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Effectiveness and impact of malaria control interventions on the malaria burden in Nigeria over 9 years period (2000 to 2008): a retrospective study

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List of Acronyms

ACT	Artemisinin-based Combination Therapy
AL	Arthemeter / Lumenfanthrine
ANC	Ante-natal Care
BCC	Behavioural Change Communication
CDC	Centre for Disease Control
CQ	Chloroquine
DALY	Disability Adjusted Life Year
DDT	Dichlorodiphenyltrichloroethane
DHS	Demographic and Health Surveys
NDHS	National Demographic Health Survey
FGN	Federal Government of Nigeria
FMoH&SS	Federal Ministry of Health and Social Services
GDP	Gross Domestic Product
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GoN	Government of Nigeria
IPT	Intermittent Preventive Therapy
IPTi	Intermittent Preventive Treatment of Infants
IPTp	Intermittent Preventive Treatment of Pregnant women
IRS	Indoor Residual Spraying
ITN(s)	Insecticide Treated Net(s)
LBW	Low Birth Weight

LGA(s)	Local Government Areas
LLIN(s)	Long Lasting Insecticide Treated Net(s)
MDG(s)	Millennium Development Goals
M&E	Monitoring and evaluation
NGO(s)	Non Governmental Organizations
NHMIS	National Health Management Information Systems
NIFAA	Nigeria Inter-faith Action Association
NMCSP	National Malaria Control Strategic Plan
NMCP	National Malaria Control Program
P. falciparum	Plasmodium Falciparum
PHC	Primary Health Care
RBM	Roll Back Malaria
RDT(s)	Rapid Diagnostic Tests
SMoH	State Ministry of Health
SP	Sulfadoxine/pyrimethamine
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Abstract

Background: Malaria is a major health problem in Nigeria accounting for most of the hospital admission across all ages. Plasmodiunm falciparum is the major malaria parasite causing malaria in the country. The adoption of the policies of ITN commenced in 2001, IPT in 2004 and ACTs in 2006; and these interventions scaled up within the period under study. Despite this scale-up, and the increased funding from all sources, internal and external, malaria burden is still significant in the country. The objective of the study is to assess the impact of malaria control activities implementation on the malaria epidemiological burden in Nigeria for the period 2000 to 2008.

Methods: Data from various sources including Nigeria National Malaria Control Program (NMCP), WHO and NDHS on malaria control interventions implemented from 2000 to 2008 were assessed and studied against the trend of malaria morbidity and mortality data.

Main findings: Between 2000 and 2008, malaria morbidity depicted by outpatient cases reduced from 20 cases per 1000 in 2001 to about 18 per 1000 population in 2008 for all ages, a reduction of 9%. This occurred after an initial rise to 53% in 2006. The proportion of malaria cases among all outpatient consultations reduced from 58% in 2001 to 45% in 2008, after a progressive rise to 71% in 2006. Total number of reported admissions increased rapidly for both under 5years and all ages' group from 2358 to 185,784 and 5935 to 538,487 respectively between 2003 and 2008. However, the proportion of deaths attributed to malaria of all malaria admitted cases reduced from 90% in 2003 to 2% in 2008 for all ages group, and also from 47% in 2004 to 2% in 2008 for the under 5 group. 12.42% of the population at risk of malaria was protected by Insecticide Transmitted Nets (ITNs) and Indoor Residual Spraying (IRS) by the year 2008 while the proportion of Artemisinine-combined therapy (ACT) available of all anti-malaria drugs for first-line treatment of malaria attained 94% in 2006 and 100% in 2007. The percentage of pregnant women who had the recommended two doses of SP as Intermittent preventive therapy (IPT) increased from 1% in 2004 to 5% in 2008.

Conclusion: The findings in this study demonstrate that Insecticide Treated Nets, Intermittent Preventive Treatment, and Artemisinine-combined Therapy are being scaled up in Nigeria. The impact of these control activities has resulted in progressive and significant decline of mortality from malaria admissions and a reduction in the proportion of malaria cases of all outpatient attendance. Other parameters and indicators have only observed a slight decline from 2007; hence it will be too early to conclude on. Further scaling up is necessary if malaria program in Nigeria would be able to close down on achieving the objective of reduction of 50% in the morbidity and mortality of malaria by 2012.

Key words: Nigeria, Malaria, Control **i**nterventions, Impact, Insecticide treated nets, Under 5years.

1. Introduction

1.1. Background

Malaria accounts for about 1.4% of the global burden of disease (WHO, 2008); and in Africa, it is the primary cause of burden of disease as measured by Disability Adjusted Life Years (DALY) lost of 10.8% (Breman et al., 2004). In 2008 alone, there were about 247 million cases of malaria and almost one million deaths – the worst hit being young children and pregnant women living in Africa. In Africa a child dies of Malaria every 45 seconds, and the disease accounts for 20% of all childhood deaths. It is documented by World Health Organization that Malaria as a public health problem can decrease gross domestic product by as much as 1.3% in countries with high disease rates. (WHO 2010)

Malaria has been known to have a devastating impact on the overall health, development and prosperity of Africa and it is addressed specifically in the United Nations Millennium Development Goals (MDGs). This reflects the agreement on development priorities among nations and the leading development institutions. These goals have galvanized into global efforts that is aimed at meeting the needs of the world's poorest countries and people. (World Bank, 2007)

Addressing the issue of malaria is very crucial to meeting many MDG targets. This is because it makes poor people to remain poor. Hence if malaria is taken out as a problem to these groups of people, their socioeconomic condition becomes better, thereby addressing in a way MDG1 (Eradicate Extreme Poverty). An estimated US$12 billion per year may be lost in Gross Domestic product (GDP) due to the disease, consuming up to 25 percent of household incomes and 40 percent of government health spending (Gallup et al, 2001; Ettling M et al, 1994; Jowet and Miller, 2005)

The disease also contributes to household poverty and stagnation of economic growth in a variety of ways, some of which are lost income for workers, reduced productivity in workers' personal and professional lives, and the negative economic impact of malaria is a deterrent to external investment and trade (Gallup et al 2001; Chima et al, 2003)

1.1. Justification for the study

A great number of interventions have been carried out either singly or in combination at different times within the period under consideration. The study is aimed at analyzing the impact of various malaria interventions in the country in a past 9 year period, which is the period from year 2000 to

2008. The study will have an impact on policy, strategies and programming. It will also inform better data collection and health management information systems.

1.2. Nigeria

Nigeria lies on the west coast of Africa with a surface area of 923,708 sq. kilometers. It is bordered by Cameroon in the East, Republic of Benin on the west, Chad republic to the North-East, Niger to the North and in the south by the Atlantic Ocean. The lowlands of the south dovetail into the plateaus and hills at the centre, with mountains in the southeast and plains in the north. The country has a population of 140million according to the 2006 census with an approximate 2.5% yearly population growth rate. It is by far the most populous country in Africa with a fairly high average population density of 156 per square kilometre. The proportion of children under 5 years of age is 20% while the proportion of the population pregnant during one year is about 5%. (FMOH, 2008).

Figure 1: Map of Nigeria showing the 36 States of the federation

The country's land area is divided into 36 States for administrative purposes with a further grouping of these 36 States into 6 geopolitical zones. Within the States are further subdivisions into smaller administrative units called Local Government Areas (LGA). Each LGA in turn is subdivided into Wards/Districts. In so many LGAs in the country, the smallest subdivision of this

unit of government called Ward/District has been taken as Health districts for the purpose of health care delivery at the grass-root level.

1.3. Health System in Nigeria

The health care provision in the country is an on-going responsibility of a decentralised government with three tiers of government doing this on concurrent basis. The country operates a mixed economy; hence private providers of health play a visible role in the health care delivery system. The federal government runs the affairs of the Federal Ministry of Health and coordinates the university teaching hospitals and federal medical centres all over the country. The State government have States Ministry of Health which adapt policies from the FMOH manages the General and Specialist Hospitals while the Local Governments Areas (LGAs) focus on the Comprehensive Health Centres, Primary Health Care centres, Basic Health Care and Dispensaries. It is worth noting that the affairs of all the other strata are coordinated by the FMOH. The total expenditure on health as percentage of GDP was 3.9 in 2005. (FMOH 2007)

1.4. Malaria situation in Nigeria

Like in many sub-Saharan African countries, Malaria *(as defined in the text box 1 below)* continues to be the main public health problem in Nigeria. It is a major cause of morbidity as well as mortality in the country (FMOH 2001). It is endemic throughout the country with more than 90% of the total population at risk of stable endemic malaria (NetMark 2001). At least 50% of the population suffers from a minimum of one episode of malaria each year (FMOH 2001). The disease is the commonest cause of outpatient attendance across all age groups (FMOH 2001).

Box 1:

What is Malaria?

Connolly (2005) describes malaria as serious and sometimes fatal parasitic disease caused by protozoan parasites of the genus *Plasmodium.* He further explains that the disease is transmitted from one person to another through a bite by Anopheles mosquitoes. Malaria may also be transmitted through malaria infected blood during blood transfusion (Connolly 2005). People infected with malaria may experience fever, chills, joint pains, and headache (CDC 2010)

It reduces by 1% Nigeria's GDP annually and is the commonest cause of absenteeism from offices, farms, markets, schools and all other types of occupational engagements and it accounts for at least 30% childhood and 11% of maternal mortalities. (FMOH 2001)

1.4.1. Epidemiological aspects

Thirty-seven (37) Anopheles species are documented to be found in the country. The commonest specie of malaria parasites is *Plasmodium falciparum* (>95%). *P. ovale* and *P. malariae* play have minor roles to play with the latter being common in children as a double infection. The dominant vector species are *Anopheles gambiae s.l.* and the *A. funestus* group. Within the Anopheles gambiae complex A. *gambiae s.s.* is the dominant species with *A. arabiensis* being found more often in the North and *A. melas* only in the mangrove coastal zone. (ORSTOM/OCEAC 1998)

The transmission of malaria occurs in the entire country. It is all year in a small part of the South of the country and 3-10 months in the remaining parts of the country. (Mara Arma (2001) and WHO/AFRO (2002)

1.4.2. Geographical considerations

Nigeria lies within 4° and 13° Northern latitude and it has a suitable climate for Malaria transmission. The climate varies from arid in the North with annual rains of 600-1,000 mm for 3-4 months duration to humid weather to the south with an annual average of 1,300-1,800 mm (and in some coastal areas up to 2,500 mm) and 9-12 months duration. (ORSTOM/OCEAC, 1998)

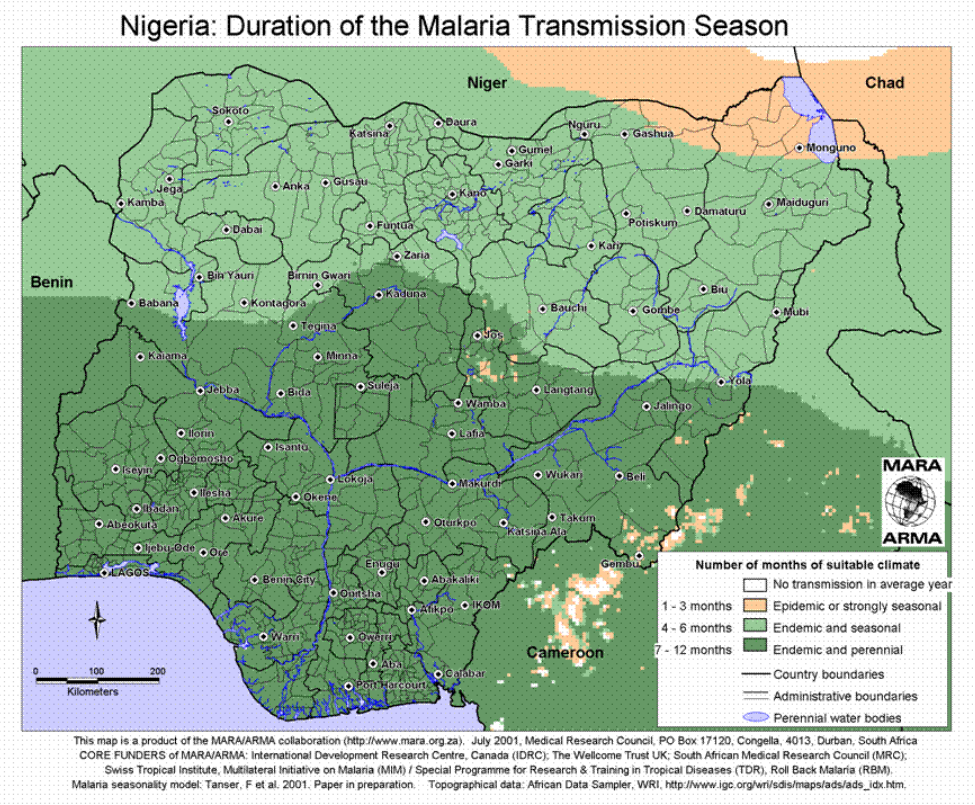

Figure 2: Malaria transmission seasons

The country's vegetation changes from Sahel savannah in the far north followed by Sudan savannah merging into Guinea savannah in the middle belt, then rain forest in the south and mangrove forest in the coastal areas.

Five (5) ecological strata have been defined which accounts for vector species, dominance, seasonality and intensity of malaria transmission experienced in the country. Nigeria is one of the countries where every inhabitant is living in the high transmission area. As at year 2008, 151,212,000 live in high transmission and no one has been classified to live in low trasmission area. Out of this population, 25,020,000 (17%) are children between ages 0 and 59 months. (WHO 2009)

1.4.3. Data Collection

The country employs routine and periodic data collection using standardized tools e.g. NHMIS and IDSR Forms. Malaria information is collected using IDSR 003 (Routine Monthly Notification Form) alongside other 22 notifiable diseases including the new addition, Avian Influenza virus. Specific malaria information collected include number of out-patient cases, in-patient cases and deaths among <5years, 5 - 14 and 15 years and above. (FMOH 2001)

Nigeria has in place a monthly reporting system. However, the frequency of reporting is often affected by the inadequate capacity, limited resources, poor communication and transmission of data from LGA health facilities levels to the State at the secondary heath care delivery level and finally the Federal levels. The Epidemiology Division of the FMOH is working together with the National Health Management Information Systems (NHMIS) for all health data generation and analysis. (FMOH 2007)

1.4.4. Assessing health impact

Health Impact Assessment (HIA) has been defined as a combination of tools, methods and procedures to judge and predict health impacts of various policies, programmes or projects (Nordic School of Public Health, 1999). HIA is fundamentally a bridge between policy/politics and research aiming at an improved evidence-based public health policy-making. During the last decades, an increasing number of countries have set national and regional targets and priorities for improving the health status of their populations. The targets have been formulated in both quantitative and qualitative terms and achieving them requires new tools and procedures (Ritsatakis, 2000).

2. Malaria Control Interventions

The National Malaria Control Strategic Plan (NMCSP) addresses national health and development priorities including the Roll Back Malaria (RBM) Goals and the Millennium Development Goals (MDGs). The NMCSP includes the following priorities:

- to reduce malaria related mortality,
- to reduce malaria parasite prevalence in children under five,
- to increase ownership and use of insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs),
- to introduce and scale-up indoor residual spraying (IRS),
- to increase the use of diagnostic tests for fever patients,
- to improve appropriate and timely treatment of malaria, and
- to increase coverage of intermittent preventive treatment (IPT) of malaria during pregnancy.

The Goal set out by the strategy is to have a reduction of malaria burden by half (50%) by the year 2010 compared to 2000. For this to be achieved the following listed objectives have been highlighted:

- A reduction in malaria prevalence from 50% population having at least one attack to 25% population having one attack yearly by the year 2010
- A reduction in all-cause child mortality by 25% in children under five years by the year 2010.
- Improvement of the main health prognostic indicators together with economic payoffs at household and national levels and therefore poverty alleviation by the year 2010.
- Contribution to health system in terms of awareness creation, advocacy for resource mobilization and Health Management Information System

Box 2:

RBM targets

- At least 80% coverage for effective case management for population at risk
- At least 80% coverage of population at risk with malaria preventive measures including sleeping under an Insecticide treated net (ITN/LLIN)
- At least 80% coverage of structures in selected areas with Indoor-residual spraying
- 100% coverage for Intermittent Preventive treatment for pregnant women attending antenatal clinics.

All these are an effort geared towards addressing the Roll Back Malaria target which are listed in box 2 on the right of this page.

2.1. Access to Treatment

Malaria-related morbidity and mortality has been increasing in Sub-Saharan Africa, primarily as a result of increased resistance to the commonly used first-line treatments, Chloroquine and Sulphadoxine–Pyrimethamine (SP) (Trape, 2003) (Snow et al. 2001). Artemisinin-based combination therapy (ACT) has been shown to improve cure rates, decrease malaria transmission and decrease anti-malarial resistance on the north-west border of Thailand (Nosten et al., 2000).

Decreased gametocyte carriage and improved cure rates have been confirmed in clinical trials conducted with ACT in Africa (von Seidlein et al. 2000; International Artemisinin Study Group 2004). Because of the attested effectiveness of ACT, there is growing international consensus that wide scale and systematic implementation of ACT is one of few effective measures that will enable malaria-endemic countries to achieve the ambitious goals set in Abuja in 2000 to 'Roll Back Malaria', particularly that of halving malaria morbidity and mortality by 2010.(David, 2004, Anayo and Chigozie, 2008)

The present choice of anti-malaria treatment which was adopted in the year 2005, a major policy change in management of malaria cases in the country stemmed from drug efficacy trials conducted at different times, first in 2000 and repeated in 2005. This led to the adoption of arthemeter/Lumefanthrine (AL) combination as the first line of management for all cases of malaria, and with a second line drug combination of Amodiaquine-Artesunate. In the context of effective vector control and low efficacy of existing monotherapy, ACT can reduce total expenditure on malaria services (see other merits in box 3). It is worth nothing also that studies have demonstrated that the drug of choice for Nigeria as the first line for management of malaria has greater effectiveness and significant cost saving effects. (Chanda et al., 2007, Muheki et al., 2004). These cost savings result from the improved clinical cure rates and decrease in malaria transmission achieved with arthemeter/Lumefanthrine (AL).

Box 3:
Artemisinin-based Combination Therapies (ACTs)
Artemisinin-based combination therapies (ACTs), made by combining compounds from the *artemisia annua* plant with various antimalarial partner drugs.

Merits:
the combination technique is expected to delay the development of drug-resistant strains of the disease.

Also, the treatment is active against gametocytes, the sexual stage of the parasite cycle, effectively reducing disease transmission.

The treatment is fast-acting and produces minimal side effects, making it possible for patients to return quickly to their daily routines

It is one thing to make drugs available, it is another issue to ensure that as many people as are in need of this treatment get them. It is still a challenge to ensure that every individual who suffers from malaria have access promptly to effective treatment especially for resource constrained health systems. It is necessary to design policy actions to address the multiple barriers of access around those of access. This should include broad interventions to revitalize the public health care system (Chuma et al, 2010). If this fails to be done, malaria will remain a major cause of morbidity and mortality in sub-Saharan Africa.(Chuma et al., 2010). The country is adopting a strategy of Scale Up For Impact (SOFI) and hence may want to assess the benefit derivable from the choice of anti-malaria treatment and the other interventions,

2.1.1. Case Management

The gold standard for detection of malaria parasites still remains slide microscopy, but it is known for long that a substantial proportion of individuals in a community may have low density infections below the microscopic detection threshold. Such submicroscopic infections contribute substantially to the infectious reservoir (SCHNEIDER et al., 2007) , as they are well capable to infect mosquitoes (Coleman et al., 2009). Therefore a radical approach to LLIN distribution to cover every household should be aimed for especially in countries endemic for malaria.(RBM, 2008.)

There is a policy in place that every suspected case of fever must be screened for malaria, and this is with the use of microscopy. Nigeria adopted a policy of malaria diagnosis based on parasitological examination in 1997.However, with the level of infrastructures in the country at the moment, this is difficult to achieve in a lot of health care delivery settings and hence Rapid Diagnostic Kits (RDT) are gaining ground in the Primary Health Care Centers while the Microscopy is reinforced in the Secondary Health Care Delivery facilities. (FMOH, 2007)

2.2. Long Lasting Insecticide-treated Nets and Insecticide Treated Nets (LLINs and ITNs)

Regular use of long-lasting insecticidal nets (LLINs) is one of the most effective ways of preventing malaria infection. This and other evidence has resulted in a considerable increase in funding for malaria control, and for LLINs in particular (Snow et al., 2008) More recently, the Global Malaria Action Plan called for rapid scale-up to universal population coverage for all people at risk for malaria (Roll Back Malaria, 2008). This scale-up in ITN delivery necessitates an

equivalent increase in monitoring and evaluation (M&E) efforts in order to determine the impact of ITN distributions as well as prioritize future programmes.

Long Lasting Insecticidal Nets (LLINs) LLINs offer protection from malaria, and if used in enough households (at least 60–80 percent in an affected area), it is said to assist in breaking the malaria transmission cycle, thus reducing the risk of transmission for all who live nearby. (World Bank, 2007) This principle has been tapped into in the strategy of achieving at least 80% coverage of ITN distribution and availability in homes.

To ensure some level of uniformity and comparability of knowledge, some terms on ITN use have been defined for programmatic purposes. These include:

- Two to three ITNs per household,
- One ITN for every two people, OR
- One for every sleeping space in a household in an at-risk community.

Typical M&E strategies report on indicators agreed upon and formalized by the RBM Monitoring and Evaluation Reference Group (MERG). Two indicators have been identified to be core in measuring progress of achievement in malaria control intervention and these are the proportion of households owning an ITN and the proportion of vulnerable populations sleeping under an ITN. Using these indicators, many studies have shown that efforts to increase ITN ownership have made tremendous progress; even though most sub-Saharan countries where Nigeria has the largest population, remain well below RBM targets for ownership (Noor et al., 2009).

In addition, these evaluations have consistently found ITN use (vulnerable groups sleeping under an ITN) lower than household ownership (Korenromp et al., 2003, Miller et al., 2007). In order to reach the RBM goals for bed net coverage and increase ITN use, it will be useful for programmes to identify and address the determinants of ITN use and non-use.

Oresanya OB et al in a study on the utilization of ITNs by U5 in Nigeria identifies that poverty constitutes an impediment against the ownership of net and she stated further that lack of targeted education curtails its use.(Oresanya et al., 2008)

Vanden Eng et al substantiated in a study of ITN use among vulnerable groups in 5 countries, focusing on the under 5 years old and came up with a result pointing to the fact that the majority of children <5 years of age living in households with ITN slept under an ITN the night before the interview. Among children < 5 years not sleeping under an ITN, the largest proportion lived in

households that did not own an ITN, despite the efforts of recent child health campaigns. This result, that the largest category of non-use is directly related to household ITN ownership indicates access is still a barrier to ITN use. This highlights the need to identify distribution strategies targeting previously unreached households to increase ownership of ITNs.(Vanden Eng et al., 2010)

In Nigeria, the research area, ITN distribution started mainly in 2001 and it is from this period that any meaningful data has been captured. The ITNs are distributed for free to all households through the Health Care centres. Since the item is distributed for free, affordability may no longer be a barrier to ownership as observed by Vanden Eng et al above. To ensure that these items distributed for free at points of use but at a tremendous cost to the providers has been backed up with a strong Behavioural Change Communication (BCC) strategy which was started in 2008. There is a good involvement of the religious leaders through constitution of NIFAA (Nigeria Inter-faith Action Association). These groups of people referred to as gate-keepers have been included in other programs but not so much in malaria programs in the past.

The country has a target of 63million nets to be distributed to achieve the WHO formula of one net protecting two and 80% coverage from ITN/LLIN distribution and usage. Up till now, 20million nets have so far been distributed covering 13 States in the country. (FMOH, 2007)

To encourage that more LLIN are replacing the ITNs and that LLIN are getting treated after a period of use, the following taxes and tariff is in force in Nigeria as depicted in table 1 below:

Table 1: Prevailing tax and tariff on types of mosquito nets (source FMOH, 2007)

Items	**Tax/Tariff**
Insecticides	0%
Mosquito Nets	20%
Insecticide-treated Nets	10%
Long-lasting Insecticidal Nets	0%

2.3. Indoor Residual Spraying

Indoor residual spraying (IRS) is the application of long-acting chemical insecticides (including DDT and other insecticides) on the walls and roofs of all houses and domestic animal shelters in a given area, in order to kill the adult mosquitoes (vectors) that land and rest on these surfaces

after feeding. The primary effects of indoor-residual spraying toward curtailing malaria transmission are to reduce the life span of malaria vector so that they can no longer transmit malaria parasites from one person to another, and also to reduce the density of them. IRS remains a strategic intervention in malaria control and part of the integrated malaria vector control approach.

In line with the renewed global interest for IRS, the country envisions to embark on IRS for malaria control. However unlike LLIN, IRS is more demanding in terms of skilled personnel in entomology, vector control as well as in pesticide sciences. It requires also a well - established delivery system including solid infrastructural and logistical supports. To this end, in 2006 the National Malaria Control Programme of Nigeria and its partners initiated a small scale pilot IRS project in three Local Government Areas: Epe in Lagos State, Barkin Ladi in Plateau State, and Damboa in Borno State. (FMOH 2007)

This small trial was conducted to assess the potential effectiveness and feasibility of IRS under local conditions before a commitment is made for scaling up. The three sites are located in three distinct ecological zones: the rain forest, Sudan savannah, and Sahel Savannah respectively. (FMOH 2007))

2.4. Intermittent Preventive Treatment

Intermittent preventive treatment given to pregnant women at routine antenatal care visits has been shown to promote healthier pregnancies and yield benefits for both the mother and her developing fetus. (Yartey, 2006) Currently, Sulfadoxin-Pyrimethamine (SP)-IPT has been rated as having the most favourable cost-benefit profile because of its relatively low cost, high compliance and efficacy in reducing maternal anaemia and low birth weight (Goodman et al, 2001, Yartey 2006).

However, implementation of IPT in pregnancy in most settings is limited by social, cultural, economic and operational challenges despite good coverage of antenatal services (Rogerson et al 2000). This is also corroborated by Holtz in a study in Malawi where it was found out that utilization of this service is still lagging behind as acceptability which is not related to socio-economic status is still an issue. (Holtz et al., 2004)

3. Objectives

3.1. General Objectives

To assess the impact of malaria control interventions implemented in Nigeria during the period 2000 to 2008 on the malaria epidemiological burden in the country.

3.2. Specific Objectives

a) To assess the trend in the level of the burden of Malaria over a 9 year period (2000 – 2008)

b) To evaluate which interventions during 2000 to 2008 has been most impactful

c) To make a comparison between the data available in the country and other sources

4. Methods

4.1. Study Design

The study is a retrospective type, to evaluate the effect of malaria control on the malaria burden in Nigeria around interventions. The design involves a time series analysis, which is suitable for evaluating programs.(Grimshaw et al., 2000). In such design we examine whether the malaria interventions has had an effect significantly greater than the underlying trend (Grimshaw et al., 2000) we also assume that without scaling up of malaria interventions, the malaria burden will fluctuate in response to climate changes in the short run, but still expected to show little change. Thus we can establish a plausibility relation between the malaria interventions and malaria burden if the scale up of the interventions followed by a decrease in malaria burden in the country in question. This plausibility relation can be supported if the magnitude in scaling up is consistent with the decrease in the burden and if the changes in the malaria burden could not be explained by other factors. (WHO, 2009)

4.2. Study Setting

4.2.1. Nigeria

Nigeria is located on the west coast of Africa with a surface area of 923,708 sq. kilometers.The country has a population of 140million according to the 2006 census with an approximate 2.5% yearly population growth rate. It is by far the most populous country in Africa with a fairly high average population density of 156 per square kilometre.

Agriculture has been the mainstay of Nigeria's economy. Over the years, the dominant role of agriculture in the economy, especially in terms of the country's foreign exchange earnings, gave way to petroleum exports. The country's economic strength is derived largely from its oil and gas reserves, which make up 99 percent of export revenues, 78 percent of government revenues, and 38.8 percent of the GDP (2006). (NDHS, 2008)

The public enterprise sector accounts for an estimated 50 percent of the total GDP, 57 percent of investments, and 33 percent of formal sector employment (Central Bank of Nigeria, 2002) Nigeria's population is unevenly distributed across the country. Large areas in the Chad Basin, the middle Niger Valley, the grassland plains, among others, are sparsely populated. The average population density for the country in 2006 was estimated at 150 people per square kilometer.

The most densely populated states are Lagos, Anambra, Imo, Abia, and Akwa Ibom. Most of the densely populated states are found in the South East, Kano state, with an average density of 442 persons per square kilometre, is the most densely populated state in the north.

4.2.2. Health System Organisation and Service Delivery

A national health policy targeted at achieving health for all Nigerians was promulgated in 1988. In view of emerging issues and the need to focus on realities and trends, a review of the policy became necessary. The new policy, referred to as the Revised National Health Policy, launched in September 2004, describes the goals, structure, strategy, and policy direction of the health care delivery system in Nigeria (NPC, 2004a). Roles and responsibilities of different tiers of government, including non-governmental organisations are outlined. The policy's long-term goal is to provide adequate access to primary, secondary, and tertiary health care services for the entire Nigerian population through a functional referral system.

The national health policy regards primary health care as the framework to achieve improved health for the population. Primary health care services include health education; adequate nutrition; safe water and sanitation; reproductive health, including family planning; immunization against five major infectious diseases; the provision of essential drugs; and disease control. The policy document requires that a comprehensive health care system delivered through the primary health centres should include maternal and child health care, including family planning services.

The health sector is characterized by wide regional disparities in status, service delivery, and resource availability. More health services are located in the southern states than in the northern states.

The proportion of children under 5 years of age is 20% while the proportion of the population pregnant during one year is about 5%. (FMOH, 2008).

4.2.3. Health Management Information System

Health information system in Nigeria is a health facility based system where the local government health facilities send their reports to the state ministry of health where those reports are collated and compiled and sent to the federal level. The health events recorded and collected at that levl include births, deaths, disease cases, health care from Traditional Birth Attendants (TBAs) and healers, village health workers where available, patent medicine vendors among other primary

health care activities. The current case scenario is to submit data from the community level 3 days into the succeeding month for data for the completed month (FMOH 2007)

However, data coming from health facilities more often than not inadequate, untimely and may be incomplete as not all the events at that level are captured as generated data. Another common challenge is data storage, transmission and transportation let alone processing. This is because of the limited or absent information technology. Poor roads network and lack of power supply to even run fax or e-mails where available all contribute to the major problem of timeliness in the submission of the limited data collected.

Health data from the private sector is largely not collected and these sectors enjoy patronage from a large proportion of the population. For as long as data from this sector remain missing, a small fraction of morbidity, mortality and health services is what is collected.

In Nigeria, the bulk of the data within the NHMIS comes from the LGAs but this is the tear of government that lack budgetary allocation to health information capturing and personnel service.

Other factors which influence the effectiveness of malaria prevention and control include but not limited to national policies, consciousness of community and personal prevention, implicit community awareness, quality of health care, facility and health personnel competence as well as effective monitoring of anti-malarial drug resistance and timely change of drug regimen when resistance occurs.

4.3. Data sources

Data to assess the impact of malaria intervention were got from the following sources, Nigeria Demographic health surveys (NDHS 2003 and 2008), World Health organization (WHO 2009), Federal Ministry of Health (FMOH 2007, available online at http://www.nmcpnigeria.org/f/m-and-e/M&E%20Framework%20270208.pdf

4.3.1. Nigeria Demographic Health Survey Data

The NDHS carried out by Measure DHS in 2003 and 2008 in Nigeria were used as part of the assessment of the impact of the interventions carried out under malaria program in the country. Since most of the data gotten from the yearly data collection in the country was from 2003, therefore the 2003 Demographic Health Survey data provided a very good baseline for the study assessment and trend. Also the study is looking at impact of interventions up till the year 2008,

the end point of the period under study; hence the NDHS of 2008 was used to make comparisons with outcomes of the analysis of the reports from WHO and NMCP.

4.3.2. World Health Organization data

The WHO data from the 2009 malaria report was used to aggregate the data to study the trends of disease incidence both in the under five years (U5yrs) and the total population. It was also used to aggregate the data of the engaged interventions to be correlated with burden of the disease for assessment of impact. It would be noted that the intervention data available for the period under study were for ITN and LLIN, ACTs delivered and other inputs like the funding. The data for indoor residual spray (IRS) was not available on long term basis, only for 2006 and 2007 when probably data collection began for such inputs.

4.3.3. Federal Ministry of Health / National Malaria Control Program data

It was a little bit difficult to assess data from this source because the website contained not so much in terms of Health Management Information Systems (HMIS). Therefore, the limited data got from this source was used to validate the WHO data sources.

4.3.4. Key informant interviews

This was a 'one on one' discussion with relevant National Malaria Control Program officials and some consultants who have worked with NMCP on a long-term basis to validate some of the data got both from the WHO source and the FMOH.

Available morbidity and mortality data were collected and assembled for years 2003 to 2008 from WHO and FMOH, RBM sources and key informant interviews. Complete data could not be found and aggregated for the years 2000 to 2002.

4.4. Study Population

The study will cover data on malaria burden and interventions for the period 200 – 2008. All data for the period of study at the national level was exhausted. Additional data was extracted from the WHO malaria report 2009, NDHS 2003 and 2008. The following data were collected for the years 2000 to 2008.

Interventions (independent variables)

1. ITN and IRS coverage.
2. Appropriate anti-malarial treatment with ACTs for children under 5years within 24hours of onset of malaria
3. Proportion of pregnant women who receive 2 doses of IPT in pregnancy

For Malaria burden, the following indicators were observed for the years under study (2000-2008)

1. Total number of malaria cases in the out-patients departments.
2. Proportion of the total malaria cases in out-patients department out of the total number of consultations in the out-patient department.
3. Number of malaria cases in the out-patients departments in Children under 5.
4. Proportion of the under 5 children malaria cases in out-patients department out of the total number of under 5 children consultations in the out-patient department.
5. Total number of malaria cases admitted in the hospitals.
6. Proportion of the malaria cases admitted out of all causes of admission in the hospitals.
7. Total number of malaria cases admitted in the hospitals in children under 5 year.
8. Proportion of the under 5 year children malaria cases admitted out of all causes of admission in the hospitals in under 5 children.
9. Total number of malaria attributed death in admitted patients.
10. Proportion of malaria attributed deaths out of the total deaths in hospitals.
11. Total number of malaria attributed deaths in children under 5 admitted in hospitals.
12. Proportion of the under 5 children malaria attributed death out of the total number of under 5 children causes of death in the hospitals.
13. Total number of deaths among under 5 from all causes.
14. Percentage of under 5 who slept under ITN the night before

4.5. Data Analysis

ITNs and IRS coverage in this study is calculated using the following formula:

100 X (number of ITNs delivered in the past 3 years + number of people protected by IRS in the current year) / population at high risk.

This formula was arrived at with the following assumptions; that each bed net is used by 2 people; the conventional nets are treated regularly; the net is not replaced before 3 years and that the population covered by IRS is different from that covered with ITNs (WHO, 2009).

The data collected for the period under study was patchy, and starting point was not uniform. For comparison, incidence was calculated for all the morbidity and mortality data using the projected population figures for the particular year under consideration. Simple ratio was used to arrive at the proportions of a particular indicator in relation to the other. (Annex on page 50)

5. Results

Tables 2 – 4 are an aggregation of the data that have been used in this study. The data sources were WHO Malaria reports, National Malaria Control Program and National Demographic Health survey.

Insecticide treated nets (ITNs) and long lasting Insecticide net (LLIN) distribution started off in year 2001 as free malaria transmission prevention commodities. Indoor residual spraying is not implemented as a policy yet but data collection has started in 2006. IPT administration was a policy from 2004 and as at 2008, 8% women reported receiving one dose at least of SP and 5% the two recommended doses (NDHS 2008). ACTs is accessed free of charge for <5years age from 2006 in the public sector health facilities.

Table 2: Malaria morbidity and mortality data from 2000 to 2008

Year	Outpatient Malaria cases (all ages)	Reported malaria cases (<5yrs)	All cause outpatient consultation (all ages)	Reported malaria admission (all ages)	Reported malaria admission (<5yrs)	All-cause admission (all ages)	All cause admission (<5yrs)	Reported Malaria deaths (all ages)	Reported malaria deaths (<5yrs)	All-cause deaths (all ages)
2000	2,476,608									
2001	2,253,519		3,882,376					4,317	4,317	
2002	2,605,381		4,488,796					4,092	4,092	
2003	2,608,479	171,812	4,237,566	5,935	2,358	96,074	32,101	5,343	5,343	
2004	3,310,229	507,173	4,970,109	41,913	12,814	342,748	102,152	6,032	6,032	7,632
2005	3,532,108	814,274	5,302,576	80,825	21,455	614,272	186,861	6,494	6,494	13,504
2006	3,982,372	865,374	5,633,088	102,303	31,151	675,044	212,596	6,586	6,586	8,747
2007	2,969,950	1,004,392		121,696	36,647	747,193	211,559	10,289	10,289	12,013
2008	2,834,174		6,305,973	538,487	185,784	1,117,763	386,707	8,677	3,487	20,813

It is observed from the tables that a lot of data are missing for the early years especially from 2000 – 2002.

Table 3: Malaria intervention data 2000 – 2008

Year	No of ITN + LLIN sold or delivered	No of people protected by IRS	Any first-line treatment course delivered (including ACT)	ACT treatment courses delivered
2000				
2001	200,000		2,253,519	
2002	218,900		2,605,381	
2003	917,964		2,608,479	
2004	4,324,230		3,310,229	726
2005	5,086,934		3,532,108	100,000
2006	8,853,589	4500	8,512,480	8,000,000
2007	3,225,594	3000	13,019,950	13,000,000
2008	6,700,000		12,000,000	12,000,000

Table 4: Funding resources for Malaria control from notable sources 2000 – 2008

Year	WHO	WB	GFATM	FGN	Total
2000	500,000				500,000
2001	550,000			2,020,000	2,570,000
2002	700,000			4,000,000	4,700,000
2003	855,000			3,530,000	4,385,000
2004	800,000			390,625	1,190,625
2005	850,000		15,000,000	1,953,125	17,803,125
2006	1,000,000	2,000,000	16,000,000	10,000,000	29,000,000
2007	1,500,000	28,700,000	20,000,000	11,000,000	61,200,000
2008	3,000,000	53,358,702	15,353,110	14,324,952	86,036,764

Trends in Malaria morbidity

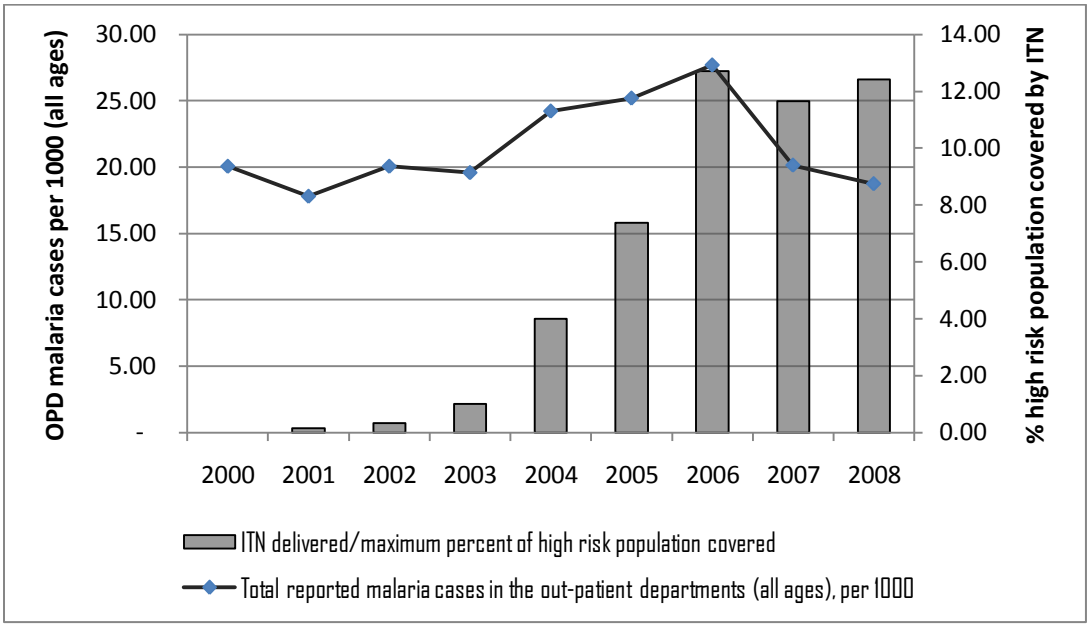

Figure 3: All ages reported malaria cases against ITN coverage.

In figure 3 above, there is progressive increase in malaria cases from 15 per 1000 in year 2001 to about 28 per 1000 population in year 2006. There was a downward trend starting from year 2006 through 2007 and resting at about 19 cases per 1000 population in year 2008. It should be noted that the cases observed did not come back to the 2001 value, hence maintaining about 20% increase from the value of 2001. On this same graph is shown the quantity of ITN and LLIN delivered over the years under consideration. The bar charts titled on the right axis shows the secondary data for the percentage coverage of high-risk population by the nets distributed. From the graph, about 12.42% of the population at risk has been protected by the year 2008.

In figure 4, which shows the proportion of malaria in outpatient department in Nigeria, it is evident that the majority of cases reported in the outpatient department in the country is malaria within the preiod under study, but it is interesting to note that like it was observed in figure 3 above, the proportion of malaria diagnosed has increased from 58% in 2001 to 71% in 2006. From 2006, there has been a downward trend in the proportion of malaria cases out of all outpatient consultations (about 45% in 2008). Data on malaria cases in OPD was not found for years 2000 and 2007.

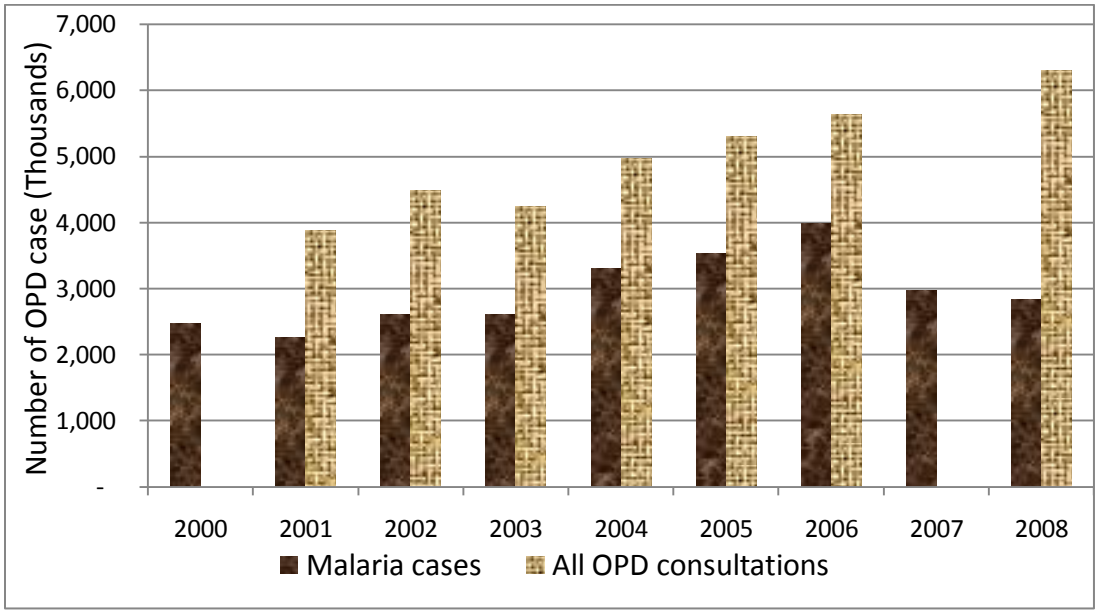

Figure 4: Proportion of malaria cases out of all outpatient consultations 2001 - 2008

Figure 5 shows the incidence of malaria among the under 5 years. There was a sharp increase in incidence of malaria among the under 5 years from 7 per 1000 in 2003 to 40 per 1000 population in year 2007. This is an almost 6 times increase in 2008 over and above the figure reported in 2003.

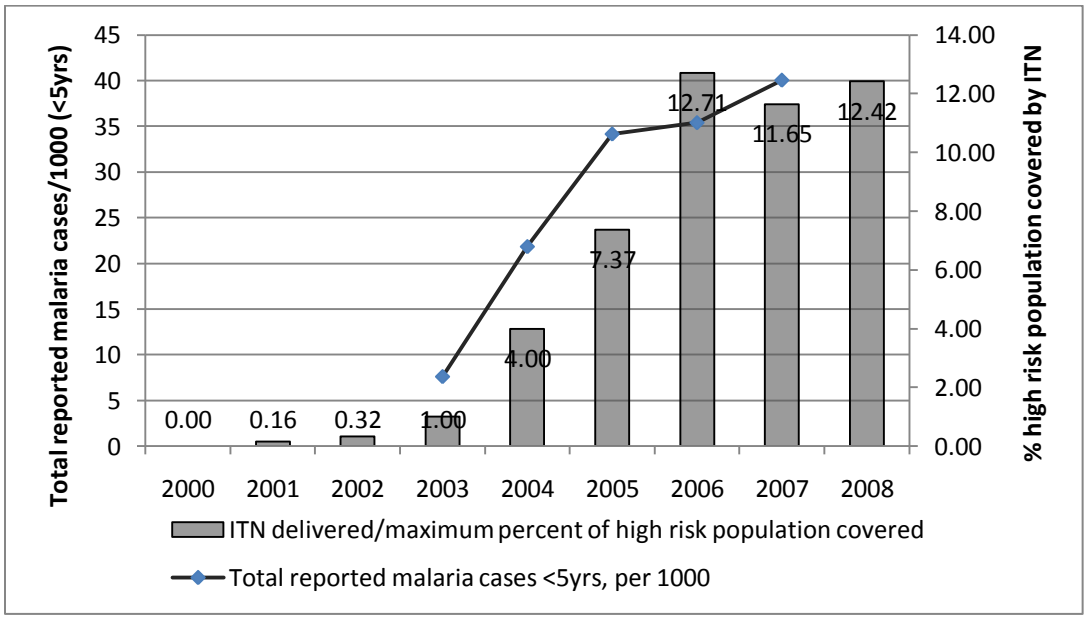

Figure 5: Reported malaria cases per 1000 of 0-59years old against quantity of ITN+LLIN delivered.

Comparing the malaria admission cases over the period of 2003 to 2008, it is observed that for both the under 5 and all ages groups, there was a progressive but slow increase in rate of admissions from year 2003 to 2007, an increase of 15 and 20 times respectively over the baseline of year 2003. From 2007, there was a sharp increase in the gradient of the curves for both of these groups to 78 and 90 times increase respectively over the 2003 figures in year 2008. It should be noted, however, that all through these years, the reported malaria admission per 1000 population was lower for under 5 age group as compared with the all ages group.

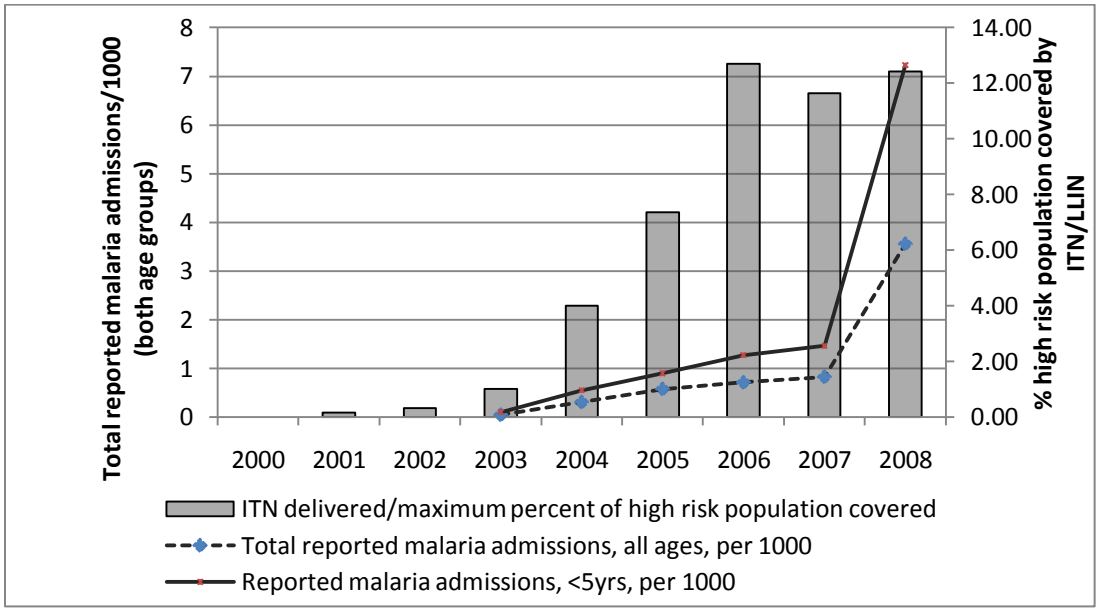

Figure 6: Comparison of reported malaria admissions among the under 5 and the all ages per 1000 population

Figures 7 and 8 overleaf is a comparison of the incidence of malaria deaths among the under 5 and the all ages group with availability of treatment regimen and by type. The arrows pointing downwards on bar diagram block for the year 2006 indicates the year when the proportion of ACT available for first-line treatment of cases of malaria reached 94% of all available anti-malaria drugs. For both groups there was a gradual increase in reported malaria deaths per 1000 population from 2001 to 2007, and then a decline from 2007 to 2008. There is a sharper decline for the “under 5” years (0-59 months) group as compared with the ‘all ages’ group. As at year 2008, the malaria death among the under 5 stood at 14 per 100,000 which is below the observed figure of 20 for the year 2001, while the death among the admitted in the all ages group was 6 per 100,000 in year 2008 as against 3/100,000 in 2001. It is also observed that the fall in the malaria

attributed deaths coincided with the year when the first-line anti-malaria was replaced 100% with ACT (i.e. year 2007)

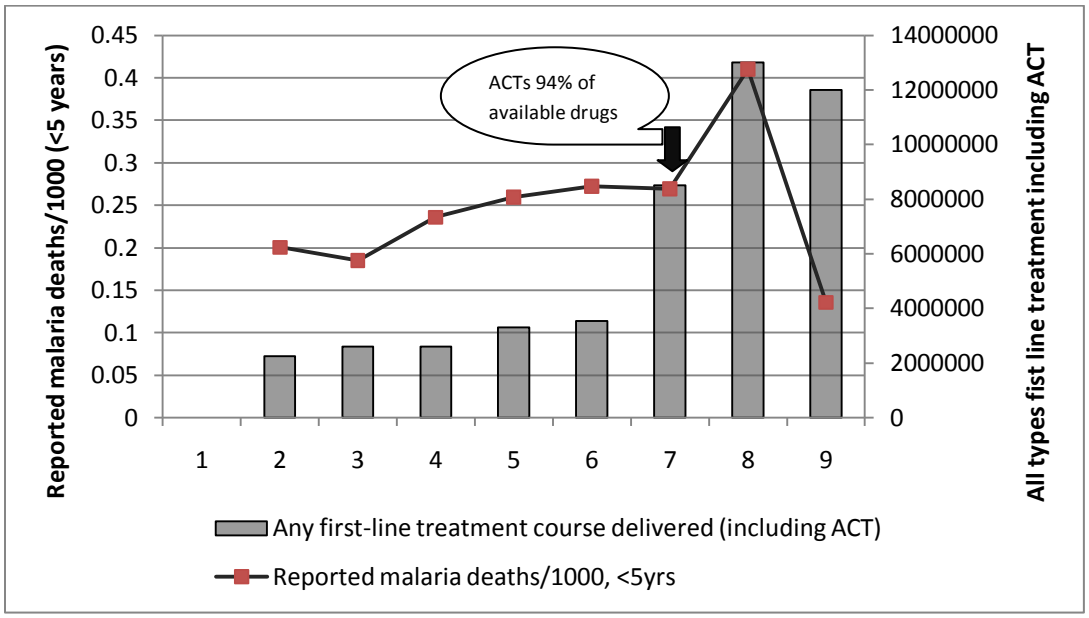

Figure 7: Graph of reported malaria deaths per 1000 population among the under 5 years against any form of first-line anti-malaria treatment.

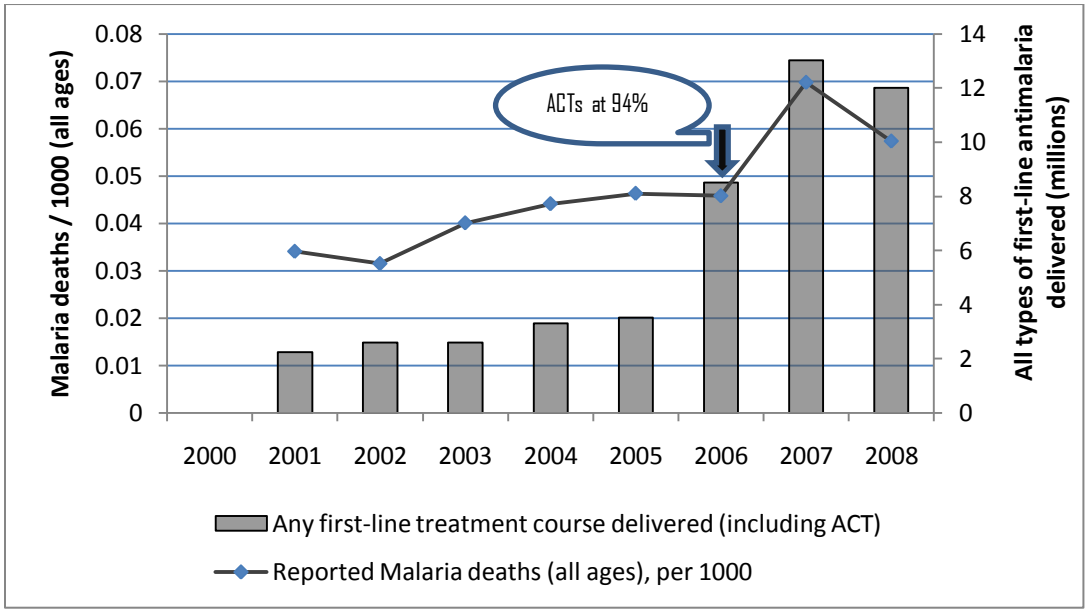

Figure 8: Graph of reported malaria deaths per 1000 population among all ages against any first-line anti-malaria treatment delivered (ACT 94% in 2006).

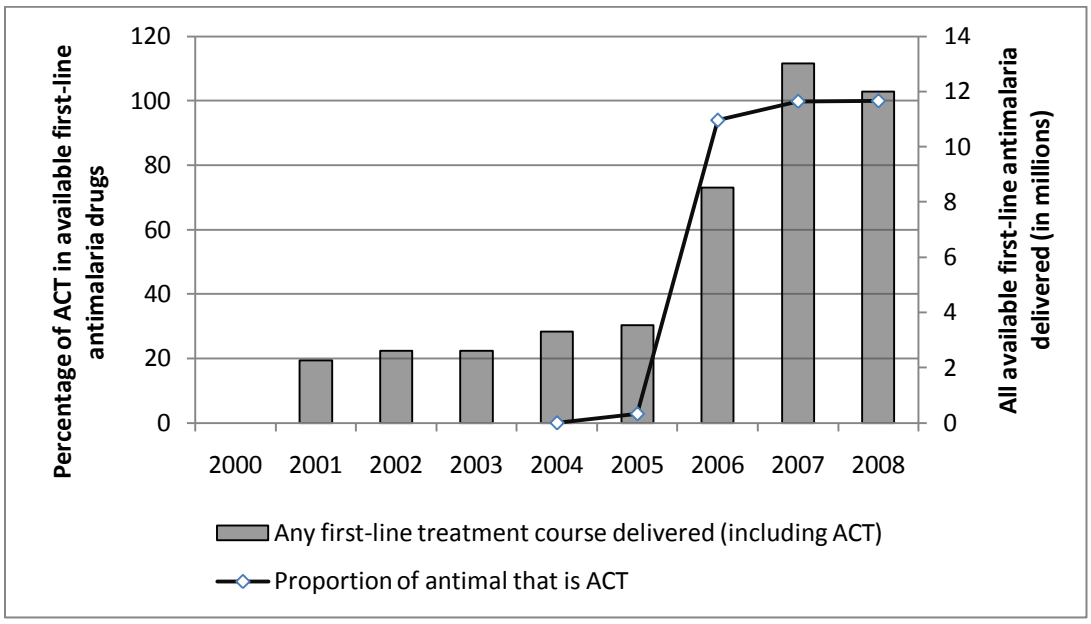

Figure 9: Plot of absolute quantity of any first-line anti-malaria delivered against the proportion of ACT first-line drug.

The figure above indicates the beginning of data collection for ACT and the gradual replacement of all first-line anti-malaria therapy with ACT. It is observed that ACT delivery as the first-line regimen commenced in 2005. The proportion of ACT delivered had reached about 94% of the circulating anti-malaria in 2006 and 100% achieved in year 2007 at 12 million doses delivery.

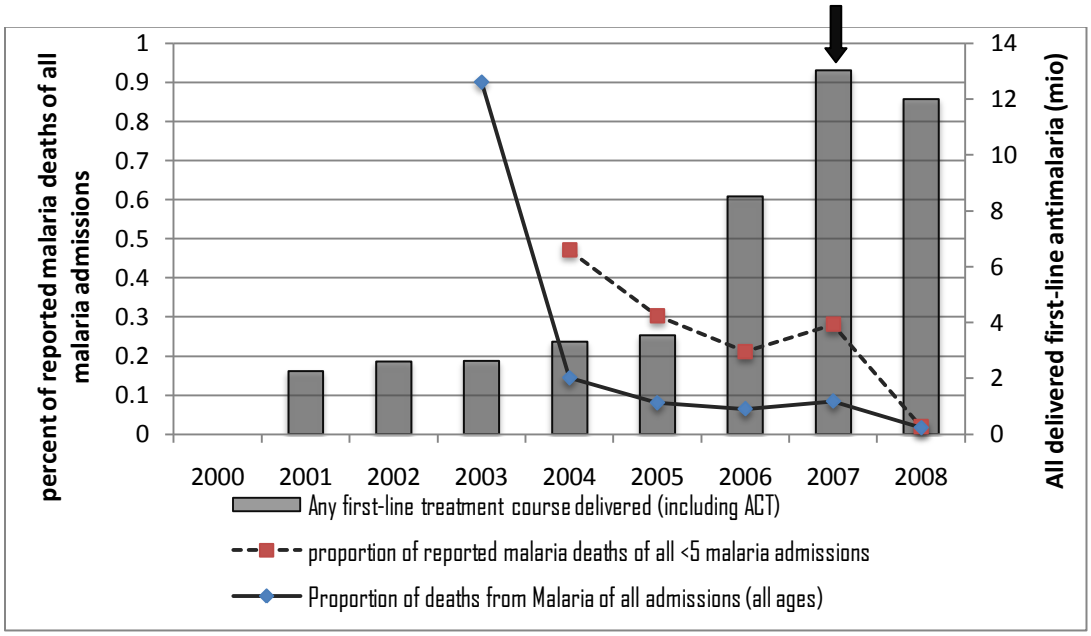

Figure 10: Plot of proportion of reported malaria deaths among the <5yrs, all ages on admission and delivery of first-line anti-malaria including ACT.

In figure 10, which is a plot of malaria mortality trends over the study period; there was a decline in the proportion of deaths from malaria in both the under 5 years and the all ages group. It should be noted that the proportion of deaths attributable to malaria reduced from 47% in 2004 to 2% in year 2008 for the under 5 year old admissions and from 90% in 2003 to 2% in 2008 for the 'all ages' group. The point at which the proportion of circulating first-line anti-malaria regimen reached 100% is indicated with the arrow pointed downwards which coincides with a further dipping of the deaths attributable to malaria among the admitted cases.

In Nigeria, data from two basic interventions have been measured from 2003. These are courses of treatment delivered and quantities of ITN and LLIN delivered. Some data is available on IRS for years 2006 and 2007. This was however was used in the calculation of the person ITN/LLIN coverage as reported above in figures 3, 5 and 6.

Comparing the level of delivery of both interventions over 2001 to 2008 in figure 11 below, it is observed that the level of interventions has increased progressively for both types of intervention accordingly over the period under consideration. There is however an observed dip in the quantity of ITN+LLIN delivered between year 2006 and 2007 and after this period and a further rise in the delivered quantity from 2008.

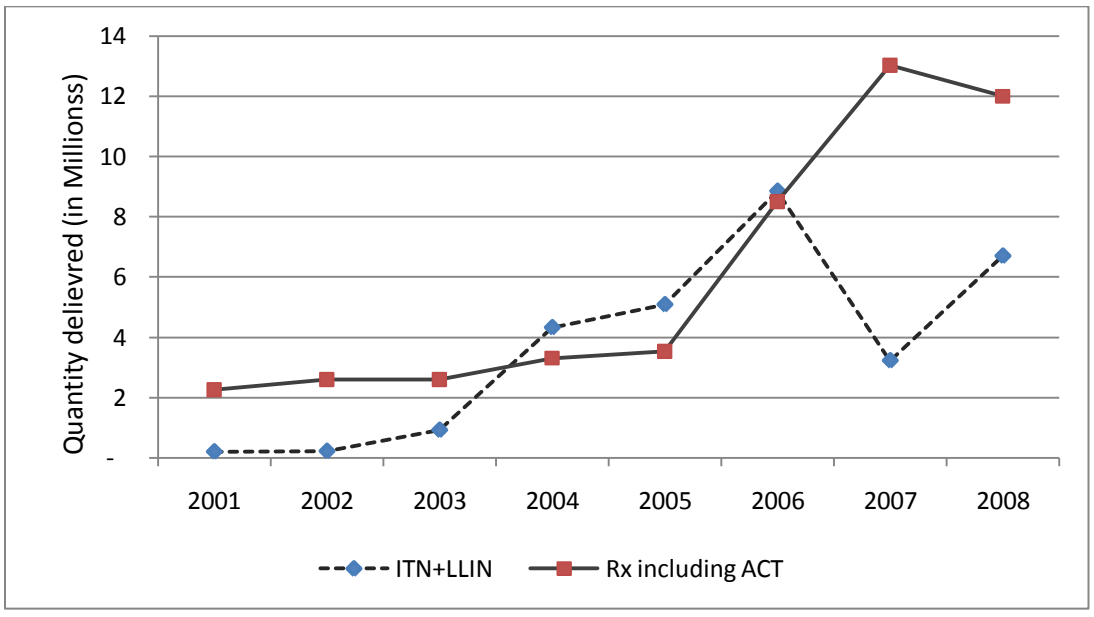

Figure 11: ITN and LLIN delivered and anti-malaria courses relationship

Comparing the availability and ownership of intervention services across geopolitical zones, in different locations and socio-economic settings is very important when trying to carry out targeted

campaigns in Nigeria. Figure 12 summarizes the use of ITNs/LLINs in different geographical locations or geopolitical zones of the country in 2003 and 2008. There is a trend of increase ownership across the zones but at varying degrees. Ownership was lowest for the South West geopolitical zone in 2003 at 0.3% and highest for North Central at 3.9%. In year 2008, ownership rose to 10.3%, the highest across all zones from 2.0% while South West still had the lowest ownership of 6% but with 20 times increase above the 2003 figure.

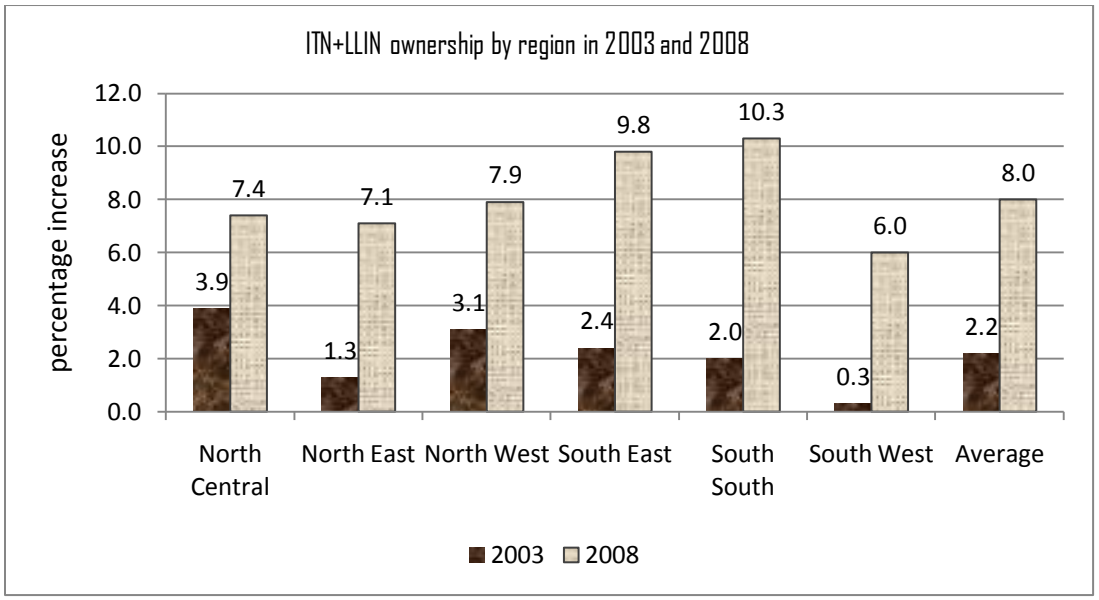

Figure 12: Ownership of insecticide treated nets in 2003 and 2008 (Data source – Nigeria NDHS 2003 and 2008)

Comparing year 2003 and 2008 for ownership of mosquito nets in both urban and rural populations, it is observed that there is an increase in the percentage of households with ordinary nets from 15.5% in 2003 to 18.5% in 2008 in rural areas and from 5.4% in 2003 to 14.1% in 2008 in the urban area. An increase in the ownership of ITN and LLINs in both settings from the initial figure of 2003 to a higher level in 2008 was also noted. (Figure 13)

What is striking and worth noting is the fact that more households in the rural areas adopt the use of mosquito nets whatever the type as a means of preventing spread and acquisition of malaria disease (see figure 13).

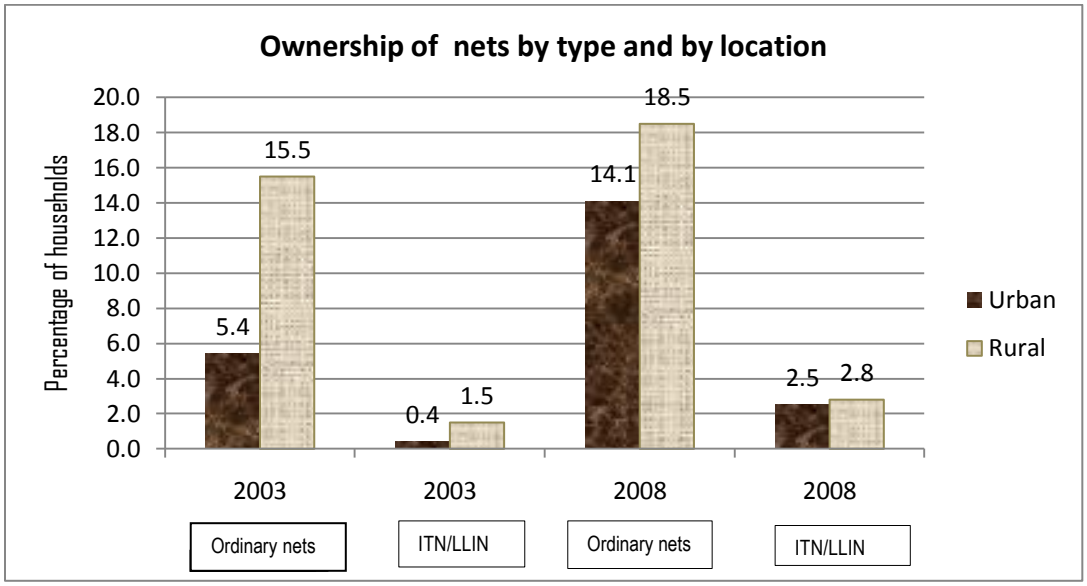

Figure 13: Ownership of nets by location and type in year 2003 and 2008.

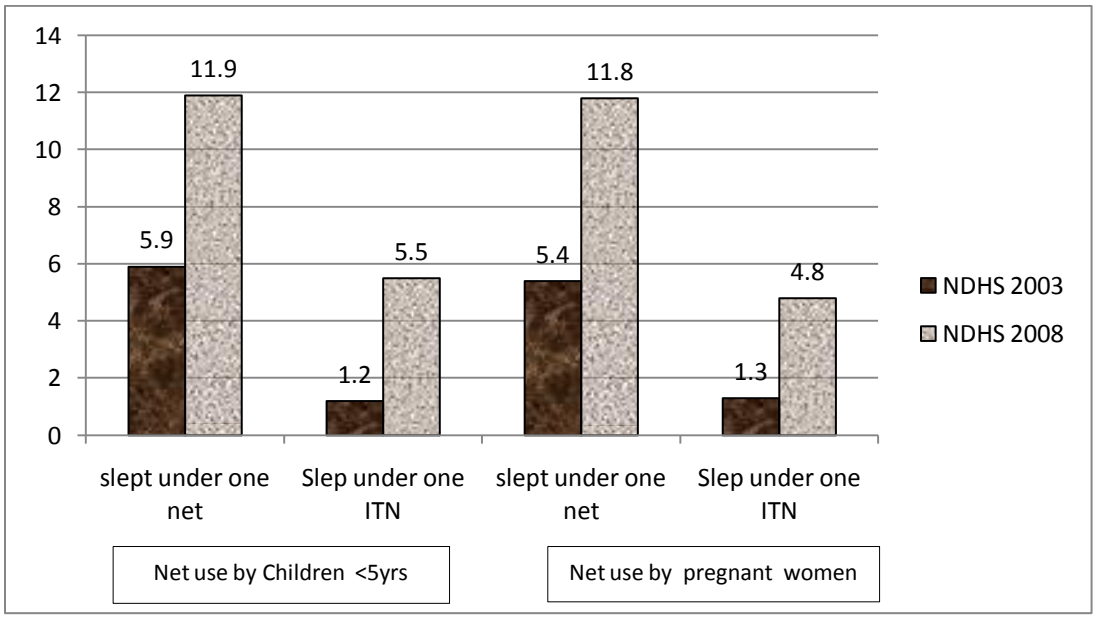

Figure 14: Trends in ownership of mosquito nets and ITNs in years 2003 to 2008

(Data source: NDHS 2003 and 2008)

In figure 14, the proportion of children <5 years who slept under a mosquito net on the night before the survey doubled in the period between 2003 and 2008 from 6 percent to 12 percent. The proportion of children sleeping under ITN increased from 1 percent to 6 percent. The

percentage of pregnant women who slept under any net and under an ITN on the night before the survey showed improvements similar to those observed for children under age five.

Financial resources for Malaria control program

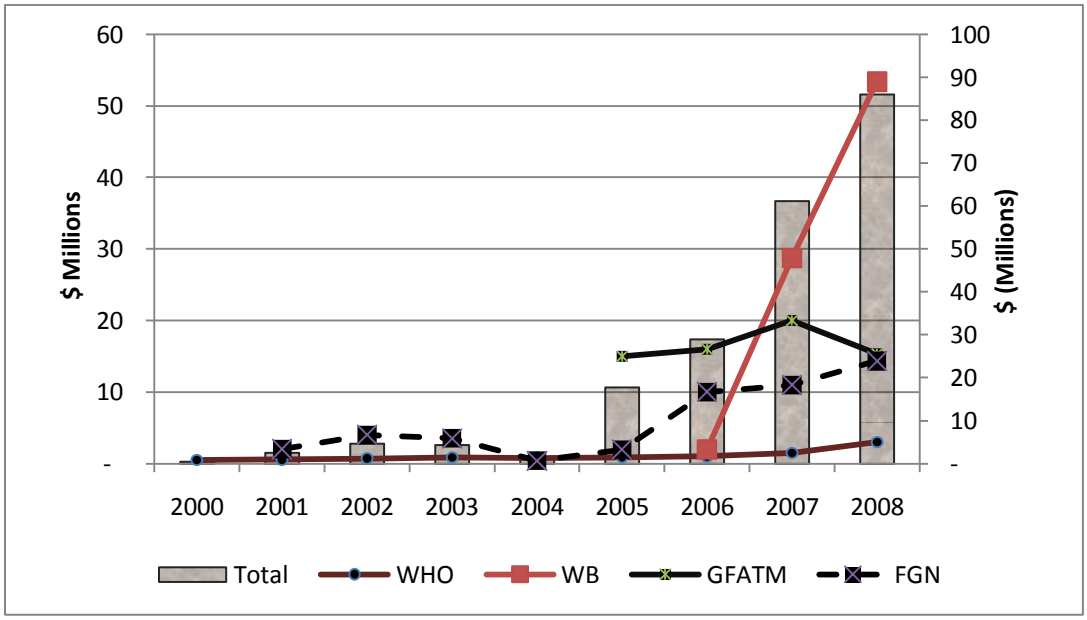

Figure 15: Trend of resources for malaria control program from major sources

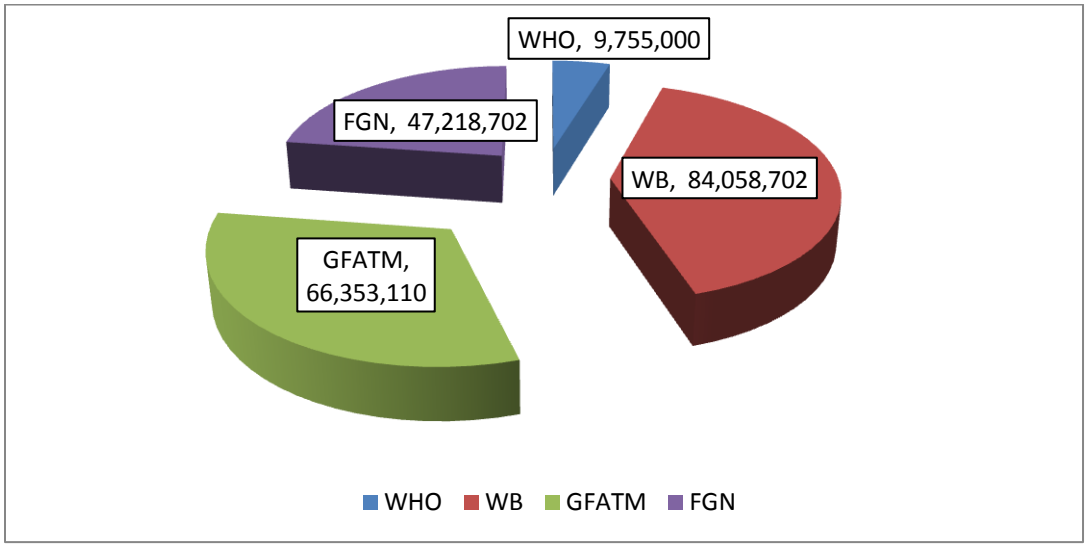

Figure 16: Showing proportion of captured financial resources for malaria control

Financial resource mobilization for malaria control has increased tremendously from year 2005 coming from all sources, the major external players being World Bank (WB), Global Fund for AIDS, Tuberculosis and Malaria (GFATM). The total commitment to malaria from these sources including that from the FGN for year 2008 alone is about 86 million dollars. (Figure 15) The commitment of the Nigerian government in monetary terms has increased from 2million dollars in 2001 to 14 million in 2008. It is worth noting that most funding for malaria as shown above comes from external sources, World Bank being the biggest contributor.

6. Discussions

Data could not be found for the years 2000 to 2002 on admissions for all ages and reported malaria cases for 0-59 years. This is probably because the tracking of activities performed through the monitoring of processes and intervention was poorly developed in the country for some programs at that point in time or such data were not yet being captured (see tables 2, 3 and 4 which showed available data that this study worked on).

The reported numbers of malaria cases (malaria morbidity data) and deaths (mortality data) are generally used as core indicators for tracking the progress of malaria control interventions and programs (WHO 2009). The study assessed the impact of malaria control interventions in Nigeria. Three main aspects of disease burden were considered which were incidence of malaria using reported outpatient cases, admissions and also rates of death from patients admitted for malaria. All these three parameters were compared with the delivered first-line anti-malaria drugs in the early phases of the control interventions (years 2000 – 2005) and then with Artemisinine-based Combination Therapy (ACTs) in the later years (years 2006 – 2008). The same was also compared with the reported delivered ITN/LLIN.

The trend of malaria morbidity for both under 5 year age and all ages groups in Nigeria was that of a progressive increase from the year 2000 until 2006 as most of the data and figures in this study depicted (refer figures 3, 4 and 5 under results). The incidence of outpatient department malaria cases rose from 15 per 1000 population in 2001 to 28/1000 in 2006 among all ages and from 7/1000 to 35/1000 population among the under 5 years. The malaria admissions during this same period increased progressively for both groups.

Nigeria had a population of about 151.2 million in 2008. From 2002, ITN/LLIN distribution had started off since 2001 but the percentage high risk group protected stood at about 12% of the total population (figures 3 – 6) in 2008. However, the proportion of Artemisinine-based combination first-line anti-malaria drug available was at 94% in 2006 and already 100% in 2007 with a total of 12million doses covering more than 100% of the total malaria cases presenting in the outpatient department. Between 2007 and 2008, there is an unexpected increase of high gradient in the reported admissions in both age groups (78 fold increase among all ages and 90 fold increases in the under 5 years age group above the 2003 figures). The spike in the progressive increase in admissions between 2007 and 2008 may not be unconnected with better data collection and reporting within the RBM program which may hitherto not have been the case. It may also mean that majority of the cases diagnosed as malaria admissions may be fever which

was not substantiated further by either microscopy or RDT. Another explanation may be the fact that ACTs treatment for the under 5 became free of charge in 2006 (FMOH 2007) and may also account for increased patronage of the government health facilities and the attendant increase in cases. However, caution is required when assessing impact of any disease intervention with hospital data especially in developing countries. (Rowe et al., 2009)

The progressive increase in the morbidity in the two age groups in consideration in spite of the interventions may be attributed to the fact that even though there is ITN/LLIN distribution, the coverage of about 13% is still too low to confer the required protection. Indoor residual spraying that would have complemented the effect of ITN/LLIN barely started in 2006 as a pilot in 3 out of 36 States in the country (FMOH 2007) and in both 2006 and 2007; only 7,500 households have been covered. There is robust evidence that a substantial coverage of high risk group with the use of ITN, IRS in combination with ACTs reduces prevalence of malaria. In Rwanda, increasing the population covered by ITNs to 70% in combination with massive nationwide distribution of ACTs resulted in a rapid decrease of malaria cases and deaths. This evidence also holds in the case of Ethiopia (Otten et al, 2009)

Furthermore, assessing the ownership of insecticide treated net (ITN) and Long-lasting Insecticide treated net (LLIN) with regards to urban and rural populations, it is clearly seen that rural population own nets more than the urban dwellers (figure 13). What is influencing the acceptance of bed nets in rural and urban settings needs to be studied further for better and tailor-made programmatic purposes. But, what may readily come to mind as a possible explanation is the fact that majority of the primary health care centers are located in the rural settings and in those settings, the distribution of nets is tied to immunizations services. (Oresanya et al, 2008)

The mortality from malaria among the under 5years and also the general population has decreased progressively from 2003 until 2006. It should be noted that the proportion of deaths attributable to malaria reduced from 47% in 2004 to 2% in year 2008 for the under 5 year old admissions and from 90% in 2003 to 2% in 2008 for the ‘all ages’ group (refer figure 10). The proportion of circulating first-line anti-malaria regimen reached 94% in 2006.

This period coincides with a further dipping of the deaths attributable to malaria among the admitted cases. It may be that a series of combined interventions is creating a better management practices for handling malaria morbidity from progressing to mortality coupled with the fact that there is overwhelming quantity of ACTs delivered and possibly available for use. This

is also in line with Zambia experience when ACTs was adopted as first-line therapy in 2002 and scaling up of the vector control with IRS and ITNs was done. There was a decrease by 61% and 66%, the rates of in-patient malaria cases and deaths respectively in 2008, compared with the 2001-2002 reference period. (Barnes et al., 2009)

The outlook of the status of ITN/LLIN bed nets ownership according to geopolitical zones in Nigeria in year 2003 and 2008 illustrates that there has actually been an increase in the ownership of ITN and LLIN in all parts of the country even though the change in adoption and utilization has not been the same across all regions. On the average, there has been an increase from 2.2% of ITN/LLIN ownership in 2003 to 8% in 2008. (NDHS 2003; NDHS 2008) This increase is nothing compared with the expected quantity to be available in the country for a meaningful intervention effect to be felt.

The distribution of ITN and LLIN in the country is still on-going, having reached a cumulative total of 29.5 million in 2008. Going by WHO recommendation that under normal prevailing conditions as set by WHO, a net will offer protection for two, it is therefore arguable that the country needs to reach a mark of about 75million delivery which is half of her population. The country has projected to reach a target of 63million which is about 80% of the required 100% in her current strategy (FMOH 2005) in line with the Abuja declaration and millennium development goals. This paragraph then pre-supposes to sum up that the country still has some task to meet up with the target that will offer adequate protection for the population and half malaria burden by 2012. (RBM 2008)

IRS complements the effect of ITN and LLIN, and the World Health Organisation summarizes as follows; the percentage of the population potentially covered is the maximum possible covered by the interventions of ITN and IRS delivered. This has been given as 100 x (number of ITNs delivered in past 3 years + number of people protected by IRS in the current year) divided by the population at risk. (WHO 2009) This indicates that IRS complements the effect of ITN under Integrated Vector Management. (Beier et al., 2008) The IRS intervention is still at its infancy in the country; hence most of the preventive efforts rely on the ITN and LLIN.

Furthermore on the interventions, the country adopted the use of ACT early in 2004. By the year 2006, an achievement of 94% mark in terms of available ACT has been reached and a further 100% by the year 2007. From the results above, most of the turn-around in the burden of Malaria especially hospitalization and death as a result of malaria infection started in year 2007. One can

arguably conclude that the reduction from 2007 in malaria attributed death may not be unconnected with the efficacy, coverage and availability of the ACTs.

IPT started as policy in 2003, and by 2008, 8% women in antenatal care ANC reported to have had at least one dose of SP and 5% had the recommended two doses in pregnancy which is an improvement over the 1% in 2004. However, 39% women used Chloroquine which was the chemoprophylactic drug before the commencement of SP policy. (NDHS 2003; FMOH, 2001) It may be interpreted that the awareness of the need to prevent malaria in pregnancy is present among the women but drug of choice still not widely known. Communication strategies should hence be strengthened in all places especially in the antenatal clinics and at immunization points.

A captured total of 210million dollars have been committed to malaria intervention in the period under study. 47 million (23%) has been contributed by the government of Nigeria. (ref. figures 15 and 16) One would be apt to conclude that most funding for malaria program is externally sourced. There would then arise the question of sustainability of the achievements should there be an end to the external support and funding. It could then be advocated for, that the funding for malaria on the part of the government be increased to forestall a reversal of the achievements in case of sudden stoppage of aids or tailing-off of assistance by donors.

Moreover, most of the impact captured so far points to curative services as opposed to preventive services. This is because there is basically a more sustained reduction in mortality rather morbidity. Reduction in morbidity seen so far had just begun in 2007, and whether this becomes progressive is yet to be realized. It may hence not be conclusive to say at this point that the impact of malaria control interventions is already being felt in the country, but it is seen to have begun but what trend it takes in the next couple of years should be studied.

Study Limitations

Study relied on aggregation of data from both the World Health Organisation and the National Malaria Control Program. Changes in the number of cases and deaths reported by countries do not necessarily reflect changes in the incidence of disease in the general population, because not all health facilities report regularly and also routine reports do not include private hospital attendees. Some may even have had home treatment and hence not captured in the data used (WHO, 2009). Therefore, data may not have been representative of country burden of disease.

There is incomplete data on some years of period under study. It would have been desirable to work on data from 2003 till 2008, but this period may be too short to assess impact of intervention programs (Grimshaw et al., 2000).

Some data from national malaria control program were at variance with that of World Health organization. It was a challenge assessing all required data from all sources in Nigeria because of administrative bottlenecks. Had all the data used in this study come from NMCP, one would have been able to examine in detail the discrepancies that occasionally existed between WHO data and those of the national control programs.

There is changing indicators, inadequate reporting of results of indicators and inconsistent method of data collection. This usually could arise as a result of policy changes, change of leadership and addressing donor interest in some circumstances.

Pooling large volume of data together for a country as populous and diverse as Nigeria may be fraught with a lot of shortcomings as other events which might have an effect on the trends, such as rainfall as the most important climatic variable affecting malaria epidemiology has not been considered. Such factors can disproportionately affect malaria burden in between periods. (RBM-MERG 2005) Also to be considered are urbanization, socioeconomic status and geographical access to health care facility. Therefore, looking at malaria control interventions impact among a smaller and coherent group may be more meaningful as malaria burden and the control interventions are not homogenous across the States or geographical strata. (Chuma et al, 2010)

Finally, since this data may not be representative of the whole population being considered, generalisability of the study is hence in doubt.

7. Conclusions and Recommendations

Across the period of study, 2000 – 2008, substantial effort in the area of ITN, ACTs and IPT is evident. Downward trend in the mortality has been observed from 2007 for both under 5 years and the general population. However, this observation occurred within the last year of the period under study hence a conclusive cause-effect association is difficult to establish since this period is too short for any meaningful conclusions. The only indicators that have consistently reduced since 2003 are proportion of malaria deaths among hospital admission in both the 0 – 59 years of age and the general population. This may not be unconnected with the ACT availability.

Admissions due to Malaria are still on the increase; the probable cause of this needs to be probed into and investigated further.

Coverage of high risk population with ITN and IRS is still low at about 12%. Data was almost completely unavailable for Indoor Residual Spraying (IRS). Since this intervention method in combination with the ITN and LLIN is known to offer the most cost-effective protection against the vector of malaria, (Bieier et al., 2008), further scaling up is required if the goal of reducing malaria burden by 50% by 2012 is to be achieved. This scale up should involve developing a comprehensive framework for full scale integrated vector management. (Bieier et al., 2008) This however will require good capacity building and regular back-stopping.

To reach a conclusion on which intervention has had most impact will be very tricky at this stage. However, if we judge with the indicator which has shown consistent downward trend; this will be the proportion of malaria attributed deaths of all hospital admission, one will conclude on improved curative care with the use of ACTs. This may anyway be coupled with other improved management practices.

A robust behavioural change communication (BCC) campaign strategy to improve on acceptability of nets and active reduction in mosquito breeding places already established needs scaled for the desired effect and impact.

Finally, one of the major hurdles towards achieving the objectives of this study was non-availability of complete data, and even when data was available, some were at variance with the other sources of data which questions the reliability of the available ones. Such discrepancies are a pointer to the weakness of the health management information systems (HMIS). Therefore, strengthening of the existing channels of data collection, collation, processing and reporting should be done. A strategy should be designed to integrate data from the private sector into the

existing captured health information. A feedback mechanism to the primary source of all health information should also be established so that health management information system (HMIS) will be able to serve the interest of the people and give better opportunities for community oriented decision-making and purposeful action.

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Malaria Epidemiological indicators and Intervention data

Year in consideration	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Approximate population figure	120,400,364	123,487,553	126,653,900	129,901,436	133,232,242	136,648,454	140,152,260	143,745,908	147,431,700	151,212,000
Population of <5yrs (17% total population)	20,468,062	20,992,884	21,531,163	22,083,244	22,649,481	23,230,237	23,825,884	24,436,804	25,063,389	25,706,040
Total reported malaria cases in the out-patient departments (all ages)		2,476,608	2,253,519	2,605,381	2,608,479	3,310,229	3,532,108	3,982,372	2,969,950	2,834,174
Total reported malaria cases in the out-patient departments (all ages), per 1000		20.06	17.79	20.06	19.58	24.22	25.20	27.70	20.14	18.74
Proportion of malaria cases out of all outpatient consultations (all ages)			58%	58%	62%	67%	67%	71%		45%
Total reported malaria cases <5yrs					171,812	507,173	814,274	865,374	1,004,392	
Total reported malaria cases <5yrs, per 1000					8	22	34	35	40	
All cause outpatient consultations (all ages)			3,882,376	4,488,796	4,237,566	4,970,109	5,302,576	5,633,088		6,305,973
All cause outpatient consultations (all ages) per 1000			31	35	32	36	38	39		42
Total reported malaria admissions, all ages					5,935	41,913	80,825	102,303	121,696	538,487
Total reported malaria admissions, all ages, per 1000					0.04	0.31	0.58	0.71	0.83	3.56
Reported malaria admissions, <5yrs					2,358	12,814	21,455	31,151	36,647	185,784
Reported malaria admissions, <5yrs, per 1000					0.10	0.55	0.90	1.27	1.46	7.23
Proportion of malaria admission out of all cause admission (all ages)					6%	12%	13%	15%	16%	48%
Total admissions from all causes (all ages)					96,074	342,748	614,272	675,044	747,193	1,117,763
Total admissions from all causes (all ages), per 1000					0.7	2.5	4.4	4.7	5.1	7.4
Proportion of malaria admission in under 5 of all causes					7.3%	12.5%	11.5%	14.7%	17.3%	48.0%
All cause admissions (<5yrs)					32,101	102,152	186,861	212,596	211,559	386,707
All cause admissions (<5yrs), per 1000					1.4	4.4	7.8	8.7	8.4	15.0
Reported Malaria deaths (all ages)			4,317	4,092	5,343	6,032	6,494	6,586	10,289	8,677
Reported Malaria deaths (all ages), per 1000			0.03	0.03	0.04	0.04	0.05	0.05	0.07	0.06
Proportion of deaths from Malaria of all admissions (all ages)					90%	14%	8%	6%	8%	2%
Reported malaria deaths, <5yrs			4,317	4,092	5,343	6,032	6,494	6,586	10,289	3,487
Reported malaria deaths/1000, <5yrs			0.20	0.19	0.24	0.26	0.27	0.27	0.41	0.14
proportion of reported malaria deaths of all <5 malaria admissions						47%	30%	21%	28%	2%
All-cause deaths (all ages)						7,632	13,504	8,747	12,013	20,813
All-cause deaths (all ages), per 1000						0.06	0.10	0.06	0.08	0.14
No of ITN + LLIN sold or delivered			200,000	218,900	917,964	4,324,230	5,086,934	8,853,589	3,225,594	6,700,000
Cummulative ITN coverage			200,000	418,900	1,336,864	5,661,094	10,748,028	19,601,617	22,827,211	29,527,211
Percentage of required ITN+LLIN delivered		0%	0%	1%	2%	9%	17%	31%	36%	47%
ITN delivered/maximum percent of high risk population covered		0.00	0.16	0.32	1.00	4.00	7.37	12.71	11.65	12.42
IRS								4,500	3,000	
Any first-line treatment course delivered (including ACT)			2,253,519	2,605,381	2,608,479	3,310,229	3,532,108	8,512,480	13,019,950	12,000,000
ACT delivered						726	100,000	8,000,000	13,000,000	12,000,000
Proportion of antimal that is ACT						0.02	2.83	93.98	99.85	100.00
Incidence rate of Malaria (FMOH)		21.00	13.00	21.00	20.00	25.00	29.00	25.00	36.90	23.35