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# Vaccines and immunization: The past, present and future in Nigeria

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**Abstract** Vaccines are arguably the most important public health tools available today. Since the successful eradication of small-pox with the use of the vaccine, many vaccines have become available to man. Of great importance to public and child health are the vaccines against the so-called six killer diseases of childhood- measles, pertussis, diphtheria, tetanus, tuberculosis and poliomyelitis. In the last 2 decades, effective vaccines against the major causes of pneumonia, another childhood killer, have become available. Data from many parts of the world including African countries have shown the benefits of the *pneumococcal* and *Haemophilus influenzae type b* vaccines. The scientific world is still searching for appropriate candidate vaccines for malaria and HIV infection. Despite the availability and effectiveness of many vaccines, the benefits to a country is highly dependent on a viable and sustainable health system which include adequate financing, dynamic and motivated workforce, strong partnerships and effective community participation. If well deployed, available vaccines as elucidated in this discourse can accelerate the achievements of the Millennium Development Goals in Nigeria and many other developing countries.

**Key words**: Vaccines, Immunizations, Nigeria.

## Introduction

*Immunity*: Protection from microbes recognized as foreign. The immune system is composed of organs & specialized cells that protect the body by identifying harmful substances & destroying them using anti-bodies, and other specialized substances & cells.

*Primary immune response*: Following antigenic challenge antibodies, specific helper and effector T lymphocytes including those producing cytokines and killer T cells are produced.

*Vaccine*: Any preparation intending to produce immunity to a disease by stimulating the production of antibodies. Can prevent or ameliorate the effect of infections by many pathogens. Most common method of administration is by injections, but can be given orally or by nasal spray.

*Candidate vaccine*: Any vaccine for which the development was foreseeable with the next decade.

*Vaccine efficacy*: A population based measure of protection rather than a measure of antibody production in an individual. This is represented by the equation below:

Rate of illness in unvaccinated population Rate of illness in vaccinated population
Rate of illness in unvaccinated population

*Vaccine preventable illness*: Is that portion of disease burden that could be prevented by immunization of entire target population with hypothetical vaccine 100% effective against the strain included in it.

*Vaccination*: Is the administrations of antigenic materials to produced immunity to a disease. It was originally used specifically to describe the injection of small pox.

*Immunization*: A process of artificial induction of immunity in an effort to protect against infectious disease.

*Active Immunization*: Induces in the recipient a degree of immunity similar to that achieved from the natural infection, and is able to prevent clinical disease. Produced by individual immune system and the immunity are usually long lasting.

*Passive Immunization*: Is the administration of exogenously preformed antibodies, and the immunity is temporary. Commonest source is that obtained transplacentally. Others are blood and blood products, immune or hyper immune globulin & animal antitoxin.

*Toxoid*: This is made from purified toxins produced by infective agent, attenuated to neutralize this toxic effect without reducing antigenicity e.g tetanus toxoid, diphtheria toxoid.

*Potency*: Ability of vaccine to elicit a particular response at a certain dose in other to work. It is a measure of a vaccine activity in biological system.

*Clinical trial:* A scientifically designed and executed investigation of the effects of a drug (or vaccine) administered to human subjects. The goal is to define the safety, clinical efficacy, and pharmacological effects (including toxicity, side effects, incompatibilities, or interactions) of the drug.

*Randomized*: Each study subject is randomly assigned to receive either the study treatment or a placebo.

*Blind*: The subjects involved in the study do not know which study treatment they receive. If the study is double-blind, the researchers also do not know which treatment is being given to any given subject.

*Double-dummy design*: Allows additional insurance against bias or placebo effect. In this kind of study, all patients are given both placebo and active doses in alternating periods of time during the study.

*Placebo-controlled*: The use of a placebo (fake treatment) allows the researchers to isolate the effect of the study treatment. Open-label means that both the participants and the scientists know what is given.

*Vector*: Is a packaging system that can help deliver the vaccine more effectively into the correct part of the body or into the correct cell to create an immune response.

*Insert*: Consists of some extra genes added into the vector.

**Types of Vaccine**

*Inactivated Vaccine:* Consist of virus particles which are grown in culture and then killed using heat or formaldehyde. These particles are destroyed but capsid proteins are intact enough to be recognized and remembered by immune system, thus evoking a response. It is non-replicating, with less interference from circulating antibodies. Requires more doses and causes a mostly humoral immune response. The antibody titre diminishes with time.

Examples of inactivated vaccines include:

Viral- poliomyelitis (salk) hepatitis A, Rabies, influenza

Bacteria- pertussis, typhoid, cholera, plague, anthrax

Fractional subunit hepatitis B, acellular pertussis, human papilloma virus

Toxoids diphtheria, tetanus

Polysaccharide pneumococcal, meningococcal, salmonella typhi

Conjugate polysaccharide- Hib, pneumococccal, meningococcal

Recombinant hepatitis b , human papilloma virus, influenza

Immune globulin homologous pooled antibody.hepatitis A, measles

Homologous human hyperimmune globulin. PEP hepatitis B, rabies, tetanus, varicella

Heterologous hyperimmune serum(antitoxin): antitoxin derived from injecting animals with the organism such as for botulism, diphtheria

Monoclonal antibodies derived from the clone of antibody producing cells, e.g. RSV.- Palivizumab

*Live Attenuated Vaccines:* Produced by modifying a naturally occurring organism (wild) usually by repeated culturing, and retains the ability to replicate and produce immune response similar to natural infection. Circulating antibody may interfere with response. Provides long lasting immunity, and one dose usually suffices. Examples of live attenuated viruses- poliomyelitis, measles, rubella, mumps, rabies, varicella, yellow fever, rotavirus, influenza. Examples of live attenuated bacteria- Bacille Calmette Guerin, typhoid.

**Benefits of Immunization**

It is a proven tool for controlling & eliminating life threatening infectious diseases (over 2million deaths per year).

Avoids suffering, disability and death.

One of the most cost effective health investment with proven strategies that make it

accessible to most hard to reach & vulnerable population.
Can be delivered effectively through outreach activities.
Ease strain on health care system, and money is saved for use in other health care services.
Has clearly defined target group.
Does not require any major change in life style.

**National Programme on Immunization (NPI)**

This was introduced in Nigeria in 1979. From 1979 1997, the program was known and called Expanded Programme on Immunization (EPI). To give a national outlook and show Federal Government commitment, the Federal Govt. established an agency called NPI under Decree 12 in August 1997. This is to effectively control the occurrence of all vaccine preventable diseases through immunization and provision of vaccine and other consumable. Focus is on prevention, control & eradication of the following vaccine preventable disease in Nigeria i.e. tuberculosis, measles, diphtheria, pertussis, neonatal tetanus, cerebrospinal meningitis, yellow fever and polio. These are targeted through immunization service delivery and this is done by administration of vaccine to susceptible target.

NPI aim the following group of people: Children of age ≤ 11month, all pregnant women and women of reproducing age group.

**Immunization schedule in Nigeria**

Birth $OPV^0$, $HBV^1$, BCG
6weeks $OPV^1$, $DPT^1$, $HBV^2$
10weeks $OPV^2$, $DPT^2$
14weeks $OPV^3$, $DPT^3$, $HBV^3$
9months Measles, Yellow fever, Vitamin $A^1$
15 months- Vitamin $A^2$

In pregnant women, or women in reproducing age group:
Tt1 at 1st contact no protection
TT2 4wks later 80% protection for 3years
TT3 6mths later 95% protection for 5 years
TT4 1year later or in subsequent pregnancy 99% protection for 10 years
Tt5 1 year later or in subsequent pregnancy 99% protection for life

**History and impact of immunisation**

Long before the causes of disease were known and the processes of recovery were understood, the Chinese trial of exposing uninfected individuals to matter from smallpox lesions was used.

This process, known as "variolation," took a variety of forms. One form consisted of removing pus and fluid from a smallpox lesion and using a needle to place it under the skin of the person to be protected. The second involved peeling scabs from lesions, drying and grinding them to a powder, and letting an uninfected person inhale this powder.

The third method involved picking up a small amount of the scab powder with a needle and then using the needle to place the powder directly into the individual's veins. Although the effects of variolation varied, ranging from causing a mild illness in most individuals to causing death in a few, the mortality and morbidity rates due to smallpox were certainly lower in populations that used variolation than in those that did not.

Edward Jenner noticed a relationship between the equine disease known as "grease" and a bovine disease known as "cow pox. “At the same time, Jenner was interested when a milkmaid told him that she could not catch smallpox because she had had cowpox. Jenner noted that there were many people like the milkmaid - people who milked cows and who did not get smallpox even when exposed repeatedly. With this in mind, Jenner undertook a daring experiment in 1796:

It soon became clear that Jenner's experiments had paid off, and that intentional infection with cowpox protected people from much more serious infection with smallpox. As a result, within a few years thousands of people protected themselves from the deadly smallpox disease by intentionally infecting themselves with cowpox. Jenner's process came to be called "vaccination," after "vacca," the Latin word for cow, and the substance used to vaccinate was called a "vaccine."

Now, over 200 years later, we have progressed from a time when vaccination was a rare event, and Jenner's theories about vaccination were not widely accepted, to the late 1900s when vaccines are so commonplace that most children receive multiple vaccinations before they reach their first birthdays. The result of such widespread vaccination has been a marked decrease in diseases which once ravaged the world's population.

Below is the timeline of some vaccines:
1721- Introduction into Britain from Turkey by Lady Wortley Montagu of inoculation of material from smallpox patients into healthy persons (*variolation*)
1796 -First vaccination against smallpox performed by Jenner
1881 -Pasteur, Roux, and Chamberland introduced anthrax vaccine

1885 -Pasteur developed rabies vaccine
1895 -Yersin produced plague vaccine
1898 -Almroth Wright developed typhoid vaccine
1921 -Calmette and Guérin introduced BCG vaccine
1923 -Ramon developed diphtheria toxoid
1927 -Ramon and Zoeller developed tetanus toxoid
1940 -National immunization campaign launched in Britain by Ministry of Health; did not become widespread until 1942
1954 -*Salk* (killed) polio vaccine introduced
1957 -*Sabin* (live) polio vaccine introduced
1960 -Measles vaccine developed by Enders
1962 -Rubella vaccine developed by Weller
1967 -Jeryl Lynn strain of live attenuated mumps vaccine licensed in the US
1968 Meningococcal (type C) vaccine developed. Measles vaccine introduced on a national scale in Britain
1970 -Rubella vaccine became available in Britain
1981 -Hepatitis B vaccine licensed in US
1988 -Measles, Mumps, Rubella (MMR) vaccine introduced into Britain
1992 -Haemophilus influenzae b (HiB) vaccine introduced into Britain

**Global Immunization Data**

Based on the World Health Organization (WHO)/UNICEF global estimates for 2008, trends related to global vaccination coverage continue to be positive. Immunization currently averts an estimated 2.5 million deaths every year in all age groups from diphtheria, tetanus, pertussis (whooping cough), and measles. More children than ever before are being reached with immunization. In 2008, an estimated 106 million children under the age of one were vaccinated with three doses of diphtheria-tetanus-pertussis (DTP3) vaccine.

More countries achieve high levels of vaccination coverage. Three regions: the Americas, Europe and Western Pacific maintained over 90% immunization coverage. The number of countries reaching 90% or more immunization coverage with DTP3 vaccine in 2008: 120 countries compared to 117 in 2007. The number of countries reaching over 80% DTP3 coverage in 2008: 151 countries in 2008 compared to 150 in 2007.

*DPT*: Global coverage of infants in 2008 with DTP3 vaccine was 82%, while in 1990 DTP3 vaccine coverage was75%. Estimated number of children vaccinated with DTP3 vaccine in 2008: 106 million.

*Polio:* Global coverage of infants with three doses of polio vaccine in 2008 was 83%, but in 1990 it was 75%. Reported number of polio cases in 2008: 1730 confirmed polio cases (including 1651 wild virus confirmed cases) as against 350 000 in 1988. The number of polio-endemic countries in 2008 was 4, as against 125 in 1988.

*Measles:* Global coverage of children by their second birthday with one dose of measles containing vaccine in 2008: 83%, while the global coverage of children by their second birthday with one dose of measles containing vaccine in 1990: 73%. Number of countries with a second dose of measles vaccine in routine immunization schedule: 133 (69% of 193 countries). Number of estimated measles deaths in 2007: 197 000 [141 000 - 267 000], of which 177 000 [126 000 - 240 000] were under age five.

*Maternal and Neonatal Tetanus*: The number of countries that had not yet eliminated MNT in 2008 was 46. Number of women living in high-risk areas protected with at least two doses of tetanus toxoid vaccine given during supplementary immunization activities (1999-2008): 90 million.

*Hepatitis B:* Global coverage of infants with three doses of hepatitis B vaccine in 2008 had increased to 69% from 1% in 1990.

Increasing uptake of new and underused vaccines

*Hepatitis B vaccine*: The use of this vaccine for infants was introduced nationwide in 177 countries (including in parts of India and the Sudan) by the end of 2008, up from 171 countries in 2007. Global hepatitis B vaccine coverage is estimated at 69% and is as high as 89% in the Western Pacific and 88% in the Americas. Coverage in the South-East Asia Region increased from 29% to 41%, over the same period. Haemophilus influenzae type B (Hib) vaccine was introduced nationwide in 136 countries (including in parts of Belarus, Pakistan and the Sudan) by the end of 2008, from 115 countries in 2007. Global coverage with three doses of Hib vaccine is estimated at 28% in 2008, reaching 90% in the Americas, but only 4% in the Western Pacific Region.

*Maternal and neonatal tetanus (MNT)*: The vaccine to prevent MNT was introduced as part of routine immunization programmes in over 100 countries by the end of 2008. Vaccination coverage with at least two doses of tetanus toxoid vaccine or tetanus-diphtheria toxoid vaccine was estimated at 74% in 2008 and an estimated 81% of newborns were protected against neonatal tetanus through immunization. As of December 2008, maternal and neonatal tetanus persist as public health problems in 46 countries, mainly in Africa and Asia.

*Pneumococcal vaccine:* Introduced in 31 countries (including five countries where the vaccine was partially introduced) by the end of 2008, up from 20 countries in 2007.

*Rotavirus vaccine*: Introduced in 19 countries (including two countries where the vaccine was partially introduced) by the end of 2008.

*Yellow fever vaccine*: Introduced in routine infant immunization programmes in 34 countries and territories out of the 44 at risk for yellow fever in Africa and the Americas.

*The unprotected children:* The number of children under one year of age who did not receive DTP3 vaccine worldwide: 23.5 million in 2008 compared to 23.9 million in 2007. Seventy percent of these children live in ten countries: Chad, China, Democratic Republic of the Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan and Uganda.

**Deaths due to vaccine-preventable diseases (VPD)**

More than 10 million deaths occur globally in children age < 5, of which 24% are due to VPD. The total number of children who died from diseases preventable by vaccines currently recommended by WHO, plus diseases for which vaccines are expected soon is 2.5 million. Distribution is hepatitis B: 600 000, Hib: 363 000, pertussis: 254 000, tetanus: 163 000, others (polio, diphtheria, yellow fever): 36 000.

Estimated number of deaths in children under five from diseases preventable by vaccines (excluding measles) currently recommended by WHO is 890 000 as Hib: 363 000, pertussis: 254 000, neonatal tetanus: 128 000, tetanus (non-neonatal): 16 000, others (polio, diphtheria, yellow fever): 19 000.

Estimated number of deaths in children under five due to rotavirus and pneumococcus: 1.3 million, as pneumococcal disease: 735 000, and rotavirus: 527 000.

**In Nigeria**

Immunization rates in Northern Nigeria are some of the lowest in the world. According to the 2003 National Immunization Schedule the percentage of fully immunized infants on the States to be targeted was less than 1% in Jigawa, 1.5% in Yobe, 1.6% in Zamfara and 8.3% in Katsina. As a result thousands of children are dying as victims of vaccine preventable diseases. In many parts of the north, barely 10 percent of children receive all of their routine vaccines. Coverage rates for the vaccine against tetanus among women are equally low. Why?

Firstly the primary health care services are highly ineffective and have deteriorated due to the lack of investment in personnel, facilities and drugs, and because of poor management of the existing resources. A formerly strong primary health care system in northern Nigeria has weakened over many years. Polio outbreaks, rumors on the safety of the polio vaccine, and subsequent campaigns disrupted routine immunization services. Routine immunization services are either no longer available or irregular; limited resources for health services and gaps in vaccine storage and distribution add to the challenge of increasing immunization coverage. There is also a problem of confidence and trust by the public in the health services resulting from the poor state of the facilities and low standards of delivery. These problems have been exacerbated by "vertical" interventions undertaken by outside agencies which undermined the capacity of the local service providers to implement sustainable programmes. At the family / community level there is a low demand for immunization due to a lack of understanding of its value.

**Development of New Vaccines**

A number of new vaccines with major potential for controlling infectious diseases have just been licensed or are at advanced stages of development. Among the illnesses targeted are rotavirus diarrhoea, pneumococcal disease, malaria and HIV which together kill more than a million children each year, most of them in developing countries. Vaccine development proceeds through discovery, process engineering, toxicology and animal studies to human Phase I, II, and III, and IV trials. The process can take more than 10 years, depending on the disease.

**The human trials**

Phase I focus is on safety, involving small groups of people(20-100)

Phase II moderate-sized "target" populations (persons close to the age and other xteristics for whom the vaccine is intended) to determine both safety and the stimulation of immune response (20-300)

Phase III - large target populations (30-3000)to establish whether a vaccine actually prevents a disease as intended (efficacy) ,

Phase IV trial is also known as post marketing surveillance trial. It involves the safety surveillance (pharmacovigilance), and ongoing technical support of a drug after it receives permission to be sold.

**Obstacles to introduction of new vaccines**

Falter in the gains of the EPI of the late 1980s. The initial high worldwide coverage decreased from 80% to < 50% of infants receiving their third dose of DPT, esp. in sub-Saharan Africa.

Increasing divergence between vaccine products used in the industrialized versus developing worlds. This divergence include newer generation vaccines, several vaccines and vaccine formulations that had formerly been used jointly in industrialized and developing country populations ceased to be recommended in industrialized countries.

Little incentive for the vaccine industry in the industrialized world to develop new vaccines against diseases that were largely limited to the developing world, as industrialized world markets are more lucrative.

The increasing stringency of regulations imposed by national vaccine licensing authorities usually result in an increase in the costs of clinical development pathways for licensure of vaccine candidates to hundreds of millions of dollars. New generation vaccines would have to cost dollars per dose in order for industry to recover an adequate return on its investmentin contrast to the pennies per dose cost of the traditional EPI vaccine.

It had become increasingly common to find that vaccines performed less well in developing country populations than in populations residing in the industrialized world. Trials of vaccines in developing countries were needed before their introduction in these settings, and trials in developing countries - not a priority for large producers in the industrialized world. If they were undertaken, they were typically deferred for years after vaccine licensure in industrialized

## Opportunities for vaccine introduction

To overcome the disincentives to industry of creating new vaccines for the developing world, Governments in the industrialized world have traditionally used 'push mechanisms. Push mechanisms - aim is to lower the risks and costs to industry of research and development, and includes; providing grants for product development, supporting the costs of clinical trials, strengthening of field sites in developing countries, providing research and development tax credits and expediting the regulatory and licensing process.

Increased funding- major contributors are foundations. This is due to the increasing recognition that infectious diseases are major threats to global security, and infectious diseases can spread rapidly from the tropics to the industrialized world. Several diseases of importance to the developing world are also potential bioterrorism threats.

The emergence of public-private partnerships (PPPs). PPPs are coordinated by nonprofit organizations that raise money from the public sector and use this money to leverage efforts by both the public and the private sectors to develop and produce affordable vaccines for the developing world. PPPs are involved in accelerating the development of vaccines against malaria, tuberculosis and HIV. Examples of PPP are the International AIDS Vaccine Initiative, the AERAS Global TB Vaccine Foundation, the Malaria Vaccine Initiative, and the Global Alliance for Vaccines and Immunization (GAVI)

The emergence of high quality vaccine producers and capable national regulatory authorities in the developing world. In Brazil, Cuba, India and Indonesia certain manufacturers have been prequalified by the World Health Organization to supply EPI vaccines for purchase by United Nations agencies. Due to location and the available market of selling vaccines, the void of the increasing departure of the international companies is being filled.

**New and Underused Vaccines in Developing Countries**

*Typhoid fever Vaccine*

*S. typhi vaccine* developed in1896, heat-killed, phenol-preserved, injectable whole-cell, still licensed in several countries despite its high reactogenicity.

Two new vaccines are currently licensed and widely used worldwide, a subunit (Vi PS) vaccine given via the intramuscular route, andTy21a- a live attenuated S typhi strain given orally.

*The Vi polysaccharide vaccine*: Administered as one dose (25g) via the IM/SC route. It is given to school-aged children and protective for at least three years, with a good safety profile. It is poorly immunogenic in infants and not used in children less than 2 years of age.

*The Ty21a vaccine*: The first live oral typhoid fever vaccine, administered as enteric-coated capsules to be swallowed every other day for one week. The vaccine is protective for at least 5-7 years.

*Rotaviruses (RV) Vaccine*

Rotavirus diarrhoea is a leading cause of severe diarrhoeal disease and dehydration in infants and under-5 yrs children globally. Three oral RV vaccines are currently licensed.

Human monovalent live attenuated RV strain, Rotarix™, given as a 2-dose monovalent oral vaccine.

Pentavalent live bovine-human reassortant vaccine, RotaTeq™, a live-attenuated, 3-dose oral vaccine. Part of national vaccination programs in several countries, including USA. A Phase III trial is ongoing in African countries (Mali, Ghana, and Kenya) and concluded at the end of 2009.

Lamb-derived monovalent live attenuated strain, LLR, which is only being used in China.

Several countries have introduced the Rotarix™ and Rotateq™ vaccines into routine immunization programmes

*RotaShield™ vaccine was introduced in the USA , administered in a three dose schedule but intussusception noted within two weeks after administration of the first two doses of vaccine, thus leading to its eventual withdrawal.

**Streptococcus pneumoniae Vaccine**

*Steptococcus pneumoniae:* infection is a leading cause of morbidity and mortality among children worldwide and particularly in developing countries, estimated that 10.6 million children less than 5 years present with pneumococcal disease every year. There are two types of vaccines currently licensed for use.

the pneumococcal polysaccharide vaccine (PPV), based on purified capsular PS

pneumococcal conjugate vaccines (PCV), obtained by chemical conjugation of the capsular PS to a protein carrier.

*23-valent polysaccharide vaccine (PPV23):* The PPV23 vaccine contains the purified capsular PS from each of the 23 different S pneumoniae serotypes that together account for 90% of cases of severe pneumococcal disease in industrialized countries. Two vaccines are currently manufactured, Pneumovax 23™ (Merck) and Pneumo 23™ (Sanofipasteur).

A good antibody response is achieved following a single IM injection in 60-80% of healthy adults and normal children over two years of age. PPV23 is unable to elicit immune memory, so that a second dose of vaccine does not boost antibody levels. Also, PPV23 does not provide protection against mucosal infection, and is thus unable to reduce nasopharyngeal carriage of pneumococci. It is poorly immunogenic in less than 2 years old children and is thus not used in infants and young children.

*Pneumococcal conjugate vaccines (PCV):* The first PCV, Prevnar ™ (Wyeth), is recommended for routine use in children aged less than two years. It is administered in a 3 doses schedule, and when possible in combination with usual routine vaccination, followed by a booster dose at 15-18 months. Alternatively, the vaccine can be administered in a two-dose immunization schedule at 3 and 5 months of age, followed by a booster immunization at 11-12 months of age. It contains poly- or oligo-saccharides from seven *S. pneumoniae* serotypes (4, 6B, 9V, 14, 18C, 19F and 23F), each conjugated to genetically detoxified diphtheria toxin CRM 197. Currently there are at least the PCV-10 and PCV-13 being used mainly in the private sector and in the high risk populations in Nigeria.

*Haemophilus influenzae type b (Hib) Vaccines*

Infections by *Haemophilus influenzae* type b are responsible for severe pneumonia, meningitis and other invasive diseases almost exclusively in children aged less than 5 years. It is estimated to cause at least 3 million cases of serious disease every year, and approximately 386 000 deaths.

*Hib conjugate vaccines*: The Hib conjugate vaccines consist of preparations of polyribosylribitol phosphate (PRP) (the capsular polysaccharide of Hib) conjugated to a protein carrier PRP covalently bound to a carrier protein. When conjugated, the carrier protein induces a T-cell dependent B-cell immune response to the polysaccharide. The Hib vaccines currently licensed for use in infants consist of PRP conjugated to a protein carrier as listed below:

the nontoxic mutant diphtheria toxin CRM 197 (oligosaccharide conjugate PRPCRM197),

tetanus toxoid (PRPT),

meningococcal outer membrane protein (PRPOMP).

The vaccines are formulated either as single antigens or as part of combination vaccines. Hib vaccines are safe and efficacious even when administered in early infancy. Liquid Hib vaccines are used directly from the vial, whereas freeze-dried vaccines must be reconstituted before administration, either with diluent or with another vaccine that has been specifically identified and indicated for this purpose by the manufacturer, such as DTP.

*Malaria Vaccine*

Approximately 350500 million cases of malaria occur annually, killing between one and three million people, the majority of whom are young children in sub-Saharan Africa. Ninety percent of malaria-related deaths occur in sub-Saharan Africa.

Malaria vaccines are in the developmental phase, and there are different strategies been developed based on the life cycle of the Plasmodium spp.

Pre-erythrocytic vaccine strategies prevent infection and/or reduce incidence and severity of disease. Aim is to generate an antibody response that will neutralize sporozoites and prevent them from invading the hepatocyte, and/or to elicit a cell-mediated immune response that will inhibit intra-hepatic parasites.

Asexual blood-stage (erythrocytic) vaccine strategies reduce disease incidence and severity. Aim is to elicit antibodies that will inactivate merozoites and/or target malarial antigens expressed on the RBC surface, thus inducing antibody-dependent cellular cytotoxicity and complement lysis; they also are intended to elicit T-cell responses that will inhibit the development of the parasite in RBCs : Sexual blood stage (transmission blocking) malaria vaccines are targeting gametocytes, gametes and/or zygotes. It aims to prevent man to mosquito transmission.

The RTS, S vaccine is the first malaria vaccine candidate to demonstrate that young children and infants exposed to intense *Plasmodium falciparum* transmission can be protected from infection and malaria disease. Current malaria prevention programs and national immunization programs need to be strengthened in order to be prepared for the introduction of malaria vaccines when approved by regulatory authorities and recommended as an additional anti-malaria tool.

**Barriers to Use of Existing Childhood Vaccines**

- Lack of disease burden data
- Weak health systems and its attendant poor logistics such as cold chain
- Poor transportation and storage systems
- Inadequate and poorly motivated health care worker
- Lack of political will
- Barriers to use of "new" vaccines
- Poor health financing
- Weak community participation
- Lack of sustainable partnerships

**Improving Vaccine Use in Developing Countries**

*Advocate its use*

- Generation of local burden of disease data (disease surveillance systems, regional sentinel sites) which can be used to create awareness and sensitized the population to support the vaccine.
- Demonstration of immunogenicity, efficacy and safety in the local population
- Cost effectiveness data (1 vaccine or comparisons?)
- Inform policy makers, opinion leaders and Health Care Workers
- Inform the community through proper and sustained engagement and involvement

*Pay for its use (GAVI)*

- Immunization Systems Strengthening (ISS) support performance/reward based system
- New Vaccine Support (NVS) vaccine provided for 1st five years
  - Decrease costs of vaccines (local production)
  - Develop easy to use vaccines (no cold chain)
  - Decrease the number of dosages
  - Targeted vaccination
  - Who to vaccinate? Importance of unvaccinated pockets? Importance of differences between rural and urban?
  - Large Household vaccination: Vaccinees chosen sequentially from those households with the largest number of susceptibles

**Conclusion**

Resources for introducing new vaccines and sustaining their use in developing countries, including Nigeria are still comparatively scarce. The resources will probably not ever be sufficient to support the use of all new generation vaccines of potential public health utility. Wise use of these funds demands several types of evidence to inform policy decisions. Simplified, inexpensive and valid methods for obtaining crucial data at the country level, such as the burden and costs of disease is needed. There is a need to create an intellectual framework via research to synthesize diverse types of relevant evidence to assess the comparative merits of alternative vaccines and then communicated to policymakers. To reduce childhood mortality we need action now, traditional advocacy methods have been slow and small in effect.

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**References**


1. Bonnie A, Okonek M and Peters PM .Vaccines--How and Why?
2. WHO vaccine-preventable disease monitoring system, 2009 global summary.
3. WHO/UNICEF Review of National Immunization
4. Coverage 1980-2008 NIGERIA JULY 2009
5. Global and regional immunization profile, African Region, 2009.
6. Global Immunization Data, October 2009.
7. WHO vaccine-preventable diseases monitoring system 2010 global summary - country profile Nigeria.