

Review

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Posted Date: 21 May 2024

doi: 10.20944/preprints202405.1388.v1

Keywords: Immunization; Barriers; Facilitators; Scoping Review; Nigeria



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Review

Exploring the Landscape of Routine Immunization in Nigeria: A Scoping Review of Barriers and Facilitators

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Abstract: Despite global efforts to improve vaccination coverage, the number of zero dose and under immunized children has increased in the African continent, particularly in Nigeria where more than 2.3 million unvaccinated children currently reside, making it the country with highest number of unvaccinated children on the African continent. It is thus imperative to identify barriers and facilitators of immunization in Nigeria with a view to formulate and design targeted interventions that can effectively bridge the immunization gap in Nigeria. In this review, we systematically mapped and summarized existing literature and data on key barriers to vaccine uptake, and facilitators influencing immunization practices in Nigeria. The electronic databases were systematically searched and articles that reported determinants of routine immunization uptake in Nigeria from inception of the databases up till October 2023 were included. The eligible articles were evaluated using a set of pre-defined criteria and the extracted data were analysed and visualized. This scoping review identified barriers spanning logistical, socio-economic, cultural, and healthcare system-related aspects, highlighting the need for a multi-pronged approach to address these challenges. While considerable progress has been made over the years, persistent barriers like distance between area of residence of caregivers and immunization centers, vaccine shortages, poor interpersonal relationship between healthcare workers and caregivers and cultural/religious influences persist. Lastly, collaborative efforts among stakeholders and communities remain paramount in ensuring improved routine immunization coverage across the Nigeria's diverse socio-cultural landscape.

Keywords: immunization; barriers; facilitators; scoping review; Nigeria

1. Introduction

Immunization is a critical and cost-effective public health interventions that has emerged as the indisputable cornerstone of global public health, effectively reducing morbidity and mortality from vaccine-preventable diseases [1]. As high as over four million deaths annually have been prevented by careful implementation of childhood immunization program around the world [1]. In recognition of the importance of childhood vaccines in public health, the World Health Organisation (WHO) in 1974 established the Expanded Programme on Immunisation (EPI) to ensure that all children have access to four recommended vaccines. This alongside other vaccines and doses constituted the routine immunization programme. Through immunization, the world has made significant progress in successfully reducing childhood diseases, especially under-five deaths since 1990, from 12.6 million to 5.4 million in 2017 [2].

Despite the proven benefits of immunization, challenges persist in ensuring that vaccines reach all individuals, particularly in resource-constrained settings [3]. Globally, while the number of zero-dose children has improved from 18.1 in 2021 to 14.3 million in 2022, this is not yet back to pre-pandemic level of 12.9 million [4]. According to 2022 estimates from the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO), Nigeria holds a large share of burden of zero dose and under immunized children, with an estimated over 2.3 million [4]. Nigeria alongside Ethiopia, the Democratic Republic of the Congo, Angola, and Guinea collectively accounts for the highest burden of missed dose and zero dose children in Africa [5,6].

Nigeria has aligned with the global momentum on immunization equity and developed the three-year national strategic plan to optimize routine immunization with a goal to reduce zero dose children to less than 10% of the target cohort by 2024 (National Strategic Plan to Optimize Routine Immunization in Nigeria (2021-2024)). In a concerted push to bolster immunization coverage, the National Primary Health Care Development Agency (NPHCDA) took decisive action by declaring a state of emergency on routine immunization. This initiative led to the establishment of the National Emergency Routine Immunization Coordination Centre (NERICC). Collaborative efforts with developmental partners such as GAVI, USAIDS, among others, have resulted in considerable progress. Penta-3 coverage, for instance, has increased from 33% in 2016 to a commendable 54% by 2022 [4]. Nevertheless, challenges persist in achieving optimal immunization coverage, with rates still currently below the WHO target.

A number of factors including economic and political terrain serve as substantial barriers impeding the achievement of high and equitable immunization rates in Nigeria [7]. These barriers include, but are not limited to hesitancy and resistance by parents fuelled mainly by rumours about the safety of vaccines and partly by religious and cultural considerations [8,9]. Socioeconomic status of the parents, accessibility to healthcare, maternal education and area of residence in the country are other factors that have been identified to contribute to vaccine resistance [8,9].

As we confront the realities of vaccine-preventable diseases, understanding the specific landscape of immunization in Nigeria is of paramount importance. While several attempts have been made to summarise findings of various studies on determinants of childhood immunization, the studies were mostly limited in scope and contextual specificity [7]. To date, there has been no comprehensive review documenting regional variations in factors affecting immunization uptake in Nigeria. To overcome these challenges, a comprehensive examination of literature is required to understand both the obstacles impeding immunization coverage and the strategies that have facilitated progress over time. Such an assessment is fundamental to crafting targeted interventions and policies to strengthen immunization programs, reduce health disparities, and improve public health outcomes. The primary objective of this scoping review is to summarize existing literature and data on barriers and facilitators of immunization in Nigeria. Through a rigorous analysis of existing literature, we aim to delineate the factors that contribute to the current state of immunization in Nigeria, identify regional differences in immunization determinants and recommend appropriate measures to address the identified challenges. This scoping review is a component of a broader study entitled 'Closing the Immunization Gap: Enhancing Routine Immunization in Nigeria by Reaching Zero Dose and Under-Immunized Children in Marginalized Communities'. The study is

based on a competitive grant awarded by Gavi to the Consortium of the African Field Epidemiology Network (AFENET)/Africa Health Budget Network (AHBN) as Country Learning Hub Partners for Immunization Equity in Nigeria (055-2022-Gavi-RFP).

2. Materials and Methods

2.1. Review Approach

The review was conducted in accordance with the published updated methodological guidance for the conduct of scoping reviews by the Joanna Briggs Institute (JBI) and Arksey and O'Malley [10,11]. Evidence synthesis and reporting was guided by the Preferred Reporting Items for Systematic Reviews and Meta-analysis extension for Scoping Reviews (PRISMA-ScR) checklist [12].

2.2. Research Questions

This scoping review attempts to answer the following fundamental questions:

- i. What are the facilitators influencing routine vaccination uptake in Nigeria?
- ii. What are the specific barriers contributing to missed and zero doses children in Nigeria's vaccination programs?
- iii. What variations exist at state and regional levels regarding barriers and facilitators of vaccination uptake in Nigeria?

2.3. Search Strategy and Study Selection

A systemic search of electronic databases comprising Google scholar, PubMed, Web of Science, EMBASE and AJOL (African Journals Online) was conducted on 28th of August 2023 and repeated on the 5th of October 2023. The search covers articles published in peer reviewed English language journals from database inception up to October 2023, targeting studies on determinants (barriers and facilitators) of immunization among human subjects in Nigeria. The search query employed Boolean operators to combine key concepts including "Immunization" or "Vaccination" or "Vaccines," "BCG vaccine" or "Bacillus Calmette-Guérin vaccine" "DTP vaccine" or "Diphtheria Tetanus Pertussis vaccine" or "Polio vaccine" OR "Pol" or "Polio Containing Vaccines" or "PCV" or "Rotavirus" or "Measles-Containing Vaccines" or "MCV" and "Facilitators" or "Drivers" or "Coverage" or "Challenges" or "Barriers" and "Nigeria" or "Nigerian," or "Abia" or "Adamawa" or "Akwa Ibom" or "Anambra" or "Bauchi" or "Bayelsa" or "Benue" or "Borno" or "Cross River" or "Delta" or "Ebonyi" or "Edo" or "Ekiti" or "Enugu" or "Gombe" or "Imo" or "Jigawa" or "Kaduna" or "Kano" or "Katsina" or "Kebbi" or "Kogi" or "Kwara" or "Lagos" or "Nasarawa" or "Niger" or "Ogun" or "Ondo" or "Osun" or "Oyo" or "Plateau" or "Rivers" or "Sokoto" or "Taraba" or "Yobe" or "Zamfara" or "The Federal Capital Territory" or "FCT" or "Abuja". The synonyms and alternative terms of the keywords were searched to ensure comprehensive coverage of the topic.

In addition, a manual search of the bibliographies of the identified articles was performed to ensure no relevant article was inadvertently missed. The search was further supplemented with grey literatures and report on the same topic through a snowball approach with government, partners and funders working in the immunization space in Nigeria.

2.4. Study Selection

2.4.1. Inclusion Criteria

The retrieved articles were examined critically and included in the study if they met following criteria:

- a) Original research articles focused on childhood vaccines and routine immunization in Nigeria
- b) Focus on at least a factor facilitating or hindering vaccine uptake,
- c) Studies in which qualitative, quantitative, or mixed methods were used and

d) Written or published in English Language and from the onset of the database till October 2023.

2.4.2. Exclusion Criteria

Studies conducted outside Nigeria or not related to barriers or drivers of immunization were excluded. Also, review articles, thesis and dissertations, editorials, letters to editor, commentary or opinion or perspective articles were excluded. The summary of the study selection criteria is presented in Table 1.

Table 1. Summary of study selection criteria.

<i>Selection criteria</i>	<i>Inclusion criteria</i>	<i>Exclusion criteria</i>
Year of publication	All articles published from inception of the databases to 2023	Articles published outside this period.
Type of publication	Peer review articles, grey literature and specific unpublished reports from stakeholders involved in vaccine administration and policy in Nigeria	Preprints, Thesis and dissertations and other publications that have not been peer reviewed.
Language	English	All other languages
Issue	Determinants of childhood vaccine uptake	Drivers and facilitators of COVID-19, influenza vaccines and other vaccines not included in the NPHDA routine immunization schedule as at October 2023

For the purpose of this review, we defined childhood immunization as all routine vaccines recommended by the NPHCDA for children under two (2) years of age in Nigeria. This includes Bacillus Calmette-Guérin (BCG) vaccine, Diphtheria, Tetanus, Pertussis (DTP) containing vaccine, Polio vaccines (Pol), and Measles-Containing Vaccines (MCV). The SPIDER framework (Table 2) was employed to systematically assess and evaluate the characteristics of included studies.

Table 2. SPIDER framework for accessing studies.

Sample	Under 2 children eligible for routine immunization in accordance to the NPHCDA recommendations, their caregivers including their parents and healthcare workers administering vaccine and providing necessary logistics and administrative responsibilities.
Phenomenon of interest	Routine vaccination recommended by the NPHCDA
Design	This includes primary studies employing exploratory, observational, or experimental study designs
Evaluation	Behaviours towards vaccination
Research type	This is mainly qualitative or mixed methods

2.5. Study Identification

The retrieved references from databases were imported into an online systematic review management tool, Covidence. The duplicate references were removed, and the remaining records were screened first by title and abstract, independently by two reviewers to ensure accuracy.

Disagreement among the reviewer's during screening was resolved by consensus or involvement of a third reviewer when there were differences of opinion. This was followed by a stage of double independent screening in which full text of the articles that scaled through the first screening process were retrieved and imported into Covidence and screened. A double independent screening was used to ensure that the eligibility criteria were strictly followed.

2.6. Data Extraction

Key data were carefully extracted from the included studies into a data collection template predesigned and previously piloted for this scoping review in Covidence. The following data were obtained from each study: the first author's name, publication year, aim of study, study population (caregivers, opinion influencers, healthcare workers), study location (state and geopolitical zone), vaccination assessed (DTP, polio, childhood vaccines in general), study design, number of participants and relevant key findings related to immunization barriers and facilitators. Authors of articles with incomplete metadata were contacted by E-mail for supplementary information.

The framework proposed by Bedford *et al.* [13] which categorises factors influencing childhood vaccination uptake into three levels (Caregiver-related (individual) factors, Health systems-factors and government policy and Community/Social context) was adopted for this study.

2.7. Data Analysis

The characteristics of the study such as the year of publication, study location, type and number of participants were summarized using basic descriptive statistics (frequency and percentages). The major findings from each of the included studies were tabulated. The identified barriers and drivers were mapped into the three conceptual themes. The identified factors were delineated according to the Nigerian six geopolitical zones.

2.8. Ethical Consideration

The Study is part of a larger study implemented by the learning hub that was approved by the National Health Research Ethics Committee of Nigeria (NHREC) with NHREC Protocol Number: NHREC/01/01/2007-31/08/2023 and NHREC Approval Number: NHREC/01/01/2007-11/09/202.

3. Results

3.1. Study Selection and Inclusion Process

Our database search yielded 7044 potentially relevant references from Scopus, PubMed, Google scholar and AJOL. An additional 14 documents were obtained from various stakeholders working in the Nigerian immunization space. Of these, 3568 references were identified and removed as duplicates and an additional 3122 references removed as irrelevant during title and abstract screening. Of the remaining 368 studies considered of interest and assessed for full-text eligibility, 7 studies were inaccessible, and 251 studies were excluded for various reasons. Overall, 110 studies were included and used for evidence synthesis and mapping [8,9,14–120]. The summary of study selection is presented in a PRISMA flow chart (Figure 1).

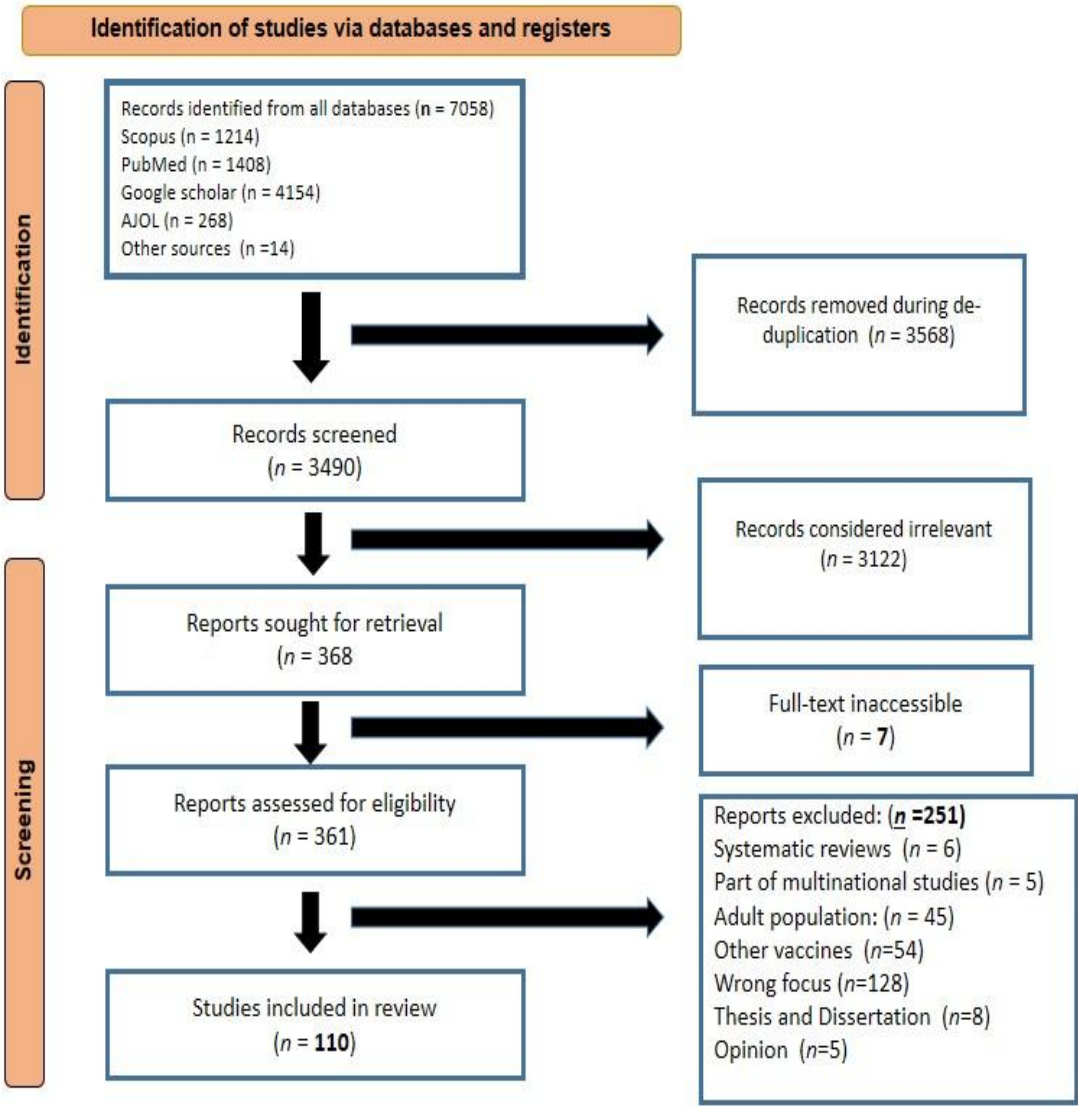


Figure 1. Selection of articles for inclusion.

3.2. Characteristics of Included Studies

The characteristics of the included studies are summarised in Table 3.

Table 3. Characteristics of included studies.

Characteristics	Number of studies (%), n=110	References
<i>Publication period</i>		
Before 1990	1 (0.9%)	[1]
Between 1990 and 2010	5 (4.5%)	[2–6]
After 2010	104 (94.5%)	[2–109]
<i>Geographical Regions</i>		
Multi-states	11 (10.0 %)	[35,46,67,74,77,83,91,98,108]

		[2,5,15,19,20,22,26,34,40–
National	26 (23.6 %)	42,46,50,56,59,60,65,71,75,76,78,84,88,90,94,107]
North-Central	4 (3.6 %)	[13,61,62,97]
North-East	9(8.2 %)	[16,34,54,58,86,92,93,95]
North-West	17 (15.5 %)	[8,9,11,18,29,31,32,39,45,47,55,57,100,102,105,106,109]
South-East	12 (10.9 %)	[10,25,28,63,64,68–70,89,103]
South-South	10 (17.3 %)	[3,12,23,24,48,51,53,80,96,104]
South-West	21 (19.1 %)	[1,4,6,7,14,17,27,30,33,37,38,43,44,49,52,72,73,82,87,99,101]

Research approach

		[1,2,5,12,13,16,19–21,26,31,34,35,38–40,42–44,46,50,52–
Mixed Method	44 (40.0 %)	54,56,71–76,78,83–86,90,92,94,95,101,107,109]
		[1,3,4,6–10,14,15,17,18,22–25,27–30,32–35,37,41,45–
		49,51,55,57,58,60–65,67–70,77,80–82,87,89,91–93,96–
Qualitative	61 (55.5 %)	100,102–106]
Quantitative	5 (4.5 %)	[35,41,47,60,65]

Data collection methods

Combination of methods	12 (10.9 %)	[9,35,43,73,74,83,101]
		[2,5,18–20,34,36,40–
Analysis of secondary data	33 (30.0 %)	42,50,53,54,56,59,60,65,71,75,76,84,86,88,90,92,94,96,107,109–
		111]
Focus Groups	7 (6.4 %)	[12,17,21,57,62,80,102]
Interviews	18 (16.4 %)	[1,3,4,6,15,17,35,48,51,61,68,97,98,103,105,106,108]
Observation	6 (5.5 %)	[14,22,27,37,58,91]
		[8,10,11,13,23–25,28,30–
Questionnaire and household surveys	34 (306 %)	34,38,39,45,47,49,52,55,63,64,67,69,70,77,81,82,85,89,99,104]
		[87,100]

Vaccines assessed

		[1,3–10,12–15,17,19,21,23,24,26,29–32,34,35,37–43,45–53,55–
Routine immunization	89 (80.9 %)	58,60,62–64,67,68,71–77,79–90,93–97,99–102,104–
		107,110,111]
Diphtheria, Tetanus, and Pertussis (DTaP) Vaccine	2 (1.8 %)	[2,33]
Diphtheria, Tetanus, and Pertussis (DTaP) Vaccine; Polio Vaccine	1 (0.9 %)	[33]
Hepatitis B Vaccine	3 (2.7 %)	[16,69,70]

Measles, Mumps, and Rubella (MMR)		[28,61,92,108]
Vaccine	5 (4.5 %)	
Polio Vaccine	10 (9.1 %)	[11,20,22,54,65,91,98,103,109,112]

A large proportion of studies ($n=26$) targeted participants residing in all states of the federation. Some other studies concentrating on selected states ($n=11$), either exclusively within the northern regions or spanning across both the northern and southern regions. The qualitative research approach ($n=61$) was the most frequently adopted study type. Data collection methods across all studies included questionnaire ($n=32$), analysis of secondary data ($n=33$), focus group discussions ($n=7$) and interviews ($n=18$). Most of the data analysed in studies involving analysis of secondary data were from Nigerian Demographic and Health Surveys (NDHS), Integrated Disease Surveillance and Response (IDSR), Multiple Indicator Cluster Survey (MICS), Post-Campaign Coverage Surveys (PCCS), Immunization Clinic Records, among others.

While vaccines included in the routine childhood immunization was the focus of most of the studies ($n=89$), few studies focused on specific childhood vaccines (Table 3).

This scoping review presented result of data involving a combined 271, 273 participants, comprising caregivers, community influencers and immunization implementing stakeholders.

3.3 Facilitators of Routine Immunization in Nigeria

3.3.1. Caregiver-Related Drivers

A total of 29 facilitators or drivers of childhood vaccines were recognised from the included studies. Of all the factors identified in various studies, maternal education of at least secondary education or higher was the most frequently mentioned ($n=19$) drivers of childhood immunization followed by delivery in a healthcare facility with skilled birth attendants ($n=14$). Moreover, maternal socio-economic status measured as high household wealth ($n=10$) and maternal age (≥ 20 years) at childbirth ($n=9$) were also mentioned in the literature (Figure 2).

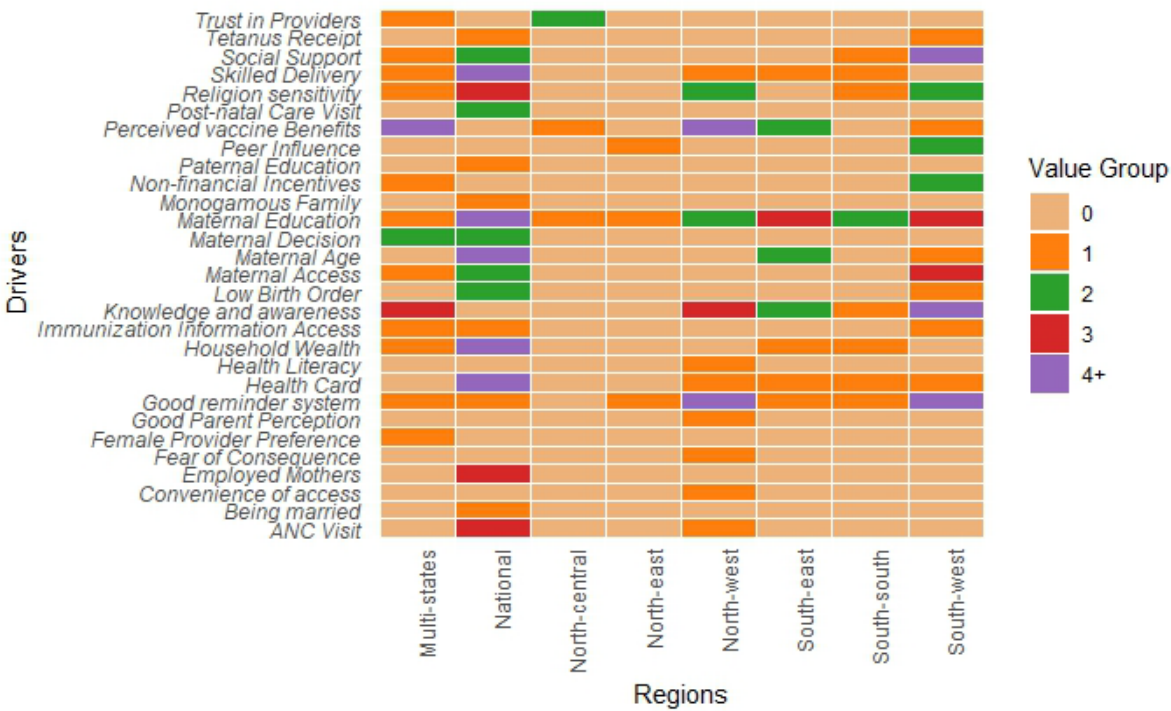


Figure 2. Caregiver-related facilitators.

Across all studies, cultural and religious factors ($n=9$) emerged prominently, alongside positive social support ($n=8$). Trust in healthcare providers ($n=3$), maternal discretion in vaccination decision-making without husband's consent ($n=4$), being married ($n=1$), and maintaining a monogamous family structure ($n=1$) were also identified as also playing significant roles in driving immunization uptake. The provision of non-financial incentives such as providing free transportation service to caregivers of vaccine eligible children ($n=3$) was also highlighted as another positive motivators.

3.3.2. Health-System Related Drivers

Adequate vaccine supply ($n=2$) and presence of a skilled healthcare workforce ($n=3$) were identified primarily as key elements of health-system related drivers. Additionally, timely immunization reminder systems and strong health information systems played were also vital. Furthermore, supportive government policies emerged as a facilitator of immunization ($n=3$). Vaccination at private health facilities was also identified ($n=1$), emphasizing their significance in the health system's role in promoting childhood immunization (Figure 3).

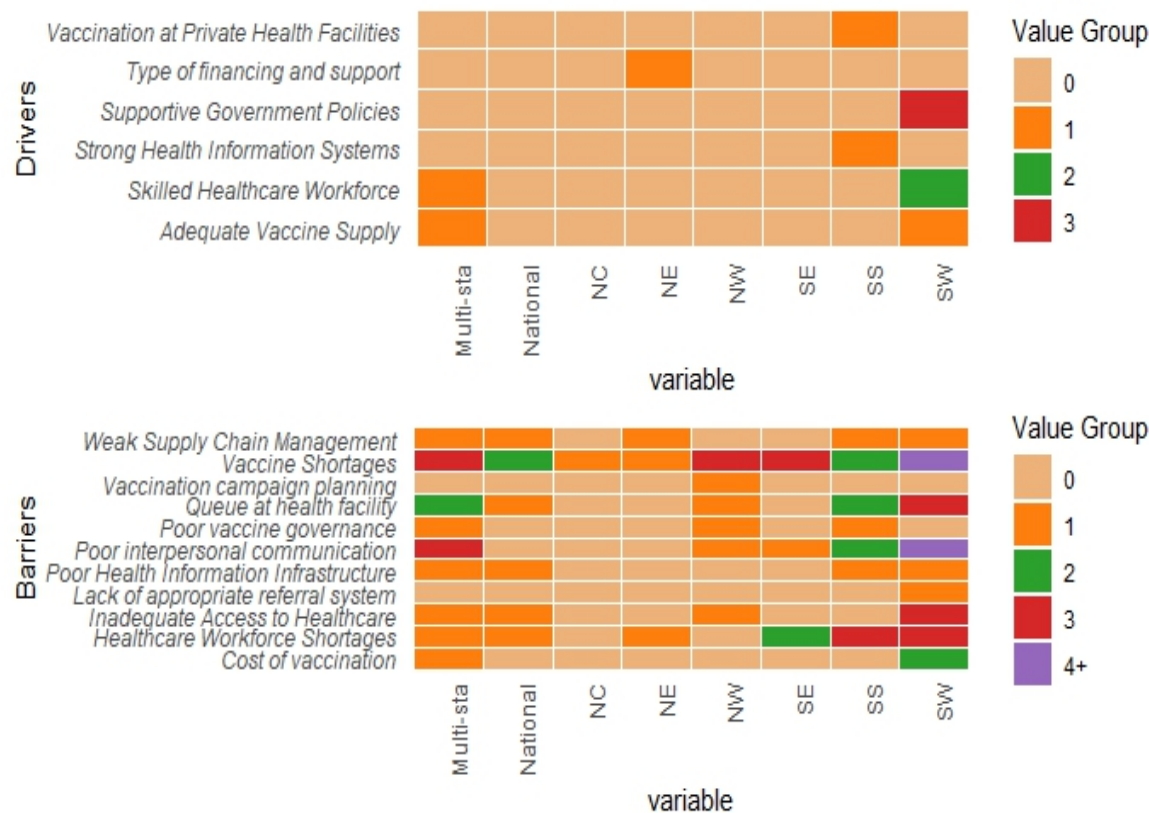


Figure 3. Health system-related facilitators and barriers .

3.3.3. Community/Social Context Related Drivers

We identified five (5) drivers of immunization related to community/social context. Notably, community engagement and social mobilization ($n=16$). Residence in highbrow areas ($n=2$) and living in urban centres ($n=6$) emerged as noteworthy drivers. The presence of vaccine advocates in the community ($n=3$) and putting adequate security protection in place via engagement of security personnel ($n=1$) have also been reported (Figure 4).



Figure 4. Social/Community related facilitators and barriers .

3.4. Barriers of Routine Immunization in Nigeria

3.4.1. Caregiver-Related Barriers

Among the recognized caregiver-related barriers, the fear of side effects of immunization ($n=20$) and misinformation ($n=19$) emerged as prominent concerns affecting caregivers' decisions regarding childhood immunization. Furthermore, cultural, or religious beliefs ($n=17$) and lack of awareness about immunization schedule ($n=19$) were key factors shaping caregivers' perceptions and behaviours. Socioeconomic barriers were also evident, with low household wealth ($n=17$) and low or no maternal education ($n=20$) playing pivotal roles in vaccine uptake. Logistical challenges ($n=29$) posed by factors such as access to healthcare services, place of immunization, and cost of transportation to access immunization, further hindered caregivers' ability to access vaccines for their children (Figure 5).

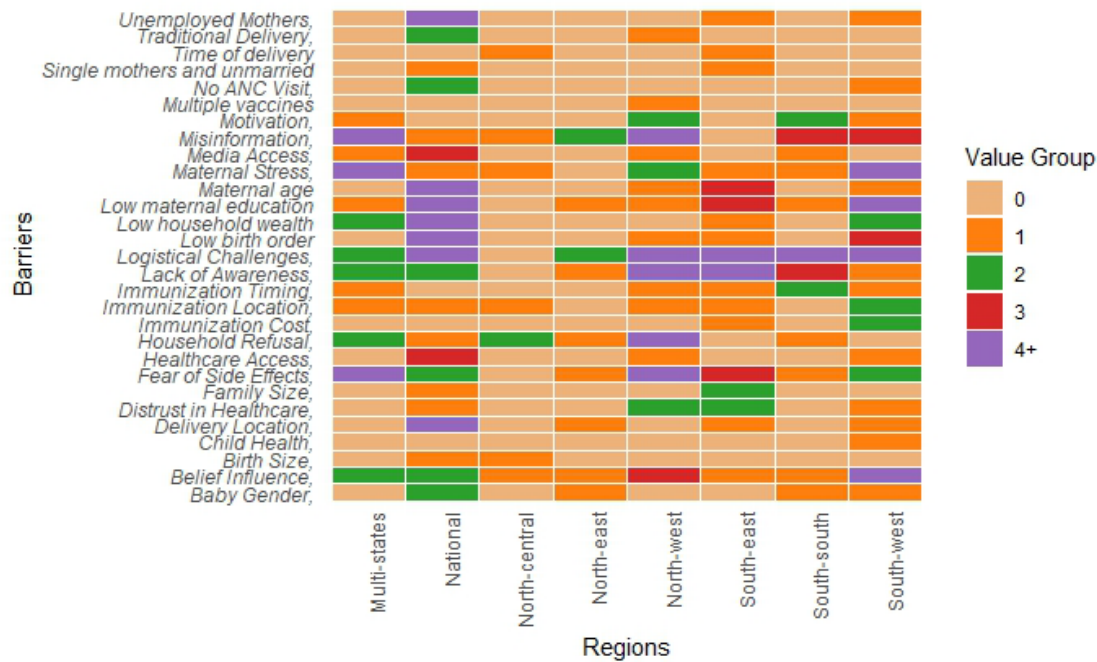


Figure 5. Caregiver-related barriers.

3.4.2. Health System-Related Barriers

Among the health system-related barriers, vaccine shortages ($n=20$) emerged as the most prominent issue, significantly affecting vaccine accessibility. Poor interpersonal communication between healthcare workers and caregivers ($n=13$) further hinders effective immunization delivery. Healthcare workforce shortages ($n=10$) and lengthy queues at health facilities ($n=8$) contribute to service limitations. Inadequate access to healthcare ($n=6$) and weak supply chain management ($n=5$) compounded these challenges. Additionally, poor health information infrastructure ($n=4$), the cost of vaccination ($n=3$), and issues related to vaccine governance ($n=3$) serve as additional hurdles in the vaccination process (Figure 4).

3.4.3. Community/Social Context Related Barriers

Residency in rural or urban slum areas ($n=14$) and regional disparities with most authors reporting residency in northern and south-south regions of the country as prominent social barriers to immunization. Additionally, ethnicity ($n=8$) with authors reporting high vaccine hesitancy or refusal among Hausa/Fulani ethnic groups compared to Yoruba and Igbos and cultural or religious beliefs ($n=6$) playing substantial roles. Challenges from insurgency, conflict, and insecurity ($n=6$), along with high vaccine hesitancy or refusal among internally displaced individuals and migrants ($n=4$), were also noted. Distrust in the healthcare system, female-headed households, low literacy rates in communities, and lack of social support were additional barriers impacting childhood immunization.

3.5. Regional Insights into Childhood Immunization Dynamics in Nigeria

Our analysis revealed distinct regional variations in factors influencing immunization practices across Nigeria's six geopolitical zones. Among studies conducted in a single state, majority were conducted in the south- west region ($n= 21$), followed by north-west region ($n=17$). Twelve of the studies were conducted in southeast while 10 and 9 studies each were conducted in the south-south and northeastern regions.

In the North-Eastern Zone, peer influence ($n=1$), robust reminder systems ($n=2$) and provision of additional security personnel bolstered acceptance and significantly supported adherence. Provision of financial incentive to health facilities based on vaccination performance was reported as

a significant motivator in this region. In the North-Western region, caregivers were motivated by perceived vaccine benefits, fear of non-immunization consequences, and a perception that vaccinating one's child makes one a good parent. Also, residents of urban and highbrow areas in northwest region tends to comply fully with immunization schedule. Health literacy and ANC visit were uniquely observed as major driving factors in this region. Additionally, the influence of community influencers such as religious and traditional rulers were noted, and their engagement and mobilization as vaccines advocates significantly improves immunization uptake in the region. Similar to the North-West, factors like knowledge, perceived benefits, and trust in healthcare providers were predominant drivers of immunization uptake in North-Central zone. Maternal autonomy in decision-making ($n=1$), health literacy ($n=1$), and fear of non-immunization consequences ($n=1$) played crucial roles in driving immunization practice in South-Eastern Zone.

South-South zone was unique for its strong peer influence ($n=2$) and widespread use of reminder systems like WhatsApp and SMS. Higher maternal education levels ($n=3$) were notable. Maternal autonomy ($n=2$), peer influence ($n=2$) alongside Health card usage ($n=1$), high maternal education ($n=6$), and the belief that vaccination defines responsible parenting ($n=1$) correlates with higher immunization uptake in the South-Western zone. Additionally, availability of vaccines and skilled health care workforce at immunization sites together with supportive government policies and provision of non-financial incentives were reported to be instrumental in driving immunization uptake in this region (Figure 2).

4. Discussion

In Nigeria, understanding the factors that influence immunization uptake and hesitancy is paramount as the country is currently home to highest number of missed dose children on the African continent. The review elucidates on these factors from the perspectives of both caregivers and immunization service providers. The reports of different studies summarized in this review revealed a multitude of interrelated and multi-layered challenges faced by caregivers in accessing immunization services in Nigeria.

The long distance between caregivers' homes and immunization centres stands out as the most frequently reported impediment to routine immunization uptake. Studies in Kenya, Ethiopia and Mozambique have similarly reported that children whose caregivers travelled shorter distances to health facilities for immunization were more likely to be fully vaccinated [121,122]. Despite initiatives like the 'Reaching Every Ward' policy by the Nigerian government, an adaptations of the WHO's 'Reaching Every District' strategy [123], more comprehensive efforts are needed to ensure the availability and easy accessibility of routine immunization services to the broader populace. Moreover, the scheduling of immunization campaigns on specific days like Mondays [83] or during market days [24], or during the rainy season [8,90] further exacerbates these accessibility challenges. This timing often conflicts with caregivers' work schedule, and further adding logistical strain and hindering their ability to prioritize vaccination schedules. In line with the finding of this study, inconvenient timing has also been identified as major hindrance to optimum immunization uptake in sub-Saharan Africa [122]. Gaining insights into caregivers' schedules via community feedback and adopting flexible immunization campaign strategies would markedly improve accessibility by aligning immunization schedules with caregivers' routines.

The finding that children of educated and employed mothers exhibited higher rates of complete vaccination aligns with report of a recent study [124]. This has been potentially attributed to better access to immunization information and a deeper understanding of its importance. Additionally, these mothers might be better able to afford and cover indirect costs associated with accessing immunization services. Promoting women's education through adult and nomadic education programs and creating opportunities for mothers to engage in gainful employment could significantly bolster immunization uptake in Nigeria.

Furthermore, the reviewed studies frequently cited instances of male heads of households refusing immunization [81]. Even when not explicitly expressed, their refusal to cover indirect costs and provide necessary support might prevent intending mothers from vaccinating their children.

This refusal is more prevalent in north-western and north central states, where conservative Hausa/Fulani ethnic groups, largely comprising husband-headed households with husbands as the primary decision-makers, are predominant. This is a key equity and gender issue as prioritized by Gavi 5.0 guideline and it has also been identified as key barrier in other sub-Saharan Africa countries [122]. Empowering women financially and specifically engaging males during immunization mobilization becomes crucial in addressing this issue.

The finding that children of caregivers from wealthy households and highbrow areas of the society were likely to be fully vaccinated than children of mothers with low household wealth or resident of urban slum or rural areas concurs with several other reports [5,125]. This may be attributed to inequalities in terms of ability to access healthcare services including immunization services between poor and wealthy households as children from impoverished parents may face challenges in reaching health facilities and may also have difficulties covering indirect cost of immunization. In addition, they may not be able to afford interference with their daily business activities to access immunization services.

Certain cultural practices, such as the masquerades and 'oro' rites in southern Nigeria, were reported to impede caregivers' access to immunization services [8]. To mitigate such barriers, proactive measures such as scheduling around cultural festivities should be taken during the planning of immunization campaigns, to ensure maximum participation and accessibility for caregivers. Furthermore, a significant disparity was observed in the immunization rates among children based on the religious affiliation of their caregivers. Children under the care of Christian caregivers, particularly within the Catholic faith, exhibited higher rates of complete immunization compared to children whose caregivers identified with the Islamic faith [68,80]. This discrepancy could be attributed to religion inspired concern about vaccine safety and an enduring impact of a religious campaign against immunization, stemming from the botched Pfizer vaccine in the 1990s in Kano state [55]. This incident triggered a widespread boycott of immunization services, particularly within the Muslim-dominated northern region of Nigeria. The recurrent mention of religion's influence on routine immunization uptake in Nigeria aligns with similar reports from neighbouring countries like Ghana [126]. Efforts should therefore be directed towards fostering community engagement, building trust, and conducting tailored awareness campaigns within religious communities to dispel myths, address concerns, and promote the importance of immunization for overall community health.

The impact of cultural gender sensitivity on immunization uptake was notably observed, especially in conservative northern regions where male heads of households may object to male vaccinators accessing their household for vaccination purposes during outreach campaigns [29]. Similar sensitivities have been identified in culturally sensitive areas like Bangladesh [127]. Deploying dedicated teams of female vaccinators and female community influencers is imperative to bolster acceptance and accessibility.

Misinformation surrounding immunization and concerns about potential side effects were consistently also highlighted across several studies as significant barriers to achieving effective immunization uptake. For instance, at the turn of millennium, there was widespread and prolonged beliefs in the Muslim dominated north and supported by influencer religious organisations that vaccines were deliberately contaminated with anti-fertility drugs and HIV virus in order to depopulate the north [128,129]. Similarly, people in other countries like France have expressed low confidence in vaccine, often fuelled by circulating rumours questioning vaccine safety [130]. Therefore, proactive measures aimed at dispelling myths and allaying fears surrounding immunization are essential to foster trust and encourage higher vaccination rates.

Within the spectrum of healthcare system-related barriers, shortage of vaccines emerged as the most frequently cited barrier, signifying a persistent gap in the consistent availability of vaccines despite multifaceted efforts by stakeholders. Moreover, the prominence of poor interpersonal communication, healthcare workforce shortages, and lengthy queues at immunization centres highlights the multifaceted nature of barriers hindering routine immunization uptake. These factors collectively underscore the need for comprehensive solutions, spanning from targeted training

programs to alleviate communication gaps among healthcare providers to strategic workforce planning initiatives aimed at mitigating staffing shortages.

Among the community/social context, resident in rural areas or in urban slum [31,47,110], residing in northern or south-south regions of the country [80], belonging to Hausa/Fulani or Kanuri ethnic groups [80,86,94], conflict affected [46,102], displacement and migration [82] were the most frequently reported barriers. The regional discrepancies in immunization uptake are not unexpected as each of the Nigeria's six geopolitical zones have varying socio-economic, cultural, and demographic development which may in turn influence health seeking behaviours including immunization practice. Northern regions in particular are economically disadvantaged regions with spectre of conflicts and armed insurgency and home to the highest number of uneducated individuals in the country [131]. Additionally, rural areas and urban slums face impediments in accessing healthcare services due to infrastructure deficit hampering vaccine delivery and coverage.

The general insecurity exemplified by Boko-haram insurgency in north-eastern states of Borno and Yobe [46,76,102] and unabated armed conflict between herdsman and farmers on land and grazing paths in Benue states [70] often leads to population displacement and migration, and consequently significant disruption of immunization efforts. In the north-western states particularly Sokoto, Kebbi and Zamfara axis, armed banditry typified by mass kidnapping, robbery along major highways, cattle rustling, and disruption of socio-economic activities by ethnic militias has resulted in internal displacement of thousands of people and missed communities [132]. The insecurity has recently extended into the south-eastern states where the armed wing of Indigenous People of Biafra has been enforcing a mandatory Monday sit-at-home order with attendant impact on vaccination coverage. The finding of severe negative impact of conflict on vaccination uptake in this study aligns with a report of multinational study where similarly conflicts and insecurity was reported to be associated with sudden drops in national and sub-national immunisation coverage [133]. The hard-to-reach conflict affected regions should be prioritized during outreach campaigns and heightened security measures should be put in place to safeguard routine immunization personnel and give confidence to the targeted populace.

5. Conclusions

This review underscores the multifaceted challenges hindering routine immunization uptake in Nigeria and the variation in factors and gaps in evidence by region. The identified barriers span logistical, socio-economic, cultural, and healthcare system-related aspects, highlighting the need for a multi-pronged approach to address these challenges. While considerable progress has been made over the years, persistent barriers like distance between area of residence of caregivers and immunization centres, vaccine shortages, poor interpersonal relationship between healthcare workers and caregivers and cultural/religious influences persist. Collaborative efforts among stakeholders and communities remain paramount in ensuring improved routine immunization coverage across the diverse socio-cultural landscape of Nigeria.

6. Future Directions

We aimed to present these findings to immunization stakeholders in Nigeria and to further prioritize and implement mitigation measures on lessons from this review so that a concerted effort will be done to address these factors in line with the mandate of the Gavi led Zero Dose Learning Hub implemented by the AFENET/AHBN consortium. It is the vision of the Zero Dose Learning Hub through the rapid assessment, implementation research, and other activities to go much deeper in to understanding these barriers for under-represented states and to understand how ZD children may face multiple deprivations and the interacting effects of multiple barriers or enablers.

7. Limitations

This review on childhood immunization in Nigeria highlights identified drivers, barriers, variations, and gaps at the sub-national level particularly. We acknowledge the potential influence

of investigator perspectives and limited data availability on their scope. It is important to note that additional potentially significant barriers relating to ZD children and missed communities may exist beyond the current identified list. Further research and data collection are crucial to gain a comprehensive understanding of the full spectrum of challenges. Moreover, the dynamic nature of immunization programs underscores the potential for the review to not fully capture the latest developments or practice changes that may have occurred recently like the focus on 100 LGAs to identify and reach ZD children and the recent introduction of the human papilloma virus vaccine in Nigeria and its associated challenges.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org. The Data Extraction Table has been provided as a supplement (S-1).

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Funding: This study was funded by Gavi - The Vaccine Alliance, based on a competitive grant awarded to the Consortium of the African Field Epidemiology Network (AFENET)/Africa Health Budget Network (AHBN) as Country Learning Hub Partners for Immunization Equity in Nigeria (055-2022-Gavi-RFP) through the Zero Dose Learning Hub (ZDLH) project in Nigeria.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of NATIONAL HEALTH RESEARCH ETHICS COMMITTEE. The Study is part of a larger study implemented by the learning hub that was approved by the National Health Research Ethics Committee of Nigeria (NHREC) with NHREC Protocol Number: NHREC/01/01/2007-31/08/2023 and NHREC Approval Number: NHREC/01/01/2007-11/09/202.

Informed Consent Statement: Not applicable.

Acknowledgments: This is to acknowledge all immunization stakeholders within and outside Nigeria that supported this review by the provision of relevant reports, documents, and guidance to this review.

Conflicts of Interest: The authors declare no conflicts of interest. All authors (including the funders) provided technical support in the design of the study; collection, analyses, interpretation of data; writing of the manuscript; and in the decision to publish the results.

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