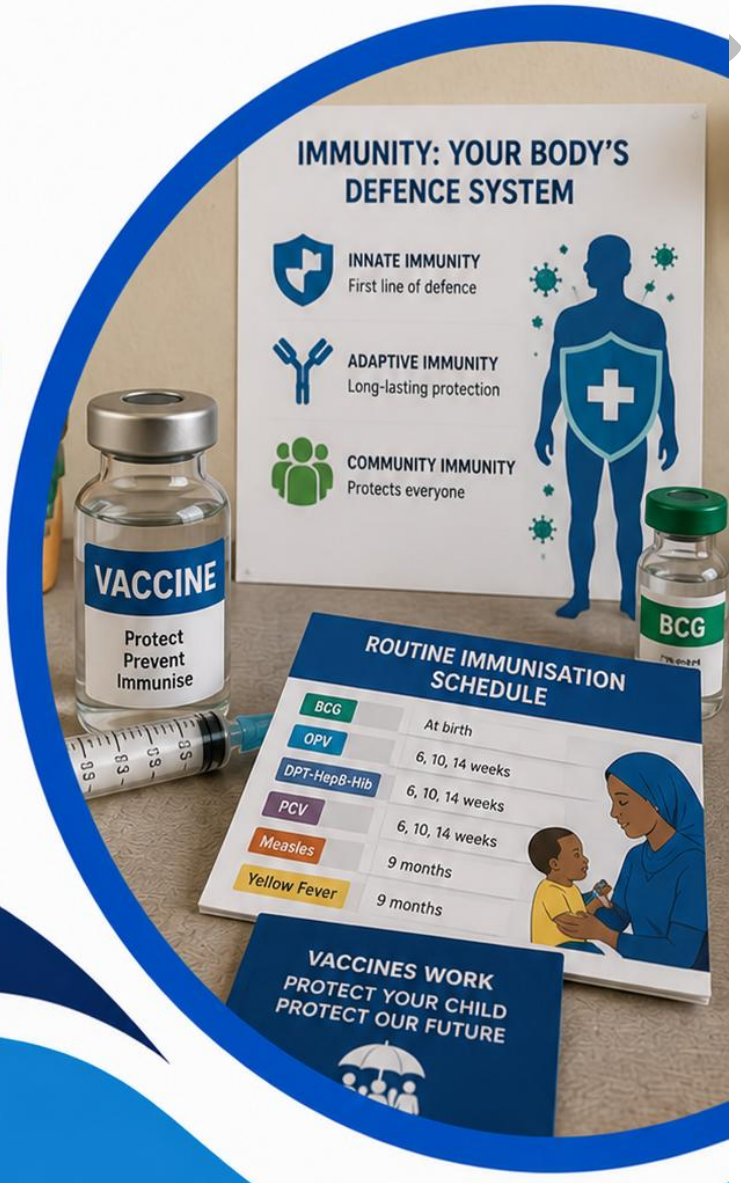
La-Net

COM 409

IMMUNITY AND IMMUNISATION PROGRAMME



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Course code: COM 409

Course title: Immunity and Immunisation Programme

Course credit load: 1 Unit

Series 1: Concepts of Immunity and Immunisation

- **Part 1.1: Definitions and Types of Immunity**
  - Sub Part 1.1.1: Definition of immunity
  - Sub Part 1.1.2: Innate and adaptive immunity
  - Sub Part 1.1.3: Active and passive immunity
- **Part 1.2: Immunisation and Vaccination**
  - Sub Part 1.2.1: Definition and distinction between immunisation and vaccination
  - Sub Part 1.2.2: Types of vaccines
  - Sub Part 1.2.3: Mechanisms of vaccine-induced protection
- **Part 1.3: Herd Immunity and Its Public Health Significance**
  - Sub Part 1.3.1: Definition and concept of herd immunity
  - Sub Part 1.3.2: Herd immunity thresholds for key diseases
  - Sub Part 1.3.3: Challenges to achieving herd immunity in Nigeria

Introduction

Immunity is the foundation upon which immunisation programmes are built. Before one can appreciate why vaccines work, how they should be delivered, or why some communities remain vulnerable to outbreaks despite vaccination programmes, one must first understand what immunity is and how the body acquires and maintains it. These biological concepts translate directly into public health practice, determining how immunisation schedules are designed and why herd immunity is a programme goal, not merely an outcome.

The aim of this Series is to define immunity and its types, distinguish immunisation from vaccination, describe the major types of vaccines and their mechanisms, and explain the concept of herd immunity and its significance for Nigeria public health practice.

We shall commence by defining immunity and examining innate, adaptive, active, and passive forms. Next, we will examine immunisation and vaccination, including vaccine types and mechanisms. Finally, we will close by examining herd immunity, its thresholds for key diseases, and the challenges of achieving it in Nigeria.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 1.1** define immunity and distinguish between its major types,
- **SLO 1.2** distinguish between immunisation and vaccination,
- **SLO 1.3** describe the major types of vaccines and explain how they induce protective immunity,
- **SLO 1.4** define herd immunity and state the threshold required for key vaccine-preventable diseases, and
- **SLO 1.5** identify the challenges to achieving herd immunity in Nigeria.

1.1 Definitions and Types of Immunity

1.1.1 Definition of immunity

Immunity is the ability of an organism to resist a specific infectious disease by deploying biological mechanisms that prevent pathogens from invading, proliferating, or causing harm. In humans, this capacity is provided by the immune system, a complex network of cells, tissues, and molecular signals distributed throughout the body. Immunity may be complete (providing full protection against infection) or partial (reducing the severity or duration of illness without preventing infection entirely).

From a public health perspective, immunity is significant not only at the individual level but at the population level: when a sufficient proportion of a community is immune, the transmission chain of an infectious agent is interrupted, protecting even non-immune individuals. This population-level protection, known as herd immunity, is the primary goal of national immunisation programmes and determines the vaccination coverage targets that programmes must achieve to prevent outbreaks.

Fill in the blank: Immunity is the ability of an organism to _____ a specific infectious disease by deploying biological mechanisms that prevent pathogens from invading, proliferating, or causing harm.

1.1.2 Innate and adaptive immunity

Innate immunity is the first line of defence against pathogens, present from birth and responding rapidly but non-specifically to any foreign substance. It includes physical barriers (skin and mucous membranes), chemical barriers (stomach acid, antimicrobial proteins), cellular components (neutrophils, macrophages, natural killer cells), and the inflammatory response. Innate immunity does not improve with repeated exposure and does not produce immunological memory, but it is essential for immediate containment of infection while adaptive responses develop.

Adaptive (acquired) immunity is the second line of defence, developing over days following initial pathogen exposure. It involves B lymphocytes (which produce pathogen-specific antibodies) and T lymphocytes (which kill infected cells and regulate immune responses). Its defining feature is immunological memory: after first exposure, the immune system retains antigen-specific memory cells that enable a faster, stronger response upon re-exposure. This memory is the biological basis of both natural immunity from prior infection and vaccine-induced immunity.

Fill in the blank: _____ immunity involves B and T lymphocytes, develops over days after pathogen exposure, and produces immunological memory enabling a faster, stronger response upon re-exposure.

1.1.3 Active and passive immunity

Active immunity is acquired when a person own immune system mounts a response against a pathogen or its antigens, producing antibodies and memory cells. It can be acquired naturally, through infection with a pathogen (natural active immunity), or artificially, through vaccination with an antigen preparation that stimulates the immune system without causing disease (artificial active immunity). Active immunity is generally long-lasting because it involves immune memory, though the duration varies by disease and vaccine type.

Passive immunity is acquired when pre-formed antibodies from another individual or source are transferred to a recipient, conferring immediate but temporary protection. Natural passive immunity occurs when maternal IgG antibodies cross the placenta to protect the foetus, and when secretory IgA is transferred through breast milk. Artificial passive immunity is provided through administration of immune globulin or antitoxin (for example, tetanus immunoglobulin after a contaminated wound). Passive immunity lasts only weeks to months, as transferred antibodies are gradually catabolised.

Fill in the blank: _____ passive immunity occurs when maternal IgG antibodies cross the placenta to protect the foetus, providing the newborn with temporary protection against diseases the mother is immune to.

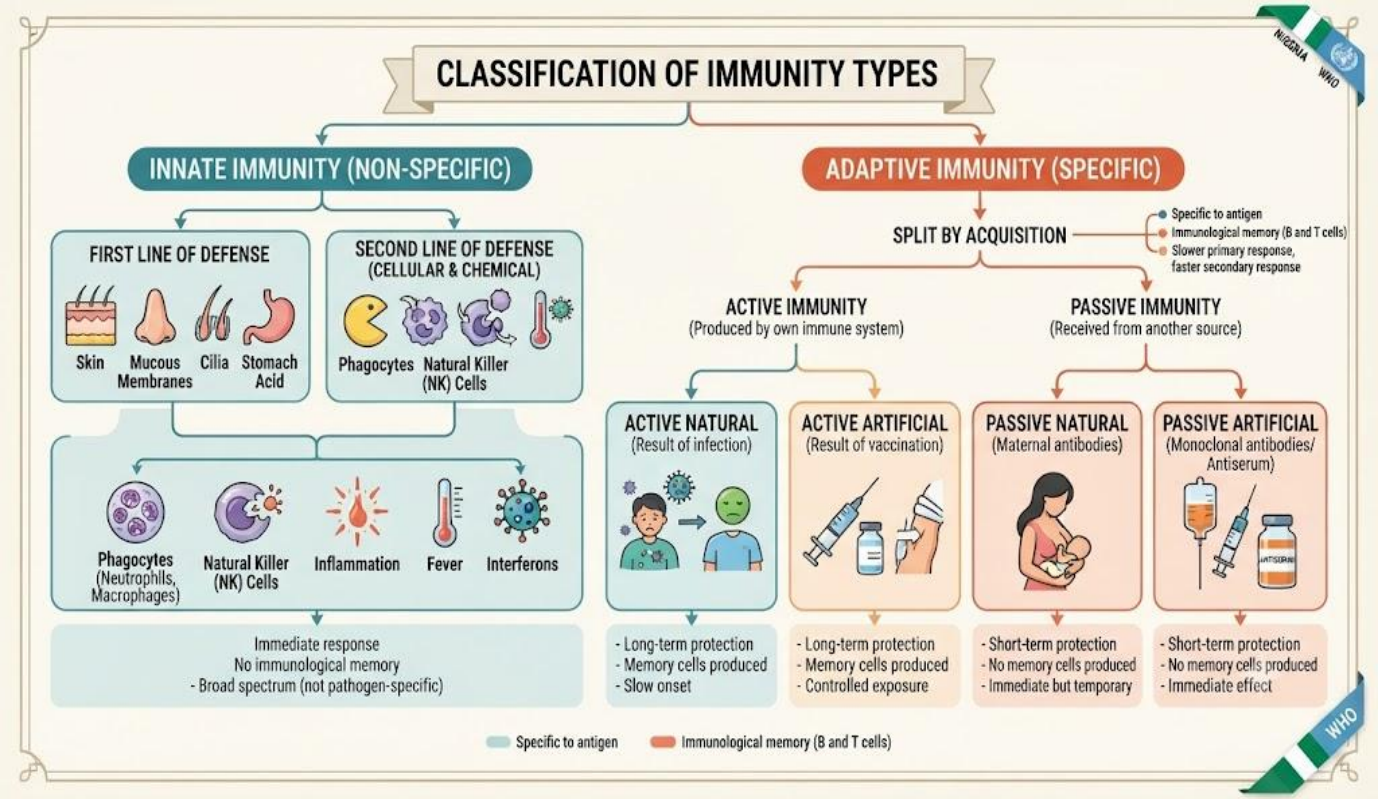

Figure 1.1: Types of immunity and their characteristics

Pilot questions 1.1

1. Define immunity.
2. Distinguish between innate and adaptive immunity.
3. What is immunological memory and why is it significant?
4. Distinguish between active and passive immunity.
5. Give one example each of natural active immunity and natural passive immunity.

1.2 Immunisation and Vaccination

1.2.1 Definition and distinction between immunisation and vaccination

Vaccination is the administration of a vaccine, a biological preparation containing antigens derived from a pathogen, into a person body to stimulate an immune response. Immunisation is

the process by which a person becomes immune to a disease, either through vaccination or through natural infection. The two terms are often used interchangeably but are technically distinct: vaccination is the act of administering the vaccine; immunisation is the outcome, the development of protective immunity following that act.

Not every vaccination results in immunisation. A person may be vaccinated but fail to mount an adequate immune response due to factors such as immunosuppression, cold chain failures that have compromised vaccine potency, improper administration technique, or pre-existing immunity that masks the response. Conversely, immunisation can occur without vaccination, through natural infection. In public health reporting, vaccination coverage (the proportion vaccinated) and immunisation coverage (the proportion protected) may therefore differ, though vaccination coverage is more routinely measured.

Fill in the blank: _____ is the act of administering a vaccine, while immunisation is the outcome, the development of protective immunity that may follow that act.

1.2.2 Types of vaccines

Vaccines are classified by their composition and method of antigen presentation. Live attenuated vaccines contain a weakened form of the live pathogen that can replicate but does not cause disease in immunocompetent individuals, producing a strong, long-lasting immune response closely resembling natural infection (examples: measles, mumps, rubella, oral polio vaccine, BCG, yellow fever). Inactivated vaccines contain killed pathogen or purified components, are generally safer for immunocompromised individuals, but typically require multiple doses and booster shots (examples: injectable polio vaccine, hepatitis A, seasonal influenza).

Subunit, recombinant, and conjugate vaccines contain only specific antigens or antigen fragments, reducing the risk of side effects while still inducing specific immunity (examples: hepatitis B, HPV, meningococcal conjugate, pneumococcal conjugate). Toxoid vaccines contain inactivated bacterial toxins, inducing immunity against the toxin rather than the organism itself (examples: tetanus and diphtheria toxoids). mRNA vaccines, introduced prominently during the COVID-19 pandemic, deliver genetic instructions for antigen production, representing a new class with rapid production potential and no risk of live pathogen exposure.

Fill in the blank: Live _____ vaccines contain a weakened form of the live pathogen that can replicate but does not cause disease, producing a strong, long-lasting immune response resembling natural infection.

1.2.3 Mechanisms of vaccine-induced protection

Vaccines protect through three primary mechanisms. First, by stimulating the production of pathogen-specific antibodies (humoral immunity) that neutralise the pathogen or mark it for destruction before it can infect cells. Second, by activating cytotoxic T cells (cellular immunity) that identify and destroy cells already infected with the pathogen, particularly important for viruses that replicate intracellularly. Third, by establishing immunological memory, ensuring that upon subsequent exposure to the pathogen, the immune response is faster and stronger, typically preventing disease or limiting its severity.

The immune response to vaccination follows the same kinetics as the primary and secondary responses to natural infection. The primary response after a first vaccine dose produces a modest antibody rise after 7 to 14 days. Subsequent doses (or booster doses) trigger a secondary (anamnestic) response, producing a rapid, high-magnitude antibody rise. This is why multi-dose vaccine schedules are essential for achieving protective antibody titres: the second and subsequent doses are not redundant but are biologically necessary to achieve durable protection.

Fill in the blank: Vaccines protect through stimulating antibody production (humoral immunity), activating cytotoxic T cells (cellular immunity), and establishing immunological _____ that enables a faster, stronger response upon subsequent pathogen exposure.

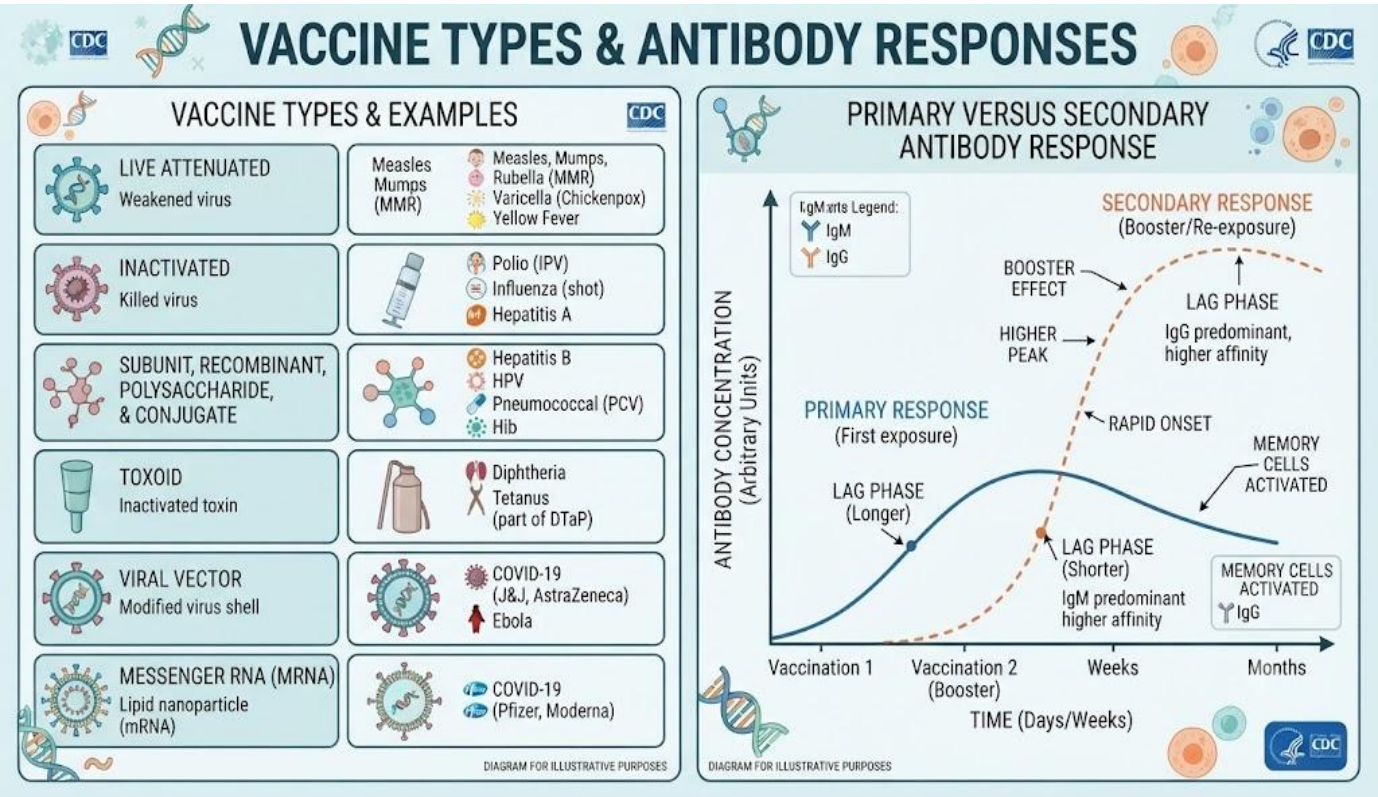

Figure 1.2: Vaccine types and mechanisms of vaccine-induced immunity

Pilot questions 1.2

1. Distinguish between vaccination and immunisation.
2. Name three reasons why vaccination may not result in immunisation.
3. Name five types of vaccine and give one example of each.
4. Why are live attenuated vaccines generally more immunogenic than inactivated vaccines?
5. Why are multiple doses necessary for some vaccines?

1.3 Herd Immunity and Its Public Health Significance

1.3.1 Definition and concept of herd immunity

Herd immunity (also called population immunity or community immunity) is the indirect protection conferred on non-immune members of a population when a sufficiently large proportion of that population is immune to an infectious disease. When enough individuals are

immune, the pathogen cannot find enough susceptible hosts to sustain transmission, and the chain of infection breaks down. This protects individuals who cannot be vaccinated, including newborns too young for certain vaccines, pregnant women for whom some vaccines are contraindicated, and immunocompromised individuals.

The herd immunity threshold (HIT) is the proportion of the population that must be immune to interrupt sustained disease transmission. It is mathematically derived from the basic reproduction number R_0, the average number of secondary infections caused by one infected individual in a fully susceptible population: $HIT = 1 - (1/R_0)$. The higher the transmissibility of a disease (higher R_0), the greater the proportion that must be immune to achieve herd immunity. Herd immunity does not mean zero transmission but rather that transmission cannot be sustained and outbreaks cannot propagate.

Fill in the blank: The herd immunity threshold is mathematically derived from R_0, the basic reproduction number, using the formula $HIT = 1 - (1/R_0)$; diseases with higher _____ require greater population immunity to interrupt sustained transmission.

1.3.2 Herd immunity thresholds for key diseases

The herd immunity threshold varies substantially across diseases depending on their transmissibility. Measles, one of the most contagious human diseases with an R_0 of 12 to 18, requires a vaccination coverage of approximately 95% to achieve herd immunity, making it the most demanding vaccine-preventable disease from a coverage perspective. Polio requires approximately 80 to 85% coverage. Mumps and rubella require approximately 85 to 92%. Seasonal influenza, with its lower R_0 of 2 to 3, requires only approximately 33 to 44% coverage.

COVID-19 presented a complex and evolving herd immunity picture: the original SARS-CoV-2 strain had an estimated R_0 of 2 to 3, but subsequent variants, particularly Delta and Omicron, had substantially higher transmissibility (R_0 estimates of 5 to 7 and 15 or more respectively), raising herd immunity thresholds beyond what vaccine coverage alone could achieve in the context of waning vaccine immunity. This experience demonstrated that herd immunity thresholds are not fixed but vary with pathogen evolution and the durability of vaccine-induced immunity.

Fill in the blank: Measles, with an R_0 of 12 to 18, requires approximately _____ % vaccination coverage to achieve herd immunity, making it the most demanding vaccine-preventable disease from a coverage perspective.

1.3.3 Challenges to achieving herd immunity in Nigeria

Achieving and sustaining herd immunity in Nigeria faces several overlapping challenges. Routine immunisation coverage for all antigens in the national schedule remains below 50% nationally, far below the thresholds required for most vaccine-preventable diseases. Geographic disparities are pronounced: northern states consistently record lower coverage than southern states, with some local government areas reporting coverage well below 30%. This spatial heterogeneity creates pockets of susceptible individuals where outbreaks can ignite and sustain, even when national average coverage appears more adequate.

Vaccine hesitancy, driven by misinformation, religious concerns, and historical distrust of immunisation campaigns (particularly following the 2003 northern Nigeria polio vaccine boycott), continues to reduce demand for vaccines in some communities. Cold chain failures, stockouts, insufficient health workforce, and poor facility infrastructure compromise supply. Nomadic and displaced populations, conflict-affected communities in the north-east, and dense informal urban settlements present operational challenges for reaching all children. Addressing these challenges requires simultaneous investment across supply, demand, and system capacity dimensions.

Fill in the blank: Achieving herd immunity in Nigeria is complicated by routine immunisation coverage below _____ % nationally, geographic disparities, vaccine hesitancy, cold chain failures, and access barriers in hard-to-reach communities.

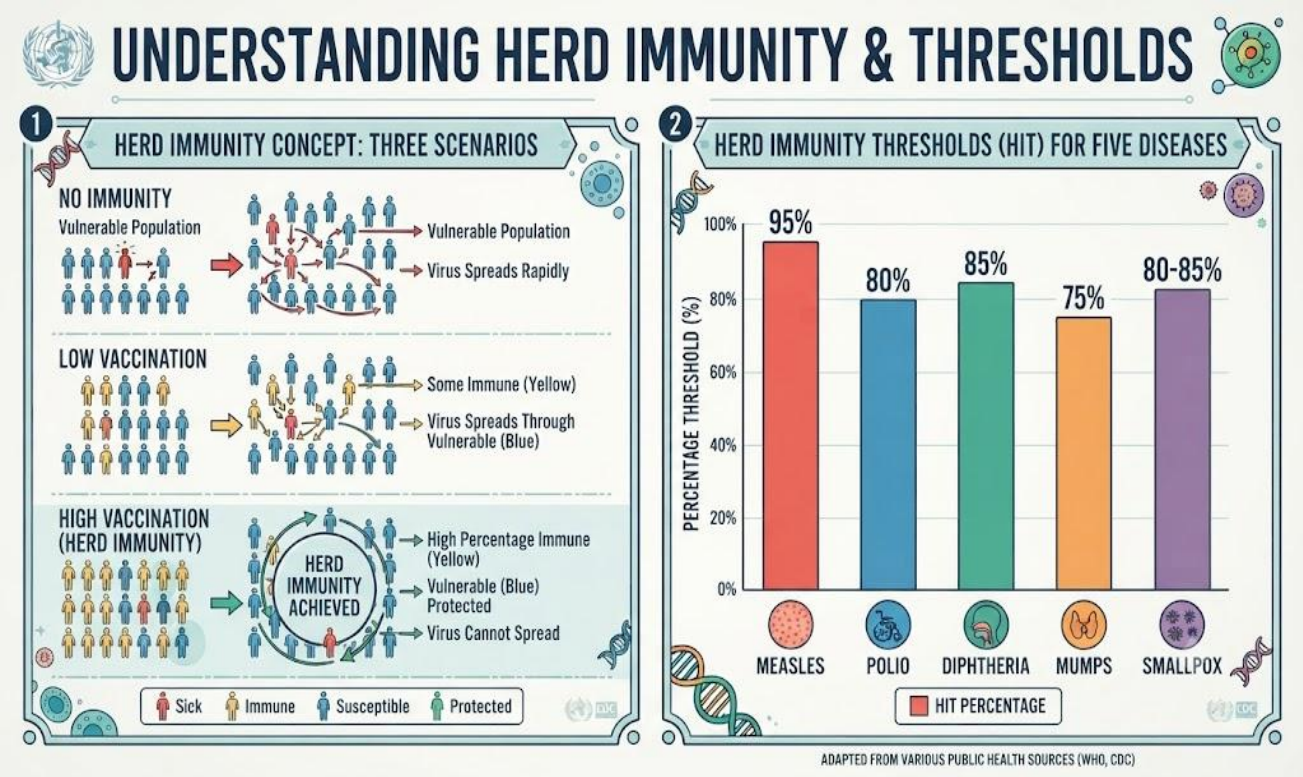

Figure 1.3: Herd immunity concept and challenges in Nigeria

Pilot questions 1.3

1. Define herd immunity.
2. Write the formula for the herd immunity threshold and explain each term.
3. What vaccination coverage is needed to achieve herd immunity against measles and why is it so high?
4. Name three challenges to achieving herd immunity in Nigeria.
5. Why does spatial heterogeneity in vaccination coverage undermine herd immunity?

Series Summary

This Series established the foundational concepts of immunity and immunisation. Immunity was defined as the capacity to resist a specific infectious disease, classified into innate (non-specific, no memory) and adaptive (specific, with memory) immunity, and further into active (self-generated, long-lasting) and passive (transferred, temporary) forms. Vaccination was distinguished from immunisation as the act versus the outcome, with the recognition that vaccine failure can prevent immunisation from following vaccination. Five vaccine types were described: live attenuated, inactivated, subunit/conjugate, toxoid, and mRNA.

Vaccine mechanisms were examined through three pathways: humoral immunity (antibody production), cellular immunity (cytotoxic T cell activation), and immunological memory. Herd immunity was defined and the mathematical relationship between R_0 and the herd immunity threshold was established, with thresholds for key diseases ranging from 33% (influenza) to 95% (measles). The Series concluded by identifying the major challenges to achieving herd immunity in Nigeria, including low routine coverage, geographic disparities, vaccine hesitancy, cold chain failures, and access barriers in marginalised communities (SLOs 1.1 to 1.5).

Glossary of Terms

- **Active immunity:** immunity produced when an individual own immune system responds to a pathogen or antigen, producing antibodies and memory cells; generally long-lasting.
- **Adaptive immunity:** the second line of immune defence involving B and T lymphocytes, antigen-specific responses, and immunological memory.
- **Herd immunity:** indirect protection conferred on non-immune individuals when a sufficiently large proportion of the population is immune, interrupting transmission chains.
- **Herd immunity threshold (HIT):** the minimum proportion of a population that must be immune to interrupt sustained disease transmission; HIT = $1 - (1/R_0)$.
- **Immunisation:** the process by which a person becomes immune to a disease, through vaccination or natural infection.

- **Immunological memory:** the adaptive immune system capacity to mount a faster, stronger response upon re-exposure to a previously encountered antigen.
- **Innate immunity:** the first line of immune defence, present from birth, non-specific, rapid, and without immunological memory.
- **Live attenuated vaccine:** a vaccine containing a weakened live pathogen that can replicate but does not cause disease, producing strong, long-lasting immunity.
- **Passive immunity:** immunity conferred by transfer of pre-formed antibodies; immediate but temporary.
- **R_0 (basic reproduction number):** the average number of secondary infections caused by one infected individual in a fully susceptible population; determines the herd immunity threshold.
- **Vaccination:** the act of administering a vaccine to stimulate an immune response.

Concept Check Questions [Series 1]

Objective questions

1. Immunity is the ability to _____ a specific infectious disease by deploying biological mechanisms against pathogens. (Linked to SLO 1.1)
2. _____ immunity involves B and T lymphocytes, produces antigen-specific responses, and generates immunological memory. (Linked to SLO 1.1)
3. _____ is the act of administering a vaccine, while immunisation is the development of protective immunity following that act. (Linked to SLO 1.2)
4. Live _____ vaccines contain a weakened pathogen capable of replicating without causing disease, producing strong, long-lasting immunity. (Linked to SLO 1.3)
5. The herd immunity threshold is calculated as HIT = $1 - (1/R_0)$; measles with an R_0 of 12 to 18 requires approximately _____ % coverage. (Linked to SLO 1.4)
6. Routine immunisation coverage in Nigeria remains below _____ % nationally, far below the thresholds required for most vaccine-preventable diseases. (Linked to SLO 1.5)

Short-answer questions

7. Distinguish between innate and adaptive immunity, noting the role of immunological memory. (Linked to SLO 1.1)
8. Describe the three mechanisms through which vaccines induce protective immunity. (Linked to SLO 1.3)

Long-answer questions

9. Discuss the types of vaccines, explaining their composition, mechanism, and the public health significance of each type. (Linked to SLOs 1.2–1.3)
10. Evaluate herd immunity as a concept, including its mathematical basis, thresholds for key diseases, and the challenges to achieving it in Nigeria. (Linked to SLOs 1.4–1.5)

Answers to Concept Check Questions [Series 1]

Objective questions

1. Resist.
2. Adaptive.
3. Vaccination.
4. Attenuated.
5. 95.
6. 50.

Short-answer questions

7. Innate immunity: present from birth, non-specific (responds to any pathogen), rapid response (minutes to hours), no immunological memory, includes skin, phagocytes, and inflammation. Adaptive immunity: develops after pathogen exposure, antigen-specific, slower primary response (days), but produces immunological memory enabling a faster, stronger secondary response upon re-exposure; basis of both natural and vaccine-induced immunity.
8. Humoral immunity: vaccines stimulate B cells to produce pathogen-specific antibodies that neutralise the pathogen or mark it for destruction before infection can establish. Cellular immunity: vaccines activate cytotoxic T cells that destroy cells already infected with the pathogen, particularly important for viruses replicating intracellularly. Immunological memory: vaccines establish antigen-specific memory cells ensuring a faster, stronger response upon subsequent pathogen exposure, typically preventing disease or reducing severity.

Long-answer questions

9. **Basic response:** Live attenuated: weakened live pathogen, strong long-lasting immunity resembling natural infection, requires cold chain, not for immunocompromised; examples: measles, OPV, BCG, yellow fever. Inactivated: killed pathogen, safer for immunocompromised, requires multiple doses and boosters; examples: IPV, hepatitis A, influenza. Subunit/conjugate: specific antigens only, reduced side effects, requires adjuvants; examples: hepatitis B, HPV, pneumococcal. Toxoid: inactivated toxin, immunises against disease rather than organism; examples: tetanus, diphtheria. mRNA: delivers antigen-coding instructions, rapid production, no live pathogen; example: COVID-19 vaccines.

Value-added response: The diversity of vaccine types reflects both the biological diversity of pathogens and the different trade-offs between immunogenicity, safety, and logistical feasibility. Live attenuated vaccines are the most immunogenic but impose cold chain requirements and cannot be given to immunocompromised individuals, creating equity concerns in high-burden settings. mRNA vaccines represent a paradigm shift in speed of development, demonstrated by COVID-19, but their long-term immune durability and the infrastructure requirements for ultra-cold chain storage create access challenges in low-resource settings like Nigeria.

10. **Basic response:** Herd immunity is indirect protection of non-immune individuals when sufficient population proportion is immune to interrupt transmission. Mathematical basis: HIT = $1 - (1/R_0)$; higher R_0 requires higher coverage. Thresholds: measles (R_0 12–18, HIT ~95%), polio (80–85%), rubella (85–92%), influenza (33–44%), COVID-19 original strain (~67%). Nigerian challenges: <50% routine coverage nationally, northern state disparities, vaccine hesitancy (2003 polio boycott legacy), cold chain failures, stockouts, hard-to-reach communities (conflict, nomadic populations, informal urban settlements).

Value-added response: The herd immunity concept has important limits that the COVID-19 pandemic exposed: it assumes stable pathogen transmissibility, durable vaccine-induced immunity, and homogeneous mixing, none of which holds when a pathogen is rapidly evolving. The Omicron variant's R_0 estimate of 15 or more meant the mathematical herd immunity threshold exceeded 90%, approaching or surpassing practical vaccination limits. This experience demonstrated that for rapidly evolving pathogens, population immunity through vaccination may need to be combined with other transmission reduction measures rather than relied upon alone.

Answers to Pilot Questions [Series 1]

Part 1.1

1. Immunity is the ability of an organism to resist a specific infectious disease by deploying biological mechanisms that prevent pathogens from invading, proliferating, or causing harm.
2. Innate immunity: present from birth, non-specific, rapid, no memory, includes physical barriers and phagocytes. Adaptive immunity: develops after exposure, antigen-specific, slower initially but produces immunological memory enabling faster secondary responses.

3. Immunological memory is the adaptive immune system capacity to mount a faster, stronger response upon re-exposure to a previously encountered antigen. It is significant because it is the biological basis of long-term protection from both natural infection and vaccination.
4. Active immunity: the person own immune system generates the response, producing antibodies and memory cells; generally long-lasting. Passive immunity: pre-formed antibodies are transferred from another source; immediate but temporary, lasting only weeks to months.
5. Natural active immunity: recovery from measles infection conferring long-term immunity. Natural passive immunity: maternal IgG antibodies crossing the placenta to protect the newborn.

Part 1.2

1. Vaccination is the act of administering a vaccine to stimulate an immune response. Immunisation is the outcome, the development of protective immunity that may follow vaccination or natural infection.
2. Any three of: immunosuppression preventing adequate immune response; cold chain failure compromising vaccine potency; improper administration technique; pre-existing immunity masking the response.
3. Live attenuated (measles vaccine); inactivated (hepatitis A); subunit or conjugate (hepatitis B or pneumococcal); toxoid (tetanus); mRNA (COVID-19 vaccine).
4. Live attenuated vaccines contain replicating pathogens that persist longer in the body, stimulating a more prolonged and comprehensive immune response resembling natural infection, including both humoral and cellular components and stronger memory.
5. Because the secondary (booster) dose triggers a much stronger anamnestic response than the primary dose, producing higher and more durable antibody titres necessary for sustained protective immunity; the additional doses are biologically necessary, not redundant.

Part 1.3

1. Herd immunity is the indirect protection conferred on non-immune members of a population when a sufficiently large proportion is immune to a disease, preventing sustained transmission of the pathogen.

2. HIT = 1 − (1/R_0). HIT is the herd immunity threshold (proportion of population that must be immune). R_0 is the basic reproduction number (average number of secondary infections from one case in a fully susceptible population). A higher R_0 yields a higher HIT.
3. Approximately 95% coverage is required because measles has an R_0 of 12 to 18, one of the highest of any vaccine-preventable disease, meaning each case infects many susceptibles; very high coverage is needed to reduce transmission sufficiently to interrupt chains.
4. Any three of: routine immunisation coverage below 50% nationally; geographic disparities (northern states consistently lower); vaccine hesitancy; cold chain failures; stockouts; access barriers for nomadic, conflict-affected, and informal urban settlement populations.
5. Spatial heterogeneity creates geographically concentrated pockets of susceptible individuals even when the national average coverage appears adequate; within these pockets, pathogens can ignite and sustain outbreaks, as seen with recurring measles outbreaks in northern Nigeria.

References and Attributions [Series 1]

Textual references

- Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). Immunobiology: The immune system in health and disease (5th ed.). Garland Science.
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- National Open University of Nigeria (NOUN). (2023). Immunity and immunisation programme course material. NOUN Press.

Figures, Plates, Tables, and Boxes

- Figure 1.1: Types of immunity and their characteristics Attribution: AI generated using prompt "Generate a classification diagram of immunity types (innate, adaptive, active natural, active

artificial, passive natural, passive artificial) with characteristics of each." Suggested OER search string: "immunity types innate adaptive active passive natural artificial classification OER"

- Figure 1.2: Vaccine types and mechanisms of vaccine-induced immunity Attribution: AI generated using prompt "Generate a two-panel diagram showing vaccine types with examples and primary versus secondary antibody response curves." Suggested OER search string: "vaccine types live attenuated inactivated subunit toxoid mRNA primary secondary antibody response OER"
- Figure 1.3: Herd immunity concept and challenges in Nigeria Attribution: AI generated using prompt "Generate a two-panel diagram showing herd immunity concept with three scenarios and a bar chart of herd immunity thresholds for five diseases." Suggested OER search string: "herd immunity threshold measles polio rubella influenza concept population immunity coverage OER"

Course code: COM 409

Course title: Immunity and Immunisation Programme

Course credit load: 1 Unit

Series 2: Factors Affecting Immunity

- **Part 2.1: Physiological Factors Affecting Immunity**
  - Sub Part 2.1.1: Age and immunity
  - Sub Part 2.1.2: Nutritional status and immunity
  - Sub Part 2.1.3: Hormonal and genetic influences
- **Part 2.2: Pathological Factors Affecting Immunity**
  - Sub Part 2.2.1: Infections and immune suppression
  - Sub Part 2.2.2: Cancers and their effect on immunity
  - Sub Part 2.2.3: Radiation and drugs as immunosuppressants
- **Part 2.3: Implications for Immunisation Practice**
  - Sub Part 2.3.1: Vaccine response in vulnerable populations
  - Sub Part 2.3.2: Contraindications and precautions in immunisation
  - Sub Part 2.3.3: Strategies to optimise immune response to vaccines

Introduction

Immunity is not a fixed, uniform capacity. It varies substantially across individuals and over time, shaped by age, nutritional status, underlying disease, medication, and genetics. These variations directly affect both the susceptibility to infection and the ability to mount adequate responses to vaccines. For health practitioners planning and delivering immunisation, understanding what suppresses or modulates immunity is as important as understanding how vaccines work.

The aim of this Series is to examine the major factors that affect immunity, covering physiological factors such as age, nutrition, and hormones; pathological factors including infections, cancers, and treatments such as radiation and drugs; and the practical implications of these factors for immunisation practice.

We shall commence by examining physiological factors affecting immunity, particularly age and nutritional status. Next, we will examine pathological factors including infections, cancers, radiation, and drugs. Finally, we will close by examining the implications for vaccine response and immunisation practice in vulnerable populations.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 2.1** describe the effects of age on immune function and vaccine response,
- **SLO 2.2** explain how nutritional status influences immunity,
- **SLO 2.3** describe how infections, cancers, radiation, and drugs impair immunity,
- **SLO 2.4** explain how these factors affect vaccine response in vulnerable populations, and
- **SLO 2.5** describe contraindications and strategies to optimise immune response to vaccination.

2.1 Physiological Factors Affecting Immunity

2.1.1 Age and immunity

Age is one of the most powerful determinants of immune function. **Neonates** are born with an immature immune system; their adaptive immunity is underdeveloped, making them highly susceptible to infection. Protection in the first weeks of life depends substantially on **maternally transferred IgG** antibodies, which decline over 3 to 6 months. This is why the immunisation schedule begins at birth (BCG, hepatitis B) and continues with frequent early doses, targeting the window when maternal antibody wanes and the infant own immune system must take over.

At the other end of the life course, **immunosenescence** (the age-related decline in immune function) reduces vaccine responsiveness in the elderly. Older adults generate lower **antibody titres** and weaker **T cell responses** following vaccination, reducing vaccine effectiveness. This is why higher-dose or adjuvanted influenza vaccines are recommended for the elderly in some settings. In the intermediate age range, adolescents and young adults typically mount the strongest immune responses, making them the most suitable age group for establishing **long-term vaccine-induced immunity**.

Fill in the blank: Age-related decline in immune function in the elderly is called _____ , which reduces antibody titres and T cell responses following vaccination and lowers overall vaccine effectiveness.

2.1.2 Nutritional status and immunity

Malnutrition is a leading cause of **secondary immunodeficiency** globally, particularly in low-income settings. **Protein-energy malnutrition** impairs multiple arms of the immune response: it reduces the number and function of T lymphocytes, depresses antibody production, impairs phagocyte function, and compromises the integrity of mucosal barriers, including gut epithelium. Children with severe acute malnutrition have markedly elevated susceptibility to infections and poorer responses to some vaccines.

Specific **micronutrient deficiencies** also impair immunity independently of overall caloric status. **Vitamin A deficiency** impairs mucosal immunity and T cell function, explaining the relationship between vitamin A supplementation and reduced child mortality from measles and diarrhoea. **Zinc deficiency** impairs T and B cell development and function. **Iron deficiency** impairs neutrophil and natural killer cell activity. **Vitamin D** has immunomodulatory roles, and its deficiency is associated with increased susceptibility to respiratory infections including tuberculosis.

Fill in the blank: _____ -energy malnutrition impairs T lymphocyte number and function, antibody production, phagocyte function, and mucosal barrier integrity, causing severe secondary immunodeficiency.

2.1.3 Hormonal and genetic influences

Hormones significantly modulate immune function. **Cortisol** (and synthetic glucocorticoids), when elevated chronically due to stress or therapeutic use, suppress **pro-inflammatory cytokines** and reduce lymphocyte proliferation, and impair both innate and adaptive responses. **Sex hormones** create differences in immune responsiveness between males and females: oestrogen generally enhances humoral immunity (explaining higher antibody responses to vaccines in females), while testosterone tends to suppress immune function. Pregnancy alters the immune balance, suppressing cellular immunity to tolerate the foetus while enhancing certain innate responses.

Genetic factors determine the **baseline capacity** of the immune system. Inherited **primary immunodeficiencies** (PIDs), such as severe combined immunodeficiency (SCID), X-linked agammaglobulinaemia, and common variable immunodeficiency, result from mutations affecting immune cell development or function, causing severe susceptibility to infection from birth. **HLA genotype** influences how effectively an individual presents vaccine antigens to T cells, contributing to inter-individual variation in vaccine responsiveness even among apparently healthy people.

Fill in the blank: _____ (synthetic glucocorticoids), when used therapeutically, suppress pro-inflammatory cytokines, reduce lymphocyte proliferation, and impair both innate and adaptive immune responses.

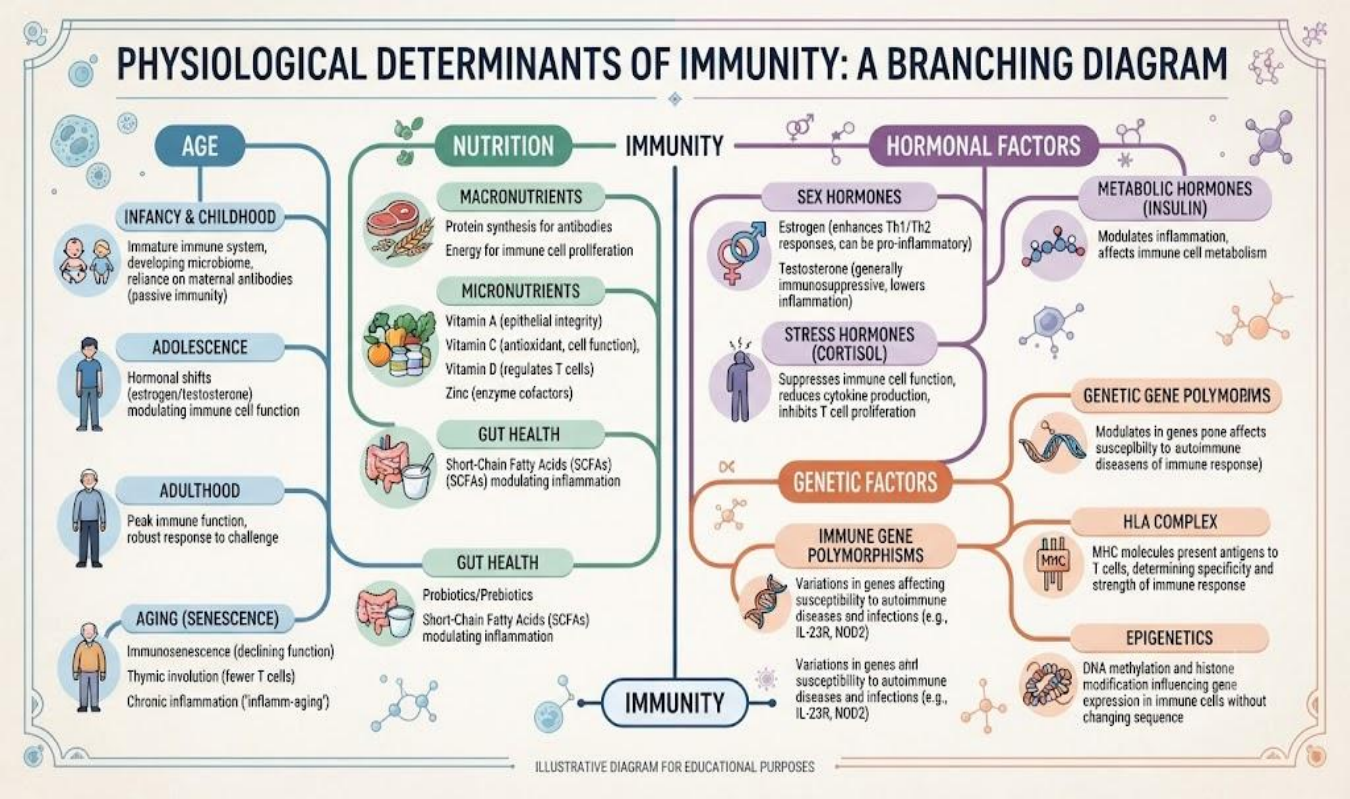

Figure 2.1: Physiological factors affecting immunity

Pilot questions 2.1

1. Why are neonates particularly susceptible to infection?
2. Define immunosenescence and state its effect on vaccine response.
3. Name four ways in which protein-energy malnutrition impairs immunity.
4. Name three micronutrients whose deficiency impairs immune function.
5. How do glucocorticoids affect immunity?

2.2 Pathological Factors Affecting Immunity

2.2.1 Infections and immune suppression

Some infections directly suppress the immune system, leaving individuals vulnerable to **opportunistic infections** and reducing vaccine effectiveness. **HIV** is the most significant example: the virus infects and progressively depletes **CD4+ T helper cells**, the central coordinators of adaptive immune responses. As CD4 counts fall below 200 cells/μL, the risk of opportunistic infections including tuberculosis, Pneumocystis jirovecii pneumonia, and cryptococcal meningitis rises sharply. HIV-infected individuals have impaired responses to many vaccines, particularly at low CD4 counts.

Measles causes transient but profound immune suppression, reducing T cell diversity and depleting immunological memory cells for up to two to three years after infection, a phenomenon called **immune amnesia**. This explains why measles is associated with high post-infection susceptibility to other infectious diseases. **Malaria** impairs splenic immune function, reducing the ability to clear parasitaemia and impairing antibody responses to certain co-administered vaccines. Understanding infection-related immunosuppression is important for **timing of vaccinations** in clinical settings.

Fill in the blank: HIV infects and depletes _____ T helper cells, the central coordinators of adaptive immunity, reducing responses to many vaccines and predisposing to opportunistic infections.

2.2.2 Cancers and their effect on immunity

Cancers can impair immunity both through the **direct effect of the malignancy** and through the immunosuppressive effects of **cancer treatments**. Haematological malignancies, including leukaemia and lymphoma, directly disrupt the immune system by replacing normal blood cell production with malignant clones. **Multiple myeloma** impairs antibody production by displacing normal plasma cells. **Chronic lymphocytic leukaemia (CLL)** produces functionally defective B cells and progressively reduces normal immunoglobulin levels, causing **hypogammaglobulinaemia** and severe susceptibility to encapsulated bacteria.

Solid tumours can also impair immunity through **immunosuppressive cytokines** secreted by tumour cells, through **physical obstruction** of lymphatic drainage, and through **nutritional depletion** (cancer cachexia). Patients with active malignancy typically generate **suboptimal vaccine responses** and may require dose adjustments or additional doses. **Chemotherapy** and **radiotherapy** (examined in Part 2.2.3) further compound the immunosuppressive burden, creating a complex picture in which timing of vaccination relative to cancer treatment requires careful clinical judgement.

Fill in the blank: Multiple myeloma impairs _____ production by displacing normal plasma cells, causing susceptibility to infections that depend on antibody-mediated protection.

2.2.3 Radiation and drugs as immunosuppressants

Ionising radiation damages rapidly dividing cells, including the **haematopoietic stem cells** of the bone marrow from which all immune cells originate. High-dose radiation (as used in cancer radiotherapy or received in nuclear accidents) causes **bone marrow aplasia** resulting in profound loss of neutrophils, lymphocytes, and platelets. Even lower doses used in targeted radiotherapy reduce immune cell populations in irradiated tissue beds. Vaccination should generally be deferred during active radiotherapy and for a defined period thereafter.

Several categories of drugs suppress immune function. **Corticosteroids** at immunosuppressive doses (equivalent to prednisone ≥20 mg/day for ≥2 weeks) significantly impair immune responses. **Immunosuppressive agents** used in organ transplantation and autoimmune disease (including methotrexate, azathioprine, mycophenolate, and calcineurin inhibitors) impair T and B cell function. **Biologics** targeting TNF-α (infliximab, adalimumab) or B cells (rituximab) are potent immunosuppressants with specific implications for live vaccine contraindication. **Cancer chemotherapy** causes profound but usually temporary immunosuppression through myelosuppression.

Fill in the blank: _____ at immunosuppressive doses (equivalent to prednisone 20 mg/day for two or more weeks) significantly impair immune responses and contraindicate live vaccine administration.

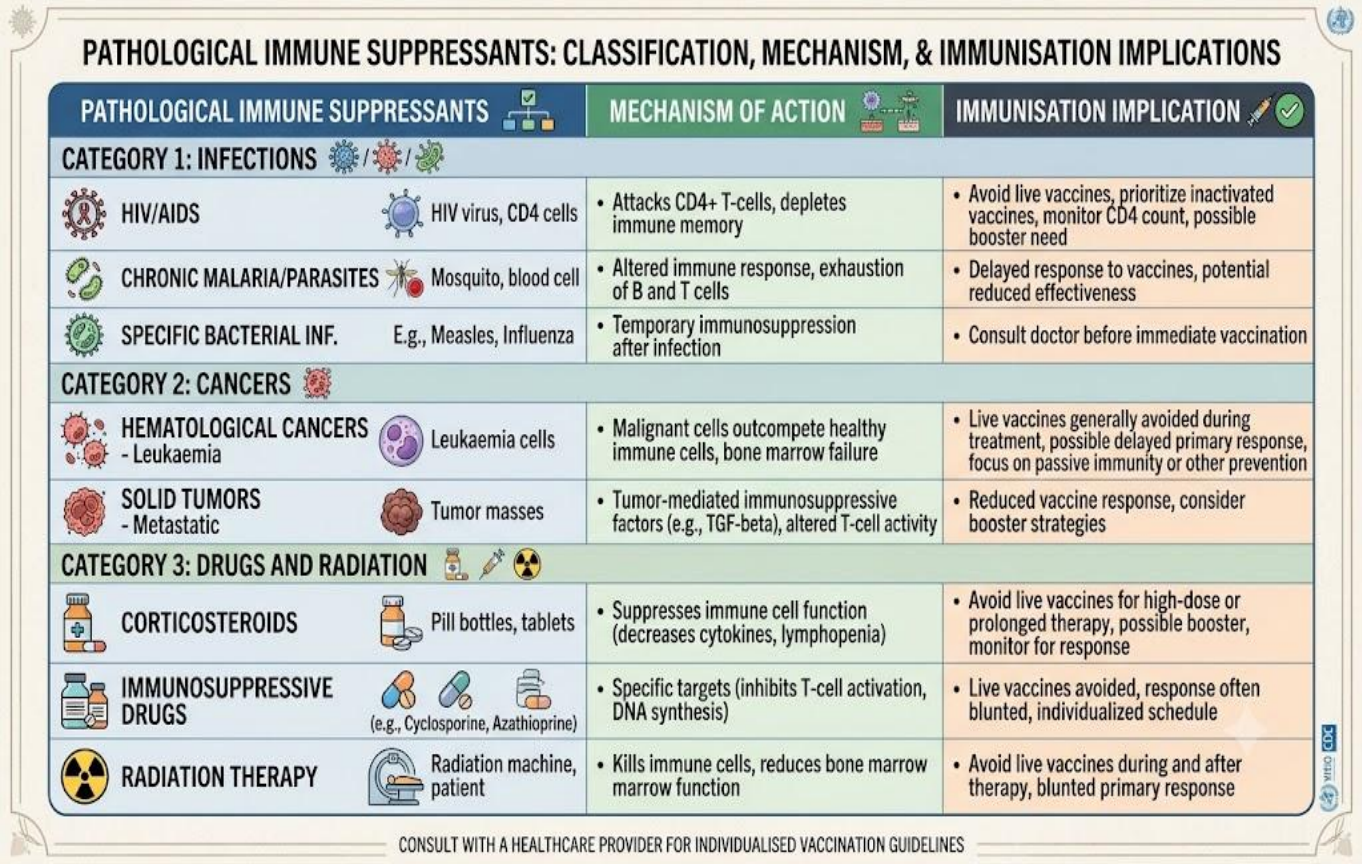

Figure 2.2: Pathological factors impairing immunity

Pilot questions 2.2

1. How does HIV impair immune function?
2. What is immune amnesia and which infection causes it?
3. Name two haematological malignancies that impair immunity.
4. How does ionising radiation affect the immune system?
5. Name three categories of drugs that suppress immunity.

2.3 Implications for Immunisation Practice

2.3.1 Vaccine response in vulnerable populations

Vulnerable populations, including **neonates and infants**, **malnourished children**, **HIV-infected individuals**, **cancer patients**, and the **elderly**, often mount suboptimal responses to standard vaccine doses or schedules. In malnourished children, responses to some vaccines (particularly oral cholera vaccine) are significantly reduced, prompting research into nutritional rehabilitation as a pre-vaccination intervention. **HIV-infected children and adults** may require higher doses, more doses, or earlier revaccination, and may have accelerated waning of vaccine-induced immunity requiring more frequent boosters.

In the **elderly**, the reduced immunogenicity of standard influenza vaccines has prompted development of **high-dose vaccines** and **adjuvanted formulations** (such as MF59-adjuvanted influenza vaccines) that produce stronger antibody responses in older recipients. **Premature infants** receive vaccines according to **chronological age** (not corrected gestational age) for most antigens, as vaccine responses are primarily driven by postnatal immune maturation rather than gestational development. Tailoring immunisation to the specific vulnerabilities of each population group is a key principle of equity-focused immunisation programming.

Fill in the blank: In the elderly, reduced vaccine immunogenicity has prompted development of _____ -dose and adjuvanted vaccine formulations that produce stronger antibody responses than standard formulations.

2.3.2 Contraindications and precautions in immunisation

A **contraindication** is a condition that significantly increases the risk of a serious adverse event following vaccination, warranting withholding the vaccine. The primary contraindication to **live attenuated vaccines** (such as MMR, varicella, yellow fever, and BCG) is **severe immunodeficiency**, including HIV with CD4 count below 200 cells/μL, primary immunodeficiencies, high-dose corticosteroid therapy, and active cancer treatment. A **precaution** is a condition that increases the risk of an adverse event or reduces vaccine effectiveness, warranting deferral of vaccination in most but not all circumstances.

Common **false contraindications** (conditions that are incorrectly used to withhold vaccines) include: mild acute illness (only severe illness with fever warrants deferral); **previous mild local or systemic reactions** to a prior vaccine dose; **antibiotic therapy** (not a contraindication for any routine vaccine); **convalescence** from a recent illness; and **stable chronic disease** including malnutrition. Recognising and correcting false contraindications is important because they are a significant driver of **missed vaccination opportunities** in Nigerian PHC facilities and community outreach settings.

Fill in the blank: The primary contraindication to live attenuated vaccines is severe _____ , including HIV with CD4 below 200 cells/μL, primary immunodeficiencies, and high-dose corticosteroid or cancer chemotherapy.

2.3.3 Strategies to optimise immune response to vaccines

Several strategies can enhance vaccine immunogenicity in populations with compromised or developing immunity. **Adjuvants** (immunostimulatory substances added to vaccines, such as aluminium salts, MF59, and AS01B) amplify and prolong the immune response, enabling protective immunity with smaller antigen quantities and fewer doses, particularly useful in the elderly and immunocompromised. **Optimal timing** of vaccination relative to immunosuppressive treatments (for example, vaccinating before planned chemotherapy or organ transplantation) maximises the immune response achievable at the time of vaccination.

Nutritional optimisation before vaccination, including vitamin A supplementation and correction of severe malnutrition where feasible, can improve vaccine responses in children with nutritional deficiencies. **Cold chain maintenance** ensures that vaccines arrive at the point of use at the potency for which their immunogenicity data was established. **Correct administration technique** (appropriate site, route, and volume) ensures adequate antigen delivery. For HIV-infected individuals, **antiretroviral therapy** to restore CD4 counts above 200 cells/μL before vaccination substantially improves responses to most vaccines and permits administration of some live vaccines previously contraindicated.

Fill in the blank: _____ (immunostimulatory substances added to vaccines such as aluminium salts and MF59) amplify and prolong immune responses, enabling protection with smaller antigen quantities and fewer doses.

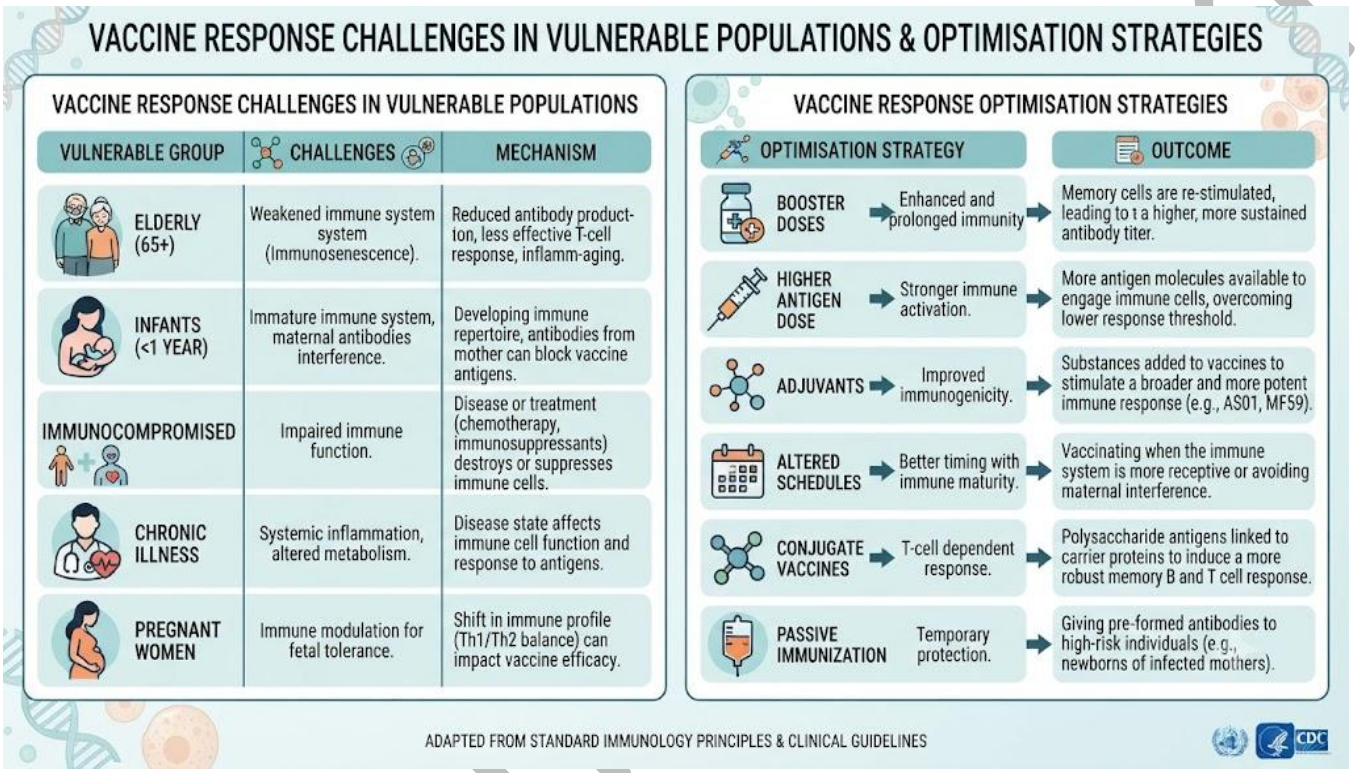

Figure 2.3: Factors affecting vaccine response and strategies for optimisation

Pilot questions 2.3

1. Why do malnourished children have reduced responses to some vaccines?
2. What is a contraindication to vaccination? Give two examples.
3. Name three false contraindications to vaccination.
4. How do adjuvants improve vaccine responses?
5. Why should vaccination ideally occur before planned chemotherapy rather than during it?

Series Summary

This Series examined the major factors that affect immunity and their implications for immunisation. Physiological factors covered included age (neonatal immaturity and immunosenescence in the elderly), nutritional status (protein-energy malnutrition and micronutrient deficiencies impairing multiple immune arms), and hormonal and genetic factors (glucocorticoids, sex hormones, and primary immunodeficiencies). Pathological factors examined included infections causing immune suppression (HIV depleting CD4+ T cells, measles causing immune amnesia, malaria impairing splenic function), haematological and solid tumour malignancies, and ionising radiation and immunosuppressive drugs including corticosteroids, biologics, and chemotherapy.

The practical implications for immunisation were examined through vaccine response in vulnerable populations, including neonates, malnourished children, HIV-infected individuals, cancer patients, and the elderly. Contraindications and precautions were distinguished from false contraindications, with the latter identified as a significant cause of missed vaccination opportunities in Nigerian settings. Optimisation strategies were described including adjuvants, optimal timing relative to immunosuppressive therapy, nutritional support, cold chain maintenance, correct technique, and ART to restore CD4 counts before vaccination in HIV-infected individuals (SLOs 2.1 to 2.5).

Glossary of Terms

1. **Adjuvant:** an immunostimulatory substance added to a vaccine to amplify and prolong the immune response, enabling protection with smaller antigen quantities.
2. **CD4+ T helper cell:** the lymphocyte subset targeted and depleted by HIV; the central coordinator of adaptive immune responses.
3. **Contraindication:** a condition that significantly increases the risk of a serious adverse event following vaccination, warranting withholding the vaccine.

4. **False contraindication:** a condition incorrectly used to withhold vaccination that does not in fact increase the risk of serious adverse events.

5. **Hypogammaglobulinaemia:** abnormally low levels of immunoglobulins (antibodies), resulting in impaired humoral immunity and susceptibility to bacterial infections.

6. **Immune amnesia:** the depletion of immunological memory cells caused by measles infection, leaving individuals susceptible to other infections for up to two to three years.

7. **Immunosenescence:** the age-related decline in immune function in the elderly, resulting in reduced antibody titres and T cell responses to vaccination.

8. **Myelosuppression:** suppression of bone marrow activity by chemotherapy or radiation, reducing production of neutrophils, lymphocytes, and other blood cells.

9. **Precaution:** a condition that increases the risk of an adverse event or reduces vaccine effectiveness, warranting deferral of vaccination in most but not all circumstances.

10. **Primary immunodeficiency (PID):** an inherited disorder of immune cell development or function, causing severe susceptibility to infection from birth.

11. **Protein-energy malnutrition:** insufficient intake of protein and calories, causing secondary immunodeficiency through impaired lymphocyte function, antibody production, and mucosal integrity.

Concept Check Questions [Series 2]

Objective questions

- Age-related immune decline in the elderly is called _____ , reducing antibody titres and T cell responses to vaccines. (Linked to SLO 2.1)
- _____ -energy malnutrition impairs T lymphocyte function, antibody production, phagocyte function, and mucosal integrity. (Linked to SLO 2.2)
- HIV infects and depletes _____ T helper cells, the central coordinators of adaptive immunity. (Linked to SLO 2.3)
- Measles causes _____ amnesia, depleting immunological memory cells and increasing susceptibility to other infections for up to three years. (Linked to SLO 2.3)
- The primary contraindication to live attenuated vaccines is severe _____ , including HIV with CD4 below 200 cells/μL. (Linked to SLO 2.5)
- _____ (immunostimulatory substances added to vaccines) amplify immune responses, enabling protection with smaller antigen quantities. (Linked to SLO 2.5)

Short-answer questions

- Explain how nutritional status affects immunity, covering both protein-energy malnutrition and micronutrient deficiencies. (Linked to SLO 2.2)
- Distinguish between a contraindication and a precaution in immunisation, and give two examples of false contraindications. (Linked to SLO 2.5)

Long-answer questions

- Discuss the pathological factors that impair immunity, covering HIV, measles, cancers, radiation, and drugs. (Linked to SLO 2.3)
- Evaluate the vaccine response challenges in vulnerable populations and describe the strategies available to optimise immune responses to vaccination. (Linked to SLOs 2.4–2.5)

Answers to Concept Check Questions [Series 2]

Objective questions

1. Immunosenescence.
2. Protein.
3. CD4+.
4. Immune.
5. Immunodeficiency.
6. Adjuvants.

Short-answer questions

7. Protein-energy malnutrition: reduces T lymphocyte number and function, depresses antibody production, impairs phagocyte function, and compromises mucosal barriers; severely malnourished children have elevated infection susceptibility and reduced vaccine responses. Micronutrient deficiencies: vitamin A impairs mucosal immunity and T cell function; zinc impairs T and B cell development; iron impairs neutrophil and natural killer cell activity; vitamin D deficiency increases susceptibility to respiratory infections including tuberculosis.
8. Contraindication: a condition significantly increasing the risk of a serious adverse event, warranting withholding the vaccine; example: live vaccines in severely immunocompromised individuals or allergy to a vaccine component. Precaution: a condition increasing risk or reducing effectiveness, warranting deferral in most circumstances. False contraindications (two examples): mild acute illness without significant fever; antibiotic therapy (not a contraindication for any routine vaccine).

Long-answer questions

9. **Basic response:** HIV: depletes CD4+ T helper cells causing progressive immunodeficiency; impairs vaccine responses especially at low CD4 counts; predisposes to opportunistic infections. Measles: causes immune amnesia depleting T cell diversity and immunological memory cells for 2 to 3 years post-infection. Cancers: haematological

malignancies (leukaemia, lymphoma, multiple myeloma) disrupt normal immune cell production; solid tumours secrete immunosuppressive cytokines; cancer cachexia depletes nutritional immune support. Radiation: damages haematopoietic stem cells causing myelosuppression and immune cell depletion. Drugs: corticosteroids suppress cytokines and lymphocyte proliferation; biologics (anti-TNF-α, rituximab) are potent immunosuppressants contraindicated with live vaccines; chemotherapy causes temporary myelosuppression.

Value-added response: The clinical significance of these pathological immunosuppressants is greatest for the decision of whether and when to administer live attenuated vaccines, which can cause disseminated infection in severely immunocompromised individuals. The interaction between HIV status, CD4 count, antiretroviral therapy, and live vaccine safety represents one of the most complex vaccine decision scenarios in Nigerian clinical practice, requiring health workers to balance the risk of vaccine-associated disease against the substantial risk of vaccine-preventable disease in an immunocompromised host.

10. **Basic response:** Vulnerable populations and challenges: neonates (immature adaptive immunity, dependent on maternal antibodies); malnourished children (impaired T and B cell function, reduced oral vaccine responses); HIV-infected (suboptimal responses especially at low CD4, accelerated waning, may need more doses); cancer patients (malignancy and treatment cause myelosuppression); elderly (immunosenescence, lower titres, weaker T cell responses). Optimisation strategies: adjuvants (amplify response enabling protection with less antigen); optimal timing (vaccinate before chemotherapy or transplantation); nutritional support (vitamin A, correct malnutrition); cold chain maintenance (preserve vaccine potency); correct technique (right site, route, volume); ART to restore CD4 above 200 before vaccination in HIV-infected individuals.

Value-added response: The principle of equity in immunisation demands that the populations with the greatest immunological vulnerability receive the most careful attention to vaccination timing, dosing, and optimisation, yet these are precisely the populations most likely to be missed by standard immunisation programmes. HIV-infected children in Nigeria represent a case in point: they are more likely to be born to mothers with limited health

system engagement, more likely to have incomplete vaccination schedules, and more likely to mount inadequate responses to the doses they do receive, compounding their infectious disease vulnerability at every stage.

Answers to Pilot Questions [Series 2]

Part 2.1

6. Neonates have immature adaptive immune systems and depend on maternally transferred IgG antibodies, which decline over 3 to 6 months. Their innate immunity is also incompletely developed, leaving them highly susceptible to infection before their own adaptive responses mature.
7. Immunosenescence is the age-related decline in immune function in the elderly. It reduces antibody titres and T cell responses following vaccination, lowering vaccine effectiveness and prompting development of high-dose or adjuvanted vaccine formulations for older recipients.
8. Reduces T lymphocyte number and function; depresses antibody production; impairs phagocyte function; compromises mucosal barrier integrity.
9. Vitamin A, zinc, and iron (also acceptable: vitamin D).
10. Glucocorticoids suppress pro-inflammatory cytokines, reduce lymphocyte proliferation, and impair both innate and adaptive immune responses, resulting in increased susceptibility to infection and contraindication to live vaccines at immunosuppressive doses.

Part 2.2

11. HIV infects and progressively depletes CD4+ T helper cells, the central coordinators of adaptive immune responses, causing progressive immunodeficiency, impaired vaccine responses, and susceptibility to opportunistic infections as CD4 counts fall.

12. Immune amnesia is the depletion of T cell diversity and immunological memory cells caused by measles infection, increasing susceptibility to other infections for up to two to three years after measles.
13. Any two of: leukaemia, lymphoma, multiple myeloma, chronic lymphocytic leukaemia.
14. Ionising radiation damages haematopoietic stem cells in the bone marrow, causing myelosuppression with loss of neutrophils, lymphocytes, and platelets, resulting in profound immune compromise.
15. Corticosteroids, immunosuppressive agents (methotrexate, azathioprine, mycophenolate, calcineurin inhibitors), and biologics (anti-TNF-α, rituximab). Also acceptable: cancer chemotherapy.

Part 2.3

1. Malnutrition impairs T and B lymphocyte function, reducing the generation of antigen-specific antibodies and memory cells in response to vaccine antigens, resulting in lower antibody titres and reduced protective efficacy.
2. A contraindication is a condition significantly increasing the risk of a serious adverse event, warranting withholding the vaccine. Examples: severe immunodeficiency for live vaccines; anaphylaxis to a previous dose or vaccine component.
3. Any three of: mild acute illness; previous mild local or systemic reaction to a prior dose; antibiotic therapy; convalescence from recent illness; stable chronic disease including malnutrition.
4. Adjuvants amplify and prolong the immune response to vaccine antigens, enabling protective immunity with smaller antigen quantities and fewer doses, particularly valuable in the elderly and immunocompromised who mount weaker baseline responses.
5. Because the immune system is most responsive when not suppressed by active chemotherapy; vaccinating before treatment maximises the antibody titres and memory cells generated, providing protection during the immunosuppressed treatment period when the patient cannot mount a de novo vaccine response.

References and Attributions [Series 2]

Textual references

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9. National Open University of Nigeria (NOUN). (2023). Immunity and immunisation programme course material. NOUN Press.

Figures, Plates, Tables, and Boxes

11. Figure 2.1: Physiological factors affecting immunity Attribution: AI generated using prompt "Generate a branching diagram showing age, nutrition, and hormonal and genetic factors as physiological determinants of immunity with specific mechanisms." Suggested OER search string: "factors affecting immunity age immunosenescence malnutrition vitamin A zinc hormones genetic OER"
12. Figure 2.2: Pathological factors impairing immunity Attribution: AI generated using prompt "Generate a three-column table of pathological immune suppressants (infections, cancers, drugs and radiation) with mechanism and immunisation implication." Suggested OER search string: "HIV immune suppression cancer chemotherapy radiation drugs corticosteroids immunosuppression vaccination OER"
13. Figure 2.3: Factors affecting vaccine response and strategies for optimisation Attribution: AI generated using prompt "Generate a two-panel diagram showing vaccine response challenges in vulnerable populations and optimisation strategies." Suggested OER search string: "vaccine immunogenicity vulnerable populations adjuvants optimisation elderly HIV malnutrition cold chain OER"

Course code: COM 409

Course title: Immunity and Immunisation Programme

Course credit load: 1 Unit

Series 3: National Immunisation Programme

- **Part 3.1: The National Immunisation Programme in Nigeria**
  - Sub Part 3.1.1: History and evolution of the NPI
  - Sub Part 3.1.2: Structure and governance of the NPI
  - Sub Part 3.1.3: The Nigerian immunisation schedule
- **Part 3.2: GAVI and Recent Advances in Immunisation**
  - Sub Part 3.2.1: The role of GAVI in Nigerian immunisation
  - Sub Part 3.2.2: New vaccine introductions in Nigeria
  - Sub Part 3.2.3: Recent advances in vaccine technology and delivery
- **Part 3.3: Challenges and Strengthening of the NPI**
  - Sub Part 3.3.1: Cold chain and logistics challenges
  - Sub Part 3.3.2: Human resource and funding gaps
  - Sub Part 3.3.3: Strategies for NPI strengthening

Introduction

A national immunisation programme translates the science of vaccines and immunity into organised, population-level delivery of protection against vaccine-preventable diseases. Nigeria

National Programme on Immunisation (NPI) is the institutional framework through which millions of children and adults receive life-saving vaccines each year. Understanding its history, structure, schedule, and challenges is essential for any health practitioner involved in planning, delivering, or evaluating immunisation services in Nigeria.

The aim of this Series is to describe the history, structure, and schedule of the Nigerian NPI; examine the role of GAVI and recent advances in vaccine technology and new vaccine introductions; and identify the major challenges to the NPI and the strategies for strengthening it.

We shall commence by tracing the history and governance of the NPI and describing the current immunisation schedule. Next, we will examine GAVI partnership and new vaccine introductions and recent technological advances. Finally, we will close by examining cold chain, human resource, and funding challenges, and the strategies being pursued to address them.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 3.1** describe the history and evolution of the Nigerian NPI,
- **SLO 3.2** explain the structure and governance of the NPI,
- **SLO 3.3** describe the current Nigerian routine immunisation schedule,
- **SLO 3.4** explain the role of GAVI and describe recent vaccine introductions and advances in Nigeria, and
- **SLO 3.5** identify the major challenges facing the NPI and describe strategies for its strengthening.

3.1 The National Immunisation Programme in Nigeria

3.1.1 History and evolution of the NPI

Nigeria immunisation history begins with the **Expanded Programme on Immunisation (EPI)**, launched by WHO globally in 1974 and adopted in Nigeria shortly thereafter. The initial schedule targeted six diseases: **tuberculosis, polio, diphtheria, pertussis, tetanus, and measles**. Coverage improved gradually through the 1970s and early 1980s but collapsed during the economic crisis of the mid-1980s. The **Universal Childhood Immunisation (UCI) initiative** of 1990, targeting 80% coverage by year-end, briefly reinvigorated the programme before another decline.

The programme was formally restructured as the **National Programme on Immunisation (NPI)** in 1996 under the Federal Ministry of Health, and the **National Primary Health Care Development Agency (NPHCDA)** assumed coordination responsibility. A landmark development was the **2003 northern Nigeria polio vaccine boycott** in Kano, Zamfara, and Kaduna states, where religious leaders alleged vaccine contamination, leading to a resurgence of polio across Nigeria and Africa. The subsequent re-engagement of northern leaders and sustained **National Immunisation Days (NIDs)** eventually resulted in Nigeria achieving **wild poliovirus-free status** in 2020, one of the most significant public health achievements in the country history.

Fill in the blank: Nigeria achieved _____ poliovirus-free status in 2020 following sustained National Immunisation Days and re-engagement of northern leaders after the 2003 vaccine boycott.

3.1.2 Structure and governance of the NPI

The NPI operates within a **three-tier governance structure** mirroring Nigeria federal system. At the **federal level**, the NPHCDA coordinates national immunisation policy, sets standards, procures vaccines, and manages donor relations. At the **state level**, State Primary Health Care Development Agencies implement the programme, manage cold chain infrastructure, and supervise LGA activities. At the **LGA level**, PHC departments plan and conduct routine

immunisation sessions at fixed facilities, outreach posts, and mobile sites, with CHEWs and community health officers as the frontline delivery workforce.

Governance is supported by the **Inter-Agency Coordinating Committee (ICC)**, a multi-partner coordination body co-chaired by the Federal Ministry of Health and UNICEF, bringing together WHO, GAVI, USAID, CDC, Rotary International, and bilateral partners. The **Immunisation Technical Advisory Group (NITAG)** provides independent scientific advice on vaccine policy, schedule updates, and new vaccine introductions. **Accountability** is maintained through the NPHCDA-managed **District Health Information System (DHIS2)**, which tracks immunisation coverage data from facilities to the national level in real time.

Fill in the blank: The _____ -Agency Coordinating Committee (ICC) is a multi-partner governance body co-chaired by the Federal Ministry of Health and UNICEF that coordinates immunisation programme support.

3.1.3 The Nigerian immunisation schedule

The Nigerian routine immunisation schedule provides vaccines at **birth, 6 weeks, 10 weeks, 14 weeks, 9 months, and 15 months** of age, targeting the major vaccine-preventable diseases of childhood. At **birth**, BCG (against tuberculosis) and hepatitis B zero dose are given. At **6, 10, and 14 weeks**, the **pentavalent vaccine** (DPT-HBV-Hib, protecting against diphtheria, pertussis, tetanus, hepatitis B, and Haemophilus influenzae type b), **oral polio vaccine**, **pneumococcal conjugate vaccine**, and **rotavirus vaccine** are administered.

At **9 months**, children receive **measles-rubella vaccine**, **yellow fever vaccine**, **meningococcal A conjugate vaccine (MenA)**, and a **vitamin A** supplement. A **second dose of measles-rubella** is given at **15 months**. **Inactivated polio vaccine (IPV)** is given at 14 weeks alongside oral polio. **HPV vaccine** for adolescent girls and **tetanus-diphtheria (Td) toxoid** for women of reproductive age complete the schedule. This comprehensive schedule, if fully delivered, would protect Nigerian children against 14 vaccine-preventable diseases.

Fill in the blank: The Nigerian routine immunisation schedule provides the _____ vaccine (DPT-HBV-Hib) at 6, 10, and 14 weeks, protecting against diphtheria, pertussis, tetanus, hepatitis B, and Haemophilus influenzae type b.

Age	Vaccine	Diseases Prevented
At Birth	BCG, OPV0, Hepatitis B0	Tuberculosis, Polio, Hepatitis B
6 Weeks	Pentavalent 1 (DPT, Hep B, Hib), PCV1, OPV1, IPV1, Rotavirus 1	Diphtheria, Pertussis, Tetanus, Hepatitis B, Haemophilus influenzae type b, Pneumonia, Polio, Rotavirus diarrhoea
10 Weeks	Pentavalent 2, PCV2, OPV2, Rotavirus 2	Same as above (second dose for continued protection)
14 Weeks	Pentavalent 3, PCV3, OPV3, IPV2, Rotavirus 3	Same as above (third dose for full protection)
6 Months	Vitamin A (1st dose)	Prevents night blindness, boosts immunity
9 Months	Measles 1, Yellow Fever, Meningitis A	Measles, Yellow Fever, Meningococcal meningitis
12 Months	Vitamin A (2nd dose)	Prevents vitamin A deficiency
15 Months	Measles 2 (MCV2)	Measles (second dose for stronger immunity)
9–13 Years (Girls)	HPV (2 doses, 6 months apart)	Human Papillomavirus, cervical cancer prevention

Table 3.1: The Nigerian routine immunisation schedule

Pilot questions 3.1

1. When was the EPI launched globally and when was it adopted in Nigeria?
2. What was the significance of the 2003 northern Nigeria polio vaccine boycott?
3. Describe the three-tier governance structure of the NPI.
4. What diseases does the pentavalent vaccine protect against?
5. Name four vaccines given at 9 months in the Nigerian immunisation schedule.

3.2 GAVI and Recent Advances in Immunisation

3.2.1 The role of GAVI in Nigerian immunisation

GAVI, the Vaccine Alliance (formerly the Global Alliance for Vaccines and Immunisation), is a public-private partnership founded in 2000 to increase access to vaccines in low- and middle-income countries. Nigeria has been a GAVI-eligible country since the Alliance inception and has received substantial support including **co-financed vaccine procurement** at reduced prices, **health system strengthening grants** for cold chain, data systems, and human resources, and **new vaccine introduction support** covering the transition costs of adding new antigens to the national schedule.

GAVI operates a **co-financing model** in which countries contribute an increasing share of vaccine costs over time as their economies grow, transitioning to **self-financing** when they cross defined income thresholds. Nigeria, as a lower-middle-income country, contributes a percentage of vaccine costs while GAVI subsidises the remainder. Key GAVI-supported vaccines in Nigeria include the **pneumococcal conjugate vaccine (PCV)**, **rotavirus vaccine**, **meningococcal A conjugate vaccine**, and **HPV vaccine**. GAVI support has been critical in enabling Nigeria to introduce vaccines that would otherwise be unaffordable within the federal health budget.

Fill in the blank: GAVI operates a _____ -financing model in which countries contribute an increasing share of vaccine costs over time, transitioning to self-financing when they cross defined income thresholds.

3.2.2 New vaccine introductions in Nigeria

Nigeria has progressively expanded its immunisation schedule through **new vaccine introductions (NVIs)** supported by GAVI and government funding. The **pneumococcal conjugate vaccine (PCV13)** was introduced in 2014, targeting pneumococcal pneumonia and meningitis, a leading cause of under-five mortality. The **meningococcal A conjugate vaccine (MenAfriVac)** was introduced as a **mass campaign vaccine** in the meningitis belt states starting from 2012, dramatically reducing meningococcal A meningitis. **Rotavirus vaccine** was introduced in 2014, targeting a major cause of severe childhood diarrhoea.

The **inactivated polio vaccine (IPV)** was added to the schedule in 2015 as part of the global switch from **trivalent to bivalent oral polio vaccine** and the endgame strategy for polio eradication, providing inactivated vaccine-induced immunity without any risk of vaccine-derived poliovirus. **HPV vaccine** was introduced through demonstration projects in selected states, targeting adolescent girls for prevention of cervical cancer. **Measles-rubella (MR) vaccine** replaced monovalent measles vaccine in 2017. Each NVI requires substantial preparation in cold chain capacity, health worker training, community sensitisation, and waste management.

Fill in the blank: The _____ conjugate vaccine (PCV13) was introduced into the Nigerian routine immunisation schedule in 2014, targeting pneumococcal pneumonia and meningitis as a leading cause of under-five mortality.

3.2.3 Recent advances in vaccine technology and delivery

Several technological advances are transforming vaccine development and delivery. **mRNA vaccine platforms**, demonstrated during COVID-19, enable rapid vaccine design and manufacture without requiring live pathogen culture, potentially compressing development timelines from years to months. **Nanoparticle and virus-like particle (VLP) platforms** present antigens in highly immunogenic configurations. **Thermostable vaccines**, which remain potent at ambient temperatures without refrigeration, address one of the most persistent operational challenges in resource-limited settings by reducing dependence on cold chain infrastructure.

Delivery innovations include **microneedle patches** (dissolving patches that deliver vaccine through the skin painlessly without needles, eliminating sharps waste and enabling self-administration), **controlled-release vaccine formulations** (single-dose vaccines that release antigen over time, mimicking multi-dose schedules and reducing follow-up visits), and **digital immunisation records** (mobile and cloud-based systems replacing paper-based registers, improving data quality and enabling tracking of missed children). The **NPHCDA digital health initiative** is progressively rolling out electronic immunisation registries across Nigerian states.

Fill in the blank: _____ vaccines, which remain potent at ambient temperatures without refrigeration, address the cold chain challenge by reducing dependence on refrigeration infrastructure in resource-limited settings.

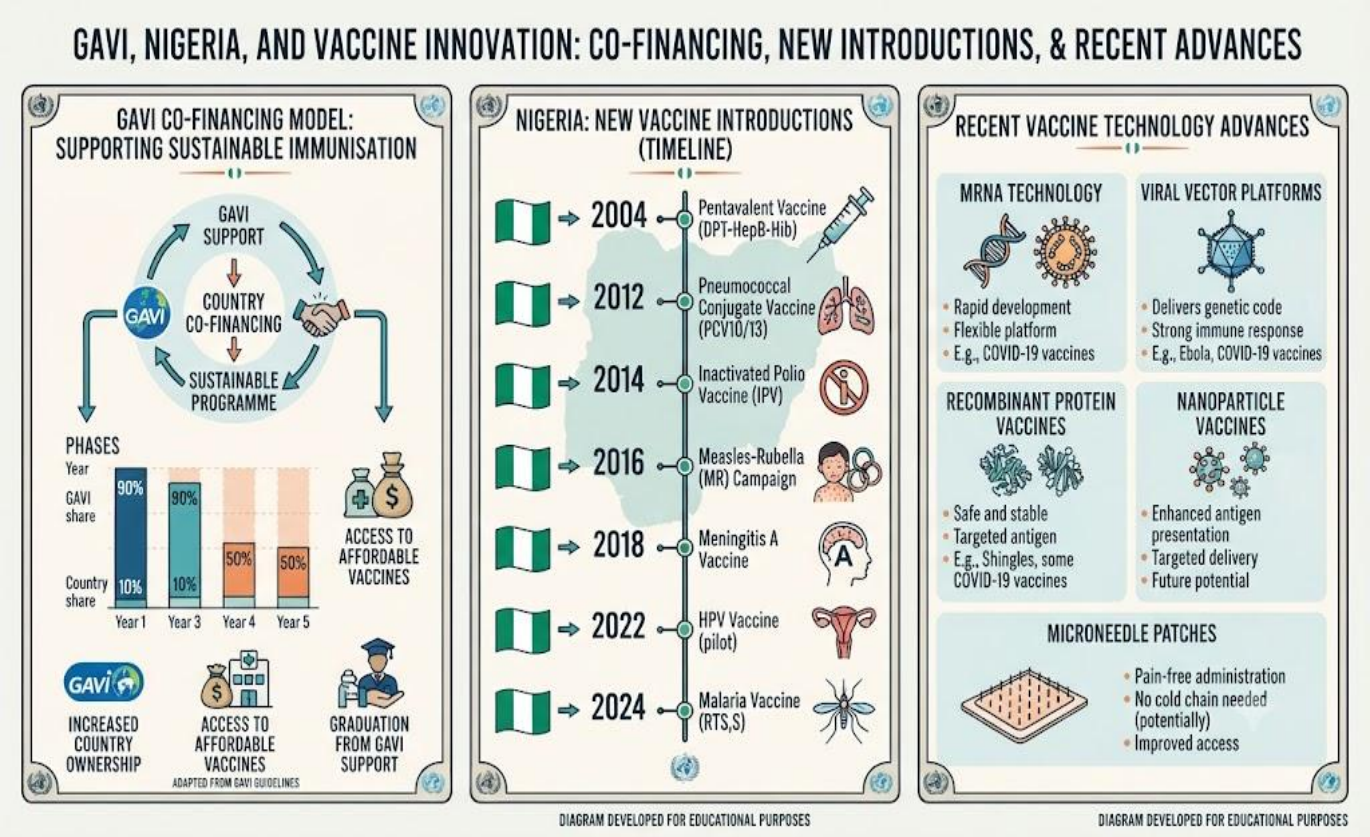

Figure 3.2: GAVI partnership, new vaccine introductions, and recent advances

Pilot questions 3.2

1. What is GAVI and how does it support Nigerian immunisation?
2. Explain the GAVI co-financing model.
3. Name four vaccines introduced into Nigeria schedule with GAVI support.
4. What is the advantage of thermostable vaccines for Nigeria?
5. Name two delivery innovations that could improve immunisation coverage.

3.3 Challenges and Strengthening of the NPI

3.3.1 Cold chain and logistics challenges

Most vaccines require storage and transport within defined **temperature ranges** (typically +2°C to +8°C for most vaccines, or below -15°C for oral polio vaccine) to maintain potency. Nigeria **cold chain system** comprises a network of **cold rooms** at federal and state levels, **refrigerators and freezers** at LGA stores and facilities, and **cold boxes and vaccine carriers** for outreach. Persistent **power supply failures** are the most critical cold chain challenge: frequent electricity outages damage or destroy temperature-sensitive vaccines stored in electrically powered equipment.

Cold chain equipment maintenance is a chronic gap, with many facilities operating ageing or malfunctioning refrigerators without servicing capacity. **Last-mile logistics** from LGA stores to outreach sites in rural and hard-to-reach communities require reliable vehicles, fuel, and logistics coordination that are frequently unavailable. **Vaccine wastage** from cold chain failures, improper handling, and open vial policy management represents a significant resource loss. The NPHCDA **Effective Vaccine Management (EVM) assessment** framework periodically evaluates cold chain performance across states and drives targeted investment in identified gaps.

Fill in the blank: Persistent _____ supply failures are the most critical cold chain challenge in Nigeria, causing frequent damage or destruction of temperature-sensitive vaccines stored in electrically powered equipment.

3.3.2 Human resource and funding gaps

The NPI depends on a large frontline workforce of **CHEWs, community health officers, nurses, and community health volunteers** who deliver immunisation at facilities and through outreach. Chronic **staff shortages** at PHC facilities, particularly in rural northern states, mean that immunisation sessions are frequently cancelled or inadequately staffed. **Health worker motivation** is undermined by irregular payment of immunisation allowances, insufficient training and refresher opportunities, and heavy workloads that leave inadequate time for outreach activities beyond facility-based sessions.

Funding for routine immunisation in Nigeria is chronically insufficient and unpredictable. The federal government **domestic vaccine procurement budget** has historically been underfunded, creating dependence on GAVI and donor financing that is inherently uncertain and time-limited. **State government contributions** vary enormously, with wealthier states (Lagos, Rivers) allocating more than less affluent ones. The **National Health Act 2014 Basic Health Care Provision Fund (BHCPF)** has a dedicated PHC allocation that includes immunisation, but implementation delays have limited its impact on immunisation financing in practice.

Fill in the blank: Chronic staff shortages, irregular payment of immunisation _____, insufficient training, and heavy workloads undermine health worker motivation and the quality of routine immunisation delivery.

3.3.3 Strategies for NPI strengthening

Nigeria has adopted a **National Immunisation Strategy** aligned with the **Immunisation Agenda 2030 (IA2030)**, the global framework for achieving universal immunisation coverage. Key strategic priorities include **reaching every district** (RED) through systematic planning to cover underserved wards and communities; **demand generation** through community mobilisation, religious leader engagement, and behaviour change communication to address hesitancy; and **data quality improvement** through digital immunisation registries and supervisory systems that provide real-time coverage data for management action.

Solar-powered **cold chain equipment** (refrigerators and freezers operating on solar energy) is being scaled up to address power supply failures at facility level. **Emergency routine immunisation** and **catch-up campaigns** target children missed by routine services. **Integrated community health worker programmes**, particularly the **CHIPS agent network**, extend immunisation outreach to household level. **Accountability mechanisms** including LGA-level performance reviews, scorecard monitoring, and public reporting of coverage data are strengthening governance and creating incentives for improved performance across the programme.

Fill in the blank: The _____ Agenda 2030 (IA2030) is the global framework aligned with Nigeria National Immunisation Strategy for achieving universal immunisation coverage by 2030.

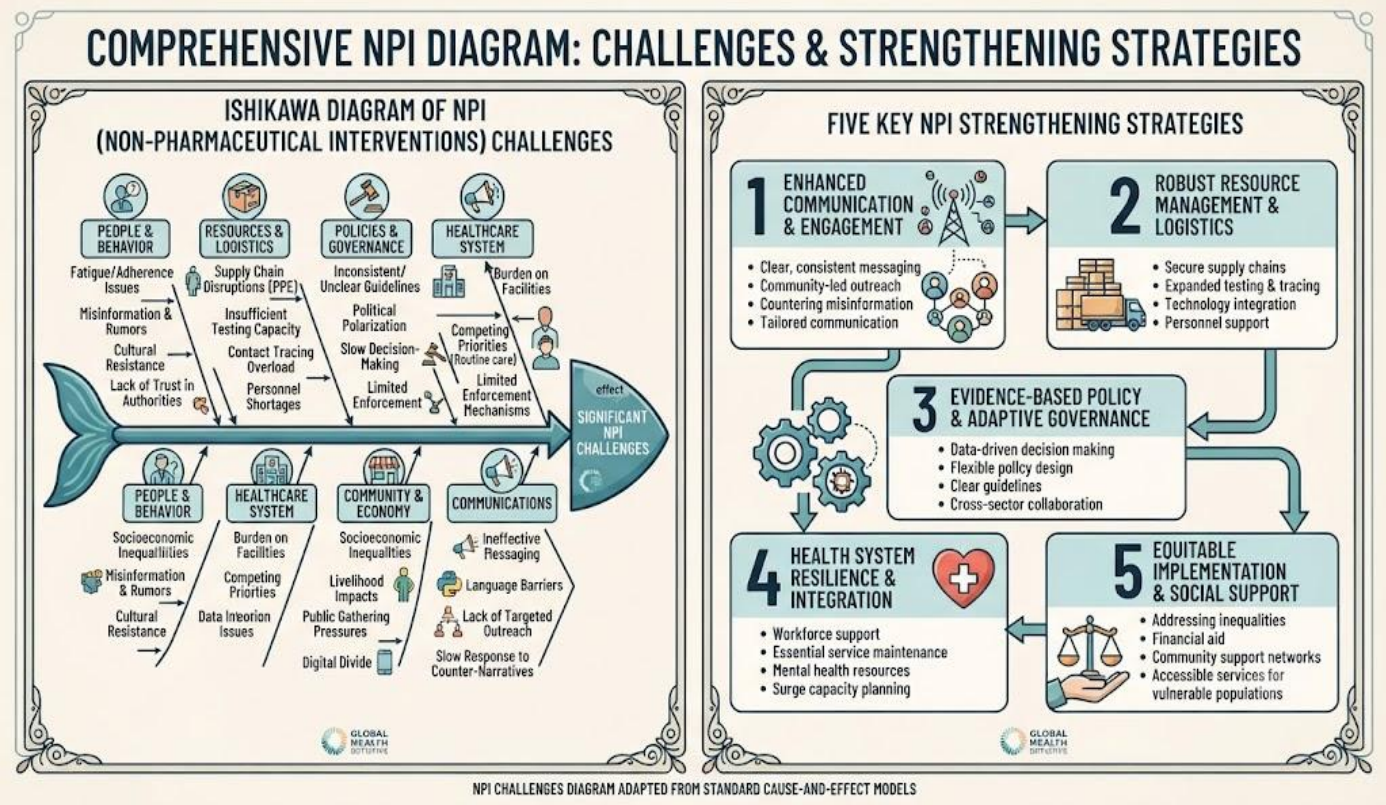

Figure 3.3: NPI challenges and strengthening strategies

Pilot questions 3.3

1. Why is power supply failure the most critical cold chain challenge in Nigeria?
2. Name three human resource challenges facing the NPI.
3. What is the BHCPF and how is it relevant to immunisation funding?
4. What does the RED strategy stand for and what is its aim?
5. Name three strategies being implemented to strengthen the NPI.

Series Summary

This Series examined the Nigerian National Immunisation Programme in its historical, structural, and operational dimensions. The NPI was traced from the EPI adoption in the 1970s through the UCI initiative, the 2003 polio boycott, the sustained NIDs, and Nigeria achievement of wild poliovirus-free status in 2020. The three-tier governance structure (NPHCDA at federal level, State PHCDA at state level, LGA PHC departments at local level) and the roles of the ICC and NITAG were described. The current routine immunisation schedule was mapped from birth through 15 months, covering 14 vaccine-preventable diseases.

GAVI partnership was described through its co-financing model and its enabling of new vaccine introductions including PCV13, MenA, rotavirus, IPV, MR, and HPV vaccines. Recent advances in mRNA platforms, thermostable vaccines, microneedle patches, and digital registries were examined. The Series concluded by identifying the major NPI challenges of cold chain failure, staff shortages, inadequate funding, and demand gaps, and the strengthening strategies of the RED approach, demand generation, solar cold chain, CHIPS outreach, and accountability mechanisms aligned with the Immunisation Agenda 2030 (SLOs 3.1 to 3.5).

Glossary of Terms

1. **CHIPS agent:** Community Health Influencer, Promoter, and Service agent; a lay community health volunteer supervised by CHEWs to extend immunisation outreach to households.
2. **Cold chain:** the temperature-controlled supply chain maintaining vaccines within required temperature ranges from manufacture to point of administration.
3. **EVM (Effective Vaccine Management):** an NPHCDA assessment framework that periodically evaluates cold chain performance across Nigerian states.

4. **GAVI:** the Vaccine Alliance; a public-private partnership founded in 2000 to increase vaccine access in low- and middle-income countries through co-financed procurement and health system support.

5. **IA2030:** Immunisation Agenda 2030; the global framework for achieving universal immunisation coverage by 2030, with which the Nigerian National Immunisation Strategy is aligned.

6. **ICC (Inter-Agency Coordinating Committee):** a multi-partner immunisation governance body co-chaired by the Federal Ministry of Health and UNICEF.

7. **NITAG:** Nigeria Immunisation Technical Advisory Group; provides independent scientific advice on vaccine policy and schedule updates.

8. **NPI (National Programme on Immunisation):** Nigeria institutional framework for delivering routine and supplementary immunisation to the population.

9. **Pentavalent vaccine:** a combination vaccine protecting against diphtheria, pertussis, tetanus, hepatitis B, and Haemophilus influenzae type b (DPT-HBV-Hib).

10. **RED (Reaching Every District):** an immunisation strategy that systematically plans to cover underserved wards and communities to achieve more equitable coverage.

11. **Thermostable vaccine:** a vaccine formulation that remains potent at ambient temperatures without refrigeration, reducing dependence on cold chain infrastructure.

Concept Check Questions [Series 3]

Objective questions

- Nigeria achieved wild _____ -free status in 2020 following sustained National Immunisation Days. (Linked to SLO 3.1)
- The _____ -Agency Coordinating Committee (ICC) co-chaired by the Federal Ministry of Health and UNICEF coordinates multi-partner immunisation support. (Linked to SLO 3.2)
- The _____ vaccine (DPT-HBV-Hib) given at 6, 10, and 14 weeks protects against five diseases. (Linked to SLO 3.3)
- GAVI operates a _____ -financing model in which countries contribute an increasing share of vaccine costs over time. (Linked to SLO 3.4)
- _____ vaccines that remain potent at ambient temperatures reduce cold chain dependence in resource-limited settings. (Linked to SLO 3.4)
- The _____ Agenda 2030 (IA2030) is the global framework aligned with Nigeria National Immunisation Strategy. (Linked to SLO 3.5)

Short-answer questions

- Describe the three-tier governance structure of the Nigerian NPI and the roles of the ICC and NITAG. (Linked to SLO 3.2)
- Explain the role of GAVI in Nigerian immunisation and name four vaccines it has supported the introduction of. (Linked to SLO 3.4)

Long-answer questions

- Describe the history and evolution of Nigeria NPI from the EPI to the achievement of wild poliovirus-free status. (Linked to SLO 3.1)
- Evaluate the major challenges facing the NPI and describe the strategies being implemented to strengthen it. (Linked to SLO 3.5)

Answers to Concept Check Questions [Series 3]

Objective questions

1. Poliovirus.
2. Inter.
3. Pentavalent.
4. Co.
5. Thermostable.
6. Immunisation.

Short-answer questions

7. Three-tier structure: Federal (NPHCDA coordinates policy, standards, procurement, donor relations); State (State PHCDA implements programme, manages cold chain, supervises LGAs); LGA (PHC departments plan and conduct sessions at fixed, outreach, and mobile sites; CHEWs are frontline delivery workforce). ICC: multi-partner body co-chaired by Federal MOH and UNICEF, coordinates WHO, GAVI, USAID, CDC, Rotary, and bilateral partners. NITAG: independent scientific advisory body on vaccine policy, schedule updates, and new vaccine introductions.
8. GAVI is a public-private partnership founded in 2000 providing co-financed vaccine procurement at reduced prices, health system strengthening grants, and new vaccine introduction support. Four vaccines: pneumococcal conjugate vaccine (PCV13, 2014), meningococcal A conjugate vaccine (MenA, 2012 campaign), rotavirus vaccine (2014), HPV vaccine (demonstration projects). Also acceptable: inactivated polio vaccine, measles-rubella vaccine.

Long-answer questions

9. **Basic response:** EPI adopted in Nigeria in the 1970s targeting TB, polio, diphtheria, pertussis, tetanus, measles. Coverage grew then collapsed in mid-1980s economic crisis. UCI initiative 1990 briefly reinvigorated programme. NPI restructured in 1996 under NPHCDA. 2003 polio vaccine boycott in northern states caused poliovirus resurgence

across Nigeria and Africa, a major setback. Re-engagement of northern leaders, sustained NIDs, and strengthened routine immunisation followed. Nigeria was removed from the polio-endemic country list and achieved wild poliovirus-free certification in 2020.

Value-added response: The 2003 polio boycott is the most instructive event in Nigerian immunisation history for two reasons: it demonstrated the devastating impact that vaccine hesitancy rooted in community distrust can have on hard-won immunisation gains, and it demonstrated that this distrust can be reversed through sustained, respectful community engagement led by credible voices within the affected communities. The decade-long process of rebuilding trust in northern Nigeria was ultimately more important to polio eradication than any cold chain improvement or schedule change, underscoring why demand generation is now a co-equal priority with supply strengthening in the NPI.

10. **Basic response:** Cold chain: power failures damage temperature-sensitive vaccines; ageing equipment lacks servicing; last-mile logistics gaps; vaccine wastage. Human resources: staff shortages especially in rural north; irregular immunisation allowances undermine motivation; insufficient training; workloads limit outreach. Funding: domestic procurement budget underfunded; donor dependence; uneven state contributions. Demand: hesitancy from misinformation and historical distrust. Strengthening strategies: RED approach for underserved wards; demand generation through community mobilisation and religious leaders; digital immunisation registries; solar-powered cold chain equipment; CHIPS agent household outreach; accountability through LGA performance reviews and scorecard monitoring, aligned with IA2030.

Value-added response: The NPI challenges are mutually reinforcing in ways that require integrated rather than sequential solutions: underfunding limits cold chain maintenance, which causes vaccine wastage, which reduces available doses, which leads to cancelled sessions, which erodes community trust, which increases hesitancy, which reduces demand even when sessions are available. Strengthening any one dimension without addressing the others produces limited impact. The most effective NPI improvement programmes treat supply, demand, quality, and accountability as a system to be strengthened simultaneously rather than as separate problems to be addressed in priority order.

Answers to Pilot Questions [Series 3]

Part 3.1

6. The EPI was launched globally by WHO in 1974 and adopted in Nigeria shortly thereafter.
7. The 2003 boycott, led by religious leaders in Kano, Zamfara, and Kaduna who alleged vaccine contamination, caused a poliovirus resurgence that spread across Nigeria and to other African countries, representing a major setback to polio eradication efforts that took over a decade to reverse.
8. Federal (NPHCDA: coordinates policy, procurement, donor relations); State (State PHCDA: implementation, cold chain management, LGA supervision); LGA (PHC departments: plan and conduct sessions at fixed, outreach, and mobile sites, CHEWs as frontline workforce).
9. Diphtheria, pertussis (whooping cough), tetanus, hepatitis B, and Haemophilus influenzae type b.
10. Measles-rubella vaccine, yellow fever vaccine, meningococcal A conjugate vaccine (MenA), and vitamin A supplement.

Part 3.2

11. GAVI (the Vaccine Alliance) is a public-private partnership that provides co-financed vaccine procurement at reduced prices, health system strengthening grants, and new vaccine introduction support to low- and middle-income countries, enabling Nigeria to access vaccines unaffordable within its domestic budget.
12. Countries contribute an increasing share of vaccine costs over time as their economies grow, while GAVI subsidises the remainder, with countries transitioning to full self-financing when they cross defined income thresholds.
13. Any four of: pneumococcal conjugate vaccine (PCV13), meningococcal A conjugate vaccine (MenA), rotavirus vaccine, inactivated polio vaccine (IPV), HPV vaccine, measles-rubella (MR) vaccine.

14. Thermostable vaccines remain potent at ambient temperatures without refrigeration, reducing dependence on Nigeria unreliable electricity supply and cold chain infrastructure gaps, enabling delivery in remote and hard-to-reach communities.
15. Any two of: microneedle patches (painless, needleless delivery, eliminate sharps waste); controlled-release single-dose formulations (eliminate multiple visits); digital immunisation records (replace paper registers, enable tracking of missed children).

Part 3.3

1. Because most vaccines require +2 to +8 degrees Celsius storage and Nigeria frequent power outages cause temperature excursions that damage or destroy vaccines stored in electrically powered refrigerators, resulting in wasted vaccines, cancelled sessions, and unprotected children.
2. Any three of: staff shortages at PHC facilities especially in rural north; irregular payment of immunisation allowances; insufficient refresher training; heavy workloads leaving inadequate time for outreach.
3. The BHCPF, established by the National Health Act 2014, is a dedicated, constitutionally protected PHC funding stream financed by a share of the Consolidated Revenue Fund. It has a PHC allocation that includes immunisation activities, representing a structural attempt to reduce dependence on donor financing for routine immunisation.
4. RED stands for Reaching Every District. Its aim is to systematically plan immunisation activities to cover underserved wards and communities that standard routine sessions fail to reach, improving geographic equity of coverage.
5. Any three of: RED strategy for underserved communities; demand generation through community mobilisation and religious leader engagement; digital immunisation registries; solar-powered cold chain equipment; CHIPS agent household outreach; LGA performance reviews and scorecard accountability.

References and Attributions [Series 3]

Textual references

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7. GAVI, the Vaccine Alliance. (2023). Nigeria country hub. GAVI Alliance. https://www.gavi.org/programmes-impact/country-hub/africa/nigeria
8. World Health Organization. (2020). Immunization Agenda 2030: A global strategy to leave no one behind. WHO Press.
9. National Open University of Nigeria (NOUN). (2023). Immunity and immunisation programme course material. NOUN Press.

Figures, Plates, Tables, and Boxes

11. Table 3.1: The Nigerian routine immunisation schedule Attribution: AI generated using prompt "Generate a table of the Nigerian routine immunisation schedule showing age, vaccine, and diseases prevented." Suggested OER search string: "Nigeria immunisation schedule NPI BCG pentavalent measles yellow fever routine childhood vaccines OER"
12. Figure 3.2: GAVI partnership, new vaccine introductions, and recent advances Attribution: AI generated using prompt "Generate a three-panel diagram showing the GAVI co-financing model, Nigeria new vaccine introductions with years, and recent vaccine technology advances." Suggested OER search string: "GAVI Nigeria vaccine alliance PCV rotavirus meningococcal HPV new vaccine introduction mRNA thermostable OER"
13. Figure 3.3: NPI challenges and strengthening strategies Attribution: AI generated using prompt "Generate a two-panel diagram showing an Ishikawa diagram of NPI challenges and five NPI strengthening strategies." Suggested OER search string: "NPI Nigeria immunisation challenges cold chain human resource funding demand generation RED strategy IA2030 OER"

Course code: COM 409

Course title: Immunity and Immunisation Programme

Course credit load: 1 Unit

Series 4: Roles of Family, Community and NGOs

- **Part 4.1: The Role of the Family in Immunisation**
  - Sub Part 4.1.1: Family as the first decision-making unit for immunisation
  - Sub Part 4.1.2: Parental knowledge, attitudes, and practices regarding vaccination
  - Sub Part 4.1.3: Barriers to family immunisation uptake and how to address them
- **Part 4.2: The Role of the Community in Immunisation**
  - Sub Part 4.2.1: Community structures supporting immunisation
  - Sub Part 4.2.2: Religious and traditional leaders as immunisation actors
  - Sub Part 4.2.3: Community health workers and volunteers in immunisation
- **Part 4.3: The Role of NGOs and Civil Society in Immunisation**
  - Sub Part 4.3.1: NGO contributions to immunisation programmes
  - Sub Part 4.3.2: Civil society advocacy for immunisation
  - Sub Part 4.3.3: Partnerships between NGOs, government, and communities

Introduction

Immunisation is not only a technical medical activity; it is fundamentally a social one. Whether a child receives a vaccine depends not on the science of immunology but on a cascade of decisions made by parents, influenced by community norms, shaped by what religious and traditional leaders say, and enabled or obstructed by the structures through which health services reach households. Understanding the social actors in immunisation is therefore as important as understanding the vaccines themselves.

The aim of this Series is to examine the roles of the family, the community, and non-governmental organisations and civil society in the immunisation programme, with specific attention to the Nigerian context and to practical strategies for engaging each actor to improve coverage.

We shall commence by examining the family as the primary decision-making unit for immunisation, including parental knowledge, attitudes, and barriers. Next, we will examine community structures, religious and traditional leaders, and community health workers. Finally, we will close by examining NGO contributions, civil society advocacy, and the partnerships that make immunisation programmes function effectively.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 4.1** explain the role of the family in immunisation decision-making,
- **SLO 4.2** describe parental knowledge, attitudes, and barriers to immunisation uptake,
- **SLO 4.3** describe community structures, religious and traditional leaders, and community health workers as immunisation actors,
- **SLO 4.4** explain the contributions of NGOs to immunisation programmes, and
- **SLO 4.5** describe civil society advocacy and multi-stakeholder partnerships for immunisation.

4.1 The Role of the Family in Immunisation

4.1.1 Family as the first decision-making unit for immunisation

The family, and particularly the **primary caregiver** (most often the mother), is the first and most critical decision-making unit in child immunisation. It is the caregiver who decides whether to bring a child to immunisation sessions, whether to return for subsequent doses, and how to respond when a child experiences a post-vaccination reaction. In contexts where immunisation requires multiple visits over months, this **sustained engagement** of the family is the single most important determinant of whether a child completes the immunisation schedule.

In Nigerian households, immunisation decisions are rarely made by the mother alone. **Husbands and fathers** often hold formal or informal authority over health-seeking decisions, including immunisation. **Grandmothers and mothers-in-law** frequently influence whether young mothers bring infants for vaccination, drawing on their own experiences and cultural beliefs. **Male partner engagement** in antenatal and immunisation messaging, and the explicit inclusion of household decision-makers (not just mothers) in immunisation education, have been shown to improve coverage in settings where paternal authority is dominant.

Fill in the blank: In Nigerian households, immunisation decisions often involve _____ and fathers, grandmothers, and mothers-in-law alongside the primary caregiver, requiring male partner engagement in immunisation messaging.

4.1.2 Parental knowledge, attitudes, and practices regarding vaccination

Parental **knowledge** about the purpose, schedule, and benefits of vaccination is a significant determinant of uptake. Parents who understand that vaccines prevent specific diseases, that multiple doses are required for full protection, and that mild post-vaccination reactions are normal and expected are more likely to complete the immunisation schedule. Conversely, parents who do not understand why a child needs a third dose of pentavalent vaccine, or who interpret a post-vaccination fever as harm caused by the vaccine, are at higher risk of **dropout** after initial doses.

Attitudes toward vaccination range from strong acceptance to active refusal, with a large proportion of parents in Nigeria occupying a **hesitant middle ground**: willing to vaccinate under the right circumstances but deterred by concerns about side effects, vaccine safety, religious appropriateness, or distrust of the health system. The **WHO Strategic Advisory Group of Experts (SAGE) model of vaccine hesitancy** identifies **confidence** (trust in vaccine safety and efficacy and health system delivery), **complacency** (low perceived disease risk reducing motivation), and **convenience** (physical and logistical access) as the three determinants of hesitancy.

Fill in the blank: The WHO SAGE model identifies confidence, _____ (low perceived disease risk), and convenience (access barriers) as the three determinants of vaccine hesitancy.

4.1.3 Barriers to family immunisation uptake and how to address them

Barriers to family immunisation uptake operate at **demand** and **supply** levels. Demand-side barriers include: **lack of awareness** of the immunisation schedule and session locations; **misconceptions** about vaccine safety, including fears of infertility, autism, or deliberate contamination (persistent in some northern Nigerian communities); **distance and transport costs** making it difficult for caregivers to reach facilities; **long waiting times** at immunisation sessions deterring busy caregivers; and **gender barriers** including restrictions on women travelling without male escort.

Effective strategies for addressing demand-side barriers include: **interpersonal communication** by CHEWs and community health volunteers at household level, providing personalised information and addressing individual concerns; **community-level social mobilisation** through town hall meetings, market announcements, and religious gatherings; **mobile immunisation** bringing sessions to communities rather than requiring caregivers to travel; **flexible scheduling** (evening or weekend sessions) matching immunisation availability to caregiver time; and **reminder systems** using SMS or community volunteer follow-up to alert caregivers about upcoming sessions and missed appointments.

Fill in the blank: _____ communication by CHEWs and community health volunteers at household level provides personalised information and addresses individual concerns, reducing demand-side barriers to immunisation uptake.

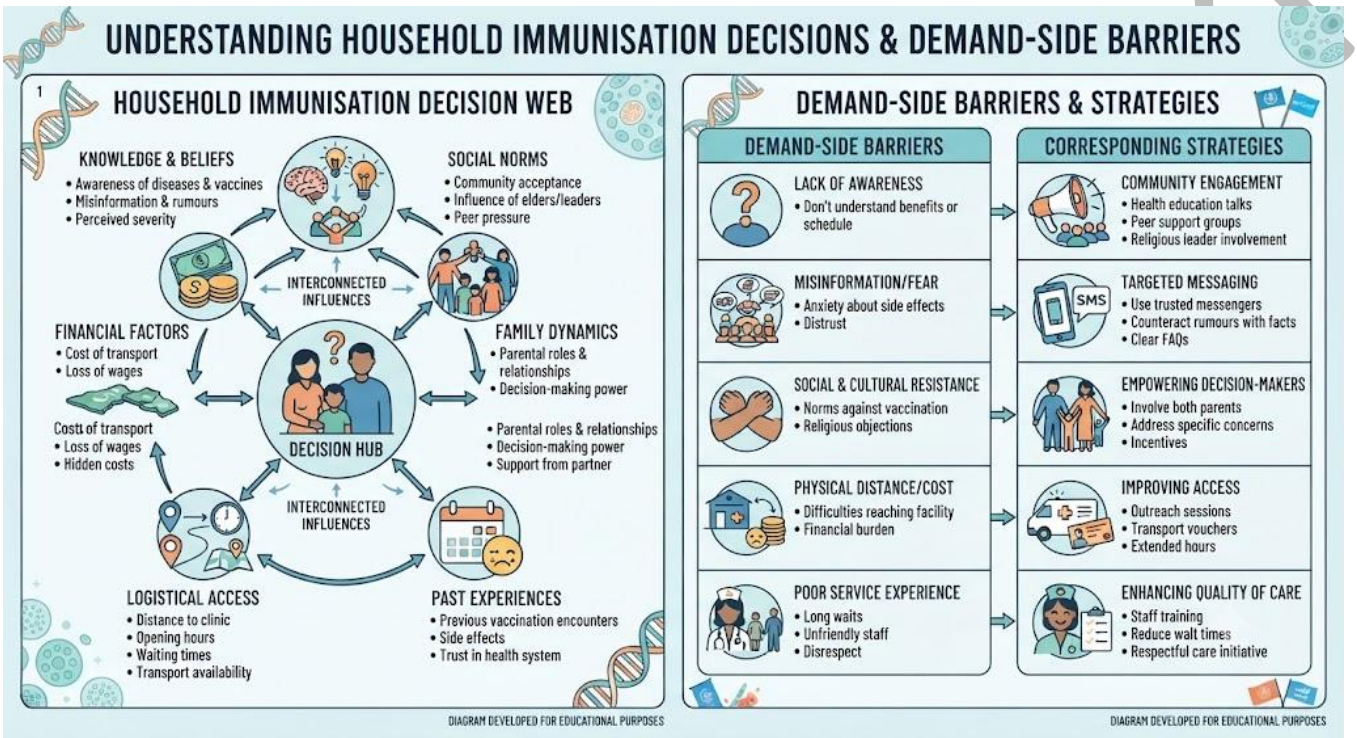

Figure 4.1: Family role in immunisation and barriers to uptake

Pilot questions 4.1

1. Why is the family described as the first decision-making unit in immunisation?
2. Name three household members beyond the mother who influence immunisation decisions in Nigeria.
3. Name the three determinants of vaccine hesitancy in the WHO SAGE model.
4. Name four demand-side barriers to family immunisation uptake.
5. Name three strategies for addressing demand-side immunisation barriers.

4.2 The Role of the Community in Immunisation

4.2.1 Community structures supporting immunisation

Communities provide the social infrastructure through which immunisation programmes reach individual households. **Ward health committees**, established within the Nigerian PHC system, are the formal community governance structure for PHC, including immunisation: they comprise community representatives, traditional leaders, religious leaders, and local government officials who jointly plan, mobilise for, and provide oversight of PHC services including immunisation sessions. Where they function well, ward health committees are among the most effective mechanisms for connecting the NPI to community needs and concerns.

Women groups (including market women associations, mothers clubs, and cooperative societies) function as powerful informal community networks for health communication, capable of rapidly disseminating immunisation information and mobilising members to attend sessions. **Community development committees** and **village health teams** in various parts of Nigeria serve similar coordination functions, providing platforms for health workers to engage community members collectively rather than individually. Building and sustaining these **community structures** requires deliberate investment in training, regular engagement, and recognition of community contributions to the immunisation programme.

Fill in the blank: _____ health committees, comprising community representatives, traditional leaders, and local government officials, are the formal community governance structure for PHC including immunisation in Nigeria.

4.2.2 Religious and traditional leaders as immunisation actors

Religious leaders (Islamic scholars, Christian pastors, and leaders of other faith communities) exercise significant influence over health decisions in Nigerian communities. Their endorsement of immunisation can overcome hesitancy rooted in religious concerns, while their opposition can trigger or sustain boycotts as demonstrated by the 2003 northern Nigeria polio crisis. In response, the **Interfaith Action for Peace in Africa (IFAPA)** and UNICEF-supported **Islamic scholars**

networks have trained thousands of religious leaders as immunisation champions, with documented positive impact on polio and routine immunisation coverage in northern states.

Traditional rulers (emirs, obas, obis, and village chiefs) command respect and compliance within their domains and have been effectively mobilised as immunisation advocates, particularly during supplementary immunisation activities. The **Sultan of Sokoto** and the **Emir of Kano** have historically played pivotal roles in endorsing and sustaining polio immunisation in their jurisdictions. Traditional rulers can mobilise community members for vaccination days, provide venues for sessions, resolve disputes about immunisation, and hold health workers accountable for service delivery in their communities.

Fill in the blank: Religious leaders exercise significant influence over immunisation decisions in Nigeria, and their _____ of vaccination can overcome hesitancy, while their opposition can trigger boycotts, as demonstrated in 2003.

4.2.3 Community health workers and volunteers in immunisation

Community Health Extension Workers (CHEWs) and **Junior CHEWs (JCHEWs)** are the frontline immunisation workforce, conducting routine sessions at PHC facilities and outreach posts, mobilising communities for sessions, maintaining cold chain equipment at facility level, completing immunisation registers, and providing health education on the importance of completing the vaccination schedule. Their effectiveness depends on adequate **training**, regular **supervision**, reliable **supply of vaccines and consumables**, and **motivational support** including timely payment of immunisation allowances.

CHIPS agents (Community Health Influencers, Promoters, and Service agents) and other **community health volunteers** extend immunisation reach to the household level, identifying unvaccinated children, reminding caregivers about sessions, accompanying families to immunisation posts, and reporting barriers and defaulters to CHEWs. Volunteer programmes work best when volunteers are selected by their own communities, receive meaningful but manageable workloads, have access to clear referral pathways, and are recognised through non-financial incentives (certificates, community respect) as well as financial support where available.

Fill in the blank: _____ agents extend immunisation reach to household level by identifying unvaccinated children, reminding caregivers, accompanying families to sessions, and reporting barriers to CHEWs.

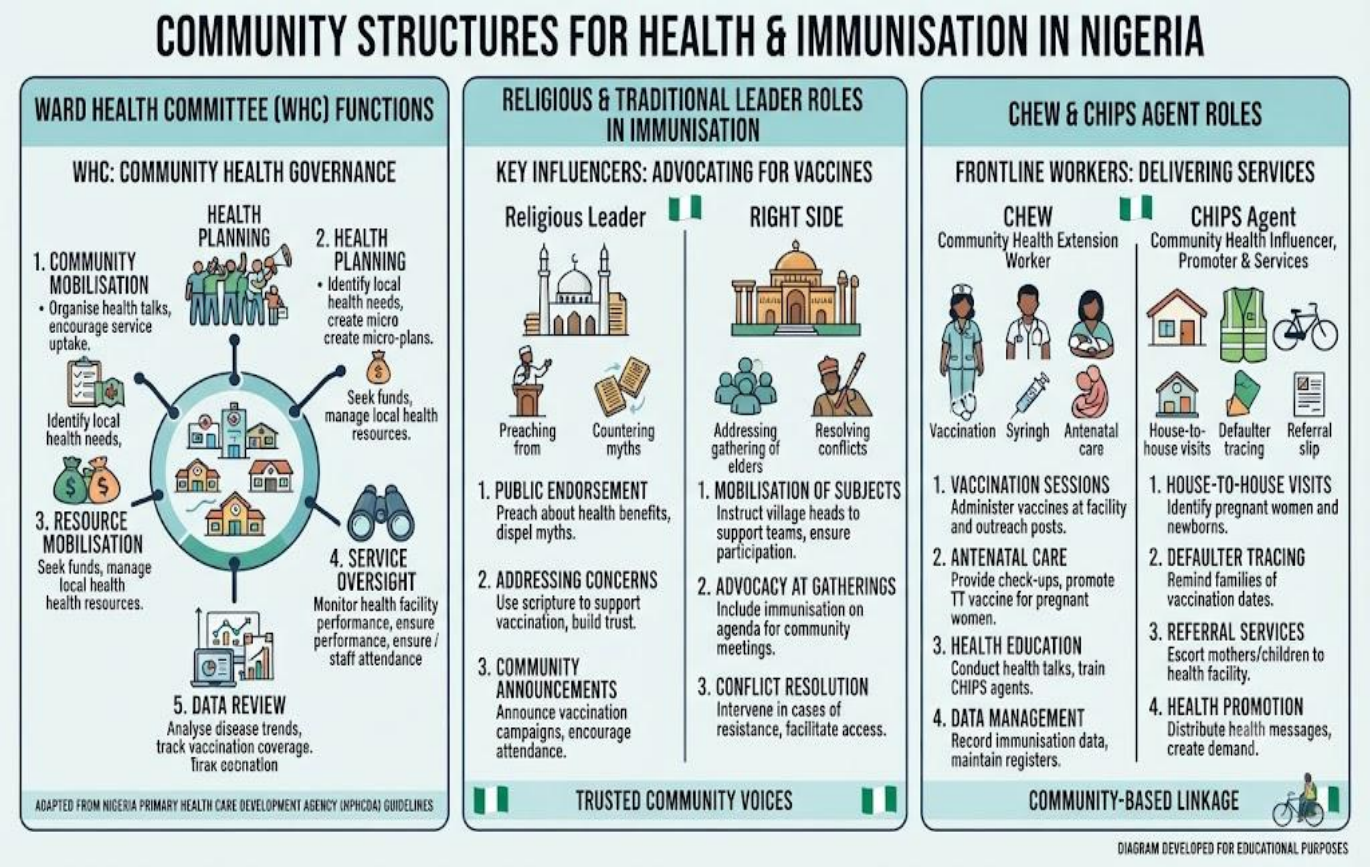

Figure 4.2: Community structures, leaders, and health workers in immunisation

Pilot questions 4.2

1. What is a ward health committee and what role does it play in immunisation?
2. Name two informal community structures that support immunisation mobilisation.
3. How did the 2003 northern Nigeria polio boycott demonstrate the influence of religious leaders on immunisation?
4. Name three ways in which traditional rulers can support immunisation.
5. What conditions are needed for CHIPS agents to function effectively?

4.3 The Role of NGOs and Civil Society in Immunisation

4.3.1 NGO contributions to immunisation programmes

Non-governmental organisations (NGOs) make diverse and substantial contributions to immunisation in Nigeria. **International NGOs** such as Save the Children, Catholic Relief Services (CRS), and Médecins Sans Frontières (MSF) implement immunisation programmes in hard-to-reach, conflict-affected, and humanitarian settings where government services cannot consistently reach, including in north-east Nigeria and among internally displaced populations. They bring **technical expertise**, **logistical capacity**, and **community trust** built through broader humanitarian and development programming that government vaccination teams alone may lack in fragile settings.

National NGOs and community-based organisations (CBOs) perform complementary functions: social mobilisation for immunisation campaigns, **defaulter tracking** (identifying and following up children who missed scheduled doses), **community feedback** collection on immunisation service quality, and advocacy with local governments for improved PHC funding and staffing. **Rotary International**, through its **PolioPlus programme**, has contributed over US$2 billion globally and significant resources specifically to Nigerian polio eradication, including financing of National Immunisation Days, social mobilisation, and surveillance activities.

Fill in the blank: _____ International, through its PolioPlus programme, has contributed over US$2 billion globally to polio eradication, including financing National Immunisation Days and social mobilisation in Nigeria.

4.3.2 Civil society advocacy for immunisation

Civil society organisations (CSOs) advocate for immunisation by holding governments accountable for immunisation commitments, making the case for increased domestic funding, and ensuring that immunisation remains a policy priority in competition with other development spending. **Budget tracking** by CSOs (monitoring whether federal and state governments actually disburse the immunisation allocations they have committed to in approved budgets) is a critical accountability function that can expose underfunding and motivate corrective action. In Nigeria,

civil society coalitions have been active in monitoring BHCPF allocations for PHC including immunisation.

CSOs also conduct **community-level accountability** work: reporting on immunisation session quality, vaccine availability, and health worker attendance through structured **community scorecards** and **social audits** that give community members a formal voice in assessing and demanding improvements to immunisation services. **Media engagement** by civil society, including investigative reporting on immunisation programme gaps and campaigns to correct vaccine misinformation, plays an important role in shaping the information environment in which parents make vaccination decisions.

Fill in the blank: Civil society _____ tracking monitors whether federal and state governments disburse committed immunisation budget allocations, exposing underfunding and motivating corrective action.

4.3.3 Partnerships between NGOs, government, and communities

Effective immunisation programmes depend on **multi-stakeholder partnerships** in which government, NGOs, community structures, religious leaders, and international agencies each contribute their comparative advantages. Government provides **policy authority**, **regulatory frameworks**, and **public financing**. NGOs bring **flexible financing**, technical expertise, and ability to operate in environments where government services are weak. Community structures and leaders provide **social legitimacy** and **last-mile mobilisation** capacity. International agencies provide **vaccines**, **technical standards**, and **coordination** across actors.

Partnership effectiveness requires **clear role definition** (preventing duplication and gaps), **shared data systems** (enabling all partners to see the same coverage picture and respond to the same gaps), **joint planning** (coordinating supplementary campaigns and outreach to avoid the fragmentation that weakens overall programme coherence), and **mutual accountability** (each partner answerable to the others and to the communities served). The **ICC structure** examined in Series 3 is the primary vehicle for this multi-stakeholder coordination at national and state level in Nigeria.

Fill in the blank: Effective immunisation partnerships require clear role definition, shared _____ systems, joint planning, and mutual accountability, with each partner answerable to others and to the communities served.

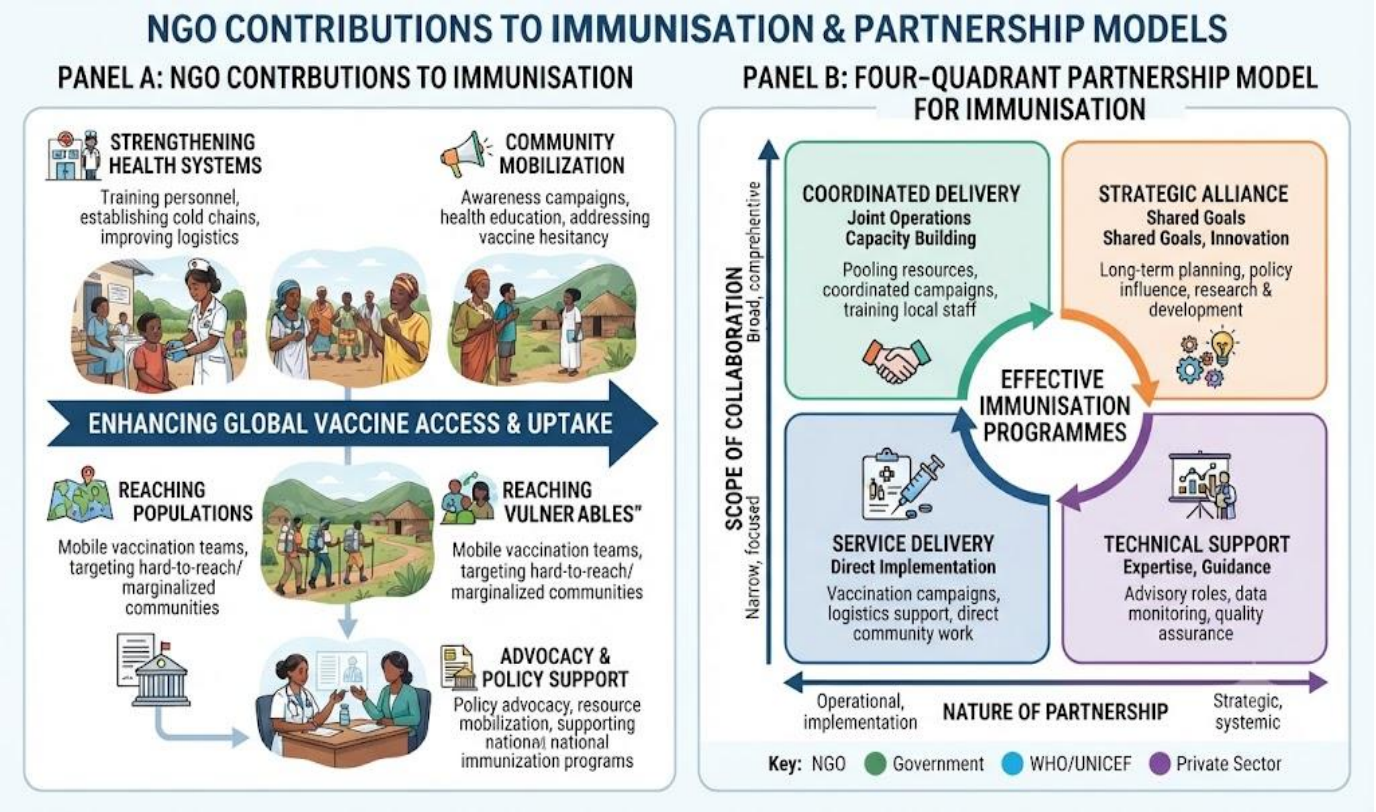

Figure 4.3: NGO contributions and multi-stakeholder partnerships in immunisation

Pilot questions 4.3

1. Name two international NGOs involved in immunisation in Nigeria and describe one contribution of each.
2. What is defaulter tracking and why is it important?
3. Name two civil society accountability functions in immunisation.
4. What comparative advantage does each of government, NGOs, and community structures bring to immunisation partnerships?
5. What four requirements does partnership effectiveness depend on?

Series Summary

This Series examined the social actors whose decisions and actions determine whether immunisation reaches every child. The family was identified as the first decision-making unit, with immunisation decisions shaped by mothers, fathers, grandmothers, and mothers-in-law. Parental knowledge and attitudes were examined through the WHO SAGE hesitancy model (confidence, complacency, convenience), and demand-side barriers were addressed through interpersonal communication, social mobilisation, mobile immunisation, flexible scheduling, and reminder systems. Community structures including ward health committees and women groups were described as essential social infrastructure.

Religious leaders and traditional rulers were examined as powerful immunisation actors whose endorsement or opposition directly affects coverage, with Nigerian examples from the polio programme. CHEWs and CHIPS agents were described as the frontline delivery and household-level outreach workforce. NGO contributions were examined through international and national NGO roles, Rotary International PolioPlus, and civil society accountability functions including budget tracking, community scorecards, and media engagement. The Series concluded by examining the multi-stakeholder partnership model that integrates government, NGOs, community structures, and international agencies for effective immunisation delivery (SLOs 4.1 to 4.5).

Glossary of Terms

1. **CHIPS agent:** Community Health Influencer, Promoter, and Service agent; a community health volunteer who extends immunisation reach to the household level.
2. **Civil society organisation (CSO):** a non-governmental, non-profit organisation engaged in advocacy, accountability, and community engagement, including for immunisation.
3. **Complacency:** low perceived risk of vaccine-preventable disease reducing motivation to vaccinate; one of the three WHO SAGE determinants of vaccine hesitancy.

4. **Community scorecard:** a structured community accountability tool through which community members formally assess and report on the quality of health services including immunisation.
5. **Confidence:** trust in vaccine safety, efficacy, and health system delivery; one of the three WHO SAGE determinants of vaccine hesitancy.
6. **Convenience:** physical and logistical access to immunisation services; one of the three WHO SAGE determinants of vaccine hesitancy.
7. **Defaulter tracking:** the systematic identification and follow-up of children who have missed scheduled immunisation doses.
8. **ICC (Inter-Agency Coordinating Committee):** the multi-stakeholder coordination body for immunisation in Nigeria, co-chaired by the Federal Ministry of Health and UNICEF.
9. **PolioPlus:** Rotary International programme that has contributed over US$2 billion globally to polio eradication, including in Nigeria.
10. **Ward health committee:** a community governance body comprising community representatives, traditional leaders, religious leaders, and local government officials that oversees PHC including immunisation at ward level.

Concept Check Questions [Series 4]

Objective questions

- In Nigerian households, immunisation decisions involve mothers, _____ , grandmothers, and mothers-in-law, requiring deliberate male partner engagement. (Linked to SLO 4.1)
- The WHO SAGE model identifies confidence, _____ , and convenience as the three determinants of vaccine hesitancy. (Linked to SLO 4.2)

- _____ communication by CHEWs at household level addresses individual concerns and reduces demand-side immunisation barriers. (Linked to SLO 4.2)
- _____ health committees comprising community representatives, traditional leaders, and local government officials oversee PHC including immunisation. (Linked to SLO 4.3)
- Religious leaders endorsement of immunisation can overcome hesitancy, while their opposition can trigger _____ as demonstrated in northern Nigeria in 2003. (Linked to SLO 4.3)
- Civil society _____ tracking monitors whether governments disburse committed immunisation budget allocations. (Linked to SLO 4.5)

Short-answer questions

- Describe the role of religious and traditional leaders in immunisation in Nigeria, with examples. (Linked to SLO 4.3)
- Explain the contributions of NGOs and civil society to immunisation programmes in Nigeria. (Linked to SLO 4.4)

Long-answer questions

- Discuss the role of the family in immunisation, covering decision-making, parental knowledge and attitudes, barriers to uptake, and strategies for addressing them. (Linked to SLOs 4.1–4.2)
- Evaluate the multi-stakeholder partnership model for immunisation in Nigeria, describing the comparative advantage of government, NGOs, community structures, and international agencies. (Linked to SLOs 4.4–4.5)

Answers to Concept Check Questions [Series 4]

Objective questions

1. Fathers.
2. Complacency.
3. Interpersonal.
4. Ward.
5. Boycotts.
6. Budget.

Short-answer questions

7. Religious leaders: Islamic scholars and Christian pastors influence health decisions; endorsement overcomes hesitancy, opposition triggers boycotts (2003 northern Nigeria polio crisis); interfaith networks and UNICEF-supported Islamic scholar training have produced immunisation champions with documented impact on coverage. Traditional rulers: emirs, obas, and village chiefs command compliance; Sultan of Sokoto and Emir of Kano pivotal in polio immunisation; they mobilise communities for vaccination days, provide session venues, resolve disputes, and hold health workers accountable.
8. International NGOs (Save the Children, CRS, MSF): implement immunisation in hard-to-reach and conflict settings, bring technical expertise and community trust. National NGOs and CBOs: social mobilisation, defaulter tracking, community feedback, local government advocacy. Rotary International PolioPlus: over US$2 billion globally to polio eradication, financing NIDs, social mobilisation, and surveillance in Nigeria. CSO accountability: budget tracking of immunisation allocations; community scorecards and social audits; media engagement to correct misinformation and report programme gaps.

Long-answer questions

9. **Basic response:** Decision-making: mother is primary caregiver but fathers, grandmothers, and mothers-in-law influence decisions; male partner engagement and inclusive household messaging improve coverage. Knowledge: parents who understand

schedule, multi-dose rationale, and normality of mild reactions complete vaccination; those who do not are at higher dropout risk. Attitudes and hesitancy (WHO SAGE model): confidence (trust in safety, efficacy, system), complacency (low perceived disease risk), convenience (access). Barriers: lack of awareness, misconceptions (infertility, autism fears), distance, long wait times, gender travel restrictions. Strategies: interpersonal communication by CHEWs, social mobilisation, mobile immunisation, flexible scheduling, reminder systems.

Value-added response: The WHO SAGE hesitancy model is particularly useful for immunisation programme planning because it directs interventions to specific determinants rather than treating hesitancy as a single problem requiring a single solution. Communities with low confidence need trust-building through transparent communication and credible messengers (religious leaders, community health workers known to the household); those with complacency need disease risk communication that makes the continued threat vivid and personally relevant; those with access barriers need service delivery innovations (mobile sessions, evening scheduling, transport vouchers) rather than communication campaigns. Failing to diagnose which determinant predominates in a specific community leads to generic interventions that address the wrong driver.

10. **Basic response:** Government: policy authority, regulatory frameworks, public financing, infrastructure. NGOs: flexible financing, technical expertise, capacity in fragile settings where government services are weak. Community structures (ward health committees, women groups, community volunteers): social legitimacy, last-mile mobilisation, community trust, feedback on service quality. International agencies (WHO, UNICEF, GAVI): vaccines, technical standards, global evidence, coordination across partners. ICC coordinates all partners at national and state level. Requirements: clear role definition (prevent duplication and gaps), shared data systems (same coverage picture), joint planning (coordinated campaigns), mutual accountability.

Value-added response: The comparative advantage model in immunisation partnerships works best when each partner genuinely contributes what the others cannot readily replicate, rather than competing for the same activities or audiences. In practice, the most common

partnership failure in Nigerian immunisation is duplication of social mobilisation activities in accessible areas while hard-to-reach communities remain uncovered, because all partners gravitate toward contexts where their investment is visible and measurable. A genuinely effective partnership explicitly maps geographic and population gaps, assigns each gap to the partner best positioned to address it, and creates accountability systems that make coverage in hard-to-reach areas as visible as coverage in urban centres.

Answers to Pilot Questions [Series 4]

Part 4.1

6. Because it is the caregiver (most often the mother) who decides whether to bring a child to sessions, return for subsequent doses, and manage post-vaccination reactions, and this sustained engagement is the most important determinant of schedule completion.
7. Husbands and fathers, grandmothers, and mothers-in-law.
8. Confidence (trust in vaccine safety, efficacy, and health system delivery), complacency (low perceived risk of vaccine-preventable disease), and convenience (physical and logistical access to services).
9. Any four of: lack of awareness of the schedule and session locations; misconceptions about vaccine safety (infertility, autism fears); distance and transport costs; long waiting times; gender barriers restricting women travelling without male escort.
10. Any three of: interpersonal communication by CHEWs at household level; community-level social mobilisation through town halls, markets, and religious gatherings; mobile immunisation bringing sessions to communities; flexible scheduling (evenings or weekends); SMS or volunteer reminder systems.

Part 4.2

11. A ward health committee comprises community representatives, traditional leaders, religious leaders, and local government officials who jointly plan, mobilise for, and provide oversight of PHC services including immunisation sessions at ward level.

12. Women groups (market women associations, mothers clubs, cooperative societies) and community development committees (also acceptable: village health teams).
13. Religious leaders in Kano, Zamfara, and Kaduna alleged vaccine contamination and called for a boycott, leading to cessation of OPV campaigns, poliovirus resurgence across Nigeria and spread to other African countries, demonstrating that religious leader opposition can halt an entire immunisation programme in affected communities.
14. Any three of: mobilising community members for vaccination days; providing venues for immunisation sessions; resolving disputes about immunisation; holding health workers accountable for service delivery.
15. Selected by their own communities; manageable and clearly defined workloads; access to clear referral pathways; recognition through non-financial incentives (certificates, community respect) and financial support where available; regular supervision and training.

Part 4.3

1. Any two of: Save the Children (immunisation in hard-to-reach and humanitarian settings); Catholic Relief Services or MSF (conflict-affected and displaced populations); Rotary International (PolioPlus, contributing to National Immunisation Days and surveillance in Nigeria).
2. Defaulter tracking is the systematic identification and follow-up of children who have missed scheduled immunisation doses. It is important because dropout between first and subsequent doses is a major cause of incomplete immunisation, and proactive follow-up can recover missed children before they are lost to the programme permanently.
3. Budget tracking (monitoring government disbursement of committed immunisation allocations) and community scorecards/social audits (structured assessment of service quality by community members). Also acceptable: media engagement to correct misinformation.

4. Government: policy authority, regulatory frameworks, public financing. NGOs: flexible financing, technical expertise, capacity in fragile settings. Community structures: social legitimacy, last-mile mobilisation, community trust.
5. Clear role definition, shared data systems, joint planning, and mutual accountability.

References and Attributions [Series 4]

Textual references

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7. Kaufman, J., Attwell, K., & Wakefield, M. (2021). The influence of social networks on vaccine uptake. Human Vaccines and Immunotherapeutics, 17(3), 793-800.
8. National Primary Health Care Development Agency. (2021). National immunisation coverage survey 2021. NPHCDA.
9. National Open University of Nigeria (NOUN). (2023). Immunity and immunisation programme course material. NOUN Press.

Figures, Plates, Tables, and Boxes

11. Figure 4.1: Family role in immunisation and barriers to uptake Attribution: AI generated using prompt "Generate a two-panel diagram showing the household immunisation decision web and demand-side barriers with corresponding strategies." Suggested OER search string: "family immunisation decision-making parental knowledge vaccine hesitancy barriers mobile immunisation social mobilisation OER"
12. Figure 4.2: Community structures, leaders, and health workers in immunisation Attribution: AI generated using prompt "Generate a three-panel diagram showing ward health committee functions, religious and traditional leader roles in immunisation, and CHEW and CHIPS agent roles." Suggested OER search string: "ward health committee religious leaders traditional rulers immunisation Nigeria CHEWs CHIPS agents community OER"
13. Figure 4.3: NGO contributions and multi-stakeholder partnerships in immunisation Attribution: AI generated using prompt "Generate a two-panel diagram showing NGO contributions to immunisation and a four-quadrant partnership model." Suggested OER search string: "NGO immunisation Nigeria Rotary civil society partnership government community international agencies OER"

Course code: COM 409

Course title: Immunity and Immunisation Programme

Course credit load: 1 Unit

Series 5: Vaccination Advocacy and Travel Medicine

- **Part 5.1: Vaccination Advocacy**
  - Sub Part 5.1.1: Principles and objectives of vaccination advocacy
  - Sub Part 5.1.2: Addressing vaccine hesitancy and misinformation
  - Sub Part 5.1.3: Communication strategies for immunisation advocacy
- **Part 5.2: Adverse Events Following Immunisation**
  - Sub Part 5.2.1: Classification of adverse events following immunisation
  - Sub Part 5.2.2: AEFI surveillance and reporting in Nigeria
  - Sub Part 5.2.3: Managing and communicating about AEFIs
- **Part 5.3: Travel Medicine and Immunisation**
  - Sub Part 5.3.1: Concept and scope of travel medicine
  - Sub Part 5.3.2: Recommended and required vaccines for international travel
  - Sub Part 5.3.3: Synthesis and the future of immunisation in Nigeria

Introduction

The final Series of this course brings together two practical dimensions of immunisation that complement the programme knowledge of earlier Series: vaccination advocacy, the active communication work needed to sustain public support and counter misinformation, and travel medicine, the specialised immunisation practice that protects Nigerian travellers going abroad and the population from diseases they may introduce on return. Together with the course synthesis, these topics complete the practical competencies needed for immunisation programme practice.

The aim of this Series is to describe the principles and communication strategies of vaccination advocacy; examine adverse events following immunisation, their classification, surveillance, and management; describe travel medicine and the recommended and required vaccines for international travel; and synthesise the course themes in the context of the future of immunisation in Nigeria.

We shall commence by examining vaccination advocacy principles and strategies for addressing hesitancy and misinformation. Next, we will examine adverse events following immunisation, their classification, surveillance, and communication. Finally, we will close by examining travel medicine and synthesising the immunisation programme knowledge and competencies developed across the full course.

Series Learning Outcomes

Upon completing this Series, you should be able to:

- **SLO 5.1** explain the principles and objectives of vaccination advocacy,
- **SLO 5.2** describe strategies for addressing vaccine hesitancy and misinformation,
- **SLO 5.3** classify adverse events following immunisation and describe AEFI surveillance in Nigeria,
- **SLO 5.4** explain how to manage and communicate about AEFIs,
- **SLO 5.5** describe travel medicine and the vaccines required and recommended for international travel, and

- **SLO 5.6** synthesise immunisation programme knowledge in the context of the future of immunisation in Nigeria.

5.1 Vaccination Advocacy

5.1.1 Principles and objectives of vaccination advocacy

Vaccination advocacy is the deliberate use of **communication, evidence, and influence** to sustain and strengthen public and political support for immunisation programmes. Its objectives include: **maintaining public confidence** in vaccine safety and efficacy; **increasing demand** for vaccination among hesitant populations; **securing political commitment** and adequate domestic funding for the NPI; **countering vaccine misinformation** before it undermines coverage; and **sustaining media** and community leader support for immunisation as a health and development priority.

Effective vaccination advocacy is **evidence-based** (drawing on epidemiological data to demonstrate disease burden and vaccine impact), **audience-centred** (tailoring messages to the specific concerns, values, and information environment of each target audience rather than delivering a single generic message), and **sustained** (not limited to crisis response when outbreaks occur or coverage falls, but maintained proactively to build and protect the social licence for immunisation before crises develop). The principles of health education and advocacy examined in related courses apply directly to vaccination advocacy practice.

Fill in the blank: Effective vaccination advocacy is evidence-based, audience-centred, and _____, maintaining proactive communication to build public support before crises such as outbreaks or coverage declines develop.

5.1.2 Addressing vaccine hesitancy and misinformation

Vaccine **misinformation** (false claims about vaccine safety, efficacy, or composition circulated as if factual) and **disinformation** (deliberately false content spread with intent to deceive) are

increasingly transmitted through **social media** at speed and scale that outpaces traditional health communication responses. Effective counter-messaging requires **rapid response capacity** (identifying and responding to false claims before they become entrenched), **trusted messenger deployment** (using community members, religious leaders, and healthcare providers, not only government spokespersons, to deliver corrections), and **inoculation** (pre-emptively warning audiences about common misinformation tactics before they encounter the false content).

For individual hesitant caregivers, the evidence consistently supports **presumptive communication** (announcing that a child is due for vaccination and preparing the vaccine, rather than opening with a question about whether the caregiver wants it, reducing the cognitive framing of vaccination as optional) and **motivational interviewing** techniques that acknowledge concerns without validating misinformation, explore the caregiver own values and motivations, and build toward a collaborative decision rather than a confrontational one. **Correcting misinformation directly** without also providing accurate alternative information is less effective than providing the accurate information prominently alongside the correction.

Fill in the blank: _____ communication announces that a child is due for vaccination and prepares the vaccine, rather than asking whether the caregiver wants it, reducing the framing of vaccination as optional.

5.1.3 Communication strategies for immunisation advocacy

Immunisation advocacy uses a **multi-channel communication strategy** matching messages to audiences and channels for maximum reach and resonance. **Mass media** (television, radio, print, and increasingly social and digital media) provide broad reach for awareness campaigns, immunisation day announcements, and counter-misinformation messaging. **Community media** (local radio in vernacular languages, community bulletin boards, mosque and church announcements) reaches audiences that national media does not serve in local languages or with community-specific relevance.

Interpersonal communication by trusted community members, CHEWs, and CHIPS agents remains the most effective channel for addressing individual hesitancy and changing behaviour, consistently outperforming mass media alone in producing actual vaccination behaviour change.

Social media engagement (official and partner social media accounts providing accurate, shareable immunisation content, monitoring platforms for misinformation, and engaging influencers as immunisation champions) is an increasingly important advocacy channel, particularly for reaching educated urban populations. **Advocacy briefs and data visualisations** directed at policymakers and funders make the evidence case for immunisation investment in formats accessible to non-technical decision-makers.

Fill in the blank: _____ communication by CHEWs and trusted community members remains the most effective channel for addressing individual vaccine hesitancy and producing actual vaccination behaviour change.

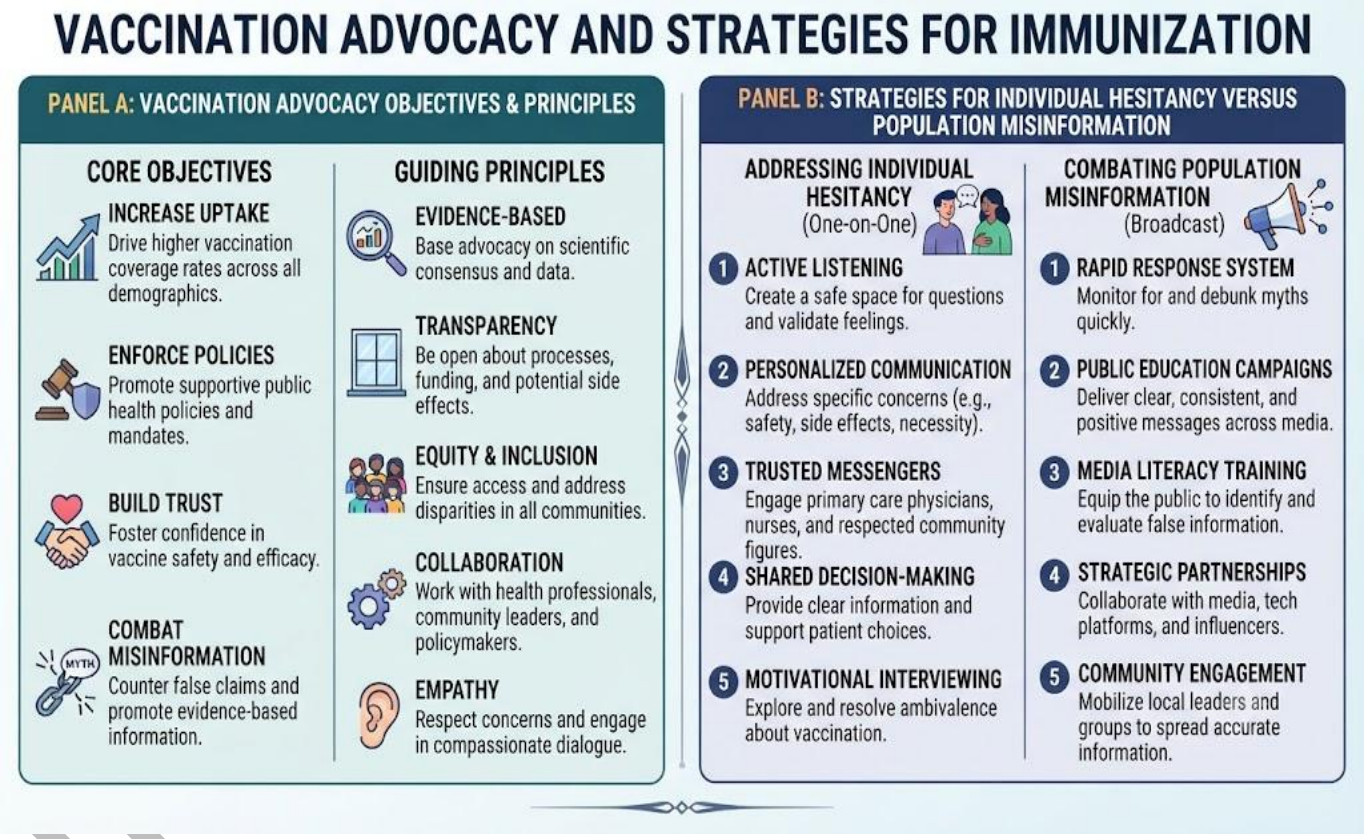

Figure 5.1: Vaccination advocacy strategies and addressing hesitancy

Pilot questions 5.1

1. State three objectives of vaccination advocacy.
2. Distinguish between vaccine misinformation and disinformation.

3. What is inoculation as a misinformation counter-strategy?
4. What is presumptive communication and why is it effective?
5. Name three communication channels used in immunisation advocacy.

5.2 Adverse Events Following Immunisation

5.2.1 Classification of adverse events following immunisation

An **adverse event following immunisation (AEFI)** is any untoward medical occurrence that follows immunisation and does not necessarily have a causal relationship with the vaccine. AEFIs are classified into five categories. **Vaccine product-related reactions** are caused by intrinsic properties of the vaccine (for example, fever following MMR vaccination). **Vaccine quality defect-related reactions** result from manufacturing defects. **Immunisation error-related reactions** are caused by incorrect administration (wrong site, wrong dose, contaminated vial).

Immunisation anxiety-related reactions are responses to the immunisation process rather than the vaccine itself, including **vasovagal syncope** (fainting), hyperventilation, and anxiety attacks, particularly common in adolescents. **Coincidental events** are conditions that occur after immunisation but are unrelated to it, coinciding only in timing. The distinction between vaccine-caused and coincidental events is critical for AEFI investigation: falsely attributing a coincidental event to vaccination can trigger unjustified hesitancy, while failing to identify a genuine vaccine-caused reaction impairs safety monitoring. Severity is classified as **serious** (requiring hospitalisation, causing persistent disability, or life-threatening) or **non-serious**.

Fill in the blank: _____ events are conditions that occur after immunisation but are unrelated to it, coinciding only in timing, and must be distinguished from genuine vaccine-caused reactions to prevent unjustified hesitancy.

5.2.2 AEFI surveillance and reporting in Nigeria

AEFI surveillance is the systematic identification, investigation, and analysis of adverse events to monitor vaccine safety and detect signals of previously unknown reactions. In Nigeria, the **NPHCDA** coordinates AEFI surveillance in partnership with the **National Agency for Food and Drug Administration and Control (NAFDAC)** and the **National Pharmacovigilance Centre (NPC)** of the Federal Ministry of Health. Every health facility administering vaccines is expected to identify, document, and report AEFIs through the national reporting system, with serious AEFIs requiring **immediate reporting** within 24 to 48 hours.

The **AEFI Investigation Committee** at national and state levels reviews reported serious events, conducts causality assessment (determining whether the event is truly vaccine-related or coincidental), and recommends corrective action where vaccine product or programme quality issues are identified. **Under-reporting** of AEFIs is a major challenge in Nigeria: health workers may not recognise reportable events, may fear attribution of blame, or may lack knowledge of the reporting pathway. **Health worker training** in AEFI recognition and reporting, and **supportive supervision** that decouples AEFI reporting from blame, are essential for improving surveillance quality.

Fill in the blank: _____ reporting of AEFIs in Nigeria is a major challenge because health workers may not recognise reportable events, may fear blame, or may lack knowledge of the reporting pathway.

5.2.3 Managing and communicating about AEFIs

Clinical management of AEFIs depends on the type and severity of the reaction. **Common minor reactions** (local redness, swelling, pain; mild fever; irritability) require only reassurance and symptomatic treatment (paracetamol for fever, cold compress for local reactions) and do not contraindicate subsequent doses. **Anaphylaxis**, the most serious immediate AEFI, requires **immediate intramuscular adrenaline**, followed by antihistamine and corticosteroid, and emergency referral. All immunisation sites must have adrenaline available and health workers trained in its administration.

Communicating about AEFIs requires **transparency** and **speed**: delayed or evasive communication about a known AEFI cluster generates more distrust than honest, timely disclosure. The **risk communication** principle of **'be first, be right, be credible'** applies directly: the first explanation people receive tends to be the most influential, making it essential that health authorities communicate early with accurate information rather than waiting for full investigation results. **Community-level communication** through CHEWs, community leaders, and ward health committees after an AEFI incident is essential for maintaining immunisation acceptance in the affected community.

Fill in the blank: Anaphylaxis, the most serious immediate AEFI, requires immediate intramuscular _____ followed by antihistamine and corticosteroid, and emergency referral.

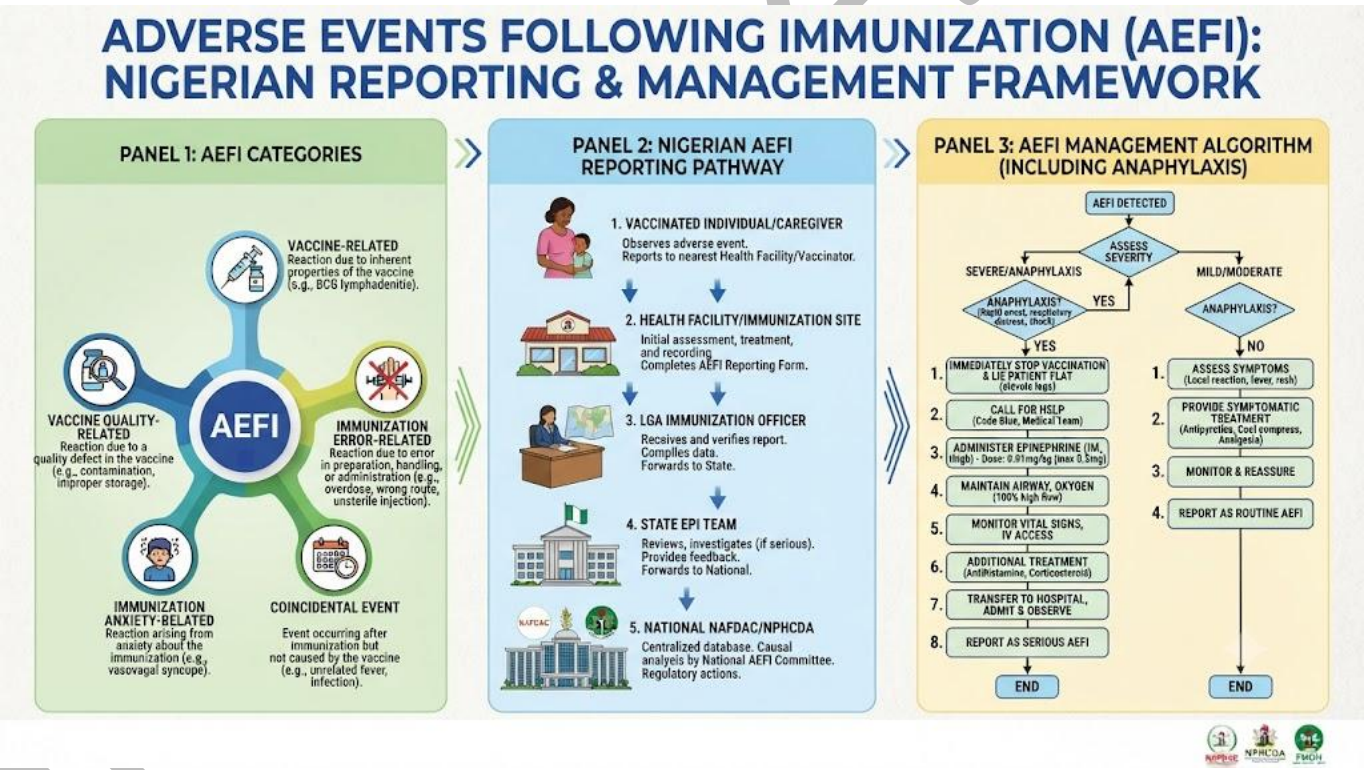

Figure 5.2: AEFI classification, surveillance, and management

Pilot questions 5.2

1. Name the five categories of AEFI.

2. Why is the distinction between coincidental events and vaccine-caused reactions important?
3. Which national bodies are responsible for AEFI surveillance in Nigeria?
4. What immediate treatment is required for anaphylaxis following immunisation?
5. Describe the risk communication principles for managing an AEFI cluster.

5.3 Travel Medicine and Immunisation

5.3.1 Concept and scope of travel medicine

Travel medicine is the branch of medicine concerned with the prevention and management of health problems associated with international travel. Its scope includes: pre-travel **risk assessment** and advice; **travel vaccinations** (both required and recommended); **malaria chemoprophylaxis** and prevention of other travel-related infections; management of illness during and after travel; and **post-travel screening** for infections that may have been acquired abroad. In Nigeria, travel medicine services are provided by travel clinics, private hospitals with international health units, and some government facilities with yellow fever vaccination centres.

The traveller risk profile determines the specific preventive measures recommended. Key **risk factors** include the **destination country** and its endemic diseases; the **purpose and duration of travel** (tourism, business, long-term mission, or humanitarian work each carry different exposure risks); the traveller **accommodation and activities** (rural versus urban, adventure versus conference travel); the traveller **health and immunisation status**; and **time before departure** (some vaccines require multiple doses over weeks or months, requiring early pre-travel consultation). Travel medicine consultations should ideally occur **at least 4 to 6 weeks before departure**.

Fill in the blank: Travel medicine consultations should ideally occur at least _____ to 6 weeks before departure to allow sufficient time for multi-dose vaccines and malaria prophylaxis to be initiated.

5.3.2 Recommended and required vaccines for international travel

Some vaccines are **required** (legally mandated by destination countries or the International Health Regulations) and others are **recommended** (advised based on destination disease risk but not legally required). The **yellow fever vaccine** is the most important required vaccine for international travel from Nigeria: travellers departing Nigeria for many countries in Africa, Asia, the Americas, and Europe must carry a valid **International Certificate of Vaccination or Prophylaxis (ICVP)** as proof of yellow fever vaccination, administered by an **authorised yellow fever vaccination centre**. Conversely, Nigeria requires proof of yellow fever vaccination for all arriving international travellers.

Recommended vaccines for travel from Nigeria vary by destination. **Hepatitis A** (recommended for travel to regions with poor sanitation), **typhoid** (recommended for destinations with high typhoid prevalence), **meningococcal vaccines** (required for Hajj and Umrah pilgrims, recommended for sub-Saharan Africa travel), **rabies pre-exposure prophylaxis** (for travellers with high animal exposure risk), and **Japanese encephalitis** (for travel to endemic Asian regions) are among the most commonly recommended. **COVID-19 vaccination** requirements and recommendations vary by destination and continue to evolve.

Fill in the blank: The _____ vaccine is the most important required travel vaccine for Nigerians, with valid International Certificate of Vaccination or Prophylaxis (ICVP) required by many destination countries.

5.3.3 Synthesis: the future of immunisation in Nigeria

This course has traced the science of immunity from its cellular and molecular foundations through to the social, political, and logistical realities of delivering vaccines to every Nigerian child. A consistent theme has been the **gap between available knowledge and equitable delivery**: the vaccines and immunological understanding needed to protect every Nigerian child exist, yet fewer than half of Nigerian children are fully immunised. Closing this gap requires not only technical solutions but **sustained political will**, **community engagement**, and **accountability** at every level of the health system.

The future of immunisation in Nigeria will be shaped by several converging forces: **new vaccine technologies** (mRNA platforms, thermostable formulations, microneedle delivery) reducing logistical barriers; **digital systems** (electronic registries, real-time coverage tracking) improving accountability; **GAVI transition** toward greater domestic self-financing requiring sustained government commitment; and **global health threats** (emerging pathogens, antimicrobial resistance) making strong immunisation systems more essential than ever. Health practitioners who combine immunological knowledge, programme competence, advocacy skill, and community engagement capacity, as developed across the five Series of this course, are the foundation on which a stronger Nigerian immunisation programme will be built.

Fill in the blank: The future of immunisation in Nigeria will be shaped by new vaccine technologies, digital accountability systems, GAVI _____ toward domestic self-financing, and the imperative of strong health systems in the face of global health threats.

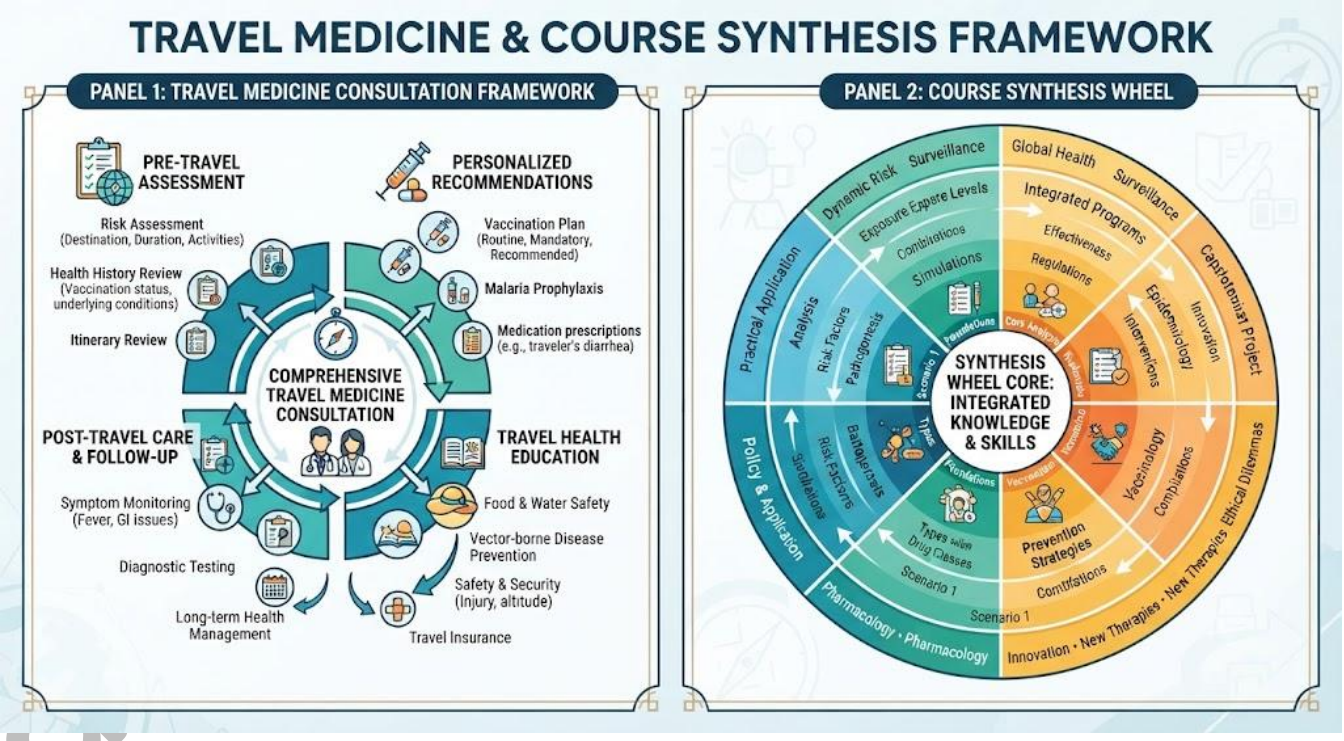

Figure 5.3: Travel medicine and the future of immunisation in Nigeria

Pilot questions 5.3

1. Define travel medicine and name three areas within its scope.

2. Name four risk factors that determine the preventive measures recommended for a traveller.
3. Why is yellow fever vaccination particularly important for Nigerian international travellers?
4. Name three vaccines recommended for specific travel destinations from Nigeria.
5. What forces will shape the future of immunisation in Nigeria?

Series Summary

This final Series completed the COM 409 course by examining vaccination advocacy, adverse events following immunisation, and travel medicine. Vaccination advocacy was described through its evidence-based, audience-centred, sustained principles and objectives, with strategies for addressing hesitancy (presumptive communication, motivational interviewing) and population-level misinformation (rapid response, trusted messengers, inoculation). AEFIs were classified into five categories (vaccine product-related, quality defect-related, immunisation error-related, anxiety-related, and coincidental), with AEFI surveillance in Nigeria coordinated by NPHCDA, NAFDAC, and the National Pharmacovigilance Centre.

AEFI management was described through clinical responses to common and serious reactions including anaphylaxis, and through risk communication principles of transparency and speed. Travel medicine was described through its pre-travel consultation framework, the distinction between required (yellow fever) and recommended vaccines, and the specific vaccines commonly advised for travel from Nigeria. The Series and course concluded with a synthesis identifying the gap between available immunological knowledge and equitable coverage as the central challenge, and the convergence of new technologies, digital systems, GAVI transition, and global health imperatives as forces shaping the future of immunisation in Nigeria (SLOs 5.1 to 5.6).

Glossary of Terms

1. **AEFI (adverse event following immunisation):** any untoward medical occurrence that follows immunisation and does not necessarily have a causal relationship with the vaccine.
2. **Anaphylaxis:** a severe, life-threatening immediate hypersensitivity reaction requiring emergency intramuscular adrenaline as first-line treatment.
3. **Causality assessment:** the process of determining whether a reported AEFI is truly caused by a vaccine or is coincidental.

4. **Disinformation:** deliberately false content about vaccines spread with intent to deceive, as distinct from misinformation which may be spread without malicious intent.
5. **ICVP (International Certificate of Vaccination or Prophylaxis):** the internationally recognised document proving yellow fever vaccination, required for entry to many countries.
6. **Inoculation:** a misinformation counter-strategy that pre-emptively warns audiences about common false claims before they encounter them.
7. **Motivational interviewing:** a communication technique that acknowledges concerns, explores values, and builds toward a collaborative decision rather than a confrontational one.
8. **Presumptive communication:** a vaccine counselling approach that announces a child is due for vaccination and prepares the vaccine, reducing the framing of vaccination as optional.
9. **Travel medicine:** the branch of medicine concerned with preventing and managing health problems associated with international travel.
10. **Vasovagal syncope:** fainting caused by an anxiety response to the immunisation process rather than a property of the vaccine; classified as an immunisation anxiety-related AEFI.

Concept Check Questions [Series 5]

Objective questions

- Effective vaccination advocacy is evidence-based, audience-centred, and _____ , maintaining proactive communication before crises develop. (Linked to SLO 5.1)
- _____ communication announces that a child is due for vaccination and prepares the vaccine, reducing the framing of vaccination as optional. (Linked to SLO 5.2)
- _____ events occur after immunisation but are unrelated to it and coincide only in timing with vaccination. (Linked to SLO 5.3)
- Anaphylaxis requires immediate intramuscular _____ as first-line treatment. (Linked to SLO 5.4)
- Nigerian international travellers to many countries must carry a valid _____ as proof of yellow fever vaccination. (Linked to SLO 5.5)
- The future of Nigerian immunisation will be shaped by new technologies, digital systems, GAVI _____ , and global health threats. (Linked to SLO 5.6)

Short-answer questions

- Describe the five categories of AEFI and give one example of each. (Linked to SLO 5.3)
- Describe the risk communication principles for managing an AEFI cluster and explain why transparency is essential. (Linked to SLO 5.4)

Long-answer questions

- Discuss vaccination advocacy, covering its principles, strategies for addressing hesitancy and misinformation, and the communication channels used. (Linked to SLOs 5.1–5.2)
- Evaluate AEFI surveillance and management in Nigeria, covering classification, reporting pathways, clinical management, and communication. (Linked to SLOs 5.3–5.4)

Answers to Concept Check Questions [Series 5]

Objective questions

1. Sustained.
2. Presumptive.
3. Coincidental.
4. Adrenaline.
5. ICVP.
6. Transition.

Short-answer questions

7. Vaccine product-related: fever after MMR vaccine. Quality defect-related: abscess from contaminated vaccine batch. Immunisation error-related: nerve injury from incorrect injection site. Immunisation anxiety-related: vasovagal syncope (fainting) in an adolescent after vaccination. Coincidental: a child develops a febrile illness from a separate infection within days of vaccination, unrelated to the vaccine.
8. Risk communication principles: be first (communicate early, before false narratives fill the information vacuum); be right (communicate accurate information even if incomplete, and correct it as more is known); be credible (use trusted messengers including community and religious leaders, not only government spokespersons). Transparency is essential because delayed or evasive communication generates more distrust than honest disclosure, and the first explanation people receive tends to be the most influential, meaning early inaccurate communication is harder to correct than early accurate disclosure.

Long-answer questions

9. **Basic response:** Principles: evidence-based (epidemiological data on disease burden and vaccine impact), audience-centred (tailored messages for specific concerns and values), sustained (proactive, not only crisis response). Objectives: maintain public confidence, increase demand among hesitant populations, secure political commitment and funding,

counter misinformation. Hesitancy strategies: presumptive communication (announcing vaccine due and preparing it); motivational interviewing (acknowledge concerns, explore values, build collaborative decision). Misinformation strategies: rapid response, trusted messengers (religious leaders, CHEWs), inoculation (pre-emptive warning). Channels: mass media (awareness), community media (vernacular, local relevance), interpersonal communication (most effective for behaviour change), social media (educated urban populations), advocacy briefs (policymakers).

Value-added response: The evidence hierarchy for immunisation communication consistently places interpersonal communication from a trusted community member above all other channels for producing actual vaccination behaviour change, yet most immunisation advocacy budgets invest disproportionately in mass media campaigns that raise awareness without changing behaviour. The most cost-effective advocacy investment in the Nigerian context is strengthening the interpersonal communication capacity of CHEWs and community health volunteers, equipping them with accurate information, skills to address common objections, and consistent supervision, rather than additional television and radio campaigns that are already widely used.

10. **Basic response:** Classification: five categories (vaccine product-related, quality defect-related, immunisation error-related, anxiety-related, coincidental) with causality assessment distinguishing genuine vaccine-caused from coincidental events. Reporting: NPHCDA coordinates with NAFDAC and National Pharmacovigilance Centre; all facilities report AEFIs through national system; serious AEFIs within 24 to 48 hours; AEFI Investigation Committee conducts causality assessment and recommends action; under-reporting is a major challenge from poor recognition, fear of blame, and unknown pathways. Clinical management: common minor reactions (reassurance, paracetamol, cold compress); anaphylaxis (immediate IM adrenaline, antihistamine, corticosteroid, emergency referral); all sites must have adrenaline available. Communication: transparency and speed; be first, be right, be credible; community-level communication through CHEWs, community leaders, and ward health committees after incidents.

Value-added response: The challenge of AEFI communication illustrates a broader tension in immunisation practice: the more transparent a programme is about known risks, the more material it provides to anti-vaccine actors who selectively amplify risks while ignoring benefits. However, concealing or minimising AEFIs consistently backfires more severely than transparent disclosure, as cover-ups discovered later generate far greater and longer-lasting damage to programme credibility than honest initial disclosure. The programmes with the strongest vaccine safety credibility are those that actively publish and discuss AEFI data, demonstrating both the rarity of serious reactions and the robustness of the surveillance system that detects them.

Answers to Pilot Questions [Series 5]

Part 5.1

6. Any three of: maintaining public confidence in vaccine safety and efficacy; increasing demand among hesitant populations; securing political commitment and domestic funding; countering misinformation; sustaining media and community leader support.
7. Misinformation is false content about vaccines spread without necessarily malicious intent. Disinformation is deliberately false content spread with intent to deceive. Both are harmful, but disinformation reflects an intentional act to undermine vaccination.
8. Inoculation is pre-emptively warning an audience about common vaccine misinformation tactics and claims before they encounter them, building cognitive resistance to false narratives in the same way that exposure to a weakened pathogen builds immunological resistance.
9. Presumptive communication announces that a child is due for vaccination and prepares the vaccine rather than opening with a question about whether the caregiver wants it. It is effective because it frames vaccination as the expected, standard action rather than an optional choice, reducing the cognitive and social space for refusal.
10. Any three of: mass media (television, radio, print, digital); community media (local vernacular radio, mosque and church announcements); interpersonal communication by

CHEWs and community health volunteers; social media; advocacy briefs for policymakers.

Part 5.2

11. Vaccine product-related, vaccine quality defect-related, immunisation error-related, immunisation anxiety-related, and coincidental.
12. Because falsely attributing a coincidental event to vaccination can trigger unjustified hesitancy and undermine coverage, while failing to identify a genuine vaccine-caused reaction impairs safety monitoring and may allow a pattern of harm to continue undetected.
13. NPHCDA coordinates AEFI surveillance in partnership with NAFDAC (National Agency for Food and Drug Administration and Control) and the National Pharmacovigilance Centre of the Federal Ministry of Health.
14. Immediate intramuscular adrenaline, followed by antihistamine and corticosteroid, and emergency referral to a higher-level facility.
15. Communicate early (be first, before false narratives fill the vacuum); communicate accurately (be right, even if information is initially incomplete); use trusted messengers including community and religious leaders (be credible); communicate at community level through CHEWs, community leaders, and ward health committees.

Part 5.3

1. Travel medicine is the branch of medicine concerned with preventing and managing health problems associated with international travel. Three areas: pre-travel risk assessment and vaccinations; malaria chemoprophylaxis and infection prevention during travel; post-travel screening for acquired infections.

2. Any four of: destination country and its endemic diseases; purpose and duration of travel; accommodation and activities (rural versus urban, adventure versus conference); traveller health and immunisation status; time available before departure.
3. Because many destination countries legally require proof of yellow fever vaccination in the form of an ICVP for entry, and Nigeria itself requires proof of yellow fever vaccination for all arriving international travellers, making it both an entry requirement for Nigerians leaving and an import prevention measure for those arriving.
4. Any three of: hepatitis A (destinations with poor sanitation); typhoid (high prevalence destinations); meningococcal vaccines (required for Hajj and Umrah, recommended for sub-Saharan Africa); rabies pre-exposure prophylaxis (high animal exposure risk); Japanese encephalitis (endemic Asian regions).
5. New vaccine technologies (mRNA, thermostable, microneedle delivery); digital accountability systems (electronic registries, real-time coverage tracking); GAVI transition toward domestic self-financing; global health threats (emerging pathogens, antimicrobial resistance) increasing the imperative of strong immunisation systems.

References and Attributions [Series 5]

Textual references

6. World Health Organization. (2021). Communicating about adverse events following immunisation: A guide for immunisation programme managers. WHO Press.
7. Goldblatt, D., & Ramachandran, M. (2020). Vaccines for international travel. BMJ, 371, m3174.
8. Bedford, H., Attwell, K., Danchin, M., & Wallace, C. (2018). Vaccine hesitancy, refusal and access barriers: The need for clarity in terminology. Vaccine, 36(44), 6556-6558.
9. National Open University of Nigeria (NOUN). (2023). Immunity and immunisation programme course material. NOUN Press.

Figures, Plates, Tables, and Boxes

11. Figure 5.1: Vaccination advocacy strategies and addressing hesitancy Attribution: AI generated using prompt "Generate a two-panel diagram showing vaccination advocacy objectives and principles, and strategies for individual hesitancy versus population misinformation." Suggested OER search string: "vaccination advocacy hesitancy misinformation presumptive communication motivational interviewing inoculation OER"
12. Figure 5.2: AEFI classification, surveillance, and management Attribution: AI generated using prompt "Generate a three-panel diagram showing AEFI categories, the Nigerian reporting pathway, and a management algorithm including anaphylaxis." Suggested OER search string: "AEFI classification surveillance reporting Nigeria NPHCDA anaphylaxis management adrenaline OER"
13. Figure 5.3: Travel medicine and the future of immunisation in Nigeria Attribution: AI generated using prompt "Generate a two-panel diagram showing the travel medicine consultation framework and a course synthesis wheel." Suggested OER search string: "travel medicine yellow fever ICVP typhoid meningococcal hepatitis A Nigeria synthesis immunisation OER"