

ADDRESSING MISSED OPPORTUNITIES FOR VACCINATION AMONG UNDER- FIVE CHILDREN IN NIGERIA: A LITERATURE REVIEW

OMOLOLAENI ABIDEMI, ALABI
Nigeria



Master of Science in Public Health
KIT (Royal Tropical Institute)
Vrije Universiteit Amsterdam (VU)

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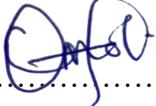
OMOLOLAENI ABIDEMI, ALABI

NIGERIA

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LIST OF ABBREVIATIONS

EPI	Expanded Program on Immunization
FMOH	Federal Ministry of Health
GAVI	The Global Vaccine Alliance
GVAP	Global Vaccine Action Plan
LGA	Local Government Areas(s)
MICS	Multiple Indicator Cluster Survey
MOV	Missed Opportunities for Vaccination
NDHS	Nigeria Demographic & Health Survey
NICS	National Immunization Coverage Survey
NPHCDA	National Primary Health Care Development Agency
RI	Routine Immunization
SMOH	State Ministry of Health
SPHCDA	State Primary Health Care Development Agency
VPDS	Vaccine-Preventable Diseases
UNICEF	United Nations Children’s Fund
WHO	World Health Organization

DEFINITION OF KEY TERMS

Missed-dose Children: “Missed-dose or Under vaccinated children refer to those who received the first dose of the diphtheria-pertussis-tetanus vaccine (Penta 1) but not the third protective dose (Penta 3)” (UNICEF, 2023).

Missed Opportunities for Simultaneous Vaccination: “Missed opportunities for simultaneous vaccination occur when a child receives at least one dose, but on the same day does not receive one or more doses for which they are eligible” (MICS/NICS, 2021).

Missed Opportunities for Vaccination: “Missed Opportunities for Vaccination (MOV) include any contact made with health services by a child or adult who is eligible for vaccination, but which does not result in the individual receiving all vaccine doses for which he or she is eligible” (WHO, 2017).

Vaccination: “Vaccination is a simple, safe and effective way of protecting one against harmful diseases before coming in contact with them. It works by using the body’s natural defences to build resistance against specific infections” (WHO, 2021)

Zero-dose Children: “Zero-dose children are children who have not received a first dose of the diphtheria-pertussis-tetanus vaccine (Penta 1) or do not receive any single dose of the vaccines in the national routine immunization schedule” (UNICEF, 2023)

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ABSTRACT

Introduction: Missed opportunities for Vaccination (MOV) have been identified as a significant contributor to vaccine-preventable diseases and a hindrance to achieving immunization coverage in Nigeria. This study aimed to explore the factors influencing MOV among children under five and identified interventions to propose quality improvement recommendations.

Methodology: This is a review of relevant literature from databases and websites of journals and organizations. The study integrated the theoretical domain framework (TDF) and Capacity, Opportunity & Motivation behavioural model (COM-B) to identify factors for MOV translating them into implementable quality improvement interventions from contexts similar to Nigeria and briefly appraised for their potential applicability in Nigeria. The framework explains the multifaceted nature of MOV, linking internal and external immunization-seeking behaviours.

Result: Despite geographical variations, the factors influencing MOV were similar across African countries. Opportunity constructs included external factors such as vaccine stockout, vaccination card screening, and knowledge, attitudes, and practices among healthcare providers. Motivation constructs had fear, vaccine mistrust, and social influences. Capacity constructs related to caregivers' knowledge, attitude, and practices. Interventions such as training healthcare providers, utilizing long waiting times for health education, and using posters with immunization details for caregivers and healthcare providers were identified and are potentially applicable in Nigeria.

Conclusion: The interconnection between these factors emphasizes the importance of addressing MOV comprehensively within local and global contexts. Reducing MOV can lead to quick gains, improving national vaccination coverage by using available resources in the country.

Keywords: 'Missed opportunities for Vaccination', 'Under-five children, 'Routine Immunization', 'Nigeria'

Word Count: 10,981

CHAPTER 1

1.0 Introduction

Immunization is a cost-effective intervention to reduce mortality, especially among children (WHO/UNICEF, 2015). Childhood vaccinations help control infectious and life-threatening diseases and avert over three million deaths each year globally (WHO,2018). In 2021, the COVID-19 pandemic disrupted childhood immunization in that 25 million children under one did not receive primary routine immunization while 18 million received no form of immunization, leading to an increase in the Under-5 mortalities globally (CDC,2021). These figures are 6 million more than those reported in 2019, the highest since 2009 (WHO,2022). The total death of 5 million children was recorded despite the substantial decline in under-5 mortalities from 93 in 1990 to 38 per 1000 live births in 2021 (UNICEF, 2023). Unfortunately, most (72%) of these deaths are from Sub Sahara Africa, with the highest burden in Niger, Nigeria, Chad, Sierra Leone, and Central African Republic (WHO,2023).

Despite efforts to improve immunization coverage, it has remained low in many states in Nigeria, and one of the identifiable reasons for inadequate coverage of childhood immunization is Missed Opportunities for Vaccination (MOV) (WHO, 2017) (Adamu, 2019). It has been noted that many children, upon contact with health services, miss the opportunity to be vaccinated even when they are eligible and due for it. This miss of opportunity could arise as a fault from either the caregiver (mothers), the provider (health workers), and or the health systems (WHO, 2017).

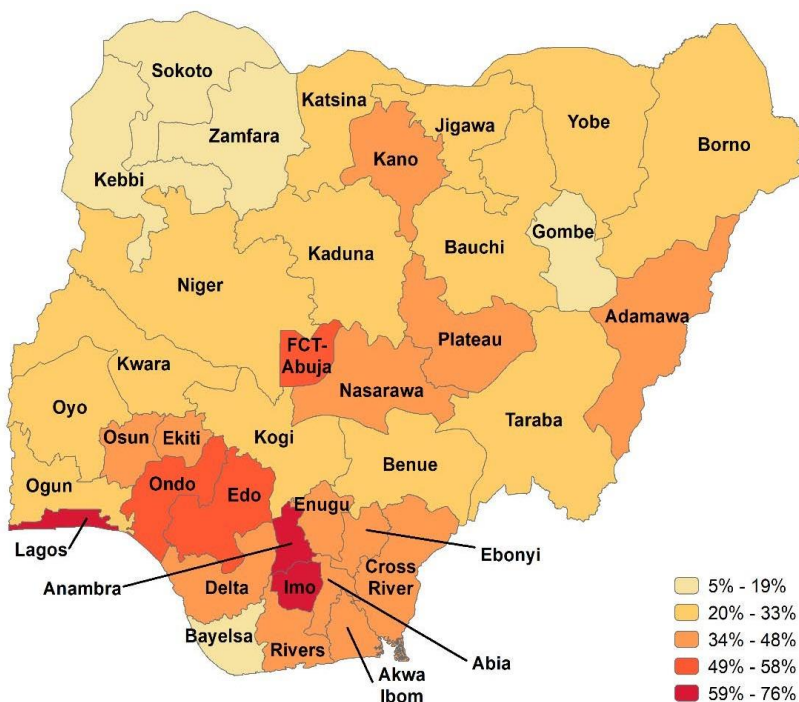
Missed opportunities could occur during health facility visits for preventative (immunization services, growth monitoring, etc.) and curative services, with the failure of the care provider to assess the eligibility of children they come in contact with (WHO, 2017). The prevalence in Nigeria reported from several studies varies from 5% to 44% (Rainey et al., 2011) (Sridhar et al., 2014) (Ibraheem et al.,2016) (Uthman et al., 2018) (Adamu et al., 2019) (Fatiregun et al., 2021) (Omuemu et al., 2023). Wide disparities also exist between different geopolitical zones in Nigeria. For example, the North West zone has a coverage of 8% compared to the South West, which has 50% immunization coverage. Some of these coverage disparities result from MOV (NPHCDA, NBS, 2017).

1.1 Background to the study

Nigeria, which is the most densely populated African country, has a projected population of approximately 231 million with an annual population growth rate of 2.53% (National Population Commission 2009) (World Fact 2023) and has remained one of the top 10 countries in the world where children that are either not immunized or not completely immunized reside (UNICEF,2023). It has up to 250 diverse ethnic groups and cultures, with the entire population split between the Muslim and the Christian religions (Federal Ministry of Information and Culture, 2022). The predominant ethnic groups are the Yoruba, Igbos, and Hausa/Fulani, and they all have different socio-cultural practices that influence vaccine uptake and impact health outcomes (Reed & Mberu, 2015). Nigeria operates a decentralized governance system comprising 36 other states and the Federal Capital Territory (FCT) (National Populations Commission 2019).; Each state is divided into 774 local governments and several wards (Ibok, 2014).

Most children who are not routinely immunized or partially immunized are in the Northern part of the country, where all states have below 50% of the penta3 coverage (NPHCDA, NBS, 2017), as shown in the figure below.

Figure 1: The map of Nigeria showing vaccination coverage of children by state.



Source: Nigeria Demography & Health Survey (NDHS 2018)

Many reasons, like low levels of knowledge on vaccines among parents, challenges with service delivery, mistrust and fears regarding immunization, as well as the attitude and behaviour of health workers, have been associated with low coverage of vaccination in these areas (NICS 2016/2017) (Rainey, 2011). Urban and rural disparities exist in Nigeria, with children in urban areas twice as likely to get vaccinated as those in rural areas (NDHS,2018). Mothers' formal education level significantly affects the likelihood of their children receiving vaccinations. Children of mothers with education beyond secondary school are more likely to be vaccinated than mothers without

formal instruction (Antai, 2015). Additionally, socioeconomic status was associated with vaccination rates, as children from affluent families tend to receive all routine immunizations (Crocker-Buque et al., 2017).

1.1.1 Health System for Immunization in Nigeria

The National Primary Health Care Development Agency (NPHCDA) is responsible for the distribution of vaccines to all states centrally, immunization guidelines as well as controlling vaccine-preventable diseases (VPDs) (Oku et al., 2017). The Expanded Programme on Immunization (EPI) began implementation in Nigeria in 1979. It required using primary healthcare facilities to vaccinate all eligible individuals regardless of whether they present for immunization services. The EPI recorded significant success in reducing VPDs between 1988-1990, with an 81.5% coverage of the Diphtheria-tetanus pertussis vaccine (DPT), after which a decline occurred (FMOH, 2016).

In 1996, less than 30% coverage rate by antigen was reported nationally, which dropped to 12.9% in 2003 (Ophori et al., 2014). In 2005, Nigeria adopted the World Health Assembly's goals for all countries to eliminate polio, reduce measles-related mortality, and eradicate tetanus-related infections of mothers and neonates. The government also adopted the millennium development goals (MDGs), which aimed at reducing (two-thirds) child mortality compared to 1990 and 2005. (Obioha et al., 2010)

Nigeria is part of the Global Vaccine Action Plan (GVAP) and, in 2010, set to achieve 90% national immunization coverage of children under the age of one and a minimum of 80% coverage in every district (Ophori et al., 2014) (FMOH, 2021). Nonetheless, an increased under-5 mortality rate from 138 to 158 per live birth was still reported in 2011 compared with the global reduction over the same period (WHO, 2013). Despite several strategies that have been put in place toward the set goals, almost 40% of under-5 mortalities in Nigeria are still reported annually to be associated with VPDs (Adeloye et al., 2017).

National Emergency Routine Immunization Coordination Centre (NERICC) began operationalising in the lowest-performing states in 2017 after raising a public health concern (FMOH, 2018). Nigeria is still committed to reinforcing service delivery for immunization and addressing the risks of VPD, in line with the global targets (Mahachi et al., (2022).

1.1.2 Routine Immunization Schedule and Coverage in Nigeria

According to the World Health Organization, vaccines provide immunity against deadly diseases such as Tuberculosis, Polio, Diphtheria, Pertussis, tetanus, measles, meningitis, hepatitis B, yellow fever, and Haemophilus influenza type B (Adamu, 2019). Because of this, a child is expected to visit the facility seven times to complete the routine immunization. The routine immunization schedule according to age in Nigeria is shown below;

Age offered	Vaccine
At Birth	Bacille Calmette Guérin(BCG) Oral Polio Vaccine 0 (OPV) Hepatitis B Vaccine (HBV)
6 Weeks	Pentavalent Vaccine 1 (Penta) Oral Polio Vaccine 1 Pneumococcal Conjugate Vaccine 1 (PCV) Rotavirus Vaccine 1 Vitamin A
10 Weeks	Pentavalent Vaccine 2 Oral Polio Vaccine 2 Pneumococcal Conjugate Vaccine 2 Rotavirus Vaccine 2
14 Weeks	Pentavalent Vaccine 3 Oral Polio Vaccine 3 Pneumococcal Conjugate Vaccine 3 Inactivated Polio Vaccine (IPV)
6 Months	Vitamin A First dose
9 months	Yellow Fever Vaccine Measles Vaccine 1 Meningitis Vaccine
15 Months	Vitamin A Second dose Measles Vaccine 2

Table 1: The current routine vaccination schedules in Nigeria

The advantages of vaccines are accomplished when they are not missed and are taken in full. Only 1 in 4 children in Nigeria has received all required vaccines, which means that most of the children do not complete the vaccination schedule, thereby reducing the effectiveness of the vaccines, especially those needed to be taken in more than one dose like the OPV, PVC and the Penta (NICS, 2016/17). The graph below shows the national completeness of routine immunization at 23%, alongside those of each geo-political zone.

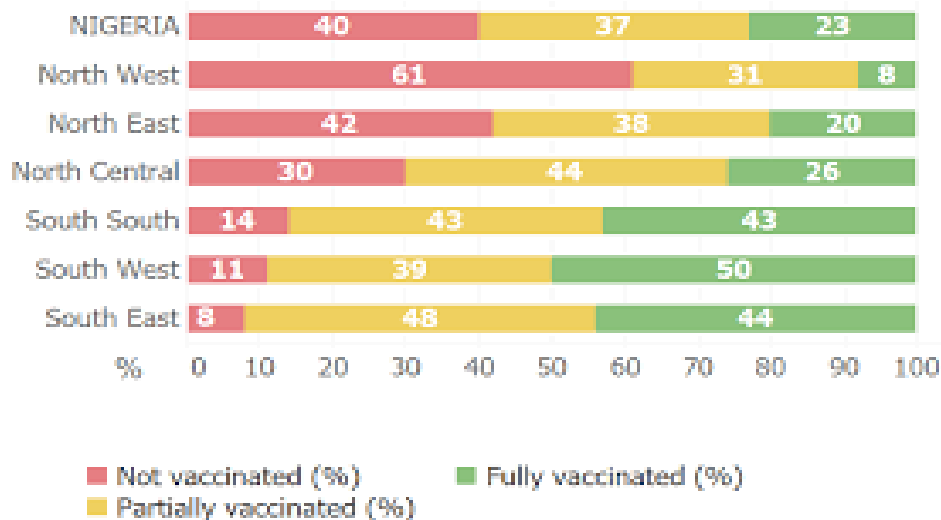


Figure 2: A Graph of the Completeness of Routine Immunization in Nigeria

Source: National Immunization Coverage Survey 2016/2017

1.1.3 Stakeholders for Immunization in Nigeria

Essential and critical stakeholders responsible for immunization include National, State, and Local actors, including International donors, caregivers, and healthcare providers. They are presented in Table 1.2 below.

Category	Stakeholders
National	Federal Ministry of Health (FMOH) National Primary Health Care Development Agency (NPHCDA)
State	State Ministry of Health (SMOH) State Primary Health Care Development Agency (SPHCDA)
Local	MOH (Medical officer for Health), LGA Immunization Officer (LIO), LGA State Mobilization Officer (SMO)
Health care providers	Professionals in the field of Vaccination
Caregivers	Mothers and Fathers of Children, or anyone taking up the responsibility
International	GAVI, UNICEF, WHO

Table 2: Stakeholders for Immunization in Nigeria

CHAPTER 2

2.0 Problem statement

VPDs have recently re-emerged in countries that previously achieved eradication or had them under control, as reported by UNICEF (2023). This resurgence is also evident in countries with ongoing disease control challenges such as Polio and Cholera (UNICEF, 2023). Nigeria is one of the countries experiencing the re-emergence of poliomyelitis despite being declared polio-free in 2020 (WHO, 2023). The resurgence was due to a vaccine-related strain- the circulating vaccine-derived poliovirus type 2 (cVDPV2) (UNICEF, 2023) (Adebisi et al., 2020). A concerning statistic reveals that out of the 25 million children who have either missed a vaccine dose or received no vaccine, approximately 3.1 million are in Nigeria, making it the second-highest figure worldwide (UNICEF, 2023). These children are at an increased risk of VPDs, as Mahachi et al. (2022) reported.

Results from the 2016/2017 National Immunization Coverage Survey (NICS) and Multiple Indicator Coverage Survey (MICS) reported that Nigeria was behind in achieving the strategic objectives of coverage. That immunization coverage was below the global target of at least 90% according to the Global Vaccine Action Plan (GVAP) (WHO/UNICEF, 2016). Furthermore, some discrepancies exist in the data from administrative and survey sources for vaccines that should be given during the same visit, per the national immunization schedule. For example, a 2.3% difference in coverage was recorded in yellow fever and measles vaccines. This difference suggests that the healthcare providers missed opportunities to administer these or those administering the vaccination. In addition, reports from research conducted in Ondo state, in the southwestern region of the country, aimed at assessing the rate of completion of the Pentavalent and Oral Polio Vaccine, found a 20% gap in the realisation (Fatiregun et al., 2021).

The 2018 National Demography Health Survey (NDHS) reported that out of 68% of children between the ages of 12-23 months who registered for a vaccination card, only 40% of the cards were present at the time of the survey. Similarly, among children aged 24-35 months, approximately 30% of vaccination cards were found out of the 65% registered for a card. The World Health Organization (2017) emphasized that these vaccination cards play a crucial role in the assessment of MOV because they give the accurate number of children who have missed vaccination when compared with the recall from the caregiver. According to the NDHS report, the vaccination cards were mainly seen in the country's South Eastern region.

In addition, the 2021 MICS report highlights that out of the 63% of children aged 12-23 months who have missed opportunities for simultaneous vaccination¹ for any dose at least once, 33.7% got their doses on a later date. Simultaneous vaccination includes cases where children received only one dose but did not receive the other eligible doses on the same day (NBS/UNICEF, 2021).

¹ Missed Opportunities for simultaneous Vaccination refers to when a child receives one dose but on the same day do not receive other doses they are eligible for (MICS/NICS, 2021)

2.1 Justification

Insufficient immunization coverage in the country is attributed to several reasons, and one major contributor is MOV (WHO, 2017). Strategies aimed at reducing MOV among children who make contact with the facilities are essential to potentially increase immunization coverage, not only at the health facility level but also at the state and national levels (WHO, 2017) (Adamu et al., 2019). As MOV is linked to the quality of health care, it is crucial to conduct assessments to understand better the burden and the factors influencing its prevalence, especially among children aged 0-23 months old, as recommended by The World Health Organization (2017). Although there is extensive documentation on factors influencing the use of immunization in Nigeria, not much has been done specifically on factors influencing MOV or the interventions/strategies available to address the issue. Because the causes of MOV are multifaceted and complex and can often be interconnected, it has become imperative to understand the underlying causes contributing to MOV and the strategies to address these problems. This approach can help stakeholders and policymakers develop better health systems policies to improve Nigeria's coverage and equity of childhood immunization.

2.2 Research Questions

- What are the factors affecting MOV in Nigeria?
- What interventions have been identified to tackle MOV?
-

2.3 Objectives

2.3.1 General Objective

To explore the factors responsible for Missed Opportunities for Vaccination and the interventions aimed at reducing MOV in Nigeria to make recommendations to improve immunization coverage and the quality of life of children.

2.3.2 Specific Objectives

1. To explore the factors responsible for missed opportunities for vaccination in Nigeria
2. To identify the interventions and strategies aimed at reducing missed opportunities for vaccination in Nigeria and other African countries
3. To develop recommendations on effectively reducing MOV through evidence-based quality improvement interventions to the Federal, State, and Local governments to improve immunization practices in Nigeria.

CHAPTER 3

3.0 Methodology

A Literature review was conducted to identify relevant articles and synthesized them into an organized summary of existing knowledge on MOV. The study aimed to discuss the factors contributing to MOV and identify the interventions to alleviate the problem in Nigeria and other African countries.

3.1 Literature Search Strategy

A systematic approach was used to gather relevant evidence from bibliographic databases such as Medline via PubMed, VU Library, Research Gate, Popline, AJOL (African Journal of Reproductive Health), Google Scholar, and the snowball method of the reference lists of retrieved articles. Additionally, grey literature from websites of international organizations focused on immunization, such as UNICEF, WHO, and Gavi, was examined. At the national level, websites of Nigerian government institutions like the NPHCDA (National primary health care development agency), the National Bureau of Statistics, the National Populations Commission, the Federal Ministry of Health (FMOH), HMIS (Health Management Information System), National Health Demography Survey, amongst others were accessed. Daily search alerts were set on Academia.edu and Lancet to stay updated with the latest publications.

3.2 Inclusion and Exclusion Criteria

The Criteria below were used to identify and select literature for the study:

Language of Publication: Articles published in the English Language alone were retrieved and included in the search.

Relevance: Preference was given to articles related to African countries.

Publication Date: The search process excluded articles published before 2013, but particular relevant articles from older literature, such as 2010, were included to provide a historical perspective on immunization in Nigeria. Furthermore, information from 2009 about the legal notice of the 2006 census final results, representing the most recent census conducted in Nigeria, was also used.

Availability: Articles whose full texts are available from the above sources were included in the research.

3.3 Keywords

Some of the significant keywords used are ‘Missed opportunities for Vaccination’, ‘Immunization’, ‘Under-five children’, ‘Interventions’, and ‘Nigeria’. The combinations are shown in detail in Annex.

3.4 Conceptual Framework for the Study

The conceptual framework used for this study has been adapted from Nnaji et al. (2023). It integrates the theoretical domain framework (TDF) introduced by (Cane et al., 2012) with the behavioural change wheel approach (COM-B) model developed by (Michie et al., 2011).

3.4.1 Justification for the Framework

Adamu (2019) constructed a causal loop diagram to demonstrate the interconnectedness and interdependence of the determinants of MOV. However, using a complexity lens to explore the factors responsible for MOV on a broader approach became necessary. Before this, researchers such as (Rainey et al., 2011) (Favin et al., 2012) (Velandia-Gonzalez et al., 2015) had developed a series of frameworks to understand why children were missing vaccinations or were under-vaccinated. Despite this, the reasons for MOV factors were not well understood because the quantitative technique restricts exploring the stakeholder's perspectives within their unique contexts (Bernard, 2017) (Creswell&Poth,2017). As a result, qualitative exploration of the phenomenon was undertaken (Macfarlane &O'Reilly-de Brun, 2012).

This study utilized the integrated theoretical domain framework (TDF) and the behavioural change wheel approach (COM-B model) used by Nnaji et al. (2023) to identify factors influencing MOV. In a different study, Adamu et al. (2019) used this model to identify caregiver-related factors that influence MOV. Likewise, De Leo et al. (2021) also used this integrated model to identify the factors influencing midwives' efforts to evidence-based practices. The TDF is a widely used qualitative research framework that provides a deeper insight into the factors responsible for an individual's behaviour. It supports the argument that a comprehensive understanding of all interconnected factors of MOV is needed to reduce MOV (Cane et al., 2012) effectively. The TDF has been used in various contexts and countries (Dyson et al., 2011) (French et al.,2012) (Alexander et al., 2014). The framework consists of 14 different but interconnected domains associated with outcomes, namely; Knowledge, Skills, optimism, social role and identity, beliefs about capabilities, beliefs about consequence, reinforcement, intentions, goals, memory, attention, environmental context, and resources, social influence, emotions and behavioural regulations (Cane et al., 2012). It was employed in this study to identify factors that are influencing MOV among children under five in Nigeria.

However, the theoretical domain framework alone could not be used to inform interventions, hence its combination with the behavioural change wheel approach model (Michie et al., 2011). Because of this, the behavioural change wheel model was developed to translate the factors identified with the TDF into practical and implementable recommendations (Michie et al., 2011). The model, which focuses on Capacity, Motivation, and Opportunity, offers an array of processes that impact both internal and external behaviours (Michie et al., 2011) (Barker et al., 2016).

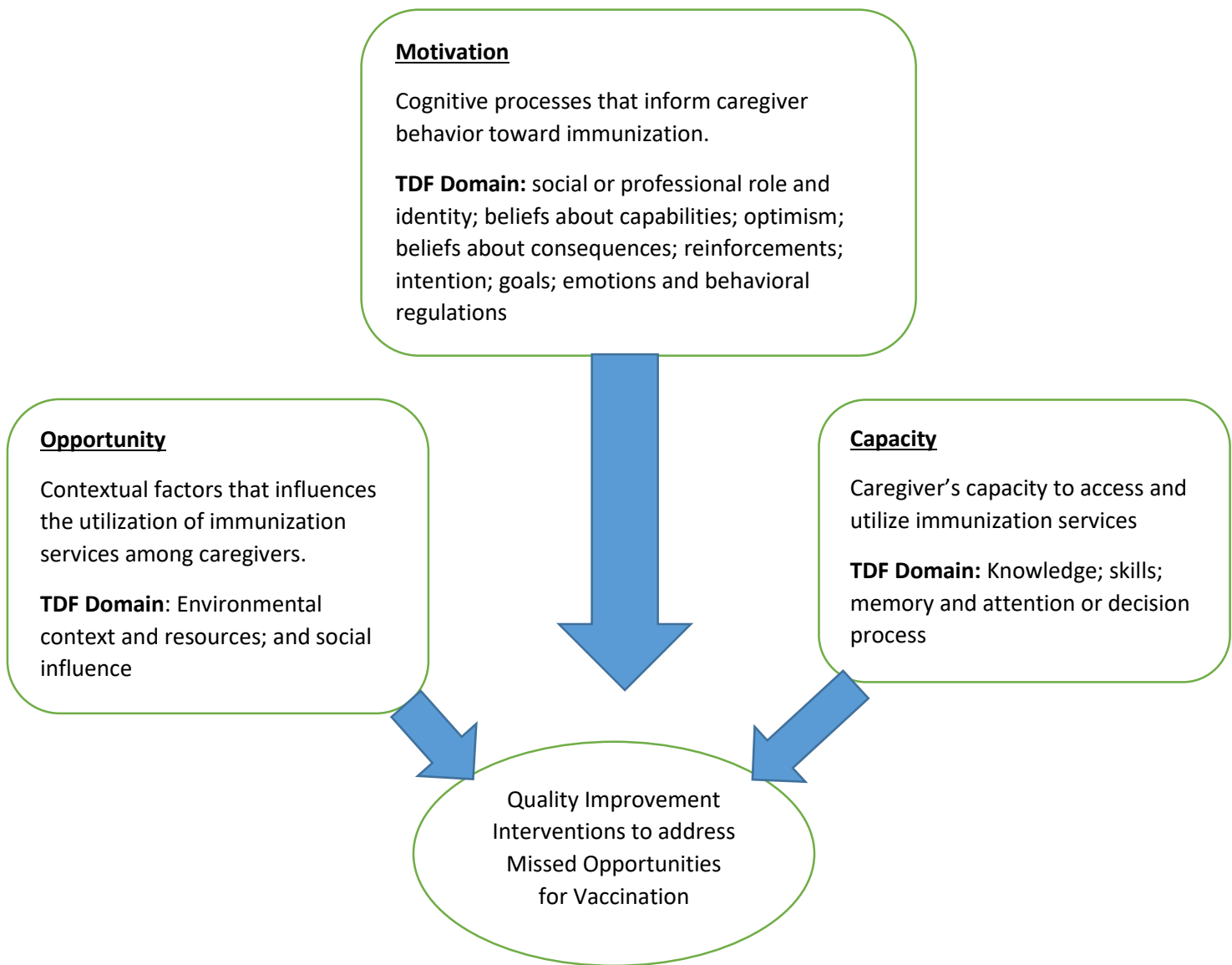


Figure 3: The Integrated framework from theoretical domain framework and behavioural change wheel approach in the context of Missed Opportunities for Vaccination adapted from Nnaji et al. (2023)

Source: Nnaji et al., (2023) Contextualizing missed opportunities for children’s vaccination: A theory-informed qualitative study in primary care settings in Cape Town, South Africa.

3.4.2 Description of the Integrated Framework

The factors identified from the integration of the TDF and the COM-B model were used to identify and structure quality improvement interventions that could address missed vaccination opportunities, as shown by the blue arrows. Each box identified distinct factors as described below:

Opportunity: This refers to the external factors, i.e. health systems that inform caregivers' decisions on immunization uptake whenever they come in contact with a health facility. This construct links to the domain of environmental context and resources, knowledge and social influence of the integrated theoretical domain framework.

Motivation refers to the factors related to the conscious intellectual processes that determine the caregiver's behaviour towards their child's immunization. This construct links to beliefs about capabilities, consequences, emotions and behavioural regulations, intentions, reinforcements, goals, optimism, and social role and identity.

Capacity refers to the factors related to the access and utilization of immunization services by caregivers for their wards whenever they contact a health facility. This construct links to the domain of skills, attention, knowledge, and memory of the integrated theoretical domain framework.

CHAPTER 4

This chapter uses the conceptual framework from Chapter 3 to analyze specific objectives 1 and 2.

4.0 RESULTS

From the literature used for this study, the following factors identified by the authors have been categorized into the COM-B Model construct and the 14 Theoretical domain framework sections, alongside their corresponding proposed interventions as shown in Table 3.1 below;

COM-B Model Construct	Corresponding TDF Domain	Factors Identified	Examples of quality interventions Identified
Opportunity	Environmental Context and Resources Knowledge	Long waiting time Vaccine Stock out Immunization Schedule Availability of Human resource Distance to the facility Knowledge, Attitude, and Practices among health care Providers Screening of vaccination card	-Provision of reminders on screening of vaccination cards in health facilities, such as stickers, IEC materials, computer screen savers, etc., for health providers. -Training health care workers on good immunization practices, sensitization on MOV, vaccine shortage forecasting, and issuance of temporary cards when in doubt of a child's status to avoid humiliating the caregivers. -Training of the entire facility, including non-immunization staff, to reinforce integrated management of childhood illnesses, to help especially during curative visits to the facility. -Carrying out health promotion services during long waiting times at the clinic

Motivation	Beliefs about capabilities Beliefs about consequences Emotions and behavioural regulations Social Influence Intentions Goals Optimism Social Role and Identity	Fear of side effects from vaccination Mistrust in Vaccines/ Safety of Vaccines Place of Delivery Perception, beliefs, and sociocultural influences Socio-economic factors Socio-demographic factors	-Provision of posters or charts providing true and false contraindications to vaccines in children -Educate health workers to properly engage caregivers to address their fears and misconceptions regarding vaccines. -Intensive integrated supportive supervision of the facilities from all levels of authority, i.e. Local government and State levels
Capacity	Skills Attention Knowledge Memory	Availability of vaccination cards during visits Caregiver's knowledge, attitude, and practices on Vaccination Access to information on routine immunization	-Provision of posters/ stickers with detailed importance of immunization and the importance of coming along with vaccination cards for every visit -Using highly punctual and knowledgeable mothers as motivation for punctuality and good attitude toward immunization

Table 3: A table showing the factors influencing MOV according to the constructs from the conceptual framework

TDF- Theoretical Domain Framework, COM-B- Behavioral change wheel (Capacity, Opportunity & Motivation).

4.1 Opportunity

This section explains the external factors that inform caregivers' decisions on immunization when they come in contact with the health facility.

4.1.1 Long waiting time

Over the years, there have been ongoing concerns about clinic waiting times when caregivers bring their children for immunization and other services (Akwataghibe et al., 2019) (Adetola et al., 2022). In Nigeria, this issue is compounded by the competition between household activities such as farming and the limited time available for childhood immunization (Cockcroft et al., 2014) (Uwaibi & Omozuwa, 2021) (Grace et al., 2022). As a result, caregivers often miss vaccinating their children when faced with long queues at the facilities because they get discouraged and leave. Even though immunization is free, some healthcare providers take advantage of the situation by charging unofficial fees to expedite the process.

Consequently, due to financial constraints, some parents prefer not to vaccinate their children or return home without completing the vaccination process (Oku et al., 2017) (Olaniyan et al., 2022). Nnaji et al. (2022) also reported high complaints regarding prolonged clinic waiting times, particularly among mothers who still have to balance responsibilities and return to work. Some of these have been attributed to staff shortages and the high demand for immunization services (Ogbuabor et al., 2023) (Olaniyan et al., 2022).

4.1.2 Vaccine Stock out

Adamu et al. (2019) noted that a lack of resources, or maintaining the same level of help with a proportional increase in the utilization of health services, leads to vaccine stockout and a shortage of other consumables, such as syringes in clinics. This situation further worsens the problem of missed opportunities for vaccination. Lack of vaccines and consumables implies that children may miss their chances to be vaccinated even when at the clinic on their scheduled dates and with their vaccination cards. A similar study by Okafor et al. (2019) and Taiwo et al. (2017) reported that 8.3% and 4% of the respondents indicated that the unavailability of vaccines at hospitals was why their child missed vaccination.

In recent years, the Government of Nigeria, with assistance from Gavi, has made efforts to enhance vaccine availability by providing cold chain systems and improving distribution capacity to prevent vaccine stockout (Gooding et al., 2019). Despite this endeavour, there remain significant gaps, for instance, Fatiregun et al. (2021) reported a lack of cold chain systems in some of the facilities in the south-western region of the country, while Adamu et al., 2020 noted that some facilities in the Northern part have vaccine cold chain systems, in the form of a refrigerator, but the designs are no longer functional. The lack of vaccine cold chain explains why certain vaccines are out of stock, as reported by (Adamu et al., 2020). To address this issue, the Local Government Immunization Officer, as part of the local government authority team, tries to ensure availability. However, the support is not consistently provided across all facilities leading to instances where caregivers are referred to other facilities. Unfortunately, even with these referrals, some opportunities are still missed due to challenges with the immunization schedule.

4.1.3 Immunization Schedule

According to a study conducted by Okafor et al. (2019), a survey of MOV in a Nigerian hospital, it was found that 72% of caregivers presented their children for immunization on the wrong days, leading to MOV. The reasons cited for this included being too busy working, travelling, or the child being ill, which hindered their ability to receive the immunization. The study also revealed that vaccination for children was administered once a week, which contributed to the high prevalence of MOV associated with immunization schedules.

Another study by Ibraheem et al. (2016) reported that fixed immunization dates significantly affected the high proportion of MOV in their research. The study found that eligible children often miss their opportunities to be vaccinated because of the lack of flexibility with the dates scheduled for immunization in facilities. Tijani (2020) further supported this theory, where he confirmed that while some mothers lacked sufficient knowledge about the importance of vaccines, others were unaware of the immunisation schedule, which directly contributes to MOV.

4.1.4 Availability of Human resource

In Nigeria, the healthcare staff responsible for vaccination face a heavy workload, leading to strict adherence to a predetermined vaccination schedule for each immunization day (Uthman et al., 2018). This strict schedule often results in overlooking children who have missed a previous antigen. In addition, healthcare providers express concerns about potential contraindications that may arise if multiple doses are administered on the same day, indicating a lack of adequate knowledge of the matter.

A similar situation was observed in a study conducted in South Africa by Nnaji et al., 2023, where immunization was carried out on a first-come, first-served basis despite the staff shortage and heavy workload. Some children were asked to return home without receiving the necessary attention due to the inability to accommodate them. Meanwhile, the situation differed in Chad, where a slightly higher than average percentage (54%) of the respondents in the study conducted by Okafor et al. (2019) indicated that despite the increasing rate of MOV, the healthcare providers offering immunization in Chad were sufficient.

The study by Okafor et al. (2019) also emphasized the importance of integration of services, where every healthcare worker in the facilities had the basic knowledge of vaccination and actively screened every child they came in contact with, regardless of the purpose of their visit (whether they are presented for immunization, curative purposes, routine checkups of the caregiver or on a visit with the caregiver to another patient in the clinic).

4.1.5 Knowledge, Attitude, and Practices among health care Providers

Studies such as Omuemu et al. (2023) and (Mahachi et al., 2022) have reported that health workers often refuse or hesitate to open a new vaccine vial, even when a child is being presented for vaccination. This hesitancy is because most vaccines, for instance, a BCG vaccine, can be used for as many as 20 children, and opening a vial for fewer children results in wastage as it cannot be stored until the next day. In addition, these authors have highlighted a lack of knowledge regarding the contraindications of vaccines among healthcare providers. Many providers do not administer vaccines to children because they do not have the proper knowledge, contributing to the prevalence

of MOV. Similarly, over half of the healthcare providers incorrectly identified that a low-fever grade is a contraindication for any vaccine in Malawi. While some reported receiving no training on VPDs or vaccination, others reported receiving training as far back as four years before the study (Ogbuanu et al., 2019).

Nnaji et al., 2022 highlighted the intimidation experienced by the caregivers due to occasional instances of healthcare providers raising their voices at them. This pressure level negatively impacts their motivation for future visits, as the providers become unnecessarily rude once an appointment is missed. The study also highlighted issues related to lack of effective communication, explicitly concerning information about contraindications and side effects caregivers should watch out for. This ineffective communication makes caregivers hesitant to seek clarity on essential issues.

4.1.6 Distance to the facility

Adamu et al. (2019) and Taiwo et al. (2017) highlighted that one of the reasons caregivers are not motivated to take their children to be vaccinated is the distance to the health facility. Some health facilities are located several miles away, and caregivers who are not financially buoyant, particularly those from lower socioeconomic status, struggle to keep up with the immunization schedule due to the transportation cost and, most probably, the associated service charges. In addition, because of the lack of proper understanding of the importance of vaccination for their children, some caregivers do not prioritize it.

A study on MOV in low and middle-income countries conducted by (Restrepo-Méndez et al., 2016) reaffirmed that distance was a significant barrier, especially for those who live in rural areas. They often have to trek a long distance to reach the health facility and encounter a long waiting queue afterwards. This process contributes to a high dropout rate and low vaccination coverage experienced in rural areas.

4.1.7 Screening of vaccination card

A Vaccination card is issued by a hospital containing a child's immunisation history. However, monitoring a child's vaccination history closely when in contact with the health facility is of significant concern. Adamu et al. (2019) emphasized that routine immunization often lacks sufficient attention to screening vaccination cards, decreasing card screening frequency.

In addition, there is reported inadequate knowledge of when to screen vaccination cards by healthcare providers. A study by Ogbuanu et al. (2019) in Chad, a country that shares a border with Nigeria, highlighted that approximately 68% of healthcare workers stated that vaccination cards and status should only be screened during scheduled vaccination visits. In contrast with Malawi, in the same study where 55% of the respondents confirmed that screening of vaccination status should be done during all visits beyond vaccination, like consultations for any form of illness or during a visit where the child accompanies their mother to the clinic.

Furthermore, Adamu et al., 2020 also reported that health facility workers often neglect screening vaccination cards, especially during peak periods or when services are not immunization related. This negligence is a significant reason why many children miss the opportunity to receive vaccinations.

4.2 Motivation

This section explains the factors related to the conscious intellectual processes determining the caregiver's immunisation decision.

4.2.1 Fear of side effects from vaccination

Adamu et al. (2019) and Nnaji et al. (2023) reported that the fear of adverse reactions and side effects, such as fever, is a significant reason mothers hesitate to present their children for vaccination. This fear affects the acceptance rate of vaccines. (Cockcroft et al., 2014) reported that some mothers fail to present their children for immunization after witnessing other children experiencing adverse reactions to the same vaccine their child is due to receive.

Additionally, Obasohan et al. (2018) linked the fear of vaccination's side effects to the caregivers' literacy level. The study confirmed that this fear is one of the leading factors associated with missed vaccinations in Niger State, Nigeria's North Central zone.

4.2.2 Mistrust in Vaccines/ Safety of Vaccines

Another reason children are missing vaccinations is due to caregivers' hesitancy, which is influenced by the myths and misconceptions surrounding vaccines. In the study by Taiwo et al. (2017), 82% of the respondents thought administering more than one vaccine shot in a single visit would overload their child's immune system. Additionally, 50% believed vaccination directly relates to infertility later in life or even death, as Cockcroft et al. (2014) reported.

Nnaji et al. (2022) also reported that some mothers believe their children will be sick once they get vaccinated, discouraging them from vaccinating their children. In a study conducted by (Cockcroft et al., 2014), respondents expressed mistrust in Government and believed it had hidden agendas. They blamed the Government for the death of many children in northern Nigeria whenever a new vaccine was introduced.

4.2.3 Place of Delivery

Another factor that has been associated with MOV is the place where the caregivers deliver their children, as suggested by various authors (Adedokun et al., 2017) (Olorunsaiye & Degge, 2016) (Adegboye et al., 2014) (Obanewa and Newell,2020). These authors highlight that health facility deliveries allow caregivers to receive vaccines for their newborn, for instance, BCG, OPV & HBV antigens, which are given at birth. Additionally, caregivers can obtain first-hand information on future immunization schedules and receive general health information related to vaccination, such as identifying contraindication symptoms in children and the importance of antenatal programs.

Cockcroft et al. (2014) and Chidiebere et al. (2014) reiterated that many of the caregivers in the northern region of Nigeria do not believe in facility births. This study confirmed that this belief is one of the reasons why their children miss the vaccination at birth. Caregivers prefer not to deliver in health facilities due to their personal opinions and lack of confidence in modern medicine and healthcare providers (Adedokun et al.,2017).

4.2.4 Perception, beliefs, and sociocultural influences

Traditional and cultural beliefs, particularly in Northern Nigeria, have been identified as factors hindering mothers from seeking vaccination for their children (Tijani, 2020) (Adamu et al., 2019). The Northern part of the country consistently exhibits the highest vaccine hesitancy levels, as Ogundele et al. (2020) reported. (Taiwo et al., 2017) also found that mothers had little belief that vaccines could prevent their children from VPDs. Additionally, Ibraheem et al. (2016) reported a high prevalence of MOV in children from monogamous homes compared to those from polygamous homes. This difference may be attributed to the lack of support a mother in monogamous homes receives, unlike the support system among mothers from a polygamous home.

The Influence of husbands is also a significant factor influencing MOV. According to Adamu et al. (2020), MOV occurs mainly among children visiting the facility for other reasons. Sometimes caregivers who visit the facility for preventative services such as family planning or visiting a friend who has just delivered refuse their children from getting vaccinated. The main reason for this refusal is the husband's lack of awareness and consent, as they were not informed about the possibility of their child getting vaccinated that day. `

Social influences, such as health groups and media, have been reported to positively impact mothers' motivation to present their children for vaccination (Burroway & Hargrove, 2018). This practice has been successful in Countries like South Africa, where social media platforms like Facebook have been utilized to provide the information the mothers need regarding the importance of immunization. Health groups also play a crucial role in disseminating this information, especially to those who do not have smartphones (Nnaji et al., 2023).

Furthermore, the acceptance of immunization by the community also goes a long way in influencing the motivation of mothers to seek vaccination for their children (Taiwo et al., 2015) (Ijarotimi et al., 2018) (Obasohan et al., 2018) (Sato, 2020). Lack of adequate engagement and sensitization may deter the community from obtaining sufficient knowledge on vaccination (Restrepo-Méndez et al., 2016).

4.2.5 Socio-economic factors

This factor is subdivided into three parts: educational level of caregivers, socio-economic status of caregivers, and place of residence of caregivers.

4.2.5.1 Education /Literacy Level of Caregivers

In Lagos State, Nigeria, Kehinde et al., 2020 reported the prevalence of MOV as 11.3%. The study revealed that the level of the father's education was 68.0%, and the mother's educational level among children who have experienced MOV was 61.3%. On the other hand, (Olugbenga-Bello et al., 2017) found that paternal literacy is associated with a child's immunisation status, while (Ijarotimi et al., 2018) argued that it is not a direct cause. In Nigeria, Mothers play a significant role in ensuring their child is vaccinated; therefore, the higher mothers' educational level, the higher the probability of a child receiving complete vaccinations (Ilah et al., 2015). Additionally, the study by Adamu et al. (2019) identified low literacy levels, which directly affected the caregivers' possession and provision of vaccination cards when presenting their children for vaccination.

Sebastin, (2015) reported that a higher level of education among caregivers is likely to be associated with a better understanding of messages related to immunization, better health-seeking behaviour, knowledge of immunization schedules and locations, higher-paying jobs, and having enough funds to cover indirect costs. While vaccination disparity rates in Nigeria are on the rise, other developing countries like Rwanda have made notable progress in reducing disparities in children's vaccination rates. Rwanda has implemented various strategies and programs to promote equity, resulting in significant advancements in ensuring equal access to vaccinations. (MOH Rwanda, 2023) (WHO, 2022) (Gavi, 2021),

4.2.5.2 Socioeconomic Status of Caregivers

In terms of the wealth quintile, Adamu et al. (2019) conducted a study where 79.3% of the caregivers belonged to the higher quintile of wealth, while 9.8% belonged to the lower quintile of wealth. The study concluded that children from parents with top socioeconomic status were twice as likely to not miss their vaccinations as those from lower socioeconomic status. This finding was also supported by a study conducted by Ilah et al. in 2015.

In contrast to the study by Adedokun et al. (2017) & Chidiebere et al. (2014), (Obanewa and Newell,2020) did not find a statistically significant association between the wealth variable and childhood immunization. The nationally representative study re-coded the wealth variable, presenting the rural population as poor relative to the urban. Despite free immunisation services, rural dwellers found it challenging to bear some indirect costs in government hospitals.

4.2.5.3 Place of Residence

Place of residence, which is also associated with socioeconomic status, is a factor that influences children from getting vaccinated (Obanewa and Newell,2020). Their study analyzed three national health demographic surveys (2003, 2008 & 2013) and stated that the odds of being fully immunized tripled in 2008 compared to 2003, while in 2013, the odds were four to five folds higher than in 2003. The primary focus was the possibility of urban, rural, and slum dwellers missing vaccinations. Children from urban areas were 69% more likely to get vaccinated than those from rural areas. The difference is attributed to health system-related factors being more dominant in rural areas, where resource availability is often prioritized differently than in urban areas. This result aligns with Adedokun et al. (2017) and Olugbenga-Bello et al. (2017), who also found a relationship between location and opportunities for vaccination. However, Olugbenga-Bello et al. (2017) noted that rural and urban dwellers have improved in ensuring their children get vaccinated.

4.2.6 Socio-demographic factors

According to (Chidiebere et al., 2014) and (Sebatin, 2015), children belonging to Christian mothers are more likely to be vaccinated than their Muslim counterparts. This disparity in religion may partly explain the low vaccination coverage in the Muslim-dominated Northern region of the country. Chido-Amajuoyi et al. (2018) also confirmed this region's increasingly intense vaccination coverage levels. They concluded that children born to parents who practice Islam (Muslim) tend to miss vaccination appointments. However, Obanewa and Newell., (2020) highlighted that the low coverage of immunization is a result of the myths and misconceptions of some Muslim leaders who believe that vaccines were contaminated with Human Immunodeficiency Virus (HIV) as well as infertility agents targeted at reducing the Muslim population. Sebatin (2015) suggested the issue is more political and socioeconomic than religious.

Nevertheless, Obanewa and Newell (2020) found no significant association between religion and vaccination opportunities in urban areas.

Regarding ethnicity, a recent study by Afolabi et al. (2021) reported that children from Hausa or Fulani ethnic groups were more likely to miss being vaccinated than those from Yoruba and Igbo ethnic groups. The Igbo ethnic group had the highest vaccination completeness rate, followed by the Yoruba, as supported by reports from National studies like NDHS & NICS. Afolabi et al. (2021) also related these findings to the sociocultural practices, the literacy level, and the mistrust in vaccines within different ethnic groups.

Children born to young mothers also tend to miss vaccinations due to a lack of childcare experience (Chidiebere et al., 2014). In the study conducted by Afolabi et al. (2021), children born to teenage mothers were the least likely to be vaccinated, while young adults had the most proportion of vaccinated children. Adedokun et al. (2017) added that older mothers have more experience with the importance of the vaccine and the effects of treating children when ill, especially on the family income. However, Chido-Amajuoyi et al. (2018) believe that the advancing age of the mother can also contribute to why children in Nigeria do not get the complete vaccination they are eligible for.

4.3 Capacity

This section explains the factors related to caregivers' access and utilization of immunization services.

4.3.1 Availability of vaccination cards during visits

The availability of vaccination cards and the proper up-to-date filling of these cards could significantly impact mothers' knowledge regarding vaccination, as mentioned by Aderibigbe et al. (2017). This study, which recorded the prevalence of MOV as 24.4%, implies that when mothers possess a vaccination card during their contact with the health facilities, and the health care providers correctly fill the cards, it increases their understanding of vaccination beyond the primary level.

4.3.2 Caregiver's knowledge and awareness of the importance of Vaccine

From the study conducted by Taiwo et al. (2017), many caregivers believe that a vaccine is essential for a child only when they are ill. Ibraheem et al. (2016) noted that most of the caregivers had the wrong information about the contraindications of vaccines for their children. For instance, children with cough, fever, and nasal discharge were reported as contraindications to vaccines, restricting the caregivers from being present for other vaccination appointments. Aderibigbe et al. (2017) also suggested that mothers with children over the age of 12 months have grown in knowledge and understanding of what vaccination is about because of the exposure they have gotten over time, while mothers with children below 12 months often have inadequate knowledge, particularly those with limited access to information on vaccines.

In Nigeria, particularly in the North, a child is more likely to get vaccinated if the mother decides to (Cockcroft et al., 2014). This attitude is directly linked with the level of information available to the mother, the mother's empowerment, and the educational group of both parents. Due to the

patriarchy, which is more prominent in this region and other areas of Nigeria, consent is more important and usually comes from more educated fathers. However, this pattern was not observed in a state in the Eastern part of the country, as reported in the same study.

Meanwhile, in a study by Nnaji et al. (2023), caregivers reported having a positive and negative attitude toward their children's immunisation. Some caregivers went as far as setting reminders on their phones for the immunization appointments, and many of them made conscious efforts to keep their vaccination cards safe, as they were aware they might not be attended to at the clinic without them. However, healthcare providers reported that many caregivers do not exercise the necessary patience, especially when the clinic is busy, often arriving late to their scheduled appointment. In addition, personal reasons, mistrust of the vaccine, inability to get consent from a spouse, and lack of adequate information on immunization were also identified as factors affecting the caregiver's behaviour.

4.3.3 Access to information on routine immunization

A study conducted in the Northern part of the country reported that caregivers lacked adequate information about routine immunization (Taiwo et al., 2017). Only a few of the respondents demonstrated a good knowledge of what vaccine-preventable diseases were and the correct route of administration of some of these vaccines. Furthermore, only a few received information about the importance of routine immunization from the radio.

However, in the study conducted by Aderibigbe et al. (2017), a high level (95.2%) of awareness and knowledge of routine vaccines was reported among caregivers. This finding is similar to the study by Maina et al. (2013) conducted in Kenya. According to the authors, the results are increased media usage. Over 50% of the respondents received information on vaccination through the media, a proven effective communication method for those with access to it. Cockcroft et al. (2014) noted that a mother's negligence and considering vaccination to be unnecessary could be attributed to their lack of access to the correct information. In addition, the same study observed that mothers who give birth at home believe that they do not have the right to receive vaccinations at a government facility. Obasohan et al. (2018) also confirmed that the high home delivery rate in Niger State was associated with the lack of information among some caregivers.

4.4 Proposed Interventions and their Applicability in Nigeria

Limited literature exists regarding proposed or implemented interventions on MOV in Nigeria and other African countries. Despite this scarcity, this study tried to identify and categorize interventions based on the various constructs from the framework.

4.4.1 Opportunity

Healthcare worker training and retraining are typical in Nigeria (Mahachi et al., 2022). However, prioritizing training for good immunization practices and sensitization is crucial to reduce MOV, as indicated in studies from Kenya (Li et al., 2016) and Burkina Faso (Kabore et al., 2020). These studies highlighted the importance of updating the healthcare workers on revised national policies, various antigens and the ongoing efforts to ensure regular screening of vaccination cards in the facilities. Similar findings were reported by Olorunsaiye et al. (2017) in a descriptive analysis of

public and private facilities in 4 countries and by Adamu et al. (2019), who proposed using educational materials like job aids and training to enhance healthcare provider's knowledge of MOV in Northern Nigeria.

A follow-up study in Kenya by Brown et al. (2018) emphasized the need to train health workers and provide information on screening children's cards even during non-immunization visits. The study also recommended legible card writing to aid the caregiver's understanding. Encouraging healthcare providers to issue temporary or new vaccination cards to caregivers who forget theirs at home was suggested to reduce the number of missed doses, and humiliation caregivers face due to this factor.

In 2018, Gavi collaborated with the Ugandan government, implementing a customized mobile app alongside a wireless temperature monitoring system to aid in reporting vaccine stock out and facilitate delivery of vials that are out of stock, particularly in rural areas. While Ugandan's national immunization coverage is stalled at 85%, the government aims to increase vaccine availability in health facilities while reducing wastage and stockout. Okeibunor et al. (2018), a study done in Malawi, also reported using flexible vaccine doses as an alternative to address health workers' hesitance towards wastage, ensuring that children don't miss their vaccinations due to insufficient numbers.

The importance of reinforcing Integrated Management of Childhood Illnesses (IMCI) in clinics was highlighted by Ogbuanu et al. (2019) and Nnaji et al. (2022) in their studies conducted in Chad, Malawi, and South Africa. Reorganizing services, especially in primary health care facilities alongside routine services, can ensure that eligible children visiting the clinics for curative purposes also receive their vaccinations. The studies also suggested that vaccines should be available in all facility areas so that vaccine stockout can be adequately managed. And training conducted for non-immunization staff will indirectly address issues related to insufficient immunization staff.

4.4.2 Motivation

Nnaji et al. (2023) recommended educating healthcare providers on establishing personal engagements with caregivers to address myths and misconceptions around immunisation. This approach will enable caregivers to become comfortable enough to share their fears with healthcare providers. This intervention will address the issues of fears, myths, and misconceptions and increase the knowledge of contraindications. The authors highlighted that it would also be good to direct immunization information to reluctant caregivers. The authors advocated that information, education, and communication (IEC) materials, such as posters containing valid contraindications to vaccination, be made available at all immunization service points, using language the caregiver can easily understand.

The impact of COVID-19 resulted in a decline in Ghana's national childhood immunization coverage rate. To address this, the Ministry of Health collaborated with the World Health Organization and Gavi to implement strategies to restore coverage levels. These strategies involved increasing immunization sensitization in communities with the involvement of community leaders. New vaccination sites were constructed by the partners in rural and far-to-reach areas, and medical boats were rented for the easy conveying of staff to the riverine areas of

Ghana. Also, The World Health Organization's construction of additional medical boats further enhanced accessibility, alleviating the demotivation caused by long queues (WHO, 2023).

These strategies involving community leaders have been proven effective as community caregivers attested to the acceptance of vaccinating their children due to the community leader's support, motivation, and trust in the vaccine. This trust reassured them of the safety of the vaccine (WHO, 2023)

The Ghanaian government also trained healthcare providers on catch-up strategies, enabling them to identify and reach children who have missed or have zero doses. With support from the implementing partners, healthcare providers have reached more children than usual. With these interventions, which have been sustained over two years (2020-2022), Ghana has recorded a 7% increase in some districts, recording more than over 90% DPT3 coverage, and a 10% increase in coverage in other districts recording over 80% of the same antigen (WHO, 2023).

4.4.3 Capacity

According to the studies conducted by Nnaji et al. (2023) and Adamu et al. (2019), training and retraining of caregivers during waiting times at the clinics for both preventative and curative services, coupled with the availability of IEC materials (in the form of posters and even fliers) can significantly improve their knowledge of MOV. These training sessions would reiterate the importance of vaccines, scheduled times of administration, and the age at which their child will be due. Furthermore, caregivers will be encouraged to bring their vaccination cards at every visit.

Both studies also highlighted the effectiveness of using highly motivated caregivers as models for others. Caregivers who are more knowledgeable and usually more punctual at the clinics can be used as influencers to encourage others' perceptions towards immunization. This intervention can serve as leverage on the interventions mentioned above under the motivation construct.

4.5 Applicability in Nigeria

The interventions have been described briefly under feasibility, funding, collaboration with partners, and potential impacts to predict their applicability in Nigeria.

4.5.1 Feasibility: The indicated interventions are feasible in Nigeria, as demonstrated by their effectiveness in countries with similar settings, such as Uganda, Kenya, South Africa, and Chad, all categorized as low-middle-income countries. Nigeria's capacity to conduct training for healthcare providers has proven feasible at the national, state, and LGA levels. Funding from the government and critical partners like UNICEF, Gavi, WHO & The World Bank have made these initiatives possible. However, the impact is not usually felt, probably because the training content is not regularly revised, so there is no motivation to learn from the training (Bhatnagar & George, 2016), as well as the sustainability of the training. Drawing lessons from Performance Based Financing (PBF), a project funded by the World Bank to improve the maternal and child health outcomes in Nigeria (Apagu et al., 2022), IMCI was included in the checklist for quarterly facility assessments and has since then been sustained by the primary health care development agencies.

4.5.2 Funding: Funding has consistently posed a challenge to implementing interventions in Nigeria. Leading implementing partners have been the significant funders of immunisation in

previous decades (NPHCDA & FMOH, 2015). However, it's worth noting that some interventions have been identified as requiring low or no funds at all (WHO, 2019). Taking Ghana as a case study, The Ghana health services, UNICEF, and the Center for Disease Control recognized the importance of utilizing facility waiting times. Consequently, they collaborated to develop an immunization flip chat, which is used to engage care providers and provide health education and promotion services. This flip chat avails them of relevant information on the importance of vaccines and why it is essential to stick to the schedule, to get the desired result (GHE, UNICEF & CDC, 2019).

Nonetheless, some strategies, such as intensive training that require colossal funding, can benefit from in-country funds, such as the unspent Gavi health system and immunization strengthening funds (HSS) (WHO, 2019). Zeng et al. (2022) also concluded that although PBF has lower efficiency, it remains one of the cost-effective interventions in Nigeria's maternal and child health.

4.5.3. Partner Collaboration: Partners such as Gavi, WHO, and UNICEF have played crucial roles in ensuring children who have missed their vaccination are reached. Taking lessons learned from experiences in Ghana (WHO, 2023), Uganda (GAVI, 2019), and PBF in Nigeria, some local governments in riverine areas were provided with speed boats to aid supervision of hard and far-to-reach facilities. These interventions increased the BCG and DPT antigens uptake rate by 13.4% and 9.7%, respectively (Zeng et al., 2022). However, it is vital to involve the partners and high-ranked personnel who can ensure the interventions' successful implementation earlier in the MOV assessment to guarantee their active involvement and participation in the project. Nigeria can enhance its efforts to reduce MOV if the partners' expertise and resources are leveraged.

4.3.4. Potential Impact: Interventions such as training can significantly impact if done efficiently and effectively (WHO, 2019). The use of flipcharts in Ghana has shown a long-term high impact in reducing missed opportunities. Drawing lessons from PBF, a series of trainings were conducted for healthcare providers on various aspects of the project, such as financial management, Essential drugs management, DHIS2 application training, etc. (Bhatnagar & George, 2016). Although they had a high impact for the duration of the project, they were not sustainable by the government of Nigeria due to the lack of refresher training after the project closure due to funding constraints.

CHAPTER 5

This Chapter comprises a discussion of the results from Chapter 4, the recommendations, and conclusions.

5.0 Discussion

This study employed an integrated TDF & COM-B model to assess the factors influencing MOV in Nigeria. The factors were identified through the domains of TDF and carefully matched to its related COM-B construct. This approach aimed to develop effective interventions that can help reduce the rate of MOV in health facilities and across Nigeria. Among the factors identified from the study, seven were categorized under the TDF domain under the opportunity construct, six were highlighted under the motivation construct, and three were placed under the Capacity construct.

The prevalence of MOV varies within contexts in Nigeria and internationally, but most factors influencing the issue are similar. In Nigeria, the most commonly reported factors include vaccine stockout, the attitude of health care providers, lack of knowledge of the caregiver, fear and Mistrust in the vaccine, as well as socioeconomic factors such as educational level, place of residence, wealth quintile, and socio-demographic characteristics such as age (Adamu et al., 2019). A similar report has been observed in countries such as South Africa (Nnaji et al., 2023), Kenya (Li et al., 2016), Chad (Ogbuanu et al., 2019), Malawi (Okeibunor et al., 2018), Burkina Faso (Kabore et al., 2020) despite geographical variations.

The interconnectedness of these factors highlights the importance of addressing MOV comprehensively within local and global contexts. Targeting these shared factors alongside collaborations and exchanging knowledge among countries can help develop tailored interventions to reduce MOV.

From various studies (Aderibigbe et al., 2017) (Okafor et al., 2019) (Fatiregun et al., 2020), the mostly reported missed antigens were yellow fever and measles. One possible reason could be the longer interval between measles and Penta 3 (3 and half months) compared to the gaps between other antigens. These two antigens are also administered last in the vaccination schedule (Okafor et al., 2019). Another factor contributing to the missed antigen might be complacency regarding the importance of vaccination after the first year of age (Fatiregun et al., 2020). This issue was observed in African and Dominican Republic studies (Garib et al., 2016).

In Nigeria, socio-demographic factors of caregivers like age, ethnicity, and religion were not significantly related to MOV in urban areas as much as in rural areas. This difference can be attributed to the broader distribution of general health care services, including immunization services, in urban areas, which grants caregivers greater access, regardless of age, ethnicity, or religion. Moreover, two out of three studies (Adedokun et al., 2017) (Obanewa & Newell., 2020) suggested that place of residence (rural/urban) is a significant determinant of MOV, while one study (Olugbenga-Bello et al., 2017) partly agreed but made reference to the rural dweller's improvement in vaccination coverage. Hence, this factor remains a potential area for further research, as further investigation is needed to understand what impact place of residence plays more comprehensively.

According to the study, MOV mainly occurred among children visiting the facility for other reasons besides vaccination, which invariably means that children who presented for vaccination had lower MOV rates. This finding aligns with reports from other countries South Africa (Nnaji et al., 2023), Kenya (Li et al., 2016), Chad (Ogbuanu et al., 2019), Malawi (Okeibunor et al.,

2018), Burkina Faso (Kabore et al., 2020). The lower MOV rates in vaccinated children can be attributed to various ongoing interventions in the country to increase general vaccination coverage. Another factor Ibraheem et al. (2016) highlighted was the high prevalence among children born to monogamous mothers in Nigeria. Findings from a similar context by (Mazige et al., 2016) emphasized the importance of social family support as a critical factor in adopting healthy immunization behaviour.

Interventions to improve immunization awareness among caregivers can be implemented at different levels: National, State, Local government, and even PHC levels. To effectively address the level of attention at the PHC levels, intervention within the capacity constructs needs to be focused on, as it is directly linked to the caregivers and their knowledge of immunization. Implementing such interventions can be achieved at low or no cost as it will likely reduce MOV significantly (Nnaji et al., 2023) (WHO, 2019). By targeting the capacity construct and empowering caregivers with knowledge on immunization, Nigeria can take significant steps towards reducing MOV, particularly among vulnerable populations.

Because of the need to develop appropriate interventions that can address multiple factors simultaneously, it is essential to recognize their interconnected nature. For instance, training healthcare providers on reporting vaccine stock out and screening vaccination cards can directly impact the immunization schedule. By ensuring vaccines are consistently available at the facilities, adjustments can be made to the immunization schedule resulting in fewer missed opportunities for children. However, for certain factors related to socioeconomic and sociodemographic characteristics, implementations of strategies might necessitate involvement from multiple relevant stakeholders, making it long-term and somewhat political, which is also a potential study area. Nevertheless, if successfully implemented, it could be a high-impact intervention reducing MOV and increasing immunization coverage nationwide.

Furthermore, conducting health promotion services during waiting times has the potential to be a cost-effective intervention as it requires little or no funds for its implementation. In contrast, despite the continued usage of IEC materials in the county, this intervention tends to have a low impact as Nigeria still lags in achieving its National coverage targets for immunization. For more extensive interventions, such as training the entire facility staff, considerable funding may be required, which might not be readily available, presenting a significant challenge. There is also a shortage of literature on analyzing and appraisal of identified interventions, making it challenging to dwell extensively on it.

Implementing the proposed interventions may encounter challenges and bottlenecks, including the need for effective collaboration between partners and the lack of participation from high-ranked national or district-level personnel (WHO, 2019). The absence of involvement from key decision-makers can undermine confidence in the implementation process, as it can be challenging to secure their attention and commitment due to their busy schedules. However, the early involvement of these high-ranked personnel can significantly benefit the intervention's success.

5.1 Limitations of the Study

Many studies did not nationally represent Nigeria, as they focused on specific populations or health facility-based samples. This limitation prevents a definitive assessment of the prevalence of MOV in all children across the country, as it might not accurately reflect the situation in other regions or settings.

Moreover, underreporting is possible as most studies based their findings on caregivers with their vaccination cards at the time of the survey. Caregivers who did not have their cards or were absent during the study might not have been accounted for, potentially leading to an incomplete representation of MOV. In addition, some of the interventions might not have been implemented, making it a challenge to assess their effectiveness or impact on reducing MOV.

Furthermore, none of the literature used in this study reported MOV prevalence in other immunization sites, such as mobile clinics or health outreaches in the communities where the prevalence could be higher. Having these data from non-facility settings and among male caregivers may be helpful. Expanding the scope of the research to include data from various environments and caregiver groups would provide a more comprehensive understanding of MOV and facilitate the development of effective interventions.

5.1.2 Opportunities of the integrated framework

The framework played a crucial role in guiding the research in an approach that systematically identifies and explores various factors based on human behaviours (caregivers and health care providers) towards immunization. It helped to understand MOV's multifaceted nature, establishing the relationship and connection between internal and external factors. The framework was also instrumental in identifying implementable interventions that could be used to address MOV.

5.2 Recommendations

Levels classify the recommendations below;

At the National/Federal level,

- The prevalence of MOV among children under 5 varies across contexts and countries. While certain common factors have been identified regardless of the majority, conducting further studies at the national level remains essential. Interventions such as training the entire facility, including (non-immunization staff) to help during curative services can address factors like long waiting times at facilities and healthcare providers' knowledge and attitude. This approach is feasible in Nigeria with ongoing implementation in states like Ondo state, Nassarawa and Adamawa due to the PBF project being piloted there. Allocating government funding to support his training and updating the training curricula would enhance the effectiveness of these interventions. While these identified factors are consistent across different prevalence scenarios, conducting additional studies is essential to customize interventions according to the context. Adhering to the WHO's updated assessment methodology (WHO, 2017) is vital to enhance the precision of these assessments.
- Given the limited available evidence on interventions specific to MOV in Nigeria, it is imperative to prioritise research aimed at both developing new interventions and analyzing

the effectiveness of existing ones. For instance, a possible area of research is the utilization of waiting times at the facilities for health promotion and education for caregivers, which has been shown to have a sustainable high impact in Ghana. Furthermore, analyzing this intervention's effectiveness would help identify the existing gaps.

- Implementing MOV initiatives can be integrated into the annual national EPI work plan. Doing so will enable the prioritization of activities and indirectly reduce MOV while addressing other immunisation-related challenges.

At the State and Local Government Levels,

- It is necessary to conduct MOV assessments at both the state and local government levels, following the assessment guidelines provided by the WHO. Subsequently, holding brainstorming sessions among key immunization stakeholders will enable the identification of essential interventions, which can be ranked based on their importance and priority.
- Drawing lessons from Ghana and PBF approach in Nigeria, services should be extended to rural areas through outreach programs. This approach will alleviate the burden of travelling long distances to facilities and experiencing long wait times while empowering the citizens with government support.
- Once interventions have been identified and begun implementation, it becomes necessary to intensify supportive supervision to ensure interventions are effectively and accurately executed. Government funding allocation towards this supervision will ensure its seamless operation.

5.3 Conclusion

This study highlights the importance of addressing the interconnected factors influencing MOV among under-5 children in Nigeria. By tackling these factors, there is a potential to increase immunization coverage and reduce the incidence of vaccine-preventable diseases.

The factors involved encompass not only caregivers and health providers but also the broader health systems within the country. The study also identified several interventions. These include training healthcare workers on good immunization practices, carrying out health promotion services during long waiting times at the clinic, provision of informative posters/ stickers with detailed importance of immunization, encouraging caregivers to bring vaccination cards for every visit and using highly punctual and knowledgeable mothers as motivation for punctuality and good attitude toward vaccination. The study identified these interventions as potentially applicable in Nigeria due to their feasibility, ease of funding, partner collaboration and potential impact drawing lessons from Nigeria and similar contexts in other countries.

These interventions have been categorized to address multiple factors simultaneously, but it is crucial to consider the contextual characteristics of Nigeria during their implementation to maximize their effectiveness. This process will ensure alignment with the needs and realities of the Nigerian health system, thereby potentially achieving desired outcomes in reducing MOV and improving immunization coverage in the country.

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Annex

Objectives		Problems		Factor-related terms from the framework and others		Geographical Scope
To explore the factors responsible for missed opportunities for vaccination in Nigeria	OR	Missed Opportunities for Vaccination	AND	Caregiver's Attitudes and Practices Level of education Socio-economic status Urban-Rural disparities Ethnicity Fear and mistrust in Vaccine Place of Delivery Health provider's attitude and practices Human resource Health System Factors Vaccine stockout Long waiting time Screening of Vaccine cards Immunization schedule Distance to facility Theoretical domain framework Behavioural change Wheel Prevalence Demographic Factors Intervention	AND	Africa Sub-Saharan Africa West Africa Nigeria Low Middle-Income Countries Nigeria
To identify the interventions and strategies aimed at reducing missed opportunities for vaccination in Nigeria and other African countries		Missed doses Unvaccinated Children Zero dose MOV Childhood Vaccination Vaccination				

Search Table: Combination of Keywords for Literature Search