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# Missed Opportunities for Vaccination: A Descriptive Study of Primary and Secondary Health Facilities in Bayelsa State, Nigeria

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***Abstract***

*Immunization is one of the most effective public health interventions aimed at reducing child morbidity and mortality yet missed opportunities for vaccination (MOV) and systemic barriers continue to undermine immunization efforts in Nigeria and Bayelsa state in particular. This study assessed the prevalence, determinants, and systemic challenges associated with routine immunization uptake in Bayelsa State. A descriptive cross-sectional design was employed, involving 354 caregivers of children under five and 50 health workers across selected facilities. Data was collected using structured questionnaires, facility checklists, and interviews. Quantitative data were analyzed using SPSS version 26 with descriptive statistics, Chi-square tests, and logistic regression. Qualitative responses were thematically analyzed. Findings revealed that 34.5% of children experienced MOV, with measles (44.3%) and oral polio vaccine (30.3%) being the most frequently missed. Systemic challenges included vaccine stockouts (54%), cold chain failures (36%), and poor service integration (58%). Logistic regression showed that stockouts (AOR = 0.42, $p < 0.001$), cold chain breakdown (AOR = 0.58, $p = 0.030$), caregiver knowledge of immunization schedules (AOR = 2.11, $p = 0.005$), and service integration (AOR = 1.89, $p = 0.022$) significantly influenced adherence. This study concludes that systemic factors outweigh caregiver-level determinants in explaining missed opportunities. Addressing supply chain gaps, strengthening cold chain infrastructure, and services' integration are crucial steps toward reducing missed opportunities and improving vaccination coverage in Nigeria.*

***Keywords****: Bayelsa State, Cold Chain, Immunization Barriers, Missed Opportunities for Vaccination, Nigeria, Routine Immunization, Vaccine Stockout.*

## Introduction

Immunization is globally recognized as one of the most cost-effective public health interventions for reducing childhood morbidity and mortality [1]. The World Health Organization (WHO) estimates that vaccination prevents between 2 to 3 million deaths each year from diseases such as diphtheria, tetanus, pertussis, influenza, and measles [2]. Recent WHO/UNICEF updates provide progress data and highlight persistent gaps in global immunization coverage which contextualize the national challenges reported here [3]. Despite this progress, many low- and middle-income countries, including Nigeria, continue to struggle with achieving optimal vaccination coverage [4]. According to UNICEF, child health and well-being during early development is significantly affected by access to essential health services, including immunization [5].

The Nigeria Demographic and Health Survey (DHS) reported persistent coverage gaps in routine immunization nationally, with regional disparities that align with the findings of this study. Nigeria accounts for one of the

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largest burdens of unimmunized children worldwide, contributing significantly to global child mortality [6]. Although the Expanded Programme on Immunization (EPI) has been in place since 1979, challenges such as vaccine stockouts, weak supply chains, and limited cold chain infrastructure undermine service delivery [7]. Recent regional analyses also identify health system factors — staffing, outreach planning and supply management — as major drivers of low coverage in Nigerian states [8]. Socio-cultural barriers, caregiver misconceptions, and geographical inaccessibility further complicate uptake [9, 10]. National analyses indicate that socioeconomic and community-level determinants strongly influence uptake patterns and must be considered alongside system factors [11].

Missed opportunities for vaccination (MOV) are particularly concerning. A missed opportunity is defined as any contact with health services by an eligible child who does not receive a due vaccine [12]. Donadel et al. provide a standardized field methodology for measuring MOV in facility surveys and support the operational definition used in this study [13]. Such missed opportunities remain widespread in Nigeria, with reports suggesting that more than one-third of facility visits by children result in MOV [14]. This indicates that even when caregivers present their children for care, systemic and provider-level lapses prevent vaccine administration [15].

In Bayelsa State, which is predominantly riverine, the immunization system is further challenged by difficult terrain, poor transportation networks, and unreliable power supply that affects cold chain maintenance [15]. Similar South–South Nigeria studies have documented comparable barriers to routine immunization in mixed-methods analyses, reinforcing the local relevance of these system constraints [16, 17]. This contributes to frequent vaccine stockouts, service interruptions, and ultimately, poor immunization outcomes.

### Problem Statement

Despite national and global commitments to universal immunization, Bayelsa State continues to record suboptimal coverage. GAVI Health Systems Strengthening (HSS2) grant was used as a stop gap to enhance human resource for health especially routine immunization service providers as well as conduct of planned outreach sessions and cold chain maintenance amongst others. Missed opportunities and systemic barriers contribute significantly to incomplete vaccination, leaving children at risk of preventable diseases. There is a lack of sufficient local evidence on the prevalence and determinants of MOV, particularly in riverine states, which makes this study critical.

### Objectives of the Study

The specific objectives were to:

1. Determine the socio-demographic characteristics of caregivers and their association with immunization adherence.
2. Identify the prevalence of missed opportunities for vaccination.
3. Identify the causes of missed opportunities for vaccination.

### Novelty of the Study

This study is novel because it provides evidence from Bayelsa State, where riverine challenges make immunization delivery unique compared to other Nigerian states. By combining quantitative and qualitative data, it highlights systemic failures that go beyond caregiver behavior, emphasizing the urgent need for health system strengthening.

## Materials and Methods

### Study Design

This study adopted a descriptive cross-sectional design utilizing both quantitative and

qualitative approaches. The mixed-methods design allowed for capturing numerical patterns on immunization coverage while also gaining deeper insights into missed opportunities for vaccinations from the perspectives of caregivers and health workers.

## Study Area

The study was conducted in Bayelsa State, Nigeria**,** located in the Niger Delta region. The state is predominantly riverine, with limited road networks and poor transport infrastructure, making health service delivery particularly challenging. The difficult terrain and frequent flooding pose barriers to cold chain maintenance and vaccine distribution, increasing the risk of stockouts and missed opportunities for vaccination.

## Study Population

The study population comprised:

1. Caregivers of children under five years who accessed services at selected health facilities.
2. Health workers (nurses, midwives, community health extension workers, and immunization officers) involved in vaccination services.

Sample Size Determination

The minimum sample size was calculated using Cochran's formula for cross-sectional studies [18]

$$n = \frac{Z^2 \times P \times (1 - P)}{d^2}$$

n = required sample size

Z-value corresponding to the desired confidence level (e.g., 1.96 for 95% confidence level)

P = estimated prevalence of missed opportunities for immunization. Based on previous studies in similar settings, an assumed prevalence of 30% was used (WHO, 2017).

d = margin of error, set at 5% (0.05)

Substituting these values:

$$n = \frac{1.96^2 \times 0.30 \times (1 - 0.30)}{0.05^2} = 322$$

This yielded a minimum of 323 participants. After adjusting for non-response, the final sample was 354 caregivers and additional 50 health workers were purposively sampled for qualitative interviews.

## Sampling Technique

A multistage sampling technique was employed:

- Stage 1: four Local Government Areas (LGAs) were selected.
- Stage 2: Within each LGA, one primary and one secondary health facility were randomly selected.
- Stage 3: Caregivers were recruited consecutively at immunization clinics until the sample size was reached.

## Data Collection Instruments

1. Structured questionnaire for caregivers – covering socio-demographic information, knowledge, perceptions, and child immunization status.
2. Facility checklist – to assess vaccine availability, cold chain functionality, staffing, and service integration.
3. Key informant interviews with health workers – to explore systemic barriers and service delivery challenges.

## Data Collection Procedure

Trained research assistants administered questionnaires face-to-face with caregivers. Health facility assessments were conducted through direct observation of cold chain equipment and records. Interviews with health workers were conducted in English, audio-recorded, and later transcribed verbatim.

## Data Analysis

- Quantitative data were entered into SPSS version 26. Descriptive statistics (frequencies and percentages) summarized participant characteristics and

immunization adherence. Associations were tested using Chi-square tests. Logistic regression was used to identify predictors of vaccination adherence, with Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) reported.

- Qualitative data were analyzed thematically. Transcripts were coded, and themes were derived regarding caregiver and health worker experiences.

## Ethical Considerations

Written informed consent was obtained from all participants. Anonymity and confidentiality were assured.

## Results

A total of 354 caregivers and 50 health workers participated. Results are presented according to study objectives.

### Socio-demographic Characteristics of Caregivers

The socio-demographic characteristics of caregivers are presented in Table 1.

**Table 1.** Socio-demographic Characteristics of Caregivers n=354

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| Age (years) | | |
| 20 – 29 | 122 | 34.5 |
| 30 – 39 | 158 | 44.6 |
| 40 – 49 | 56 | 15.8 |
| 50 + | 18 | 5.1 |
| Education | | |
| No formal education | 41 | 11.6 |
| Primary | 83 | 23.4 |
| Secondary | 157 | 44.4 |
| Tertiary | 73 | 20.6 |
| Marital status | | |
| Married | 291 | 82.2 |
| Single | 42 | 11.9 |
| Divorced/Widowed | 21 | 5.9 |
| Occupation | | |
| Self-employed | 173 | 48.9 |
| Unemployed | 95 | 26.8 |
| Formally employed | 86 | 24.3 |

Table 1 indicates most caregivers were women aged 30–39 years and married. Nearly two-thirds had at least secondary education, and almost half were self-employed. This demographic profile reflects the typical population responsible for child health decisions in Bayelsa State and shows that many mothers are balancing informal work with childcare.

### Prevalence of Missed Opportunities For Vaccination

Table 2 presents the immunization status of children based on caregiver responses.

**Table 2.** Immunization Status of Children n=354

| Status | n | % |
|---|---|---|
| Fully immunized for age | 232 | 65.5 |
| Not fully immunized for age | 122 | 34.5 |

Two-thirds of children were fully immunized, while one-third had missed at least one vaccine dose as indicated in Table 2 above. This indicates a substantial proportion of children are at risk of vaccine-preventable diseases due to incomplete immunization. Similar multicenter analyses in Nigeria report delays and incomplete vaccination as ongoing challenges to coverage and timeliness [18].

Table 3 shows the types of vaccines most commonly missed among partially vaccinated children.

**Table 3.** Vaccines Missed among Non-compliant Children n=122

| Vaccine | n | % of Partially Vaccinated |
|---|---|---|
| Measles | 54 | 44.3 |
| OPV | 37 | 30.3 |
| BCG | 18 | 14.8 |
| Yellow Fever | 13 | 10.7 |

Measles vaccine was the most missed vaccine (44.3%), followed by OPV (30.3%) as shown in table 3. This suggests that later schedule doses and outreach-dependent vaccines are more vulnerable to being missed, possibly due to stockouts or reduced clinic attendance at those ages.

### Underlying Causes of Missed Opportunities for Vaccination

Table 4 outlines the major causes of missed opportunities for vaccination as reported by caregivers and health workers.

**Table 4.** Underlying Causes of Missed Opportunities for Vaccination (MOV) n=122

| Cause | n | % |
|---|---|---|
| Poor health worker screening | 44 | 36.1 |
| Vaccine stockouts/unavailability | 38 | 31.1 |
| Caregiver-related factors (misconceptions, fear, competing priorities) | 25 | 20.5 |
| Long waiting times/poor scheduling | 15 | 12.3 |
| Total | 122 | 100 |

The most common underlying cause of MOV as indicated in table 4 was poor health worker screening (36.1%), where children visiting facilities for other services were not assessed for their immunization status. Vaccine stockouts and unavailability followed closely (31.1%), underscoring systemic supply challenges. Caregiver-related factors, including misconceptions and fear of side effects, accounted for 20.5% of MOV, while long waiting times and poor scheduling contributed 12.3%. This distribution suggests that although caregiver attitudes matter, the majority of MOV stem from health system deficiencies, particularly in service delivery and vaccine availability.

## Discussion

This study examined the prevalence and determinants of missed opportunities for vaccination (MOV) in Bayelsa State, Nigeria. The findings correspond to the three objectives outlined in the Introduction and provided insight into systemic and caregiver-related factors affecting child immunization.

### Socio-Demographic Characteristics of Caregivers and Immunization adherence

The study revealed that most caregivers were within their reproductive age, married, and had

at least secondary education. However, socio-demographic characteristics such as education level and occupation were not significantly associated with immunization adherence. This finding is consistent with similar studies in Nigeria and Ethiopia, which reported that while caregiver education may influence health knowledge, systemic constraints often outweigh its impact on vaccination uptake [19, 20].

This suggests that even educated caregivers cannot ensure full immunization if vaccines are unavailable or service delivery is inconsistent. Future research should explore whether targeted interventions for less-educated mothers could yield additional gains when systemic barriers are simultaneously addressed. Evidence from Nigeria suggests that strengthened community engagement and participatory approaches improve routine immunization delivery and uptake in similar settings [21].

## Prevalence of Missed Opportunities for Vaccination in Health Facilities

The prevalence of MOV in this study was 34.5%, with measles and oral polio vaccines being the most missed. This aligns with WHO's global review of MOV, which estimated prevalence rates between 25–40% in low- and middle-income countries [22]. Nigerian studies have also reported comparable figures, with MOV ranging from 30% to 43% in different states [23, 24]. For example, facility-based surveys in North-Central Nigeria report MOV rates and system-level contributors that align with our findings [25].

## Causes of Missed Opportunities for Vaccination

The most common underlying cause of MOV was poor health worker screening (36.1%), where children visiting facilities for other services were not assessed for their immunization status. Vaccine stockouts and unavailability followed closely (31.1%), underscoring systemic supply challenges. Caregiver-related factors, including misconceptions and fear of side effects, accounted for 20.5% of MOV. This distribution suggests that although caregiver attitudes matter, the majority of MOV stem from health system deficiencies, particularly in service delivery and vaccine availability. These align with WHO's framework on common causes of MOV, which include health worker knowledge gaps, systemic inefficiencies, and caregiver hesitancy or confusion. From a Health System Strengthening perspective, missed opportunities reflect a failure in service delivery integration, where immunization is not consistently offered across all child health contacts.

The high rate of missed measles vaccination is concerning, as measles remains one of the leading causes of childhood mortality in Nigeria. Regional analyses have shown that missed measles doses substantially increase the risk of outbreaks, underscoring the public health consequences of MOV [26]. This finding highlights the importance of strengthening last-contact opportunities, particularly during health facility visits for non-immunization services. Further studies could examine whether integrating measles vaccination with other outreach services would reduce this gap.

## General Implications and Future Research

This study demonstrates that systemic barriers, rather than caregiver characteristics, are the strongest determinants of missed opportunities for vaccination. The findings reinforce the need for supply chain improvements, cold chain sustainability, and integrated services to strengthen Nigeria's immunization program.

Future research should:

1. Conduct longitudinal studies to assess how systemic improvements affect MOV over time.

2. Evaluate community-based interventions such as outreach clinics and mobile vaccination in riverine regions.
3. Investigate the impact of digital reminders and tracking systems on caregiver adherence.

## Conclusion

This study demonstrated that missed opportunities for vaccination remain a significant challenge in Bayelsa State, with one in three children affected. Systemic barriers such as vaccine stockouts, cold chain failures, and poor service integration were the strongest determinants of incomplete immunization, outweighing caregiver socio-demographic factors.

The findings justify the need for urgent health system strengthening to improve vaccine availability and service delivery. Integrating immunization with maternal and child health services, alongside investment in reliable supply chains and cold chain infrastructure, offers practical solutions. These recommendations are also consistent with the Immunization Agenda 2030 (IA2030) global strategy, which prioritizes equity and system strengthening to close coverage gaps [27].

These insights are useful for policymakers and health managers to design targeted interventions that reduce missed opportunities and improve immunization coverage. Future research should explore sustainable innovations, such as solar-powered cold chain systems and digital reminder tools, to further enhance vaccine uptake in hard-to-reach areas.

## Data Availability

All data generated and analyzed during this study are available from the corresponding author upon reasonable request.

## Authors Contributions

- Joshua Iyeneomi: Study conceptualization, data collection, manuscript drafting, and critical revision.
- Muhammad Abdulrahman: Methodological guidance, data analysis, review of manuscript, and data validation.
- Onyekwere Iwundu Anthony: Technical supervision, literature review support, and manuscript editing.

All authors reviewed and approved the final version of the manuscript.

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## Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this manuscript.

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