Vaccine-preventable Diseases: An Examination of Measles and Polio in Nigeria*

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Abstract

Vaccination remains one of the most effective and economical public health measures for preventing disabilities and deaths. Whereas the widespread approach to the use of vaccines ensures the control of an array of infectious diseases, developing countries continue to grapple with the burdens of vaccine-preventable diseases (VPDs) with their attendant bearing on childhood mortality. This paper examines the state of affairs in Nigeria in the context of measles and polio. We argue that Nigeria still faces the health challenges posed by VPDs not only because there are social, cultural and political obstacles but largely because there has been an underutilization of epistemic resources as well as a sustained dependence on foreign sources for vaccine production and supply. Therefore, the paper suggests and explores a cost-effective approach that links the unmet vaccination needs in Nigeria to a largely Nigerian initiative towards a solution.
Keywords: measles, Nigeria, polio, vaccination

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1. Introduction and Problem

Vaccination as a means of enhancing host resistance to infectious diseases remains one of the most effective and economical public health tools for preventing morbidity. It is a biomedical exercise as well as a form of social intervention which has not only ensured the eradication of small pox from the garden of human experience, (Odewumi, 2009; Søborg et al, 2009) but also continues to save millions of lives on the global plane. Its aesthetic appeal is that once people are exposed to the antigenic part of an infectious agent, their immune system responds in a manner such that they become protected from diseases associated with it. Hence, the logic of vaccination is that every vaccinated person will mount an effective immune response (Poland, Ovsyannikova & Jacobson, 2008). Additionally, vaccines are quite safe in comparison to most pharmaceutical and biological agents (Jacobson, Zabel & Poland, 2003). Although vaccination brings about the control of an array of infectious diseases, some countries continue to face the burdens posed by a number of vaccine-preventable diseases[1] (VPDs).

Roukens and Visser (2008) note that 90% of the annual cases of VPDs occur in sub-Saharan Africa, circulating debilitating conditions such as measles, meningitis, mumps, poliomyelitis, and typhoid fever. According to Adu (2008), Nigeria ranks 15th amongst countries with the highest cases of VPD-associated morbidity and mortality. Against this background, this paper examines the problem of VPDs in Nigeria using examples of measles and polio. Whereas hitherto attempts to understand the situation and proffer workable solutions have focused on social, cultural, and political obstacles; this paper argues that the health challenges posed by VPDs in Nigeria arise largely because there has been an under-utilization of available resources

[1] VPDs are diseases for which there are either no effective treatment or for which the cost of treatment is greater than that of prevention. To be classified as a VPD, there must be an available effective vaccine for the given disease.

as well as a sustained dependence on foreign sources for vaccine production and supply. In addition, seemingly vaccinated children come down with VPDs due to lack of proper pre and post-vaccination laboratory evaluation. Ultimately, we propose a framework that takes into consideration the economic as well as the scientific dynamics of the situation.

1.1. Methodology & Conceptual Framework

This paper employs the archival method of research, drawing from extant literature relevant to its thematic concerns. It frames its arguments around the use of local resources and strategies vis-à-vis solving the challenges posed by VPDs in a developing nation context. This is an approach akin to the concept of regionalization (Storper, 1997), a notion which emphasizes the utilization of resources specific to individual places to meet economic challenges. On that note, the paper links the unmet vaccination needs in Nigeria to a largely Nigerian solution.

2. Background to Vaccination in Nigeria

Concerted vaccination attempts in developing countries were first attempted in 1974 via the WHO Expanded Program of Immunization (Rey & Girard, 2008). This was begun with the notion of reaching out to countries inadequately poised to meet the economic challenges posed by VPDs such as tetanus, tuberculosis, diphtheria, measles, pertussis, and poliomyelitis. However, epidemiological surveillance often showed that many Nigerian states were still confronted with VPDs such as polio (Ajao & Oyemade, 1981), measles, tetanus, and yellow fever despite the international pledge and commitment to fight the aforementioned diseases. For reasons that included the failure of this initiative, Nigeria commenced a National Program of Immunization in 1988, an initiative that largely involved the free administration of vaccines to children younger than five years. 50% of children were initially immunized, and vaccine coverage was expected to rise with time. However, coverage had gradually and drastically dwindled by early 1990 (Renne, 2006). Today, VPDs remain a major health challenge

exemplified by their attendant effects on childhood mortality as well as other associated deformities. Indeed, Nigeria is adjudged one of the least successful of African countries in achieving child survival (Ngowu, Larson & Kim, 2008) through the use of preventive strategies, such as vaccines, to reduce the burden of diseases to which this category of the population is most susceptible and vulnerable.

Perhaps, because most societies treat healthcare as an important goal of public policy (Green, 2005) Nigeria government has organized a series of National and State Immunization Days aimed at improving the national coverage (Obioha, Ajala & Matobo, 2010). Nevertheless, the Nigerian response to the low success rate of vaccination campaigns has been largely inadequate. For example, the Nigerian Government adopts a uni-perspective approach that tends to conceive these failures as resulting from under-funding. According to that stance, therefore, increases in spending would ensure increase in the rate of vaccination success. Since the Nigerian Government felt the needed funds were not available, a partnership was formed with such International corporate bodies as the WHO and GAVI for the "cheap" provision of vaccines (Agbonlahor, 2004). However, that step constitutes a subtle way of trading off the initiative for vaccination science and policy. Consequently, Nigeria is not officially responsible for the supply, security, and management of vaccines, (Agbonlahor, 2004) but has ceded the responsibility to the UNICEF. Overall, this passive battle creates an ambience for the propagation of VPDs.

3. Two VPD: Measles and Polio

Measles is a viral disease which accounts for 44% of total deaths due to VPDs (Adu, 2008) which is more mortality than any other VPD (Akinloye et al, 2005). In the unvaccinated or partially vaccinated child, measles manifests clinically with pneumonia, heart failure, croup, and gastroenteritis. Although there is an effective vaccine, measles continues to take the lives

of many children in the developing world, particularly in Africa (Aaby, 1988). Empirical studies by Burstrom, Aaby, and Mutie (1993) concluded that measles is a significant contributor to infant and child mortality within the African region. Globally more than 30 million people are infected yearly. In 2004 alone, measles killed an estimated 454,000 people, of which more than 95% were located in the sub- Saharan Africa (Adetunji et al, 2007). This obviously highlights the high morbidity and mortality associated with measles.

With large and persistent outbreaks occurring with high morbidity and mortality (Adu, 2008), measles is the most common and the most severe of the acute infections of childhood encountered in Nigeria (Familusi, 1981). A recent study by Adetunji et al (2007) found that measles cases are still commonly diagnosed in the hospital setting, and thus concluded that measles still accounts for a considerable proportion of paediatric emergencies. It is also alarming that the cohorts of susceptible unvaccinated children are at risk of contracting and causing measles outbreak in their community (Baba, Omede, Omotara & Ambe, 2007). Put simply, measles remains a threat to Nigerian children.

On the other hand, polio is a serious viral disease that afflicts the central nervous system of infants and children, causing paralysis. Between 5%-10% of those paralyzed die when their breathing muscles become paralyzed (Adu, 2008). Furthermore, it is disheartening to note that polio often gives rise to a population of people who ultimately take to begging for alms in the streets, and who in later years constitute an economic liability to the community (Ajao & Oyemade, 1981). With no specific treatment, vaccination alone (commonly through the oral polio vaccine) offers a reliable, preventive window of escape from the debilitating disease. Indeed, this preventive measure is so effective that the 53 Member States of the WHO European Region were certified polio-free more than eight years ago (Jagessar, Lazarus,

Laurent, Matic & Emiroglu, 2008), an achievement partly responsible for the reduction of the number of global polio cases.

Today, Nigeria remains polio-endemic in addition to India, Pakistan, and Afghanistan (Dutta, 2008) despite the Nelson Mandela's launch of Kick Polio out of Africa Campaign that begun in 1996 (Jegede, 2007). While most of the remaining cases of wild polio occur in Northern Nigeria (Renne, 2006), from where they have been noted to spread to parts of Central Africa and the Middle East (Katz, 2006; Pallansch & Sandhu, 2006), about 18 Nigerian States reported infection to wild poliovirus in 2005 (Obioha, Ajala & Matobo, 2010). This is a saddening situation, considering the position that Nigeria occupies in the sub-region in particular, and in Africa generally.

4. Obstacles to Effective Vaccination in Nigeria

The effectiveness of vaccines is dependent on their successful delivery from factory to lymphocyte[2] (Carstens, 2009). This suggests that the success of vaccines is not strictly a medical matter. Obstacles to effective vaccination may arise at the level of the "factory," which involves the quality of vaccines or the type of microbial strain used in their preparation. Obstacles may also arise at the level of the "lymphocyte," which involves the immune status of would-be vaccine recipients as well as whether or not there are inhibitory antibodies in them. From a sociological viewpoint, obstacles to successful vaccination therefore constitute those factors that impede the quality of the vaccine produced, its supply, its accessibility, its manner of administration as well as to whom it is administered. We now examine four of such obstacles in relation to how they have impeded the success of measles and polio vaccination in Nigeria.

[2] Lymphocytes are specialized white blood cells that form the basis of successful vaccination by either producing antibodies (the B class) or by inducing cellular activation (the T class) which destroy the infectious agent (specific to the administered vaccine) upon subsequent exposure.

4.1. Culture

Culture constitutes an intercalation of beliefs, mores, and modes of thought inherent in (and shared) by a group of people. Tangwa (2005) describes culture as congenital tinted spectacles through which people look at reality. Health and disease form a part of the wider human social experiences. Thus, cultural and personal values would affect the recognition of illness, seeking healthcare, acceptance of and attitude towards care givers (Nelson et al, 2007). In short, culture influences health (Kogan, 1974). In the context of vaccination, certain cultural practices however seem to enhance the propagation of VPDs in Nigeria. For instance, the general population is characterized by an attitude of low regard for scientific knowledge (Afolabi 2007; Afolabi 2009b), something which is much worse in the unlettered. Thus, a number of mothers (and fathers, depending on the context of decision-making) still show reluctance in taking vaccination seriously, and do not often consent to their children receiving vaccination.

Especially in the Northern parts of Nigeria, vaccination campaigns are specifically hampered due to a cultural attitude that involves circulating false information (through the use of family and religious networks). These falsehoods range from claiming that vaccines contain anti-fertility drugs and cancerous agents (Jegede, 2007), to saying that vaccines destroy the egg of the female (Renne, 2006), thereby encumbering her reproductive function in later years. It is no surprise therefore that vaccine coverage remains low, thus encouraging the continued spread of VPDs in Northern Nigeria. This has been particularly relevant in the case of polio where there was a vaccination boycott in 2003 which was backed by state governments in Kano, Kaduna, and Zamfara states (Jegede, 2007). In that year, however, the temporary suspension of poliovirus immunization contributed to a national epidemic of poliomyelitis. Besides leaving more than 30% of children unvaccinated (Pallansch &Sandhu, 2006), the 2003 vaccine boycott

created a global health crisis (Kaufman & Feldbaum, 2009) that led to the reinfection of at least 20 previously poliovirus-free countries (Jenkins et al, 2008).

4.2. Underutilization of Epistemic Resources

Another impediment to the success of vaccine delivery is lack of optimal utilization of some of the available scientific resources. Medical laboratory scientists, for instance, are the group of healthcare providers whose professional responsibilities include the production and evaluation of vaccines. Unfortunately, this area has been almost completely abandoned in their training. Also, while there are a number of post-graduate courses in virology, hardly is there an avenue, such as a research institute[3], for the practical demonstration and development of the theory as well as techniques acquired in the course of the training, especially those tailored towards vaccine production and research. As such, effective transmission of available knowledge on vaccine production and evaluation no longer occurs, or when transmitted there are insufficient avenues for their utilization; a situation that breeds brain drain.

4.3. Substandard Vaccine Science

Vaccination success has also been affected by what we here refer to as the practice of substandard vaccine science in the context of vaccination. For safety reasons, as well as for ensuring optimal vaccine efficacy, it is critical that recipients of vaccines be evaluated prior to receiving vaccines. In other words, there are scientific exclusion and inclusion criteria that ensure successful vaccination. For example, potential vaccine recipients with conditions such as myasthenia gravis and thymomas[4] (Roukens & Visser, 2008) are to be excluded. Nevertheless, little or no pre-laboratory screening currently takes place (Agbonlahor, 2004). For measles, another exclusion criterion is the presence of circulating haemagglutination inhibition antibody in would-be vaccine receivers (Baba, Omede, Omotara & Ambe, 2007).

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[4] Administering the polio vaccine to a child with myasthenia gravis may lead to vaccine acquired polio. Thus, these exclusion criteria serve the dual purpose of safeguarding would-be vaccines as well as ensuring that vaccines are given to those in whom protection can be achieved.

The implication of not carrying out pre-vaccination laboratory screening is that a sizeable number of children who should normally be excluded from vaccination are vaccinated but remain at risk for VPDs because their immune system fail to produce protecting levels of antibody to the infectious agents. Since most of these "vaccinated" children eventually become afflicted by the disease which vaccination should help prevent, the socio-cultural aftermath is that people who happen to know, or those who are told of these incidences of vaccine failure, are left doubtful of the efficacy of vaccination campaigns and programs. Indeed, events of vaccine failure negatively shape the willingness of parents to vaccinate their children (Jagessar, Lazarus, Laurent, Matic & Emiroglu, 2008).

Post-vaccination testing of vaccine recipients is also essential. Presently, this process takes place in just one laboratory in Ibadan, Southwest Nigeria. Dutta (2008) however observes that an efficient laboratory network is essential for rapid and reliable analysis of stool samples, thus a single laboratory being saddled with this task is clearly not an efficient enough way of practicing scientifically sound vaccination.

4.4. Reliance on External Aid

Reliance on foreign bodies such as UNICEF and GAVI by the Government of Nigeria for its procurement and supply of vaccines tends to impress upon the mind the false notion that the menace of VPDs is the concern of these bodies and corporations. Thus, this somehow severs a sense of responsibility on the part of the Government. That attitude however weakens the Nigerian scientific community in terms of directly or indirectly limiting the kinds of relevant vaccine research they can carry out.

One rather bitter pill about depending on foreign vaccine aid is that these agencies often feel reticent to give the same level of support when there is no crises situation (Tomori, 2004).

Coming from a former WHO Regional Virologist, this view deserves some level of attention. In addition, dependence on foreign supply means that vaccine receivers may only get partially protected or do not get protected at all if the local aetiologic agent differs considerably from commonly circulating infectious agents. It also ignores the genetically encoded tendency for the vaccine recipients at the receiving end to react to some of the substances (for example, thimorosal, neomycin, and gelatin) used in constituting vaccines. But how can a local initiative help address the unmet vaccination needs in Nigeria?

5. A Modest Proposal

Existing infections undergo frequent mutations, rendering available therapy less effective. This obviously becomes alarming for a nation like Nigeria that is yet to fully explore the benefits of vaccination, even in its traditional paradigm. In other words, there is a new paradigm in vaccinology known as vaccinomics which attempts to minimize the limitations inherent in the traditional paradigm of administering the same type and dose of vaccine to everyone regardless of gender. Briefly, the vaccinomics paradigm examines the influence of immune response gene polymorphisms on the heterogeneity of humoral, cell-mediated and innate immune responses to vaccines at both the individual and population levels (Poland, Ovsyannikova & Jacobson, 2008). It has been said that any infectious disease can be eliminated provided that it can be prevented by an effective and affordable vaccine, and that the requisite program is cost-effective (Rey & Girard, 2008). Besides cost-effectiveness, a viable approach must address such scientific issues as vaccine receivers getting sick following vaccination, failure of vaccine recipients to elicit immune response and prevent target disease, and the advent of circulating vaccine-derived viruses.

5.1. The Financial Angle

Let us take a close look at the table below taken from Agbonlahor (2004) which gives a rough estimate of the amount of money Nigeria spends annually to get six vaccines.

Vaccine	**Cost (in Dollars)**
Oral Polio Vaccine	10, 024999.95
Yellow fever	8, 500002.82
Hepatitis B	5, 200004.80
Measles	3, 010000.00
DPT (Diphtheria, Pertusis and Tetanus)	1, 005000.00
BCG (Bacille Calmette Guerin)	1, 08000.00
Total	**28, 820007.00**

We gathered (from personal communication by scientists involved in vaccine research) that one third of this total cost is ample to build two laboratories devoted to the production of vaccines using indigenous microbial isolates/strains. This shows that the present stance of procuring vaccines from foreign sources is not an economically sound option. Rather than maintain the status quo, funds for vaccine importation can be gradually diverted to build well-equipped vaccine labs, preferably one at a time.

5.2. The Scientific Angle

A number of scientific challenges face vaccination today. As stated earlier, the logic and apparent strength of vaccination is that every vaccinated person will mount an effective immune response (Poland, Ovsyannikova & Jacobson, 2008). This approach assumes that the same dose amount will be needed by everyone to generate effective immunity. In other words, vaccination in this paradigm ignores genetically encoded unique individual variations in response to biologic agents (Afolabi, 2009a). This limitation helps explain some instances of vaccine failure, vaccine reactions, partial protection following vaccination, and circulating vaccine-derived viruses, which are well reported in the literature (for instance: Nalin, 2002; Kew et al. 2005; Renne, 2006; Aziz, Midha, Waheed & Bhatnagar, 2007).

With this notion in mind, one can only say that the Nigerian Federal Government, as a matter of policy, needs to seriously rethink the level of commitments vis-à-vis vaccine production as well as adhering strictly to the scientific tenets of vaccination. Perhaps, the need for the latter is best exemplified by a recent laboratory evaluation. Baba, Omede, Omotara and Ambe (2007) found that there was 73% of measles vaccine failure in a North-eastern location because children that ought to have been excluded from vaccination (based on certain immune system parameters) received vaccines. Unfortunately, this means that the time and efforts invested in that exercise were in vain.

Healthcare is something in which some people must make affirmation steps and take actions to provide to those who need it (Green, 2005). In the context of VPDs, the Government of Nigerian, who often doubles as a policy-maker, does not appear to be doing enough. This may however be due to the reticent position of professional scientists in showing interest in matters of political nature. Nevertheless, policy-makers and researchers with their common interest in promoting the health of the population have the collective responsibility of working closely together in generating and using sound evidence as the basis of decision-making (Lucas & Gilles, 2003). Nigerian scientists therefore need to fashion a platform where they can exchange ideas with Government officials with an emphasis on shaping vaccine-related policies. Attempts should also be made to invite Nigerian nationals working abroad in vaccine Research Institutes for training, retraining, and collaboration purposes. Lastly, medical laboratory scientists must see to it that the art and science of vaccine production and testing are properly reintroduced into the Nigerian university curriculum.

Conclusion

Since the foundations of vaccinology were laid in the 1790s (Barry, 2005), a number of nations have achieved considerable strides in employing vaccination as a tool for fighting VPDs.

Despite its human, intellectual, and material resources, Nigeria has not succeeded in the fight against VPDs such as measles and polio. Thus, of the 3.3 million children born yearly (Fed Rep Nig, 2001), a significant portion may well remain potential "biological fodders" for the rampage of these diseases if Nigeria does not rethink the current stance towards vaccine matters. An urgent need exists to re-channel and redirect existing foreign vaccine support for the furtherance of local scientific development in the arena of vaccine production and research. This, we believe, will set the country on a successful path to effectively deal with VPDs as well as other vaccine controllable infectious diseases including cervical cancer, HIV/AIDS, and malaria. Otherwise, and from a developmental viewpoint, Nigeria may have no specifically regional technological dynamic (Storper, 1997) in the context of a local structure that can effectively deal with the challenges of VPDs.

The principal obstacle to vaccination campaigns in Nigeria is in the North where religious and political leaders either completely reject or show antagonism towards vaccines on grounds that they are being contaminated in the Western world with anti-fertility agents and HIV (Yahya, 2007; Kaufmann & Feldbaum, 2009). However, one important question worth asking is this: would this animosity still be in place if the vaccines are being manufactured in Nigeria, by Nigerians, and (perhaps, mainly) for Nigerians?

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