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PERSPECTIVE

PAN Advisory Committee on Immunisation

Paediatric Association of Nigeria (PAN) recommended routine immunization schedule for Nigerian children

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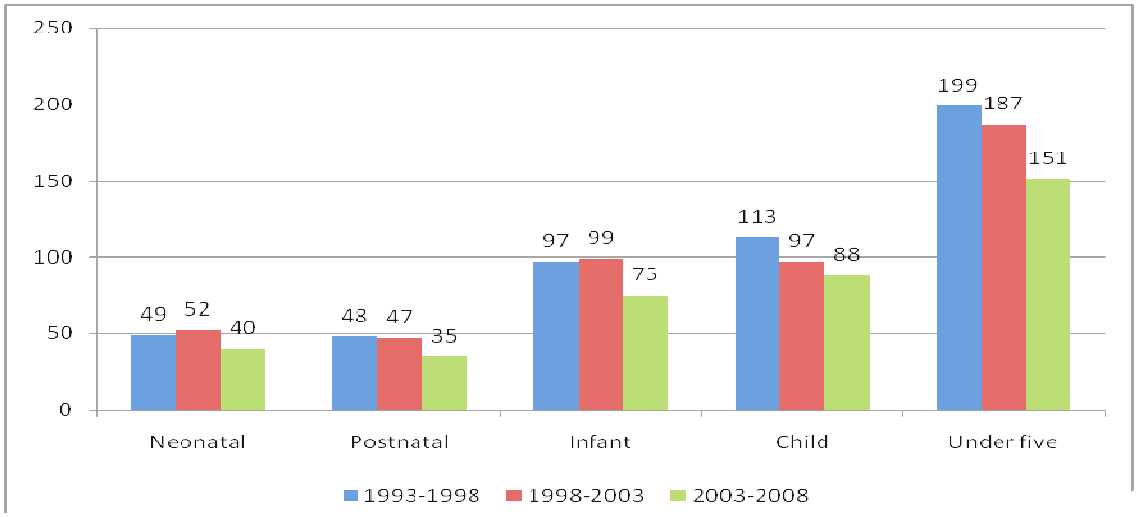
Abstract Vaccine preventable diseases are a major contributor to child morbidity and mortality especially in the Sub-Saharan Africa and Nigeria in particular. It accounts for 17% of global total under-five mortality per year and 22% of child mortality in Nigeria. This implies that appropriate deployment of relevant vaccines would significantly reduce mortality and speed up the achievement of Millennium Development Goal 4 (MDG 4). In this paper, the Paediatric Association of Nigeria recommends a comprehensive routine immunization schedule for children of all ages striking a delicate balance between optimal immune response generation and avoidance of undue exposure to high risk environment; while avoiding neutralization by maternal antibodies.

Introduction

Vaccine preventable diseases are a major contributor to child morbidity and mortality especially in the Sub-Saharan Africa and Nigeria in particular. It accounts for 17% of global total under-five mortality per year.[1]
In Nigeria, vaccine preventable diseases were responsible for 22% of child mortality amounting to over 200,000 deaths per year.[2] This implies that appropriate deployment of relevant vaccines would significantly reduce mortality and speed up the achievement of Millennium Development Goal 4 (MDG 4). Although the Expanded Programme on Immunization (EPI) has been in place in Nigeria for more than 30 years (since 1979), the under five mortality has only decreased from 192 in 1990 to 157 in 2008.[3] Figure 1 shows the slow trend of progress in mortality rates in Nigeria across three successive five year periods preceding the 2008 survey.

Fig 1. Trends in early childhood mortality rates (Deaths per 1,000)



Neonatal mortality: the probability of dying within the first month of life. **Post-neonatal mortality:** the difference between infant and neonatal mortality. **Infant mortality:** the probability of dying before the first birthday. **Child mortality:** the probability of dying between the first and fifth birthdays. **Under-five mortality:** the probability of dying between birth and the fifth birthday.

Source: National Demographic and Health Survey 2008[3]

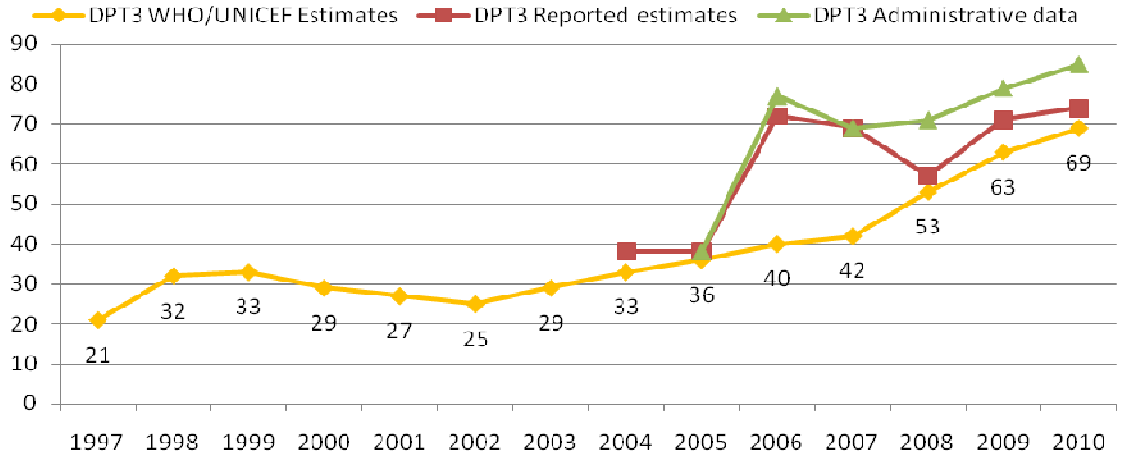
This is further corroborated by a study[4] covering 1970-2003 which showed that the EPI programme had little effect on under five mortality rate in Nigeria

The World Health Organization (WHO) initiated the EPI in 1974 with the goal of making vaccines available to all children throughout the world. Since the commencement of the EPI in Nigeria in 1979, very limited number of 'new' vaccines has been added to the initial basic recommended number. Over a period of about 30 years, only Hepatitis B and yellow fever vaccines have been added. Although there are plans to include *Haemophilus influenza b* (Hib) vaccine this year (2012) and later (2013), Pneumococcal vaccine; the pace of expansion is rather too slow in comparison to child morbidity and mortality rates.

Hepatitis B vaccine was introduced into the country's routine immunization schedule in 2004[5,6], 22 years after the vaccine became available in the global market in 1982. *Haemophilus influenza b* vaccine which became available in 1987 is only being introduced in Nigeria in 2012 - 25 years later. Nigeria is the 45th out of 46 countries in the WHO African region to introduce the Hib vaccine (only before Guinea Bissau). Obviously, this trend does not augur well for the Nigerian child.

Apart from the narrow range of antigens available to the average Nigerian child, routine immunization coverage has remained poor over the years. The Diphtheria-Pertussis-Tetanus 3 (DPT 3) coverage has only increased from 33 in 2004 to 69 in 2010.[7] This persistent low coverage (Fig 2) together with frequent vaccine stock outs has greatly compromised the future of Nigerian children and requires urgent and focused attention from all concerned.

Fig. 2: DPT3 coverage for Nigeria. Source: WHO vaccine-preventable diseases: monitoring system 2011 global summary[8]



[a]Regular data not available from 1997-2004. [b]Regular data not available from 1997-2003

Additionally, the children who get to be immunized according to our compromised schedule do not receive booster doses. This again increases their susceptibility to the same diseases in late childhood as acquired immunity wanes. Booster antibody responses are not only faster and stronger than the primary series, but are also more prolonged and of higher neutralizing capacity.[9] Most Nigerian children do not benefit from booster vaccine doses due to its total absence in the National routine immunization schedule.

It is generally agreed that antibody titres are generally higher with increasing age of immunisation. As infants grow older, the immune system matures and transmitted maternal antibodies disappear. This explains the usual postponing of the commencement of primary series to at least 6–8 weeks of age or even up to three months of age in some countries[10]

Accelerated infant vaccine schedules in which three vaccine doses are given at a one month interval (2, 3, 4 or 3, 4, 5 months) result in lower responses than schedules in which more time elapses between doses (2, 4, 6 months), or between the priming and boosting doses. However, vaccine antibodies elicited by primary immunization with non-live vaccines eventually wane.[9] Also, longer interval ($\geq$ 4 months) between priming and boosting doses allows time for affinity maturation of memory B cells leading to enhanced capacity to respond to antigens and thus higher secondary responses.[9,11]

Our primary doses are however, scheduled with shorter intervals. This is done for two major reasons; to ensure compliance and to induce early enough but moderate levels of protection before children are exposed to our high risk environment. There is therefore an even greater need for booster doses for Nigerian children so as to achieve optimum protective antibody levels and for longer duration. Studies have shown that the lower response to early primary DPT vaccine series becomes insignificant after the booster dose.[10]

According to WHO[12], "several countries are appropriately providing additional vaccine antigens, but they lag

behind in providing the adequate number of doses or booster doses for traditional vaccines and give little consideration to older age groups."There has not been appreciable number of immunogenicity studies in respect of response to routine vaccines in our population so as to establish the adequacy of immune response and the length of protection. Data from disease surveillance and immunogenicity studies would enhance the periodic review of routine immunization schedule for the country.

Vaccines should be administered to children at ages when optimal immune response would be obtained but also, before children are exposed to the risk of contracting the target disease. Developing a routine immunization schedule requires maintaining a delicate balance between these two factors and also ensuring that administered antigens are not neutralized by maternal antibodies.

In view of all the foregoing, it has become imperative to develop a more comprehensive National routine Immunization Schedule for the country so as to significantly enhance the health of the Nigerian child. The general objective of this paper by the Paediatric Association of Nigeria (PAN) is to recommend an optimum National Routine Immunization Schedule that will help achieve an early comprehensive protection of the Nigerian child from major infectious causes of morbidity and mortality in the Nigerian environment. The specific objectives include;

- To increase the number of antigens covered in the routine immunization schedule
- To extend the schedule beyond infancy to include the older child and adolescents
- To institutionalize and provide adequate number of booster doses
- To maintain traditional antigens and improve on them
- To advocate for the protection of the rights of our children to good health.
- To provide guidelines for catch-up immunization for older children who are not previously immunized.

Opportunities and Strengths

Currently, there is a level of Federal Government commitment to immunization of children at the presidential, ministerial and agency levels (though more commitment needs to shift from polio only, to routine immunization).

The basic health system structure that will drive routine immunization programme is already in place. These are structures from the Federal to State and Local Governments and even to wards and settlements. These have been well articulated in a micro plan by the National Primary Health Care Development Agency. It however requires revitalization and strengthening especially at the state and local government levels for effective functioning.

The National Health Bill has been carefully articulated and it is at an advanced stage of being signed into law. It has provisions for proper funding of health programmes and services. It is however regrettable that it took so long to get to the current stage, while children are dying.

Data[13,14] have shown that routine immunization is more acceptable to mothers in Nigeria and other countries than campaigns. The well known wave of OPV rejection in Northern Nigeria in 2003 was not to the routine OPV but to the house to house campaigns.

Challenges

The challenges which are not insurmountable include wrong attitude and mal-orientation of health workers, poor political commitment, beaurocratic bottle-necks and low level of awareness. Others are poor global donor interest in routine immunization and the overshadowing influence of supplemental immunization activities (SIAs) over routine immunization activities. Paediatric Association of Nigeria is willing to partner with Governments to overcome these challenges.

PAN Recommendations

This is a follow up to the PAN position paper on immunization which was submitted to Government in 2008. We here recommend an optimal routine immunization schedule that considers early exposure of Nigerian children to infections, low response to too early and short interval primary series vaccination and therefore greater need for boosting. There should be enough resources to invest in the health of Nigerian children. The recommended optimum schedule is presented in Tables 1 - 3 below.

*The other type of typhoid vaccine, Ty21a, has liquid and capsule forms. The liquid form is no longer available. The capsule form for individuals $\geq$ 5 years requires 3-4 orally administered doses, taken every other day. If the schedule is interrupted by an interval > 21 days, restart the series from beginning. If the delay is less than 21 days, resume series without repeating the previous dose. Booster doses are given after 3-7 years.

**DTaP contains the normal infant doses of diphtheria tetanus and acellular pertussis vaccines.

***Tdap contains lower doses of diphtheria and pertussis, but same infant dose of tetanus; the size of the letter indicates the size of the dose.

*+The other type of Cholera vaccine, Dukoral, is not licensed for children < 2 years. Children aged 2-5 years should receive 3 doses $\geq$ 7 days apart (but not more than six weeks). Intake of food and drink should be avoided for one hour before and after vaccination. If the interval between doses is delayed for more than six weeks, primary vaccination should be restarted. One booster dose is recommended every six months, and if the interval between primary immunization, and the booster is more than 6 months, primary immunization must be restarted.

Table 1: Proposed Routine Immunization Schedule from infancy to childhood and adolescents

Age	Vaccines	Notes
Birth	[1]BCG	0.05ml for infants < 12 months, 0.1ml for children ≥ 12 months
	[2]OPV 0	If > 2 weeks, skip birth dose)
	[3]Hep B-1(Birth dose)	If > 2 weeks, skip birth dose)
6 weeks	OPV-1	
	[4]Penta-1 (Hib+DTP+Hep B)	
	[5]Rota 1	Do not give if child is ≥ 15 weeks ($3^1/_2$ months)
	[6]PCV13-1	
10 weeks	OPV-2	
	Rota 2	Do not give if child is ≥ 32 weeks (8 months)
14 weeks	OPV-3	
	Penta-2	
	PCV13-2	
6 months	Penta-3	Last dose of Hep B not given earlier than 24 weeks of age and 16 weeks from 1st dose
	PCV 13-3	3rd dose given at a minimum of 2 months after 2nd dose
	[7]Vit A-1	100,000 IU for 6-11 month old, 200,000 IU for ≥ 12 month old
9 months	Measles-1	
	Yellow fever	Booster every 10 years
12-15 months	OPV	
	[8]DTaP- booster	
	Vit A-2	Repeat every 6 months until 5 years of age
18 months	Hepatitis A	2 doses at 6 months interval
	[10]MMRV (or [11]MMR + Var or Measles-2 + [9]Var)	
2 years	Typhoid (Vi Polysaccharide) vaccine*	Re-vaccinate every 4 years
5 years	OPV	
	DTaP**	
	MMR	
10 - 14 years	[13]Tdap***	Every 10 years
	Yellow fever	Every 10 years
	[14]HPV quadrivalent (males and females)	Three doses at 0, 2 and 6 months interval
≥ 15 years	5 dose [15]TT schedule+ (females only)	See below for the schedule

Table 2: Vaccines for special groups

Age	Vaccines	Notes
12-15 months	[12]Men ACYW135 (conjugated)	For children in the meningitis belt only. Polysaccharide vaccine is given after 2 years.
> 1 year	Cholera vaccine*+ (Sanchol and mORCVAX)	During epidemics and at refugee camps. 2 doses 14 days apart and a booster 2 years later

Adults and children less than six years should receive two doses of Dukoral ≥ 7 days apart (but not more than six weeks). Intake of food and drink should be avoided for one hour before and after vaccination. If the interval between doses is delayed for more than six weeks, primary vaccination should be restarted. A booster dose every two years is recommended. If the interval between the primary series and booster immunization is more than two years, primary immunization must be repeated.

+Tt immunization schedule for females of child bearing age (15 – 45 years)

- TT 1 - First contact: No protection
- TT 2 - 4 weeks after first dose: offers protection for 3 years
- TT 3 - 6 months after 2nd dose: protects for 5 years

- TT 4 - 1 year after 3rd dose: offers protection for 10 years
- TT 5 - 1 year after 4th dose: protects throughout child bearing years

General Notes

The manufacturer's instructions should be followed strictly.
When multiple injectable vaccines are required during the same visit, they should be given at different sites.
OPV should be given to children less than five years of age at the time of each supplementary immunization activity.
When a dose in the primary series is delayed, resume without repeating the previous dose.

Table 3: Typical recommended routine Immunization Card

Age	Vaccines
Birth	BCG, OPV 0, Hep B- Birth dose
6 weeks	OPV-1, Penta-1, Rota 1, PCV-1
10 weeks	OPV-2, Rota 2
14 weeks	OPV-3, Penta-2, PCV-2
6 months	Penta-3, PCV 3, Vit A-1
9 months	Measles-1, Yellow fever
12-15 months	OPV, DTaP, Vit A-2
18 months	Hepatitis A, MMRV
2 years	Typhoid
5 years	OPV, DTaP, MMR
10 - 14 years	Tdap, Yellow fever, HPV (males and females)
≥ 15 years	5 dose TT schedule (females only)

Notes to the schedule

[1]**BCG** – Bacillus Calmette-Guerin. It is given intradermally on the upper left arm.
For children of six months of age and less, mantoux test should first be carried out to exclude active infection or previous immunity before BCG is given (children less than six months do not mount sufficient reaction to tuberculin test)[15].

[2]**OPV** – Oral polio vaccine; two drops given orally. Minimum interval between doses is four weeks.

[3]**Hep B** - Hepatitis B vaccine is given intramuscularly at the outer thigh at birth or soon after-not later than two weeks of age. Four doses of Hepatitis B vaccine could be given (including the birth dose), but the last dose (3rd or 4th) must not be given earlier than 24 weeks (six months) and 16 weeks (4 months) from the fist dose.[16]

[4]**Penta-1** (Hib+DTP+Hep B) – Pentavalent vaccine contains Haemophilus influenza, Diphtheria, Tetanus, Pertussis, and Hepatitis B vaccines. It is given intramuscularly on the outer thigh. The third dose is scheduled at six months due to the Hep B component as explained above.

[5]**Rota** – Rotavirus vaccine given orally with minimum of four weeks interval between doses. Rotarix requires two doses only while RotaTeq requires three doses. The first dose of either vaccine is to be given at age not later than 15 weeks, and last dose not later than 32 weeks of age. Catch-up immunization not recommended. The use of rotavirus vaccines should be part of a comprehensive strategy to control diarrhoeal diseases which should include, among other interventions, improvements in hygiene and sanitation, zinc supplementation, community-based administration of oral rehydration solution and overall improvements in case management.[12]

[6]**PCV13** – 13-valent Pneumococcal conjugate vaccine. Second dose should be given at a minimum of 4 weeks after 1st dose. Third dose is given at a minimum of two months after 2nd dose.

[7]**Vit A** – Vitamin A. Although this is not a vaccine but a micronutrient, it is integrated into routine immunization as an effective means of raising supplementation coverage. It is administered orally at six monthly intervals until five years of age. First dose is given at age not less than six months. Dose is 100,000 IU for 6-11 months and 200,000 IU for 12 months or less ..

[8]**DTaP** – Diptheria, Tetanus and acellular Pertussis vaccine.
[9]**Var** - Varicella vaccine can be given singly or in combination.
[10] **MMRV** - Measles, Mumps, Rubella and Varicella vaccine.
[11] **MMR** – Measles, Mumps and Rubella vaccine.
[12]**Men A & C** – Meningococcal ACYW135 conjugate vaccine. The polysaccharide vaccine is not given to children less than 2 years.
[13]**Tdap** – Infant dose of Tetanus and smaller doses of Diphtheria and acellular Pertussis vaccine is used for boosters to avoid unwanted reactions.
[14]**HPV** – Human papiloma virus vaccine is for both males and females. There are 2 types; quadrivalent and bivalent.
[15]**TT** – Tetanus toxoid.

Catch-up immunization schedule for children < 5 years who are not previously immunized.

- BCG - for children of six months or less, mantoux test should first be carried out to exclude active infection or previous immunity before BCG is given (children less than 6 months do not mount sufficient reaction to tuberculin test)[15].
- Rotavirus vaccine – last dose must be given not later than 32 weeks. Do not initiate rotavirus vaccination if child is 15 weeks or older.
- Pertussis vaccine – give acellular vaccine in place of whole cell if child is above three years.
- Beside above exceptions, children less than five years who are not previously immunized should follow the normal recommended schedule maintaining the minimum intervals between doses.

Catch-up immunization schedule for children 5-18 years who are not previously immunized

Vaccine	Notes
BCG	Mantoux test should first be carried out to exclude active infection before BCG is given.
Tdap	Given once, then every 10 years unless a booster is required
Yellow fever	Repeat every 10 years
5-dose TT	All females ≥ 15 years
HPV quadrivalent (males and females ≥ 10 years)	Three doses at 0, 2 and 6 months after dose 0. Not recommended after 26 years
Typhoid (Vi Polysaccharide) vaccine	Re-vaccinate every 3-7 years
Varicella	1 dose for < 7 years and 2 doses for > 7 years with 2 months interval

Booster doses of other vaccines should be administered as applicable.

Additional recommendations

- Disease surveillance should be institutionalized as part of routine services in the health sector.
- Periodic immunogenicity studies should accompany disease surveillance and Routine Immunization as part of monitoring and evaluation of vaccine impact.
- Routine Immunization coverage to be raised urgently to 85-90% for all vaccines.
- Eradicate vaccine stock-outs by establishing a robust vaccine forecasting and a special express fund release mechanism specifically for vaccines.
- Maximal exploitation of solar energy for optimum vaccine cold chain maintenance.
- Protect Routine Immunization by ensuring that supplemental immunization activities are not done at the expense of Routine Immunization and by allocating more funds for Routine Immunization than for SIAs.
- Development partners must be guided to put the global agenda in the context of peculiar country situations while Nigeria insists on owning her programmes and policies.
- Establish a Nigerian Vaccines and Immunization Advisory Committee comprising Paediatricians who are immunization experts as chair and majority of membership; then Epidemiologists, Immunologists, ex-officio members from federal agencies involved in vaccine issues as well as non-voting representatives from relevant medical and health professional associations.
- Institutionalize routine monitoring and reporting of adverse events following immunization and integrate it into the pharmaco-vigilance system.
- Review routine immunization schedule periodically to adapt to changing disease and vaccine trends.
- Integration of routine immunization with other high impact child survival interventions such as nutrients supplementation.

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