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Post-introduction Monitoring Of The Measles-Rubella Vaccine in Kebbi State, Nigeria: Lessons Learned

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ABSTRACT

A crucial tactic for hastening the eradication of measles and controlling rubella, especially in low- and middle-income nations with ongoing transmission, is the inclusion of the Measles Rubella (MR) vaccine in national immunization schedules. Phased supplemental immunization efforts (SIAs) and routine immunization integration were used in Nigeria to introduce the MR vaccine. In order to document implementation performance, identify operational gaps, and distil lessons learned to guide future campaigns, this study presents the results of the Post-Introduction Monitoring (PIM) of the MR vaccine carried out during the October 2025 Integrated Measles-Rubella-Polio (MR-P) campaign in Kebbi State, northwest Nigeria. Administrative tally data, digital supervision checklists, Lot Quality Assurance Sampling (LQAS), Global Tracking System (GTS) settlement reach analysis, inside and outside household monitoring, adverse events following immunization (AEFI) surveillance, and non-compliance resolution data were all used in this mixed-methods observational design. The lessons gained were informed by qualitative insights via supervision reports and review meetings, while quantitative data were triangulated across sources to evaluate coverage, equity, safety, and quality of execution. During the campaign, MR vaccinations were administered to 94% of eligible children (2,443,583/2,597,924), with a high settlement reach (93%) across 21 local government areas (LGAs), including 85% of settlements with compromised security. In participating LGAs, digital tracking via the Fionet application reached 100% adoption, improving real-time accountability. 17 out of 21 LGAs fulfilled the ≥90% coverage requirement for both MR and nOPV2 vaccinations, according to LQAS data. There were 1,013 recorded AEFI cases, most of which were not serious, suggesting that surveillance measures were working. Insecurity, sporadic shortages of vaccines, sociocultural motivated non-compliance, and inconsistent LGA leadership involvement were among the main obstacles. The PIM results show that even in unsafe and difficult-to-reach locations, high MR coverage may be attained by integrated digital monitoring, robust community involvement, and methodical supervision. Kebbi State's lessons highlight the significance of early stakeholder involvement, improved security coordination, and ongoing capacity building to maintain Nigeria's progress toward measles and rubella elimination.

Keywords: Measles-Rubella vaccine; post-introduction monitoring; Supplemental Immunization Activities; Kebbi State; Nigeria

1. INTRODUCTION

Despite the availability of a safe, efficient, and reasonably priced vaccine, measles continues to be one of the major causes of vaccine-preventable childhood morbidity and mortality worldwide [1]. Measles outbreaks still happen, especially in nations with weak health systems, inadequate routine immunization coverage, and complicated humanitarian crises [2]. The World Health Organization (WHO) estimates that vaccination prevented over 57 million deaths globally between 2000 and 2022. Although rubella is frequently mild in children, it offers serious concerns during pregnancy and can result in congenital rubella syndrome (CRS), which is linked to long-term problems such congenital heart disease, cataracts, and deafness. The WHO African Region adopted the objective of measles elimination and rubella control in response to the global burden of measles and rubella, and it encouraged member states to incorporate the combination measles–rubella (MR) vaccine into their national immunization schedules [3]. Nigeria, which has a disproportionately high measles burden in sub-Saharan Africa, started the MR vaccine's progressive introduction through national supplemental immunization activities (SIAs) and then integrated it into regular immunization programs. With ramifications for program delivery, surveillance, logistics, and community participation, the introduction of the MR vaccine signifies a strategic change from measles-only immunization to a dual-disease prevention approach [4].

Northwest Nigeria's Kebbi State offers a special operating setting for the introduction of the MR vaccine. There are 21 local government areas (LGAs) in the state, including riverine, urban, rural, and difficult-to-reach settlements. Delivery of immunization services is complicated by enduring issues such insecurity, population displacement, cross-border migration, societal opposition to vaccination, and limitations in the health system. The state's prior SIAs have revealed problems with non-compliance, supervision gaps, and settlement accessibility, highlighting the necessity of strong monitoring systems. A crucial part of vaccine introduction is post-introduction monitoring (PIM), which is intended to evaluate whether recently introduced vaccines are being administered in accordance with national recommendations, safely, and fairly. The evidence on coverage, cold chain performance, health worker preparedness, adverse event surveillance, data quality, and community acceptance are all provided by the PIM. PIM also provides a forum for identifying operational bottlenecks and best practices in the context of SIAs, which can help guide routine vaccination strengthening and subsequent rounds [5].

The Kebbi State Integrated Measles-Rubella-Polio (MR-P) campaign in October 2025 provided a chance to perform a thorough PIM using a variety of data sources, such as digital supervision tools, settlement tracking systems, and independent monitoring. The results of the PIM for the MR vaccination in Kebbi State are presented in this report, with an emphasis on lessons learned, equity of reach, safety monitoring, and implementation performance. This study intends to add to the body of information supporting the introduction of the MR vaccination in Nigeria and other high-risk settings throughout sub-Saharan Africa by methodically recording achievements and difficulties [6].

2. METHODS

2.1 Study Design

This study used a cross-sectional, mixed-methods post-introduction monitoring (PIM) design that was carried out in Kebbi State, Nigeria, during and right after the integrated measles-rubella-polio (MR-P) Supplemental Immunization Activity (SIA) in October 2025. The PIM framework integrated qualitative synthesis of supervisory observations and review meeting reports with quantitative analysis of administrative and monitoring datasets. In both routine vaccination and SIA situations, the strategy is in line with WHO-recommended approaches for vaccine post-introduction evaluation and monitoring [7].

2.2 Study Area

Aleiro, Arewa Dandi, Argungu, Augie, Bagudo, Birnin Kebbi, Bunza, Dandi, Fakai, Gwandu, Jega, Kalgo, Koko/Besse, Maiyama, Ngaski, Sakaba, Shanga, Suru, Wasagu/Danko, Yauri, and Zuru are the 21 local government areas (LGAs) that make up Kebbi State, which is situated in northwest Nigeria. Urban areas, isolated rural settlements, riverine communities, and security-compromised areas impacted by banditry and population displacement are all included in the state. Immunization delivery faces a range of

access, supervision intensity, and community participation issues due to these various geographic and security contexts.

2.3 Description of the Integrated MR-P Campaign

In addition to delivering the human papillomavirus (HPV) vaccine to eligible girls in specific LGAs, the October 2025 Integrated MR-P campaign targeted children aged 9–59 months who were eligible for the MR vaccine and children eligible for the novel oral polio vaccine type 2 (nOPV2). House-to-house (H2H) teams, permanent and temporary fixed posts, school-based immunization, and outreach to special populations and sites of interest (POIs) such markets, car parks, nomadic settlements, and insecure regions were among the vaccination tactics [8].The State Primary Health Care Development Agency (SPHCDA), provided technical and operational support for the multi-day campaign, which was organized by the Gates Foundation/Mcking, Kebbi State Emergency Operations Centre (EOC), National Primary Health Care Development Agency (NPHCDA), World Health Organization (WHO), United Nations Children's Fund (UNICEF), Solina Center for International Development and Research (SCIDaR), eHealth Africa (eHA), and civil society partners. Daily evening review meetings (ERMs) at state and LGA levels were used to track performance, identify gaps, and implement corrective actions in real time [9-20].

2.4 Data Sources

Multiple data sources were triangulated to assess coverage, quality, safety, and equity of MR vaccine delivery:

Administrative Tally Sheet Data: Daily vaccination tallies aggregated at ward, LGA, and state levels were used to estimate administrative coverage for MR, nOPV2, and HPV vaccines.

Digital Supervision and Monitoring (ODK): Integrated SIA implementation checklists were deployed using Open Data Kit (ODK) by senior supervisors and independent monitors from WHO, UNICEF, and partner agencies to assess team composition, vaccine availability, injection safety, documentation, and adherence to operational guidelines.

Global Tracking System (GTS) and e-Tally: Settlement reach and accessibility were monitored using GTS and electronic tally systems to determine the proportion of planned settlements reached, including security-compromised settlements.

Fionet Application: Digital vaccination tracking using the Fionet application was implemented in selected LGAs to monitor team movement, enumerate eligible children, and link vaccination events to geographic locations in real time.

Inside and Outside Household Monitoring: Independent monitors conducted in-process monitoring of vaccinated children inside households and at public locations to verify finger marking and vaccination status.

Lot Quality Assurance Sampling (LQAS): Post-campaign LQAS surveys were conducted across all 21 LGAs to assess whether MR and nOPV2 vaccination coverage met the ≥90% performance threshold.

Adverse Events Following Immunization (AEFI) Surveillance: AEFI data were collected through routine reporting forms and campaign-specific surveillance mechanisms, including classification of serious and non-serious events.

Non-Compliance and Missed Children Tracking: Data from redo, non-compliance (NC), and child-absent resolution teams were analyzed to assess the effectiveness of follow-up strategies.

2.5 Study Variables and Indicators

Administrative vaccination coverage, settlement reach, team readiness and supervision quality, vaccine availability and waste rates, percentage of children vaccinated both inside and outside of households, LQAS pass/fail status by LGA, number and type of AEFI reported, and resolution rates for non-compliance and child-absent cases were among the indicators evaluated [21-22].

2.6 Data Analysis

The frequencies, proportions, and coverage percentages at the state and LGA levels were used in a descriptive analysis of the quantitative data. To confirm conclusions and detect differences between administrative and independent monitoring data, results from several data sources were triangulated. To

contextualize quantitative results and enlighten the lessons gained, the qualitative data from field observations, ERM reports, and supervisory narratives was thematically synthesized [23].

2.7 Ethical Considerations

The PIM made use of regular programmatic data gathered for vaccination program monitoring and public health surveillance. The analysis did not contain any personal identifiers. According to national norms for secondary analysis of anonymized public health program data, ethical approval was therefore not necessary. The Kebbi State Emergency Operations Center and pertinent implementing partners granted permission to utilize the data [24].

3. RESULTS

3.1 Overall MR Vaccination Coverage

Out of an anticipated target population of 2,597,924 children aged 9–59 months, 2,443,583 eligible children received the measles–rubella (MR) vaccine during the October 2025 Integrated MR-P campaign, yielding an overall administrative coverage of 94%. Although coverage percentages varied among LGAs, they were consistently high in most of them. A number of LGAs achieved coverage of 100% or higher, which is indicative of population migration, catch-up of children who were previously missed, and conservative goal estimations in specific areas. Equitable reach across genders was demonstrated by the sex-disaggregated study, which revealed that 54% of vaccinated children were female and 46% were male. Administrative data triangulated with inside and outside household monitoring suggested that high reported coverage was supported by field verification, with the majority of sampled children showing evidence of vaccination through finger marking [25-30].

3.2 Settlement Reach and Accessibility

During the campaign, 12,749 (93%) of the 13,773 intended settlements in Kebbi State were successfully reached. The majority of LGAs, particularly those with challenging terrain and scattered rural populations, have a high settlement reach. Significantly, 2,519 (85%) of the 2,952 settlements categorized as security-compromised were reached, proving the efficacy of adaptive operational techniques, such utilizing particular outreach modes, interacting with local leaders, and deploying teams in a flexible manner. The accuracy of settlement reach reporting was verified by the Global Tracking System (GTS) and e-Tally triangulation, which allowed for quick remedial action at daily review meetings and nearly real-time visibility of operational progress. The majority of unreached settlements were found in regions with severe instability or physical inaccessibility as a result of flooding and inadequate road systems [31–35].

3.3 Supervision Coverage and Process Quality

Throughout the program, 17,080 submissions for digital supervision were tracked using the ODK-based Integrated SIA implementation checklist. Strong partner involvement in quality assurance is demonstrated by the fact that WHO staff made the bulk of submissions, followed by state and partner supervisors. House-to-house teams had more supervision coverage than both permanent and temporary fixed positions. Senior supervisors' results showed that team readiness and adherence to operating requirements were generally strong. 99% of the teams that were observed had access to daily implementation plans, and 98% of them had a complete team composition. The majority of locations had sufficient vaccine availability; however, at the time of the visit, 2% of teams lacked MR vaccines and 7% of teams lacked nOPV2 vaccines, indicating sporadic supply chain gaps. The HPV vaccination shortages were more severe, with 11% of teams without the vaccine, especially in some LGAs. There were few reports of AD syringes, watery ice packs, and injection safety and cold chain performance which are generally excellent. However, 3–5% of teams lacked banners, mobilizers, or an ideal site layout, which could have an impact on community awareness and service flow. This indicates deficiencies in visibility and site management.

3.4 Adverse Events Following Immunization (AEFI)

A total of 1,013 AEFI cases 1 serious and 1,012 non-serious events were found throughout the 21 LGAs by AEFI surveillance during the campaign. Headache (46%), fever below 38°C (29%), and muscle soreness (7%) were the most frequently reported responses. Functional surveillance and referral systems are suggested by the low percentage of serious AEFI and the timely reporting of cases. Despite these

advantages, 4% of supervised teams did not have AEFI reporting forms, which highlights the need for more standardization and readiness. Although it also highlights the significance of ongoing communication to manage caregiver expectations and lessen concern associated to mild post-vaccination reactions, the rising volume of reported non-serious AEFI represents increased knowledge among vaccinators and caregivers.

3.5 Non-Compliance and Missed Children Resolution

A significant part of the campaign's equity strategy was the tracking of non-compliance and child absences. Through focused follow-up actions, 97% (14,516) of the 15,012 non-compliance cases were successfully addressed and vaccinated. Religious convictions (12%), perceived lack of need for vaccination (8%), and no explanation (68%) were the main causes of initial non-compliance. 17,109 eligible children who were absent during initial visits were found using the child-absence tracking. Of these, 99% (16,954) were revisited and vaccinated, proving the value of methodical redo techniques and excellent collaboration between immunization workers and community organizations. Most effective resolutions came from Non-Compliance Resolution Teams (NCRT), which were backed by local influencers and civil society organizations.

3.6 Inside and Outside Household Monitoring Findings

High in-process coverage was demonstrated by inside-household monitoring data from 16,020 sampled children, which revealed that 95% had received the MR vaccination and 93% had received nOPV2. Among the children in the sample, a few of LGAs, including as Dandi, Fakai, Ngaski, Yauri, and Zuru, attained 100% coverage for both vaccines. Sakaba LGA was designated as a priority location for increased follow-up because to its relatively lower MR coverage of 77%. These results were confirmed by outside household monitoring, which showed that 97% of the youngsters in the sample had vaccination finger marks. In the majority of cases, coverage across LGAs over 90%, with many LGAs attaining universal coverage among children in the sample. Confidence in stated administrative coverage is strengthened by the consistency of both internal and external monitoring.

3.7 Lot Quality Assurance Sampling (LQAS) Results

To evaluate vaccination performance independently, post-campaign LQAS questionnaires were carried out in each of the 21 LGAs. Four LGAs recorded three or more missed children and were categorized as not reaching the performance criteria for the MR vaccination, whilst 17 LGAs met the ≥90% coverage requirement. For nOPV2, similar outcomes were seen, with 17 LGAs meeting the LQAS requirements and 4 failing. According to an analysis of LQAS data, non-compliance and child absence were the main causes of missed children, followed by unvisited homes. With the majority of LGAs reporting awareness levels between 91% and 97%, caregiver awareness of the program was typically high. The gender distribution among sampled children was balanced, and the majority had received three or more doses of OPV and pentavalent vaccines, suggesting relatively strong routine immunization foundations in most LGAs.

4. DISCUSSION

The measles–rubella (MR) vaccine's post-introduction monitoring (PIM) in Kebbi State offers thorough proof that integrated supplemental immunization activities (SIAs) can achieve high vaccination coverage and equitable reach, even in environments marked by insecurity, population mobility, and limitations in the health system. In comparison to national and subnational MR SIA outcomes reported in Nigeria and other countries in the WHO African Region, where post-campaign coverage has ranged between 85% and 95%, the overall MR administrative coverage of 94% observed during the October 2025 Integrated MR–P campaign is favourable [36].

4.1 Interpretation of Coverage and Equity Outcomes

The success of combining several delivery tactics, such as house-to-house vaccination, permanent and temporary fixed posts, school-based initiatives, and outreach to particular populations, is demonstrated by the high MR coverage attained in Kebbi State. Crucially, the validity of reported performance is strengthened by the consistency of LQAS findings, administrative coverage, and both within and outside home monitoring. In Nigeria and other places, similar triangulation techniques have been suggested to

lessen the constraints of administrative data, especially in situations when population denominators are unclear. Given the known difficulties in providing immunization services in northern Nigeria's conflict-affected areas, reaching 85% of security-compromised villages is a noteworthy accomplishment. This highlights the operational importance of adaptive strategies like using special vaccination points, interacting with community gatekeepers, and deploying teams in a flexible manner. The Kebbi example shows that good immunization performance is not always impeded by insecurity when proper planning and coordination are in place.

4.2 Role of Digital Tools in Campaign Quality

Campaign monitoring and accountability were greatly improved by the incorporation of digital tools, such as the Fionet application, e-Tally, the Global Tracking System (GTS), and ODK-based supervisory checklists. The quick discovery of gaps in settlement reach, team preparedness, and vaccination supply made possible by real-time data access allowed for the implementation of corrective measures through daily review sessions. Evidence from sub-Saharan African contexts and other Nigerian SIAs indicates that digital supervision tools enhance program responsiveness, decrease reporting delays, and improve data completeness. Even in settings with limited resources, digital vaccination monitoring can be implemented at scale, as demonstrated by the 100% usage of the Fionet application in participating LGAs. Beyond immediate campaign monitoring, such platforms offer opportunities for longitudinal tracking of missed children and integration with routine immunization systems, supporting broader health system strengthening goals [37-40].

4.3 Safety Monitoring and Community Confidence

The campaign's AEFI surveillance results show a working safety monitoring system with prompt reporting of mostly non-serious incidents. The low rate of severe AEFI supports the MR vaccine's acceptability for widespread usage and is consistent with international data on its safety [41–45]. However, the finding that a small percentage of teams lacked AEFI reporting tools highlights the necessity of maintaining focus on standardization and readiness, especially as Nigeria moves from campaign-based MR delivery to routine immunization. Maintaining caregiver confidence and limiting the escalation of vaccine reluctance depend on open communication about anticipated moderate adverse responses. Proactive risk communication can greatly reduce non-compliance and misinformation, particularly in areas with strong religious and cultural influence, according to experiences from other African MR introductions [46].

4.4 Addressing Non-Compliance and Missed Children

The significance of specialized follow-up procedures, including Non-Compliance Resolution Teams (NCRT), is shown by Kebbi State's high-resolution rates for non-compliance (97%) and child-absent cases (99%). Previous measles and polio campaigns in Nigeria have shown that the main reasons for initial refusal include lack of perceived necessity, religious views, and unclear reasons. It has been repeatedly demonstrated that increased acceptance and uptake can be achieved through focused community discourse, the participation of reputable local leaders, and the involvement of civil society organizations. However, the recurrence of lost children in a subset of LGAs, as determined by LQAS, emphasizes the necessity of a persistent focus on team performance and microplanning quality. The finding that houses not visited were the leading cause of missed children suggests operational rather than attitudinal barriers, emphasizing the value of strengthened supervision and accountability [47].

4.5 Implications for Measles and Rubella Elimination

The Kebbi State PIM results add to the increasing amount of data that, when combined with robust monitoring and community participation frameworks, integrated SIAs can hasten the eradication of measles and control of rubella. The strategic significance of MR SIAs as a bridge toward more robust routine immunization programs is supported by the convergence of high MR coverage, functional safety surveillance, and efficient resolution of missed children. Lessons from Kebbi State highlight the need for ongoing investment in digital health technologies, security-sensitive planning, and local leadership participation as Nigeria moves forward with its measles elimination strategy. As the nation works to maintain high MR coverage through regular services and stop resurgence in high-risk groups, these components will become more crucial [48].

5. Lessons Learned

The post-introduction surveillance of the MR vaccination in Kebbi State revealed several important lessons. In order to improve community acceptance, facilitate access, and address non-compliance, early and ongoing involvement with traditional, religious, and political leaders was essential. Proactive involvement with parents and guardians was made possible by the prompt delivery of advocacy letters to schools and religious organizations, which decreased resistance throughout implementation. The nighttime review sessions and daily refresher courses provide efficient venues for addressing new issues, reiterating best practices, and carrying out remedial measures in real time. At the state and local government levels, the implementation of standardized digital supervisory tools promoted evidence-based decision-making and improved accountability. The campaign also highlighted the importance of security coordination and risk mitigation strategies for protecting frontline health workers. The need for improved cooperation with security agencies, insurance systems, and psychosocial support for impacted staff is highlighted by incidents involving injuries and fatalities among vaccinators.

6. Policy and Programmatic Implications

The results of this PIM have a number of ramifications for Nigerian immunization practices and policy. First, when accompanied by careful planning and monitoring, integrated delivery of MR with other antigens can increase coverage and efficiency [49-50]. Second, in order to improve data quality and responsiveness across SIAs and regular vaccination, it should be a top priority to scale up digital tracking and oversight technologies. Third, accessing underrepresented people requires consistent investment in non-compliance resolution methods and community engagement. Lastly, protecting healthcare personnel and guaranteeing the continuation of vaccination services in unsafe environments depend on managing security concerns through coordinated planning and support mechanisms.

7. Limitations

There are a number of limitations to this study, including the possibility that population migration across LGAs and inaccurate population denominators could affect administrative coverage estimates. This worry is lessened by triangulation with independent monitoring and LQAS, although there is still some degree of ambiguity. Furthermore, the PIM's cross-sectional design restricts the ability to draw conclusions about the causes of certain interventions and results. The majority of the qualitative insights came from review sessions and supervisory reports, which could be biased. Future research using structured qualitative interviews with frontline staff and caregivers may offer a more thorough knowledge of the contextual elements affecting campaign effectiveness.

8. CONCLUSION

The measles-rubella vaccine's post-introduction monitoring in Kebbi State shows that even in difficult operational circumstances, well-coordinated integrated SIAs may accomplish high coverage, equitable reach, and efficient safety surveillance. In Nigeria and similar contexts throughout sub-Saharan Africa, the lessons learnt from this experience offer important direction for improving MR vaccine administration and increasing efforts to eradicate measles and rubella.

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