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Review

Current Trends of Immunization in Nigeria: Prospect and Challenges

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Abstract: Immunization is aimed at the prevention of infectious diseases. In Nigeria, the National Programme on Immunization (NPI) suffers recurrent setbacks due to many factors including ethnicity and religious beliefs. Nigeria is made up of 36 states with its federal capital in Abuja. The country is divided into six geo-political zones; north central, north west, north east, south east, south west and south south. The population is unevenly distributed across the country. The average population density in 2006 was estimated at 150 people per square kilometres with Lagos, Anambra, Imo, Abia, and Akwa Ibom being the most densely populated states. Most of the densely populated states are found in the south east. Kano with an average density of 442 persons per square kilometre, is the most densely populated state in the northern part of the country. This study presents a review on the current immunization programme and the many challenges affecting its success in the eradication of childhood diseases in Nigeria.

Key words: immunization, childhood diseases, Nigeria, religious and ethnic beliefs

Introduction: Policy Guidelines and Targets of EPI in Nigeria

At the end of 2011, Nigeria was estimated to have a population of 167 million [1]. The Expanded Programme on Immunization (EPI), introduced in 1978 with the aim of providing routine immunization to children less than the age of two years, recorded initial but intermittent successes. The optimum level was recorded by the early 1990s with the country achieving a universal childhood immunization coverage of 81.5%. But since that period of success, Nigeria has witnessed gradual but consistent reduction in immunization coverage. By 1996, the national data showed less than 30% coverage for all antigens, and this decreased to 12.9% 2003 [2]. This figure which is consistent with the 2003 national immunization coverage survey figures is among the lowest in the world and explains the poor health status of children in the country. It is the worst in the west African subregion, only better than Sierra Leone. For instance, the polio epidemic in Nigeria is the worst in the African region and constitutes threat to other nations [3].

The vision of EPI in Nigeria is to improve the health of Nigerian children by eradicating all the six killer diseases, which are polio, measles, diphtheria, whooping cough, tuberculosis, and yellow fever. Between 1985 and 1990, as outlined in the national health plan for that period, the objectives of EPI were to strengthen immunization, accelerate disease control and introduce new vaccines, relevant technologies and tools. In1995 in line with the above, Nigeria became a signatory to the World Health Assembly, adopted the World Health Assembly Resolution (WHAR) and United Nations General Assembly Special Session (UNGASS) goals for all countries to achieve by 2005 (i) polio eradication, (ii) measles mortality reduction and (iii) maternal and neonatal tetanus elimination (MNTE). Nigeria also adopted the millennium development goals (MDGs) calling for a two-third reduction in child mortality, as compared to 1990, the year 2005. In addition to the above, the country ratified the United Nations General Assembly Special Session (UNGASS) goals urging Nigeria to achieve by 2010 (i) ensure full immunization of children under one year of age at 90% coverage nationally with at least 80% coverage in every district or equivalent administrative unit, and (ii) vitamin A deficiency elimination. In 1998 following from the above, Nigeria laid out the core activities of EPI policies which included the following: (i) monitoring of the performance, quality and safety of the immunization system through indicators; (ii) assessment of the current burden of vaccine-preventable

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diseases as well as the "future" burden of vaccine preventable diseases in terms of sickness, death and disability, as well as the economic burden; (iii) assessment of the impact of vaccination strategies, through on-going epidemiological surveillance and reliable laboratory confirmation, as well as impact assessments in Nigeria; (iv) monitoring of the national immunization policies, particularly the vaccines used in the country and the target population for these vaccines (immunization schedules); and (v) monitoring of the overall proportion of children and women who are vaccinated (immunization coverage) and ensuring that all districts of the country are well covered with vaccination. In 2000, following the African Regional Summit on EPI held in Harare in November 1999, the Federal Ministry of Health specifically stated its policies on the country's initial visions for EPI as follows:

(i) Immunization System Strengthening: By the year 2004, Nigeria should achieve the EPI district-focused plan and attain 80% DPT3 coverage in all the states of the federation. The specific policy also stated that the government should ensure increased funding for EPI.

(ii) Accelerated Disease Control: By the year 2004, there should be no cases of acute flaccid paralysis associated with wild poliovirus in Nigeria. As for measles, by the year 2004 the country should have reduced measles morbidity by 90% and measles mortality by 95%; while the coverage for yellow fever is expected to increase to at least 80%.

(iii) Innovations: By the year 2004, Nigeria should include vitamin A and hepatitis B (HB) in its national immunization programmes; and the vaccination coverage should not be less than 80% as with other antigens. Under the new technology drive, the country should adopt the multi-dose vial policy (MDVP) and vaccine vial monitor (VVM) and also introduce new methods for monitoring its use [4].

Immunization against childhood diseases such as diphtheria, pertussis, tetanus, polio and measles is one of the most important means of preventing childhood morbidity and mortality. Achieving and maintaining high levels of immunization coverage must therefore be a priority for all health systems. In order to monitor progress in achieving this objective, immunization coverage data can serve as an indicator of a health system's capacity to deliver essential services to the most vulnerable segment of a population [5].

Vaccination of Children

Immunization and vaccination are two of the most important public health interventions and constitute a cost effective strategy to reduce both the morbidity and mortality associated with infectious diseases.

Over two million deaths are delayed through immunization each year worldwide [6, 7]. Despite this fact, vaccine-preventable diseases remain the most common cause of childhood mortality with an estimated three million deaths each year [8]. In recent times, vaccination has had a major impact on measles deaths. From 2000 to 2005, more than 360 million children globally received measles vaccine through supplementary immunization activities. Moreover, improvements have been made in routine immunization over this period.

These accelerated activities have resulted in a significant reduction in estimated global measles deaths. Overall, global measles mortality decreased by 60% between 1999 and 2005. The largest gains occurred in Africa where measles cases and deaths decreased by nearly 75% [9]. Thus, there is a lot of pressure on health facilities in different countries in controlling the disease through vaccination. Indeed, measles is targeted by the WHO in its expanded programme of immunization (EPI).

According to the National Programme on Immunization [10], routine immunization of children in Nigeria is carried out using the following vaccines;

- BCG (Bacilli Calmette Guerin)—at birth or as soon as possible after birth
- OPV (Oral Polio Vaccine)—at birth and at 6, 10, and 14 weeks of age
- DPT (Diphtheria, pertusis, tetanus)—at 6, 10, and 14 weeks of age
- Hepatitis B—at birth, 6 and 14 weeks
- Measles—at 9 months of age
- Yellow Fever—at 9 months of age
- Vitamin A—at 9 months and 15 months of age

According to the Nigerian Federal Ministry of Health definition, a child is considered fully vaccinated if he or she has received a BCG vaccination against tuberculosis; three doses of DPT to prevent diphtheria, pertussis (whooping cough), and tetanus; at least three doses of polio vaccine; and one dose of measles vaccine. All these vaccinations should be received during the first year of life, over the course of five visits, including the doses delivered at birth. According to this schedule, children aged 12–23 months would have completed their immunizations and be fully immunised. To keep track of the delivery of these immunizations, Nigeria also provides parents or guardians with a health card on which each dose is recorded.

In their study, Henry *et al.* [11] showed only immunizations completed for children aged 12–23 months, the usual age group for reporting immunization rates. Their results revealed that one-fourth of all children aged 12–23

months had received the three recommended doses of polio but many missed the corresponding third dose of DPT3, which was received by only 5.1% of one-year olds. Only 2.2% of children 12–23 months of age received all recommended doses. More children in Yobe (3.8%) than in Katsina (2.5%) and Zamfara (0.2%) received all recommended doses ($p = 0.05$). Further analysis of the data shows that 67% of parents who were unable to receive all immunizations reported lack of vaccine as a problem, and 13% had difficulties with the long wait. Children in the urban areas have consistently higher immunization rates than those in the rural areas. Overall, 4.6% of children 12–23 months of age had received all of the recommended doses by one year of age, compared to only 1.1% in the rural areas ($p = 0.005$).

The greatest urban advantage is associated with the BCG dose, which is administered at birth and probably reflects the higher proportion of births in health care facilities in the urban areas. For DPT3 and Polio3 the urban and rural rates are much closer.

Like many other sub-Sahara African countries, Nigeria is still experiencing tremendous crises in maternal and child health care. These crises reflect more on under-five morbidity and mortality, which has not witnessed a significant improvement from its level since the 1990s. For instance, in 1990, the under-five mortality rate was 147 deaths per 1000 births, while in 1995 it increased to 176 deaths per 1000 births, and in 2000 it was 153 deaths per 1000 births [12–15]. According to the latest Nigerian demographic and health survey (2004), out of every 1000 children born in Nigeria, 70.49 died before reaching five years of age, with female and male infant mortality estimated at 67.34 and 73.55 deaths/1000 live births respectively. In recognition of the risks faced by Nigerian children, one of the important services covered by PHC in Nigeria is immunization. Although immunization began in Nigeria in 1956 when smallpox was severe nationwide the national immunization tagged Expanded Programme on Immunization started in 1979 to combat deadly childhood diseases, which were regarded as the cause of high infant morbidity and mortality in Nigeria. These diseases are polio, measles, yellow fever, whooping cough, diphtheria, tuberculosis of and marasmus [4]. Although malaria is not included in the list of childhood diseases, researches are ongoing to develop a malaria vaccine which will hitherto prevent and reduce infant malaria. Recently, a purified irradiated PFSPZ vaccine administered to individuals by inoculation in the skin proved safe, suboptimally immunogenic and protective. Also, efforts are on towards an effective vaccination to combat influenza. In a recent report, changing the amino acid residue in the stem cell region of the HA2 subunit of the haemagglutinin molecule showed promise as a strategy for cell culture based influenza vaccines.

Coverage

Immunization coverage is a health output the ultimate effect of which is a reduction in disease incidence. Disease surveillance systems currently lag behind coverage assessments, and reported cases of vaccine-preventable diseases in most countries are only a small, and unknown, fraction of the actual number of cases occurring. Disease surveillance systems are essential tools for effective health systems: they provide early warning of disease outbreaks and provide information essential to the management of immunization programs. Strengthening surveillance systems as part of improvement of immunization programs is therefore of vital importance. Achieving high levels of coverage is, by itself, not a sufficient indication of the effectiveness of a health care system, as deficiencies in other areas could be widespread. However, *lack* of progress in moving towards high levels of coverage is a strong indication of failure to provide essential services to protect the health of the most vulnerable segment of a population. For diphtheria, pertussis, tetanus (DPT), a minimal coverage goal of 80 percent (three doses) by 2005 has been proposed by the Global Alliance for Vaccines and Immunization (GAVI), to be achieved in all districts in all countries.

Countries across the world, at different levels of income, have shown that this is achievable with sustained efforts [5].

Immunization Coverage per Antigen in Nigeria 1995–2011

UNICEF estimates of coverage per antigen provides information on only four antigens in Nigeria, which are used for this study, although there is also an alternative data source from the Central Bank of Nigeria. These are BCG (TB), DPT (diphtheria, pertusis and tetanus), polio and measles.

According to UNICEF data between 1995 and 2005, BCG coverage in Nigeria witnessed a decline from 80% in 1990 to 42% in 1995 and fluctuated between 43% in 1996 and 60% in 2003. In 1997, BCG recorded 53%. This means that the target of at least 80% coverage as indicated in EPI policy in Nigeria could not be met, just as it was still not met in 2005. The BCG coverage shows over 35% increase from the 40.50% coverage recorded in 2006 against the 76.41% coverage for 2010 and over 53% from the 23% coverage in 2003. The highest BCG coverage was reported in Enugu State with 99.55%, while the lowest was

reported in Kano State with 35.23%.

EPI policy in Nigeria stipulated that by 2004 no community in the country should have or report cases of diphtheria. The results show that this vision is not yet realized. In 1990, DPT had a coverage of 56%. This dropped to 31% in 1995, and to 26% in 1996, and ranged between 25% and 45% between 1997 and 2005. Apart from 56% in 1990, the peak between 1995 and 2005 was 45% recorded in 1997. Although the national DPT3 coverage stands at 67.73%, there was an almost 95% increase in coverage in 2010 as against the 36.3% coverage recorded in 2006. This figure is applicable not only to the national figure but also across all the zones. The southeast zone with a coverage of 91.18% presents the highest figure, while the northeast zone with 46.16% presents the lowest. The DPT3 coverage by States shows that Enugu state had the highest DPT3 coverage of 98.21%, while Taraba State showed the lowest DPT3 coverage with 15.63%.

In 1990, polio coverage was 55%. This dropped to 31.5% in 1995 and, between 1996 and 1999 it dropped to between 26% and 19%. In 2000, it increased picked to 26% and continued to rise to 45% in 2005. These results show that the country's target of eradicating polio in Nigeria by the year 2004, through 95% coverage was not met. Oral polio vaccine (OPV3) coverage shows a national figure of 73.95% coverage with the southeast zone at 86.63% as the highest and the northeast zone with 60.2 as the lowest rate. The trend shows a drop from 38.60% in 2003 to 36.70% in 2006 and an increase to 73.95% in 2010. The OPV3 coverage by states shows that Enugu state recorded the highest coverage with 99.11%, while Taraba State recorded the lowest with 18.75%.

Measles' coverage was 54% in 1990 and dropped to 44% in 1995 with further drop to 38% in 1996. The peak coverage was 69% in 1997, which later dropped to 40% in 1998 and to 35% in 1999. Since 1999, there was no significant change over the years, except in 2004 and 2005 when the coverage dropped to 32%. The downward trend in the coverage of all the antigens appears to be associated with political problems. These political problems included low government commitment to ensure the fulfilment of EPI policy [12]. It also included over-centralization in the administration of EPI at the federal level of governance in Nigeria. Also, the poor coverage of measles between 1998 and 2005 was blamed on vaccine shortages and administrative problems, as it applied to Polio coverage between in 1996, 1999 and 2000 when Polio recorded 26%, 19% and 26% respectively [4].

However, the coverage for measles also showed a rise from 25.30% in 2003 to 32.70% in 2006 and 63.55% in 2010. Looking at the zones, the data show 82.35% coverage in the southeast, 74.40% in the southsouth and 47.15% in the northeast as the lowest. The measles coverage by state shows that Enugu state had measles coverage of 97.77%, Zamfara had a median coverage of 65.48%, while Kano recorded the lowest coverage of 16.48%.

Current Epidemiological Situation of Polio in Nigeria

1. More States in Nigeria were polio-free in 2006 than in 2005: 22 States did not report wild poliovirus case in 2006 as compared to 16 in 2005.
2. NPI has adopted a more integrated strategy that aims at increasing the acceptability/ demand for immunization in general and reducing the child mortality.
3. In 2006, Nigeria reported a high poliovirus transmission mainly in six states in the northern area of the country. According to WHO data, 438 wild poliovirus cases had been confirmed in 15 states, as of June 9, 2006. This compares with 173 cases for the same period in 2005. Today Nigeria accounts for 83% of the global wild poliovirus cases in 2006 and for 98% of the cases in Africa. In 2013, Nigeria still has cases of wild poliovirus and in November, 2013, the Bill and Melinda Gate Foundation on polio eradication pledged its support for the total eradication of the poliovirus by 2015.

- Nigeria is the last polio endemic country in Africa with a high polio transmission in the northern part of the country
- Six of the country's 37 states—Bauchi, Jigawa, Kaduna, Kano, Zamfara and Katsina—accounted for 90% of all cases in Nigeria in 2006.
- The total number of confirmed wild poliovirus cases in Nigeria for the year 2005 was 801 with a total of 21 states infected. Nigeria accounted for 41% of the global wild poliovirus cases in 2005 [13].

As on March 14, 2005, 18 States in Nigeria reported the infection of wild polio virus. The infection affected 55 local government areas (LGAs) in the country, with the majority of the infected LGAs being in the northern zone. Only Edo State recorded polio infection in two of its LGAs in 2005. As of August 2005, 55 LGAs 18 states were still seriously affected by polio infections in. The above data suggest that since 1975 when EPI started in Nigeria, and even with government attention directed to public health care (PHC) since 1985, Nigeria remains endemic to poliomyelitis. Since 2000, government has directed its EPI programme on eradication of polio [4].

In 2011, one of polio due to wild poliovirus (WPV1) was reported, with onset on February 7, from an LGA in Borno state (Marte) that was previously infected in 2010.

Table 1. Wild polio virus case

Wild polio virus type	Year	
	2010	2011
Wpv1	7	40
Wpv3	11	12
Total	18	52

Data in WHO as of 11 Jan 2011 for 2010 data and 10 Jan 2012 for 2011 data.

Although the genetic data is not yet available for this case, it is highly likely that it represents a continuation of the 2010 transmission in the same area. One case due to cVDPV2 has also been reported, from Zamfara, with onset in January.

In 2010, Nigeria reported a total of 21 cases of polio due to WPV (8 WPV1 and 13 WPV3), from 21 LGAs in eight states, versus 388 cases from 198 LGAs in 27 states in 2009. This is the lowest incidence of both types over a 12-month period that Nigeria has ever recorded. Circulating vaccine-derived poliovirus (cVDPV) incidence also dropped significantly in 2010, with 27 cases reported from 23 LGAs in eight states versus 154 in 96 LGAs in 15 states in 2009. The eight cases of WPV1 were detected in 2010 in three different transmission areas; the earliest WPV1 case of the year, in Sokoto in April, was a continuation of transmission within Sokoto from 2008–2009. No further cases have been detected in this transmission chain. The four cases in Borno and the one case in Kano (in addition to multiple cases in Chad) are genetically related to each other and are due to a continuation of transmission within Borno from 2009 (and as noted above, it is likely that the February 2011 case is from the same transmission chain). The two Kebbi cases are related to each other, although there is a genetic evidence indicating missed transmission, and represent continuation of transmission in the north-central and far north-western areas from 2008 and 2009. The 13 WPV3 cases from 2010 demonstrate different transmission patterns. While there is one clear example of continuation of transmission from 2009 in the same area in Zamfara, several states have reported cases that appear to be due to sporadic importations (Delta, Katsina, one of the Zamfara cases, FCT); and the largest group of seven cases spreading across three north-western states (Zamfara, Kebbi, Sokoto) was due to the introduction of WPV3 previously circulating (2009) in north-eastern states on the other side of the country. This transmission chain also spread to Niger and Mali. Fifteen of the 27 cVDPV2 cases with onset in 2010 are from two clear transmission chains, one involving Kano, Kaduna, and Kebbi, and the other Kano, Borno, and Yobe. There is evidence from Kano in particular, but also Kaduna, Sokoto, and Kebbi, of transmission continuing from 2009. Clearly, cVDPV2 is also moving through the country, and in 2010 a case related to the Sokoto transmission was reported from Niger Republic. One case due to cVDPV2 was reported from Zamfara in 2011. Another case of WPV3 with an onset of paralysis on November 30 was reported in Bursari district of Yobe State. The total number of cases for 2011 was 52 [14–18].

The nationwide strike and restricted movement in a number of states have affected the preparations for the national immunization plus days planned for February 4–7 and March 3–6. The National Stakeholders meeting planned for January 9–11 to review the 2012 emergency action plan was also postponed for the same reason.

Community volunteers are being recruited to rapidly scale up community-based communication initiatives in Kano, Kebbi and Sokoto states.

Poliovirus transmission over the last 12 months therefore shows two patterns; one is the continuation of transmission in key areas, often undetected for relatively long periods; the other is the movement of viruses often across wide areas, with genetic gaps indicating that different transmission chains have been missed for several months. Although case numbers have been much lower than in previous years, the evidence of missed transmission, along with the continued detection of all three poliovirus types, represent significant epidemiological risks. As noted in October 2010, detailed case investigations show that polio cases, whether due to WPV or cVDPV, are overwhelmingly un-immunized or under-immunized.

There is a high preponderance of failure to immunize due to reported non-compliance, and community surveys around cases confirm the importance of non-compliant and under-informed communities in sustaining poliovirus transmission [19].

Eradicating Polio

Among the greatest obstacles to polio eradication in Nigeria is the lack of basic health infrastructure, which limits vaccine distribution and delivery, as well as internal strife and the sometimes oppositional stance that marginalized communities take against what is perceived as a vertical (top down) intervention. Another challenge has been maintaining the potency of live (attenuated) vaccines in extremely hot or remote areas. The oral polio vaccine must be kept at 2–8°Celsius for vaccination to be successful [20].

Poliovirus transmission in Nigeria has been significantly reduced in 2010 following real progress in improving programme quality and community engagement and

reaching more children consistently with the vaccine. This progress provided a strong platform for completing eradication in 2011. The developments noted above demonstrate that the national programme is actively seeking new and effective ways to improve quality and to finish the job. However the ERC is hampered by a number of issues. The continued circulation of all three poliovirus types, the continued evidence of quality gaps and failure to reach all children in key high risk areas during IPDs, and the evidence of surveillance gaps detected through genetic analysis and special field investigations all show that polio can and will return with a vengeance if the programme does not rapidly succeed in further improving quality. The inevitable distraction of political leadership in the period leading up to national and state elections is a further concern. The ERC believes that the programme must rapidly step up effort to close remaining quality gaps and complete eradication. The basic elements necessary for doing this already exist; the key will be ensuring effective implementation of existing plans and strategies. Mop-up responses must achieve the intended high quality; high risk operational plans and intensified ward communication strategies must be developed and implemented in key high risk areas.

Measles

The potential impediments to the eradication of measles include the lack of appreciation of disease severity, transmission among adults, waning immunity, the possibility of transmission from subclinical cases, misinformation, quality, intensity and duration of vaccine-induced immunity, low vaccination rates and coverage, the burgeoning acquired immune deficiency syndrome epidemic, vaccine failures, global travel and international spread of measles, and the threat from bioterrorism [21–23]. A key issue is the duration of vaccine efficacy in developing countries [24]. Despite intense efforts to eradicate it, measles still infects 30–40 million people worldwide and causes half a million deaths a year [25]. It is the leading killer among vaccine-preventable diseases and causes an estimated 44% of the 1.7 million vaccine-preventable deaths among children each year [26]. The case fatality rate of measles in developing countries is high, particularly among infants, and reaches 30% among patients admitted to hospital [27]. Even in affluent countries, the complication rate is high and epidemics cause severe morbidity, permanent sequelae, and death [28].

Immunization against measles is usually carried out by means of the following vaccines;

- Live vaccines
- Live attenuated vaccines containing measles, mumps, and rubella (MMR)
- A combined measles, mumps, rubella, and varicella vaccines (MMRV)
- Human normal immunoglobulin (HNIG)
- Vitamin A supplements administered to children diagnosed with measles [29–31]

Factors Affecting Routine Immunization 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 in the targeted states 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 victims of vaccine-preventable diseases.

There are several reasons for these low rates. Firstly, primary health care services are highly ineffective and have deteriorated due to the lack of investment in personnel, facilities and drugs, as well as poor management of existing resources. There is also a lack of confidence and trust by the public in the health services resulting from the poor state of 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 [32]. Some of these problems are briefly discussed below;

Misperceptions of routine immunization

Incorrect knowledge as to the preventive role of routine immunization is widespread in Nigeria. Quantitative research conducted in six states in 2004 reveals that in rural Enugu, diarrhoea, fever, convulsion, vomiting and malaria are believed to be vaccine-preventable diseases (VPDs), while in rural and urban Kano, malaria, teething problems, vomiting, convulsion and pneumonia are listed. During pilot community research in March 2005, a number of immunization decision-makers and caregivers in Katsina state stated that only polio immunization is required that once a child has received its polio 'drops', it is immunised against all childhood illnesses, including those for which there is no vaccine available, e.g. acute respiratory infection [32]. Those least likely to demonstrate high levels of correct knowledge include people who do not use public facilities for the treatment of common illnesses, those who lack easy access to public health facilities, and illiterates [33].

Influence of religion

In Nigeria, the greatest challenge to the acceptance of immunization is a religious one especially among the northern Nigerian Muslims. Generally, the Muslim north has the low immunization coverage, the least being 6% (northwest) and the highest being 44.6% (southeast).

In Ekiti state (southwest), for example, the northeast and west of Ekiti, with a stronger Islamic influence, has low immunization coverage and also poor educational attainment. Christians have 24.2% immunization coverage as compared to only 8.8% for Muslims [34].

Inadequate cold chain equipment

Over the years Nigeria has received huge quantities of cold chain equipment. Despite this support, much of the cold chain appears to be beyond repair. This is partly due to the focus on polio eradication, which uses freezers. In one zonal store, only one of the three cold rooms was working, with only a single compressor operational. Substantial numbers of solar refrigerators have been bought in the last few years; although, a useful addition these are expensive ($5,000 each) and prone to breakdowns. At the state level, the cold stores are poorly equipped and badly managed. More than half of the refrigeration equipment is either broken or worn out. In the eight states visited, 47% of the installed solar fridges were broken and $205,000 worth of solar equipment remained uninstalled [35].

Political problems

The downward trend in the coverage of all the antigens appears to be associated with political problems. In Nigeria, the boycott of polio vaccinations in the three northern states in 2003 created a global health crisis that was political in origin [36, 37]. These political problems included low government commitment to ensure the fulfilment of EPI policy as well as over-centralization in the administration of EPI at the federal level of governance in Nigeria. The poor coverage of measles between 1998 and 2005 was blamed on vaccine shortages and administrative problems, as was the case in 1996, 1999 and 2000 when polio coverage was only 26%, 19% and 26% respectively [4]. Some positions offer potential for patronage due to the large payments for NID activities. This has led to political appointments and frequent changes in personnel as some LGA chairmen wish to bestow or repay political favours. Even at the state government level, increased political interference has been reported to be in the appointment of civil servants, also resulting in frequent changes of staff and the appointment of inappropriately qualified staff [38].

Rejection of routine immunization

Another problem and challenges facing immunization programmes in Nigeria is the rejection of selected vaccines/vaccination by parents or religious bodies more especially in the northern part of this country. The reasons for such rejection are outlined below;

a) Fear and confusion

Many decision-makers and caregivers reject routine immunization due to rumour, incorrect information, and fear. Attempts to increase coverage must include awareness of people's attitudes and the influence of these on behaviour. Fears regarding routine immunization are expressed in many parts of Nigeria. Fathers of partially immunised children in Muslim rural communities in Lagos State see hidden motives linked with attempts by non-governmental organisations (NGOs) sponsored by unknown enemies in developed countries to reduce the local population and increase mortality rates among Nigerians. Belief in a secret immunization agenda is prevalent in Jigawa, Kano and Yobe States, where many believe activities are fuelled by Western countries determined to impose population control on local Muslim communities [32, 39].

b) Low confidence and lack of trust

Lack of confidence and trust in routine immunization as effective health interventions appears to be relatively common in many parts of Nigeria [38]. A 2003 study in Kano State found that 9.2% of respondents (mothers aged 15–49) evinced 'no faith in immunization', while 6.7% expressed 'fear of side effects'. For many, immunization is seen to provide at best only partial immunity, e.g. in Kano and Enugu [32, 40]. The widespread misconception that immunization can prevent all childhood illnesses reduces trust because when, as it must, immunization fails to give such protection, faith is lost in immunization as an intervention, for any and all diseases.

Shortage of vaccines and immunization supplies

Under the NPI's the first mandate is to "support the states and local governments in their immunization programmes by supplying vaccines, needles and syringes, cold chain equipment and other things and logistics as may be required for those programmes". However, the supply of vaccines has always been problematic for Nigeria, primarily because funds were not sufficient and were not released on time. For example in 2001 the whole amount was approved but only 61% was released, the late release of funds (April 2001) meant that vaccine had to be bought on the spot market at inflated prices. In 2002 no funds were released and by March 2003 the funding cycle had only reached the stage of getting the budget approved. NPI

did not supply any syringes for Rubella infection in 2005, and the only safety boxes that have been supplied are the limited quantities given by donors for SIAs. Following an assessment in 2003, it was decided that UNICEF would supply vaccines in future. In the last quarter of 2003, UNICEF began supplying vaccines through a procurement services agreement, and this arrangement continues to date. However, it has not solved the problem of vaccine shortages. For example, cerebrospinal meningititis (CSM) vaccine was not supplied in time to allow CSM immunization to take place before the cerebro-spinal meningitis season, and some states had to buy their own stocks of CSM using state funds. Measles vaccine also arrived too late to limit the effects of a measles outbreak in the north, and an insufficient quantity of measles vaccine was supplied to Abia [37].

Perceived Benefits of Routine Immunization

Key benefits include the good health and survival of children. Another is the cost-saving benefit of immunization from a lower incidence of disease and less frequent visits to the hospital. In 2004, parents in both Lagos and Enugu stated that immunization reduces mortality and morbidity, helps to minimise the anxiety associated with rearing children, and helps to maximise use of time and money.

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