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Barriers to Routine Immunization: A Descriptive Study of Secondary and Primary Health Facilities in Bayelsa state, Nigeria

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Abstract

Immunization has remained a cost effective and critical public health intervention aimed at reducing child morbidity and mortality, yet it has continued to face logistics and systemic barriers that undermines its efforts in Nigeria and Bayelsa state in particular. This study assessed the 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. Structured questionnaires, facility checklists, and interviews was used in collecting data. 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. 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 barriers to immunization. Addressing supply chain gaps, strengthening cold chain infrastructure, and services' integration are crucial steps toward reducing immunization barriers and improving vaccination coverage in Nigeria.

Keywords: *Bayelsa State, Barriers, Descriptive Study, Routine Immunization.*

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]. Despite this progress, many low- and middle-income countries, including Nigeria, continue to struggle with achieving optimal vaccine coverage [3].

Nigeria accounts for one of the largest burdens of unimmunized children worldwide, contributing significantly to global child mortality [4]. 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 immunization service delivery [5, 6]. Socio-cultural barriers, caregiver misconceptions, and geographical inaccessibility further complicate uptake [7-10].

The immunization system in Bayelsa State, which is predominantly riverine, is further challenged by difficult terrain, poor transportation networks, and unreliable power supply that affects vaccine supply and effective cold chain management contributing to

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frequent vaccine stockouts, service interruptions, and poor immunization coverages [11, 6, 12].

Problem Statement

Despite national and global commitments to universal immunization, Bayelsa State continues to record suboptimal childhood vaccination coverages. Several factors contribute significantly to un-immunized/under-immunization, leaving children at risk of preventable diseases. The lack of sufficient local evidence on the barriers affecting routine immunization, particularly in riverine states, makes this study critical.

Objectives of the Study

The specific objectives were to:

1. Analyze systemic and logistical barriers affecting routine immunization delivery.
2. Evaluate caregiver knowledge, perceptions, and attitudes toward immunization.
3. Examine the role of service integration in improving immunization coverage.

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 barriers 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

Sample Size Determination

The minimum sample size was calculated using Cochran's formula for cross-sectional studies [13]

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

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 (14).

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 involving three stages 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 systemic barriers, caregiver perceptions, and health worker experiences.

Ethical Approval

This Study was granted full approval by the Bayelsa State Health Research Ethics Committee (BSHREC) with Approval Number: BSHREC/Vol.1/24/04/01.

Written informed consent was obtained from all participants. Caregiver 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

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 above shows that 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.

Systemic and logistical Barriers

Table 2. Barriers Reported by Health Workers n = 50

Barrier	**n**	**%**
Frequent vaccine stockouts	27	54.0
Cold chain failure	18	36.0
Power outages	33	66.0
Inadequate cold chain equipment	14	28.0
Staffing shortages	21	42.0
Lack of integrated services	29	58.0
Irregular transport for outreach	19	38.0

More than half of health workers reported vaccine stockouts, and two-thirds reported power outages affecting storage as shown in table 2 above. These findings indicate major infrastructure and supply challenges that could directly lead to missed vaccination opportunities.

Table 3. Availability of Selected Vaccines n = 50

Vaccine	**Always available**	**Sometimes unavailable**	**Frequently unavailable**
BCG	34 (68%)	13 (26%)	3 (6%)
OPV	31 (62%)	14 (28%)	5 (10%)
Pentavalent	36 (72%)	11 (22%)	3 (6%)
Measles	22 (44%)	20 (40%)	8 (16%)
Yellow Fever	23 (46%)	18 (36%)	9 (18%)

Table 3 above indicates that Measles and yellow fever vaccines were the least consistently available, with fewer than half of facilities reporting uninterrupted supply. This inconsistency explains why these vaccines were most commonly missed by children.

Table 4. Association between Stockouts and Immunization Adherence n = 354

Stockout experienced	Compliant (n)	Non-compliant (n)	Total
Yes	76	81	157
No	156	41	197

$\chi^2(1) = 22.17$, $p < 0.001$

Table 4 above shows that children attending facilities with reported stockouts were significantly more likely to be incompletely immunized. This strong association underscores how supply-chain reliability directly affects vaccination outcomes.

Caregiver Knowledge, Perceptions, and Attitudes Toward Immunization

Table 5. Caregiver Knowledge & Perception Indicators n = 354

Indicator	n	%
Aware of full immunization schedule	206	58.2
Believe vaccines are beneficial	274	77.4
Express vaccine hesitancy	94	26.6
Fear of vaccine side effects	68	19.2
Believe vaccines cause infertility	17	4.8
Believe only sick children should not vaccinate	213	60.2

While most caregivers recognized the benefits of vaccines, only about half could correctly state the full schedule as shown in table 5 above. A quarter expressed some hesitancy, mostly related to fear of side effects, which could influence timely completion of vaccination schedules.

Table 6. Association between Hesitancy and Adherence n = 354

Hesitancy	Compliant (n)	Non-compliant (n)	Total
No	170	90	260
Yes	62	32	94

$\chi^2(1) = 0.16$, $p = 0.69$

Table 6 above indicates vaccine hesitancy was not significantly associated with immunization adherence. This indicates that systemic barriers may be stronger determinants of incomplete immunization than parental attitudes alone.

Table 7. Reasons for Vaccine Hesitancy among Hesitant Caregivers n = 94

Theme/Concern	Frequency (n)	Percentage of Hesitant Caregivers (%)
Fear of side effects (e.g., fever, swelling)	42	44.7
Rumors about infertility or sterility	17	18.1

Belief that too many vaccines harm children	15	16.0
Past negative experience at health facility	11	11.7
Religious or cultural objections	9	9.6

Table 7 shows that fear of side effects was the most common reason for vaccine hesitancy, reported by nearly half (44.7%) of hesitant caregivers. Rumors about infertility or sterility (18.1%) and beliefs that too many vaccines harm children (16.0%) were also prominent concerns. Past negative experiences at health facilities (11.7%) and religious or cultural objections (9.6%) contributed to hesitancy but to a lesser extent. These findings indicate that misinformation and fear are the primary drivers of hesitancy, while structural and cultural factors also play a role.

Service Integration

Table 8. Integration of Immunization with Other Services n = 50 Health Workers

Integrated with;	**Yes(n)**	**%**
Antenatal care (ANC)	35	70.0
Postnatal care (PNC)	24	48.0
Nutrition services	21	42.0
Growth monitoring	19	38.0
Child outpatient clinics	22	44.0
Family planning services	13	26.0
Immunization integrated into all services	21	42.0

Table 8 above indicates integration with ANC was the most common (70%), whereas integration with family planning was least (26%). This shows that while some facilities are already using integrated approaches, there is potential to scale this up to improve vaccine uptake.

Table 9. Barriers to Integration n = 50 Health Workers

Barrier reported	**n**	**%**
Staff shortage	23	46.0
Lack of coordination	19	38.0
Poor awareness of protocols	14	28.0
No national directive	12	24.0
Infrastructure limitations	16	32.0

Staff shortages and lack of coordination were the main barriers to service integration as indicated in table 9 above. These weaknesses limit the potential benefits of offering multiple services during a single visit.

Predictors of Full Immunization

Table 10. Adjusted Predictors of Full Immunization n = 354

Predictor	AOR	95% CI	p-value
Vaccine stockout (Yes)	0.42	0.25–0.71	0.001
Cold chain failure (Yes)	0.58	0.35–0.94	0.030
Fear of side effects (Yes)	0.65	0.39–1.08	0.094
Knowledge of immunization schedule (Yes)	2.11	1.25–3.58	0.005
Integration with ANC (Yes)	1.89	1.09–3.26	0.022
Facility type (Secondary vs PHC)	1.41	0.83–2.38	0.200
Caregiver education (Secondary+)	1.18	0.67–2.05	0.560

Table 10 above shows vaccine stockouts and cold chain failures were significant negative predictors of full immunization, while knowledge of the immunization schedule and integration with ANC significantly increased the odds. Caregiver education and facility type were not significant, underscoring the primacy of systemic factors over individual characteristics.

Discussion

This study examined the barriers to routine immunization in Bayelsa State, Nigeria. The findings correspond to the three objectives outlined in the Introduction and provide 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 [15-18, 24].

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.

Systemic and Logistical Barriers Affecting Routine Immunization Delivery

The most prominent barriers identified were vaccine stockouts, cold chain failures, and poor service integration. These findings are consistent with evidence from Kenya and Ethiopia, where weak supply chains and cold chain breakdowns were found to limit vaccine coverage despite adequate caregiver demand [19, 20]. In Nigeria, persistent power outages and logistical bottlenecks in riverine states like Bayelsa worsen these challenges [21].

This demonstrates that immunization inequities are largely driven by structural deficiencies rather than caregiver reluctance. Addressing supply chain inefficiencies and investing in reliable cold chain infrastructure are critical to improving coverage. Future research could evaluate the cost-effectiveness of solar-powered cold chain systems in riverine areas as a sustainable solution.

Caregiver Knowledge, Perceptions, and Attitudes toward Immunization

Although most caregivers had good knowledge and positive attitudes toward vaccination, this did not directly translate into adherence, except in cases where caregivers had precise knowledge of immunization schedules. Similar findings were reported in Enugu, Nigeria, where mothers demonstrated awareness of vaccination benefits but still faced systemic constraints that limited completion [22].

This suggests that health education alone, while important, is insufficient without concurrent improvements in vaccine availability and service delivery. More research is needed on how digital reminder tools or mobile health interventions could complement knowledge and ensure timely vaccine completion.

Role of Service Integration in Improving Immunization Coverage

The study found that integration of immunization with antenatal and postnatal care significantly improved adherence, nearly doubling the odds of full vaccination. This supports WHO's recommendation for integrated service delivery as a strategy to increase coverage [23].

In Bayelsa State, where geographic challenges limit frequent facility visits, integrated services ensure that caregivers can access multiple interventions in a single visit. Further operational research could explore models for scaling up integrated service delivery, particularly in hard-to-reach communities.

General Implications and Future Research

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

Future research should:

- Conduct an in-depth study on vaccine supply and management.
- Conduct longitudinal studies to assess how systemic improvements affect vaccination coverages over time.

Conclusion

This study demonstrated that systemic and logistical barriers remain a significant challenge in optimal routine immunization uptake 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 other health services including but not limited to maternal and child health services, alongside investment in reliable supply chains and cold chain infrastructure, offers practical solutions. These recommendations are in keeping with the Immunization Agenda 2030 (IA2030) global strategy and GAVI 6.0 strategy which prioritizes equity and system strengthening to close coverage gaps [25, 26].

These insights are useful for policymakers and health managers to design and implement policies and interventions that reduce vaccine stock out to the barest minimum for enhanced immunization coverages. Future research should explore sustainable innovations, such as Primary Health Center solarization and Human Resource for Health equity, to further enhance vaccine uptake and coverage.

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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