Knowledge, Attitude and Adherence to Routine Childhood Immunization among Mothers in Agwara Local government area, Niger State Nigeria

USMAN SHEHU SALIHU
LCU/PG/002455

Being an MPH Presentation Submitted to the Department of Public Health, Faculty of Basic Medical and Health Sciences, Lead City University, Ibadan, Oyo State, Nigeria

In Partial Fulfillment of the Requirements for the Award of Master Degree (MPH) in Public Health

2023

Certification

This is to certify that Usman Shehu SALIHU with Matriculation Number LCU/PG/002455 carried out this research work titled "Knowledge, Attitude and Adherence to Routine Childhood Immunization among Mothers in Agwara Local government area, Niger State Nigeria" in the Department of Public health, Faculty of Basic Medical and Health Sciences, Lead City University, Ibadan, Oyo state, for the award of Master Degree (MPH) in Public Health and that this has not been previously submitted.

_____ _____

Dr. Abideen Salako **Date**

(Supervisor)

_____ _____

Dr. T. A. Olowolafe **Date**

(Head of Department)

Dedication

This project is dedicated to God Almighty.

Acknowledgement

My acknowledgement goes to the Almighty God for giving me the grace, ability, spiritual wisdom and physical strength to go through this course to a successful end.

I sincerely appreciate my Supervisors Dr. Salako and Dr.F.TAkinsolu who are always been there for me with constructive advice. They painstakingly guided me through the quest for knowledge despite their tight schedule and also despite my mistakes, omission and commission; indeed, they are born teachers and mentors.

Many thanks to the Head of Department Dr. Olowolafe, and Lecturers of the department of Public Health; Miss Oladejibi, Mrs. Akinpelu Mr. Akanni and other who have in one way or the other impacted my life during the Programme.

My sincere gratitude goes to my parents Mall Salihu and Mallama Hafsat, my Wife Hajiya Lantana and friends (Mr Chiroma Laminu, Adedokun Sofiat, Nufaisat Mohammed) for their prayers and support.

Even though the above mentioned institution(s) and persons have assisted in the process of this research work, I alone stand responsible for the errors, if any, found in the work.

Abstract

Immunization remains a veritable child survival strategy in curtailing the unwholesome indices with worse/lowest indices in the northern and rural part of Nigeria. Thus, this study evaluated the Knowledge, Attitude and Adherence to Routine Childhood Immunization among Mothers in Agwara Local Government area, Niger State in Northern Nigeria.

The descriptive cross-sectional study design enrolled 354 mothers from all communities within Agwara Local Government area of Niger State using milti stage cluster sampling method. World Health organization validated instrument on immunization coverage and survey was adopted. Data collected was analysis using descriptive (frequency and percentage count) and inferential statistics (Chi-square). Data management and analysis was done using Statistical Package for Social Science Version 25.

The study found that the mean age of the mothers was 30.8 + 5.837 years and that of their partners was 38.62 + 7.97 years with average number of 2.52 + 1.30 children. The overall percentage of mothers with good knowledge and positive attitude towards routine childhood immunization were 65.3% and 52.2% respectively. The adherence level to routine vaccine were BCG 59.3%, Hep-47.4%, OPV-46.9%, PCV-41.0% Penta-40.0% and Measles-20.0%. The study showed that mothers do often forget their children immunization appointment and claimed that they need a reminder to meet up with their children immunization appointment. The study discovered that there was statistical significance associated between knowledge (Chi-square value 6.056, p-value 0.014) and attitude (Chi-square value 15.653, p-value<0.001), and adherence to routine childhood immunization. Other socio-demographical factor namely religion, education qualification, marital status, family type, occupation, age at first marriage, age at first birth, and partner's age. Education and occupation had statistical significance association with adherence to routine immunization. The adherence level in Agwara Local Government Area is quite low when compared with proposed adherence level of 90% in National policy on immunization. And this could be attributed to low knowledge and negative attitude. Thus. it would be recommended that adequate immunization educational programme be provided for the mothers. In addition, national customized immunization reminder apps could be developed to alart the mothers of immunization schedules.

Keyword: Routine childhood immunization, mothers, attitude, knowledge, adherence.

Word Count: 300

Table of Content

List of Table

List of Figure

Chapter One

Introduction

This chapter gives information on the history of immunization, importance of immunization as well as the significance of this study. It also gives a brief description of the key terms relative to this study as well as the hypothesis and scope guiding the aims and objectives of this study.

1.1 Background to the Study

The survival of the Nigerian child remains an uncertainty with the country contributing to approximately 13% of global number of children who dies before the 59months of age[1]. The morbidity and mortality of the children under 5years of age are primarily alluded to vaccine preventable diseases such as Pneumonia, Tetanus, and Diarrhea Diseases, which can be prevented by the adoption of the routine vaccination in the National Program of Immunization schedule[2].However, irrespective of the uniqueness routine vaccine, the vaccine coverage in Nigeria remain below best international acknowledge target globally with less than 30% as reported by the NDHS 2018 for from the proposed global vaccine action plan which aimed at ensuring the delivery of universal access to immunization with associated targets of 90% at the national vaccination coverage and at least 80% vaccination coverage in every district[3].The government with international and national partners has continued to institute different measures at improving the immunization coverage and the child health indices across the country[4]. While the Southern state have shown remarkable positive trends in the immunization coverage and child health indices, the northern region including the Agwara local government Area of Niger still have some disparagingly poor child health indices with corresponding below par immunization coverage making the attainment of the Sustainable Development Goals (SDG) 3 a phantasm[5]

Considering the challenges associated with the low immunization coverage in Nigeria and the significant interlink between maternal socio-economic, educational status, among other factors and the adoption of routine immunization[6]. Furthermore, the factors that influence immunization coverage among Africa children were classified into two broad categories of modifiable and non-modifiable factors. The modifiable factors (obstetric history, maternal knowledge, maternal attitude and self-efficacy and maternal outcome expectation) were revealed as having a direct relationship with the childhood immunization uptake[7].

Therefore, improving the vaccine coverage and child survival strategy adoption in Agrara LGA Niger state Nigeria will entail evaluating the knowledge, attitude and adherence to routine childhood immunization, so as to help guide in the institution of health education among women and healthcare strategy and policy towards reducing the child survival. Thus, the aim of this study is to assess the level of Knowledge on Routine Childhood Immunization among mothers in Agwara LGA of Niger State Nigeria.

1.2 Statement of the Problem

Despite the EPI's goals, Nigeria has one of the lowest rates of routine vaccination coverage in the world[7, 8]. According to a recent survey of 40 districts, the median coverage for each vaccination dose is less than 50%[9]. The third dosage of the diphtheria-pertussis-tetanus vaccination had the lowest coverage of all immunizations, ranging from 1% to 63 percent in different districts. A study ascribed this disparity to a lack of adequate understanding and perspective on immunization programs as a key tool for improving children's and babies' health[6].

Second, this research is in line with the World Health Organization's immunization plan 2030. For the decade 2021–2030, IA2030 establishes an ambitious worldwide vision and strategy for vaccines and immunization.

Niger State, characterized as one of the poorest-performing states in routine immunization (RI) within Nigeria, confronts a profound challenge in safeguarding the health of its children. The disconcerting statistic reveals that merely 39 percent of eligible children in Niger State received the Pentavalent 3 vaccine in 2020, leaving over 150,000 children unimmunized. This scenario is particularly alarming, emphasizing a substantial gap in the coverage of essential vaccines critical for protecting children against preventable diseases[7].

Within this broader context, the localized examination of Agwara Local Government Area in Niger State becomes imperative to comprehend the specific factors influencing routine childhood immunization. The overarching problem centers on the insufficient uptake of immunization services, as evidenced by the low Pentavalent 3 vaccine coverage. This situation implies that a considerable number of children in Agwara are at an increased risk of vaccine-preventable diseases, underscoring a pressing public health concern.

1.3 Justification of the Study

Immunization today saves more than three million lives a year. Millions of children, however, continue to lack access to even the most fundamental immunizations and die from illnesses that can be prevented with the use of vaccines. How well kids become immunized depends on a number of factors, including moms' educational background, age, marital status, socioeconomic situation, and religion.

1.4 Aim and Objectives of the Study

The following aim and objectives of the study will be focused on:

The aim of this study is to evaluate the mothers'/caregivers' levels of knowledge, attitude and adherence to routine childhood immunization in Agwara LGA, Niger State, Nigeria.

The Objectives of this study are to:

i. Assess the level of knowledge on routine childhood immunization among mothers in Agwara LGA, Niger State

ii. Examine the attitude towards routine childhood immunization among mothers in Agwara LGA, Niger State

iii. Investigate the level of adherence to routine childhood immunizations among mothers in Agwara LGA, Niger State

1.5 Research Questions

i. What is the level of knowledge on routine childhood immunization among mothers in Agwara LGA, Niger State?

ii. What is the attitude towards routine childhood immunization among mothers in Agwara local government of Niger state?

iii. What is the level of adherence to routine childhood immunization among mothers in Agwara LGA, Niger State

1.6 Hypotheses

The following hypotheses were tested in this study:

H_O1: There will be no significant relationship between knowledge, Attitude and adherence to routine childhood immunization among mothers in Agwara local government.

H_O2: There will be no significant difference in knowledge of routine immunization among mothers in Agwara local government based on academic qualification.

H_O3: There will be no significant difference in adherence to routine immunization among mothers in Agwara local government based on academic qualification.

1.7 Significance of the Study

The findings of this study would be helpful in the following ways:

1. The outcomes of this study may provide essential and latest information on knowledge, attitude and adherence to routine childhood immunization among mothers in Agwara local government of Niger state, Nigeria.
2. The outcome of this study may encourage public health research institutes, policy makers, ministry of health, governments, non-governmental organizations and other relevant stakeholders to create interest in planning or designing program on knowledge, attitude and adherence to routine childhood immunization among mothers
3. The findings of the study would serve as a knowledge base and reference point for other researchers who may be interested in routine childhood immunization and adherence to immunization schedule

1.8 Scope of the Study

The scope of this study will focus on the following:

1. Independent variables of knowledge, attitude and adherence.
2. Dependent variable of routine childhood immunization.

3. Descriptive survey research design.

4 The Population for this study will be mothers of children aged 0-24 months residing in Agwara LGA, Niger State.

5 Agwara local government area, Niger state as the study area.

6 A multi-stage cluster sampling technique was used.

7 Frequency distribution was used to analyze the level of knowledge and attitude of mothers/care givers on routine childhood immunization.

8 A chi-square test is to test association between the knowledge and adherence of mothers

1.9 Limitation of the Study

The below limitation were encountered in this study:

Some of the respondents were not be able to read and understand some of the question items in the questionnaire. However, efforts were made by the researcher with the help of the research assistants to interpret to such respondents in local language, specifically in Agwara Kambari. In addition, some of the respondents felt reluctant in the process of administration of questionnaires. However, the affected respondents were persuaded and assured by the researcher on the confidentiality of their responses. Some respondents were also hostile to the researcher and his assistants, such respondents were left alone and replaced immediately by a willing respondent.

1.10 Operational Definition of Terms

The relevant constructs in the study are operationalized as follows.

- **Routine Childhood Immunization:** it is a system of activities through which countries provide access to lifesaving vaccines and control, in order to eradicate immunization-preventable diseases among children (especially under-five)

- **Knowledge of Routine Childhood Immunization:** This is the fact or information and skill acquired through experience of practical understanding of routine childhood immunization.
- **Attitude towards routine childhood immunization:** This is the disposition of a mother/caregiver to respond positively or negatively towards a particular event or situation such as routine childhood immunization.
- **Child Health Improvement:** This is act of a mother/caregiver to join in activities that help in proper, better and further development of a child's physical, mental, intellectual, social and emotional wellbeing; such that diseases and infirmities are also inhibited.
- **Mothers:** It a term describing a female parent or a woman having or regarded as having the status, function or authority of a female parent.
- **Caregivers:** It is a term describing a person who provides direct attention and nurture to another individual who is either too young or too old to care for themselves**.**

Endnotes

[1]M., Abul Abbas, A. H. Lichtman, & S. Pillai. *Cellular and Molecular Immunology*, 10e, South Asia Edition-E-Book. **Elsevier Health Sciences**, 2014.

[2]A. Olaniyan & C. Isiguzo. *The Socioecological Model as a framework for exploring factors influencing childhood immunization uptake in Lagos state, Nigeria*. **BMC Public Health** 2021, 21:867 https://doi.org/10.1186/s12889-021-10922-6.

[3]National Population Commission-NPC/Nigeria and ICF. Nigeria Demographic and Health Survey 2018, Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.

[4]A. N., Galadima, A. Z., Nor, M. S., Salmiah, & A., Norliza. *Factors influencing childhood immunization uptake in Africa: A systematic review*. **BMC Public Health** 21, no. 1, 2021.

[5]V.Y. Adam, E.D. Onowugbeda, O.I. Osuji, & O.D. Omohwovo. *Prevalence and management of perceived adverse events following immunization in Infants attending well baby clinics in Benin City, Nigeria*. **Journal of Community Medicine and Primary Health Care** 32, no. 2, 2020: 57–67.

[6]D. Adejinka, O. Oladimeji, F. Adeyinka & C. Aimakhu. *Uptake of childhood immunization among mothers of under-five in southwestern nigeria*. **The Internet Journal of Epidemiology** 7, no. 2, 2019.

[7]MICS-NICS 2021 Preliminary Estimates of Vaccination Coverage and Timeliness among Children Aged 12-23 Months, UNICEF.

[8]O. J. Kanma-Okafor, O. A. Adefolalu, & M. R. Balogun. "*Maternal knowledge, attitude and compliance regarding immunization of under five children in primary health care centres in Ikorodu Local Government Area, Lagos State*". **Journal of Clinical Sciences** 16, no. 1, 2019: 7.

[9]R., Gunnala , I. U., Ogbuanu, O. J., Adegoke, H. M., Scobie, B. V., Uba, K. A., Wannemuehler, A. Ruiz ,H., Elmousaad, C. J., Ohuabunwo, M. Mustafa, P., Nguku, N. E., Waziri, & J. F. Vertefeuille. "*Routine vaccination coverage in northern nigeria: results from 40 district-level cluster surveys, 2014-2015*." **PLOS ONE** 11, no. 12. 2016. e0167835.

[10]G. C. Adeyanju, P. Sprengholz, C. Betsch, & T. A. Essoh. *Caregivers' willingness to vaccinate their children against childhood diseases and human papillomavirus: a cross-sectional study on vaccine hesitancy in malawi*. **Vaccines** 2021, 9, 1231. https://doi.org/10.3390/vaccines9111231

Chapter Two

Literature Review

This chapter highlights on the literature that is available in the topic especially the basic concern and aim of the research is to see the Knowledge, Attitude and Adherence to Routine Childhood Immunization among Mothers in Agwara Local government area, Niger State Nigeria. It includes literature regarding theories on the topic and review of the observed evidence of previous studies. As for concern, several books, journal articles, research studies and the Internet have been reviewed in this subject. The main objective of the literature review is to find out what research studies have been conducted in one's selection of developing research design. Thus, the previous studies cannot be unobserved because they provide the foundation of the present study.

2.1 Conceptual Review

2.1.1 Overview of Immunization

- Definition of Immunization

Immunization is a term used to describe the process of receiving vaccines. Immunization is the process of making a person immune or resistant to an infectious disease, usually by the use of a vaccine. These vaccinations help to boost the body's own immune system, which protects the person against infection or sickness in the future; thus, it represents the ability to develop immunity[1].

Immunization can happen naturally, such as an individual being accidently exposed to an infectious substance, or it can happen artificially, such as when a person receives vaccination. Regardless of the situation, vaccination confers inhibition to specific pathogenic substances

through the production of some specific proteinous antibodies that are particularly designed for eradication of these pathogenic substances in the body. Antibodies have no capacity to act upon a complete viral entity; instead, they react to a particular aspect known as antigen. Immunity to a certain pathogen can be passively or actively acquired. Passive immunity involves receiving either lymphocytes produced or antibodies by another immunized person's system; active type of immunization involves stimulating a person's immune system to generate lymphocytes and antibodies[2].Immunization strengthens the body's defenses against diseases caused by germs and viruses. Immunity (the body's ability to fight itself against diseases caused by specific bacteria or viruses) can develop spontaneously (when humans are exposed to bacteria or viruses) or can be given by doctors via vaccination. When people are immunized against a disease, they are usually immune to it or only acquire a mild form of it. Due to the fact that no vaccination is 100% effective, some persons who have been inoculated may still get the disease[3].

Many diseases that were once widespread and/or lethal (such as polio and diphtheria) are now infrequent or under control in communities and nations where immunizations are extensively administered. Vaccination has totally eradicated one illness, smallpox. Vaccines have proven to be extremely effective in preventing serious disease and increasing global health. Many major infections, including most sexually transmitted infections (such as HIV infection, syphilis, gonorrhea, and Chlamydia infections), tick-borne infections (such as Lyme disease), and many tropical diseases, still lack effective vaccinations (such as dengue)

Following vaccination recommendations is critical for people's own health, as well as the health of their families and community members. Many of the diseases that immunization prevents are easily transmitted from person to person. These infections can spread quickly among youngsters who have not been immunized. Vaccines available today are quite safe and well tolerated by the

majority of people. They have very little side effects[4].Immunity is the body's ability to defend itself against infections. Individuals are exposed to pathogens, which are foreign disease-causing substances such as bacteria, viruses, and fungus, on a daily basis. Innate and adaptive immunity are both components of immunity. Innate immunity, also known as natural or hereditary immunity, refers to a person's natural defenses, which include physical barriers (skin, hair), defense mechanisms (saliva, gastric acid), and general immunological responses (inflammation). Innate immunity is a type of immunity that is passed down through the generations. External defenses, commonly known as the first line of defense, make up innate immunity. External defenses, which include things like the skin, tears, and stomach acid, work to protect an organism from pathogen exposure, while internal defenses, also known as the second line of defense, address a pathogen once it has entered the body and include things like inflammation and fevers, as well as the chemical and cellular components that make up the innate immune system. Innate immunity is quick to react, but it isn't tailored to the threat.

When B cells come into contact with a pathogen, they form memory cells in addition to developing into antibody-producing plasma cells. Memory cells are a type of B cell that is formed after a primary infection and has the ability to recognize the pathogen. They have a long lifespan, with some lasting for decades and reactivating if the same infection infects them again. While the adaptive immune response to infection may take days or even weeks to respond on the first encounter, the response to infection is often faster and more robust on subsequent encounters because to the presence of memory cells. Protection from some diseases can last a lifetime, albeit it varies by individual and ailment[5].

Immunity that emerges from immunological memory is known as adaptive immunity. The body is exposed to a certain antigen (which is associated with a pathogen) and produces antibodies

against it. Adaptive immunity, also known as acquired immunity, is a type of immunity that develops after a person is exposed to a pathogen and develops immunity to it. It could also happen as a result of vaccination, in which a vaccine imitates a certain disease and triggers an immune response in the vaccinated person without making them sick.

- Active immunity

Active immunity is the act of exposing the body to an antigen in order to trigger an adaptive immune response. This response can take days or weeks to develop, but it can endure for months or even years. Infection with the hepatitis A virus, also known as HAV; in the wild and later recovery initiates a natural active immune response that mostly results in protection throughout life. Similarly, administering hepatitis A vaccination (via 2 doses) results in an acquired type of active immune response that provides long-term (potentially permanent) defense. Because a vaccine has only been available during later era of 1980s, further studies on duration of protection have only been up to 25 years, hence the disclaimers on time of protection afore-mentioned. Active immunity can arise naturally or as a result of vaccination[6].

- Natural immunity

When a person is infected with a virus, natural immunity develops. The body develops immune memory for the virus after the initial infection, providing immunity against the sickness so that if it is encountered again, they can fight it off quickly and avoid developing clinical disease[7].

- Vaccine-induced immunity

It's also known as artificial active immunity, and it occurs when a person develops resistance to a disease after being immunized. Immunization is the procedure that occurs in the body when a vaccine is administered to provide immunity against a pathogen. Vaccines use a pathogen that

has been weakened or killed, or parts of it, that are known to stimulate the immune system and cause an immunological response. Vaccines are usually given as injections, although some are also given by mouth or as a nasal spray[8]. When a person's immune system recognizes a virus, it goes to work destroying and removing it. This includes the production of new antibodies and memory cells that are specific to the infection. If the body is exposed to the same pathogen again in the future, the memory cells associated with that pathogen will become active, prompting the creation of antibodies to defend the body. The fundamental advantage of active immunity obtained through vaccination over spontaneous infection is that the individual does not have to experience the disease in order to develop immunity[9].

In order to keep huge populations of people safe from infectious diseases, vaccination and immunity are required. The influenza vaccine, for example, keeps millions of people from contracting influenza each year, and SARS-CoV-2 immunization campaigns around the world are likely to have avoided a large number of cases and deaths[10].

- Passive Immunity

Passive immunity is the process of generating IgG antibodies to guard against infection; it provides instant, but short-term protection that might last anywhere from a few weeks to three or four months at most. Passive immunity is usually divided into two categories: natural and acquired. The transfer of maternal tetanus antibody (mostly IgG) across the placenta offers natural passive protection to the newborn for several weeks/months until the antibody is destroyed and lost. Acquired passive immunity, on the other hand, is the procedure of collecting serum from immune people, pooling it, concentrating the immunoglobulin fraction, and injecting it into a vulnerable person.

Passive immunity refers to disease protection provided by antibodies produced outside of the body. Passive immunity is a type of immunity that does not require prior exposure to a disease agent (either through infection or immunization), takes effect right away, and usually does not last very long (up to a few months). Passive immunity is usually short-lived because the supply of antibodies is not replenished as quickly as it would be if the immune system were producing them. Passive immunity can be inherited or created artificially.

Immunity passed down from mother to kid is known as maternal passive immunity or natural passive immunity. Antibodies move across the placenta to the unborn child while still in the womb and can provide protection against illnesses in the weeks and months after delivery. Antibodies present in breast milk, particularly colostrum, the protein-rich milk produced in the first few days after birth, provide passive immunity to disease to a newborn after birth. Passive immunity from mothers is vital for safeguarding infants until their immune systems grow enough to do so[11].

The injection of antibodies produced by a different person or animal, or created artificially in the laboratory, into an individual confers artificial passive immunity. Antisera are antibody-containing preparations that are utilized as a therapeutic treatment when a danger of infection exists. Antisera or anti-venom may be given after a bite from a potentially rabies-infected animal, when a baby is delivered to a Hepatitis B-positive mother, or after a bite from a poisonous snake bite to provide passive immunity[12].

In terms of the number of fatalities saved per year, vaccination is believed to be one of the most successful and cost-effective public health interventions of the twentieth century. It not only prevents around 3 million child deaths per year in the underdeveloped world, but it also has the potential to save an additional 2 million fatalities if immunization programs are extended and

completely implemented[14]. Certain characteristics, such as mothers' educational backgrounds, age, marital status, socioeconomic situation, and religious background, can influence how well children get immunized. In affluent countries, vaccination programs are more organized, but in countries with large populations, the situation is dire. Childhood disease prevention is mostly accomplished by immunization, which is a comprehensive series of injections given to children shortly after birth[15].

Active immunization and passive immunization are two types of vaccination. The body's immune system is triggered to develop specific antibodies for a particular pathogenic agent via active vaccination. When a person is exposed to a disease, active immunity might develop naturally. A person who exhibits a comeback from a first episode of measles, for example, is protected against subsequent infection by the virus causing measles since the virus drives the immune system to develop defense mechanism against that recognized and kills the pathogen on subsequent visit. Vaccination is sometimes therefore being used to intentionally generate active immunity. Vaccines are antigen-based medicines that boost the immune system without producing sickness. The goal of receiving immunization is for ascertaining that a sufficient population of lymphocytes and antibodies able to respond to any certain disease or toxic substance are present prior being exposed. Active immunity is usually throughout life and may be reignited speedily via a re-exposure to the infectious substance[16].

Passive immunization provides instant but temporary defense against a pathogenic substance and can occur spontaneously, such as a fetus obtaining an antibody from the mother through the placenta or through breast-feeding via the mother's breast milk. Passive immunity to a specific disease, such as the hepatitis B virus (HBV), can also be falsely induced. Resistant globulin in the serum, which contains antibodies generated for HBV, can be given to someone who doesn't

have immunity against a viral entity. These antibodies are made via serum obtained from animals and/or humans who have been diseased with the virus or have been inoculated against it.

Through the placenta, a newborn baby gains passive immunity from its mother. Passive immunity can also be obtained through antibody-containing blood products such as immune globulin, which can be administered when rapid protection against a specific disease is required. The main advantage of passive immunity is that it provides instant protection, whereas active immunity takes time to develop (typically several weeks). Passive immunity, on the other hand, only lasts a few weeks or months. Only active immunity lasts a long time.

History of immunization

Edward Jenner published his work on the development of a smallpox vaccine in 1798. He had first proposed that protection from smallpox sickness may be gained through injection with a related virus, vaccinia or cowpox, two years earlier, in 1796. In a method known as vaccinal, he inoculated eight-year-old James Phipps with cowpox pustule liquid obtained from the hand of a milkmaid, Sarah Nelmes. The boy was infected with cowpox. However, when Jenner introduced the boy to smallpox eight weeks later, the boy did not catch the disease[17].

There were various theories of disease during the nineteenth century, but Louis Pasteur was the first to propose The Germ Theory of Disease in 1877. In 1879, he developed the world's first live attenuated bacterial vaccine (chicken cholera). In 1882, Robert Koch identified the tubercle bacillus as the cause of tuberculosis, which became known as Koch's bacillus. Emile Roux developed the diphtheria toxin in 1888[18]. Many scientists contributed to the development of passive serum therapies, including Emil Von Behring, who created the first effective therapeutic serum against diphtheria, and Paul Ehrlich, who developed enrichment and standardization protocol that allowed for an exact determination of diphtheria antitoxin quality. Emil Von

Behring and ShibasaburoKitasato developed an efficient therapeutic serum against tetanus, and Tetanus toxoid was introduced in 1914[19]. In 1961, the United States approved the use of oral polio vaccine types 1 and 2, which were produced by Albert Sabin and generated in monkey kidney cell culture. Sabin first released a monovalent live oral poliovirus vaccine in 1960, followed by a trivalent version in 196329. Today, this is the most widely used polio vaccine. In 1965, the United States approved a live attenuated measles virus vaccine. The recommended age for normal administration has been raised to 12 months from 9 months[20].

Following the tremendous success of vaccine development, particularly the successful eradication of smallpox, the World Health Organization (WHO) established the Expanded Program on Immunization (EPI) in 1974 in order to provide vaccination to the majority of the world's population before their first birthday[21].Tuberculosis, diphtheria, tetanus, pertussis, polio, and measles were the six diseases targeted by this campaign. The WHO did not suggest that yellow fever vaccine be included in the national immunization program of countries where the disease is common until 1988.

In 1992, the World Health Assembly recommended that all babies be vaccinated against hepatitis B[22].

Expanded Program on Immunization

The World Health Organization (WHO) started the global effort to use vaccination as a public health intervention in 1974 when it launched the EPI. Since then,immunization has remained one of the most cost-effective public health interventions for reducing global child morbidity and mortality (Machingaidze, Wiysonge, & Hussey, 2015)[23]. The EPI program is a blueprint of how to manage the technical and managerial functions required to routinely vaccinate children with a

limited number of vaccines, providing protection against diphtheria, tetanus, whooping cough, measles, polio, and tuberculosis, and to prevent maternal and neonatal tetanus by vaccinating women of childbearing age with tetanus toxoid (Shen, Fields, & McQuestion, 2014)[24].

The original intent of EPI was to deliver multiple vaccines to all children through a simple schedule of child health visits (Shen, Fields, & McQuestion, 2014)[24]. This was challenging because at that time the health systems in most poor and developing countries were frail and in some cases nonexistent (Shen, Fields, & McQuestion, 2014)[24]. Vaccine coverage levels were less than 5%, until around 1990 when most of the poor countries had institutionalized immunization programs based on the EPI blueprint, and by 1991, the global target of vaccinating 80% of the world's children was declared to have been met, likely saving millions of lives (Shen, Fields, & McQuestion, 2014)[24]. These successes were attributed to the building of the capacities and capabilities of these countries through the EPI blueprint that was developed at the inception of the program (Shen et al., 2014)[25].

The cost of vaccination in the developing world has grown from less than one United States Dollar (USD) in 2001 to about $21 for boys and $35 for girls in 2014, asincreasingly expensive vaccines are being introduced into national immunization programs, and vaccines for girls, such human papillomavirus vaccines, are being introduced more widely (Shen, Fields, & McQuestion, 2014)[24].To address these and other challenges, additional efforts are needed to strengthen 8 critical components of RI: policy, standards, and guidelines; governance, organization, and management; human resources; vaccine, cold chain, and logistics management; service delivery; communication and community partnerships; data generation and use; and sustainable financing, though these may not affect the rates of vaccination among boys and girls (Shen et al., 2014)[25]. Countries are expected to adapt the available WHO global-level policies, standards, and

guidelines to develop their own structures to provide overall guidance to their countries' immunization activities. In the majority of nations, the national program of immunization provides leadership and a wide range of other functions as part of its role in building strong governance, organization, and management(Shen et al., 2014)[25].

There is a growing need for a highly trained health workforce as a result of the increasing complexity of immunization services caused in part by the rising number of vaccines given to a child and the growing populations of children who require these services. The quality of the health workforce has become more critical in the face of theincreasing cost of vaccines, making competent handling and oversight of limited and expensive stocks a key issue. Despite the growing demand for skills in the health workforce, the same basic method of vaccination training is still in use that was in place 30 years ago (Shen et al., 2014)[25]. Vaccines, cold chain, and logistics management have become increasingly important with the growing number of new vaccines for disease prevention, eradication of existing outbreaks, and frequent mass campaigns that require additional storage equipment, finance, and expertise in the management of the entire system. Communication and community partnerships are central to the EPI activities and the use of immunization services, especially to enlighten and mobilize the community to support immunization (Shen, Fields, & McQuestion, 2014)[24]. In practice, this requires the support of the health workforce and other trustworthy persons to ensure that parents or caregivers are kept informed of where and when, as well as how many times, they are required to bring children for vaccination. Health personnel remains the most cited source of health information including key details about immunization. (Shen, Fields, & McQuestion, 2014)[24].

The role of quality data in guiding policymakers to make informed programmatic decisions cannot be overemphasized. Data are usually obtained from vaccine coverage reports, either by

periodic population-based surveys such as NDHS and Mixed Indicator Cluster Surveys, or by routine administrative reports (Shen et al., 2014)[25].

Expanded Program on Immunization in Africa

The World Health Organization (WHO) started the global effort to use vaccination as a public health intervention in 1974 when it launched the EPI. Since then,immunization has remained one of the most cost-effective public health interventions for reducing global child morbidity and mortality (Machingaidze, Wiysonge, & Hussey, 2015)[23]. There have been several efforts over the years to increase EPI coverage globally, such as the Global Alliance for Vaccines and Immunization, universal childhood immunization; millennium development goals (MDGs); Global Immunization Vision and Strategy; and most recently, the Global Vaccine Action Plan (Machingaidze et al., 2015)[26].These efforts, combined with specific regional efforts, such as the WHO African regional office EPI strategic plans of action, implemented in the periods 2001-2005 and 2006- 2009, and the Reaching Every District approach, plus individual national EPI efforts, have raised global immunization coverage. For example, three doses of the diphtheria-tetanus-pertussis (DTP3) vaccine at 12 months of age rose from 5% coverage in 1974 to 85% in 2010. Despite this global progress, sub-Saharan Africa attained only 77% DTP3 coverage by 2010 (Machingaidze et al., 2015; WHO, 2015)[27, 28].

There has been substantial progress in the performance of the EPI in Africa since its launch in 1974, though inter and intra-country differences exist. The introduction of meningococcal group A, Haemophilus influenza type B, and hepatitis B vaccines across the continent indicate development and growth in the right direction. On the other hand, according to national immunization coverage scorecards for 2014 (Machingaidze et al., 2015; WHO, 2015)[27,28], polio and measles outbreaks as well as high vaccine dropout rates across the continent are indicators of

failures in the EPI system that require evidence- based remedial interventions. There is an urgent need to come up with strategies to improve the immunization system, strengthening poor infrastructure, addressing a lack of qualified manpower, and finding ways to provide more affordable and appropriate vaccines at all times. Increased financial and political commitment by African leaders is necessary if Africa is to sustain the gains made in EPI and improve upon them in theAfrican region (Machingaidze et al., 2015; WHO, 2015)[27,28].

In 2014, 129 countries, accounting for 66% of the 194 WHO Member States, attained the coverage target of ≥ 90% for DTP3 at the national level. Of these, 119 nation states had sustained this coverage for the last 3 years and 109 of them for the last 5 years. Additionally, by 2014, DTP3 coverage in 35 nations was below 80%, compared to 32 in 2013, and 30 in 2011. Of those 35 countries with coverage below 80% in 2014, 27 were already below this threshold in 2013 and 8 were above 80% in 2013, including 2 for which the coverage rate was above 90% (WHO, 2015). Nineteen countries never surpassed this 80% threshold at any time since 2010, five countries had DTP3 coverage below 80% in 2013 but succeeded in raising it above the 80% threshold 2014, and only one reached a rate of 90%. In 2014, 18.7 million children, compared to 18.8 million in 2013 and 19.2 million in 2011, were estimated not to have received three doses of DTP-containing vaccines. Nigeria's coverage stands at the 75% within the same period.

Nigerian Immunization and Vaccine Development

Nigeria introduced EPI in 1978 with the aim of providing routine immunization tochildren under two years of age, and saw some initial but recurrent successes with the highest level in the early 1990s, when Nigeria achieved childhood immunization coverage of 81.5% (Ophori, Tula, Azih, Okojie, & Ikpo, 2014)[29]. However, since that period of success, Nigeria has seen slow but sure and consistent falls in immunization coverage. By 1996, national coverage had dropped to less

than 30% for all antigens and decreased further to 12.9% in 2003, which was also consistent with the 2003 national immunization coverage survey findings. The downward fall in coverage of all antigens seems to have been linked with poor government political will and commitment resulting in failure of the fulfillment of EPI policies as reflected in over-centralization in the management of EPI at the federal level of governance and vaccine shortages and other administrative problems (Ophori et al., 2014)[30]. The government came up with a program to revitalize and sustain the immunization system in 1999, in synergy with the polio eradication program, leading to the establishment of the National Program on Immunization (NPI). The focus of the NPI is on providing support to the states and LGAs in the implementation of immunization programs (WHO Regional Office for Africa, n.d.)[31]

In Nigeria, WHO is providing technical support to authorities at federal, state, local government, and ward levels in the strengthening and implementation of the Reaching Every Ward (REW) strategy (WHO Regional Office for Africa, n.d.)[31]. This followed the signing of a memorandum of understanding between WHO and the Government of Nigeria, under which WHO will provide technical support for health workers at all levels. The support of WHO, along with other development partners, has greatly contributed to increased access and utilization of routine immunization services in the form of improved coverage (WHO Regional Office for Africa, n.d.)[31].

In a study in Bungudu, Zamfara state, North West Nigeria (Gidado et al., 2014)[32], on determinants of routine immunization coverage, it was found that five factors were significantly associated with full immunization coverage; these included satisfactory level of knowledge on RI, having at least secondary education, receiving ante-natal care (ANC), having received information on RI 12 months preceding the study, and delivery at health facility by mothers.

Among these factors, having a satisfactory level of knowledge on RI and at least attaining secondary education were the only independent determinants of full immunization after performing logistic regression (Gidado et al., 2014)[32]. However, it was also the case that this study, through community-based, was limited by geographical scope and acknowledged the fact that if it had been conductedeven in the entire state, the result could have been different; hence the result cannot begeneralized to the North West zone.

Additionally this study did not take into account the role of socioeconomic status (place of residence, closeness to the routine immunization services, income levels, and educational level of respondents) of parents/caregivers, apart from their level of education, their biological characteristics (age, sex, parity, birth order), cultural factors (ability to take decision independently, religious affiliation, and tribe/ethnicity), place ofresidence (rural/urban), distance and cost of transport, session plan and cost of immunization services.

Abdulraheem and Onajole (2011) looked at the reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children in Awe Nasarawa state. They found that the major reasons for noncompletion of vaccination among rural children were the concerns among parents on the safety of the immunization, long distance walk to the service point, and long waiting time at health facilities (Abdulraheem & Onajole, 2011)[33]. However, Abdulraheem and Onajole did not find any significant differences with respect to vaccination completeness due to factors such as mothers' age, marital status, schooling level and gender of the child, though one of the limitations of the study was the fact that the sample population was from a homogenous rural community and participants were mainly poor women and children. This might have resulted in an underestimation of the role of socio-demographic factors such as educational levels, gender and marital status (Abdulraheem & Onajole, 2011)[33]. Again, this study

also lacked geographical spread and the sample size was not representative and canonly apply to the community where the study was conducted.

Rahji and Ndikom (2013) conducted a similar study in Ibadan, during which theyattempted to identify factors influencing compliance with the immunization regimen among nursing mothers in Moniya Community. They found the health workers' attitude,long waiting for time, and cost of immunization were factors hindering compliance with immunization schedules (Rahji & Ndikom, 2013)[34]. Age, occupation, education, religion and time spent at the centers also were found to have a significant relationship with compliance with immunization regimen (Rahji & Ndikom, 2013)[34].

Finally, Tagbo et al. (2014) conducted a hospital study in Enugu on vaccination coverage and its determinants in children aged 11 - 23 months in an urban district of Nigeria concluded that vaccination coverage was associated with high maternal education, government employment, delivery of a child in a government hospital, and knowledge of the age at which a child should start and complete routine vaccinations were independent predictors of high vaccination coverage. One of the limitations of this study was that it was hospital-based, and was only conducted in an urban setting and socannot be a complete reflection of what is happening at the community level. (Tagbo et al. 2014)[35].

Types of Vaccines

Based on the origin of the antigens of the vaccine, live attenuated, dead inactivated, toxoid, and subunit vaccines are divided into one of four categories. Subunit vaccines are further divided into those that use recombinant DNA technology to produce the antigen and those that use traditional bacterial growth cycles. In addition, all known vaccines contain some other substances which are

present because they boost the immune response, are needed for product stability, are the vehicles for vaccine carrying, or are a byproduct of the production process.

- Toxoid vaccines

Some pathogenic substances, such as tetanus, diphtheria, botulism, and cholera, induce disease by secreting an exotoxin; additionally, some diseases, such as pertussis, seem partially toxin mediated[35, 36]. The main toxin in tetanus (called tetanospasmin) attaches to membrane receptors found solely on pre-synaptic motor nerve cells. The toxin's consequent absorbance and movement to the CNS prevents the processing of glycine, which is required for optimum ctivities of GABA neurons.

Because GABA neurons inhibit motor neurons, their absence causes excessive action in motor nerve cells, causing the muscles generatedvia nerves to contract more often than usual, resulting in muscular spasms, which are a common symptom of tetanus. The final product is then produced by ultra-filtration, which removes any superfluous proteins left over from the manufacturing process. The toxoid is physico-chemically comparable to the native toxin, eliciting cross-reacting antibodies, but formaldehyde treatment renders it non-toxigenic[37].

Simultaneously, toxoid molecules that aren't absorbed by dendritic cells go through lymph channels to where they connect with B cells, which each has its own B-cell receptor (BCR). When tetanus toxoid binds B cell via an immunoglobulin receptor which identifies it, the toxoid is internalized, processed via the endosomal route, and presented on surface of cell as an MHC II:toxoid complex, just as it is in the dendritic cell. These activities take place in a lymph node, resulting in the B cell with the MHC II:toxoid complex found on it and also touching the activated TH2, which has receptors that are peculiarto the complex. The mechanism, known as

linked recognition, causes the TH2 to activate the B cell, causing it to develop into a plasma cell that produces IgM at first, and then switches to IgG; in addition, a portion of B cells becomes memory cells. The adaptive immune response to a protein antigen-like tetanus toxoid is described in the following process; T-dependent vaccinations are antigens that require the involvement of helper T-cells in order to elicit an immunological response. Polysaccharide antigens, on the other hand, elicit a slightly different reaction.

The basis for tetanus vaccination is the generation of antibodies against the toxoid that have a greater capacity to attract toxin than the receptor-binding sites on nerve cells; when exposed to C. tetani, this toxin: antibody complex is incapacitated to bind to the receptor, neutralizing the toxin and inhibiting development of disease. Toxoid vaccinations aren't very immunogenic until they're given in big doses or in several doses; one issue with utilizing greater doses is that tolerance to the antigen can develop[35].

An adjuvant is placed in the vaccination to guarantee that the adaptive immune response is sufficiently effective to produce long-lasting immunity. An aluminum salt (either the hydroxide or phosphate) is used in diphtheria, tetanus, and cellular pertussis vaccines.There are three major benefits of toxoid vaccinations. To begin with, they are benignsince they can’tinitiate the infection they inhibit and hence no risk of virulence recurrence. Secondly, since the vaccination antigens aren't actively replicating, they can't infect people who haven't been inoculated. Thirdly, they are very stable and last for long because they are not vulnerable to weather and light fluctuations that can occur when vaccinations are consumed by the public[36].

There are a few drawbacks of toxoid vaccinations. First, they usually require an adjuvant and many dosages. Secondly, local minor side effects at the vaccine site often occur, which could be attributable to the adjuvant or a type III reaction, which manifests as redness and induration at

the site of injection some hours after immunization and typically resolves within 48–72 hours. Excess antibody at the site binds to toxoid molecules, triggering complement activation via the typical passageway, resulting in a less severe local biological response.

- Killed/inactivated vaccines

Inactivated vaccinations are those that have been killed, whereas killed vaccines are those that have been inactivated[40, 41]. Typhoid was one of the first lethal vaccines developed, and it was employed by British military in the late 1800s. In the United Kingdom, the most commonly used inactivated vaccinations are polio and hepatitis A; in a lot of other countries, total cell pertussis vaccine is still the most generally used vaccine.

The adaptive immunological response to a killed vaccination is remarkably identical to the response to a toxoid vaccine, except that the antibody response is targeted towards a far broader variety of antigenic substances. As a result, immature dendritic cells phagocytose the entire organism after injection; breakdown within the phagolysosome generates a variety of pathogenic fragments, which are presented on the cell surface as discrete MHC II: antigenic fragment complexes. The activated mature dendritic cell will present a number of TH2 cells within the draining lymph node, each having a TCR for a different antigenic fragment.

Each B cellsusually having a BCR for a different fragment of antigen, will bond with antigens that flow through channels of lymph, internalize them, and present them as an MHC II:antigenic fragment, resulting in linked recognition with the correct TH2. B-cell activation, differentiation, and proliferation are induced through the release of IL2, IL4, IL5, and IL6 by the TH2, having succeeding isotype switch and development of memory cell. This process takes about 14 days, though further exposure to the pathogen triggers a subordinate reaction including the initiation of

numerous memory cells, resulting in increased volume of diverse immunoglobin G molecules between 24 to 48 hours.

HAV is a known inactivated vaccination that occupational health professionals might employ. It is inactivated by formalin, cell culture-adapted strain of Hepatitis A virus (HAV) that produces inhibiting antibodies and possesses a defensive effectiveness of over 90%. Vaccination for laboratory employees who work with HAV and sanitation workers who come into touch with sewage should be considered. Vaccination may also be administered to personnel who work with wards in residential settings with inadequate hygiene standards. A primary vaccine followed by a booster 6 to 12 months later should provide protection for at least 25 years[42].

Killed/inactivated vaccinations have similar benefits as toxoid vaccines, having added benefit that they contain the antigenic substance simplicated with illness, resulting in antibody production against each of them. Vaccines that have been killed or inactivated have a number of drawbacks. Because the microorganisms cannot grow in the host, a single dosage cannot provide a powerful indication to the adaptive immune system; ways to counteract this involves using multiple doses and administering the vaccine with a linked adjuvant[43].

- Subunit vaccines

Subunit vaccines are a development of the killed vaccine strategy; instead of producing antibodies against all of the pathogen's antigens, a specific antigen (orantigens) is used, and infection is prevented when the antibody produced by a B cell binds to it. As a result, the identification of that specific antigen is crucial for the development of an effective subunit vaccine (or combination of antigens). Examples of single-antigen subunit immunizations include the Hepatitis B and Haemophilus influenzae type b (Hib) vaccines[43].

The adaptive immune response to a subunit vaccine varies depending on whether the vaccine antigen is a protein or a polysaccharide; subunit vaccines based on protein antigens, such as hepatitis B and influenza, are T-dependent vaccines like toxoid vaccines (as previously discussed), whereas polysaccharide vaccines are T-independent[44]. A T-independent subunit vaccination that might be utilized in the workplace is Pneumovax, which uses the capsular polysaccharide from 23 common pneumococcal serotypes as the vaccine antigen. The shot is administered intramuscularly or into deep subcutaneous tissue[45].

A few polysaccharide molecules are phagocytosed by immature dendritic cells (and macrophages) at the injection site. They subsequently travel to the surrounding lymph nodes where they come into contact with naive TH2. However, because the TCR only recognizes protein molecules, the TH2 is not activated even when a mature dendritic cell supplies it and it is shown on MHC II molecules[46]. While traveling through lymphatic channels to the same draining lymph nodes as phagocytosed polysaccharide molecules, non-phagocytosed polysaccharide molecules come into contact with B lymphocytes, each of which has a unique BCR.

Because it is composed of linear repeats of the same high molecular weight capsular polysaccharide, the vaccine antigen binds with considerable avidity to several receptors on a B cell with the required specificity[47]. Without the assistance of TH2, this kind of multivalent binding can stimulate the production of IgM by B cells. Because the TH2 isn't involved, isotype switching is constrained, which causes little IgG to be produced and few memory B cells to be formed.

A specific IgM antibody in the blood binds to the pathogen's capsular polysaccharide when Streptococcus pneumoniae passes mucosal barriers in a properly immunized person, enabling complement-mediated lysis to occur[48]. Although IgM is not very good at neutralizing or

opsonizing, it is extremely good at activating complement. Pneumovax should be administered to employees who have a history of chronic lung, heart, kidney, or liver disease, asplenia or hyposplenia, immunosuppression, or who are at risk for a CSF leak. Additional dosages every five years are advised for people with chronic renal failure and splenic dysfunction, where immune response attenuation is anticipated[49].

By covalently joining T-independent immunizations to a protein molecule, they can be transformed into efficient T-dependent vaccines (a process known as conjugation). Following phagocytosis by immature dendritic cells, the conjugated protein and polysaccharide molecules are presented at the cell surface as MHC II: protein and MHC II: polysaccharide complexes. In the draining lymph node, this activated mature dendritic cell will move to a T-cell-rich area where it will activate a TH2 with high specificity for the carrier protein[50].

The polysaccharide: protein combination attaches to a B cell with a high selectivity for the polysaccharide when vaccine antigen is simultaneously supplied down draining lymph channels to the B-cell-rich region of draining lymph nodes[51]. The polysaccharide: protein complex is ingested, phagocytosed, and the protein is expressed as a cell surface complex with MHC II. The activated TH2 and this B cell then recognize one another for the carrier protein with remarkable specificity. Co-stimulation and cytokine release caused by TH2 participation result in IgM, then IgG, and memory cell formation[52].

Subunit vaccines have the same benefits as toxoid vaccines, with the added benefit of being able to distinguish between vaccinated and infected persons; For instance, only an adaptive immune response to the surface antigen is achievable with hepatitis B vaccination, whereas infection results in core and e immune responses[53]. The same disadvantages of toxoid vaccinations apply

to subunit vaccines, such as the requirement for an adjuvant (and generally repeated doses) and the likelihood of local reactions at the injection site[54].

- Live attenuated

Around the year 1000 AD, China and India developed a therapy known as variolation that produced protection by a live smallpox inoculation and a variety of other methods[55]. An early kind of "attenuation" involved exposing "well individuals" to various samples from a person who had a milder form of smallpox in the hopes of making the recipient develop a less severe illness[56,57]. Many numerous methods for weakening a viral pathogen so that it can be used in men and women.

One method involves growing the virus in a different host—for instance, the measles virus is grown in chick egg fibroblasts—where viral replication results in the appearance of a number of mutant types. Mutants with enhanced virulence for the foreign host are then selected as potential vaccine strains because they typically show reduced virulence for the human host; this is an especially useful method for RNA viruses with a high mutation rate.

The procedure is largely empirical; therefore, it is impossible to determine which of the observed genomic nucleotide changes are associated with lower virulence. As a result, the molecular basis of attenuation in these conditions remains unknown. Another method involves raising the wild virus in an artificial growth medium at a temperature lower than that of the human body; over time, a strain may emerge that thrives at this lower temperature but multiplies so slowly in people that adaptive immune responses can eradicate it before the virus can spread and cause infection.

Measles, mumps, rubella, and chickenpox are examples of attenuated vaccines (live) that could be utilized in the workplace. The vaccination for measles, for example, is administered deep into the body, where virions reach numerous cell types via receptor-mediated endocytosis. Viral proteins are proteolytically degraded in the cytosol, and the peptides produced are loaded onto major histocompatibility complex type I molecules, which are then displayed on the cell surface. Circulating cytotoxic T cells (Tc) with high-specificity TCRs can detect the complex and release cytokines that tell the (infected) cell to commit suicide (apoptosis) [58].

Some Tc appear to become memory cells, although the mechanism behind this is unknown. Virus vaccine will also be phagocytosed by immature dendritic cells, triggering the same process as protein antigens, which results in the development of plasma cells, destroying Immunoglobin-G antibodies, and memory cells.

Both systems of defense activate when a person who has received the recommended vaccinations inhales wild measles virus. As a result, T cells can kill infected cells that are replicating locally at the site of infection; if a virus manages to get past this and spread through the bloodstream, an IgG antibody will bind to it and prevent illness by neutralizing the virus's attachment to the target cell. Live attenuated vaccines have the drawback of potentially causing the disease they are intended to prevent, either because they revert to virulence or because they are not sufficiently attenuated for some individuals.

New Development Techniques

The first vaccination, a live, attenuated virus, was used to prevent smallpox. Attenuation is the process of weakening a virus so that it can still elicit an immune response but not cause sickness

in a human host. Live, attenuated viruses are utilized in many vaccines today, including those for measles and several influenza vaccines.

Others employed inactivated forms of toxins produced by bacteria, such as dead viruses, fragments of bacteria, or inactivated forms of toxins produced by bacteria. Although inactivated viruses, bacteria fragments, and toxins cannot cause illness, they can nevertheless elicit an immune response that protects against future infection.

New techniques, on the other hand, are being used to develop other vaccines:

• Live recombinant vaccines

• DNA vaccines

• mRNA vaccines are only a few of the new forms.

Attenuated viruses (or bacterial strains) are used as vectors in live recombinant vaccines: a virus or bacterium from one disease works as a delivery vehicle for an immunogenic protein from another infectious agent. This method is used in certain circumstances to boost the immune response; in others, it is employed when administering the actual agent as a vaccination would result in sickness.

HIV, for example, cannot be attenuated enough to be used as a vaccine in people due to the significant risk of illness. Researchers start with a whole virus and find a part of the virus's DNA that isn't required for reproduction. This area is then inserted with one or more genes that code for immunogens from different infections. (Each gene is essentially a set of instructions for the body to follow in order to produce a specific protein.) In this example, scientists choose genes

that code for a protein specific to the pathogen of interest: an immunogen that will trigger an immune response to that pathogen.

A baculovirus (a virus that only infects insects) may be employed as a vector, and the gene for a specific influenza virus immunogenic surface protein could be introduced. When the modified virus is injected into a person's body, the immunogen is expressed and displayed, triggering an immune reaction against the immunogen and hence the pathogen from which it came. Human adenoviruses, in addition to insect viruses, have been proposed as viable vectors for recombinant vaccines, particularly against illnesses like AIDS.

The vaccinia virus, which is used in smallpox vaccines, was the first to be utilized in live recombinant vaccines[47]. Experimental recombinant vaccinia strains have been developed to protect against a variety of diseases, including influenza, rabies, and hepatitis B.

DNA vaccines are made up of DNA that codes for a specific antigen and is injected directly into the muscle. The DNA is inserted into the cells of the individual, which then manufacture the antigen produced by the infectious pathogen. This antigen elicits an immunological response because it is alien. Because DNA is durable and easy to manufacture, this sort of vaccine is reasonably easy to make, but it is still experimental because no DNA-based vaccines have been shown to elicit the large immune response required to prevent infection. Researchers anticipate that DNA vaccines can provide immunity against parasitic diseases such as malaria, for which there is presently no human vaccine[48].

mRNA vaccines are designed to deliver a snippet of messenger RNA (ribonucleic acid) to a cell, allowing the cell's protein-making machinery to produce a protein. That protein, which is made from the mRNA code, looks like a pathogen's (virus, bacteria, fungus, or parasite) protein that

causes an immune response. The protein is subsequently "presented" to immune cells, which then initiate an immunological response that includes killer cells and antibody-producing cells. All of this means that vaccines don't include any of the pathogens for which they're designed. All that is required of researchers is the genetic code for the protein that will be produced by the recipient's cells[49].

New Delivery Techniques

You usually picture a doctor or nurse giving you an injection when you think of immunization. However, future vaccination delivery strategies may differ from what we currently utilize. Inhaled vaccinations, for example, are already in use in specific situations: influenza vaccines are available as a nasal spray. For seasonal flu, one of these vaccines is offered each year. A patch application, which uses a matrix of extremely small needles to deliver a vaccination without the use of a syringe, is another option.

This mode of distribution could be especially effective in distant locations because it does not require the use of a skilled medical professional, which is typically required for vaccines administered via syringe. Another challenge that researchers are attempting to solve is the so-called cold chain issue. To stay alive, many vaccines require low storage temperatures. Unfortunately, in places of the world where immunization is critical for disease management, temperature-controlled storage is frequently unavailable. The ability of the smallpox vaccine to be stored at relatively high temperatures and remain viable for reasonable periods was one of the reasons for smallpox eradication's success.

Some modern vaccines, on the other hand, cannot resist such temperatures. In April 2010, a volcanic explosion in Iceland halted air travel in Northern Europe, including planes carrying 15

million doses of polio vaccination intended for West Africa. Officials were concerned that the delay in delivering the vaccines might allow polio to spread or that the vaccines would become ineffective due to high temperatures in the cargo holds of the grounded planes[50]. Such circumstances underscore the need for vaccination ingredients that can be carried conveniently and remain viable in a variety of settings.

Researchers at the University of Oxford's Jenner Institute investigated one possible solution to this challenge in early 2010. The researchers started with a tiny filter-like membrane and coated it with an ultrathin layer of sugar glass, trapping virus particles inside. The viruses utilized by the researchers may be maintained in this form for up to six months at temperatures as high as 113°F without losing their capacity to elicit an immunological response. In comparison, one of the two viruses examined was virtually eliminated after only one week in liquid storage at 113°F.

The success of medical research for vaccines that are easier to give, survive transport even without refrigeration, and deliver a more robust and long-lasting immune response is critical to the future of immunization. In addition, vaccines continue to be effective against a wide range of infectious diseases.

The following are the most commonly used four immunoglobulin preparations;

(I) Human Hepatitis B Immunoglobulin: The vial sizes for human hepatitis B immunoglobulin are 200 and 500 IU. Human protein ranges from 10 to 100 mg/ml in each milliliter, with gamma globulins making up at least 95% of the total (IgG). One milliliter does not contain hepatitis B antibodies. It is utilized in the workplace to safeguard non-immune medical personnel against hepatitis B virus exposure (together with an appropriate vaccination programme).

(II) Human Rabies Immunoglobulin Ph: 500-unit vials of human rabies immunoglobulin are available. Human protein ranges from 40 to 180 mg per milliliter, with gamma globulins making up at least 95% of the total (IgG). One milliliter does not contain 150 IU of rabies antibodies. It is given to non-immune people who have been exposed to rabies as part of post-exposure prophylaxis.

(III) Human Tetanus Immunoglobulin: A 250 IU vial of human tetanus immunoglobulin is available. Gamma globulins make up at least 95% of the human protein in each milliliter, which ranges from 40 to 180 mg/ml (IgG). Plasma from screened donors in the United States was used to create this product. Tetanus antibodies do not amount to 100 IU per milliliter. This medication is provided to treat tetanus-prone wounds that have significant soil/manure contamination and to treat any wounds if the patient is thought to be non-immune, albeit it is doubtful that healthcare professionals will use it.

(IV) Human Varicella-Zoster Immunoglobulin: Human Varicella-Zoster Immunoglobulin comes in vials containing 250 mg of protein (40–180 mg/ml), at least 95% of which are gamma globulins (IgG). This product is prepared with plasma from American donors who have undergone background checks. A milliliter of Varicella-Zoster antibody contains less than 100 IU. It is administered to non-immune people who have been exposed to chickenpox as part of their post-exposure prophylaxis.

Benefits of Immunization

Each year, about 100 million children are inoculated against tuberculosis, polio, measles, diphtheria, tetanus, pertussis, hepatitis B, Haemophilus influenza type B, and yellow fever in some countries. Each year, these immunizations are predicted to save 2.5 million lives. Vaccines provide more than just disease protection for youngsters. Children who received immunizations

were not only healthier throughout their childhood, but also scored much higher on language, math, and verbal thinking tests, according to a recent study in the Philippines[51].

Immunization protects the population and aids in the prevention of serious diseases. The benefits of illness prevention by immunizations far outweigh any potential negative consequences. Vaccine safety receives greater public attention than vaccine effectiveness, despite the fact that vaccines are significantly safer than medicinal medications. The cornerstone of immunization programs in babies against a slew of childhood diseases is successful pre-exposure vaccination with numerous antigens. Global child mortality can be reduced by promoting universal access to safe and effective vaccines that have been shown to fulfill the moral imperative of each individual in the community to live a healthier and richer life[52].

Immune memory minimizes the repercussions of infection, thus protection against diseases lasts a long time. Vaccination lowers the spread of infectious agents by delaying the transmission process, resulting in a higher reduction in disease incidence. The average n and basic reproduction number of a single main case introduced into a susceptible population determine the coverage rate required to stop transmission. Vaccines can protect against associated diseases or infections, such as the enterotoxin Escherichia coli vaccination, which has been shown to protect against diarrhoea caused by Salmonella enterica. The introduction of vaccinations is predicted to reduce global incidence and the burden of cervical cancer. Vaccination advantages are well documented to extend beyond prevention and to enrich the lives of diverse civilizations and nations. Vaccination serves the healthcare needs of society's most vulnerable people, resulting in positive economic growth[53].

Factors Affecting Full Child Immunization

Characteristics of Mothers

Children's immunization rates are known to be influenced by a number of factors in both developed and developing countries. In a Nigerian study, the link between childhood immunization and maternal education was shown to be substantial, indicating that children whose mothers have only a primary education are less likely to get immunized than those whose mothers had no education[54]. The socioeconomic position of the family was revealed to be a substantial predictor of child immunization. However, when compared to wealthier households, poor families were much less likely to immunize their children, according to the statistics, living in a household headed by a woman is a considerable vaccination disadvantage for children[55].

According to another study, 20% of mothers interviewed in Iji Nike, Enugu East Local Government Area (LGA), did not immunize their children against measles because they did not comprehend the vaccine schedule. Either 6% of these mothers had a post-secondary education, while 50% of these mothers had only a primary education or no formal education at all[44]. The features of the mother have a significant impact and are the most well-known determinants of full child immunization. According to many research, women with a low level of education and who are unemployed are less likely to complete a child's vaccine[57,58]. A woman's education allows her to access relevant health services, communicate effectively, and digest knowledge on prenatal care, childhood vaccines, and nutritional requirements[59].

Child Characteristics

Child features such as a child's sex, birth order, delivery location, and antenatal care (ANC) follow-up have been found as factors that influence full immunization coverage among children

(Michter, 2020)[60]. Fixed effects of the child's characteristics were statistically dependent on the child's characteristics in a study conducted in 2004 to identify factors that determine the receipt of the full series of diphtheria–pertussis–tetanus s vaccines (DPT3) among children aged 12-35 months in the Northern part of Nigeria[61].

Societal and cultural context

Vaccination uptake is thought to be culturally sensitive, impacted by local perceptions of children illnesses and household decision-making processes[62]. While some authors in African communitiesattribute low vaccine coverage to cultural differences, others have recognized cultural prejudices as an etiological issue for avoidable disease[64,65,66,67].

Religious and political influences

Religion is a significant predictor of childhood immunization, with decreased probabilities of immunization related with Islamic religious affiliation. Some parents have little awareness of immunizations, and what they do know is frequently wrong[57]. Parents decline to take their children for immunizations for a variety of reasons, the most common of which is to protect their children from damage[68,69]. Another well-known example is Nigeria, where allegations circulated in 2002–2003 that the OPV was being used to reduce the fertility of young Muslim girls. In numerous states, polio vaccination was halted for a year as a result of this. It advocated for the suspension of OPV in July 2003, claiming to have evidence that it was contaminated with anti-fertility chemicals[70].

Social and economic circumstances

In comparison to mass vaccination campaigns, a parent's higher socioeconomic status is linked to a higher likelihood of the kid being vaccinated under a routine immunization program[71]. There is

a clear link between poor socioeconomic position and vaccination deficiencies. The link is most likely mediated by the numerous factors associated with poverty.

Children from low-income families, for example, are more likely to have uneducated moms, low-income parents, and multiple siblings. Poor people are also more likely to be unaware of health services and have transportation problems[72].Individuals' socioeconomic situation has a tremendous influence on their conduct, which in turn influences health-seeking behavior and, eventually, child survival[73]. Furthermore, higher socioeconomic standing is linked to improved health[61]. Inequity in vaccination coverage between rural and urban areas is also a concern, and it is unquestionably linked to supply-related factors.

Access to vaccination facilities, the availability of childhood immunization programs, and demand-related factors such as mothers' knowledge and attitudes are only a few examples[74]. According to reports, children in urban areas are more than twice as likely as children in rural regions (16%) to be fully vaccinated[75].

Poor Knowledge of Vaccines

A lack of knowledge was a significant barrier to childhood immunization, in addition to a lack of health facilities, low literacy level, lack of commitment among health workers, and rough terrain (Abdulraheem et al., 2011; Kabir, Iliyasu, Abubakar, & Gajida, 2005; Oluwadare, 2009)[76,77,78]. Oluwadare (2009) reported that poor immunization coverage occurred as a result of a lack of cold chain, poor road conditions, lack of quality of service, and lack of access roads. Oluwadare found that residents who lived in areas that lacked health centers and had to walk long distances to have their childrenimmunized had low immunization rates[78].

Additional reasons for low immunization included lack of information about immunization (40.7%), and participants lacking proper information about returning for the third dose of

DPT/OPV. Almost 12% lacked motivation to participate in routine immunization (Adeiga et al., 2007)[79]. Family caregivers' inadequate knowledge of vaccine-preventable diseases may have led to misconceptions about the risk from these diseases to children. Even family caregivers who possessed basic vaccine knowledge might fail to get their children vaccinated (Tadesse, Deribew, & Woldie, 2009)[80]. Poor immunization rates might be due to mothers not knowing the benefits of vaccine- preventable diseases, and being illiterate (Sharma & Bhasin, 2008)[81].

Adeiga et al. (2007) conducted a retrospective study among 210 children, aged 12to 23 months, in difficult-to-reach areas along the coast of Lagos[79]. A child was deemed unimmunized if the child received no doses of vaccine at all. A child was considered fully immunized if the child received BCG at birth against tuberculosis, three doses of DPT to prevent diphtheria, pertussis (whooping cough), and tetanus, at least three doses of polio vaccine and one dose of measles at age 9 months. A child who did not receive three doses of DPT was labeled partially immunized. The study results showed that 82 (39%) of the 210 children were not immunized and only 44 (21%) were fully immunized. Of infants at 1 year of age, only 21 (10%) of the children had completed immunization.

The rate for BCG was highest with 44.8%, probably because full BCG vaccination indicates the infant received one dose. Of the children in the study, 15.7% received DPT/OPV, with 15.7%, whereas measles was the lowest with 11.9%. In addition, 41.7% of the 103 children who started the receiving DPT immunization did not complete the third dose of the regimen. Also, it was found that 65 .3% Of 127 children who started BCG, 30.1% dropped out by the time of they would have received receiving the measles vaccination. A full BCG vaccination occurs when an infant receives one dose of BCG.

Researchers conducted a study in Wongo district, south Ethiopia, among children aged 9–23

months (Tadesse et al., 2009)[82]. Children who received all the recommended vaccines, including BCG, pentavalent, polio, and measles by the age of 23 months were considered to be fully immunized. In contrast, children who missed one recommended vaccine were deemed defaulters. Of the children, 418 (41.7%) were fully immunized and412 (41.2%) were partially vaccinated; the BCG and measles rate was 76.2%. Most mothers were not aware that newly recommended vaccines, including hepatitis B and Haemophilus had been added (Tadesse et al., 2009)[82].

Delayed immunization should be prevented to avoid unvaccinated individuals infecting others; however, low immunization persisted frequently in developing countries, including Nigeria (Clark & Sanderson, 2009; NPC, 2009)[83]. A study conducted by Sadoh and Eregie (2009) investigated 512 Nigerian children to determine timeliness of receiving vaccines and the completion of schedules in Benin City. An estimated 30% of the children received their first immunization 4 weeks after birth. Full immunization among the children was 44.3%. Full immunization occurred when a child received a BCG vaccination against tuberculosis, three doses of polio vaccine, three doses of DPT to prevent diphtheria, pertussis, and tetanus, three doses of Hepatitis B, one dose of measles, and one dose of yellow fever each at nine months of age. The highest rates of full vaccinations were vaccines at birth, BCG 89.5%, OPV 96.7%, and Hepatitis B 93.8%; whereas the receipt of vaccines was lowest for measles (57.6%) and yellow fever (57.2%) which should be administered at 9 months of age. The researchers found the large majority of children 73.2% received the measles vaccine at 9 months of age, whereas 11.3% received it at 10 months, 4.8% at 11 months, and 2.1% at 12 months. Differences in receipt of vaccines occurred as mothers' attitudes affected taking childrento health centers to be immunized.

Children who were not vaccinated were likely to be at higher risk for a host of vaccine-preventable diseases including measles, tetanus, TB, mumps, and polio (WHO, 2008b).

Poliovirus is a highly contagious viral infection that is likely to be contracted by children less than 5 years old compared with any other group. It is often transmitted through the fecal–oral route, especially among children in unsanitary and crowded conditions. Poliovirus, if not prevented, may lead to permanent physical disability. The northern states in Nigeria continued to have outbreaks of poliomyelitis; in 2009, 537 cases of poliomyelitis occurred compared to 353 cases in 2007 (Jenkins et al., 2008; Okonko et al., 2008; Renne, 2006; WHO, 2010c)[84,85,86]. Children aged 12 to 23 months received three doses of polio vaccine in northern zones included North Central, 57.7%; North East, 45.2%; and Northwest 37.1% (NPC, 2009). In Nigeria, the Polio Eradication Program has been successful in reaching more districts and wards through funding by WHO. There were 537 cases of poliomyelitis in 2009, compared to 39 cases in 2010 (WHO, 2011)[87]. However, outbreak of wild poliovirus Type 1 and Type 3 continued to occur, in 2010, 21 wild poliovirus cases occurred, compared with 33 in 2011 (Global Polio Eradication Initiative, 2011)[88]. Measles immunization rates among children aged 12 months in Nigeria were 41% in 2009, compared with 33% in 2000 and 54% in 1990 (WHO, 2011)[87].

2.1.2 Immunization Programs

Community Partnership

Forming community partnerships is an effective way for public health professionals to achieve active community involvement that can promote knowledge and awareness of vaccine-preventable diseases. For example, the presence of female health workers among groups advocating for the use of vaccines might have a greater impact onthe target audience (Carrol et al., 2007; Mulumba, Daoud, & Kabang, 2007)[89,90]. Collaborative relationships are essential among consumers and organizations in the community to address health and social issues (Olusanya, 2007)[91]. Community involvement is the process of people working together for a

common interest and includes service providers, religious and social communities, and special-interest groups. Increased participation or involvement could empower community partners to use resources available to solve their problems (Babalola & Aina, 2004; Becker, Kovach, & Gronseth, 2004; Ohnishi & Nakamura, 2009)[92,93,94]. In Nigeria, faith-based organizations provide about 60% of health care, especially in remote and rural areas. The Christian Health Association of Nigeria operates throughout the country and provides about 40% of health care services in rural areas (Antai, Ghilagaber, Wedren, Macassa, & Moradi, 2009;Larbi et al., 2004)[95,96].

Coalition partnerships are beneficial because they enhance community resources by avoiding duplication of services and providing opportunities for special interest groups to participate in developing public policy (Findley et al., 2004; 2008)[97]. To have consistent, routine immunization coverage, community institution advocates, stakeholders, and social clubs have to play a more prominent role in promoting community-wide programs like childhood immunization. Evidence demonstrated the success community partnerships had in providing training to health service providers, increasing community health promotion activities on childhood immunization, working with local community stakeholders to identify and address vaccine-preventable diseases, and empowering family caregivers to become active participants in matters related to the immunization status of their children (Findley et al., 2008; Rosato et al., 2008)[97,98].

State and Local Partnerships

Partnerships between communities and state governments provide a wealth of information that promotes planning and implementation of public health programs and infrastructure reform. Collaboration between state and local organizations has increased public debate on health issues affecting communities (Padgett, Bekemeier & Berkowitz, 2004)[99]. The Nigerian Red Cross provided assistance to the Zaria local government area to control the spread of measles in the

northern part of Nigeria (International Federation of Red Cross and Red Crescent Societies, 2007)[100]. The Nigerian Red Cross retrained volunteers and community health workers to carry out health education efforts to preventchildhood and adult diseases. The Nigerian Red Cross also collaborated with the state's ministry of health to address measles diseases among children less than 5 years of age.

The Nigeria Partnerships for Transforming Health Systems has contributed immensely to the improvement of health systems with ministry and departments of healthat federal, state, and local government levels. The aim was to improve the health status of poor Nigerians. In addition, Partnerships for Transforming Health Systems partners with private sector, civil society, and other development partners and focuses on four health conditions: malaria, TB, sexually transmitted infections, and common childhood diseases (Chukwuani et al., 2006; Oluwadare, 2009; Shiffman & Okonofua, 2007)[101].

In Nigeria, coalitions have been created for social services, one of which is called Maternal, Newborn, and Child Health Care; that coalition came into existence in 2007. In2003, the infant mortality rate was 100 per 1000 live births compared to 87 per 1,000 in 1990. The global campaign against polio in northern Nigeria has not been successful due to inadequate knowledge of Western medicine. As a result, the wild poliovirus exists in Northern Nigeria (Battersby, Feilden, Gruber, & Oguntoyinbo, 2005; Jegede, 2007)[102, 103].

Numerous states have developed coalitions of consumers in partnership with the United Nations Population Fund (UNFPA) to assist states in providing training for midwives, physicians, and other health care professionals. UNFPA also supplies medical equipmentto health care facilities (Galadanci, Idris, Sadauki, & Yakasai, 2010; Nzama & Hofoney 2005; Shiffman & Okonofua, 2007)[104,105,106].

There has been progress in polio eradication in Nigeria as a result of technical assistance from UNFPA between 2006 and 2007, during implementation of Immunization Plus Days. The program helped to reduce the incidence of wild polio from 399 cases in 2006 to 86 in 2007 (Arulogun & Obute, 2007; Jenkins et al., 2008; Weiss, Winch, & Burnham, 2009)[107,108,109].

International Partnerships

Nigeria's health system has received financial support and technical assistance from WHO, the World Bank, the United States Agency for International Development, UNICEF, UNFPA, and the Department for International Development (DFID) of the United Kingdom. The aim of the international support has been to increase capacity building by promoting health care systems, training health care workers, and providing technical support and funding local government areas (Fasina, Kaplan, Kahn, & Monath,2008; Ikharehon, 2007)[110].

In various parts of Nigeria, UNICEF has contributed significantly to reducing mortality and morbidity by organizing immunization activities, efforts to prevent transmission of HIV/AIDS, malaria control, and provision of basic health services. In Northern Nigeria, WHO and UNICEF worked with the National Program on Immunization to reduce polio by providing support on staffing, training, and logistics (Battersby et al., 2005)[111]. With the effective collaboration of UNICEF, WHO, and the RedCross, an increase in immunization coverage occurred in Nigeria, increasing use of delivery services and coordinating immunization services at the community level (Aylward, 2006; Meremikwu & Ehiri, 2009; Moss, 2009; Ryman, Dietz, & Cairns, 2008)[112,113,114]. DFID has its main office in Abuja, Nigeria, and has played an active role in partnership with Nigerian stakeholders and other organizations to ameliorate social problems in Nigeria. DFID has provided for improved health care delivery in many local government areas. DFID has worked with federal and state governments to enhance health systems and build

capacity to better serve the people (Battersby et al., 2005; DFID,2004, 2008; House of Commons International Development Committee, 2009)[111,115,116]. As previously discussed, a strategy was introduced in 2006 to reach all previously unreached eligible children ages 23 to 59 months. Anambra State implemented house-to-house vaccination and experienced improvement for various vaccines; however, rural areas continued to face enormous challenges in infrastructure and accessibility.

Health Care Structure of Nigeria

Nigerian health care is structured on three levels. The national government is responsible for tertiary care, the state government is responsible for secondary care, and the local government areas are responsible for primary care. The state and local government areas have primary responsibility for implementing health-related activities, whereas the federal government formulates policies and provides directives that are managed through the Federal Ministry of Health, Abuja (2004). The National Health Policy and Strategy, initiated in 1988 and revised in 2004, was intended to promote betterhealth for all Nigerians.

The National Primary Health Care Development Agency provides technical knowledge and other related information on policy direction and supervising implementation of delivery system for the Federal Ministry of Health. Primary health care facilities provide free basic preventive care and promote health services including immunizations, health education, and antenatal services. The local government area is responsible for managing health delivery activities at the primary level. To ensure effective implementation of primary health services, each local government area issubdivided into wards; each ward plays an important role in supporting health services.

At the local government area, the national program on immunization manager reports to the primary health care coordinator. The national program on immunization manager is responsible

for overseeing cold chain officers and ensuring record keeping is adequate atall facilities in the district. Management and technical committees exist in various local government areas; however, lack of coordination is apparent. As a result, wards cannot get the appropriate materials (Adeyemo, 2005; Khemani, 2006)[117,118].

The state and the 774 local government areas provide financial resources to run primary care services. The federal government also takes responsibility to manage teaching hospitals and train medical doctors, in contrast to the state-trained nurses, midwives, and health care workers. One problem is that the Federal Ministry of Healthmight give directives but cannot mandate that the State Ministry of Health implement health policies and programs. Therefore, transparency and accountability are lacking (Khemani, 2006)[118].

Wide gaps existed in the three-tier system, especially in policy formulation at the national level and actual implementation was invested at the states and local government areas. For example, during polio eradication exercises, it was the federal government thatplanned and developed the program and provided materials that would be helpful, including posters, banners, and stickers to be used in local areas. In addition, health goalsand objectives were planned at the national and global levels. The result was that these materials, designed by federal ministry of Health, were inappropriate to use at the local and communities, due to a disconnection between cultures (Jombo et al., 2008; Obadare,2005; Obute & Arulogun, 2007; Yahya, 2007)[119,120,121].

Each state provides funds for primary healthcare, hiring, and training personnel for local government areas through the state ministry of health. The state director ministry of health oversees the implementation services provided by local government areas. Local government areas have sole responsibility for providing public primary health care, whereas the state ensures that secondary health care remains viable. The activities of primary health care are headed by a

local government area coordinator who communicates with other levels in each local government. Lack of effective coordination on vaccines, drug procurement, and distribution to various levels of the system is common, and resources were not allocated efficiently (Battersby et al., 2005)[111]. In addition, each level of the healthcare system in Nigeria is autonomous. Therefore, it is common to find that administrators of activities of primary, secondary, and tertiary healthcare systems are not accountable to each other. The result is that the three-tier system duplicated roles (Bankole et al., 2010; Oluwadare, 2009)[122,123].

State Government Level

The state ministries of health focus on training nurses, midwives, and health technicians who provide good care services, especially for clients refer from community health services. Early identification of health problems and interventions are provided to address health issues such as teaching self-examination for breast cancer. Most secondary healthcare facilities are located in district, division, and zonal levels of the state. Services provided by this level of care include diagnosis and treatment, blood bank, and physiotherapy. However, basic amenities are lacking in most of these facilities in ruralareas (Chukwuani et al., 2006; Kawuwa et al., 2007)[124,125].

Tertiary Health Care

This level of health care focused on restoration and rehabilitation of patients to an optimal level of functioning. These advanced functions were performed by teaching hospitals and other specialized hospitals. Services included orthopedic, psychiatric, maternity, and pediatric. A patient who sustained a spinal cord injury, for example, might be referred to a rehabilitation facility for training to improve or enhance remaining abilities. Tertiary health facilities were overburdened due to inadequate healthcare services at primary health centers (Akande, 2004; Bankole et al., 2010; Ehiri, Oyo-Ita, Anyanwu, Meremikwu, & Ikpeme 2005; Sule et al., 2008)[126,127]. Routine immunizations performed at tertiary clinics often did not have necessary

adequate cold chain (Aderibigbe, Osagbemi, & Bolarinwa, 2010)[128]. A study was performed that included a tertiary hospital and three health centers in the middle belt zone of Nigeria (Aderibigbe et al., 2010)[128]. Researchers found all cases of adverse reactions to vaccine administration (93%) occurred at tertiary health facility. Cases seen according to facility indicated that Facility A accounted for three cases (5.3%) of adverse reactions, whereas one case (1.8%) occurred at Facility B, and no case of vaccine adverse reactions occurred at Facility C; however, 53 cases (93%) of adverse reactions occurred at a tertiary facility. Inaddition, the health clinic at the hospital had inadequate cold chain, compared with three health facilities outside the hospital.

The nation's low socioeconomic status continues to affect adequate provision of funding for public health care. Nigeria ranks 159 of 177 countries in poverty, with a human-development index of 0.448 (in a range of 0 to 1; United Nations Development Programme [UNDP], 2010)[129]. Lack of drugs, vaccines, and cold chains in healthcare facilities were common, and inadequate medical equipment continued to result in the reduction of the use of healthcare facilities, especially by rural residents (Babalola & Fatusi, 2009; Ehiri et al., 2005; Oluwadare, 2009)[130,131,132]. The result was that most citizens preferred to be served by private medicine vendors. Private medicine vendors carried and sold drugs at their convenience and patent medicine stores were the major sources of carefor people with low socioeconomic status and low levels of education (Afolabi, 2008; Onwujekwe, 2005; Uzochukwu & Onwujekwe, 2005)[133,134]. Regulation of medicine dealers has become a major problem for the federal government (Mohamed, 2007; Obot, 2004)[135,136].

In 2003, the Pharmaceutical Council of Nigeria was assigned responsibility for regulating private medicine dealers by the federal government. In addition, a governmentagency under the Federal

ministry of health, the National Agency for Food and Drug Administration and Control, has the responsibility for drug and product registration, and for imports and exports, in an attempt to control use and distribution of placebos sold as efficacious medicine.

National Program on Immunization in Nigeria

One of the components of Child Survival Programs is the National Program on Immunization (NPI). The National Vaccination Initiative (NPI) was created to ensure that vaccination facilities are extended to a wider community using various methods such as health education, vehicle provision, and the cold chain methodology, among others. It first appeared in Nigeria in 1979. Because of its WHO adoption, it was initially known as the Expanded Program on Immunization (EPI). The Federal Government established NPI under Decree 12 in August 1997 to provide it a national perspective and demonstrate Federal Government commitment.

The goal is to successfully limit the spread of all vaccine-preventable diseases by immunizing people and providing vaccines and other consumables. Tuberculosis, measles, diphtheria, pertussis, neonatal tetanus, cerebrospinal meningitis, yellow fever, and polio are among the vaccine-preventable diseases in Nigeria that are being targeted for prevention, control, and eradication. These were targeted through the provision of vaccination services, which included the injection of vaccine to susceptible targets. The NPI is aimed towards the following individuals: All pregnant women and women of reproductive age, as well as children aged 0-11 months[135].

Likewise, additional TT programs for women of reproductive age, Polio Eradication, and Measles Eradication activities are planned and implemented on an annual basis until the goals/objectives are accomplished[136].The National Immunization Program (NPI) is solely

responsible for overseeing and improving routine and supplemental immunization operations in Nigeria. Many states hold National Immunization Days (NIDs), local immunization days (LIDs), immunization plus days (IPDs), and child health weeks on a regular basis, all with the goal of increasing immunization coverage and reaching every child (including those in hard-to-reach areas) regardless of their immunization status. Nigeria is a signatory to the World Health Assembly's Declaration on the Survival, Protection, and Development of Children, which was adopted in 1988.

In May 2007, NPI amalgamated with the National Primary Health Care Development Agency (NPHCDA) as part of the Federal Government's Health Sector Reform. All three levels of government in Nigeria (federal, state, and local) are key partners, dedicated to developing policies and providing assistance for the execution of an efficient vaccination program. The government provides free vaccines and immunization services to all eligible populations through functional PHC centers, government and private health facilities, in order to target national interests and priorities. In order to achieve maximal protection against children's killer illnesses and other vaccine preventable diseases, the government ensures the provision of vaccinations and the use of a national immunization schedule for:

i. Eligible children 0–11 months.

ii. Eligible children 0-59 months.

iii. Women of child bearing age 15–49 years[137].

Nigeria's national vaccination program (NPI) and public awareness campaigns

The National Program on Immunization (NPI) is a ministry of health program tasked with avoiding disease, disabilities, and mortality in children and adults due to vaccine-preventable

diseases. The National Vaccination Initiative (NPI) was created to ensure that vaccination facilities are extended to a wider community using various methods such as health education, vehicle provision, and the cold chain methodology, among others. It first appeared in Nigeria in 1979. Because of its WHO adoption, it was initially known as the Expanded Program on Immunization (EPI). The Federal Government established NPI under Decree 12 in August 1997 to provide it a national perspective and demonstrate Federal Government commitment.

The goal is to successfully limit the spread of all vaccine-preventable diseases by immunizing people and providing vaccines and other consumables. Tuberculosis, measles, diphtheria, pertussis, neonatal tetanus, cerebrospinal meningitis, yellow fever, and polio are among the vaccine-preventable diseases in Nigeria that are being targeted for prevention, control, and eradication.

These were targeted through the provision of vaccination services, which included the injection of vaccine to susceptible targets. EPI is aimed towards the following demographic: All pregnant women and women of reproductive age, as well as children aged 0-11 months[138]. In 1988, the World Health Assembly announced the Global Polio Eradication Initiative, setting the year 2000 as the deadline for poliomyelitis eradication. Poliomyelitis cases decreased from 350 000 in 165 countries in 1988 to 355 in 2013, mostly in three countries: Nigeria, Afghanistan, and Pakistan, thanks to aggressive mass immunization and effective regular immunization. In response to this worldwide concern, Nigeria developed a program aimed at eliminating diseases such as polio, meningitis, and others through SIAs/catch-up campaigns (Immunization Plus Days (IPDs), Local Immunization Days (LIDs), Child Health Week, and so on) To enhance routine immunization coverage and control out-break events such as meningitis, measles, and yellow fever, which is

normally planned and carried out on a regular basis based on needs and results of coverage survey[15].

Similarly, actions such as additional tetanus toxoids for women of childbearing age, Polio Eradication, and Measles Elimination are planned and carried out on an annual basis until the goals/objectives are reached. In Nigeria, EPI is solely responsible for overseeing and improving routine and supplemental vaccination operations. Many jurisdictions hold National Vaccination Days (NIDs), Local Immunization Days (LIDs), Immunization Plus Days (IPDs), and Child Health Weeks on a regular basis, all with the goal of increasing immunization coverage and reaching every child (including those children in hard-to-reach areas) irrespective of their immunization status.

Nigeria is a signatory to the World Health Assembly's Declaration on the Survival, Protection, and Development of Children, which was adopted in 1988. In May 2007, NPI amalgamated with the National Primary Health Care Development Agency (NPHCDA) as part of the Federal Government's Health Sector Reform. All three levels of government in Nigeria (federal, state, and local) are key partners, dedicated to developing policies and providing assistance for the execution of an efficient vaccination program. The government provides free vaccines and immunization services to all eligible populations through functional PHC centers, government and private health facilities, in order to target national interests and priorities.

In order to achieve maximal protection against children's killer illnesses and other vaccine preventable diseases, the government ensures the provision of vaccinations and the use of a national immunization schedule for:

I. Eligible children 0–11 months.

II. Eligible children 0-59 months.

III. Women of child bearing age 15–49 years.

2.1.3 Nigerian immunization schedule

One of the guiding ideas in the administration of NPI vaccinations to children is that vaccine protection must be offered before they reach the high-risk age for the diseases, and that this should be done to as many children as possible (up to 95 percent) in order to achieve herd immunity. Herd immunity, also known as social immunity or population immunity, is a type of indirect protection from infectious diseases that arises when a high percentage of a community becomes immune to an infection, offering some protection for others who are not[139].

The chains of infection are likely to be interrupted in a population with a large number of immune persons, which stops or slows the spread of the disease. The lower the chance that those who are not immune will come into touches with an infected individual, the greater the proportion of people in a society who are immune[140].

The policy of the Expanded Immunization Program is based on the epidemiological pattern of diseases in the country, vaccine availability, and the operational capabilities of the National Immunization Program[141]. At birth, a child takes one dose of Bacille Calmette-Guerin (BCG), Oral Polio Vaccine (OPV0), Hepatitis B Vaccine(HepB0); OPV1, Pentavalent1, Pneumococcal Conjugate Vaccine (PCV1), HBV1;OPV1, Pentavalent1, Pneumococcal Conjugate Vaccine (PCV1), Hepatitis B, IPV at 6 weeks; OPV2, Pentavalent2, PCV2, HBV2 at 10 weeks; OPV3, Pentavalent3, PCV3, HBV3 at 14 weeks, Measles, meningococcal and Yellow Fever at 9 months and lastly Vitamin A at 15 months[15].

Table 2.1: Immunization schedule

Vaccine	Due age	Max age	Dose	Diluent	Route	Site
For Infants						
BCG	At birth	till one year of age	(0.05 ml until 1 month) 0.1ml Beyond age 1 month	YES Manufacturer supplied diluent (Sodium chloride)	Intra-dermal	Upper Arm - LEFT
Hepatitis B - Birth dose	At birth	within 24 hours	0.5 ml	NO	Intra-muscular	Antero-lateral side of mid-thigh - LEFT
OPV-0	At birth	within the first 15 days	2 drops	-	Oral	Oral
OPV 1, 2 & 3	At 6 weeks, 10 weeks & 14 weeks	till 5 years of age	2 drops	-	Oral	Oral
Pentavalent 1, 2 & 3** (Diphtheria+ Pertussis + Tetanus + Hepatitis B + Hib)	At 6 weeks, 10 weeks & 14 weeks**	1 year of age	0.5 ml	NO	Intra-muscular	Antero-lateral side of mid-thigh - LEFT
Fractional IPV (Inactivated Polio Vaccine)	At 6 & 14 weeks	1 year of age	0.1 ml	NO	Intra-dermal	Upper Arm - RIGHT
Rotavirus‡ (Where applicable)	At 6 weeks, 10 weeks & 14 weeks	1 year of age	5 drops	NO	Oral	Oral
Pneumococcal Conjugate Vaccine (PCV) (Where applicable)	At 6 weeks & 14 weeks At 9 completed months - booster	1 year of age	0.5 ml	NO	Intra-muscular	Antero-lateral side of mid-thigh - RIGHT
Measles / Rubella 1st dose ##	At 9 completed months-12 months.	5 years of age	0.5 ml	YES Manufacturer supplied diluent (Sterile water)	Sub-cutaneous	Upper Arm - RIGHT
Japanese Encephalitis – 1 @ (Where applicable)	At 9 months-12 months@	15 years of age	0.5 ml	YES - Manufacturer supplied diluent (Phosphate Buffer Solution)	Sub-cutaneous	Upper Arm - LEFT
Vitamin A (1st dose)	At 9 months	5 years of age (1 lakh IU)	1 ml	-	Oral	Oral

Source: National Immunization Schedule 2018 (India)

The vaccination schedule for children in the United States includes 13 vaccines that are recommended. Some vaccines require booster shots during adulthood to maintain immunity, while others provide protection for life. Getting vaccinated against the flu is advised once a year. Immunization regimens are meticulously crafted to protect children from potentially fatal diseases at a moment in their lives when they are most susceptible to infection. It is critical to stick to the schedules, not only for your child's health but also for the health of people around them. Alternative immunization schedules are not advised since they put children at unnecessary risk. The first series of vaccines in the United States begins at birth and continues every one to three months until the child reaches the age of 15 months.

Between birth and 15 months, the following 10 immunizations will have been started (and in some cases completed):

• Hepatitis B (HepB) vaccine: three doses given at birth, 12–18 months, and 6–18 months.

• Rotavirus (RV) vaccine: Rotarix (two-dose series administered at 2 and 4 months) or RotaTeq (two-dose series given at 2 and 4 months) (three-dose series given at 2, 4, and 6 months)

• DTaP vaccination (diphtheria, tetanus, and pertussis): a five-dose series given at 2, 4, 6, 15–18 months, and 4–6 years.

• Hib vaccine: ActHIB or Hiberix given as a four-dose series at 2, 4, 6, and 12–15 months, or PedvaxHIB administered as a three-dose series at 2, 4, and 12–15 months.

• Pneumococcal vaccine (PCV13): Prevnar 13 is administered in a four-dose series at ages 2, 4, 6, and 12–15 months, with a single dose of Pneumovax 23 administered at age 2 to children with high-risk heart or lung disorders.

• Polio vaccination (IPV): a four-dose series administered at 2, 4, 6–18 months, and 4–6 years of age.

• MMR vaccination (measles, mumps, and rubella): Two doses given at 12–15 months and 4–6 years.

• Varicella (VAR) vaccine: This vaccine, often known as the chickenpox vaccine, is administered in two doses at 12–15 months and 4–6 years.

• Hepatitis A (HepA) vaccine: a two-dose series administered at 12 and 18–23 months.

• Influenza vaccine (IIV): Given annually by injection starting at the age of 6 months (two doses given at least four weeks apart for children 6 months to 8 years if it is their first flu vaccination, and one dose for everyone else)

From the age of 18 months to the age of sixteen years, during this time, some of the above-mentioned vaccines will continue to be administered. By the time your child is 4–6 years old, they will have completed all of the vaccines they began early in life (with the exception of the flu vaccine, which they must get every year). These three further vaccines, which should be finished by the age of 16, will be given to them:

• Tdap vaccine (tetanus, diphtheria, and pertussis): To increase immunity to the DTaP vaccine, one dose is given at the age of 11 or 12.

• Meningococcal vaccine: either a two-dose series of Menactra or Menveo given at 11 or 12 years old and again at 16, or a single dose of MenQuadfi administered at 2 years old or as a booster shot at or after 15 years old.

• HPV vaccine: A two-dose series of Gardasil 9 given at 11 or 12 years old, with a follow-up dose six to 12 months later.

Role of Women's Autonomy in Completion of Immunization Schedule

The term *women's autonomy* has been described by many researchers as the ability of a woman to take an independent decision about the family that either affects her or her children without any interference from the family. The word *autonomy* is used interchangeably with *volitional control* and *empowerment*. Bharati (2014) also reported similar definitions of *women's autonomy* by several researchers. According to Bharati, (2014) defined *autonomy* as the opportunities for women to receive education and to work outside the home, while Bharati (2014) quoted Miles-Doan who defined *autonomy* as a woman's position within household power relations such as her bargaining power.

He also defined *autonomy* as control over the household and societal resources. Finally, Bharati (2014, quoted Jejeeboy and Sathar who stated that autonomy entails five interconnected elements, such as knowledge or experience acquired; decision-making power; physical autonomy which includes ability to go out freely without seeking permission based on need; emotional independence and economic and social sovereignty which includes right to use and control over resources. The overlapping of the definitions and concept of women's autonomy has brought researchers recently, to begin to investigate the role of women autonomy on the status of their own health as well as the health of their children (Bharati, 2014)[141].

In a study on the impact of women's autonomy, on their children's nutritional and immunization status as measured by the women's decision-making power through four main parameters of decision making on her own health care, large household purchase, going to relatives or friend's house and spending the husband's earning (Bharati, 2014)[141]. These decision-making controls are

directly or indirectly associated with the socioeconomic characteristics of the household and cultural conditions of the society, this is consistent with similar findings from another study in India and Nepal (Bharati, 2014; Desai & Johnson, 2002)[141,142]. Bharati (2014) also found that the proportion of independent decision making of women is very small when compared to the joint decision making with their husband, while the proportion of women who could not take any decision independently is very high among the Indian women (Bharati, 2014)[141]. Similarly, urban women have more decision-making powers as compared to their rural counterparts, while literate women have more autonomy than illiterate women, but on the use of husband's money, the illiterate women have almost twice the autonomy their counterparts that are more educated (Bharati, 2014)[141].

These findings on the impact of women's autonomy on the health of their children as reported by Bharati, (2014) are consistent with findings from another study in India and Nepal on women's decision making and child health. Familial and social hierarchies, in which they found that women autonomy increases their use of emergency care or preventive health care services including children's immunization and can influence even women that have less decision-making authority. While even women that are high powered when living in communities where women have less decision-making powers may have their powers significantly curtailed (Bharati, 2014). As a fall out of this effect, even doctors may refuse to treat emergency patients based on the sole decision of women in a highly male-controlled society (Bharati, 2014; Desai & Johnson, 2002)[141,142]. Similarly, Ebot (2015) and Singh, Haney, and Olorunsaiye (2013) found a positive relationship between women's autonomy and children's health outcomes including immunization status.

2.1.4 The Immunization Compliance Concept in Children

Compliance is defined as cooperative behavior and adherence to recommended therapy as recorded in the clinic record over a period of time, with compliance criteria including, among other things, keeping clinic appointments on a regular basis[143]. The client's actual attendance at the health unit or hospital on the appointment day to receive the prescribed care[144]. The term compliance is defined or conceived in the context of this study as obtaining the required number of vaccine doses at the right age as specified on the immunization schedule and recorded in the child's record card. Noncompliance could have a severe impact on the country's current immunization campaign.

The number of wild polio virus cases was over 200 percent higher in the first quarter of 2006gb than in the same period of 2005. This was thought to be the result of poor-quality campaigns, erroneous data, and pockets of non-compliance linked to a lack of understanding of the need for multiple OPV doses[145]. Parents have frequently cited child illness, procrastination, and a lack of awareness regarding immunization and where to receive services as reasons for non-compliance with RI62. Similarly, misconceptions, misinformation, ignorance, and skepticism have all been identified as substantial barriers to routine immunization. According to their research, 16% of the population believes diseases are caused by evil spirits, witchcraft, or heat.

25% of people have never heard of the measles vaccine. In addition, 27% did not believe immunization was effective, and 4% were not allowed to get immunized by their husbands. The remaining 28% said immunization was unnecessary because the youngster was healthy[146].

2.1.5 Nigerian Barriers to Childhood Immunization Compliance

Nigeria is working to improve routine immunization in order to lessen the burden of vaccine-preventable diseases, particularly in the north. Thirty studies found that children under the age of one had national vaccination coverage for critical vaccines, while eighteen did not. When it comes to childhood immunizations, national immunization coverage is believed to be low. Lack of awareness about immunization, distance to access point, and financial hardship were all barriers for parents and caregivers.

In vaccinations and immunization programs, there is a lack of partner support and trustworthiness. The number of offspring, lifestyle, migration, occupation, and parent forgetfulness, as well as problematic time and language barriers, were all linked to low immunization rates. Limited human resources and poor infrastructure to manage the cold chain and appropriate vaccination supplies were highlighted as barriers at the health system level by health care professionals[147].

2.1.6 Vaccine Coverage and Retention

To help developing nations expand vaccination coverage and supply novel vaccines that can save even more lives, innovative funding methods have been put in place. Since the year 2000, governments have stepped up to the plate, increasing vaccination and immunization funding. Many governments are exhibiting strong and effective leadership and national ownership of their vaccination programs, which is critical for long-term sustainability of immunization spending[148]. In order to increase immunization coverage, community participation is critical. In most countries, raising public awareness and demand for immunization benefits is a critical component of a functioning immunization program.

In 2003, the WHO estimated that vaccination avoided 2 million infant deaths, and immunization remains one of the most successful and cost–effective public health programs. From 42 in 2002 to 45 in 2003, the number of developing nations considered to have achieved the UNICEF medium-term strategic plan's aim of 80percent coverage for DPT3 in every district grew. Nonetheless, poor countries have devised techniques for delivering immunization to hard-to-reach populations[149].According to WHO, coverage of the expanded program on immunization (EPI) has increased worldwide since 1985, but more work has to be done in Nigeria to meet the targets, particularly in the north[150].

2.1.7 Information on Routine Immunization for Mothers and Caregivers in Nigeria

One of the most essential variables in the improvement of mother and child health services has been communication access[151]. In both urban and rural areas of Nigeria, mothers' awareness of immunization was proven to be a predictor of full immunization[152]. According to studies, mother education is a significant determinant of child health, with no other factor having the same effect. It was also discovered that maternal education is the most powerful independent predictor of childhood death[153]. Another study discovered a clear link between children's immunization patterns and their mother's educational level. It was also discovered that mothers with at least a primary level of education were 1.7 times more likely than mothers with no education to have their children fully immunized[154].

In 2011, the country made success in terms of reducing the number of endemic polioviruses in the country as well as improving the implementation of routine immunization services[155]. Traditional and religious leaders were said to have played a role in these developments. Community leaders and religious leaders typically persuaded moms and caregivers to vaccinate their children rather than coercing them[156]. The results of a study in Lagos that looked at mothers'

propensity to get SMS reminders for immunization services were encouraging news, as most moms expressed an interest in receiving the rest[157].

If this trend can be adopted in the North, it could pave the way for greater vaccination coverage in the region. Because non-attendance for immunization appointments is still a problem for healthcare management, reminders have been found to be beneficial in improving clinic attendance and increasing childhood immunization rates[158].

2.1.8 Participation of the Community and Dissemination of Immunization Information

Childhood diseases can only be discovered by adequate information dissemination to mothers/caregivers in a safe environment. It has been proven that if easy and high-quality services are available, moms are typically quite ready to have their children vaccinated. Higher vaccination coverage, fewer left-outs and dropouts, and fewer incidences of vaccine-preventable illnesses (VPDs) arise from community participation in the immunization program because an informed community has faith in the vaccination program and hence supports and requires immunization services, and because immunization services are suited to the context of the community (time, place, and convenience)[159,160].

Only by establishing continuous dialogue with the community will PHC personnel succeed in sharing information about routine immunization. Any approach for reaching the hard-to-reach must include community partnerships. Vaccination coverage is better in areas where residents are aware of their rights, the benefits of health services, and where, when, and how to obtain them[161].

A medical service based on an understanding of how communities acquire and share information, communication with communities must be suitable in content, language, and channel of

transmission[162]. For example, the media may reach wealthy and urban households, but it may not reach impoverished and rural households as effectively[163]. Instead, making sure that information is shared where people generally congregate and that messages are relevant to various demographic groups is more likely to be effective[164].

Low vaccine coverage has long been blamed on a lack of community engagement and involvement in the programs. However, a study indicated that vaccine coverage in rural areas was surprisingly higher than in metropolitan areas, which was attributed to better community mobilization and participation in the delivery of immunization services[165].

2.1.9 Access to Medical Services

Other factors that affect children's immunization status include access to health facilities such as prenatal care and delivery location. According to studies, moms who attend prenatal clinic and give birth in a health facility are more likely to fully vaccinate their children since antenatal clinic is a way for women to learn about immunization[166]. It's also similar to a Columbia study on the uptake, behavioral, and attitudinal determination of hepatitis B immunization among babies, which found that immunization was substantially associated with health-care provider recommendation

2.1.10 The Cold Chain

The cold chain is the interconnection of equipment or people that ensure vaccine potency by keeping vaccine cold all the way from the manufacturer to the mother/child.

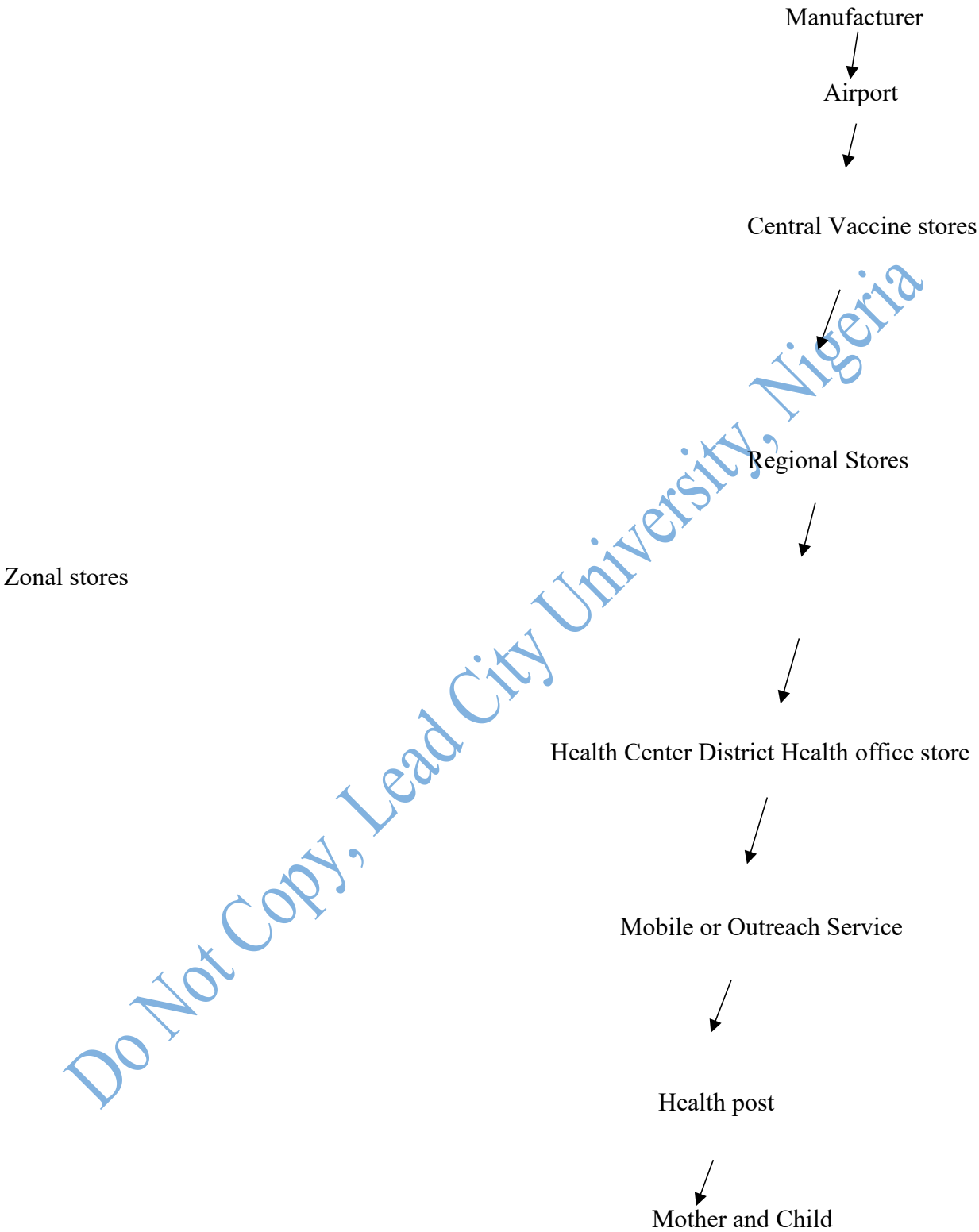


Figure 2.1. The Cold Chain

Source:[124]

2.2 Theoretical Framework

2.2.1 Model of Health Belief

One of the first theories of health behavior was the Health Belief Model (HBM). It was created in the 1950s by a group of social psychologists from the US Public Health Service who wanted to explain why so few individuals were participating in illness prevention and detection programs. HBM is an effective model for dealing with problem behaviors that raise health issues (for example, high-risk sexual behavior and the danger of obtaining HIV) [167]. According to the Health Belief model, a person's health-related behavior is influenced by their perceptions of four key areas:

- The severity of a potential illness
- The person's susceptibility to that illness
- The benefits of taking a preventive action and
- The barriers to taking that action[165].

HBM is a common nursing model that is used to address concerns such as patient compliance and preventive health care practices. The model proposes that a person's perception of a threat posed by a health problem, as well as the value associated with measures aimed at minimizing the threat, drive health-seeking behavior. The relationship between a person's ideas and behavior is addressed in HBM. It allows for a better knowledge and prediction of how clients will act in connection to their health and how they will adhere to medical treatments.

The main ideas and definitions behind the health belief model

• The Health Belief Model's Constructs

• Susceptibility to the health problem

• Severity of the health problem

• Benefits of the recommended remedy

• Perceived barriers to adopting the recommended solution

Perceived susceptibility: a person's belief that a health problem is personally relevant or that an illness diagnosis is correct. A higher perceived risk of infection is likely to increase demand for immunization against it.

Perceived severity: Even if one acknowledges personal susceptibility, action will not be taken unless the intensity is perceived to be severe enough to cause substantial organic or social issues. This can be measured by the length of the illness or whether the disease will cause disability or long-term repercussions. The level of knowledge with the disease can have an impact on this.

Perceived benefits: refers to a patient's perception that a particular treatment will cure or prevent an ailment.

Perceived barriers**:** refers to the factors responsible for preventing a patient from adopting the recommended solutions[166].

Some of the factors preventing mothers from obtaining or completing immunization for their children include lack of knowledge, cultural background, and lack of finances etc.

Modifying factors: include personality variables, patient satisfaction, and socio-demographic factors. The health belief model however is realistic. It recognizes the fact that sometimes wanting to change health behavior isn't enough to actually make someone actually do it, and

incorporates two more elements into its estimations about what it actually takes to get an individual to make the leap.

The most frequent paradigm for studying health-related behaviors is the Health Belief Model (HBM). People are more likely to engage in disease prevention actions if they believe (a) they are extremely susceptible to the disease; (b) the disease is serious; (c) the behaviors are beneficial; (d) the behaviors have few barriers; and (e) they are cued to do so.

The Health Belief Model (HBM) proposes that demographics, perceived risk of influenza, perceived benefit of influenza vaccination, perceived safety of influenza vaccination, social norms, worry about influenza vaccination, anticipated regret, and perceived control were composed of the model's predictors in a study on Parents' Perception and Decision on their Children's Vaccination Against Seasonal Influenza in Guangzhou, these variables are then linked with the vaccination intake[168].

The health belief model was a good fit for determining what factors might influence parents' views and vaccination decisions for their children against seasonal influenza. Due to the constraints of the HBM model, social norms and emotional elements (worry/anxiety, anticipated regret) should be included as extra factors in the original HBM to increase the predictive ability of the HBM for parental decision on seasonal influenza vaccine for children.

Another study claimed that self-efficacy may be added to the other HBM variables without changing the theoretical structure of the model. However, similar studies suggested that important HBM dimensions have indirect effects on behavior as a result of their effect on perceived control and intention, which could be considered more proximal action determinants[168].

The social ecological model was also utilized to investigate the socioeconomic aspects linked to childhood immunization coverage. This concept examines how a person interacts with his or her social environment in order to improve people's lives. The interaction between the individual and their environment is recognized and articulated in this approach. There are four or five stages to the Social Ecological Model. The individual level of internal determinants of behavior, such as knowledge, attitudes, beliefs, and skills, is at the center or base. External influences such as family and friends, the individual's physician, and key opinion leaders are included at the interpersonal level. At this level, social norms, social identity, and role definition emerge and operate, influencing lifestyle and health-care decisions.

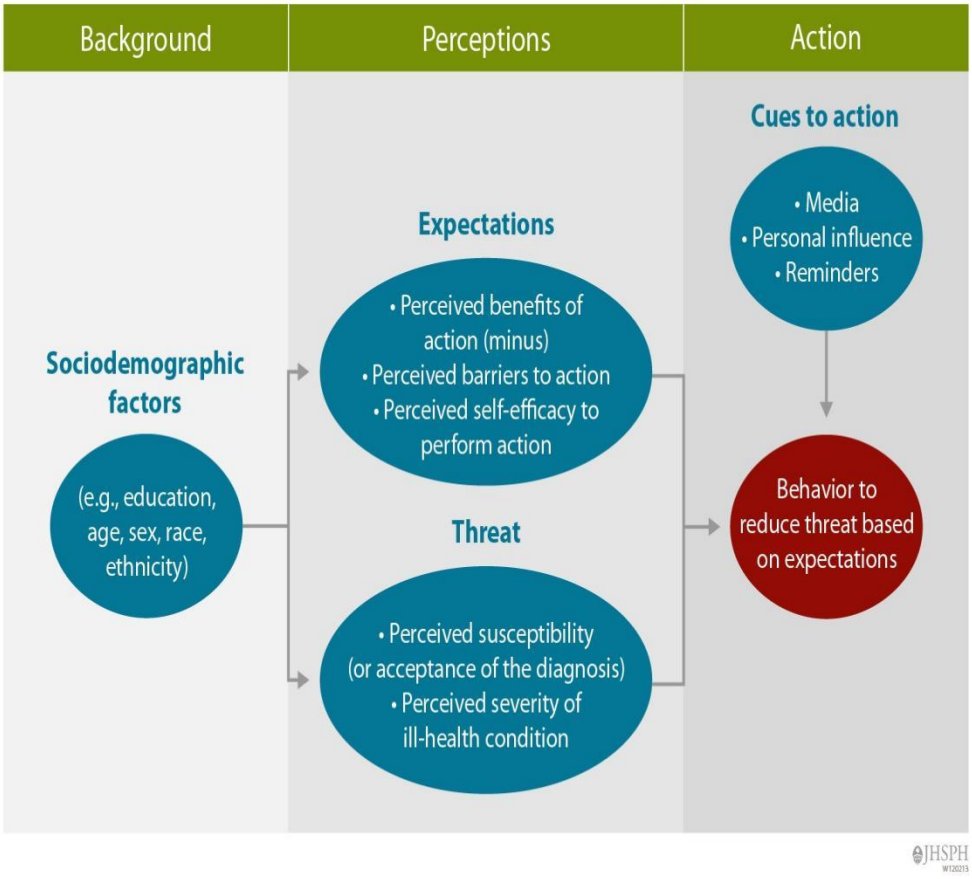


Fig 2.2: The Health Belief Model (Adopted by Ministry of Health)

Source;[135]

2.2.2 The Theory of Planned Behavior (TPB)

In 1980, the Theory of Reasoned Action was developed to forecast an individual's intention to engage in a certain behavior at a specific time and location. The hypothesis was designed to describe all behaviors over which humans can exercise self-control. Behavioral intent is a fundamental component of this paradigm; behavioral intentions are impacted by one's attitude about the likelihood that a behavior would produce the expected result, as well as one's subjective assessment of the risks and advantages of that outcome[169].

The TPB has been used to predict and explain a variety of health behaviors and intents, including smoking, drinking, using health services, breastfeeding, and substance use, among others. According to the TPB, behavioral success is dependent on both motivation (intention) and skill (behavioral control). It divides beliefs into three categories: behavioral, normative, and control. The TPB is made up of six components that together indicate a person's genuine behavioral control[170]

• Attitudes - This refers to the degree to which a person views the behavior of interest favorably or negatively. It requires thinking about the consequences of executing the behavior.

• Behavioral intention - This refers to the motivating variables that drive a specific conduct, with the stronger the intention to perform the activity, the more likely it will be performed.

• Subjective norms - This is the belief that the majority of people approves or disapproves of a particular action. It has to do with a person's ideas about whether or not peers and important individuals in his or her life think he or she should partake in the conduct.

• Social norms - These are the unwritten rules of conduct in a group of people or in a larger cultural environment. In a group of people, social norms are regarded normative, or standard.

• Perceived power - This relates to the availability of circumstances that may help or hinder a person's ability to perform an action. Each of those characteristics is affected by a person's perceived behavioral control, which is influenced by perceived power.

• Perceived behavioral control - This refers to a person's perception of the ease or difficulty of performing the behavior of interest. Perceived behavioral control varies across situations and actions, which results in a person having varying perceptions of behavioral control depending on the situation. This construct of the theory was added later, and created the shift from the Theory of Reasoned Action to the Theory of Planned Behavior.

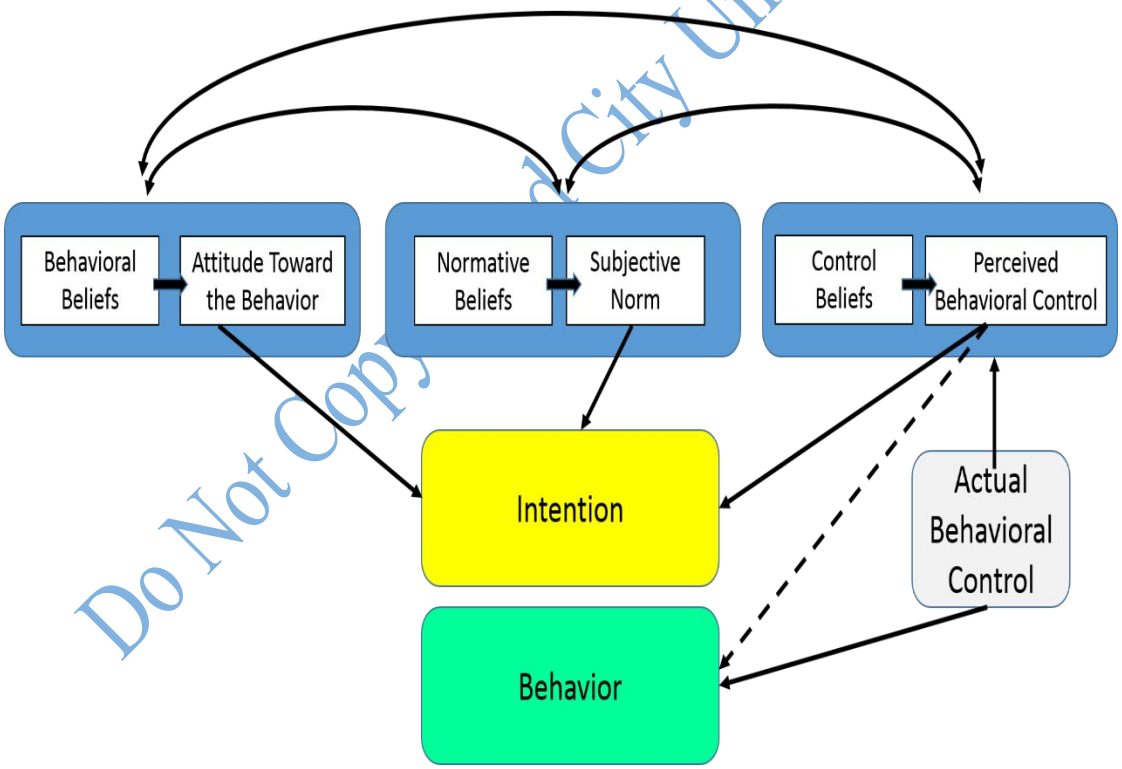


Fig 2.3: Theory of Planned Behaviour.

Source:[142]

The theory of planned behavior (TPB) is a psychology concept that connects thoughts to actions. According to the theory, an individual's behavioral intentions are shaped by three basic components: attitude, subjective norms, and perceived behavioral control[171]. IcekAjzen developed the idea in order to improve the prediction power of the theory of reasoned action (TRA). TPB should involve perceived behavioral control[172]. TRA did not include a component for perceived behavior control. TPB has been used to investigate the relationships between beliefs, attitudes, behavioral intentions, and behaviors across a wide range of human domains. Advertising, public relations, advertising campaigns, healthcare, sport management, and sustainability are examples of these disciplines[164]

The theory of planned behavior (TPB) claims that behavior is driven by an individual's "belief structure," which is ultimately decided by their purpose to carry out the behavior[169]. When it comes to the COVID-19 vaccine, belief structure includes attitudes toward the vaccine (i.e., whether it is perceived to be necessary, beneficial, or effective), subjective norms (i.e., whether significant others support getting the vaccine), and perceived behavioral control (i.e., how much COVID-19 vaccination is perceived to be within the individual's control)[167]. New components are being added to the TPB framework all the time to make it more usable[167]. For example, found that the addition of "anticipated regret" substantially increased the predictive value of TPB in terms of older adults' intention to get a seasonal influenza vaccination.

2.2.3 Psychological Antecedents

Betsch and colleagues established the 5C model (5 psychological antecedents of the vaccination technique)[12]. The 5C model reveals psychological antecedents that can predict whether or not a person will get vaccinated. Confidence, complacency, restrictions, calculation, and collective responsibility are the five antecedents. The 5C scale is designed to examine these 5

psychological antecedents of vaccination and to provide insight into how a person might think, feel, and act in relation to vaccination[10, 11]. These antecedents have varied degrees of influence on immunization behavior and measure mental representations, attitudinal, and behavioral proclivities that result from the individual's environment and setting. These antecedents are used nowadays as a framework to assess VH in the high-income countries to find whether people will or will not take the COVID-19 vaccine[17].

2.3 Review of Empirical Studies

In a study to determine mothers' knowledge, attitudes and practices towards child immunization, it was revealed that the majority of interviewed mothers (97%) had a positive attitude towards immunization and also believed that vaccination plays an important role in disease prevention. 32% do not have sufficient information about the routine vaccination schedule and subsequently, 36% of children have incomplete vaccination[172].

According to the study the reasons for incomplete vaccination are: a lack of knowledge about a routine vaccination schedule (25.5%), limited information about the necessity of the second or the third dose of vaccination (18.6%), fear of post-vaccination side effects (16%) and fear of a child illness (9.6%). A significant association was found between mothers' education, practice and attitude regarding immunization. Health institutions (49.5%) and internet sources (21.3%) were the most popular sources of information about immunization[172].

The study further concluded that incomplete immunization is related to mother's lack of information about the immunization schedules, limited awareness about the second and the third dose of vaccination, and it is also related to fear of child getting sick after the vaccination[172]. Some respondents believe that vaccination is not safe and can cause serious side effects. But the majority of mothers have a positive attitude towards child immunization, but their levels of

awareness are very low and they do not comprehensive information about a routine vaccination schedule. It is necessary to raise public awareness of the importance of immunization by implementing educational programs and by traditional and social media[137].

Previous study on maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria. A total of 750 mothers were enrolled in a household survey using WHO cluster sampling in Atakumosa West LGA. Semi-structured questionnaires were used to obtain data on socio demographic characteristics, knowledge on RI, attitudes, and perception of mothers towards RI program, a total of 723 mothers (96.4%), stated that immunization is beneficial to children, and 98.5% agreed that childhood vaccines are safe[22].

Most respondents (82.4%) indicated that they would advise other mothers to take their children for routine immunization. Very few mothers had contrary attitudes that immunization can cause infertility in life (0.9%), that government promotes immunization for its selfish interests (1.2%) and that there are local substitutes for routine immunization (6.4%).

The study revealed that the mean (±SD) age of the mothers were 27.9 (± 6.1) years; 76% (571/750) had good knowledge of RI and VPD and a majority demonstrated a positive attitude towards the RI program. Antenatal care (ANC) attendance [OR 3.7; 95% CI (2.0 - 6.7)] health facility delivery [OR 1.7 (1.2 - 2.7)]; higher level of education [OR 1.9; 95% CI (1.4 - 2.5)], and mothers´ tetanus toxoid immunization status [OR 4.0 (2.3 - 7.2)] were significantly associated with having good knowledge of the RI program. The findings of this study show overall satisfactory maternal knowledge and positive attitudes and perceptions regarding the childhood RI program.

Attendance of antenatal care, health facility delivery of child and higher level of education were positively associated with having good knowledge of the immunization program and VPDs. The study therefore suggested that future efforts are needed to improve maternal knowledge and address misconceptions that may limit vaccination coverage rates in Osun and other regions of Nigeria and further issues explored on how to enhance knowledge and practices[156].

Another study assessed the knowledge and practice of childhood routine immunization among mothers/caregivers attending primary health care centers in Benin City, the study also identified factors contributing to mother's caregiver's knowledge of immunization and areas needing attention. It was a descriptive cross-sectional study involving 640 females whose wards were receiving immunization in 35 PHCs in Benin City[169].

Mothers who met the inclusion criteria were recruited using a pre-tested interviewer administered structured questionnaires using a multistage sampling technique. Relationship between dependent and independent variables was determined using logistic regression analysis, at 95% confidence interval and p-values level less than 0.05 were considered significant. Results show that all the caregivers were aware of immunization. 498(77.8%) with the media being as source of information. A higher proportion of respondent (44.8%) had good knowledge while (38.6% and 12.6%), fair and poor knowledge of immunization respectively. BCG and OPV were the most known vaccines (89.1%), followed by HBV (77.8%), DPT and PENTA were known by 70.6% and 66.1% of respondents respectively.

The study revealed good knowledge of immunization amongst the caregivers and good practice with regards to the actual purpose of immunization. knowledge and practice of immunization in this study was good although they were not as significant to what was expected due to the rigorous health education which occurs before immunization sessions daily and the yearly

routine and supplementary immunization campaign by the federal and state government, also emphasis need to be given to educating and empowering the girl child and also raising awareness on family planning to enable improvement in the immunization coverage[165].

In another study carried out to provide empirical information on the effect of immunization on child development in Gombe Local Government Area of Gombe state, Nigeria. The objectives of the study were to determine the level of children immunization in Gombe Local Government Area and to assess the effect of immunization on child development in Gombe L.G.A. The Level of Immunization uptake was analyzed with over 70%, also effect of the immunization on child development was equally analyzed[71].

400 Mothers/caregivers were randomly interviewed and systematic sampling techniques were used to obtain their housing samples. Inferential and descriptive statistics were used to analyze data obtained from the field. The result shows that Immunization is no doubt a way of improving Child health and Development in the study Area with 0.000 significant levels (p value ≤ 0.05)[71]. The result of this study is in contrary to the World Health Organization report of which states that Gombe state experiences low immunization uptake with less than 50% coverage, and the Nigerian Demographic and Health Survey (2019) that said that Gombe state emerged the least in terms of all age appropriate vaccination with just 6.1% in the north east and recorded the highest with children with no vaccination of 34.4% in the region, also with high level of children morbidity and mortality in Nigeria[71].

In another study carried out to assess the mothers' knowledge and attitude toward childhood vaccination influence uptake as the most adequate tool and preventive aspects to infectious disease epidemics. The study assessed and measured the knowledge and attitude of postnatal

mothers toward vaccination. The study adopted a cross-sectional study design, whereby 200 postnatal mothers were identified during their postnatal visit to clinics.

The subjects were accessed using questionnaire to assess the level of knowledge and attitude of mothers regarding vaccination. The objectives were to study the level of knowledge, the attitude, and to find the association between knowledge and attitude of the study subjects. The data were analyzed using SPSS version 16. The results were analyzed through chi-square test. The association between age (p = .031), education (p = .021), occupation (p = .013), and knowledge score toward vaccination was found to be statistically significant.

However, ethnicity (p = .127), employment (p = .197), and mode of delivery (p = .750) toward mothers' The association between age (p = .031), education (p = .021), occupation (p = .013), and knowledge score toward vaccination was found to be statistically significant. However, ethnicity (p = .127), employment (p = .197), and mode of delivery (p = .750) toward mothers' vaccination knowledge were not significant for the study. Mother's education, age, and occupation were found to be associated with attitude toward childhood vaccination.

No association was found between ethnicity, employment, and mode of delivery with attitude of childhood vaccination. More than half of the studied mothers had good knowledge scores on vaccination; more than two-thirds of the studied mothers had good attitude scores on vaccination. However, the religious misconception and fear of autism was the main cause of vaccine resistance in Malaysia[71].

A scholar conducted another study which mainly aimed at identifying some other factors that predict caregiver's utilization of routine immunization services. This was a retrospective observational study that analyzed previously collected exit interview data conducted during

routine supervision of immunization sessions using a standard structured questionnaire on mobile phones via the 'open data kit' software. The study revealed that 97.5% of caregivers were aware of the importance of routine immunization, while good knowledge of vaccine administered constitutes 92.3%, awareness of days for follow up visit was 97.4% and satisfaction of routine immunization services was 99.2%. However, among the caregivers 22% had reported experience of an adverse events following immunization. Awareness of caregivers of the importance of routine immunization was found to be associated with caregiver's awareness of vaccine administered (odds ratio: 0.079; 95% CI: 0.063-0.098[75].

The target group is biased to caregivers who actually access the services, hence, a limitation of the study. This may explain the disconnection between high level of awareness & satisfaction in routine services among caretakers and the low immunization performance coverage earlier stated in the background. The Source of information for immunization and demographic variables was not part of the study. Bias may have been introduced in the study as data collection was carried out by health staff across the sectors. Suggested answers to questions on satisfaction were either yes or no or not graded; hence may not be a true reflection of the level of satisfaction. A stratified sample of all records was not used but all records for the said period. Data used for analysis are mostly from fixed sites with few from outreach sites, and caregivers' views on immunization services in both sites may differ. A major strength of this study is the use of extensive data set with a statewide representation from all the LGAs. Findings also provided trusted evidence for decision making for child immunization health outcomes and services and contributed to the body of literature, which is currently scarce. Finally, it has provided a better understanding of the mechanisms through which mobile phone technology supports community-based health care delivery[75].

In a study on the National immunization coverage rate masks sub national immunization coverage gaps at the state and local district levels. The objective of the study was to determine the socio-demographic factors associated with incomplete immunization in children at a sub-national level. Cross-sectional study using the WHO sampling method[72].

Fifty randomly selected clusters (wards) in four districts (two urban and two rural) in Enugu state, Nigeria. 1254 mothers of children aged 12–23 months in July 2020. Full immunization coverage (FIC) rate in Enugu state was 78.9% (95% CI 76.5% to 81.1%). However, stark difference exists in FIC rate in urban versus rural districts. Only 55.5% of children in rural communities are fully immunized compared with 94.5% in urban communities. Significant factors associated with incomplete immunization are: children of single mothers (aOR=5.74, 95%CI 1.45 to 22.76), children delivered without skilled birth attendant present (aOR=1.93, 95%CI 1.24 to 2.99), children of mothers who did not receive postnatal care (aOR=6.53, 95%CI 4.17 to 10.22), children of mothers with poor knowledge of routine immunization (aOR=1.76, 95%CI 1.09 to 2.87), dwelling in rural district (aOR=7.49, 95%CI 4.84 to 11.59), low-income families (aOR=1.56, 95%CI 1.17 to 2.81) and living further than 30min from the nearest vaccination facility (aOR=2.15, 95%CI 1.31 to 3.52).

The study extends the body of knowledge on immunization uptake in rural areas vis-à-vis urban areas at the sub-national level, our results can be generalized to similar contexts in Nigeria and beyond and provides important evidence to policymakers and programme managers for improving immunization coverage. However, our study is not without limitations. First, health system factors including vaccine availability, healthcare personnel and logistics, which are known to influence uptake of immunization coverage were not adequately explored.

Also, paternal factors that may influence the completion of immunization were not evaluated. However, the primary goal of this study was not to assess the effect of these factors. Second, new vaccines recently introduced into the Nigeria RI schedule (specifically, Rotavirus vaccine and Pneumococcal conjugate vaccine) were not explored. Although, maternal recall has been shown to be a reliable estimate of maternal recall in Senegal, Ethiopia and Tanzania, there is little evidence that it is a reliable coverage measure in Nigeria[67].

In a study conducted to assess the effect and cost-effectiveness of educating mothers about childhood DPT vaccination on immunization uptake, knowledge, and perceptions in Uttar Pradesh, India: A randomized controlled trial[168]. The study tested a brief intervention that provided mothers face-to-face with information on the benefits of the tetanus vaccine. Participants were 722 mothers of children aged 0–36 months who had not received 3 doses of diphtheria–pertussis–tetanus (DPT) vaccine (DPT3). Mothers were randomly assigned in a ratio of 1:1:1 to 1 of 3 study arms: mothers in the first treatment group received information framed as a gain (e.g., the child is less likely to get tetanus and more likely to be healthy if vaccinated), mothers in the second treatment group received information framed in terms of a loss (e.g., the child is more likely to get tetanus and suffer ill health if not vaccinated), and the third arm acted as a control group, with no information given to the mother.

The surveys were conducted at baseline (September 2015) and after the intervention (April 2016). The primary outcome was the proportion of children who had received DPT3 measured after 7 months of follow-up. The analysis was by intention to treat. A total of 16 (2.2%) participants were lost to follow-up. The coverage of DPT3 was 28% in the control group and 43% in the pooled information groups, giving a risk difference of 15 percentage points (95% CI: 7% to 22%, $p < 0.001$) and a relative risk of 1.52 (95% CI: 1.2 to 1.9, $p < 0.001$).

The information intervention increased the rate of measles vaccination by 22 percentage points (risk difference: 22%, 95% CI: 14% to 30%, $p < 0.001$; relative risk: 1.53, 95% CI: 1.29 to 1.80) and the rate of full immunization by 14 percentage points (risk difference: 14%, 95% CI: 8% to 21%, $p < 0.001$; relative risk: 1.72, 95% CI: 1.29 to 2.29). It had a large positive effect on knowledge of the causes, symptoms, and prevention of tetanus but no effect on perceptions of vaccine efficacy. There was no difference in the proportion of children with DPT3 between the group that received information framed as a loss and the group that received information framed as a gain (risk difference: 4%, 95% CI: −5% to 13%; $p = 0.352$; relative risk: 1.11, 95% CI: 0.90 to 1.36).

The cost per disability adjusted life year averted of providing information was US$186, making the intervention highly cost-effective with respect to the WHO-recommended threshold of once the gross domestic product per capita (US$793 in the case of Uttar Pradesh). Key study limitations include the modest sample size for this trial, limiting power to detect small differences in the framing of information, and the potential for contamination among households[168].

A study which specific objectives were to assess enabling factors of the current strategies, assess barriers of current strategies, determine feasible strategies focusing on the caregiver, and determine achievable strategies focusing on the health system that will improve adherence to immunization schedule. A cross-sectional mixed method study involving caregivers (n = 214) of well babies attending the Maternal and Child Health clinic. Data was collected using semi-structured questionnaires, focus group discussions, and key informant interviews and analyzed using SPSS V.20. There was a significant relationship between the level of education and marital status of the caregivers and adherence to immunization schedule. Barriers found that is related to

adherence to immunization schedule included far distance from health facility, baby's sickness, and vaccine stock-outs while employment of a caregiver was a constrainer factor[156].

The study found that the achievable strategies focusing on the health system that will improve adherence to the immunization schedule were more flexible clinic hours and running immunization clinics for more hours in a day, availability of vaccines on daily basis, phone call reminders by health care providers, and creating awareness on the importance of vaccinations and more so on the importance of adhering to the immunization schedule. These provide possible solutions for health facilities and decision makers to improve immunization adherence[156].

In a study which aim and objective was to measure the basic timely childhood immunization coverage and to identify determinants of factors influencing childhood immunization coverage in Sindh, Pakistan. Data from Maternal and Child Health Program Indicator Survey 2013–2014 which was conducted in Sindh province of Pakistan was used. Outcome measure was full coverage of the basic immunization schedule from child's vaccination card. The association of receiving basic immunization with demographic factors, socioeconomic status, mother and child health information sources, and perinatal care factors were tested by binary logistic regression. The basic immunization rates were 69.1% for under five weeks old, 38.3% for six to nine weeks, 18.8% for 10–13 weeks, 44.0% for 14 weeks-eight months, 60.4% for nine to 11 months, and 59.1% for over one year. Child's age, number of living children, parent's education level, wealth, the source of mother and child health information, number of antenatal cares, and assistance during delivery were associated with completing basic immunization[157].

Increasing childhood immunization coverage rates remains a national public health goal in low-income countries. The immunization completion rate among children aged 0–23 months in Pakistan has been increased since the EPI program was initiated by the WHO in 1978, but was

still lower than the rates of other low- and middle-income countries as well as the goal of the WHO and UNICEF. This study provided strong support for further efforts to improve the full basic immunization rate by identifying the key determinants of complete and timely childhood immunization coverage.

Low vaccination coverage and delays for immunization results in the loss of herd immunity which lead to the outbreaks of vaccine-preventable diseases in unvaccinated infants in Pakistan. Policy-makers should identify mothers at risk of low immunization coverage and make the effort to tailor interventions informing mothers of the need for full immunization and motivating them to receive regular WHO-recommended ANC. Further longitudinal studies are needed to explore the factors associated with timely and complete full immunization and to determine the effect of educational interventions and mass immunization campaigns on completing immunizations and on infant mortality rates[56].

A previous researcher conducted a study to evaluate the Knowledge and Attitude towards Routine Immunization among Caregivers/Mothers of Under-Five Years Children in Gwagwalada Area Council Abuja-FCT. A descriptive cross-sectional study was employed and a facility-based cluster sampling technique was conducted, using a 25-item questionnaire that was modified and adopted by the researcher. Caregivers with at least one under-five child were targeted. Data collected over a 4week period was analyzed using SPSS version 21[67].

A total of 170 respondents gave informed consent and participated in the study. Approximately 54.1% have good knowledge of routine immunization. Also 96% was revealed to have good attitude towards routine immunization. Immunization Age and level of education of caregiver was found to be significantly associated with knowledge (P-value0.05). However, there is a significant association between attitude and knowledge (P-value< 0.05). There is an overall high

level of knowledge and good attitude towards routine immunization services among caregivers of under-five in Gwagwalada[67].

This Knowledge was found to be significantly affected by age and level of education of caregiver. There was a significant statistical association between knowledge with attitude of caregivers towards routine immunization [67].

Also, a study was carried out by a scholar aimed to assess the knowledge, attitude, and compliance of mothers regarding immunization of under five children in Ikorodu Local Government Area, Lagos State. The study, descriptive cross-sectional in nature was carried out among 250 mothers of under five children at health centers in Ikorodu selected by multistage sampling. An interviewer administered questionnaire was used as the survey tool. Data were analyzed using Expanded Program on Immunization – Info Version 7.1.1.14. $P < 0.05$ was considered statistically significant[20].

All respondents were aware of immunization, more than half (72%) of them had good knowledge about the immunization of under- five children, all the mothers (100%) had a positive attitude toward immunization and a majority (86.4%) of the respondents had fully immunized their children. There was a statistically significant association between the mother's age, occupation, level of education, nature of the family and the level knowledge of the respondents. There was also a statistically significant association between the mothers' age and occupation and their compliance with the immunization of their children.

Respondents with older children had to recall their immunization experiences sometimes over10 years earlier. Because the mothers were routine clinic attendees, many could not show immunization cards to support the claim that the index child had an immunization card[20].

A research team also carried out a study, its main objective is to identify some other factors that predict caregiver's utilization of routine immunization services. This was a retrospective observational study that analyzed previously collected exit interview data conducted during routine supervision of immunization sessions using a standard structured questionnaire on mobile phones via the 'open data kit' software[75]. The study revealed that 97.5% of caregivers were aware of the importance of routine immunization, while good knowledge of vaccine administered constitutes 92.3%, awareness of days for follow up visit was 97.4% and satisfaction of routine immunization services was 99.2%.

However, among the caregivers 22% had reported experience of an adverse events following immunization. Awareness of caregivers of the importance of routine immunization was found to be associated with caregiver's awareness of vaccine administered (odds ratio: 0.079; 95% CI: 0.063-0.098. The major strength of this study was the use of extensive data set with a statewide representation from all the LGAs. The target group is biased to caregivers who actually access the services, hence, a limitation of the study. This may explain the disconnection between high level of awareness & satisfaction in routine services among caretakers and the low immunization performance coverage earlier stated in the background.

The Source of information for immunization and demographic variables was not part of the study. Bias may have been introduced in the study as data collection was carried out by health staff across the sectors. Suggested answers to questions on satisfaction were either yes or no or not graded; hence may not be a true reflection of the level of satisfaction. A stratified sample of all records was not used but all records for the said period. Data used for analysis are mostly from fixed sites with few from outreach sites, and caregivers' views on immunization services in both sites may differ.

The study carried out by an author to investigate Mothers' Knowledge and Attitudes towards Child Immunization in Georgia. In the framework of a cross-sectional study, 188 mothers with children from three to five years of age, were surveyed in 7 kindergartens of Tbilisi (capital city of Georgia) [9]. The semi-structured questionnaire was administered in a face-to-face manner. The majority of interviewed mothers (97%) showed a positive attitude towards immunization and believes that vaccination plays an important role in disease prevention. 32% do not have sufficient information about the routine vaccination schedule and subsequently, 36% of children have incomplete vaccination. The reasons for incomplete vaccination are: a lack of knowledge about a routine vaccination schedule (25.5%), limited information about the necessity of the second or the third dose of vaccination (18.6%), fear of post-vaccination side effects (16%) and fear of a child illness (9.6%).

A significant association was found between mothers' education, practice and attitude regarding immunization. Health institutions (49.5%) and internet sources (21.3%) were the most popular sources of information about immunization. The study showed that the most important source of information on vaccination is medical staff. It is necessary to increase the use of mass media (television, radio, printed press, Internet) to raise awareness about the importance of immunization. In this regard, efforts of electronic media in recent years may increase the immunization indicator.

In a study carried out by a team of researchers to assess mothers' knowledge in rural communities about routine immunization and acceptability of mobile phone reminder text messages as an intervention for improving uptake and timely completion of routine immunization[8]. The study adopted a descriptive cross-sectional design among 3440 consenting mothers of infants in six randomly selected Nigerian states and in the Federal Capital Territory

(FCT). The study used a Focus Group Discussion guide and validated questionnaire to collect data; the study analyzed data using a thematic approach and descriptive statistics. Respondents' ages were 26.7±5.5 years.

Knowledge of routine immunization was poor; attitudinal disposition was positive. Most (90.5%) indicated willingness to accept reminder text messages for routine immunization and 91.5% opined that mobile phones can be effective in providing such information. Mothers' willingness to accept the use of SMS reminder text messages for promoting routine immunization completion requires well-designed and culture sensitive persuasive messages. While the reminder text messages helped mothers already attending immunization clinics to complete their children's vaccinations, there is a bigger contribution on which future studies should focus.

Qualitative analysis was performed on focus groups and semi-structured interviews using deductive coding methods. The study sample included 44 mothers/caregivers and 24 community leaders residing in Lagos State, Nigeria, and 19 healthcare workers (routine immunization focal persons) working in the primary healthcare setting in Lagos state. Study participants discussed factors at each level of the SEM that influence childhood immunization uptake, including intrapersonal (caregivers' immunization knowledge, caregivers' welfare and love of children), interpersonal (role of individual relationships and social networks), organizational (geographical and financial access to health facilities, health facilities attributes, staff coverage, and healthcare worker attributes), community (community outreaches and community resources), and policy-level (free immunization services and provision of child immunization cards) [171].

2.4 Conceptual Model/Framework

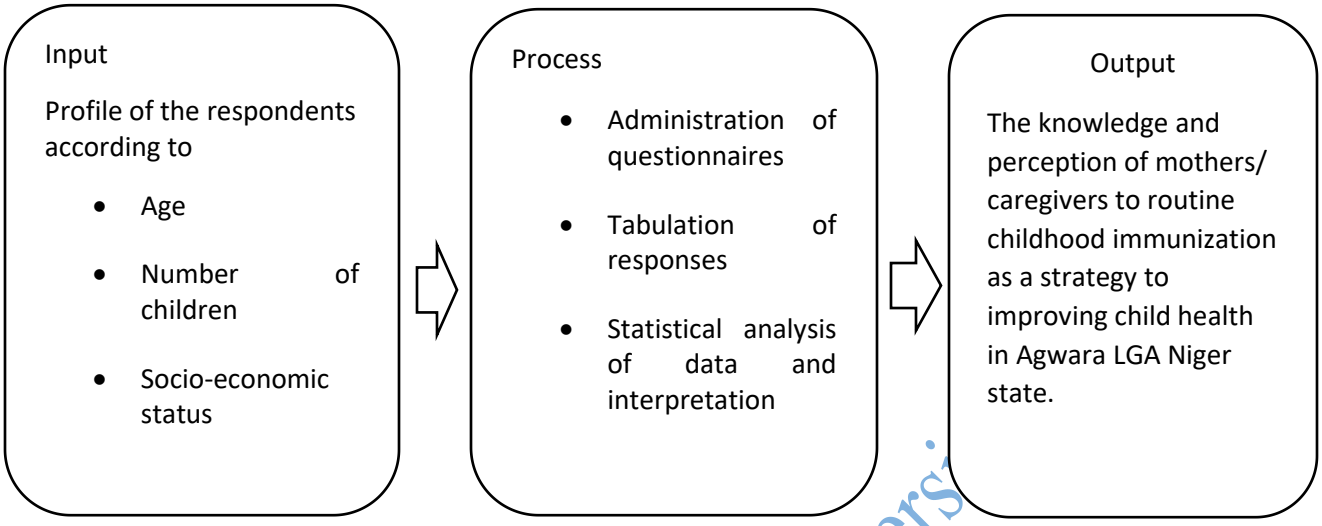


Fig:2.4 The Health Belief Model (Adopted by Ministry of Health)

Source:[155]

The input is the Profile of the respondents according to age, number of children and socio-economic status. The research process includes administration of questionnaires, tabulation of responses and Statistical analysis of data and interpretation. The output is the knowledge, attitude and adherence to routine childhood immunization among mothers in Agwara LGA Niger state.

2.5 Summary of Gaps in Literature Reviewed.

Immunization saves millions of lives every year, and vaccines enable the protection of children from serious diseases. Vaccination is the administration of vaccines to help the immune system develop protection from disease. It is the most cost-effective mechanism for disease prevention. Immunization protects and helps control serious diseases in the population and community.

The benefits of disease-prevention through vaccines are much greater than the possible side effects. Vaccine safety rather than effectiveness gets more public attention even though vaccines

are far safer than therapeutic medicines. Mothers' knowledge and attitudes affect immunization greatly. In a study conducted in Nigeria, the relationship between childhood immunization and maternal education was significant and indicated that children whose mothers have primary education are less likely to be immunized than those whose mothers do not have any education. Incomplete immunization could be related to mothers' lack of information and factors that influence knowledge and attitude include; lack of knowledge about routine immunization schedules, and fear of post-vaccination side effects. Attitudes of mothers also have an effect on immunization and a significant relationship exists between ethnicity and awareness of immunization, between level of education and awareness of immunization and between age and attitude to immunization.

Endnotes

[1]F.T., Ajayi, *A guide to primary health care practice in developing countries: 4th edition, 2019*. Felicity Print Limited Akure.

[2]B.G. Allison. *Norms within networks: Opinion leader and peer network influences on mothers/caregivers 'childhood immunization decisions in rural northern Nigeria, Doctor of Philosophy Dissertation, Columbia University, 2018 Vaccine Timeline*. Historic Dates and Events Related to Vaccines and Immunization, 2018.

[3]J. Alouf. "From 'diphtheritic' poison to molecular toxicology, Am SocMicrobiol News, 1987, vol. 53 (pg. 547-550) http://www.asm.org/ASM/files/CCLIBRARYFILES/FILENAME/0000000240/531087p547.pdf

[4]Tikkanen. 2020. Immunization. 2021. https://www.britannica.com/science/immunization

[5]K. G. Andreoli "*Self-concept and health beliefs in compliant and noncompliant hypertensive patients*." **Nursing Research** 30, no. 2021.

[6]D. Antai. "*Inequitable childhood immunization uptake in Nigeria: A multilevel analysis of individual and contextual determinants*." **BMC Infectious Diseases** 9, no. 1 2019.

[7]K.J. Awosan, M.T.O. Ibrahim, E.U. Yunusa, B.A. Isah, M.O. Raji, & N. Abubakar. "*Knowledge, attitude and compliance with full immunization of children against vaccine preventable diseases among pregnant mothers in sokoto, Nigeria*." **International Journal of Contemporary Medical Research IJCMR**5, no. 6, 2018.

[8]S. Babalola & A. Adewuyi. *Factors influencing immunization uptake in Nigeria. A theory-based research in six states.Abuja **PATHS***.2019; 7.

[9]S. Babalola. "*Determinants of the uptake of the full dose of diphtheria–pertussis–tetanus vaccines (dpt3) in Northern Nigeria: A Multilevel Analysis*." **Maternal and Child Health Journal** 13, no. 4, 2019: 550–558.

[10]S. Becker, H. Peter, H., Gray, C., Gultiano, & E., Black, *The determinants of use of maternal and child health services in Metro Cuba*. The Philippines Health Transition Review 3(1) 2020:77-89.

[11]B. Bernard, J. Blass, A. Turpin & M. Raynaud. "*Chemical characterization of tetanus toxin and toxoid. Amino acid composition, number of SH and S-S groups and N-Terminal amino acid*." **European Journal of Biochemistry** 17, no. 1 2019: 100–105.

[12]T. Byamukama. "*Influence of community-based interventions on routine immunization uptake among children under five years in Ntungamo District-Uganda*." **Texila International Journal of Public Health** 9, no. 4, 2021: 62–83.

[13]J. C. Caldwell, "*Education as a factor in mortality decline an examination of Nigerian data*." **Population Studies** 33, no. 3, 2021: 395.

[14]J. Cassell, "*The social shaping of childhood vaccination practice in rural and urban Gambia*." **Health Policy and Planning** 21, no. 5, 2019: 373–391.

[15]C. Decouttere, D. B. Kim & V. Nico. "*Advancing sustainable development goals through immunization: A literature review*." **Globalization and Health** 17, no. 1 2021.

[16]Centers for disease control and prevention (CDC 2018). *Vaccines and immunization: Why are childhood vaccines so important?* Vaccines, 18(1): 23-34.

[17]B. Harini "*How to transport crucial vaccines without cooling*" **Scientific American** 322, 6, 13**.** 2020: 12-25. https://doi.org10.1038/scientificamerican620-13b

[18]T. M. da Costa, L. S. Paulo, S. M. Amilton, T. P. Ivan, & D. Sigulem. "*The impact of short message service text messages sent as appointment reminders to patients' cell phones at outpatient clinics in São Paulo, Brazil*." **International Journal of Medical Informatics** 79, no. 1, 2010: 65–70.

[19]M. Dugas, E. Dube, B. Kouyate, A. Sanou, and G. *Bibeau: Portrait of a length vaccination trajectory in burkina faso: from cultural acceptance of vaccines to actual immunization*. **BMC Int. Health Hum Rights**, 14; 9 Suppl 1:S9, 2019. https://doi:10.1186/1472-698X-9-S1-S9

[20]Expert Review Committee (ERC). Nigeria's campaign to increase acceptance of routine and polio immunization services, 2019.

[21]E. A. Osayame, O. R. Oluwafemi, B. Badejoko, L. O. Oyeneyin, A. Butali, E. D. Lowenthal, & A. P. Steenhoff. "*Automated phone call and text reminders for childhood immunisations (primm): Arandomised controlled trial in Nigeria.*" **BMJ Global Health** 4, no. 2, 2019.

[22]B. E. Adedire, O. Ajumobi, O. Bolu, P. Nguku, & I. Ajayi . *Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria*. **Pan African Medical Journal** 40 (1):8 2021. https://doi:10.11604/pamj.supp.2021.40,1,30876

[23]K. J., Awosan, M. T. O. Ibrahim, E. U. Yunusa, B. A. Isah, M. O. Raji, & N. Abubakar. "*Knowledge, attitude and compliance with full immunization of children against vaccine preventable diseases among pregnant mothers in Sokoto, Nigeria.*" **Int J Contemp Med Res** 5, no. 6 2018: F10-F16.

[24]H. M., Scobie, M., Edelstein, E., Nicol, A., Morice, N., Rahimi, N. E., MacDonald, M. C. Danovaro-Holiday, & J. Jawad. "*Improving the quality and use of immunization and surveillance data: Summary report of the Working Group of the Strategic Advisory Group of Experts on Immunization*." **Vaccine** 38, no. 46 (2020): 7183-7197.

[25]J., Noh, Y., Kim, N., Akram, K., Yoo, J., Park, J., Cheon, Y., D, Kwon, & J., Stekelenburg. "*Factors affecting complete and timely childhood immunization coverage in Sindh, Pakistan; A secondary analysis of cross-sectional survey data.*" **PloS one** 13, no. 10 2018: e0206766.

[26]R., Van De Pas, M. A., Widdowson, R. N., Ravinetto, P., Srinivas, T. J., Ochoa, T. O., Fofana, & W., Van Damme. "*COVID-19 vaccine equity: a health systems and policy perspective*." **Expert review of vaccines** 21, no. 1 2022: 25-36.

[27]S., Abdullahi. "*Factors affecting completion of childhood immunization in North West Nigeria*." **PhD diss**., Walden University, 2018.

[28]W., Deressa, P., Kayembe, A. H., Neel, E., Mafuta, A., Seme, & O., Alonge. "*Lessons learned from the polio eradication initiative in the Democratic Republic of Congo and Ethiopia: analysis of implementation barriers and strategies*." **BMC Public Health** 20, no. 4 2020: 1-15.

[29]B., Yarnoff, D., Kim, F., Zhou, A. J., Leidner, O., Khavjou, L., Bates, & C. B. Bridges. "*Estimating the costs and income of providing vaccination to adults and children*." **Medical Care** 57, no. 6 2019: 410-416.

[30]M. A., Hofstetter, & S. Schaffer. "*Childhood and adolescent vaccination in alternative settings*." **Academic Pediatrics** 21, no. 4 2021: S50-S56.

[31]World Health Organization. *Delivering global health security through sustainable financing: 26-27 July 2017, Seoul, Republic of Korea*. No. WHO/WHE/CPI/2018.38. World Health Organization, 2018.

[32]K., Ward, S., Stewart, M., Wardle, S. V., Sodha, P., Tanifum, N., Ayebazibwe, R., Mayanja, H., Luzze, D. C., Ehlman, L., Conklin, & M., Abbruzzese. "*Building health workforce capacity for planning and monitoring through the Strengthening Technical Assistance for routine immunization training (START) approach in Uganda*." **Vaccine** 37, no. 21 2019: 2821-2830.

[33]L. E., Duijzer, W., Van Jaarsveld, & R. Dekker. "*Literature review: The vaccine supply chain*." **European Journal of Operational Research** 268, no. 1 2018: 174-192.

[34]V., Gehrau, S., Fujarski, H., Lorenz, C., Schieb, & B., Blöbaum. "*The impact of health information exposure and source credibility on COVID-19 vaccination intention in Germany.*"

[35]E. C. Muathe, M. Kamau, & E. Rajula. "*Exploring strategies to improve adherence to immunization schedule: A study among children attending maternal and child health clinic at Kenyatta National Hospital, Nairobi, Kenya*." **International Journal of Pediatrics**2020: 1–8.

[36]E. Paul, U. J. Agu, C. L. Aniebo, S. A. Agu, L. O. Lawani & Y. Acharya. "*Factors associated with incomplete immunisation in children aged 12–23 months at subnational level, Nigeria: A cross-sectional study*." **BMJ Open** 11, no. 6, 2021.

[37]O.J. Fatunde & J. B. Familusi. "*Post-neonatal tetanus in nigeria: the need for booster doses of tetanus toxoid*." **Nigerian Journal of Paediatrics** 28, no. 2, 2001.

[38]G. Fominyen "*Volcanic ash delays west african polio vaccination*." **Thomson Reuters**, April 20, 2010. Last modified April 20, 2010. Accessed January 24, 2023. https://www.reuters.com/article/us-polio-vaccination-idUKTRE63J5L120100420 .

[39]K. Hashimoto, O. Nobuyuki, T. Hironobu, M. Hiroko, T. Makoto, T. Kaoru, & Y. Yusuke. "*Slam (cd150)-independent measles virus entry as revealed by recombinant virus expressing green fluorescent protein*." **Journal of Virology**76, no. 13, 6743–6749. 2002.

[40]D. L. Heymann, "*Mass Vaccination and Public Health." Control of communicable diseases manual 18th edition,* **American Public Health Association, Washington DC** 2015.

[41]James Lind Institute. Benefits of immunization. https://www.jliedu.com/blog/benefits-immunization,2019. accessed on the 08-06-2022.

[42]K., Jamil, A. Bhuiya, K. Streatfield, & N. Chakrabarty. "*The immunization programme in bangladesh: impressive gains in coverage, but gaps remain*." **Health Policy and Planning**14, no. 1, 1999: 49–58.

[43]T. Jordan, M. Elizabeth, E. Ray, P. Johnson, & W. D. Evans. "*Text4baby: using text messaging to improve maternal and newborn health*." **Nursing for Women's Health** 15, no. 3, 2011: 206–212.

[44]P. O. Dienye, I. Kalamawei, & O. Best. "*Community participation and childhood immunization coverage: A comparative study of rural and urban communities of Bayelsa State, South-South Nigeria.*" **Nigerian Medical Journal** 53, no. 1 2012: 21.

[45]A. M., Kazi, N. Ahsan, W. Mughis, S. Jamal, R. Allana, M. Raza, & S. Muneer, "*Usability and acceptability of a mobile app for behavior change and to improve immunization coverage among children in pakistan: a mixed-methods study*." **International Journal of Environmental Research and Public Health** 18, no. 18 2021: 9527.

[46]K. Allison, J. Glasser, V. Covello, & D. Gust. "*Development of vaccine risk communication messages using risk comparisons and mathematical modeling*." **Journal of Health Communication** 13, no. 8, 2008: 793–807.

[47]K., Micek, K. A., Hester, C., Chanda, R., Darwar, B., Dounebaine, A. S., Ellis, P., Keskinocak, A., Leslie, M., Manyando, M. S., Manyando, & D., Nazzal. "*Critical success factors for routine immunization performance: A case study of Zambia 2000 to 2018.*" **Vaccine***: X* 11 2022: 100166..

[48]M. M. Levine, G. C. Woodrow, J. B. Kaper, G. S. Cobon. New Generation Vaccines, 2nd edn, Marcel Dekker, Inc. Google Scholar 2020.

[49]M. O. Raji, A. S. Abdullahi, S. I. Luqman, M. Hafsah, R. A. Oladigbolu, & A. U. Kaoje. "*Assessment of the knowledge of fathers, uptake of routine immunization, and its associated factors in a rural community of North West Nigeria*." **Annals of African Medicine** 18, no. 2, 2019: 97.

[50]M. Nichter. "*Vaccinations in the third world: A consideration of community demand*." **Social Science & Medicine** 41, no. 5, 2020: 617–632.

[51]Ministry of Health and Family Welfare, Government of India. **Immunization handbook for medical officers**, India, 2018: 107-116.

[52]P. A. M., Ntenda. "*Factors associated with non-and under-vaccination among children aged 12–23 months in Malawi. A multinomial analysis of the population-based sample*." **Pediatrics & Neonatology** 60, no. 6 2019: 623-633.

[53]Nigeria Strategy for Immunisation and PHC System Strengthening [NSIPSS] 2018 – 2028 Final Draft April 18, 2018

[54]N. N. Akwataghibe, E. A. Ogunsola, J. E. Broerse, O. A. Popoola, A. I. Agbo, & M. A. Dieleman. "*Exploring factors influencing immunization utilization in Nigeria—A mixed methods study*." **Frontiers in Public Health** 7, 2019.

[55]N. N. Akwataghibe, E. A. Ogunsola, O. A. Popoola, A. I. Agbo & Marjolein A. Dieleman. *Using participatory action research to improve immunization utilization in areas with pockets of unimmunized children in Nigeria*. **Health Res Policy Sys** 2021, 19(Suppl 2):88 https://doi.org/10.1186/s12961-021-00719-9.

[56]J. W. Noh, Y. M. Kim, N. Akram, K. B. Yoo, J. Park, & J. Cheon, "*Factors affecting complete and timely childhood immunization coverage in Sindh, Pakistan; A secondary analysis of cross-sectional survey data*". **PLoS ONE** 2018, 13(10): e0206766. https://doi.org/10.1371/journal.pone.0206766

[57]J. Abbasi, "*Study suggests lasting immunity after COVID-19, with a big boost from vaccination*." **JAMA**326, no. 5: 376. 2021.

[58]J. I., Duru, S., Usman, O., Adeosun, K. V., Stamidis, & L., Bologna. "*Contributions of volunteer community mobilizers to polio eradication in Nigeria: the experiences of non-governmental and civil society organizations*." **The American Journal of Tropical Medicine and Hygiene** 101, no. 4 Suppl 2019: 74.

[59]M. R., Francis, H., Nohynek, H., Larson, V., Balraj, V. R., Mohan, G., Kang, & J. P., Nuorti, "*Factors associated with routine childhood vaccine uptake and reasons for non-vaccination in India: 1998–2008*." **Vaccine** 36, no. 44 2018: 6559-6566.

[60]F., Okonofua, L. F., Ntoimo, S., Yaya, B., Igboin, O., Solanke, C., Ekwo, E.A. K., Johnson, I., Sombie, & W., Imongan. "*Effect of a multifaceted intervention on the utilisation of primary health for maternal and child health care in rural Nigeria: a quasi-experimental study*." **BMJ open** 12, no. 2 2022: e049499.

[61]J. M. Olive, & B. Aylward . Poliovirus vaccine. World Health Bulletin 2019; 77:194.

[62]O. Oladepo, I. O. Dipeolu, & O. Oladunni. "*Outcome of reminder text messages intervention on completion of routine immunization in rural areas, Nigeria*." **Health Promotion International** 36, no. 3, 2020: 765–773.

[63]O. Oladepo, I. O. Dipeolu, & O. Oladunni. "*Nigerian rural mothers' knowledge of routine childhood immunizations and attitudes about use of reminder text messages for promoting timely completion*." **Journal of Public Health Policy** 40, no. 4, 2019: 459–477.

[64]S., Birhanu, A., Anteneh, Y., Kibie, & Ayalew Jejaw. "*Knowledge, attitude and practice of mothers towards immunization of infants in health centres at Addis Ababa, Ethiopia*." **Am J Health Res** 4, no. 1 2016: 6-17.

[65]M. C., Navin, J. A., Wasserman, M., Ahmad, & S., Bies. "*Vaccine education, reasons for refusal, and vaccination behavior.*" **American journal of preventive medicine** 56, no. 3 2019: 359-367.

[66]T. Powell-Jackson, C. Fabbri, V. Dutt, S. Tougher, K. Singh "*Effect and cost effectiveness of educating mothers about childhood DPT vaccination on immunisation uptake, knowledge, and perceptions in Uttar Pradesh, India: A randomised controlled trial"*. **PLoS Med**2018, 15(3): e1002519. https://doi.org/10.1371/ journal. pmed.1002519

[67]R. Msheliza, C. E. Chibuzo & L. V. Ojo. *An evaluation of knowledge and attitude towards routine immunization among caregivers/mothers of under-five-year children in Gwagwalada Area Council, Abuja-FCT*. **International Journal of Recent Innovations in Medicine and Clinical Research Open Access**. ISSN: 2582-1075 https://ijrimcr.com/ Volume-2, Issue-4, 2020: 30-37

[68]A. Raufu, *Polio vaccine plans in Nigeria*. **British Medical Journal**, . https://doi:10.1136/bmj.327.7410.380-c 2003; 327-380.

[69]D. Salisbury, M. Ramsay, & K. Noakes. "Figure 26.1 from Immunisation against Infectious Disease: Semantic Scholar." https://www.semanticscholar.org/paper/Immunisation-against-infectious-disease-Salisbury-Ramsay/ee69ddfb9d512348164b4da67c1dbbc9bbf62a91/figure/56.

[70]H. Samuelsen "*Infusions of health: The popularity of vaccinations among Bissa in Burkina Faso*." **Anthropology & Medicine** 8, no. 2-3, 2020: 163–175.

[71]S. Dayyabu, M. Isma'il, B. Yayaji, A. Umar, Y. Abdullahi & I. Abdullahi. *Assessment of an evaluation on the effect of Immunization on Child Development in Gombe Local Govt*. Area Gombe – Nigeria. Vol. 1 No. 1 & 2.e-issn: 2811-1621 December, 2021

[72]S. G. Ishaku, G. Umeh, B. Adzu, A. Onimisi, F. Braka, & M Dauda. *Caregivers experience and satisfaction with routine immunization services in Kaduna State, North-West, Nigeria, 2017-2019*. **J Med Bas SciRes** 2020; 1(1):127-137.

[73]B. Shea, A. Neil, & H. David. "*Increasing the demand for childhood vaccination in developing countries: A systematic review*." **BMC International Health and Human Rights** 9, no. S1 2018.

[74]C. Chen, F. C., Liceras, S., Flasche, S., Sidharta, J., Yoong, N., Sundaram, & M., Jit. "*Effect and cost-effectiveness of pneumococcal conjugate vaccination: a global modelling analysis.*" **The Lancet Global Health** 7, no. 1 2019: e58-e67.

[75]T. Verulava, M. Jaiani, A. Lordkipanidze, R. Jorbenadze, & B. Dangadze. "*Mothers' knowledge and attitudes towards child immunization in Georgia*." **The Open Public Health Journal** 12, no. 1, 2019: 232–237.

[76]E. A., Obeagu, "*A Systematic review on childhood immunization among men with infants: Africa perspective*." ***International Journal of Current Research in Medical Sciences*** 8, no. 9 2022: 15-24.

[77]A., Lindstrand, T., Cherian, D., Chang-Blanc, D., Feikin, & K. L., O'Brien, "*The world of immunization: achievements, challenges, and strategic vision for the next decade*." **The Journal of Infectious Diseases** 224, no. Supplement_4 2021: S452-S467.

[78]L., Bruni, A., Saura-Lázaro, A., Montoliu, M., Brotons, L., Alemany, M. S., Diallo, O. Z., Afsar, D. S., LaMontagne, L., Mosina, M., Contreras, & M., Velandia-González."*HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019*." **Preventive medicine** 144 2021: 106399.

[79]K. A. Khan. "*To estimate the immunization status of children from 0 to 7 years of age*."

[80]O. O., Oleribe, J., Momoh, B. S., Uzochukwu, F., Mbofana, A., Adebiyi, T., Barbera, R., Williams, & S. D., Taylor-Robinson, "*Identifying key challenges facing healthcare systems in Africa and potential solutions*." **International journal of general medicine** 2019: 395-403.

[81]E., Gooding, E., Spiliotopoulou, and P., Yadav. "*Impact of vaccine stockouts on immunization coverage in Nigeria*." **Vaccine** 37, no. 35 2019: 5104-5110.

[82]K., De Boeck, C., Decouttere, & N., Vandaele. "*Vaccine distribution chains in low-and middle-income countries: A literature review*." **Omega** 97 2020: 102097.

[83]World Health Organization. *Delivering global health security through sustainable financing: 26-27 July 2017, Seoul, Republic of Korea*. No. WHO/WHE/CPI/2018.38. World Health Organization, 2018.

[84]M., Abdulkadir, & R., Rainis. "*Socio-Economic Determinants of Routine Immunization Coverage in Dutse, Jigawa State, Northern Nigeria, May 2018.*" 2020.

[85]O. G., Chido-Amajuoyi, I., Osaghae, & S., Shete. "*Reasons patients cite to their health-care professional for not initiating or completing human papillomavirus vaccination*." **JNCI Cancer Spectrum** 7, no. 4 2023: pkad047.

[86]T. O., Victoria, M. S., Omole, F. A. B., JP, W.A., Miller, A.O., Olaniyan, S. A., Olanrewaju, A. C., Omolayo, & P. O., Adediji. "*Factors Influencing Routine Immunization Uptake among Nursing Mothers Attending Primary Health Centres in Ibadan Southeast Local Government.*" **American Journal of Pediatric Medicine and Health Sciences (2993-2149)** 1, no. 6 2023: 109-124.

[87]P., Eze, U. J., Agu, C. L., Aniebo, S. A., Agu, L. O., Lawani, & Y., Acharya, Y. "*Factors associated with incomplete immunisation in children aged 12–23 months at subnational level, Nigeria: a cross-sectional study*." **BMJ open** 11, no. 6 2021: e047445.

[88]T., Chotpitayasunondh, T. K., Fischer, J. M., Heraud, A. C., Hurt, A. S., Monto, A., Osterhaus, Y., Shu, & J. S., Tam. "*Influenza and COVID-19: What does co-existence mean?*." **Influenza and Other Respiratory Viruses** 15, no. 3 (2021): 407-412.

[89]M. E., Nyström, K., Johan, K., Christina, & A. G., Boel. "*Collaborative and partnership research for improvement of health and social services: researcher's experiences from 20 projects.*" **Health research policy and systems** 16, no. 1 (2018): 1-17.

[90]V., Haldane, F. L., Chuah, A., Srivastava, S. R., Singh, G. C., Koh, C. K., Seng, & H., Legido-Quigley. "*Community participation in health services development, implementation, and evaluation: A systematic review of empowerment, health, community, and process outcomes*." **PloS one** 14, no. 5 2019: e0216112.

[91]C. Okoli, M. Hajizadeh, M. M. Rahman, & R. Khanam. "*Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003–2017."* **BMC Health Services Research** 20 2020: 1-14.

[92]World Health Organization. *Delivering global health security through sustainable financing: 26-27 July 2017, Seoul, Republic of Korea*. No. WHO/WHE/CPI/2018.38. World Health Organization, 2018.

[93]D. P., Ferdinand, S., Nedunchezhian, & K. C., Ferdinand. "*Hypertension in African Americans: advances in community outreach and public health approaches*." **Progress in cardiovascular diseases** 63, no. 1 2020: 40-45.

[94]World Health Organization. "*Universal health coverage partnership annual report 2019: in practice: bridging global commitments with country action to achieve universal health coverage*." 2020.

[95]B. S., Ibrahim, R., Usman, Y., Mohammed, Z. Datti, O., Okunromade, A., A., Abubakar, & P. M., Nguku. "*Burden of measles in Nigeria: a five-year review of casebased surveillance data, 2012-2016*." **The Pan African Medical Journal** 32, no. Suppl 1 2019.

[96]H., Babacan. "*Public–private partnerships for global health: Benefits, enabling factors, and challenges*." **Handbook of global health** 2020: 1-34.

[97]O. C., Ekwebelem, O. V., Nnorom-Dike, A. T., Aborode, N. C., Ekwebelem, J. C., Aleke, & E. S., Ofielu. "*Eradication of wild poliovirus in Nigeria: Lessons learnt*." **Public Health in Practice** 2 2021: 100144.

[98]World Health Organization. "*Defining competent maternal and newborn health professionals: background document to the 2018 joint statement by WHO, UNFPA, UNICEF, ICM, ICN, FIGO and IPA: definition of skilled health personnel providing care during childbirth*." 2018.

[99]B., Sule, B. S., Ibrahim, & M. Y., Adamu. "*The Politics of Regional Security Threat in Nigeria.*" **SINERGI: Journal of Strategic Studies & International Affairs** 2, no. 1 2022: 48-75.

[100]G., Di Giuseppe, L., Folcarelli, R., Lanzano, F., Napolitano, & M., Pavia. "*HPV Vaccination and Cervical Cancer Screening: Assessing Awareness, Attitudes, and Adherence in Detained Women*." ***Vaccines*** 10, no. 8 2022: 1280.

[101]World Health Organization. *Delivering global health security through sustainable financing: 26-27 July 2017, Seoul, Republic of Korea*. No. WHO/WHE/CPI/2018.38. World Health Organization, 2018.

[102]B. V., Uba, N. E., Waziri, A., Akerele, O., Biya, O. J., Adegoke, S., Gidado, G., Ugbenyo, E., Simple, N., Usifoh, A., Sule, & B., Kibret. "*Strengthening facility-based immunization service delivery in local government areas at high risk for polio in Northern Nigeria, 2014-2015.*" **The Pan African Medical Journal** 40, no. Suppl 1 2021.

[103]A., Oyo-Ita, X., Bosch-Capblanch, A., Ross, A., Oku, E., Esu, S., Ameh, O., Oduwole, D., Arikpo, & M., Meremikwu. "*Effects of engaging communities in decision-making and action through traditional and religious leaders on vaccination coverage in Cross River State, Nigeria: A cluster-randomised control trial.*" **Plos one** 16, no. 4 2021: e0248236.

[104]S. C., Masefield, A., Msosa, & J., Grugel. "*Challenges to effective governance in a low income healthcare system: a qualitative study of stakeholder perceptions in Malawi*." **BMC health services research** 20, no. 1 2020: 1-16.

[105]A. I., Ayede, O. O., Ashubu, K. R., Fowobaje, S., Aboubaker, Y. B., Nisar, S. A., Qazi, R., Bahl, & A. G., Falade. "*Management of possible serious bacterial infection in young infants where referral is not possible in the context of existing health system structure in Ibadan, South-west Nigeria*." **PLoS One** 16, no. 3 2021: e0248720.

[106]B., Uzochukwu, E., Onwujekwe, C., Mbachu, C., Okeke, S., Molyneux, & L., Gilson. "*Accountability mechanisms for implementing a health financing option: the case of the basic health care provision fund (BHCPF) in Nigeria*." **International journal for equity in health** 17 2018: 1-16.

[107]S. O., Okafor, C. I. Ugwu, J. O. Nkwede, S. Onah, G. Amadi, C. Udenze, & N. Chuke. "*COVID-19 public health and social measures in Southeast Nigeria and its implication to public health management and sustainability*." **Oppor Chall. Sustain** 1, no. 1 2022: 61-75.

[108]E. A., Eboreime, J., Eyles, N., Nxumalo, O. L., Eboreime, & R., Ramaswamy. "*Implementation process and quality of a primary health care system improvement initiative in a decentralized context: a retrospective appraisal using the quality implementation framework*." **The International journal of health planning and management** 34, no. 1 2019: e369-e386.

[109]I., Manggat, R., Zain, & Z., Jamaluddin. "*The impact of infrastructure development on rural communities: A literature review*." **International Journal of Academic Research in Business and Social Sciences** 8, no. 1 2018: 637-648.

[110]N. H., Alkali, & R. B., Mohammed. "*Tertiary hospital standards in Nigeria: A review of current status*." **Annals of African Medical Research** 3, no. 1 2020.

[111]E. O., Ogboghodo, V. O., Omuemu, O., Odijie, & O. J., Odaman. "*Cold chain management: An assessment of knowledge and attitude of health workers in primary health-care facilities in Edo State Nigeria*." **Sahel Medical Journal** 21, no. 2 2018: 75.

[112]E., Shadmi, Y., Chen, I., Dourado, I., Faran-Perach, J., Furler, P., Hangoma, P., Hanvoravongchai, C., Obando, V., Petrosyan, K. D., Rao, A. L., Ruano, L., Shi, L. E., de Souza, S., Spitzer-Shohat, E., Sturgiss, R., Suphanchaimat, M. V., Uribe, & S., Willems. "*Health equity and COVID-19: global perspectives*." **International journal for equity in health** 19, no. 1 2020: 1-16.

[113]C. J. I., Uneke, I. Obeka, B. I. Uneke, A. Umeokonkwo, C. A. Nweze, K. I. Otubo, and O. E. Uguru. "*An assessment of nursing mothers' and young people's access to proprietary and patent medicine vendors' services in rural communities of south-eastern Nigeria: implication for review of national drug policy*." **Journal of Pharmaceutical Policy and Practice** 14, no. Suppl 1 2021: 92.

[114]A. S., Oyeyemi, O., Oladepo, A. O., Adeyemi, M. A., Titiloye, S. M., Burnett, & I., Apera. "*The potential role of patent and proprietary medicine vendors' associations in improving the quality of services in Nigeria's drug shops*." **BMC health services research** 20 2020: 1-12.

[115]E., Racine, S. Kusch, M. A. Cascio, & A. Bogossian. "*Making autonomy an instrument: a pragmatist account of contextualized autonomy*." **Humanities and Social Sciences Communications** 8, no. 1 2021: 1-15.

[116]E., Schildkrout. "*Dependence and autonomy: The economic activities of secluded Hausa women in Kano, Nigeria.*" **In Women and work in Africa**, pp. 55-81. Routledge, 2019.

[117]J., Goven. "*Gender politics in Hungary: Autonomy and antifeminism*." **In Gender politics and post-communism**, pp. 224-240. Routledge, 2018.

[118]A. O., Ayinde, A., Olubukola, A. A., Ayobami, A. C., Grace, F. E., Ugba, & M., Oluwadare. "*Knowledge and Attitude of Nursing Mothers and their under Five Infants on Immunization Regimen in Makun Health Center, Ogun State*." **Central Asian Journal of Medical and Natural Science** 3, no. 1 2022: 50-64.

[119]O. A., Adefolalu, O. J., Kanma-Okafor, & M. R., Balogun. "*Maternal knowledge, attitude and compliance regarding immunization of under-five children in primary health care centers in Ikorodu local government area, Lagos state*." 2019.

[120]A. H. M., Ali, M. A., Abdullah, F. M., Saad, & H. A. A., Mohamed. "*Immunisation of children under 5 years: mothers' knowledge, attitude and practice in Alseir locality, Northern State, Sudan*." **Sudanese journal of paediatrics** 20, no. 2 2020: 152.

[121]T., Verulava, M., Jaiani, A., Lordkipanidze, R., Jorbenadze, & B., Dangadze, B. "*Mothers' knowledge and attitudes towards child immunization in Georgia*." **The Open Public Health Journal** 12, no. 1 2019.

[122]P., Matta, R., El Mouallem, M., Akel, S., Hallit, & M. C., Fadous Khalife. "*Parents' knowledge, attitude and practice towards children's vaccination in Lebanon: role of the parent-physician communication*." **BMC Public Health** 20 2020: 1-9.

[123]M., Šeškutė, E., Tamulevičienė, & G.,Levinienė. "*Knowledge and attitudes of postpartum mothers towards immunization of their children in a Lithuanian tertiary teaching hospital*." **Medicina** 54, no. 1 2018: 2.

[124]S. Z., Alshammari, I., AlFayyad, Y., Altannir, & M., Al-Tannir. "*Parental awareness and attitude about childhood immunization in Riyadh, Saudi Arabia: A cross-sectional study*." **International Journal of Environmental Research and Public Health** 18, no. 16 2021: 8455.

[125]P. E., Konwea, F. A., David, & S. E., Ogunsile. "*Determinants of compliance with child immunization among mothers of children under five years of age in Ekiti State, Nigeria.*" **Journal of Health Research** 32, no. 3 2018: 229-236.

[126]U. V., Asiegbu, D. C., Obu, A. F., Una, C. T., Ezeonu, & O. K., Asiegbu. "*Evaluating mothers knowledge and attitude as a contributing factor to the low childhood immunization uptake in*

Ebonyi State, Nigeria." **African Journal of Medical and Health Sciences** 19, no. 8 2020: 127-135.

[127]E. Hussain, & Z. Mohammed. "*Parents' Attitudes toward Immunization and its Relation with Pediatric Immunization Compliance at Primary Health Care Centers in Karbala City, Iraq*." **Iraqi National Journal of Nursing Specialties** 34, no. 1 2021: 50-58.

[128]N. N. Mahfouz, W. H., Ali, M. A., El Wakeel, T. M., Rabah, A. A., Elmowafi, & I. H., Kamel. "*Adherence to compulsory vaccination during coronavirus Disease-19 pandemic in Egypt*." **Open Access Macedonian Journal of Medical Sciences** 9, no. A 2021: 217-221.

[129]M., Loihala, N. H., Hasim, & A. C., Mustamu. "*Effectiveness of Interactive Health Games on Knowledge, Attitude, Compliance with Immunization Officers and Family Planning*." **Age (years)** 12, no. 16 2020: 17-25.

[130]M., Butt, R. Mohammed, E., Butt, S., Butt, & J., Xiang. "*Why have immunization efforts in Pakistan failed to achieve global standards of vaccination uptake and infectious disease control?*" **Risk management and healthcare policy** 2020: 111-124.

[131]A. N., Galadima, N. A. M., Zulkefli, S. M., Said, & N., Ahmad. *"Factors influencing childhood immunisation uptake in Africa: a systematic review.*" **BMC Public Health** 21, no. 1 2021: 1-20.

[132]A. R., Carolina, D., Efendi, & M. Dyah Kurniasari. "*Determinant factor of childhood basic immunization compliance during the COVID-19 pandemic in Jambi City, Jambi Province, Indonesia.*" **Journal of Nursing Practice** 5, no. 1 2021: 77-88.

[133]M., Alabadi, & Z., Aldawood. "*Parents' knowledge, attitude and perceptions on childhood vaccination in Saudi Arabia: a systematic literature review.*" **Vaccines** 8, no. 4 2020: 750.

[134]O., Oladepo, I. O., Dipeolu, & O., Oladunni. "*Outcome of reminder text messages intervention on completion of routine immunization in rural areas, Nigeria*." **Health Promotion International** 36, no. 3 2021: 765-773.

[135]A. H., Azeez, & M. F., Khalifa. "*Evaluation of Reasons for Partial Compliance and Non-compliance to the Routine Childhood Vaccination Schedule in Al-Russafa District*." **Pakistan Journal of Medical & Health Sciences** 16, no. 03 2022: 999-999.

[134]O., Tal, Y., Ne'eman, R., Sadia, R., Shmuel, E., Schejter, & M., Bitan. "*Parents' attitudes toward children's vaccination as a marker of trust in health systems*." **Human Vaccines & Immunotherapeutics** 17, no. 11 2021: 4518-4528.

[141]E. I., Obeagu. "*A Systematic review on childhood immunization among men with infants: Africa perspective*." **International Journal of Current Research in Medical Sciences** 8, no. 9 2022: 15-24.

[142]S. Gentle. "*Knowledge and Attitude of Mothers towards Immunization in Emohua Local Government Area of Rivers State.*" **Int J Innov Healthc Res** 7, no. 4 (2019): 38-52.

[143]P. L. F. Zuber, G. K. S. konombo, A. Dembele-Traore, J. D. Millogo, A. Outtara, & A. Valian, *Mass measles vaccination in urban Burkina Faso*, Bulletin of the world Health Organization, WHO,79(4) 2021:296-300.

[144]S. Babalola. "*Determinants of the uptake of the full dose of Diphtheria–Pertussis–Tetanus Vaccines (DPT3) in Northern Nigeria: A multilevel analysis*." **Maternal and Child Health Journal** 13, no. 4, 2019: 550–558.

[145]S. Becker, H. Peter, H. Gray, C. Gultiano, & E. Black. *The determinants of use of maternal and child health services in Metro Cuba*. **The Philippines Health Transition Review** 3 (1) 2019:77-89.

[146]M., Ghattas, G., Dwivedi, M., Lavertu, & M. G., Alameh. "*Vaccine technologies and platforms for infectious diseases: Current progress, challenges, and opportunities*." **Vaccines** 9, no. 12 2021: 1490.

[147]J. C. Caldwell, "*Education as a factor in mortality decline: An examination of Nigerian data*." **Population Studies** 33, no. 3, 2021: 395.

[148]C. Decouttere, D. B. Kim , & V. Nico. "*Advancing sustainable development goals through immunization: A literature review*." **Globalization and Health** 17, no. 1, 2021.

[149]E. A. Croyle. *Vaccine transport*, **Scientific American Journal**, 322(1) 2020:12 25.

[150]M Dugas, E Dube, B Kouyate, A Sanou, G Bibeau *: Portrait of a length vaccination trajectory in Burkina Faso: from cultural acceptance of vaccines to actual immunization*. **BMC Int. Health Hum Rights**, 2019, 14;9Suppl 1:S9. doi: 10.1186/1472-698X-9-S1-S9.

[151]O. A. Ekhaguere, R. O. Oluwafemi, B. Badejoko, L. O. Oyeneyin, A. Butali, E. D. Lowenthal, & A. P. Steenhoff. "*Automated phone call and text reminders for childhood immunisations: A randomised controlled trial in Nigeria*." **BMJ Global Health** 4, no. 2, 2019.

[152]E. C. Muathe, M. Kamau, & E. Rajula. "*Exploring strategies to improve adherence to immunization schedule: A study among children attending maternal and child health clinic at Kenyatta National Hospital, Nairobi, Kenya*." **International Journal of Pediatrics**2020: 1–8.

[153]P. Eze, Paul, U. J. Agu, C. L. Aniebo, S. A. Agu, L. O. Lawani, & Y. Acharya. "*Factors associated with incomplete immunisation in children aged 12–23 months at subnational level, Nigeria: A cross-sectional study*." **BMJ Open** 11, no. 6, 2021.

[156]Federal Ministry of Health. *Saving newborn lives in Nigeria: Newborn health in the context of the Integrated Maternal, Newborn and Child Health Strategy*. 2nd edition, Federal Ministry of Health 2019; 8-16.

[155]G. Fominyen. "*Volcanic Ash Delays West African Polio Vaccination*" Thomson Reuters, 2010 https://www.reuters.com/article/us-polio-vaccination-idUKTRE63J5L120100420.

[156]A. M.Kazi, N. Ahsan, W. Mughis, S. Jamal, R. Allana, M. Raza, & S. Muneer, "*Usability and acceptability of a mobile App for behavior change and to improve immunization coverage among children in Pakistan: A mixed-methods study*." **International Journal of Environmental Research and Public Health** 18, no. 18 2021: 9527.

[157]Ministry of Health and Family Welfare, Government of India. Immunization Handbook for Medical Officers, 2018: 107-116

[158]N. N. Akwataghibe, E. A. Ogunsola, J. E. Broerse, O. A. Popoola, A. I. Agbo, & M. A. Dieleman. "*Exploring factors influencing immunization utilization in Nigeria—A Mixed Methods Study*." **Frontiers in Public Health** 7, 2019.

[159]N. N. Akwataghibe, E. A. Ogunsola, J. E. Broerse, O. A. Popoola, A. I. Agbo, & M. A. Dieleman. *Using participatory action research to improve immunization utilization in areas with pockets of unimmunized children in Nigeria*. **Health Res Policy Sys** 2021, 19(Suppl 2):88 https://doi.org/10.1186/s12961-021-00719-9.

[160]J. Abbasi. "*Study suggests lasting immunity after COVID-19, with a big boost from vaccination*." **JAMA**326, no. 5, 2021: 376.

[161]M., Kyprianidou, E., Tzira, P., Galanis, & K., Giannakou. "*Knowledge of mothers regarding children's vaccinations in Cyprus: A cross-sectional study*." **PLoS One** 16, no. 9 2021: e0257590.

[162]O. Oladepo, I. O. Dipeolu, & O. Oladunni. "*Outcome of reminder text messages intervention on completion of routine immunization in rural areas, Nigeria*." **Health Promotion International** 36, no. 3, 2020: 765–773.

[163]S. B. Omer, D. A. Salmon, W. A. Orenstein, P. M. deHart, & N. Halsey. "*Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases*." **New England Journal of Medicine** 360, no. 19, 2019: 1981–1988.

[164]T. Powell-Jackson, C. Fabbri, V. Dutt, S. Tougher, K. Singh "*Effect and cost effectiveness of educating mothers about childhood DPT vaccination on immunisation uptake, knowledge, and perceptions in Uttar Pradesh, India: A randomised controlled trial*". **PLoS Med** 2018, 15(3): e1002519. https://doi.org/10.1371/journal.pmed.1002519

[165]D. Salisbury, M. Ramsay, K. Noakes, Green Book: Immunization against infectious disease 2006 edition, 2019 http://www.dh.gov.uk/en/Policyandguidance/Healthandsocialcaretopics/Greenbook/DH_4097254.

[166]H. Samuelsen. "*Infusions of health: The popularity of vaccinations among Bissa in Burkina Faso*." **Anthropology & Medicine** 8, no. 2-3, 2020: 163–175.

[167]Nigeria: Summary Document: Making 'Reaching Every District Operational." https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=12320&lid=3.

[168]N. E. Uwaibi, *Determinants of full vaccination status in children attending immunization clinic in a tertiary hospital in Benin City, Nigeria*. **J. Appl. Sci. Environ. Manage**. Vol. 24 (8) 1383-1390 August 2020.

[169]N. L. Vecchiato, "*Sociocultural aspects of tuberculosis control in Ethiopia*." **Medical Anthropology Quarterly** 11, no. 2, 2018: 183–201.

[170]O. A., Adefolalu, O. J., Kanma-Okafor, & M. R., Balogun. "*Maternal Knowledge, Attitude and Compliance Regarding Immunization of under Five Children in Primary Health Care Centres in Ikorodu Local Government Area, Lagos State*." **Journal of Clinical Sciences** 16, no. 1, 2019: 7.

[171]T Verulava, M. Jaiani, A. Lordkipanidze, R.Jorbenadze, B. Dangadze. *Mothers knowledge and attitude toward child immunization in Georgia*. **Open public Health Jornal**. 10 Vol 12. Pag 232-237: 2019. https://doi.org/10.2174/1874944501912010232.

[172]S. Pasteur. "*The economic value of vaccination: Why prevention is wealth*." **Journal of Market Access & Health Policy** 3, 2015.

Chapter Three

Methodology

The main purpose of this work is to investigate Knowledge, Attitude and Adherence to Routine Childhood Immunization among Mothers in Agwara Local government area, Niger State Nigeria. This chapter describes the method and the procedure to be used in conducting the study, the procedure and method are presented under the following sub-headings.

3.1 Research Design

The study design for this study was a cross-sectional design.

3.2 Population of the Study

The Population for this study was all mothers of children aged 0-24 months residing in Agwara LGA, Niger State.

Study Area

The study was conducted in all the communities in Agwara local government of Niger state. Agwara LGA is located in the northwestern region of Niger state.

3.3 Sample and Sampling Techniques

A multi-stage cluster sampling technique was used.

At stage one, three political words were selected in Agwara LGA using simple random sampling

At stage two, a simple random sampling was used to select two communities each from the selected political word

A cluster sampling technique was used in selecting eligible mothers with children 0-24months in the communities selected.

Sample Size

30% of immunization coverage in Nigeria was adopted from the national Demographical Health Survey (NDHS, 2018).

$$\underline{N = Z^2 \text{ X } P\ (1 - P)}$$

$$e^2$$

Where N=required sample size

Z= Level of confidence

P= Expected prevalence of immunization coverage in Nigeria

e=Error of estimation

N= 322+ 10% non-response rate = 32

322 + 32 = 354

N = 354

3.4 Description of the Research Instrument

A WHO validated questionnaire on immunization coverage and survey was adopted for the purpose of this research.

Section A: The socio-demographic characteristics

Section B: Knowledge of the Mothers/Care givers on Immunization. Each response is scored on a Yes and No format; Yes=1, No=2.

Section C: The Possible factors non adherence to routine childhood immunization. Each response is scored on a 4-point modified Likert format of Strongly Agree (SA), Agree (A),

Disagree (D) and Strongly Disagree (SD) with allotment of points in the following order; SA=1, A=2, D=3, SD=4.

Section D: Attitude of mothers to routine childhood immunization.

All data collected is clean and entered into the statistical package for social science (SPSS).

3.5 Validity of Research Instrument

Validity of research instrument assesses the extent to which the instrument measures what it is designed to measure. In ensuring validity of the instrument, a questionnaire was presented to the researcher's supervisor and other lecturers in the Department of Public health, Faculty of basic and applied sciences, Lead City University, Ibadan for construct and content validity. Other experts from other related fields were also consulted for constructive criticisms. Necessary corrections were affected before the administration of the instruments in order to improve quality of the questionnaire.

3.6 Reliability of the Research Instrument

Reliability of a research instrument indicates the extent to which it is without bias (error free) and hence ensures consistent measurement across time and across the various items in the instrument (the observed scores). In ensuring this, the validated instrument was given to twenty (20) mothers/caregivers in Bida Local Government Area who are not part of the respondents, but possess similar characteristics with the actual respondents. A Cronbach alpha method was used to determine the coefficient of the reliability and reliability coefficient ranged between 0.77 and 0.93.

3.7 Method of Data Collection

The researcher collected a letter of introduction from the Head, Department of Public health, for identification purpose. The letter was presented to the local government chairman of Agwara local government, Niger State. Furthermore, three (3) Research Assistants were recruited, trained and engaged in the course of carrying out the study. Then, questionnaires were administered with the help of the trained Research Assistants.

3.8 Method of Data Analysis

All data collected is clean and entered into the statistical package for social science (SPSS). Frequency distribution was used to analyze the level of knowledge and attitude of mothers'/care givers on routine childhood immunization

A chi-square test was used to test association between the knowledge and adherence of mothers.

Endnotes

[1]Nigeria Population Commission. *Nigeria demographic and health survey 2018*. NPC, ICF, 2019.

[2]Y.Yamane, Mathematical Formula for Sample size Determination, 1967.

[3]National Population Commission and Bereau of statistics Estimates 2017.

Chapter Four

Results and Discussion of Findings

This chapter gives result of the responses of Mothers/Caregivers who participated in this study whose aim was to ascertain their level of knowledge and evaluate their attitude towards routine childhood immunization as a means of enhancing childhood livelihood. These women were recruited from across the communities in the Agwara local government with reference to provided inclusion and exclusion criteria.

4.1 Analysis of Socio-Demographic Data

The mean age of mothers, and their partners' were30.8±5.837 and 38.62±7.97 years respectively. The age of the mothers at first marriage, and at delivery of first birth were 22.00±3.60, and 23.75±4.18 years respectively. The mean number of children at enrollment of the mothers into the study was 2.52±1.30 with the average age of the children was 9.3±5.43 years.

Of the three hundred participants, one hundred and ninety-nine (58.5%) mother had at least primary level of education while only one hundred and forty-one (41.5%) has no formal education. 214 (62.9%) of the respondents are Muslims, 121 (35.6%) are Christians, while 3 (0.9%) practices other religion. Majority of the mothers (88.2%) were married, 17 (5.0%) are divorced, 10 (2.9%) are single, 7 (2.1%) are widow, while 6 (1.8%) are separated.

Of the married women, 205(60.3%) are in polygamous family, while 134 (39.4%) are monogamous family. The larger proportion of the mothers (65.9%) are Housewife, while others (34.1%) are into occupation relating to sale and services, clerical work, professional job, agriculture, and manual work.

Concerning the partners of the respondent, 33.8% of the respondents' partners has higher academic qualification, 105 (30.9%) has secondary education, 89 (26.2%) has no formal education, while 31 (9.1%) has primary education. Most of the partners 124 (36.5%) are into agriculture, 71 (20.9%) are into sale and services, 57 (16.8%) are into clerical job, 45 (13.2%) are into professional job, and 40 (11.8%) are into manual job.

Table 4.1a: Quantitative Socio-Demographic Characteristics of the Respondents

Quantitative Variable	Mean	Std. Deviation
Respondent' age	30.80	5.84
Partner's age	38.62	7.97
Age at first marriage	22.00	3.60
Age at first birth	23.75	4.18
Age of last child	9.30	5.43
How many children have you ever had?	2.52	1.30

Source: Field Survey

Table 4.1b: Qualitative Socio-Demographic Characteristics of the Respondents

Qualitative Variable	Frequency	Percentage (%)
Academic Qualification		
No formal education	141	41.5
Primary	51	15.0
Secondary	105	30.9
Higher	43	12.6
Religion		
Islam	214	62.9
Christianity	121	35.6
Traditional	2	0.6
Others	3	0.9
Marital status		
Single	10	2.9
Married	300	88.2
Divorced	17	5.0
Widowed	7	2.1
Separated	6	1.8
Family Type		
Monogamous	134	39.4
Polygamous	205	60.3
Occupation		
Professional/Managerial	15	4.4
Clerical	18	5.3
Sales and Services	59	17.4
Skills Manual Job	8	2.4
Unskilled Manual Job	2	0.6
Agricultural	14	4.1
Housewife	224	65.9
Partner's Academic Qualification		
No formal education	89	26.2
Primary	31	9.1
Secondary	105	30.9
Higher	115	33.8
Partner's Occupation		
Professional/Managerial	45	13.2
Clerical	57	16.8
Sales and Services	71	20.9
Skills Manual Job	33	9.7
Unskilled Manual Job	7	2.1

Agricultural	124	36.5

Source: Field Survey

4.2 Presentation of Data

4.2.1 What is the Level of Knowledge on Routine Childhood Immunization among Mothers in Agwara LGA, Niger State?

Concerning the definition of Immunization: Of the 340 respondents, 259 (76.2%) answered correctly that immunization is the process by which an individual's immunes system becomes fortified against an infectious agent through vaccination while 81(23.8%) answered incorrectly on the same questions. Also

Concerning vaccination: 233 (68.5%) of the respondents correctly answered that vaccination is the process of introducing a vaccine into the body to produce protection from a specific disease while 107(31.5) answered incorrectly. 244 (71.8%) accurately answered that vaccine is a preparation that is used to stimulate the body's immune response against disease, was while 96 (28.2%) answered incorrectly was. Of the total respondents, 240 (70.6%) correctly that immunization helps to prevent childhood diseases while 100 (29.4 %) answered the same question incorrectly.

Concerning Safety of immunization: 276 (81.2%) answered correctly that childhood immunization is safe for children while 64(18.8%) of the respondent answered the same question incorrectly. One hundred and thirty-one (38.5%) respondents answered correctly that immunization prevents all childhood diseases while 209(61.5%) answered the same question incorrectly. Of all the respondents, 218 (61.4%) answered correctly that vaccine treatable diseases are tuberculosis, diphtheria, tetanus, measles, yellow fever, cholera and pertussis (whooping cough) while 122 (35.9%) of the respondent answered incorrectly .One hundred and eighty-four respondents (54.1%) correctly believed that childhood vaccines do not have side

effect that are harmful to the child while 156 (45.9%) incorrectly believed that vaccines do. Also, two hundred and twenty-two respondents (67.1%) correctly answered that getting multiple shots in one visit cannot overload a child's immune system while 112 (32.9%) responded to the question incorrectly.

Concerning the completion of immunization: 252 (74.9%) of the respondents correctly answered that it is important for a child to be taken to a health facility to complete his/her routine immunization, while 88 (25.9%) answered incorrectly. Out of the total respondents, 175 (51.5%) responded correctly that routine vaccines are sufficient to reach all the children while 165 (48.5%) incorrectly responded to the same question. Also, of all respondents, 248 (72.9%) correctly answered that area of residence of mother/caregiver to health centers could affect the adoption of immunization while 92(27.1%) responded to the same question incorrectly.

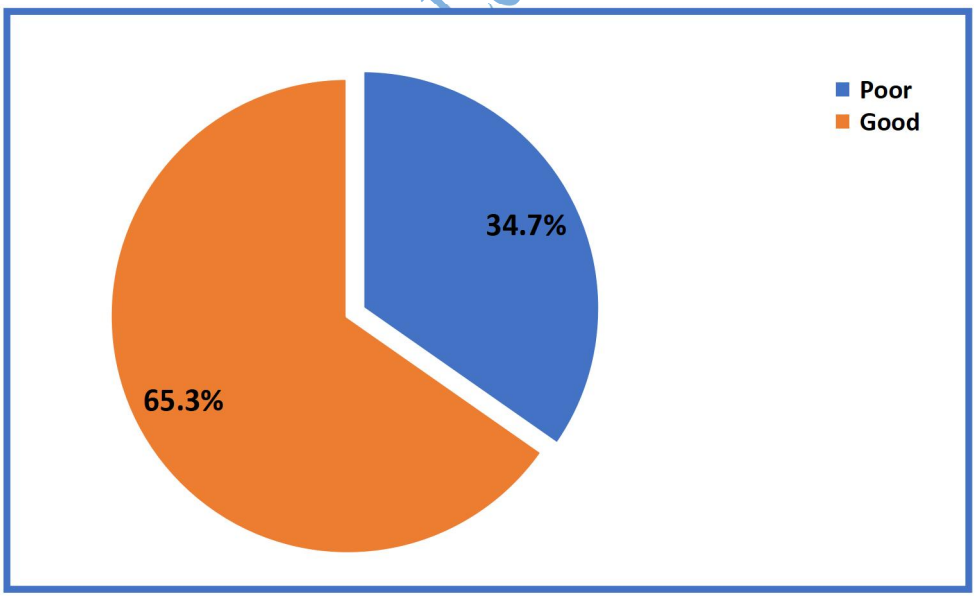
Table 4.2: Knowledge of Mothers on Immunization

Variable	Correct response (%)	Incorrect response (%)
Immunization is the process by which an individual's immunes system becomes fortified against an infectious agent through vaccination	259 (76.2)	23.8(81)
Vaccination is the process of introducing a vaccine into the body to produce protection from a specific disease	233 (68.5)	107 (31.5)
Vaccine is a preparation that is used to stimulate the body's immune response against disease	244 (71.8)	96 (28.2)
Immunization helps to prevent childhood diseases	240 (70.6)	100 (29.4)
Childhood immunization is safe for children	276 (81.2)	64 (18.8)
Immunization prevents all childhood diseases	131 (38.5)	209 (61.5)

Vaccine treatable diseases are tuberculosis, diphtheria, tetanus, measles, yellow fever, cholera and pertusis (whooping cough)	218 (64.1)	122 (35.9)
It is important for a child to be taken to a health facility to complete his/her routine immunization	252 (74.1)	88 (25.9)
Childhood vaccines do have side effect that are harmful to the child	184 (54.1)	156 (45.9)
Getting multiple shots in one visit can overload a child's immune system	228 (67.1)	112 (32.9)
Routine immunization is sufficient to reach all children for immunization	175 (51.5)	165 (48.5)
Area of residence of mother/caregiver to health centers could affect the adoption of immunization	248 (72.9)	92 (27.1)

Source: Field Survey

4.2.1: The Overall Knowledge of the Mothers on Routine Childhood Immunization in Agwara LGA, Niger State.



Source: Field Survey

Figure 4.1: Knowledge of Mother's on Immunization

Figure 4.1 above illustrates the level of knowledge of mothers on immunization. The figure shows that 65.3% of the respondents has good knowledge of immunization, while 34.7% has poor knowledge.

4.3: What is the Attitude of Mothers towards Routine Childhood immunization in Agwara LGA, Niger State?

Seventy-one (20.9%) of the respondent agrees that bringing my child for immunization is a waste of time, 251 (73.8%) disagree on the question while 18 (5.3%) are not sure on the same question .Of all the respondents, 179 (52.6%) agrees that they do take my child for immunization early, 89 (26.2%) disagree on the question while 72 (21.2) are not sure on the same question. One hundred and sixty-two respondents (47.6%) of the respondent agrees that they prioritize their child's immunization over other activities, 101 (29.7%) disagree while 77 (22.6%) are not sure on the same question. Of the 340 respondents, 165 (48.5%) agrees that Babies can be left without vaccination if they look healthy, 155 (45.6%) disagree on the question while 20 (5.9%) are not sure on the same question. Of all the respondents, 238 (70%) of the respondents agrees that they like to complete their child's immunization, 30(8%) disagrees while 72(21.2%) are not sure on the same question. Two hundred and twenty-nine (67.4%) of the respondents agrees that they always keep their child's immunization card, 26(10.6%) disagrees, while 75(22.1%) are not sure on the same question.

Of all the respondents, 229 (67.4) agrees that they can produce their child's immunization card when needed, 60(17.6%) disagrees while 51(15%) of the respondent are not sure on the same question. Out of all the respondents, 220(64.7%) agrees that they always immunize their child at

the specified time, 49(14.4%) disagree on the question while 13(3.8%) of the mothers are not sure. Two hundred and seven respondents (60.9%) agrees that fear of child illness after immunization does not allow them bring their child for immunization, 118(34.7%) disagree on the question while 154(45.3%) of the respondent are not sure. Out of the 340 respondents, 173(50.9%) of the respondents agrees that the fear of side effects or adverse effect doesn't allow them take their child for immunization, 154(45.3%) disagree, while 13(3.8%) of the respondents disagree on the question.

However, one hundred and sixty-eight respondents (49.4%) of the respondent agrees that they always forget their child's immunization schedule, 129(37.9) of the respondent disagrees while 43(12.6%) are not sure on the same question. And, out of the 340 respondents, 246(72.4%) agrees that they need a reminder for their child's next appointment, 62(18.2%) disagree on the question while 32(9.4%) are not sure on the same question.

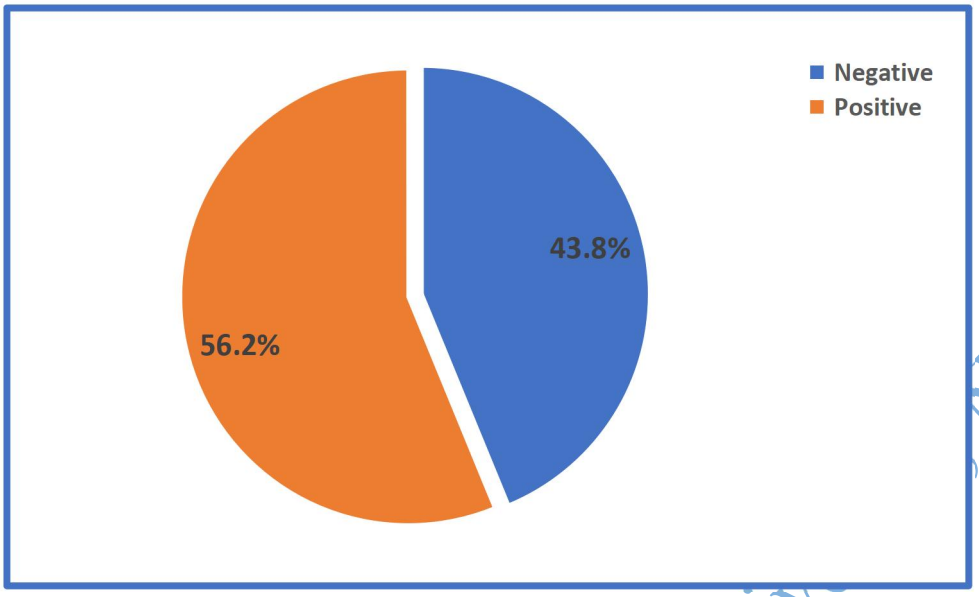
Table 4.3: Attitude of Mothers towards immunization

Variable	Frequency	Percentage
Bringing my child for immunization is a waste of time		
Agree	71	20.9
Disagree	251	73.8
Not sure	18	5.3
I do take my child for immunization early		
Agree	179	52.6
Disagree	89	26.2
Not sure	72	21.2
I prioritize my child's immunization over other activities		
Agree	162	47.6
Disagree	101	29.7
Not sure	77	22.6
Babies can be left without vaccination if they look healthy		
Agree	165	48.5

Disagree	155	45.6
Not sure	20	5.9
I like to complete my child's immunization		
Agree	238	70
Disagree	30	8
Not sure	72	21.2
I always forget my child's immunization schedule		
Agree	168	49.4
Disagree	129	37.9
Not sure	43	12.6
I always keep my child's immunization card		
Agree	229	67.4
Disagree	26	10.6
Not sure	75	22.1
I need a reminder for my child's next appointment		
Agree	246	72.4
Disagree	62	18.2
Not sure	32	9.4
I can produce my child's immunization card when needed		
Agree	229	67.4
Disagree	60	17.6
Not sure	51	15
I always immunize my child at the specified time		
Agree	220	64.7
Disagree	49	14.4
Not sure	71	20.9
Fear of child illness after immunization does not allow me bring me bring my child for immunization		
Agree	207	60.9
Disagree	118	34.7
Not sure	15	4.4
The fear of side effects or adverse effect doesn't allow me take my child for immunization		
Agree	173	50.9
Disagree	154	45.3
Not sure	13	3.8

Source: Field Survey

4.4.1: Level of Mothers' Attitude towards Immunization



Source: Field Survey

Figure 4.4.1: A pie chart showing the percentage of attitude to immunization

Figure *4.4.1* above illustrates the level of attitude of mothers towards immunization. The figure shows that 56.2% of the respondents has positive attitude towards routine immunization, while 43.8% has negative attitude.

4.5: what is Level of Mothers' Adherence to Routine Childhood Immunization in Agwara LGA, Niger State?

Table 4.6 shows the percentage of adherence to immunization schedule form 0 to 3 months, 4 to 9 months and 10 months and above.

At 0-3 months, the adherence level for routine vaccines - BCG, HepB-0, OPV-0, OPV-1, PCV-1, Penta-1, OPV-2, PCV-2, and Penta-2 are below 50%; while, at 4-9 months and 10 months and above, the adherence level for BCG, HepB-0, OPV-0, OPV-1, PCV-1, and Penta-1 were above 50% 954.3%-61.2%). On the other hand, the adherence for OPV-2, PCV-2, Penta-2, OPV-3, PCV-3, Penta-3, and measles-1 remain less than 50% coverage irrespective of the period.

Table 4.4: Level of adherence to routine childhood Immunization among mothers

Variable	0 to 3 months (%)	4 to 9 months (%)	10 months and above (%)
BCG	42.6	61.2	74.0
HepB-0	42.9	58.6	70.6
OPV-0	48.9	57.8	69.5
OPV-1	46.8	54.3	59.9
PCV-1	48.9	56.0	58.8
Penta-1	44.7	57.8	57.1
OPV-2	36.2	42.2	44.6
PCV-2	36.2	41.4	44.6
Penta-2	36.2	40.5	44.6
OPV-3		27.6	28.8
PCV-3		27.6	27.7
Penta-3		25.9	27.1
Measles1		19.0	20.9

Source: Field Survey

4.7 Discussion of Findings

Level of Knowledge on Routine Childhood Immunization among Mothers in Agwara LGA, Niger State

The result of this study shows that the overall knowledge of mothers on routine immunization is 65%. This is lower to a study that reported 76% knowledge of immunization among mothers in Atakumos-west local government of Osun State. The differences maybe to the educational level of the respondents.

In a study conducted in Bennin city reveal that 44.8% of the respondant had good knowledge on routine immunization. This is lower to a study reported in Atakumasu LGA of Osun State. The differences may be due to educational level of the respondant. Another study in Gwalada area council reported that 54.1% have good knowledge of routine immunization. This is lower to a study reported in Atakumasu LGA of Osun State.

Another study in Ikorodu LGA of Lagos State reported 72% of mothers had good knowledge about routine immunization. This is similar to the study that reported 76% in Atakumosu LGA of Osun State. The relation could be level of education and shared the same geographical and cultural identity.

Level of Mothers Attitude of towards Routine Childhood Immunization among in Agwara LGA, Niger State

The finding of this study shows that 56% is the Level of Mothers Attitude of towards Routine Childhood Immunization in Aqwara LGA. This result is lower to a study that documented 96.4% mothers' positive attitude towards routine childhood immunization in Atakumasu LGA of Osun State. The differences could be the educational level of the respondents. positive attitude of mothers have positive attitude towards their children immunization. A study reported in

Gwagwalada Area council of Abuja FCT that, 96% was revealed to have good attitude towards routine immunization. This is similar to a study that reveal 96.4% in Atakumosu LGA of Osum State. The similarities could be population density of the areas.

A study also in Ikorodu LGA of Lagos State reported that 100% of the respondant had positive attitude toward immunization. This is similar to study that reported 96.6% in Atakumasu LGA of Osun State. The similarities could be due educational level of the respondant.

Level of Adherence to routine childhood immunization

The finding of this study shows that the adherence level of routine childhood immunization is low among mothers in Aqwara LGA of Niger State. This study is similar to a study that reported 69.1% and 60.4% immunization for under five weeks and nine months in Pakistan Respectively. A study reported that 86.4% of the respondents had fully immunized their children in Ikorodu LGA of Lagos State. This is higher to that reported in Atakumosu and Pakistan. The difference could be good access to service providing center.

Endnote

[1]E. B Adedire, O Ajumobi, O Bolu, P Nguku,& I Ajayi. *Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria*. **Pan Afr Med J**. 2021 Nov 12;40(Suppl 1):8. doi: 10.11604/pamj.supp.2021.40.1.30876. PMID: 36157559; PMCID: PMC9474928.

[2]W. M. Almutairi, F. Alsharif, F. Khamis, L. A. Sallam, L. Sharif, A. Alsufyani, F. N. Alshulah, &R. Alqasimi. *Assessment of mothers' knowledge, attitudes, and practices regarding childhood vaccination during the first five years of life in Saudi Arabia*. **Nurs Rep**. 2021 Jul 5;11(3):506-516. https://doi:10.3390/nursrep11030047 PMID: 34968325; PMCID: PMC8608048.

[3]B. M. Manal & A. Ahlam. *Knowledge, attitude and practice of mothers toward children's vaccination at Alfatih One in Sudan*. **Open Journal of Nursing** Vol.11 No.7.2021https://doi:10.4236/ojn.2021.117047.

[4]M. Kagoné, M. Yé, E. Nébié, A. Sie, A. Schoeps, H. Becher, O. Muller & A. B. Fisker. *Vaccination coverage and factors associated with adherence to the vaccination schedule in young children of a rural area in Burkina Faso*, **Global Health Action**, 2017, 10:1, https://doi:10.1080/16549716.2017.1399749

[5]P. E. Konwea, F. A. David, S. & E. Ogunsile. *Determinants of compliance with child immunization among mothers of children under five years of age in Ekiti State, Nigeria*, **Journal of Health Research.** 2018, 32:3, ISSN: 2586-940X

[6]N. E. Uwaibi, *Determinants of full vaccination status in children attending immunization clinic in a tertiary hospital in Benin City, Nigeria*. **J. Appl. Sci. Environ. Manage**. Vol. 24 (8) 2020 1383-1390

[7]H. Hobani, &A. Eman. "*Factors related to parents' adherence to childhood immunization*." **BMC Public Health** 22, no. 1, 2022.

Chapter Five

Conclusion

This chapter majorly focuses on the discussion of findings, summary, conclusion and recommendation based on the findings of the study.

5.1 Summary of Findings

Research has shown that immunized children are directly protected against infectious diseases such as measles, tetanus, polio, hepatitis, whooping cough etc. Agwara LGA of Niger state is populated with children whose mothers/caregivers are deficient of sufficient exposure and education. Caregivers and mothers from across the local government were recruited for the study where the mean age of respondent was 30.8 SD±5.837; this indicated that most of them were still at their youthful age.

The findings of the study reveal that the level of mothers' education relates to their knowledge on childhood immunization is modarate as claimed by 65% of the respondents on table 4.2. This finding was supported by many of those interviewed during the interviews. They asserted that there is a lot of awareness among mothers about childhood immunization against killer diseases in Agwara Local Government.

This agrees with the findings of an author who also register a modarate level of knowledge and attitude towards childhood immunization amongst mothers/caregivers and their partner.

With reference to the study which indicated that (56%), of the mothers have positive attitude towards their children immunization.. This is also in accordance with the findings of a study where participants expressed positive attitude towards childhood immunization in Atakumosa-west Local Government Area, Osun State reported 96.4% positive attitude towards routine

childhood immunization. This shows a higher level of attitude than this finding of this present study (56%). This gap can be as a result of lack of adequate knowledge of immunization in the study area.

The findings show OPV-1, PCV-1, and Penta-1 were above 50% 954.3%-61.2%). On the other hand, the adherence for OPV-2, PCV-2, Penta-2, OPV-3, PCV-3, Penta-3, and measles-1 remain less than 50% coverage. This shows there is poor adherence to routine childhood immunization among mothers in Agwara LGA. The reason behind this is related to distance to assess immunization service, failure to conduct out reach session by service providers, no community involvement in session plan and fear of adverse event that followed immunization since some mothers complain that children become restless after receiving a vaccine. This deprive mothers to go for the second and third dose of vaccination.

5.2 Conclusion

Routine immunization as a major inhibitor to childhood mortality can never be overemphasized, records haven shown that the level of awareness and appreciation of the process is gradually progressing in some regions of the world especially in West Africa where children suffer more poverty implicated mortality than any other part of the world.

This study has established that age range of mothers plays a significant role in adherence to routine immunization of their children/wards even though level of education suggested that uneducated mothers are even more likely to cover immunization schedules for children. Attitude and knowledge had different level of significance in the women recruited but it was generally

discovered that mothers/caregivers in Agwara local government of Niger state would embrace immunization process if they are well informed and encouraged to participate.

5.3 Recommendations

The recommendations of this study are as follows;

- Federal government should make funds available to the public health sector and give non-governmental organization free hand to operate on the awareness and spread of the knowledge and adherence to childhood routine immunization.
- Fathers should be better involved in the improvement of their child's health via compliance with childhood routine immunization schedules.
- Public health workers and others health personnel at community and local government level should gear up their sensitization of mothers/caregivers on the importance of adequate knowledge and positive attitude towards Childhood immunization.
- Door to door immunization exercises should be given more priority as this will help reach out to children of caregivers and mothers that are less likely to attend hospital appointments to complete the immunization booked for their children.
- From the findings of these study, it is also important to rule out the effect of religious believes in any way they can affect the participation of mothers/caregivers.

5.4 Contribution to Knowledge

This study has added to knowledge on the area of readiness, adherence and knowledge of mothers and caregivers on issues relating to the immunization of their children. Agwara Local government presents some evidences which agreed with previous studies and also negate some suggestions from previous study respectively.

This study helped to establish that northern Nigeria is actually populated with mothers and caregivers who have knowledge on routine immunization and at the same time has a positive attitude toward immunization but has poor adherence to routine childhood immunization. This is due to religious belief, distance from the service point, no community involvement and fear of injection. Under-aged parenting was also observed and these under aged mothers are less informed and more likely to exhibit non-adherence to covering routine immunization scheduled for their children.

5.5 Suggested Areas for Further Research

The following suggestions were made based on the findings of the study;

- What are the personal and family-based benefits when mothers/caregivers and their partners are involved in the routine immunization of their children?
- What facilities those attract women in local and rural communities to attend medical centers in their environment since numerous research has established that they are less likely to meet up with appointments?
- What are the ways in which mothers and caregivers in local and rural areas can be more convinced to be involved in childhood routine immunization?

Bibliography

Journals

Abbas, A., Lichtman, A., & Pillai, S. *Cellular and Molecular Immunology*, 10e, South Asia Edition-E-Book. **Elsevier Health Sciences**, 2014.

Abbasi, J. "*Study suggests lasting immunity after COVID-19, with a big boost from vaccination*." **JAMA**326, no. 5: 376. 2021.

Abdulkadir, M., & Rainis, R. "*Socio-Economic Determinants of Routine Immunization Coverage in Dutse, Jigawa State, Northern Nigeria, May 2018*." 2020.

Abdullahi, S. "*Factors affecting completion of childhood immunization in North West Nigeria*." **PhD diss**., Walden University, 2018.

Adam, V. Y., Onowugbeda, E. D., Osuji, O. I., & Omohwovo, O. D. *Prevalence and management of perceived adverse events following immunization in Infants attending well baby clinics in Benin City, Nigeria*. **Journal of Community Medicine and Primary Health Care** 32, no. 2, 2020: 57–67.

Adedire, B. E. Ajumobi, O. Bolu, O., Nguku, P. & Ajayi I. *Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria*. **Pan African Medical Journal** 40 (1):8 2021. https://doi:10.11604/pamj.supp.2021.40.1.30876

Adedire, E. B., Ajumobi, O., Bolu, O., Nguku, P., & Ajayi, I. *Maternal knowledge, attitude, and perception about childhood routine immunization program in Atakumosa-west Local Government Area, Osun State, Southwestern Nigeria*. **Pan Afr Med J**. 2021 Nov 12;40(Suppl 1):8. doi: 10.11604/pamj.supp.2021.40.1.30876. PMID: 36157559; PMCID: PMC9474928.

Adefolalu, O. A., Kanma-Okafor, O. J., & Balogun, M. R. "*Maternal knowledge, attitude and compliance regarding immunization of under-five children in primary health care centers in Ikorodu local government area, Lagos state*." 2019.

Adefolalu, O. A., Kanma-Okafor, O. J., & Balogun, M. R. "*Maternal Knowledge, Attitude and Compliance Regarding Immunization of under Five Children in Primary Health Care Centres in Ikorodu Local Government Area, Lagos State*." **Journal of Clinical Sciences** 16, no. 1, 2019: 7.

Adefolalu, O. A., Kanma-Okafor, O. J., & Balogun, M. R. "*Maternal knowledge, attitude and compliance regarding immunization of under five children in primary health care centres in Ikorodu Local Government Area, Lagos State*". **Journal of Clinical Sciences** 16, no. 1, 2019: 7.

Adeyanju, G. C., Sprengholz, P., Betsch, C., & Essoh, T. A. *Caregivers' willingness to vaccinate their children against childhood diseases and human papillomavirus: a cross-sectional study on vaccine hesitancy in malawi*. **Vaccines** 2021, 9, 1231. https://doi.org/10.3390/vaccines9111231

Adeyinka, D., Oladimeji, O., Adeyinka, F., & Aimakhu, C. *Uptake of childhood immunization among mothers of under-five in southwestern nigeria*. **The Internet Journal of Epidemiology** 7, no. 2, 2019.

Ajayi, F.T. *A guide to primary health care practice in developing countries: 4th edition, 2019*. Felicity Print Limited Akure.

Akwataghibe, N. N., Ogunsola, E. A., Broerse, J. E., Popoola, O. A., Agbo, A. I., & Dieleman, M. A. "*Exploring factors influencing immunization utilization in Nigeria—A mixed methods study*." **Frontiers in Public Health** 7, 2019.

Akwataghibe, N. N., Ogunsola, E. A., Broerse, J. E., Popoola, O. A., Agbo, A. I., & Dieleman, M. A. "*Exploring factors influencing immunization utilization in Nigeria—A Mixed Methods Study*." **Frontiers in Public Health** 7, 2019.

Akwataghibe, N. N., Ogunsola, E. A., Broerse, J. E., Popoola, O. A., Agbo, A. I., & Dieleman, M. A. *Using participatory action research to improve immunization utilization in areas with pockets of unimmunized children in Nigeria*. **Health Res Policy Sys** 2021, 19(Suppl 2):88 https://doi.org/10.1186/s12961-021-00719-9.

Akwataghibe, N. N., Ogunsola, E. A., Popoola, O. A., Agbo, A. I., & Dieleman, M. A. *Using participatory action research to improve immunization utilization in areas with pockets of unimmunized children in Nigeria*. **Health Res Policy Sys** 2021, 19(Suppl 2):88 https://doi.org/10.1186/s12961-021-00719-9.

Alabadi, M., & Aldawood, Z. "*Parents' knowledge, attitude and perceptions on childhood vaccination in Saudi Arabia: a systematic literature review.*" **Vaccines** 8, no. 4 2020: 750.

Ali, A. H. M., Abdullah, M. A., Saad, F. M., & Mohamed, H. A. A. "*Immunisation of children under 5 years: mothers' knowledge, attitude and practice in Alseir locality, Northern State, Sudan*." **Sudanese journal of paediatrics** 20, no. 2 2020: 152.

Alkali, N. H., & Mohammed, R. B. "*Tertiary hospital standards in Nigeria: A review of current status*." **Annals of African Medical Research** 3, no. 1 2020.

Allison. B.G. *Norms within networks: Opinion leader and peer network influences on mothers/caregivers 'childhood immunization decisions in rural northern Nigeria, Doctor of Philosophy Dissertation, Columbia University, 2018 Vaccine Timeline*. Historic Dates and Events Related to Vaccines and Immunization, 2018.

Almutairi, W.M., Alsharif, F., Khamis, F., Sallam, L.A., Sharif, L., Alsufyani, A., Alshulah, F.N. & Alqasimi, R. *Assessment of mothers' knowledge, attitudes, and practices regarding childhood vaccination during the first five years of life in Saudi Arabia*. **Nurs Rep**. 2021 Jul 5;11(3):506-516. https://doi:10.3390/nursrep11030047 PMID: 34968325; PMCID: PMC8608048.

Alshammari, S. Z., AlFayyad, I., Altannir, Y., & Al-Tannir, M. "*Parental awareness and attitude about childhood immunization in Riyadh, Saudi Arabia: A cross-sectional*

study." **International Journal of Environmental Research and Public Health** 18, no. 16 2021: 8455.

Andreoli, K. G. "*Self-concept and health beliefs in compliant and noncompliant hypertensive patients*." **Nursing Research** 30, no. 1981.

Antai. D. "*Inequitable childhood immunization uptake in Nigeria: A multilevel analysis of individual and contextual determinants*." **BMC Infectious Diseases** 9, no. 1 2009.

Asiegbu, U. V., Obu, D. C., Una, A. F., Ezeonu, C. T., & Asiegbu, O. K. "*Evaluating mothers knowledge and attitude as a contributing factor to the low childhood immunization uptake in Ebonyi State, Nigeria*." **African Journal of Medical and Health Sciences** 19, no. 8 2020: 127-135.

Awosan, K.J., Ibrahim, M.T.O., Yunusa, E.U., Isah, B.A. Raji, M.O., & Abubakar. N. "*Knowledge, attitude and compliance with full immunization of children against vaccine preventable diseases among pregnant mothers in sokoto, Nigeria*." **International Journal of Contemporary Medical Research IJCMR**5, no. 6, 2018.

Ayede, A.I., Ashubu, O.O., Fowobaje, K.R., Aboubaker, S., Nisar, Y.B., Qazi, S.A., Bahl, R. and Falade, A.G. "*Management of possible serious bacterial infection in young infants where referral is not possible in the context of existing health system structure in Ibadan, South-west Nigeria*." **PLoS One** 16, no. 3 2021: e0248720.

Ayinde, A. O., Olubukola, A., Ayobami, A. A., Grace, A. C., Ugba, F. E., & Oluwadare, M. "*Knowledge and Attitude of Nursing Mothers and their under Five Infants on Immunization Regimen in Makun Health Center, Ogun State*." **Central Asian Journal of Medical and Natural Science** 3, no. 1 2022: 50-64.

Azeez, A. H., & Khalifa, M. F. "*Evaluation of Reasons for Partial Compliance and Non-compliance to the Routine Childhood Vaccination Schedule in Al-Russafa District*." **Pakistan Journal of Medical & Health Sciences** 16, no. 03 2022: 999-999.

B. M. Manal & A. Ahlam. *Knowledge, attitude and practice of mothers toward children's vaccination at Alfatih One in Sudan*. **Open Journal of Nursing** Vol.11 No.7.2021https://doi:10.4236/ojn.2021.117047.

Babacan, H. "*Public–private partnerships for global health: Benefits, enabling factors, and challenges*." **Handbook of global health** 2020: 1-34.

Babalola, S. "*Determinants of the uptake of the full dose of Diphtheria–Pertussis–Tetanus Vaccines (DPT3) in Northern Nigeria: A multilevel analysis*." **Maternal and Child Health Journal** 13, no. 4, 2019: 550–558.

Babalola, S., & Adewuyi, A. *Factors influencing immunization uptake in Nigeria. A theory-based research in six states.Abuja* ***PATHS***.2005; 7.

Babalola. S. "*Determinants of the uptake of the full dose of diphtheria–pertussis–tetanus vaccines (dpt3) in Northern Nigeria: A Multilevel Analysis*." **Maternal and Child Health Journal** 13, no. 4, 2019: 550–558.

Becker, S., Peter, H., Gray, H., Gultiano, C., & Black, E., *The determinants of use of maternal and child health services in Metro Cuba*. **The Philippines Health Transition Review** 3(1) 2020:77-89.

Becker, S., Peters, D. H., Gray, R. H., Gultiano, C., & Black, R. E. *The determinants of use of maternal and child health services in Metro Cuba*. **The Philippines Health Transition Review** 3 (1) 2019:77-89.

Bernard, B., Blass, J., Turpin, A. & Raynaud, M. "*Chemical characterization of tetanus toxin and toxoid. Amino acid composition, number of SH and S-S groups and N-Terminal amino acid*." **European Journal of Biochemistry** 17, no. 1 2019: 100–105.

Birhanu, S., Anteneh, A., Kibie, Y., & Jejaw, A.. "*Knowledge, attitude and practice of mothers towards immunization of infants in health centres at Addis Ababa, Ethiopia*." **Am J Health Res** 4, no. 1 2016: 6-17.

Bruni, L., Saura-Lázaro, A., Montoliu, A., Brotons, M., Alemany, L., Diallo, M.S., Afsar, O.Z., LaMontagne, D.S., Mosina, L., Contreras, M. & Velandia-González, M. "*HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019*." **Preventive medicine** 144 2021: 106399.

Butt, M., Mohammed, R., Butt, E., Butt, S., & Xiang, J "*Why have immunization efforts in Pakistan failed to achieve global standards of vaccination uptake and infectious disease control?*" **Risk management and healthcare policy** 2020: 111-124.

Byamukama, T. "*Influence of community-based interventions on routine immunization uptake among children under five years in Ntungamo District-Uganda*." **Texila International Journal of Public Health** 9, no. 4, 2021: 62–83.

C. J. I., Uneke, I. Obeka, B. I. Uneke, A. Umeokonkwo, C. A. Nweze, K. I. Otubo, and O. E. Uguru. "*An assessment of nursing mothers' and young people's access to proprietary and patent medicine vendors' services in rural communities of south-eastern Nigeria: implication for review of national drug policy*." **Journal of Pharmaceutical Policy and Practice** 14, no. Suppl 1 2021: 92.

Caldwell, J. C. "*Education as a factor in mortality decline an examination of Nigerian data*." **Population Studies** 33, no. 3, 2021: 395.

Carolina, A. R., Efendi, D., & Kurniasari, M. D. "*Determinant factor of childhood basic immunization compliance during the COVID-19 pandemic in Jambi City, Jambi Province, Indonesia.*" **Journal of Nursing Practice** 5, no. 1 2021: 77-88.

Cassell, J. "*The social shaping of childhood vaccination practice in rural and urban Gambia*." **Health Policy and Planning** 21, no. 5, 2019: 373–391.

Centers for disease control and prevention (CDC 2018). *Vaccines and immunization: Why are childhood vaccines so important?* Vaccines, 18(1): 23-34.

Chen, C., Liceras, F. C., Flasche, S., Sidharta, S., Yoong, J., Sundaram, N., & Jit, M. "*Effect and cost-effectiveness of pneumococcal conjugate vaccination: a global modelling analysis.*" **The Lancet Global Health** 7, no. 1 2019: e58-e67.

Chido-Amajuoyi, O. G., Osaghae, I., & Shete, S. "*Reasons patients cite to their health-care professional for not initiating or completing human papillomavirus vaccination*." **JNCI Cancer Spectrum** 7, no. 4 2023: pkad047.

Chotpitayasunondh, T., Fischer, T.K., Heraud, J.M., Hurt, A.C., Monto, A.S., Osterhaus, A., Shu, Y. and Tam, J.S. "*Influenza and COVID-19: What does co-existence mean?*." **Influenza and Other Respiratory Viruses** 15, no. 3 (2021): 407-412.

Croyle, E. A. *Vaccine transport*, **Scientific American Journal**, 322(1) 2020:12 25.

da Costa, T. M. Paulo, L. S., Amilton, S. M., Ivan, T. P. & Sigulem, D. "*The impact of short message service text messages sent as appointment reminders to patients' cell phones at outpatient clinics in São Paulo, Brazil*." **International Journal of Medical Informatics** 79, no. 1, 2010: 65–70.

Dayyabu, S., Isma'il, M., Ahmad, B. Y., Abdullahi, U. Y., & Abdullahi, I. *Assessment of an evaluation on the effect of Immunization on Child Development in Gombe Local Govt*. Area Gombe – Nigeria. Vol. 1 No. 1 & 2.e-issn: 2811-1621 December, 2021

De Boeck, K., Decouttere, C., & Vandaele, N. "*Vaccine distribution chains in low-and middle-income countries: A literature review.*" **Omega** 97 2020: 102097.

Deressa, W., Kayembe, P., Neel, A. H., Mafuta, E., Seme, A., & Alonge, O. "*Lessons learned from the polio eradication initiative in the Democratic Republic of Congo and Ethiopia: analysis of implementation barriers and strategies*." **BMC Public Health** 20, no. 4 2020: 1-15.

Di Giuseppe, G., Folcarelli, L., Lanzano, R., Napolitano, F., & Pavia, M. "*HPV Vaccination and Cervical Cancer Screening: Assessing Awareness, Attitudes, and Adherence in Detained Women*." ***Vaccines*** 10, no. 8 2022: 1280.

Dienye, P. O. Kalamawei, I., & Best., O. "*Community participation and childhood immunization coverage: A comparative study of rural and urban communities of Bayelsa State, South-South Nigeria.*" **Nigerian Medical Journal** 53, no. 1 2012: 21.

Dugas, M. Dube, E., Kouyate, B., Sanou, A. & Bibeau G. *Portrait of a length vaccination trajectory in burkina faso: from cultural acceptance of vaccines to actual immunization*. **BMC Int. Health Hum Rights**, 14; 9 Suppl 1:S9, 2019. https://doi:10.1186/1472-698X-9-S1-S9

Duijzer L. E., Van Jaarsveld, W. & Dekker, R. "*Literature review: The vaccine supply chain*." **European Journal of Operational Research** 268, no. 1 2018: 174-192.

Duru, J. I., Usman, S., Adeosun, O., Stamidis, K. V., & Bologna, L. "*Contributions of volunteer community mobilizers to polio eradication in Nigeria: the experiences of non-governmental and civil society organizations*." **The American Journal of Tropical Medicine and Hygiene** 101, no. 4 Suppl 2019: 74.

Eboreime, E. A., Eyles, J., Nxumalo, N., Eboreime, O. L., & Ramaswamy, R. "*Implementation process and quality of a primary health care system improvement initiative in a decentralized context: a retrospective appraisal using the quality implementation framework*." **The International journal of health planning and management** 34, no. 1 2019: e369-e386.

Ekhaguere, O. A., Oluwafemi, R. O., Badejoko, B., Oyeneyin, L. O., Butali, A., Lowenthal, E. D., & Steenhoff, A. P. "*Automated phone call and text reminders for childhood immunisations (primm): Arandomised controlled trial in Nigeria.*" **BMJ Global Health** 4, no. 2, 2019.

Ekhaguere, O. A., Oluwafemi, R. O., Badejoko, B., Oyeneyin, L. O., Butali, A., Lowenthal, E. D., & Steenhoff, A. P. "*Automated phone call and text reminders for childhood immunisations: A randomised controlled trial in Nigeria*." **BMJ Global Health** 4, no. 2, 2019.

Ekwebelem, O. C., Nnorom-Dike, O. V., Aborode, A. T., Ekwebelem, N. C., Aleke, J. C., & Ofielu, E. S. "*Eradication of wild poliovirus in Nigeria: Lessons learnt*." **Public Health in Practice** 2 2021: 100144.

Eze, P., Agu, U. J., Aniebo, C. L., Agu, S. A., Lawani, L. O., & Acharya, Y. "*Factors associated with incomplete immunisation in children aged 12–23 months at subnational level, Nigeria: A cross-sectional study*." **BMJ Open** 11, no. 6, 2021.

Fatunde, O.J. & Familusi, J. B. "*Post-neonatal tetanus in nigeria: the need for booster doses of tetanus toxoid*." **Nigerian Journal of Paediatrics** 28, no. 2, 2001.

Ferdinand, D. P., Nedunchezhian, S., & Ferdinand, K. C. "*Hypertension in African Americans: advances in community outreach and public health approaches*." **Progress in cardiovascular diseases** 63, no. 1 2020: 40-45.

Francis, M. R., Nohynek, H., Larson, H., Balraj, V., Mohan, V. R., Kang, G., & Nuorti, J. P. "*Factors associated with routine childhood vaccine uptake and reasons for non-vaccination in India: 1998–2008*." **Vaccine** 36, no. 44 2018: 6559-6566.

Galadima, A. N., Zulkefli, N. A. M., Said, S. M., & Ahmad, N. *"Factors influencing childhood immunisation uptake in Africa: a systematic review.*" **BMC Public Health** 21, no. 1 2021: 1-20.

Gehrau, V., Fujarski, S., Lorenz, H., Schieb, C., & Blöbaum, B. "*The impact of health information exposure and source credibility on COVID-19 vaccination intention in Germany.*"

Gentle, S. "*Knowledge and Attitude of Mothers towards Immunization in Emohua Local Government Area of Rivers State.*" **Int J Innov Healthc Res** 7, no. 4 (2019): 38-52.

Ghattas, M., Dwivedi, G., Lavertu, M., & Alameh, M. G. "*Vaccine technologies and platforms for infectious diseases: Current progress, challenges, and opportunities*." **Vaccines** 9, no. 12 2021: 1490.

Gooding, E., Spiliotopoulou, E., & Yadav, P. "*Impact of vaccine stockouts on immunization coverage in Nigeria*." **Vaccine** 37, no. 35 2019: 5104-5110.

Goven, J. "*Gender politics in Hungary: Autonomy and antifeminism*." **In Gender politics and post-communism**, pp. 224-240. Routledge, 2018.

Gunnala, R., Ogbuanu, I.U., Adegoke, O.J., Scobie, H.M., Uba, B.V., Wannemuehler, K.A., Ruiz, A., Elmousaad, H., Ohuabunwo, C.J., Mustafa, M. & Nguku, P. "*Routine vaccination coverage in northern nigeria: results from 40 district-level cluster surveys, 2014-2015*." **PLOS ONE** 11, no. 12. 2016. e0167835.

Haldane, V., Chuah, F. L., Srivastava, A., Singh, S. R., Koh, G. C., Seng, C. K., & Legido-Quigley, H. "*Community participation in health services development, implementation, and evaluation: A systematic review of empowerment, health, community, and process outcomes*." **PloS one** 14, no. 5 2019: e0216112.

Harini, B. "*How to transport crucial vaccines without cooling*" **Scientific American** 322, 6, 13**.** 2020: 12-25. https://doi.org10.1038/scientificamerican620-13b

Hashimoto, K. Nobuyuki, O. Hironobu, T. Hiroko, M. Makoto, T. Kaoru, T. & Yusuke. Y. "*Slam (cd150)-independent measles virus entry as revealed by recombinant virus expressing green fluorescent protein*." **Journal of Virology**76, no. 13, 6743–6749. 2002.

Heymann, D. L. "*Mass Vaccination and Public Health*." *Control of communicable diseases manual 18th edition,* **American Public Health Association, Washington DC** 2015.

Hobani, H. & Eman, A. "*Factors related to parents' adherence to childhood immunization*." **BMC Public Health** 22, no. 1, 2022.

Hofstetter, M. A. & Schaffer, S. "*Childhood and adolescent vaccination in alternative settings*." **Academic Pediatrics** 21, no. 4 2021: S50-S56.

Hussain, E., & Mohammed, Z. "*Parents' Attitudes toward Immunization and its Relation with Pediatric Immunization Compliance at Primary Health Care Centers in Karbala City, Iraq*." **Iraqi National Journal of Nursing Specialties** 34, no. 1 2021: 50-58.

Ibrahim, B. S., Usman, R., Mohammed, Y., Datti, Z., Okunromade, O., Abubakar, A. A., & Nguku, P. M. "*Burden of measles in Nigeria: a five-year review of casebased surveillance data, 2012-2016*." **The Pan African Medical Journal** 32, no. Suppl 1 2019.

Ishaku, S.G., Umeh, G., Adzu, B., Onimisi, A., Braka, F., Dauda, M., Iyal, H.A., Iliyasu, N., Yates, S.M., Shamang, A.F. & Samaila, L.H. *Caregivers experience and satisfaction with routine immunization services in Kaduna State, North-West, Nigeria, 2017-2019*. **J Med Bas SciRes** 2020; 1(1):127-137.

Jamil, K., A. Bhuiya, K. Streatfield, & N. Chakrabarty. "*The immunization programme in bangladesh: impressive gains in coverage, but gaps remain*." **Health Policy and Planning**14, no. 1, 1999: 49–58.

Jordan, E. T., Ellen M. R., Pamela J., & Evans W. D. "*Text4baby: using text messaging to improve maternal and newborn health*." **Nursing for Women's Health** 15, no. 3, 2011: 206–212.

Kagoné, M., Yé, M., Nébié, E., Sie, A., Schoeps, A., Becher, H., Muller, O. & Fisker, A.B. *Vaccination coverage and factors associated with adherence to the vaccination schedule in young children of a rural area in Burkina Faso*, **Global Health Action**, 2017, 10:1, https://doi:10.1080/16549716.2017.1399749

Kazi, A.M., Ahsan, N., Mughis, W., Jamal, S., Allana, R., Raza, M., Muneer, S., Mughal, M.A.K., Kaleemuddin, H., Sameen, F. & Ahmed, R.M. "Usability and acceptability of a mobile app for behavior change and to improve immunization coverage among children in pakistan: a mixed-methods study." **International Journal of Environmental Research and Public Health** 18, no. 18 2021: 9527.

Kennedy, A., Glasser, J., Covello, V., & Gust, D. "*Development of vaccine risk communication messages using risk comparisons and mathematical modeling*." **Journal of Health Communication** 13, no. 8, 2008: 793–807.

Khan, K. A. "*To estimate the immunization status of children from 0 to 7 years of age*."

Konwea, P. E., David, F. A., & Ogunsile, S. E. "*Determinants of compliance with child immunization among mothers of children under five years of age in Ekiti State, Nigeria.*" **Journal of Health Research** 32, no. 3 2018: 229-236.

Konwea, P. E., David, F. A., & Ogunsile, S. E. *Determinants of compliance with child immunization among mothers of children under five years of age in Ekiti State, Nigeria*, **Journal of Health Research.** 2018, 32:3, ISSN: 2586-940X

Kyprianidou, M., Tzira, E., Galanis, P., & Giannakou, K. "*Knowledge of mothers regarding children's vaccinations in Cyprus: A cross-sectional study*." **PLoS One** 16, no. 9 2021: e0257590.

Levine, M. M. Woodrow, G. C. Kaper, J. B. Cobon, G. S. *New Generation Vaccines*, 2nd edn, Marcel Dekker, Inc. 2020.

Lindstrand, A., Cherian, T., Chang-Blanc, D., Feikin, D., & O'Brien, K. L. "*The world of immunization: achievements, challenges, and strategic vision for the next decade*." **The Journal of Infectious Diseases** 224, no. Supplement_4 2021: S452-S467.

Loihala, M., Hasim, N. H., & Mustamu, A. C. "*Effectiveness of Interactive Health Games on Knowledge, Attitude, Compliance with Immunization Officers and Family Planning*." **Age (years)** 12, no. 16 2020: 17-25.

Mahfouz, N. N., Ali, W. H., El Wakeel, M. A., Rabah, T. M., Elmowafi, A. A., & Kamel, I. H. "*Adherence to compulsory vaccination during coronavirus Disease-19 pandemic in Egypt*." **Open Access Macedonian Journal of Medical Sciences** 9, no. A 2021: 217-221.

Manggat, I., Zain, R., & Jamaluddin, Z. "*The impact of infrastructure development on rural communities: A literature review*." **International Journal of Academic Research in Business and Social Sciences** 8, no. 1 2018: 637-648.

Masefield, S. C., Msosa, A., & Grugel, J. "*Challenges to effective governance in a low income healthcare system: a qualitative study of stakeholder perceptions in Malawi*." **BMC health services research** 20, no. 1 2020: 1-16.

Matta, P., El Mouallem, R., Akel, M., Hallit, S., & Fadous Khalife, M. C. "*Parents' knowledge, attitude and practice towards children's vaccination in Lebanon: role of the parent-physician communication*." **BMC Public Health** 20 2020: 1-9.

Micek, K., Hester, K.A., Chanda, C., Darwar, R., Dounebaine, B., Ellis, A.S., Keskinocak, P., Leslie, A., Manyando, M., Manyando, M.S. & Nazzal, D. "*Critical success factors for routine immunization performance: A case study of Zambia 2000 to 2018.*" **Vaccine***: X* 11 2022: 100166.

Msheliza, Y. R., Chibuzo, E., & Ojo, O. V. *An evaluation of knowledge and attitude towards routine immunization among caregivers/mothers of under-five-year children in Gwagwalada Area Council, Abuja-FCT*. **International Journal of Recent Innovations in Medicine and Clinical Research Open Access**. ISSN: 2582-1075 https://ijrimcr.com/ Volume-2, Issue-4, 2020: 30-37

Muathe, E. C. Kamau, M. & Rajula E. "*Exploring strategies to improve adherence to immunization schedule: A study among children attending maternal and child health clinic at Kenyatta National Hospital, Nairobi, Kenya*." **International Journal of Pediatrics**2020: 1–8.

Navin, M. C., Wasserman, J. A., Ahmad, M., & Bies, S. "*Vaccine education, reasons for refusal, and vaccination behavior*." **American journal of preventive medicine** 56, no. 3 2019: 359-367.

Nichter, M. "*Vaccinations in the third world: A consideration of community demand*." **Social Science & Medicine** 41, no. 5, 2020: 617–632.

Noh, J.W., Kim, Y.M., Akram, N., Yoo, K.B., Cheon, J., Lee, L.J., Kwon, Y.D. and Stekelenburg, J. "*Factors affecting complete and timely childhood immunization coverage in Sindh, Pakistan; A secondary analysis of cross-sectional survey data.*" **PloS one** 13, no. 10 2018: e0206766.

Noh, J.W., Kim, Y.M., Akram, N., Yoo, K.B., Park, J., Cheon, J., Kwon, Y.D. and Stekelenburg, J. "*Factors affecting complete and timely childhood immunization coverage in Sindh, Pakistan; A secondary analysis of cross-sectional survey data*". **PLoS ONE** 2018, 13(10): e0206766. https://doi.org/10.1371/journal. pone.0206766

Ntenda, P. A. M. "*Factors associated with non-and under-vaccination among children aged 12–23 months in Malawi. A multinomial analysis of the population-based sample*." **Pediatrics & Neonatology** 60, no. 6 2019: 623-633.

Nyström, M. E., Karltun, J., Keller, C., & Andersson Gäre, B. "*Collaborative and partnership research for improvement of health and social services: researcher's experiences from 20 projects*." **Health research policy and systems** 16, no. 1 (2018): 1-17.

Obeagu, E. A. "*A Systematic review on childhood immunization among men with infants: Africa perspective*." ***International Journal of Current Research in Medical Sciences*** 8, no. 9 2022: 15-24.

Ogboghodo, E. O., Omuemu, V. O., Odijie, O., & Odaman, O. J. "*Cold chain management: An assessment of knowledge and attitude of health workers in primary health-care facilities in Edo State Nigeria*." **Sahel Medical Journal** 21, no. 2 2018: 75.

Okafor, S. O., Ugwu, C. I., Nkwede, J. O., Onah, S., Amadi, G., Udenze, C., & Chuke, N. "*COVID-19 public health and social measures in Southeast Nigeria and its implication to public health management and sustainability*." **Oppor Chall. Sustain** 1, no. 1 2022: 61-75.

Okoli, C., Hajizadeh, M., Rahman, M. M., & Khanam, R. "*Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003–2017."* **BMC Health Services Research** 20 2020: 1-14.

Okonofua, F., Ntoimo, L.F., Yaya, S., Igboin, B., Solanke, O., Ekwo, C., Johnson, E.A.K., Sombie, I. and Imongan, W. "*Effect of a multifaceted intervention on the utilisation of primary health for maternal and child health care in rural Nigeria: a quasi-experimental study*." **BMJ open** 12, no. 2 2022: e049499.

Oladepo, O., Dipeolu, I. O., & Oladunni, O. "*Outcome of reminder text messages intervention on completion of routine immunization in rural areas, Nigeria*." **Health Promotion International** 36, no. 3 2021: 765-773.

Oladepo, O., Dipeolu, I. O., & Oladunni, O. "*Nigerian rural mothers' knowledge of routine childhood immunizations and attitudes about use of reminder text messages for promoting timely completion*." **Journal of Public Health Policy** 40, no. 4, 2019: 459–477.

Olaniyan A. & Isiguzo, C. *The Socioecological Model as a framework for exploring factors influencing childhood immunization uptake in Lagos state, Nigeria*. **BMC Public Health** 2021, 21:867 https://doi.org/10.1186/s12889-021-10922-6.

Oleribe, O.O., Momoh, J., Uzochukwu, B.S., Mbofana, F., Adebiyi, A., Barbera, T., Williams, R. & Taylor-Robinson, S.D. "*Identifying key challenges facing healthcare systems in Africa and potential solutions*." **International journal of general medicine** 2019: 395-403.

Omer, S. B., Salmon, D. A., Orenstein, W. A., Dehart, M. P., & Halsey, N. "*Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases*." **New England Journal of Medicine** 360, no. 19, 2019: 1981–1988.

Oyo-Ita, A., Bosch-Capblanch, X., Ross, A., Oku, A., Esu, E., Ameh, S., Oduwole, O., Arikpo, D. and Meremikwu, M. "*Effects of engaging communities in decision-making and action through traditional and religious leaders on vaccination coverage in Cross River State, Nigeria: A cluster-randomised control trial.*" **Plos one** 16, no. 4 2021: e0248236.

Pasteur, S. "*The economic value of vaccination: Why prevention is wealth*." **Journal of Market Access & Health Policy** 3, 2015.

Powell-Jackson, T., Fabbri, C., Dutt, V., Tougher, S., & Singh, K. "*Effect and cost effectiveness of educating mothers about childhood DPT vaccination on immunisation uptake, knowledge, and perceptions in Uttar Pradesh, India: A randomised controlled trial*". **PLoS Med**2018, 15(3): e1002519. https://doi.org/10.1371/ journal. pmed.1002519

Powell-Jackson, T., Fabbri, C., Dutt, V., Tougher, S., & Singh, K. "*Effect and cost effectiveness of educating mothers about childhood DPT vaccination on immunisation uptake, knowledge, and perceptions in Uttar Pradesh, India: A randomised controlled trial*". **PLoS Med** 2018, 15(3): e1002519. https://doi.org/10.1371/journal.pmed.1002519

Racine, E., Kusch, S., Cascio, M. A., & Bogossian, A. "*Making autonomy an instrument: a pragmatist account of contextualized autonomy*." **Humanities and Social Sciences Communications** 8, no. 1 2021: 1-15.

Raji, M. O., Sani, A. A., Ibrahim, L. S., Muhammad, H., Oladigbolu, R. A., & Kaoje, A. U. "Assessment of the knowledge of fathers, uptake of routine immunization, and its associated factors in a rural community of North West Nigeria." **Annals of African Medicine** 18, no. 2, 2019: 97.

Raufu, A. *Polio vaccine plans in Nigeria*. **British Medical Journal**, https://doi:10.1136/bmj.327.7410.380-c 2003; 327-380.

Salisbury, D. Ramsay, M. Noakes, K. *Green Book: Immunization against infectious disease 2006 edition*, 2019 http://www.dh.gov.uk/en/Policyandguidance/Healthandsocialcaretopics/Greenbook/DH_4097254

Samuelsen, H. "*Infusions of health: The popularity of vaccinations among Bissa in Burkina Faso*." **Anthropology & Medicine** 8, no. 2-3, 2020: 163–175.

Schildkrout, E. "*Dependence and autonomy: The economic activities of secluded Hausa women in Kano, Nigeria.*" **In Women and work in Africa**, pp. 55-81. Routledge, 2019.

Scobie, H.M., Edelstein, M., Nicol, E., Morice, A., Rahimi, N., MacDonald, N.E., Danovaro-Holliday, M.C. & Jawad, J. "*Improving the quality and use of immunization and surveillance data: Summary report of the Working Group of the Strategic Advisory Group of Experts on Immunization*." **Vaccine** 38, no. 46 (2020): 7183-7197.

Šeškutė, M., Tamulevičienė, E., & Levinienė, G. "*Knowledge and attitudes of postpartum mothers towards immunization of their children in a Lithuanian tertiary teaching hospital*." **Medicina** 54, no. 1 2018: 2.

Shadmi, E., Chen, Y., Dourado, I., Faran-Perach, I., Furler, J., Hangoma, P., Hanvoravongchai, P., Obando, C., Petrosyan, V., Rao, K.D., Ruano, A.L. Shi, L., de Souza, L. E., Spitzer-Shohat, S., Sturgiss, E., Suphanchaimat, R., Uribe, M. V., & Willems, S. "*Health equity and COVID-19: global perspectives*." **International journal for equity in health** 19, no. 1 2020: 1-16.

Shea, B. Neil, A. & David, H. "*Increasing the demand for childhood vaccination in developing countries: A systematic review*." **BMC International Health and Human Rights** 9, no. S1 2018.

Sule, B., Ibrahim, B. S. A., & Adamu, M. Y. "*The Politics of Regional Security Threat in Nigeria.*" **SINERGI: Journal of Strategic Studies & International Affairs** 2, no. 1 2022: 48-75.

Tal, O., Ne'eman, Y., Sadia, R., Shmuel, R., Schejter, E., & Bitan, M. "*Parents' attitudes toward children's vaccination as a marker of trust in health systems*." **Human Vaccines & Immunotherapeutics** 17, no. 11 2021: 4518-4528.

Uba, B.V., Waziri, N.E., Akerele, A., Biya, O., Adegoke, O.J., Gidado, S., Ugbenyo, G., Simple, E., Usifoh, N., Sule, A. & Kibret, B. "*Strengthening facility-based immunization service delivery in local government areas at high risk for polio in Northern Nigeria, 2014-2015.*" **The Pan African Medical Journal** 40, no. Suppl 1 2021.

Uneke, C. J., Obeka, I., Uneke, B. I., Umeokonkwo, A., Nweze, C. A., Otubo, K. I., & Uguru, O. E. "*The potential role of patent and proprietary medicine vendors' associations in improving the quality of services in Nigeria's drug shops*." **BMC health services research** 20 2020: 1-12.

Uwaibi, N. E. *Determinants of full vaccination status in children attending immunization clinic in a tertiary hospital in Benin City, Nigeria*. **J. Appl. Sci. Environ. Manage**. Vol. 24 (8) 2020 1383-1390

Uzochukwu, B., Onwujekwe, E., Mbachu, C., Okeke, C., Molyneux, S., & Gilson, L. "*Accountability mechanisms for implementing a health financing option: the case of the basic health care provision fund (BHCPF) in Nigeria*." **International journal for equity in health** 17 2018: 1-16.

Van De Pas, R., Widdowson, M. A., Ravinetto, R., N Srinivas, P., Ochoa, T. J., Fofana, T. O., & Van Damme, W. "*COVID-19 vaccine equity: a health systems and policy perspective*." **Expert review of vaccines** 21, no. 1 2022: 25-36.

Vecchiato, N. L. "*Sociocultural aspects of tuberculosis control in Ethiopia*." **Medical Anthropology Quarterly** 11, no. 2, 2018: 183–201.

Verulava, T., Jaiani, M., Lordkipanidze, A., Jorbenadze, R., & Dangadze, B. "*Mothers' knowledge and attitudes towards child immunization in Georgia*." **The Open Public Health Journal** 12, no. 1, 2019: 232–237.

Verulava, T., Jaiani, M., Lordkipanidze, A., Jorbenadze, R., & Dangadze, B. "*Mothers' knowledge and attitudes towards child immunization in Georgia*." **The Open Public Health Journal** 12, no. 1 2019.

Victoria, T.O., Omole, M.S., JP, F.A.B., Miller, W.A., Olaniyan, A.O., Olanrewaju, S.A., Omolayo, A.C. and Adediji, P. O. "*Factors Influencing Routine Immunization Uptake among Nursing Mothers Attending Primary Health Centres in Ibadan Southeast Local Government.*" **American Journal of Pediatric Medicine and Health Sciences (2993-2149)** 1, no. 6 2023: 109-124.

Ward, K., Stewart, S., Wardle, M., Sodha, S.V., Tanifum, P., Ayebazibwe, N., Mayanja, R., Luzze, H., Ehlman, D.C., Conklin, L. & Abbruzzese, M. "*Building health workforce capacity for planning and monitoring through the Strengthening Technical Assistance for routine immunization training (START) approach in Uganda*." **Vaccine** 37, no. 21 2019: 2821-2830.

Yarnoff, B., Kim, D., Zhou, F., Leidner, A. J., Khavjou, O., Bates, L., & Bridges, C. B. "*Estimating the costs and income of providing vaccination to adults and children*." **Medical Care** 57, no. 6 2019: 410-416.

Zuber, P. L., Conombo, K. G., Traore, A. D., Millogo, J. D., Ouattara, A., Ouedraogo, I. B., & Valian, A. *Mass measles vaccination in urban Burkina Faso*, Bulletin of the world Health Organization, WHO,79(4) 2021:296-300.

Internet

Alouf. J. "From 'diphtheritic' poison to molecular toxicology, Am SocMicrobiol News, 1987, vol. 53 (pg. 547-550) http://www.asm.org/ASM/files/CCLIBRARYFILES/FILENAME/0000000240/531087p547.pdf

Fominyen, G. "*Volcanic ash delays west african polio vaccination*." Thomson Reuters, April 20, 2010. Last modified April 20, 2010. Accessed January 24, 2023. https://www.reuters.com/article/us-polio-vaccination-idUKTRE63J5L120100420.

James Lind Institute. Benefits of immunization. https://www.jliedu.com/blog/benefits-immunization,2019. accessed on the 08-06-2022.

Nigeria: Summary Document: Making 'Reaching Every District Operational."
https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=12320&lid=3

Salisbury, D. Ramsay, M. & Noakes, K. "Figure 26.1 from Immunisation against Infectious Disease: Semantic Scholar." https://www.semanticscholar.org/paper/Immunisation-against-infectious-disease-Salisbury-Ramsay/ee69ddfb9d512348164b4da67c1dbbc9bbf62a91/figure/56.

Tikkanen. 2020. *Immunization*. 2021. https://www.britannica.com/science/immunization

World Health Organization. "*Defining competent maternal and newborn health professionals: background document to the 2018 joint statement by WHO, UNFPA, UNICEF, ICM, ICN, FIGO and IPA: definition of skilled health personnel providing care during childbirth*." 2018.

World Health Organization. "*Universal health coverage partnership annual report 2019: in practice: bridging global commitments with country action to achieve universal health coverage*." 2020.

World Health Organization. *Delivering global health security through sustainable financing: 26-27 July 2017, Seoul, Republic of Korea*. No. WHO/WHE/CPI/2018.38. World Health Organization, 2018.

Book.

Expert Review Committee (ERC). Nigeria's campaign to increase acceptance of routine and polio immunization services, 2019.

Federal Ministry of Health. *Saving newborn lives in Nigeria: Newborn health in the context of the Integrated Maternal, Newborn and Child Health Strategy*. 2nd edition, Federal Ministry of Health 2019; 8-16.

Ministry of Health and Family Welfare, Government of India. Immunization handbook for medical officers, India, 2018: 107-116.

National Population Commission and Bereau of statistics Estimates 2017.

National Population Commission-NPC/Nigeria and ICF. Nigeria Demographic and Health Survey 2018, Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.

Nigeria Population Commission. *Nigeria demographic and health survey 2018*. NPC, ICF, 2019.

Nigeria Strategy for Immunisation and PHC System Strengthening [NSIPSS] 2018 – 2028 Final Draft April 18, 2018

Olive, J. M. & Aylward, B. Poliovirus vaccine. World Health Bulletin 2019; 77:194.

Yamane, Y. Mathematical Formula for Sample size Determination, 1967.

Informed Consent

Title of Study

Knowledge, Attitude and Adherence to Routine Childhood Immunizaton among Mothers in Agwara Lga, Niger State

Principal Investigator

Salihu Usman Shehu

Public Health Department, Leadcity University

Leadcity University, Toll Gate, Ibadan,

+2348054056500

usmandansalihui@gmail.com

Purpose of Study

My name is SalihuUsman Shehu, a master of public health student at the Faculty of public health, Lead city University, Ibadan. I am conducting a study on the "Knowledge, attitude and adherence to routine childhood immunization in Agwara LGA Niger state

I am interested in understanding the level of knowledge on routine childhood immunization among mothers. I want to assess the attitude of mothers towards routine childhood immunization. I will also want to assess the level of mothers adherence to routine childhood immunization I will greatly appreciate your participation in my study. Your insight will assist me assess on the level of knowledge and adherence to routine childhood immunization among mothers in Agwara LGA Niger state.

Research Procedure

If you accept to be part of this study, you will be asked to answer questions about yourself as well as questions about the Knowledge, attitude and adherence to routine childhood immunization. To fill the questionnaire will take about 5 to 10 minutes of your time.

Risks and Benefits

There are minimum or no risks if you take part in this study. There are also no incentives but the information you provide will help to give you more insight on routine childhood immunization

Compensation

There is no monetary compensation or incentive for this study. Participation is voluntary.

Confidentiality

Like it is stated above, your comments will be anonymous. Every effort will be made by the researcher to preserve your confidentiality. Confidentiality and privacy will be maintained by keeping all materials under lock and key. Your name and identity will not be recorded.

Contact Information

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the Primary Investigator, please contact the Institutional Review Board at

Voluntary Participation

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a

reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

Consent

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Department Public Health

Faculty of Basic medical and applied science

Lead City University, Ibadan, Oyo State

Questionnaire

Dear respondent,

The researcher is a postgraduate student of the Department of public health, Lead City University, Ibadan. In partial fulfillment of the requirements for the award of Master of Science [MSc] in Public health; the researcher is conducting a study on Knowledge, attitude and adherence to routine childhood immunization among mothrs in Agwara LGA, Niger State. This questionnaire is therefore designed to elicit information in relation to the variables being studied.

Your responses to the question items below shall be highly appreciated, treated confidentially and used strictly for academic purposes. Kindly fill them as appropriate.

Thank you for your anticipated cooperation.

Section A: Socio-Demographic Information

1. **Age:** ……..
2. **Academic Qualification:** No Formal Education [ ] Primary [ ] Secondary [ ] Higher [ ]
3. **Religion:** Islam [ ] Christianity [ ] Traditional [ ] Other [ ]
4. **Marital Status:** Single [ ] Married [ ] Divorced [ ] Widowed [ ] Separated [ ]
5. **Family Type:** Monogamous [ ] Polygamous [ ]
6. **Occupation:**

Professional / Managerial [ ]

Clerical Job [ ]

Sales and Services [ ]

Skills Manual Job [ ]

Unskilled Manual Job [ ]

Agricultural [ ]

Housewife [ ]

Others, Pls. specify ____

7. Partner's Age……..

8. Partner's Academic Qualification: No Formal Education [ ] Primary [ ] Secondary [ ] Higher [ ]

9. Partner's Occupation:

Professional / Managerial [ ]

Clerical Job [ ]

Sales and Services [ ]

Skills Manual Job [ ]

Unskilled Manual Job [ ]

Agricultural [ ]

Housewife [ ]

Others, Pls. specify ____

10. How many children have you ever had?.....

11. How many living children do you have?

12. Age at first marriage……

13. Age at first birth……..

14. Age of last child……

Section B: Knowledge of the Mothers on Immunization.

Instruction**:** Please tick (✓) in the appropriate column that suits your response in the following statements. Yes, and No

S/n	Statement	Yes	No	Don't Know
7.	Immunization is the process by which an individual's immune system becomes fortified against an infectious agent through vaccination			
8.	Vaccination is the process of introducing a vaccine into the body to produce protection from a specific disease			
9.	Vaccine is a preparation that is used to stimulate the body's immune response against disease			
10.	Immunization helps to prevent childhood diseases			
11.	Immunization can cause infertility later in life			
12.	Childhood immunization is safe for children			
13.	Immunization prevents all childhood diseases			
14.	Vaccine treatable diseases are tuberculosis, diphtheria, tetanus, measles, yellow fever, cholera and pertussis (whooping cough)			

15.	It is important for a child to be taken to a health facility to complete his/her routine immunization			
16.	Childhood vaccines do have side effect that are harmful to the child			
17.	Getting multiple shots in one visit can overload a child's immune system			
18.	Routine immunization is sufficient to reach all children for immunization			
19.	Area of residence of mother/caregiver to health centres could affect the adoption of immunization			

Section C: Attitude of Mothers to Immunization

Instruction: Please tick (✓) in the appropriate column to indicate the extent to which you agree or disagree with the statements below: A- Agree, D- Disagree, NS- Not sure

S/N	Statement	A	D	NS
20.	Bringing my child for immunization is a waste of time			
21.	I do take my Child for immunization early			
22.	I prioritize my Child's immunization over other activities			

23.	Babies can be left without vaccination if they look healthy			
24.	I like to complete my Child's immunization			
25.	I always forget my Child's immunization Schedule			
26.	I always keep my Child's immunization card			
27.	I need a reminder for my Child's next appointment			
28.	I can produce my child's immunization card when needed			
29.	I always immunize my Child at the specified time			
30.	Fear of child illness after immunization does not allow me bring my child for immunization			
31.	The fear of side effects or adverse effect doesn't allow me take my Child for immunization			

Section D: Investigate the Level of Adherence to Routine Childhood Immunizations among Mothers

Instruction: Please tick (✓) in the appropriate column

32. Is there evidence of immunization card? Yes [ ] No [ ]

33. Number of visits in the immunization card…….

34. Did the child complete the immunization schedule? Yes [ ] No [ ]

35. If no, what delay you in completing your child immunization?

i. The vaccine is not available [ ]

ii. Poorly trained medical staff [ ]

iii. Distrust in vaccine and immunization program [ ]

iv. Distance to access point [ ]

v. No money [ ]

Immunization Card Observational check list- Ask for the child card

Date……..

Date of Birth

Child's Age (in months)……..

S/N	Vaccine	Check
1.	**BCG**	
2.	**HepB-0**	

3.	**OPV-0**	
4.	**OPV-1**	
5.	**PCV-1**	
6	**Penta-1**	
7.	**OPV-2**	
8.	**PCV-2**	
9.	**Penta-2**	
10.	**OPV-3**	
11.	**PCV-3**	
12.	**Penta-3**	
13.	**Measles1**	

Usman Shehu Salihu
Biodata

A. Personal Data

Name:	Usman Shehu Salihu
Home Address:	Agwara Road.
Email Address:	usmandansalihu@gmail.com
Phone Number:	08054056500
Date of Birth:	November 2nd, 1980
Nationality:	Nigerian
Marital Status: Single	Married
Sex:	Male

B. Educational Background with Dates

Primary School Leaving Certificate 1992

Central Primary School, Babanna

Teachers grade 11 certificates 1998

Teachers' college, Babanna

Diploma in community health (CHEW) 2002

School of health technology, Jega

Diploma in social development 2007

College of basic and advance studies

Bachelor of Science; (Sociology) 2011

Usman Danfodio University Sokoto

Bachelor in Public Health (Conversion) 2020-2022

Jama'atu college of Health sciences

Masters of Public Health *2022-current*

Lead City University, Ibadan, Ibadan, Oyo State

C. Work Experience with Dates

LIO.Agwara LGA Niger state 2018-till date

Local govt immunization officer

- I oversee and manage all aspects of the local government's immunization programs, including routine childhood immunization, supplementary immunization activities (SIAs), and vaccination campaigns.
- I coordinate the procurement, distribution, and maintenance of vaccines and related supplies to ensure an adequate and continuous vaccine supply within the local government area.

Agwara LGA

Cold Chain Officer

- I oversee the entire cold chain system, including storage, transportation, and monitoring of vaccines and temperature-sensitive medical supplies.
- I conduct regular inspections of cold storage units to verify the quality and integrity of stored vaccines. Implement corrective actions to address temperature excursions and equipment failures

W.H.O. Niger

State technical facilitator on Immunization

- I provide technical assistance and guidance to state health authorities in the planning, implementation, and monitoring of immunization programs, ensuring alignment with national and global vaccination strategies.
- I help advocate for the importance of immunization through engagement with key stakeholders, including government officials, community leaders, and healthcare providers. Promote vaccination as a public health priority

W.H.O. Niger

BCI focal person

- I help to conduct audience research and segmentation to better understand the behaviors, attitudes, and communication preferences of the target population. Use insights to inform BCI planning.
- I coordinate and execute BCI campaigns, ensuring timely implementation and monitoring of activities. Collaborate with cross-functional teams to achieve campaign goals.

Abarshi secondary school yauri 2013

Laboratory Assistant (NYSC)

- Cleaned and sanitized equipment and workstation in compliance with health and safety regulations.
- Demonstrated competence in collecting lab samples for testing.
- Properly calibrated and adjusted equipment to achieve precise test results.
- Created and updated record of all supplies and equipment to monitor inventory.

Awards

1. President drug free club for NYSC member Yauri zone, year 2013.

2.Award as number three best L.I.O in Niger state in the year 2019

Extra-Curricular Activities: Reading, Farming and Travelling

Name and Address of Referee:

1. Barmani Aliyu

WHO LF Minna

08037756144

2.Alh. Audu salihu.

Zonal director PHC Borgu and Agwara

08054506190, 08023320505.

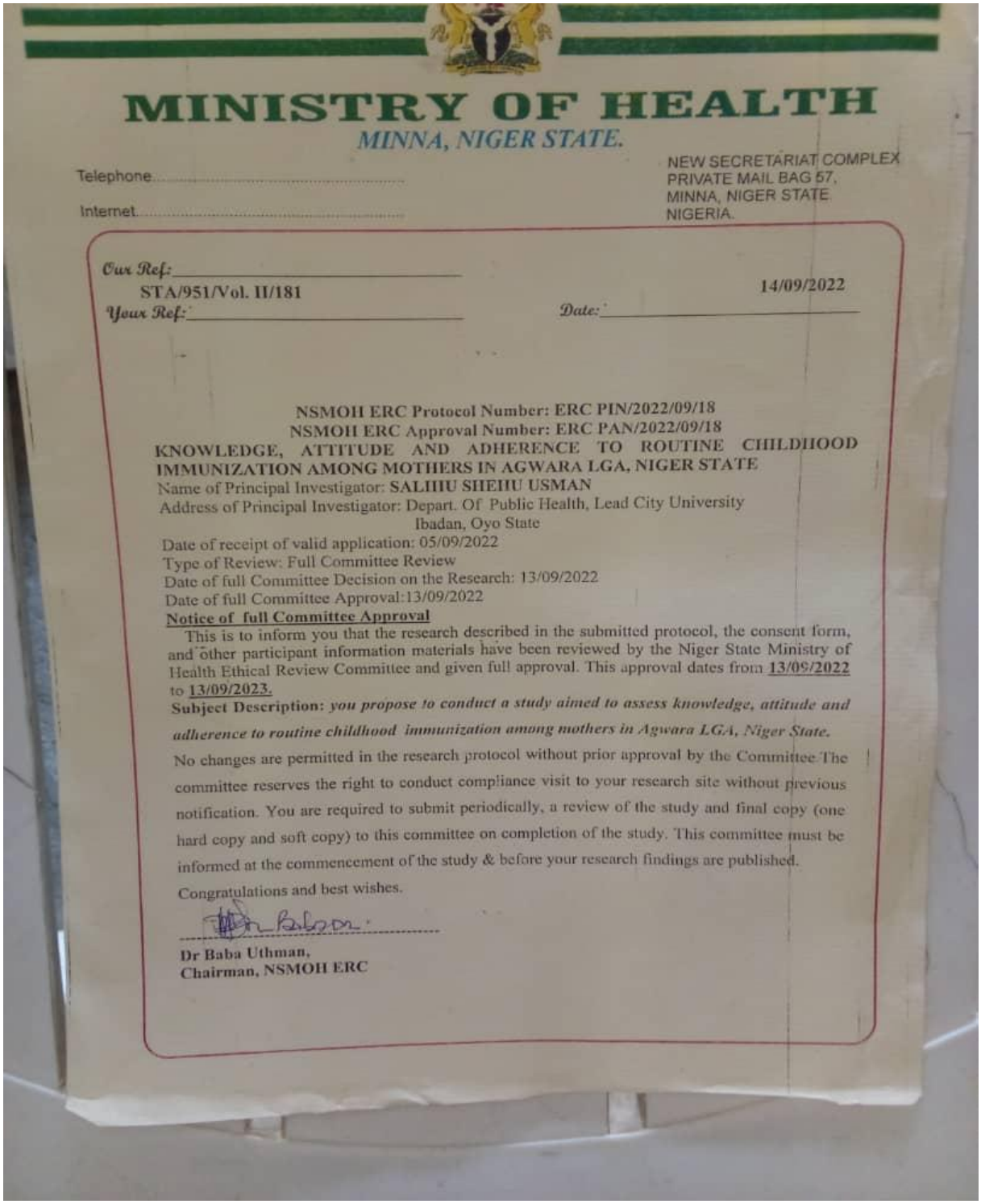
3.Mustapha salihu

Agwara LGA education authority

08053606753

_____ _____

Signature Date



MINISTRY OF HEALTH

MINNA, NIGER STATE.

Telephone.....

Internet.....

NEW SECRETARIAT COMPLEX
PRIVATE MAIL BAG 57,
MINNA, NIGER STATE
NIGERIA.

Our Ref: STA/951/Vol. II/181

Your Ref:

Date: 14/09/2022

NSMOH ERC Protocol Number: ERC PIN/2022/09/18
NSMOH ERC Approval Number: ERC PAN/2022/09/18

KNOWLEDGE, ATTITUDE AND ADHERENCE TO ROUTINE CHILDHOOD IMMUNIZATION AMONG MOTHERS IN AGWARA LGA, NIGER STATE

Name of Principal Investigator: **SALIHU SHEHU USMAN**
Address of Principal Investigator: Depart. Of Public Health, Lead City University Ibadan, Oyo State
Date of receipt of valid application: 05/09/2022
Type of Review: Full Committee Review
Date of full Committee Decision on the Research: 13/09/2022
Date of full Committee Approval:13/09/2022

Notice of full Committee Approval

This is to inform you that the research described in the submitted protocol, the consent form, and other participant information materials have been reviewed by the Niger State Ministry of Health Ethical Review Committee and given full approval. This approval dates from **13/09/2022** to **13/09/2023.**

Subject Description: ***you propose to conduct a study aimed to assess knowledge, attitude and adherence to routine childhood immunization among mothers in Agwara LGA, Niger State.***

No changes are permitted in the research protocol without prior approval by the Committee The committee reserves the right to conduct compliance visit to your research site without previous notification. You are required to submit periodically, a review of the study and final copy (one hard copy and soft copy) to this committee on completion of the study. This committee must be informed at the commencement of the study & before your research findings are published.

Congratulations and best wishes.

Dr Baba Uthman,
Chairman, NSMOH ERC

University Compliance Certification

This is to certify that this thesis by Usman Shehu SALIHU with Matric No. LCU/PG/002455in the Department of Public Health, Faculty of Basic Medical and Applied Sciences, Lead City University, Ibadan is in full compliance with the approved university format.

_____ _____

Signature **Date**