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REVIEW

Adolescent vaccination in Nigeria: the what, why and who

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Abstract

Adolescents are individuals aged 10 – 19 years. Having survived vaccine-preventable childhood diseases some of them remain susceptible because they either did not receive or did not complete their childhood immunization schedule. They also become exposed to other vaccine-preventable organisms such as human papillomavirus. Adolescent immunization is thus an important strategy to consolidate on the gains of childhood survival programmes while ensuring that the adolescent reaches adulthood healthy and protected from vaccine preventable diseases. This article discusses the status of adolescent immunization in Nigeria, explores reasons for the status-quo, provides reasons for the consideration of an adolescent immunization programme and suggests possible vaccines for inclusion as well as possible strategies for implementing the programme.

Introduction

Immunization is one of the major pillars of preventive health care.[1] Despite its huge successes which include the eradication of the dreaded smallpox disease, immunization programmes still face a lot of challenges[1] Vaccination programmes have traditionally and universally targeted children.[2,3] Expanding

immunization services to adolescents (persons aged 10 to 19 years) on the other hand has lagged behind especially in the African region.[3]
Many countries utilize the Expanded Programme on Immunization (EPI) schedule which started out targeting six killer childhood diseases namely- tuberculosis, diphtheria, pertussis, tetanus, measles and poliomyelitis.[4] Although the schedule has been expanded to include vaccines against more diseases, countries determine which new vaccines to introduce and at what pace. The World Health Organization's most recent immunization table recommends a booster dose of tetanus diphtheria for adolescents as well as 3 doses of hepatitis B for those who missed their childhood doses.[5] Countries are also being encouraged to introduce the human Papilloma Virus (HPV) vaccine, but these are not the only vaccines that adolescents could benefit from.

Nigeria uses the EPI schedule and in recent times has included a second dose of inactivated polio virus (IPV) vaccine, meningococcal vaccine, rotavirus vaccine and second dose of measles vaccine into the immunization schedule.[6] Despite the presence of HPV vaccine in the schedule, it is either not available in the public health service (which provides vaccines for free to the general population) or is available at a cost beyond the reach of the general population. The vaccine is however, available at variable prices (often unaffordable to majority of Nigerians) in private health facilities. Additionally, the recommended boosters and the hepatitis B vaccination programme for adolescents have not been implemented.

In this write up we review the current status of adolescent immunization in Nigeria, some of the reasons why Nigeria should focus on adolescent immunization and discuss some vaccine preventable diseases with impact on adolescent health that should be considered in an adolescent immunization programme for Nigeria and possibly other low- and middle-income countries.

Adolescent immunization in Nigeria

As in other countries, Nigeria developed a formal immunization programme for children following the inception of EPI.[7] The initial target was for infants with immunization commencing at birth and the last vaccine given at 9 months. More recently with the introduction of the second dose of measles at 15 months of age, the last vaccine in the series, it is expected that every child should be completely vaccinated by 2 years of age.[6]

As part of the EPI schedule, Nigeria provides HPV vaccine for girls aged 9 to 13 years. This is the only vaccine that specifically targets adolescents but is not yet available in the public sector and a strategy for its deployment is yet to be enunciated. Tetanus toxoid now given as tetanus diphtheria combination is offered to women of childbearing age (15-49 years). Though covering some part of the spectrum of the age of adolescence the vaccine is offered through antenatal care clinics to pregnant women and as such is not targeted specifically in the adolescent age group. In fact, its main objective is for the prevention of neonatal tetanus.

With the advent of the Covid-19 pandemic, some countries have included Covid-19 vaccines in their vaccination schedules following the approval of the vaccines for different age groups including the adolescent age range.[8] Nigeria is yet to approve the vaccines for persons below the age of 18 years except for those who wish to receive the vaccines for educational and international travel purposes.[8] Thus, to all intents and purposes, Nigeria does not have a functional adolescent immunization programme.

Rationale for adolescent vaccination

The period of adolescence straddles childhood and adulthood. Even though this period is considered as a healthy stage of life significant death, illness and injury occur during this period.[9] In 2017, 56 million people died globally.[10] The lowest contribution to this death toll was from the age groups 10-14 years (319,600) and 15-19 years (516,500) reflecting their relative good health.[10] Most of the deaths, injury and illness in adolescence is preventable but it has been recognized that the existing health services serve adolescents the least well.[11] This is especially so in resource limited countries. Not many African countries have adopted the WHO recommendation on adolescent vaccination.[3]

In Nigeria, adolescents make up 23% of the national population of 200 million people.[12] The adolescent mortality rate though much lower than the under-five mortality rate at 8/1000 for those aged 10-14 years and 9/1000 for those aged 15-19 years, is significant.[12] It is pertinent to note that that the top three causes of mortality in the adolescent age group in Nigeria are lower respiratory tract infections, diarrhea and meningitis.[13] Some of the causes of these conditions are vaccine preventable . Thus, the lives and health of adolescents could be better safe guarded through vaccination. The current approach to vaccination looks at the life course noting that events in the first decade of life could impact adolescence while those in adolescence could impact adulthood.[11] This is a compelling reason to address adolescent immunization. The life-course approach to immunization requires that immunization schedules and access respond to an individual's stage in life, their lifestyle and specific vulnerabilities/risks to infectious disease that they may face.[14] It recognizes the role of immunization as a strategy to prevent diseases and maximize health over one's entire life regardless of an individual's age.[14]

Immunization coverage in Nigeria has been perennially low since the 1980s when vaccination coverage reached 81.6%.[15] The low immunization coverage means that many children are either unimmunized or incompletely immunized. Meanwhile, there is no provision in the Nigerian schedule for catch-up immunization for those who missed or did not complete their immunization in the first 2 years of life. This would result in large numbers of children growing into adolescence incompletely immunized or not immunized at all. This has serious implications for disease outbreaks which may involve older groups including adolescents.

Nigeria is one of ten countries contributing to the 23 million children who are unvaccinated or under-vaccinated globally.[16,17] In 2018, only 31% of Nigerian children received all requisite vaccines while 19% did not receive any vaccines.[18] This means almost 70% of children are either unvaccinated or under-vaccinated. With no catch-up immunization schedule these children remain susceptible through adolescence into adulthood. It is also well documented that the immunity garnered by immunization (some vaccines) in infancy may wane and immunization can result in an epidemiological shift with the average of age at occurrence of diseases increasing thus increasing the risk to the unvaccinated adolescent.[19] The period of adolescence is a good point to boost waned immunity and provide initial vaccination (some vaccines) for those who missed immunization in infancy and childhood. WHO recommends catch-up schedules as part of a well-functioning immunization system.[20]

Adolescence is an age group in which risk-taking is common and this may result in injuries which the adolescent may attempt to hide from caregivers or avoid optimal treatment.[21] Many instances of tetanus have been recorded in this age group speaking to a need for boosters for those with waned immunity or primary vaccination against tetanus in those who missed infant immunizations.[22-24] Adolescents may also be involved in risky behaviour that may predispose them to infections like Hepatitis B.[25] Unwanted pregnancies are also common in this age group and such teenage mothers may not access orthodox care and their babies may be born unprotected against neonatal tetanus.[26]

Some diseases do not pose a risk until adolescence. For example, HPV exposure begins to occur at sexual debut in adolescence and as such the vaccine should be administered in early adolescence prior to sexual debut.[27] Also, some diseases such as chickenpox cause greater morbidity and potential for complications in adolescence.[28]

Adolescents have been implicated in the spread of infections within their households. They have been known to spread pertussis to young infants who are yet to be vaccinated.[29]The potential benefits of adolescent vaccination in terms of disease control in general and in contribution to the health of the adolescent makes it imperative that this strategy should be considered by Nigeria and indeed low- and middle-income countries that do not have such a programme in place.

Benefits of vaccination

In the past many children died from vaccine preventable diseases. Those who survive to adolescence and adulthood may become immune and sometimes with the scars of vaccine preventable diseases such

as limb paralysis from poliomyelitis. With the development of immunization, children survived with immunity but without the scars of the diseases. Vaccines are noted to have contributed significantly to the reduction of under-five mortality from 12.6 million deaths in the 1990 to 5.2 million in 2019.[30] Vaccines are documented to save 2-3 million lives yearly.[4] There are statistics that indicate the role of vaccines in the reduction of the incidence of vaccine preventable diseases such as diphtheria, pertussis and poliomyelitis which is at the verge of global eradication.[31] Vaccines prevent morbidity and disability from vaccine preventable diseases.[6]

Vaccines are noted to be one of the most cost-effective interventions of public health. For every dollar spent on vaccines there is a return of 26 dollars.[32] Vaccines contribute to economic development of countries and are also important in preventing antibiotic resistance, a condition that is reputed to cause up to 10 million deaths annually.[33] The benefits of vaccines are thus well documented and would accrue to adolescents specifically and the population in general if deployed to target adolescents specifically. Also vaccinating adolescents will help in consolidating the gains of child survival activities which have succeeded in increasing the survival of children into adolescence.

Introducing new vaccines

To achieve maximal protection from vaccine preventable diseases for adolescents, new vaccines may need to be introduced into existing vaccination programmes while strengthening those programmes and the health system. The WHO has a document that details the guidelines and principles of the introduction of new vaccines into vaccination programmes.[34] The key issues to be considered are categorized into factors that pertain to the disease, those related to the vaccine and factors related to the capacity of the programme and health system to successfully introduce and continue to deliver the vaccine sustainably over the long term.[34] It is important to determine if the target disease is a public health priority based on the magnitude of the disease burden, the perception of the health community and lay public, recommendation of WHO and the availability of other prevention/control measures for the target disease.[34] The vaccine efficacy, the safety, cost effectiveness and availability of a reliable supply are important factors to consider. Other factors such as funding and competing priorities are very important in deciding on which vaccines to include in a vaccination programme.[34]

The addition of a new vaccine into a vaccination programme has effects which may or may not be beneficial. A vaccination programme that is weak and unable to reach large sections of the target population may record worse performance if a new vaccine is added on.[34] Thus, considerations of the ability of the health system to accommodate the new vaccine in terms of storage, handling additional doses of vaccine, the schedule and the number/training requirements of the health workforce must be evaluated.[34] The prevailing attitude of the public towards the vaccination programme and vaccines in general should be assessed to determine if they are conducive to introducing a new vaccine as vaccine hesitancy may result in very low acceptance of an introduced vaccine.

Potential vaccine candidates for adolescent vaccination programmes

The following vaccines target diseases that are prevalent in Nigeria and many low- and middle-income countries. These vaccines may be considered for introduction into vaccine programmes.

Human papilloma virus vaccine

Cervical cancer, the fourth most common cancer in women globally and the commonest gynaecologic cancer in Nigerian women is caused by the human papilloma virus.[35,36] It was responsible 342,000 deaths globally in 2020 and about 90% of the deaths and new cases are in low- and middle-income countries.[35] The age-standardized incidence rate of cervical cancer in Nigeria is in the range 14.9-18.6 per 100,000 population with mortality in the range of 11.4-19.0 per 100,000 population.[37] HPV is sexually transmitted; the risk for acquiring the virus increases following sexual debut of girls. In males the virus is implicated in the cause of penile cancer in addition to venereal warts which affect both genders. Early screening for cervical cancer involves a vaginal examination for visual assessment of the cervix and testing using acetic acid on the cervix or obtaining a Papanicolaou (Pap) smear which requires the expertise of a histopathologist to read the slides or testing for HPV DNA.[35] These basic

investigations are not available/accessible to many women in sub-Saharan Africa including Nigeria.[38] Many women with cervical cancer present at very late stages when the outcome of care is poor.[39] Awareness about the disease is equally poor not only among adults but also among adolescents.[40-42] .

Vaccination is a major strategy in the control of cervical cancer. The available vaccination strategies include vaccinating all adolescents (male and female) or prioritizing females where funding is not adequate. According to the WHO achieving high vaccination coverage in girls (>80%) reduces the risk of HPV infection in boys too.[43]

The HPV vaccine, a recombinant vaccine is known to be efficacious and has been reported to decrease the incidence of cervical cancer by 90% [44] and has a good safety profile. There are bivalent vaccines targeting serotypes 11 and 18 of the HPV which are commonly implicated in cervical cancer and the quadrivalent which targets 4 serotypes- 6, 11, 16 and 18 and the more recent nonavalent vaccine which targets 9 serotypes. The vaccine has been available since 2014, but its uptake has been challenged with a lot of vaccine hesitancy. In Nigeria, lack of awareness and accessibility as it is currently not available for free from the routine immunization service providers are documented challenges.[42]

Varicella vaccine

Varicella also known as chickenpox is a highly contagious infection with potential for serious complications such as bacterial infection of the skin lesions, pneumonia, central nervous system involvement, glomerulonephritis and hepatitis. Varicella is responsible for many school days lost. Adolescents are recognized as one of the subgroups with more severe disease.[28] Death has been reported in immunocompromised persons and children on immunosuppressant therapy.[45]

In Nigeria, varicella is a common infection although there is no national data; a study reported 68% prevalence rate of chicken pox antibodies among children aged 6- 15 years indicating a high rate of exposure.[46]

Varicella vaccine is a live attenuated vaccine with an efficacy of 92%. It may be given alone or in combination with MMR. The introduction of universal varicella immunization programme led to 98% reduction of varicella cases in all age groups in the United States.[28] A single dose of the vaccine is protective in >95% of recipients for adolescents less than 13 years. Above 13 years, two doses separated by 4-8 weeks interval is recommended. The vaccine should not be given to pregnant adolescents or those intending to get pregnant within one month.

Hepatitis B vaccine

The hepatitis B virus (HBV) is a DNA virus which is spread through vertical transmission to newborns from infected mothers as well as through percutaneous and per mucosal contact with infectious body fluids (blood, semen, vaginal secretions, serum), sharing/use of contaminated sharps. Hepatitis B virus is also sexually transmitted.

Nigeria is classified as being highly endemic with a pooled prevalence rate of 9.5%.[47] Infection with HBV presents a range of clinical features from asymptomatic to symptomatic. Thus, a patient could have acute HBV infection or chronic HBV infection. Complications of the acute infection include acute fulminant disease. Chronic infection which is the persistence of HBsAg for six months or more is more likely to develop in children (90%) who acquire the infection perinatally or during the first year of life.[28] Only about 5-10% of those who acquire the infection as adolescents and adults develop chronic infection. However, chronic HBV infection acquired during later childhood or adolescence is usually accompanied by more active liver disease and increased serum aminotransferase concentrations.[28] Chronic HBV infection may be complicated by chronic liver disease (hepatic failure, chronic active hepatitis, chronic persistent hepatitis, liver cirrhosis) and hepatocellular cancer.

The hepatitis B vaccine is a recombinant vaccine. It is 70- 85% effective in preventing vertical transmission if given within 48 hours of birth and up to 95% effective if given simultaneously with hepatitis B immunoglobulin.[48] It also prevents horizontal infection. In Nigeria, coverage of the birth

dose is about 53% while coverage for the third dose is 50%.[18,49] This suggests that many adolescents are susceptible because they did not get their infant immunization. Sexual exposure, illegal injection drug use, contact with infected persons and living in an endemic area also increase the susceptibility of the Nigerian adolescent to HBV. Unvaccinated adolescents should receive 3 doses of the vaccine at 0-1, 1-2- and 4-6-month time points at 11-12 years of age before onset of risk factors for HBV infection.

Rubella vaccine

Rubella is a viral infection which manifests as postnatal and congenital forms. The postnatal form is generally a mild disease with up to 25-50% of adults being asymptomatic. Congenital rubella on the other hand results in catastrophic events ranging from spontaneous abortions and foetal death to a constellation of congenital abnormalities (the congenital rubella syndrome).

The public health significance of rubella is due to the congenital rubella syndrome. In Nigeria there is no national prevalence value for congenital rubella syndrome, but different authors have reported cases of congenital rubella while sero-epidemiological studies have shown rubella to be endemic with rubella seropositivity increasing with age but with significant sero-negativity amongst female adolescents and women of childbearing age (indicating susceptibility).[47-49] The immunization schedule does not include a rubella containing vaccine.

Different strategies for rubella control have included adolescent vaccination, universal infant vaccination, and health worker vaccination. For rapid and significant control to occur a combination of strategies is needed. Indeed, for immediate impact adolescent immunization must be included as adolescents are the very next cohort of mothers.

The rubella vaccine is a live attenuated vaccine. It is available in combination with measles, or measles and mumps or measles, mumps and varicella vaccines. A single dose of the vaccine confers long term immunity in more than 90% of recipients.[28] Rubella should not be given to adolescents who are known to be pregnant or those considering becoming pregnant within 3 months of vaccination.

Meningoccocal vaccine

Neisseria meningitidis is a gram-negative intracellular diplococcus which causes meningitis, a disease with high potential for mortality. *N. meningitidis* causes various infections such as meningococcaemia, pneumonia, septic arthritis and pericarditis. Adolescents are at considerable risk for infection with this organism especially those living in crowded environments like hostels.

N. meningitidis has 12 serogroups. Serogroup A has been known to cause epidemics in the meningitis belt of sub-Saharan Africa.[53] Northern Nigeria is part of the meningitis belt and has witnessed several epidemics in the past.[53] However, following the phased introduction of meningococcal vaccine against serogroup A in 20 countries of the meningitis belt from 2010 there has been dramatic reduction in serogroup A cases while other seroroups have become more prevalent.[54] In Nigeria a large epidemic due to serogroup C occurred in 2016/17 which speaks to the need of multivalent vaccine, as replacement by non-vaccine serotypes can cause outbreaks.[53]

Meningococcal vaccines include monovalent type (MenAfric A), bivalent type against serogroups A and C, trivalent type against serogroups A, C and W as well as quadrivalent vaccines which cover the serogroups A, C, W and Y.[54] There are polysaccharide and polysaccharide conjugate vaccine types

Tetanus toxoid

Tetanus is a fatal infection caused by *Clostridium tetani*. Tetanus occurs in two forms. Neonatal tetanus results from contamination of the umbilical cord, ear piercing or a male circumcision wound in infants of mothers who are unvaccinated against tetanus. Post neonatal tetanus occurs in older children who did not receive / complete their primary vaccinations and often follows wound contamination and occasionally chronic otitis media.

Neonatal tetanus is preventable by mothers being vaccinated as they may transmit anti-tetanus antibodies to their babies. In Nigeria the schedule recommends 5 doses for women of reproductive age (15-49 years) and this is able to prevent neonatal tetanus in newborns throughout the reproductive period of the mother. This regimen also serves to prevent puerperal tetanus in the mother.

The maternally acquired antibodies often wane in the first few months of life thus, infants are recommended to commence their primary series of vaccination at the age of 6 weeks in Nigeria by receiving pentavalent vaccine which contains tetanus toxoid in addition to other antigens.

Nigeria continues to report cases of neonatal tetanus as coverage of two doses of tetanus toxoid containing vaccine is suboptimal. In addition, the majority of deliveries take place outside of orthodox health care with a high risk of exposure to unclean environment and the attendant risk of tetanus.[18,55] One of the challenges is that the schedule for mothers only operates for pregnant women who access antenatal care and starts at age 15. Thus, non-gravid adolescent females and adolescent males are excluded. Several reports on post-neonatal tetanus indicate that up to 50% of the cases are aged above 10 years.[22-24] This may be an under representation as most of the studies did not cover the entire age range of adolescence.[22-24] In these studies, the cases often had no/incomplete vaccinations and no booster doses. Another important fact is that these studies reported male predominance amongst the cases.

The tetanus vaccine is a toxoid, and it may be given alone or in combination with diphtheria toxoid (Td) or with diphtheria toxoid and acellular pertussis vaccine (Tdap). Booster doses of Td vaccine are recommended from 11-12 years as immunity to tetanus toxin is documented to wane from 9-13 years.[56]

Diphtheria toxoid

Diphtheria, a disease with high fatality rate is caused by *Corynebacterium diphtheriae*. Although no longer as common as it used to be, outbreaks have been reported and adolescents have been represented in such outbreaks.[57] In a study on infant mother pairs, it was documented that up to 30% of infants are born unprotected against diphtheria because their mothers were either not vaccinated and not naturally exposed to the causative organism.[58] Nigeria now offers tetanus diphtheria (Td) vaccine to pregnant women instead of tetanus toxoid. This is commendable but requires that the intervention be expanded to involve all adolescents both male and female which will cater for those who missed the primary immunization series in infancy while serving as a booster for those whose immunity has waned.

Diphtheria vaccine is a toxoid and is often given in combination with tetanus toxoid (Td) or with tetanus toxoid and acellular pertussis vaccine (Tdap). Booster doses of Td vaccine are recommended from 11-12 years.[56]

Pertussis vaccine

Pertussis also known as whooping cough is caused by *Bordetella pertussis*. In well-resourced countries the resurgence of pertussis despite high coverage with the vaccine was attributable to waned immunity.[59] Involvement of newborns led to renewed efforts at vaccination with such vaccination strategies as cocooning. This involves vaccinating all adults, adolescents and children who would be in contact with a given infant.[60] Adolescents have been particularly indicted as potential contacts infecting young infants.[29,61] In Nigeria, data are not reliable mainly because of the difficulty of making bacteriological diagnosis. The disease may thus be underreported. Considering that the vaccine is often in combination with other vaccines (diphtheria, tetanus) it may be more beneficial to use these combination vaccines as booster dosing for adolescents who received their primary vaccination while also providing an opportunity to vaccinate those who didn't receive infant vaccinations.

Yellow fever vaccine

Yellow fever is a viral haemorrhagic fever caused by the yellow fever virus. It is spread by the bite of an *Aedes aegypti* mosquito. Epidemics of yellow fever have been recurrent in Nigeria and in the African continent. In a review of the outbreaks that occurred between 2017 and 2019 in Nigeria, 7894 persons

were affected of which 1794 (23%) were aged between 11 and 20 years. The case fatality rate was 2.7%.[62]

Yellow fever vaccine is a live attenuated vaccine produced in chicken egg. It is given at the age of 9 months in Nigeria and a single dose of yellow fever vaccine is protective for life. However, the coverage for the vaccine is only about 54% meaning that many children grow into adolescence and adulthood unprotected.[18] Yellow fever vaccine is only given to other age groups than infants during outbreaks or as a requirement for international travel. Routinely vaccinating adolescents may result in smaller outbreaks and less intense response to contain an outbreak.

Pneumococcal vaccines

There is a high prevalence of pneumococcal disease and its complications among children and adults with chronic diseases.[63] These include adolescents with anatomic or functional asplenia (including sickle cell disease), nephrotic syndrome, cerebrospinal-fluid leaks, or immunosuppression (including human immunodeficiency virus [HIV], organ transplantation etc. Also, vaccination is indicated in malignancies like Hodgkin's disease and other lymphomas, chronic kidney disease. The high prevalence of sickle cell anaemia in sub-Saharan Africa requires the incorporation of pneumococcal vaccine into the sickle cell care programs which exist in secondary and tertiary health institutions in the region.

Pneumoccocal vaccines are either protein conjugate or polyssacharide. The protein conjugate vaccines are recommended for children under five years of age. For adolescents at risk as already identified the conjugate vaccine is given followed by the polysaccharide vaccine at least 8 weeks later.

Covid-19 vaccines

These are vaccines developed against the corona virus disease caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2). At least 6 of the various vaccines targeting the virus have been approved for use in children.[8] Although, the disease seemed to be milder in sub-Saharan Africa compared to other WHO regions some countries in Africa like South Africa did record significant morbidity and mortality.[64] Children and adolescents have been affected resulting in a minority of deaths. This may be an underestimation based on the testing algorithms of many countries which generally exclude children and adolescents. However, Sam-Agudu et al[8] have called for children and adolescents to be included in the Covid immunization programme in Africa. Vaccination of children and adolescents they opined, would obviate the need for school closures thus avoiding academic and psychologic impacts of disruption in education and intergenerational (adolescents to parents/grandparents) transmission of SARS-CoV-2. They recommend that at the least children at high risk for severe disease and mortality and older adolescents living with adults at high risk should be prioritized for vaccination. It is noted that for coverage of 70% to be achieved in all African countries, children (at least 10 years and older) will need to be vaccinated.[8] While some African countries have included children in their covid-19 vaccination programmes, Nigeria is yet to do so.[8]

Future vaccines

Much research is currently directed towards vaccines against HIV and tuberculosis. These are likely to target adolescents. It is thus important to be proactive to commence a programme for adolescents in countries that do not have adolescent programmes while existing programmes should be strengthened.

Challenges to implementing adolescent vaccination

A potential challenge to implementing adolescent vaccination programme in Nigeria is choosing a delivery strategy. Multiple strategies may be required to achieve the objective of reaching all adolescents with vaccines. While school-based vaccination programme would reach a lot of adolescents, this would not be adequate as secondary school enrolment rate is only 54.4%.[65] Mass immunization may rapidly increase coverage in the target age group, but this will not be sustainable as mass immunization programmes require a lot of resources which are often unavailable in low- and middle-income countries. Using all health care visits will only reach few adolescents as most

adolescents do not visit the hospital. Of importance for any delivery strategy will be demand creation. This would require creating adequate awareness among all stakeholders – parents, adolescents, health care providers and society in general.

Vaccine hesitancy is another likely challenge. In many countries where the HPV vaccine was introduced coverage has been variable with a global coverage of 12.2% in 2018.[66] Vaccine hesitancy has been a significant factor mitigating against the uptake of vaccines in many countries including Nigeria.[67,68] Vaccine hesitancy has also been a major determinant of low uptake of the more recent Covid-19 vaccines. Vaccine hesitancy may accrue from parents and from the adolescents themselves. Community engagement and adequate information dissemination will be required to elicit vaccine confidence in order to generate adequate demand and uptake of vaccines.

It is important that political commitment is garnered and that important stakeholders are aware and interested. In the strategic plan for adolescent development for the period 2007-2011 adolescent immunization was not mentioned.[9] A more recent assessment of needs also did not allude to adolescent immunization despite recognizing the potential of HPV infections.[69] This writeup aims to create the needed awareness amongst health care workers who are major stakeholders.

As it has been for other vaccines that have been introduced funding will be a major challenge to implementing a comprehensive adolescent vaccination programme. It is also pertinent to note that the infant vaccination programme and the more recent covid-19 vaccination programme have not achieved optimal coverage. This a major factor that is already recognized in efforts to strengthen the immunization programme in Nigeria.[70] In recognition of the fact that coverage is variable in the different sections of the country with some of the least performing states in terms of coverage having a higher burden of disease, and to allow for equity the strategy of phased introduction of vaccines has been employed.[70] This involves introducing new vaccines in states that meet the set criteria of performance. While contemplating adolescent immunization, efforts must be put in place to ensure the success of the current childhood immunization programme as well as the covid-19 vaccination programme. As the success of these two programmes will be the springboard on which to introduce adolescent immunization.

Promoting Adolescent vaccination in Nigeria - next steps

Multi-sectoral collaborations involving the health, education and communication sectors, communities and their leaders and donor agencies would be required to ensure that adolescent immunization becomes a reality in Nigeria. There is need for political will and commitment culminating in appropriate budgetary provisions for adolescent immunization programme. Nationally representative research to generate evidence for the burden and epidemiology of vaccine preventable diseases in adolescence and implementation strategies for adolescent immunization programmes in Nigeria will be needed. The evidence generated will be germane to decisions on prioritization. Much advocacy for the establishment of adolescent immunization programmes will be required. Demand creation through public enlightenment and training/retraining of health care workers on the importance and benefits of adolescent immunization are necessary inputs for a successful adolescent immunization programme. In addition, the expansion of well child visits to include visits in adolescence/inclusion of immunization assessments at school entry would ensure that children at all ages including adolescents are age-appropriately immunized. Vaccine production and supplies within Nigeria would also need to be considered.

Conclusion

Adolescents make up a significant proportion of the Nigerian population and many low- and middle-income countries. Introducing and maintaining an adolescent immunization programme will not only consolidate the gains of childhood survival interventions but ensure that the next generation of adults reach adulthood in good health.

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