reported by respondents. Technical activities related to data processing, sorting cards, extracting data from source documents, and calculating indicators were more frequently performed (82%) than analytical tasks. For the latter, 36% of centers conducted a "review of the previous PRP," 64% performed "graph plotting," and 55% conducted "bottleneck identification."

Except for the "review of the previous monitoring PRP", which 56% of respondents reported being able to carry out, respondents rated their capacity to perform all other tasks more favourably (≥75%). The situation was more critical for PRP development, carried out in only 9.09% of centers, although 75.00% of managers stated that they had a high capacity to do so. Overall perception of self-monitoring among respondents was satisfactory (81.58%) or very satisfactory (7.89%).

ii) Data validation

Validation was characterised by good administrative preparation (72.73%), indicated by information notes sent to actors, and higher involvement of dispensary/maternity unit managers (100%) compared to COGECS members (50%). The self-monitoring report was available in 60% of health centers. Other findings at this stage included: "report preparation" (9.09%) and "report transmission" to the health zone office (0%). Overall perception of validation was favourable (73.68% satisfactory, 15.79% very satisfactory), and observations arising from validation were recorded in the supervision notebook (70%).

iii) Feedback on results

- Around 50% of respondents did not systematically participate, particularly COGECS members, due to the perceived informal nature of the process and scheduling conflicts. Attendance and involvement were considered positive (78%) and useful (≈92%).
- Feedback was conducted in 71.43% of health zones, with regular participation of 58.33% of stakeholders, generally satisfactory involvement, and content covering results, bottlenecks, microplans or PRPs, sometimes temporal comparisons, and financial aspects.

3.1.4. Use of monitoring results

i) Quality of problem resolution plans (PRPs)

At the time of the survey, 90.90% of health centers had a PRP. Assessment of PRP quality showed a mixed profile: one health center achieved satisfactory quality (high scores on all three criteria), while most PRPs were acceptable (Table 1). Overall, feasibility was good, but innovation was low, and relevance required strengthening.

Table 1. Assessment of the quality of the corrective action plans (PRPs) developed following the monitoring of activities for the second semester of 2024

Health center	Availability and display	Relevance	Innovation	Feasibility	Overall quality of the PRP
Health center 1	Yes	0%	100%	100%	Acceptable
Health center 2	Yes	0%	100%	100%	Acceptable
Health center 3	Yes	50%	50%	100%	Acceptable
Health center 4	Yes	100%	100%	100%	Satisfactory
Health center 5	Yes	0%	0%	100%	Acceptable
Health center 6	Yes	NA	NA	NA	NA
Health center 7	Yes	66%	33%	100%	Acceptable
Health center 8	No	ND	ND	ND	ND
Health center 9	Yes	NA	NA	NA	NA
Health center 10	Yes	50%	50%	100%	Acceptable
Health center 11	Yes	66%	66%	100%	Acceptable

3.1.5. Implementation of PRP actions

Implementation levels varied considerably: 36.36% of health centers had completed 100% of actions; others displayed intermediate (66%) or low (33%) implementation levels (Table 2). Common actions included engaging community health workers for mobilization, systematic searching of child health cards, and improved stock management. Several health post heads reported undocumented implementation, underscoring the need for formal follow-up tools.

"…lack of follow-up… another activity carried out with no proof…" (Health post head)

3.1.6. Follow-up mechanisms for PRP implementation

PRP follow-up occurred during meetings in 45.45% of health centers. No standardized documentation system was identified. Two centers reported having no formal follow-up mechanism (Table 2). At the commune/health zone level, few structured actions were observed. Although commune-level CODIR meetings discussed performance and planned corrective measures, PRP follow-up was not formally included on the agenda. Local managers reported being unaware that such follow-up was expected within the monitoring framework.

> *"Since the removal of incentives… commitment has decreased… and I didn't know that follow-up was my responsibility." (Health post head)*

Table 2. Main findings on recommendations, follow-up, and the implementation rates of corrective action plans (PRP)

Health center	Availability of a follow-up mechanism for PRP implementation			PRP implementation level
	Health center level	Commune level	Health zone level	
Health center 1	Yes	No	No	83%
Health center 2	Yes	No	No	100%
Health center 3	No	No	No	100%
Health center 4	Yes	No	No	NA
Health center 5	Yes	No	No	100%
Health center 6	Yes	No	No	NA
Health center 7	Yes	No	No	33%
Health center 8	Yes	No	No	100%
Health center 9	Yes	No	Yes	NA
Health center 10	No	No	No	50%
Health center 11	Yes	No	No	66%

3.1.7. Perceived contribution of PRPs to performance

In 81.82% of health centers, managers estimated that implementation of PRP actions improved indicators (better input management, reduced duplicate cards, intensified outreach strategies, increased coverage of targets).

> *"…it strengthens systematic retrieval of child health cards… centralization at the pharmacy… improved data quality and follow-up."* (Health post head)

3.2. Discussion

This study analyses the implementation of the semi-annual monitoring of vaccination activities in Benin, confirms previous observations, and identifies critical gaps and challenges in the cycle of generating and judiciously using evidence for action.

3.2.1. Strength of the monitoring model and data quality

Semi-annual monitoring, routinely carried out in health facilities for nearly three decades, is formally and robustly established in Benin, supported by normative, regulatory, and even cultural dynamics, as well as mimetic or coercive rationalities [9]. Although solid, the monitoring system must be supported by a surveillance mechanism to ensure functional ownership and generate the expected results [9].

Typical of health information systems in low- and middle-income countries, the contrast observed between, on the one hand, the high availability of inputs and universal accessibility of services, and, on the other hand, wide fluctuations in utilization, continuity, and quality, as well as the recurrence of over-coverage rates (>100%), confirms the need for continuous support [4], [10]-[13]. Priority should therefore be given to strengthening the monitoring system to ensure its effective capacity to address recurrent problems in vaccination data, which often disrupt decision-making and programme action in many countries [14].

The introduction of regular audit and control tools, ensuring verification of completeness and consistency, could improve data reliability and their use for decision-making [11], [15], [16]. However, such improvements can only be sustained if health workers are consistently motivated and trained in data management [17].

3.2.2. Data analysis and use

The comparative review of performance between 2023 and 2024 highlights a stable and optimal performance in terms of inputs and accessibility, alongside a progressive improvement in utilization,

continuity, and quality, particularly in centers where overperformance ('super rate') was observed. These findings underscore the importance of semi-annual monitoring, which enables the identification of bottlenecks and guides operational adjustments.

However, the assessment of the monitoring process shows that health centers carry out data collection and technical calculation tasks easily and diligently, yet perform very little in-depth analysis and planning (9.09%). This finding is corroborated by self-assessments showing that staff feel more capable and competent with technical tasks than with bottleneck analysis and corrective planning. This lack of analytical capacity constitutes a major barrier to establishing routine practices of data analysis and use for local decision-making [18]. Digitalization, whose partial pilot was satisfactory in one health zone, could serve as a Trojan horse to reduce workload and improve data analysis and use [19].

3.2.3. Quality and use of problem resolution plans (PRPs)

In addition to the low production of PRPs during self-monitoring (9.09%), the variable quality of available PRPs reflects low levels of data use [4]. This mirrors persistent operational challenges in microplanning and the limited local capacity for data use [18]. Findings of moderately relevant actions, low innovation, and insufficient documentation of follow-up align with analyses and recommendations by Gavi [7] and Scobie *et al*. [20]. These highlight that improving data use requires harmonised tools, robust technical support, clear delineation of responsibilities, institutionalised feedback loops, and integration of regular monitoring mechanisms (dashboards, task assignment, and timelines) within coordination bodies. Establishing a complete decision cycle, coupled with optimal digitalization of the data management system, is a key factor in sustainably improving vaccination performance [1], [17], [20], [21].

3.2.4. Community participation in data use

The insufficient involvement of COGECS members in monitoring activities, especially during feedback sessions, constitutes a major weakness, as structured community engagement supports vaccination demand generation, strengthens transparency, and fosters trust in the health system [22]. Integrating community representatives into feedback activities could, through a social accountability approach, strengthen ownership of the monitoring process and promote their active involvement in decision-making and implementation of action plans and recommendations [22].

3.2.5. Contribution to performance and programmatic implications

The positive perception of the impact of PRPs and data use on vaccination indicators (81.82%) is consistent with findings by Mafigiri *et al*. [18], who emphasised the important role of microplans in identifying and addressing community health problems and in improving service delivery [18], [23].

Several programmatic priorities emerge from these findings and analyses:

i) Simplification and standardization of the process, particularly the self-monitoring and PRP follow-up phases, through formalization and digitalization of tools and procedures [1], [19], [24].
ii) Strengthening community engagement across all phases and enhancing participatory accountability through a functional PRP follow-up mechanism integrated into coordination platforms and supported by harmonized and intelligent tools [17], [20], [22], [25].
iii) Promoting an effective and innovative continuous capacity-building system, based on formative supervision, mentorship, experiential learning, and collaborative problem-solving [18], [26]-[28].

These recommendations align with international strategies aimed at improving data use for decision-making [7], [19], [20].

4. CONCLUSION

This study confirms that Benin's semi-annual vaccination monitoring system is functionally established, with optimal input availability and service accessibility. However, critical gaps persist: only 9.09% of health centers developed a PRP during self-monitoring; innovation was limited, follow-up documentation was insufficient, and community participation was irregular. No standardized follow-up mechanism exists at the district level. Despite these limitations, 81.82% of centers reported improved performance following PRP implementation, revealing untapped potential. Technical capacity for data collection does not automatically translate into analytical capacity for decision-making.

Three priorities emerge: accelerating digitalization of monitoring tools; institutionalising PRP follow-up within existing coordination platforms with clear accountability; and strengthening community participation through social accountability approaches. These investments are essential to transform monitoring from a compliance exercise into a genuine driver of continuous quality improvement in vaccination services.

ACKNOWLEDGMENTS

The authors thank Gavi, the AEDES–IRSP-CAQ–Ministry of Health consortium, staff of the DDS, health zones and health centers, members of the Steering Committee, and IRSP and AEDES personnel who contributed to the implementation of this study.

FUNDING INFORMATION

This study received financial support from Gavi and technical support from experts of the Ministry of Health, IRSP, and AEDES.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Paraïso														

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The study adhered to ethical principles for health research. The protocol was approved by the institutional committee of scientists and research ethics experts at IRSP. Administrative authorisations were obtained from the Ministry of Health and participating health zones.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [LS], upon reasonable request.

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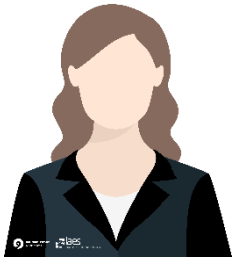

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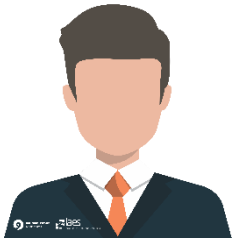

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