A Descriptive Analysis of Intervention Coverage Scale Up for Malaria Prevention in Pregnancy and Equity of Services

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I. Introduction

Malaria, a disease both preventable and treatable, remains a significant burden on health and is directly linked to reduced economic development in many African countries [1]. The burden of malaria is more onerous on pregnant women, especially those in rural areas and of the poorest economic quintile. Therefore, to achieve any substantial reduction in the global malaria burden, countries may need to reprioritize distribution of proven preventive interventions to these most vulnerable groups. This study analyzes whether scaling up of external funding since 2005 has resulted in more equitable distribution of two specific interventions: Insecticide-treated nets (ITN) and intermittent preventive treatment (IPTp)[1]. It does so by comparing ITN and IPTp coverage rates before and after scale up between pregnant women in the richest and the poorest quintiles and those living in urban versus rural areas[2]. Based on relative changes of coverage rates between these groups, it appears that increased external funding is associated with equitable distribution of interventions.

This paper also examines a secondary issue: Whether the Demographic Health Survey (DHS) is an adequate data source to monitor the desired outcomes and to evaluate the impact of existing interventions over time in different population subgroups.

A. Background and Significance

Notable progress has been made in reducing the burden of malaria since 2000 [3]. However, the impact of malaria in the developing world remains a significant threat to the health and well-being of pregnant women and young children. The World Health Organization (WHO) reports a 25% global reduction the malaria mortality rate since 2000 [4] and a 17% reduction of case incidence.

But this reduction is far from equally distributed among countries. Of the 216 million cases of malaria in 2010, 81% occurred in just 17 African[3] countries [5]. Ninety-one percent of malaria deaths occur in Africa, and more than 40% of

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[1] IPTp refers to intermittent preventive treatment for pregnant women

[2] What this paper does not examine are malaria trends in morbidity or mortality, which are difficult to document due to inconsistent and limited data collection and variations in country settings (e.g. seasonality, changes to health service systems, and weak health infrastructures). Thus estimations and extrapolations across countries are difficult 2. The World Health Organization: **World Malaria Report 2012.** Geneva: WHO; 2012..

[3] WHO African region does not include Sudan, Somalia, Egypt, Morocco, Libya, or Tunisia.

estimated global deaths from malaria occur in the Democratic Republic of the Congo (DRC) and Nigeria alone [5].

The burden of malaria is even more disproportionately cast on pregnant women and their infants, especially in malaria endemic areas of Africa where there are 30 million pregnancies at risk. Malaria infection in pregnancy contributes to approximately 200,000 newborn deaths and 10,000 maternal deaths [6-8] in these regions.

Malaria infection during pregnancy, primarily by *Plasmodium falciparum,* is associated with multiple poor outcomes in both mother and infant. For pregnant woman, the infection leads to pre-term birth, low birth weight, miscarriage, and anemia, often severe enough to result in maternal death [9]. In the newborn, it is a major contributing factor to low birth weight and prematurity and as a consequence, malaria is a significant risk factor for infant mortality. Malaria can also contribute to "sub-optimal growth and development" or intrauterine growth restriction (IUGR) of infants, which in turn leads to long term disabilities in both physical and economic development [1].

A few sub-Saharan African countries however, have had substantial success in reducing malaria incidence and mortality and are on track to meet international reduction targets. The Roll Back Malaria Global Malaria Action Plan calls for a 75% reduction in global malaria cases by the end of 2015 from the 2000 incidence levels [10]. Already, malaria mortality rates have fallen in Africa by 33% since 2000 [11].

Rwanda, by reducing its malaria hospital admission rates by 75% between 2000 and 2011, illustrates that large-scale reduction of the malaria burden is possible [5]. Among others, Madagascar and Zambia are 2 countries that have reduced their case rate by >50% as reported by the WHO in the 2010 World Malaria Report. This indicates that these goals, as set by the Roll Back Malaria Partnership[4] (RBMP), are achievable but continued evaluation of progress is needed.

Without dramatically decreasing rates of malaria in Africa, achievement of many of the Millennium Development Goals is unlikely [12]. The reductions in malaria case incidence and mortality rates have been quicker in countries that have lower number of cases and deaths to begin with. However, with scale up of interventions,

[4] The Roll Back Malaria Partnership is the global framework for coordinated action against malaria and composed of many key players including WHO, UNICEF, UNDP and the World Bank.

the countries with the greatest burden of malaria in 2000 have also had the greatest number of averted cases and averted deaths during the last decade [5].

In spite of the progress achieved since 2005, and the financial investments made by both African countries and the global community toward scale up, there is still inadequate program coverage for malaria prevention in pregnant women in many African countries [13]. Reports from the RBMP suggest that funding may be at its peak level of US$ 1.6 billion; however, the projected financing needed to control malaria could be as high as US$ 6 billion annually [9, 14][5] This shortfall requires an even greater examination of the most effective way to extend equitable coverage to vulnerable populations in Africa. RBMP's Global Malaria Action Plan (2008) identified the need of examining who benefits the greatest from available treatments. It further noted that the poor and rural populations tend to have "lower quality treatment" and that there is currently insufficient evidence on how to scale up interventions for these populations [10].

The economic cost of malaria can be measured in terms of lost GDP per year. For Africa this is a loss of 1.3 % per year [11]. This negative economic impact includes stagnation of growth due to excessive use of health service resources, the tying up of skilled medical personnel, lost worker productivity especially in agricultural dependent markets, and substantial use of limited global funds. Thus, there is sufficient motivation to reduce the overall malaria burden.

B. Morbidity/mortality of malaria in pregnancy

There are a number of reasons why the malaria burden is higher on pregnant women and their infants. In areas of moderate to high stable malaria transmission, particularly of P*. falciparum*, adults often acquire high levels of immunity to malaria. A pregnancy results in a state of altered immunity making the woman exceptionally vulnerable to infection. Primagravidas are at even higher risk [15]. The symptoms and complications of an infection during pregnancy may vary depending on transmission intensity and the level of acquired immunity [16]. Also, depending upon the level of immunity, an infection may remain asymptomatic thus

[5] For further discussion on adequacy of external funding for malaria control see Snow, R.W., *Equity and adequacy of international donor assistance for global malaria control: an analysis of populations at risk and external funding commitments.*

untreated. The consequence is undetected high levels of placental parasitization resulting in severe maternal anemia [17], prematurity [18], and IUGR [17].

Preterm birth and growth restriction are primary causes of low birth weight in infants (LBW) [19], which in turn is a leading cause of neo-natal deaths and deaths of children under 5 years old (U5MR) [20]. LBW can be a result of both prematurity and IUGR; prematurity carries the higher risk of early child mortality, and babies who are preterm and exhibit growth restriction have an even greater risk of death compared to either prematurity or IUGR alone [17].

Although based on just a few studies, it is estimated that malaria infection during pregnancy may result in 75,000 to 200,000 infant deaths globally [17]. That being said, malaria incidence, death, and admissions data is often incomplete or inconsistent making it difficult to draw conclusions or examine trends in many African countries [2]. In any event, this study does not examine mortality or morbidity rates as outcomes, but rather how increased funding affects equitable distribution of prevention interventions.

Transmission of malaria is dependent on several factors including the parasite, the vector (mosquito), individual immunity, and the environment or climate. Transmission may be seasonal [4] and epidemic[6] or more commonly stable endemic transmission. This study looks specifically at countries with stable endemic transmission.

Unstable and seasonal malaria is often found in more arid regions, whereas stable malaria, with seasonal variations which generally peak at the end of the rainy season, is endemic in much of the African continent. While the socioeconomic and mortality impacts of the malaria burden in unstable transmission areas can be very high at times [22], it is the areas of chronic and persistent, or stable endemic transmission, of malaria that prevention in pregnancy is recommended and most efficacious.

[6] An epidemic usually occurs in areas such as highland zones, arid areas and desert fringes where the population has little immunity to malaria due to low transmission so change in climate and other conditions often leads to a favorable situation for transmission. (WHO) As a result, malaria epidemics often lead to very high levels of morbidity and mortality 21. Lynch C: **Forcasting malaria epidemics.** In *Humanitarian Exchange*. London: Humanitarian Practice Network-ODI; 2005..

C. Malaria Prevention and Treatment

The primary interventions available for prevention and treatment of malaria in pregnancy (MiP) and those recommended by The World Health Organization[7] (WHO) are: IPTp with sulfadoxine-pyrimethamine (SP) for prevention of asymptomatic infections among pregnant women [10] in areas of moderate or high transmission of *P. falciparum*; ITNs or preferably, long-lasting insecticidal nets (LLIN)[8]; along with effective case management for treatment of malaria infection and anemia [8].

Controlled trials have demonstrated the efficacy of ITNs and IPTp in malaria prevention among pregnant women [12, 22, 23]. These are key components of the RBM Global Malaria Action Plan along with indoor residual spraying, readily available diagnostic tools and treatment of malaria [5, 10]. In order to ultimately eliminate malaria, global partnerships such as the President's Malaria Initiative (PMI) and the RBM Partnership seek universal access to and utilization of ITNs for at risk populations. Universal is defined by the WHO as "every person at risk sleeping under a quality insecticide-treated net" or in a space protected by indoor residual spraying; and every pregnant woman at risk receiving at least one dose of IPTp during each of the second and third trimesters (in settings where IPTp is appropriate) [10].

As noted above, the WHO recommends a threefold approach to treatment and prevention of MiP. This study looks at two of those interventions, ITN's and IPTp, and the equitable distribution, or more accurately the change in equity, of these interventions across wealth quintiles and urban and rural strata. While an important component of malaria control, case management is not considered here. Malaria illness and the resulting acute high fever during pregnancy are directly linked to prematurity and still birth, or spontaneous abortion of the fetus and the acute effective treatment of malaria illness is an important control measure during pregnancy. However, the malaria illness event is not common during pregnancy and household surveys do not typically collect information on malaria illness during

[7] Also recommend for general malaria control is indoor residual spraying (IRS), the spraying of insecticides on the walls of homes.
[8] This study uses the indicator ITN which includes the indicator LLIN

pregnancy and appropriate diagnosis and treatment – thus readily available national data is lacking.

Given its transmission by a highly efficient vector, the control of malaria is unique in that it requires rapid delivery of interventions on a large scale [24, 25]. The intensive delivery of intervention and treatment package approach has been termed "Scaling-Up for Impact" (SUFI) [25] by the global malaria partnerships and has been actively and successfully applied in many African countries since 2005.

Nonetheless, this successful scale-up has encountered multiple barriers that ultimately affect the potential of malaria control programs. Program coverage success should be viewed as a combination of all the resources and efforts put into scaling up coverage minus the factors that inhibit scale up. These factors and current health system barriers to SUFI include: sustained political and budgetary commitment to malaria control, weak health systems, lack of adequate and well-trained health workforce [10], and distribution systems and supply chain breakdown[9]. These barriers are more likely to inhibit program scale up for the poorest and rural populations thus resulting in inequitable coverage of the following malaria prevention interventions for pregnant women.

1. ITN/LLIN (Vector Control)

The efficacy of ITNs has been demonstrated in multiple randomized controlled trials [26-28]; the results of several studies in Africa show that ITNs can reduce U5MR by up to 20% [12, 22, 23]. The development of LLINs and the increasing use of these nets has removed the need for regular net retreatment creating a very cost effective tool in the battle against malaria [26].

However, high coverage rates are needed to obtain the full potential of ITNs [24, 27]. The most effective and equitable delivery method, whether it be free mass campaigns, social and commercial marketing or through health system outlets such as immunization clinics and antenatal clinic (ANC's), or a combination of these, remains controversial [23]. But regardless of delivery method, ITNs, similar to immunizations, when used at high levels within the community, may provide some benefit to those unprotected by decreasing the overall transmission [28].

[9] These barriers are referenced in many global reports on malaria (e.g., multiple WHO: World Malaria Reports and PMI reports and are not individually cited here.

The RBM Global Malaria Plan's position statement on ITN delivery recommends universal access to LLIN's through a combination of delivery systems. These systems include free or highly subsidized nets which eliminate cost as a barrier. Furthermore, the plan emphasizes making LLINs available to all at risk groups especially young children and pregnant women [10]. A study from Tanzania revealed that the voucher system there is a successful delivery system but that gaps remained in coverage of the poorest segments of the population again highlighting the need for a multi-dimensional approach [29].

Another debate concerning ITNs is whether there ought to be targeted delivery versus mass distribution to achieve universal coverage. The argument being to what degree should vulnerable groups receive priority in coverage or if resources are best spent toward improving universal coverage regardless of need [27, 28]. While it is an important debate it is beyond the scope of this paper.

Generally speaking, social marketing net campaigns have had a greater degree of success in wealthier regions than in the poorest and rural sectors. This has been addressed by a RMB policy which now emphasizes the need for free or highly subsidized ITNs [30].

In the World Malaria Report 2010, approximately 80% of available ITNs were actually used within the home and by the 2012 publication of the World Malaria Report, this percentage had risen to 90% [31] suggesting that areas with low usage may be a result of insufficient availability of ITNs and not behavioral factors. Small regional studies have shown that net usage may also be seasonal, thus complicating assessment of trends [12].

Finally, it should be mentioned that catch up and keep up campaigns are an important component of current malaria control operational plans. "Catch up" being the mass distribution delivery method used in order to achieve universal coverage, or in this case, the routine delivery of nets to pregnant women through antenatal visits, and "keep up" efforts which are continuous delivery systems that address the efficacy decay and loss of nets.

Increased ownership and use of ITNs from SUFI has resulted in many nets now in need of re-treatment. The average net insecticide efficacy is approximately 3 years [31]. While many countries have made great strides towards universal coverage and have moved to LLINs versus conventional ITNs, sustainability in

replacing nets is the next set of challenges for stakeholders in the malaria community.

Barriers to scale up of ITN coverage include, but are not limited to: cost of net, previous lack of availability, decay, and discomfort primarily related to heat. However, barriers may differ by region and season and there appears to be no conclusive research on the issue as of yet [32]. In any event, as the primary control tool of malaria prevention, it will be essential that ITNs are equitable distributed to the groups that need them the most.

2. IPTp

A second and effective tool in malaria control for pregnant women is IPTp, but countries have lagged in achieving universal coverage. In 2000, the Abuja Declaration set a target coverage goal for 60% of pregnant women in malaria-endemic countries, especially in Africa, to have access to IPTp by 2005. This goal was not achieved and coverage of IPTp through ANCs in Africa remains suboptimal [5]. The first country to adopt IPTp with sulfadoxine-pyrimethamine (SP) was Malawi in 1993. Kenya followed in 1998, then Uganda and Tanzania policy implementation began in 2000 [33]. Thirty-six of forty-five sub-Saharan African countries have national IPTp policies [5] yet coverage remains low. Why MiP programs in Africa have not made greater progress in reaching the RBM Initiative targets of 80% IPTp coverage by 2015 is unclear despite multiple surveys [34].

In high transmission settings, all pregnant women should receive at least 2 doses[10] of IPTp after fetal motion is first felt (quickening) or in the 2nd and 3rd trimesters and at least one month apart. The WHO recommends SP for IPTp in high transmission settings [10]. The doses should be taken regardless of whether the woman is currently infected or not [35] and at the first and second routine antenatal clinic visit [36] IPTp should be administered as directly observed therapy (DOT).

Some of the barriers to uptake of IPTp DOT include but are not limited to:

1. Clean cups and potable water in clinics for med administration, [35]
2. availability/stock-outs of SP, (multiple PMI reports)
3. timing or late presentation to ANC (multiple PMI reports)
4. health worker knowledge

[10] Some country policies call for 2 doses while others like Zambia call for 3.

5. supply chain breakdown.

Behavioral factors of ANC staff may also be a significant barrier to IPTp coverage. To access IPTp, women must physically go to ANC facilities. But access does not appear to be a barrier to scale up of IPTp as most countries in Africa already have high ANC attendance [10], thus behavioral factors both of staff and pregnant women may be a significant cause in the languid scale up of IPTp coverage across Africa.

3. Cost of Prevention

Funding (external) for the elimination of malaria is higher than it has ever been, up from US$ 100 million in 2003 to US$ 1.6 billion in 2010 [14]. Meanwhile, the aforementioned interventions for malaria, both treatment and prevention, are highly cost effective especially when compared to other diseases[11]. The correlation between global spending on malaria prevention and the impressive reduction in related mortality makes a strong case for continued malaria control scale up [37, 38].

The bulk of money spent on malaria control programs goes to preventive interventions, which include LLINs, IRS, and IPTp. The reasoning behind this spending model is that, even as the burden of malaria is reduced, prevention resources will still be needed to prevent re-emergence [10] until malaria is eliminated.

It should be noted that the actual cost of IPTp is very low and less affected by fluctuations in external funding whereas ITN scale up is affected by changes in levels of global funding because the cost of providing an ITN is greater than IPTp. The drug cost of a single adult dose of SP for IPTp would cost $ 0.05-0.15; so the drug cost of a 2-dose IPTp regimen would be $0.10 – 0.30 per pregnancy.
As for ITNs, The WHO estimates a LLIN, which typically lasts 3 years, costs US$ 1.39 per person per year of protection [39]. Meanwhile, there are more houses in need of ITNs than pregnant women receiving IPTp as everyone needs to sleep under an ITN for effective coverage.

[11] "At a cost of $2-24 per disability-adjusted life year (DALY) saved, the only intervention that is more cost effective is childhood immunization." 10. RBM: **Global Malaria Action Plan.** Geneva: Roll Back Malaria Partnership; 2008.

4. Barriers

However cost-effective the direct prevention measures are there remain myriad barriers to effective scale up of malaria prevention. And many of these barriers are also primarily associated with the poorest members of society [40].

Rural populations tend to live in housing that does not provide protection against mosquitoes and are thus more likely to be infected, failures in supply chain at varying points, or inability of supplies such as anti-malarial drugs to reach rural ANC's in the rainy season all contribute to the complex problem of delivering malaria prevention and treatment in low resource countries [5].

Women in these countries, whether rural or urban, often face significant barriers of their own. These include a lack of education, cultural marginalization and entrenched gender inequities in some societies which pose further barriers to women's access to, and use of, healthcare services [30].

Despite the costs, barriers and problems with ITN and IPTp delivery discussed above, the scale up of current malaria prevention and treatment strategies is dramatically reducing the number of malaria infections across Africa [13]. A remaining challenge, however, is how best to equitably distribute these interventions.

D. Equity

Providing equitable distribution of malaria prevention and treatment interventions has been a chronic problem for scale up efforts as described by a variety of authors and noted in numerous malaria control partnership reports. Margaret Whitehead, in her classic paper on equity and in regards to the provision and distribution of health services, stated "*Equity is concerned with creating equal opportunities for health, and with bringing health differentials down to the lowest level possible"* [41]. She also promoted the definition frequently used in WHO publications, "*equity refers to differences which are unnecessary and avoidable but, in addition, are also considered unfair and unjust. So, in order to describe a certain situation as inequitable, the cause has to be examined and judged to be unfair in the context of what is going on in the rest of society*"[41].

Equitable distribution is particularly important to malaria control strategies because malaria is so closely linked to poverty [23, 24]. Studies have consistently shown that the greatest burden of disease is borne by the poorest of the population.

Barat (2004) cites a previous analysis of DHS data that the wealthiest 20% are 2.5 times more likely to benefit from public health services than the poorest 20%[12] [40]. This is pertinent because 90% of malaria deaths occur in Africa, the poorest continent on earth, and where malaria accounts for approximately one in five of all childhood deaths [1].

Studies also show that this poorest group consistently uses less of the available health resources or interventions and that those who are of moderate or high SES receive more of the available interventions while experiencing less of the disease burden [42] and was originally proposed by Julian Hart in 1971, as the "inverse care law" [43].

Another principle in equity discussions is the "inverse equity hypothesis." This principle supposes that any new treatment options or interventions are first available to, and consumed by, the richer groups and then eventually trickle down to become available to the poor. Thus, the implementation of a new intervention would initially be expected to show a short term rise in inequity ratios for coverage, morbidity and mortality indicators. As coverage of the intervention expands, and the lower SES groups gain higher levels of access, the ratio then decreases [44].

When considering equitable distribution of malaria interventions between rich and poor, it must also be noted that "equitable" does not necessarily mean "equal." One view holds that "equity" means that groups such as the poorest quintile or rural people receive at least an equal per capita amount of coverage versus their urban or wealthy counterparts. A second view of equity demands that since the poorest and rural dwellers bear the greatest burden they ought to receive a greater portion of the resources available.

Given the vast disparities of malaria prevention and treatment coverage in the past, even achieving equal per capita coverage is a significant improvement for the poor or rural. However, equal coverage should be viewed only as a beginning. A sustained effort is needed to achieve truly "equitable" coverage, which means that the amount of coverage truly equates with the burden a particular group bears.

As a side note to the equity discussion, previous research has demonstrated that the method of distribution of ITNs is an important factor in achieving equity. Free

[12] Based on a sample of 44 developing countries

ITNs (as the cost of the net is a significant barrier), and wide spread distribution of these nets (delivered to everyone and not just pregnant women) yields the most equitable coverage [23, 28]. However the cost of this form of ITN service delivery is substantial.

IPTp coverage presents a slightly different challenge in achieving equity. Sulfadoxine-pyrimethamine (SP) itself is very inexpensive but must be obtained at an ANC, which can be a barrier to delivery especially for the rural poor who have reduced access, and to those with lower levels of education. However, since pregnant women do not compose a high proportion of the population, and because ANC attendance is relatively high and IPTp is inexpensive, the low level of coverage is the result of a weak service delivery system and not necessarily that of inhibiting cost. Thus the examination of equitable delivery of these two interventions should also be viewed separately.

With external funding at an all-time high and effective, proven interventions already in widespread use, it appears that further reductions of the malaria burden are within reach. Nonetheless, any hope of achieving malaria control or elimination objectives is dependent upon policies which target interventions and treatments to the neediest segments of society [40]. In other words: A strategy focused on equity. As for poor or rural pregnant women, who bear among the highest burden of malaria, equitable distribution of these interventions is a persistent problem. Therefore, this analysis focuses on whether scaled-up interventions are resulting in a more equitable distribution to such pregnant women, the methodology of which is discussed below.

II. Methods

The central question for this study is: As national programs in malaria-endemic countries in Africa increase their coverage of ITN and IPTp among pregnant women, did the distribution and coverage reach rural and urban populations and the poorest and richest quintiles equitably?

A. Study Design

This study is a descriptive analysis of data from 15 sub-Saharan African malaria-endemic countries (see Appendix A for country list and survey years), which met the inclusion criteria listed below. First, the analysis assessed coverage trends and

equity ratios in order to examine the likelihood that intervention coverage scale up for malaria prevention in pregnancy has been associated with improved equity of services delivered between the years 2005 and 2011. (Null hypothesis: As countries have increased intervention coverage, the prior inequities whereby rural and poor women have lower rates of coverage for the interventions remain unchanged.)

Second, the analysis compared malaria indicator questions of national cluster sampled household surveys to answer the primary research question regarding scale up of interventions and the impact on equity of services.

Indicators of concern were: Distribution of MiP interventions to rural and urban populations and socio-economic distribution based on household wealth index lowest versus highest quintile (or poorest versus least poor). Interventions assessed included: ITNs--did the subject sleep under an ITN the night before the survey?; and IPTp--were 2 doses, at least 1 at an ANC, taken for any live birth pregnancy in the last 2 years?

Inclusion Criteria were based on the following:

1. Malaria endemic sub-Saharan African country with stable, high transmission. Endemic defined by the WHO as having a constant measurable incidence both of cases and of natural transmission in an area over a succession of years.
2. Two publicly available DHS/MIS/MICS population-based national survey final country reports in sub-Saharan African countries with the first survey occurring before January of 2005[13] (prior to scale up implementation) and not after December 2008; and the second survey after January of 2010 with use of most recent survey if there are multiple surveys.
3. Surveys must include comparable data on ITNs and IPTp in pregnant women.

While all malaria endemic African countries were eligible for the study only 15[14] met the inclusion requirements and were selected for analysis: Angola, Burkina Faso, Democratic Republic of the Congo, Kenya, Liberia, Madagascar, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania (Zanzibar), Uganda, Zambia and Zimbabwe.

[13] Fieldwork for the Malawi DHS 2004 began in 2004 but completed in 2005.

[14] Originally, 16 sub-Saharan countries were included in the analysis. Rwanda terminated their IPTp policy in 2008 due to reduce prevalence of malaria and was dropped from the study

B. Data Collection and Sources

National cluster sampled household surveys or nationally representative population-based surveys including the Demographic and Health Surveys (DHS), UNICEF Multiple Indicator Cluster Surveys (MICS), and Malaria Indicator Surveys (MIS), between the years 2004 and 2011, were the sources of data used for this study.

DHS country reports provide country specific and comparative data on a variety of health indicators for monitoring and impact evaluation in the areas of population, health, and nutrition. They also collect data on multiple malaria indicators. In order to improve and monitor national programs and policies, Measure DHS uses web-based dissemination to share survey results after country reports are finalized and results have been disseminated nationally. Survey reports and all supporting dissemination documents are publically available on the Measure DHS website [45].

The MIS, developed by the Monitoring and Evaluation Reference Group of Roll Back Malaria (RBM-MERG), is another household survey that collects national and regional data from a representative sample of respondents on malaria specific indicators [45]. Like the DHS, the MIS also gathers data on SES and urban and rural rates. Almost all of the questions in the MIS instrument are derived from the Demographic and Health Surveys and the Multiple Indicator Cluster Surveys.

For 3 countries, Burkina Faso 2006, DRC 2010, and Sierra Leone 2010, MICS final reports were utilized. The MICS survey was developed by UNICEF and is carried out by government organizations with the support and assistance of UNICEF to provide comparable data on the situation of children and women globally. UNICEF works in conjunction with other household survey programs, in particular the Measure DHS program, to produce survey questions that help to provide a coordinated approach to survey implementation, with the objective of providing comparability across surveys and to avoid duplication of efforts. MICS are disseminated freely via the internet [46].

Using either all DHS or all MIS surveys for the countries in the sample would have been optimal. However, since these were not available the next best option was to compare the same type of survey for each country i.e., MIS to MIS or DHS to DHS. This was not always feasible either, thus for 6 countries mixed survey types

were used. DHS was the most common survey used (17 surveys) followed by MIS (10 surveys) and then MCIS (3 surveys). The countries in which mixed survey types were used were: Burkina Faso (MICS/DHS), DRC (DHS/MICS), Liberia (DHS/MIS), Madagascar (DHS/MIS), Nigeria (DHS/MIS), and Sierra Leone (DHS/MICS).

It should be noted that the goal of the Measure DHS program is to "collect data that are comparable across countries" [45]. However, while the sample frame methodology (the process of selecting nationally representative samples) can be similar and the wording of the questions are similar, they may cover a variety of different health indicators [44][15] and hence the surveys vary in focus from country to country. While most of the questions in the MIS survey were derived from the DHS and MICS framework, [45] comparisons of the questions across the separate surveys is required to adequately answer the current research question. Any survey using a different time frame, category or having a significantly different wording, is noted in the results section.

Surveys conducted in developing countries are more likely to have incomplete and inconsistent responses and recording of responses given the complex issues in reaching certain population sub-groups. Furthermore, important differences exist between the surveys. For example, the DHS is carried out at various times of the year, including the dry season, while the MIS is usually conducted during the high malaria transmission season [45]. In areas where malaria transmission tends to be more seasonal this may create inconsistencies in the conclusions since bed net usage during high transmission times would be higher. As noted by Eisele, to draw accurate conclusions that direct policy, the various surveys ought to be comparable not just between countries but over time as well [47]. An example of the difficulty in using different survey types in research can be found when comparing the Senegal DHS 2005 and MIS 2006 where a dramatic increase in coverage may be attributed to seasonal use of interventions. Seasonal changes may have less impact on IPTp distribution data as the question refers to a live birth pregnancy in the last 2 years.

[15] *Among the extant household health data sets that have been analyzed using techniques based on the Filmer-Pritchett approach are ones collected by the USAID-supported Demographic and Health Survey (DHS) program, the UNICEF multiple indicator cluster surveys (MICS), and the WHO World Health* 44. Gwatkin DR: **10 best resources on... health equity.** *Health Policy Plan* 2007, **22:**348-351..

Study Population: The research question focused on the sub-population of pregnant women, or women with a live birth pregnancy in the past 2 years, in sub-Saharan African countries. The aforementioned surveys all collect IPTp data on women between the ages of 15-49 who had a live birth in the last 2 years and ITN data on pregnant women ages 15-49 who slept under an insecticide treated bed net the night before the survey.

C. Key Analysis Variables

To examine if intervention coverage scale up for malaria prevention in pregnancy has been associated with improved equity of services the following variables were analyzed.

ITN: In all 3 survey types the ITN indicator under investigation was defined as "Percentage of *pregnant* women age 15-49 who slept under an ITN the night preceding the survey" or occasionally stated as "last night".

Although many surveys distinguish between ITNs and LLINs, due to the relatively recent introduction of LLINs and that the category of ITNs includes all LLINs, the ITN indicator was used as it likely represents a more accurate depiction of past coverage. An insecticide-treated net is defined as one that was treated in the past 12 months.

IPTp: For analysis of IPTp, the survey indicator examined was most commonly stated as "Among women age 15-49 with a live birth in the two years preceding the survey, the percentage who received 2 plus doses of IPT at least one of which was during an ANC visit." Intermittent preventive treatment was defined as sulfadoxine–pyrimethamine provided at predefined intervals during pregnancy. For Zambia MIS 2006 and 2010 the indicator is reported as, "For the last birth in the five years preceding the survey" versus the standard 2 years with no specification as to "live birth" or not. The data available for Liberia DHS 2007 was any SP/Fansidar versus the Liberia MIS 2011 which gave data on "received 2 plus doses and one at an ANC".

Disbursement: External funding sources for malaria programs include, but may not be limited to, UNICEF, International Development Agency, The Global Fund for AIDS, TB and Malaria, the USAID-President's Malaria Initiative, USAID, and individual country contributions. The source for disbursement of external funds for malaria control comes from the Organization for Economic Co-operation and

Development, is reported in millions and was compiled by the Malaria in Pregnancy Consortium.

Equity: There are a variety approaches to measuring equity and every country engenders its own inequalities. Nonetheless, there are two common methods for examining equitable distribution across a country; 1. comparison of coverage by socioeconomic status, using asset-based wealth quintiles; and 2. urban versus rural dwelling based on country designation [28].

SES Wealth Quintiles[16]*:* Poverty and malaria are strongly associated and can be demonstrated by the presence of higher malaria mortality rates being found in low GNI per capita countries [5].

Since economic activity in low resource countries may not always be cash-based, there are difficulties in the measurement of household income [40]. In attempts to quantify equity measurements, academics have found that "household assets are closely enough related to household consumption/expenditures for the former to serve as a reasonable proxy for the latter" [44]. Thus, survey respondents are divided into quintiles based on an index of household assets as a proxy indicator of SES.

Rural vs. Urban: This next approach, urban versus rural dwelling/residence, to assess equity is often presented as a risk ratio but comes with a particular set of problems. Standard definitions of urban and rural do not actually exist across countries, thus designation of "urban" and "rural" was based on the in-country systems provided in the surveys.

The cause of the urban/rural disparity is most commonly associated with the difficulties of providing access to marginalized areas. Webster noted in 2007 that disparities in geographic areas will need to be rectified for scale up programs to achieve maximum impact [48]. Eisele (2006) states national level estimates of ITN coverage ought to be separated by urban and rural strata in order to illustrate the higher levels of access that urban populations have to ITN outlets and other

[16] *"The wealth index is a composite measure of a household's cumulative living standard. The wealth index is calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. DHS separates all interviewed households into five wealth quintiles to compare the influence of wealth on various population, health and nutrition indicators45. MeasureDHS:* ***Demographic and Health Surveys.*** *USAID; 2012..*

socioeconomic factors while simultaneously having a lower risk for malaria infection. Eisele further recommends that data be disaggregated by highland and lowland areas, but that is beyond the scope of this study [47].

Education: Levels of education are typically reported in DHS, MICS and MIS in categories of none, primary incomplete, primary complete, secondary-plus and these categories can be predictors of health seeking behavior [40]. For a woman to obtain IPTp, she must attend an ANC which is an action linked with education. Education is also linked to use of ITNs/LLINs. In one study, individuals with secondary or higher education were approximately eight times more likely to have used a purchased product in the household to prevent malaria than were those who reported primary or no education, and those with moderate or high incomes were five times more likely to have ever used a purchased product than those with lower incomes [49]. Since a woman's level of education is associated with rural or urban dwelling and is also associated with SES, it could be used as a co-variate in the modeling. For the purposes of this study however, given the close association between wealth quintile and education, level of education was not used as a contributing variable.

D. Analysis

The purpose of this descriptive analysis is to discern whether scale up ITN/IPTp coverage resulted in improved and equitable coverage for pregnant women in the lowest wealth quintile and those living in rural areas. While absolute changes may be descriptive of coverage increases for a particular group over time, equity is a measure of a given group's coverage relative to another's. Therefore, this analysis compares the coverage ratios of pregnant women in the poorest to the wealthiest wealth quintiles (PWCR) to quantify equity within a given survey. As such, a country with a higher coverage ratio for the poorest quintile will have a PWCR >1, indicating a greater distribution of interventions to the poorest quintile and thus greater equity.

The above analysis gives a snapshot of equity in a country at the time of the survey used. To show the change in equity before and after scale-up, this analysis compares the PWCR of the post scale-up survey (S2) to the PWCR from the pre-scale up survey (S1). Again, if equity for the poorest wealth quintile increased over the 2 surveys, then this equity ratio will be >1, indicating greater equity of coverage.

The analysis uses precisely the same method to also determine equity relating to pregnant women dwelling in rural versus urban areas. In this case, the equity index is the ratio of the coverage of rural women to urban women in a given survey (RUCR), and the equity achieved after scale-up is measured using the ratio of the RUCR from S2 to RUCR in S1. Again, equity ratios >1 indicate an increase in equity.

The above methodology was performed independently for both ITN and IPTp interventions. Therefore this analysis ends up providing four separate Equity Indices[17] for pregnant women in the fifteen African nations surveyed: ITN PWCR, ITN RUCR, IPTp PWCR and IPTp RUCR, all of which indicate changes in equity between the pre- and post- scale up surveys.

III. Results

(Refer to Appendix A and B for complete listing of country specific results.)

A. ITN

1. Absolute Coverage Increase: All countries in the sample had an absolute increase in ITN coverage for pregnant women from S1 to S2. The mean increase in ITN coverage of pregnant women was 20.4%. Proportional changes for ITN S1 to S2 ranged from a 1.01 fold increase (Sierra Leone) indicating almost no change in coverage to a 7 fold increase in Nigeria. The mean fold increase was 2.97. See Table 1 for comparison of country rank between absolute rate of increase and proportional change ranking.

2. SES Change: Using the PWCR as a measure of equity, 11 out of the 15 countries improved ITN coverage to the poorest quintile, 2 lacked sufficient data (Liberia, Mozambique), and 2 (Angola, Sierra Leone) had indices less than1. Ten of these 11 (DRC being the exception) had absolute increases in coverage greater for poorest versus wealthiest. The largest gap increase was found in Tanzania where ITN coverage for the poorest women increased by 52.1% and for the wealthiest by only 3.8%. Prioritization based on burden could also be found in Burkina Faso where absolute increase for poor was 36% versus a decrease in coverage of wealthiest by

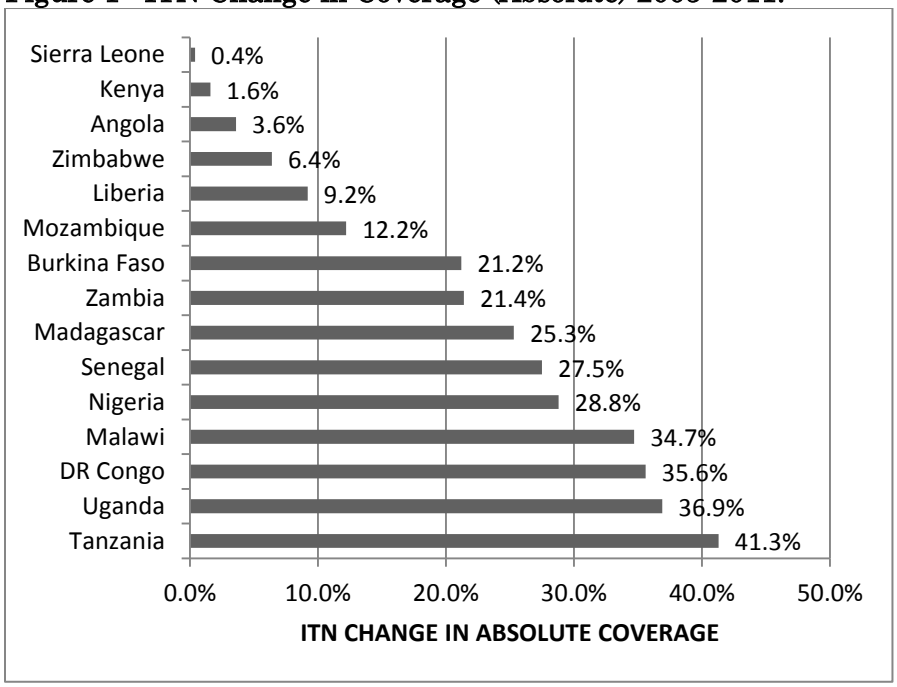
[17] This method is similar to that used by R. Steketee and T. Eisele in *Is the Scale up of Malaria Intervention Coverage Also Achieving Equity?,*

8%. (Kenya ITN rural vs. urban was the only other country where stealing from the rich to give to the poor could be found.)

Table 1: Absolute and Proportional Change Comparison

Absolute Change ITN		Proportional Change ITN		Absolute Change IPTp		Proportional Change IPTp	
Tanzania	41.3%	Nigeria	7.0	Liberia	37.2%	Burkina Faso	8.2
Uganda	36.9%	DR Congo	6.1	Sierra Leone	31.1%	Angola	7.0
DR Congo	35.6%	Uganda	4.7	Senegal	29.4%	Senegal	4.2
Malawi	34.7%	Senegal	4.2	Malawi	17.2%	DR Congo	4.1
Nigeria	28.8%	Tanzania	3.6	DR Congo	15.9%	Sierra Leone	4.0
Senegal	27.5%	Malawi	3.4	Angola	15.0%	Liberia	4.0
Madagascar	25.3%	Zimbabwe	3.0	Madagascar	13.1%	Madagascar	3.0
Zambia	21.4%	Mozambique	2.7	Kenya	12.9%	Nigeria	2.7
Burkina Faso	21.2%	Burkina Faso	1.9	Zambia	12.9%	Kenya	2.0
Mozambique	12.2%	Zambia	1.9	Burkina Faso	9.3%	Uganda	1.5
Liberia	9.2%	Madagascar	1.5	Nigeria	8.3%	Malawi	1.4
Zimbabwe	6.4%	Liberia	1.3	Uganda	8.3%	Zambia	1.2
Angola	3.6%	Angola	1.2	Tanzania	4.6%	Tanzania	1.2
Kenya	1.6%	Kenya	1.0	Zimbabwe	1.0%	Zimbabwe	1.2
Sierra Leone	0.4%	Sierra Leone	1.0	Mozambique	-0.3%	Mozambique	1.0
Average	20.4%		3.0		14.4%		3.1

Figure 1: ITN Change in Coverage (Absolute) 2005-2011.

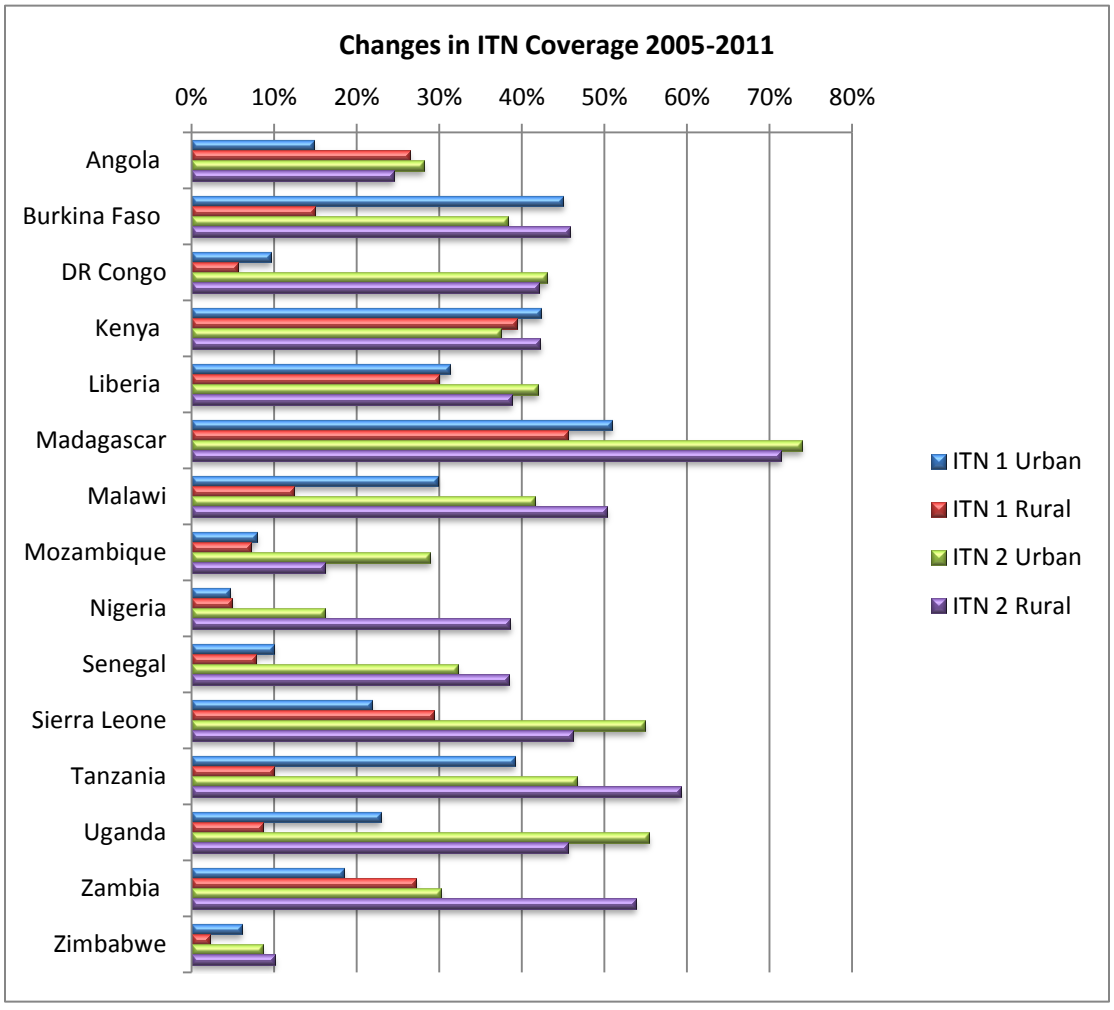


Length of time between surveys may vary. See Appendix 1 for survey years.

3. Urban Rural Comparison: Using the RUCR as an equity measure, 11 out of 15 countries improved equity of ITN distribution to rural women, 1 had no change (Liberia), 1 (Angola) had a decrease in ITN distribution to rural areas, and 2 (Mozambique, Sierra Leone) did not improve the equity of coverage.

In the baseline surveys examined, ITN coverage for rural populations was greater in only the following 4 countries: Angola, Nigeria, Sierra Leone, and Zambia. In the second set of surveys (ITN2) there were 7 countries with greater rural coverage: Kenya, Liberia, Malawi, Nigeria, Senegal, Tanzania and Zimbabwe. Nigeria was the only country to maintain greater coverage in rural areas from one survey set to the next.

Figure 2: Changes in urban and rural ITN Coverage 2005-2011 between the initial (S1) and follow-up (S2) surveys



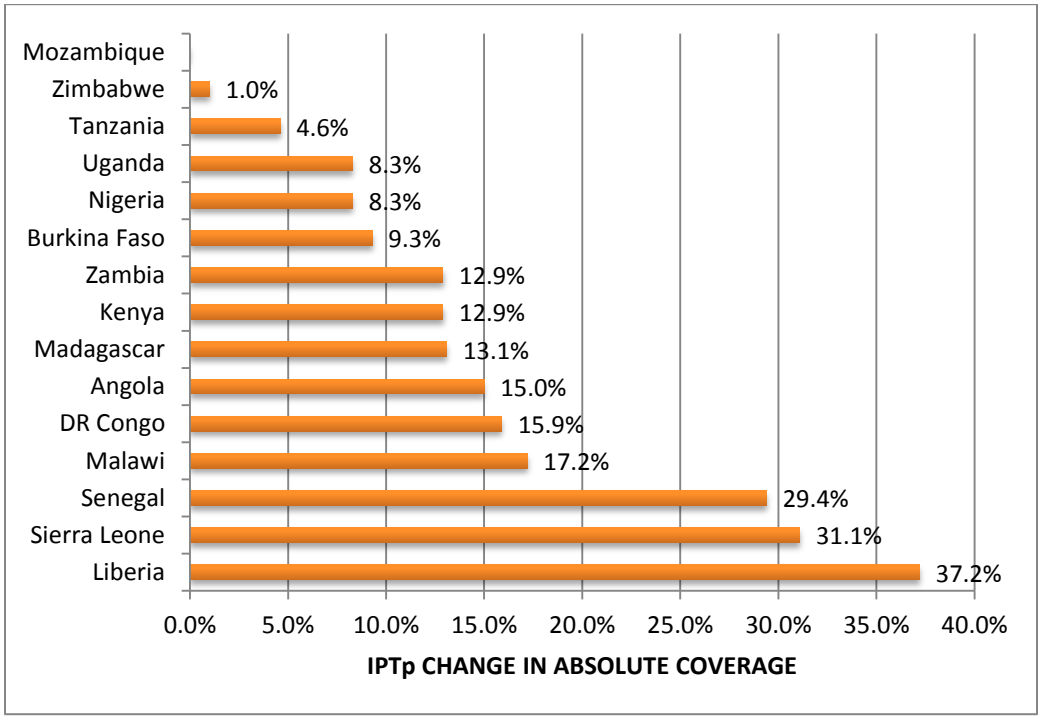
4. Method of coverage/disbursement: With the exception of Zimbabwe and Tanzania which has a voucher scheme with top-up fee, all countries included in the study distributed free ITN's at ANC visits by the time of the second survey (2010 or 2011). At the time of its second survey in 2010, Zimbabwe was still using mass campaigns to deliver nets to high risk areas [50].

IPTp

1. Coverage Increase: For IPTp coverage, all but 1 country showed an absolute increase in coverage; Mozambique had a decrease in coverage. The average increase for IPTp coverage was 14.4%. IPTp proportional change in coverage ranged from 0.98--fold increase to an 8.2--fold coverage increase. The average proportional change was a 3.1--fold increase. See Table 1.

2. SES Change: Once again using the PWCR as a measure, 8 out of 15 countries improved IPTp coverage to the poor (DRC, Kenya, Liberia, Malawi, Nigeria, Tanzania, Uganda and Zambia), 1 lacked data on wealth quintiles (Mozambique), and 6 countries did not improve equity.

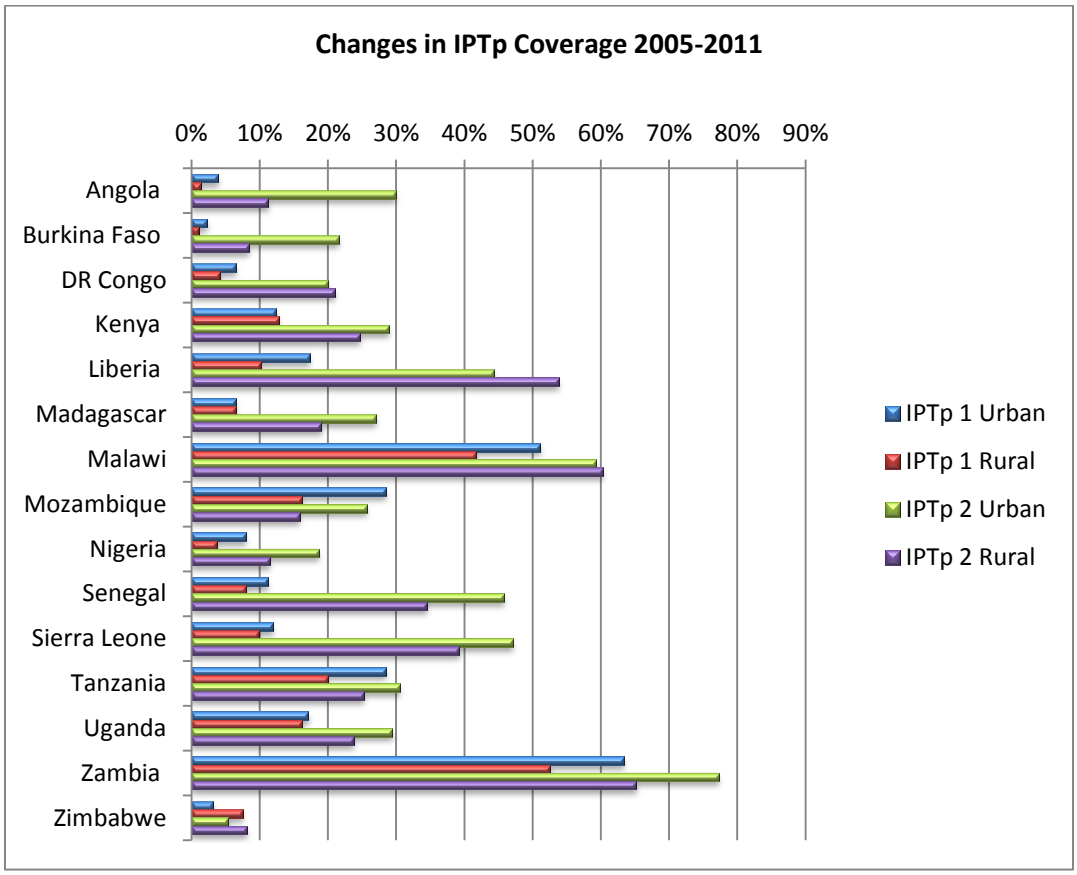
Figure 3: IPTp Change in Coverage (Absolute) 2005-2011



3. Rural Urban Comparison: Using the RUCR equity measure 7 out of 15 countries saw improved equity of IPTp coverage for rural women (DRC, Liberia, Malawi, Mozambique, Nigeria, Senegal, Tanzania). Mozambique had a decrease in IPTp coverage for both urban and rural but the decrease in coverage was greater in urban pregnant women (-2.8%) than for rural pregnant women (-0.3%). Of the countries that improved equity, 4 countries (DRC, Liberia, Malawi, Tanzania) had absolute coverage increases for rural women that were greater than for urban. For example, Malawi had a 19% increase in rural coverage versus an 8% increase in urban coverage. This indicates MiP program priorities are directed toward vulnerable populations in these countries.

In the baseline survey (IPTp -S1), Kenya and Zimbabwe were the only 2 countries with greater rural than urban coverage. Madagascar had equal rural urban coverage. In IPTp-S2, 4 countries, DRC, Liberia, Malawi, and Zimbabwe had greater rural coverage. As was the case in the ITN analysis, only 1 of the original countries (Zimbabwe) maintained greater rural coverage through the period of study.

Figure 4: Changes in IPTp Coverage 2005-2011 (Urban/Rural)



4. Method of coverage/disbursement: Some countries charge a small fee for ANC service packages. Of the 15 countries analyzed, 3 charged a fee for IPTp, 4 reported no fee charged and the remaining countries did not provide data in their reports. The coverage and disbursement of IPTp is covered more thoroughly below as it is related to ANC coverage.

Summary of ITN/IPTp Coverage and Equity Ratios: The barriers and hindrances to scale up of ITN's and IPTp's differ thus making comparisons is difficult. However, it should be noted that PWCR's for ITN's had a substantially higher median (5.4) than the other ratios which had medians between 1.0 and 1.6. Refer to Appendix B.

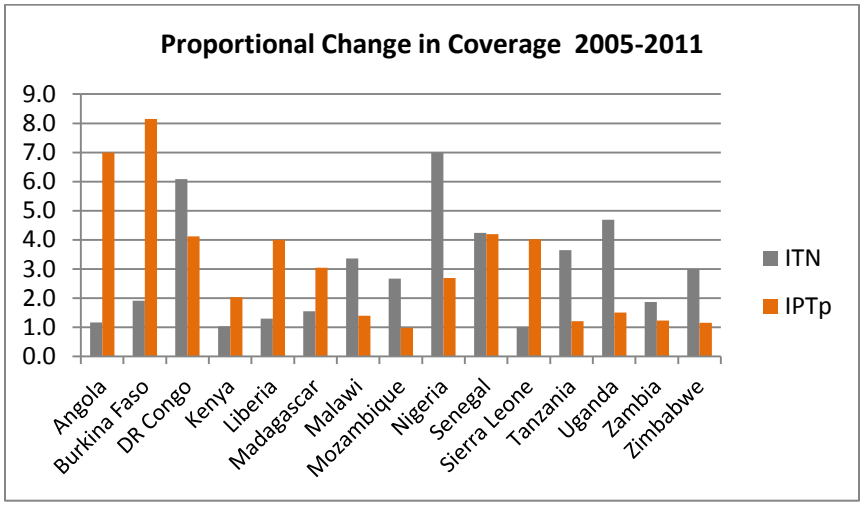
In general, coverage for both ITNs and IPTp increased in most of the countries in the sample; and while there was also a generalized improvement toward equity, only in a few countries, was there marked improvement in specifically reaching a higher proportion of the most vulnerable pregnant women.

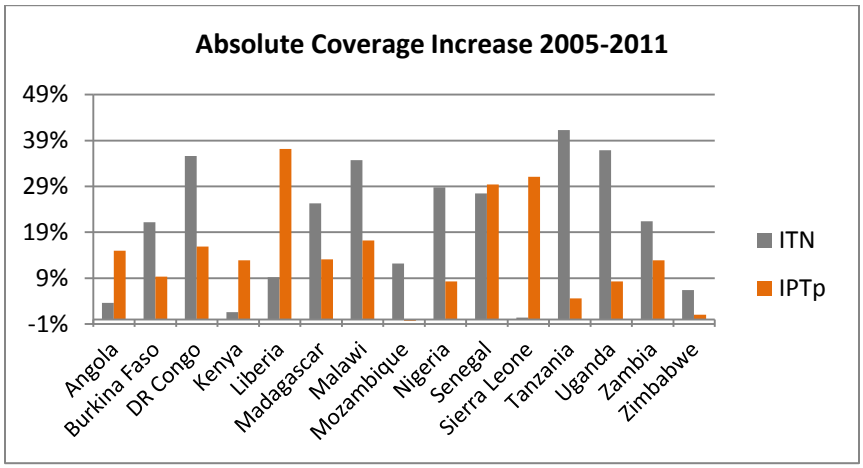
Table 2 (below) ranks countries by absolute coverage (at the second survey (S2)) and compares the respective PWCR and RUCR ratios (S2). This is to analyze whether there is any apparent link between countries with high coverage rations and corresponding high equity ratios.

Table 2: Absolute Coverage and Equity Ratio Comparison

ITN Country	Absolute Coverage at S2	PWCR at S2	RUCR at S2	IPTp Country	Absolute Coverage at S2	PWCR at S2	RUCR at S2
Madagascar	71.5%	1.7	0.97	Zambia	69.4%	0.8	0.8
Tanzania	56.9%	1.1	1.27	Malawi	60.1%	0.9	1.0
Malawi	49.4%	1.3	1.21	Liberia	49.6%	1.2	1.2
Uganda	46.9%	1.0	0.82	Sierra Leone	41.4%	0.7	0.8
Zambia	45.9%	1.5	1.78	Senegal	38.6%	0.5	0.8
Burkina Faso	44.5%	1.0	1.20	Tanzania	26.3%	0.8	0.8
DR Congo	42.6%	0.7	0.98	Kenya	25.4%	0.7	0.9
Kenya	41.4%	1.1	1.13	Uganda	24.5%	0.8	0.8
Liberia	40.2%	N/A	0.99	DR Congo	21.0%	1.1	1.1
Senegal	36.0%	2.5	1.19	Madagascar	19.5%	0.8	0.7
Nigeria	33.6%	2.1	2.40	Mozambique	18.6%	N/A	0.61
Sierra Leone	27.6%	0.8	0.84	Angola	17.5%	0.3	0.4
Angola	25.6%	0.4	0.87	Nigeria	13.2%	0.2	0.6
Mozambique	19.5%	N/A	0.56	Burkina Faso	10.6%	0.4	0.4
Zimbabwe	9.6%	1.0	1.17	Zimbabwe	7.3%	1.5	1.5

Figure 5: Proportional and Absolute Changes in Coverage 2005-11





C. ANC Coverage: Given that a woman must attend an ANC to meet the indicator analyzed, (IPTp 2+, at least 1 at ANC) ANC coverage should also be examined. At the time of second survey, 13 countries had ANC (≥ 1 visit) coverage that was higher than 85%. Two countries Angola (80%) and Nigeria (58%) did not. The average ANC coverage for at least one visit among the15 countries was 89%.[18]

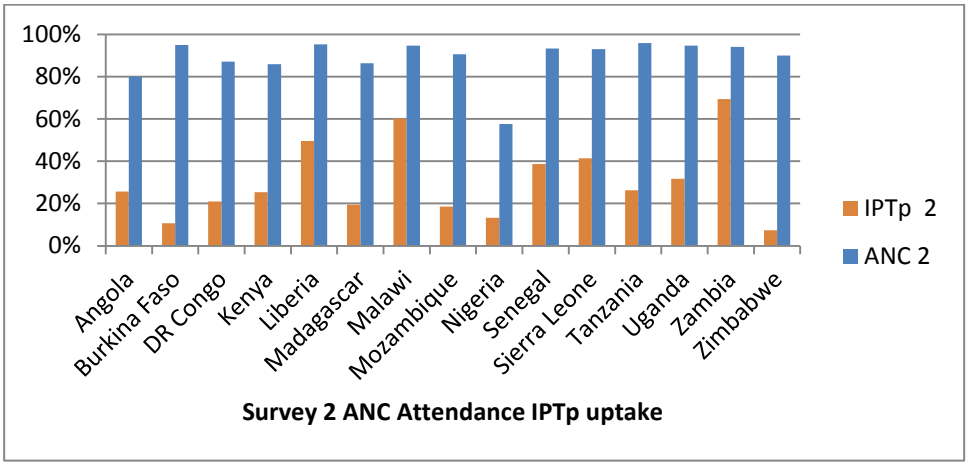
Liberia had the greatest increase of ANC coverage (16% increase) and the greatest increase in IPTp (37% increase). While Burkina Faso had a 10% increase in ANC

[18] Average excluding Angola and Nigeria is 92%.

visits between S1 (2006) and S2 (2010), improvements in equitable coverage of IPTp were not seen. Furthermore, the IPTp coverage difference in 2006 between poorest and richest quintiles was only 0.05% higher for the wealthiest quintile. By 2010 this disparity had grown so that the wealthiest had almost 12% greater coverage indicating that prioritization of national malaria control programs may have not been directed toward vulnerable women, whereas ITN coverage was more equitably distributed to this population

Mozambique had a 3% increase in ANC coverage between 2007 and 2011 but a small decrease in rural and urban coverage of IPTp. (2007; Urban 28.5%: Rural 16.1%) (2011; Urban 25.7%: Rural 15.8%).

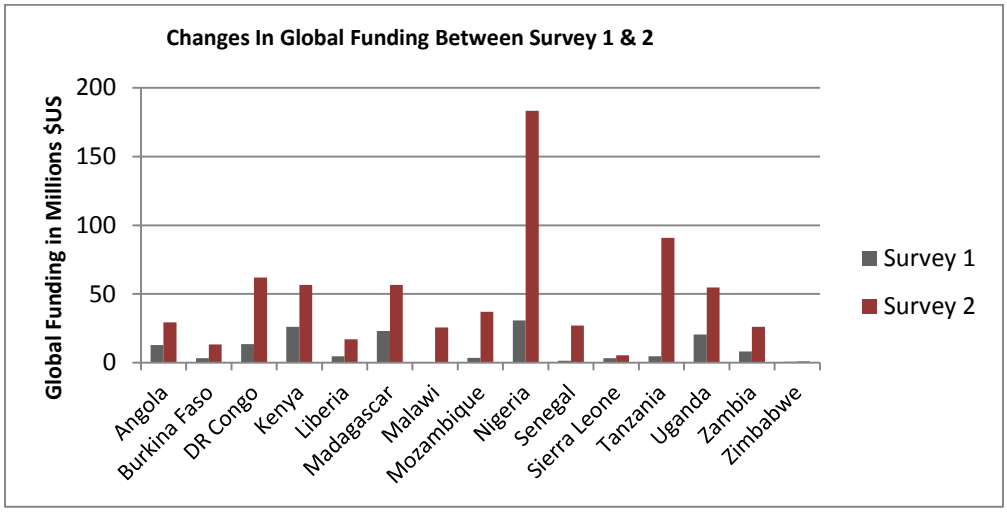
Figure 6: Antenatal clinic attendance and IPTp uptake 2010-2011



D. Funding and Coverage: On average, the funding for the 15 countries increased by almost 6-fold.[19] Relative increases in funding were greatest for Malawi, Senegal, and Tanzania. All 3 countries showed improvement in the 4 equity indices and 3--fold increases in ITN coverage. However, Senegal had a 4.2--fold increase in both ITN and IPTp coverage.

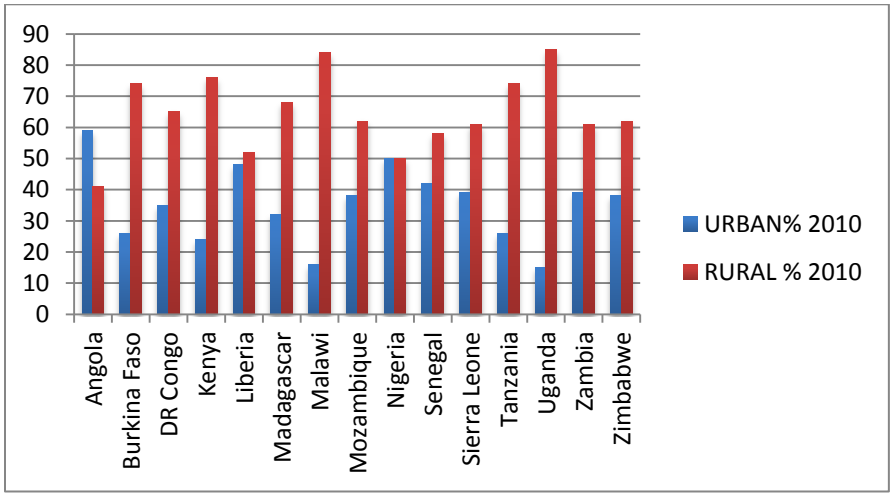
[19] The average of funding in millions of $US is not informative to this discussion since country populations, level of development, and program needs differ.

Figure 7: Changes in Global Funding Between S1 and S2



E. Urban rural population breakdown: In 2010, almost all the countries had higher percentages of the population living in rural areas. Angola has a higher urban percentage and Nigeria is split evenly at 50%. According to the World Bank data, the countries in this study saw a shift, albeit often small, from rural to urban during the period from 2008 to 2010, the exception being Senegal, where population distribution remained the same [51].

Figure 8: Rural/urban comparison for countries in 2008 and 2010



F. Comparability of data set indicators: Three nationally representative population-based surveys (DHS, MICS, and MIS) were used. The following inconsistencies were found in the indicators of interest in the first set of surveys: Zambia MIS 2006 (and 2010) used a 5 year span versus a 2 year recall span for IPTp indicator questions. Mozambique 2011 DHS did not provide wealth quintile information for ITN or IPTp coverage but did provide overall coverage for pregnant women. Liberia 2007 DHS provided household net ownership only, so the MIS 2005 figure was used. Liberia 2007 DHS also gave "any S/P Fansidar" only versus "2+ doses 1 at ANC". Burkina Faso 2006 MICS provided "household net usage" but no data for pregnant women sleeping under ITN the night before the survey. Surveys used from 2010 and 2011 were compatible and not inconsistences were found save Zambia's 5 year span for IPTp recall.

Another area of concern between the studies is the varying time intervals between studies of a given country. The median time interval between surveys was 4 years, (Table 4) with the greatest being 6 years for Malawi and the shortest being 2 years for Madagascar.

Table 3: **Interval (years) between Survey 1 and Survey 2**

Country	Years	Country	Years
Angola	4	Nigeria	2
Burkina Faso	4	Senegal	5
DR Congo	3	Sierra Leone	2
Kenya	3	Tanzania	5
Liberia	4	Uganda	3
Madagascar	2	Zambia	4
Malawi	6	Zimbabwe	5
Mozambique	4		

IV. Discussion

This descriptive analysis of 15 sub-Saharan countries demonstrated that equitable distribution of MiP interventions continues to improve in Africa. Equity of ITN coverage, however, appears to have increased faster than IPTp, suggesting that more complex service delivery issues remain for the IPTp intervention. Meanwhile,

the data in this study do not indicate that the degree of absolute coverage in a country predicts the degree of equity of coverage in that country. However with ITNs, countries with higher absolute coverage showed a greater *rate of improvement* of equity from the first to the second study. Meanwhile, absolute coverage of IPTp does not appear to be an indicator of rate of improvement of equity. In sum, countries appear to be achieving greater equity of ITN coverage faster than IPTp coverage. But given the increase in equity in most of the countries studied, the overall trend in equity is encouraging.

1. Overall increases in equity

Five countries, DRC, Malawi, Nigeria, Senegal and Tanzania, had improvements in all (4) equity indices during the period of analysis. And while some of these 5 countries did not have PWCR or RUCR (equity ratios) much greater than 1, the results can be interrupted to say that even as the rich continued to get richer, so to speak, the poorest quintile also got at least a little richer in terms of coverage. Furthermore, the equity ratios used in this analysis do not necessarily mean there was a high degree of equity in all these countries. Only that over time, (from S1 to S2,) equity improved. For example, while IPTp coverage in Tanzania (S2) was still slightly greater in urban areas and richest quintiles, increases in coverage to the poorest and rural groups exceeded that of increases to the rich and urban. This would indicate that the malaria control programs in that particular country are at least prioritizing delivery of interventions to poor and rural pregnant women. And this seems to be representative of a majority of the countries studied.

In terms of quantifying overall improvements in equity, ITN increased the most. Median PWCR from S1 was 0.5; median PWCR from S2 was1.1 and the median S2/S1 PWCR was 5.4, indicating a brisk rate of increase of ITN coverage ratios between these two survey time points. ITN equity ratios for the rural/urban comparison also increased, though not as dramatically, from a median RUCR of 0.95 in S1 to 1.15 in S2, with a median S2/S1 RUCR of 1.6.

IPTp equity increases were more moderate between the two studies. The median S2/S1 PWCR for this intervention was 1.2 and RUCR was 1.0, indicating only modest if any increase in equity between the two surveys.

The results of this study could be viewed as disappointing in that only a third of the countries increased equity in all of the indicators. However, in addition to the 5

countries mentioned above, the remaining countries (except Angola and Sierra Leone) achieved more equitable distribution in one or both categories, if not necessarily in all four. For example, Kenya, Uganda and Zambia improved equity of coverage in 3 out of 4 MiP interventions but lagged behind solely in achieving equity of IPTp to rural women. The absence of wealth quintile data in S1 for Liberia and Mozambique leaves no clear conclusion regarding changes in equity for these nations.

2. Trends between absolute coverage and equity.

While the aim of this study was to examine change in equity between S1 and S2, the critical question that remains is "What are the characteristics of the countries that improved equity?" This analysis was not able to fully address this question but there did appear to be a trend between countries with high absolute ITN coverage and more equitable distribution to the poor and rural. See Appendix B. This is reasonable since the more ITN's that are disbursed the more likely it is that some will reach the poorest and rural dwelling women.

No such trend appears to exist regarding absolute coverage of IPTp and equity. Countries demonstrating improvements in coverage equity were scattered throughout the range of absolute IPTp coverage levels. Zambia, for example, with its IPTp coverage at almost 70% did not prioritize delivery of IPTp to rural women who comprise a greater proportion of the population than urban women. It is possible that as IPTp scale up continues and eventually reaches ITN levels of coverage, equity may improve as well.

3. Changes in absolute coverage:

While equity is the primary focus of this analysis, 2 countries were notably low in their absolute increase in ITN coverage. The average increase in coverage of ITNs for all 15 countries was 20% (range was 0.4% to 41.3%).[20] However, Kenya's change in coverage between surveys was only 1.6%. Kenya began, however, with (MIS:2007) high coverage (40%)[21], indicating that some delivery systems are in place, so it is possible that transmission rates were lower at the time of the second

[20] This is a logical outcome given that a high proportion of global funding for malaria prevention is directed toward scale up of ITNs. The Global Fund and PMI expenditure for ITN's is 43% and 35% of their budget respectively 39. WHO: **World Malaria Report 2011.** Geneva: World Health Organization; 2011.

[21] Only Madagascar had initial higher coverage percentage at 46%.

survey (MIS:2010) or some other factor beyond the scope of this study was present. Nonetheless, since only 41% of pregnant women in Kenya slept under a bednet in 2010, the rate of coverage increase in not sufficient for Kenya to meet universal coverage goals anytime soon. That being said, Kenya did have improvements in equity in all areas except IPTp for rural women.

Sierra Leone also had a low ITN absolute coverage increase (0.4%). It began in S1 with moderate ITN coverage (DHS 2008: 27.2%) but had virtually no increase in coverage as reported in S2 (MICS 2010: 27.6%) Several issues could be at play here. First, given the condition of the health infrastructure in Sierra Leone after so many years of civil war, this might appear to be a reasonable finding. However, there was a dramatic scale up of IPTp (31% absolute change or 4 fold increase) in Sierra Leone (second only to Liberia), indicating some scale up of service delivery[22].

This low change in ITN coverage could have other explanations as well. For example, there also may be seasonal (DHS conducted in April versus MICS in Oct) or regional inconsistencies between the surveys in Sierra Leone. It is also possible that such a small increase in coverage may be due to the fact that limited project funds were directed toward ITN scale up. Intensive health worker training in IPTp may have occurred, improving uptake of that intervention, or that the gap of only 2 years between surveys did not allow sufficient time for the effects of scale up to be measured are other possibilities. However, this result, along with the conclusion that the country did not achieve improvements in equity on any of the indicators, suggests the need for further and attention to funding requirements. The overarching point is that the factors affecting coverage rates in a country are not always clear, may vary from country to country and from intervention to intervention.

Factors Affecting Scale up

It should be noted that in a discussion of scale up of ITNs and IPTp, service delivery issues are more likely to affect the coverage rates of IPTp whereas cost is more commonly associated ITN coverage disparities. While these 2 interventions may have different components and barriers to scaling up coverage, both ITN and

[22] Sierra Leone also had one of the lowest disbursement/capita rates at 1.45

IPTp together, along with case management, make up the MiP intervention package. Currently ANC's are the most effective method of MiP package delivery.

Delivery of IPTp is a somewhat more complex issue. It requires specific timing, multiple doses, and higher levels of ANC staff knowledge and training than distribution of bednets. Therefore, ANC attendance remains a key element in the delivery of IPTp (and ITNs). As previously mentioned, ANC coverage/attendance was relatively high in this study with an average of 89% pregnant women having ≥ 1 visit.[23] However, IPTp coverage in the second survey (S2) remains low (that is, not on track to meet RBM coverage targets) with the 15 country overall coverage mean being 30.6% (range 7% to 69%). This is an improvement however, from the results of a 2009 study which looked at coverage of 27 sub-Saharan countries using DHS/MICS/MIS surveys from 2006-2008 where few countries had greater than 20% coverage [28].

This analysis is also further evidence that high ANC coverage rates do not guarantee high IPTp uptake or equitable distribution among the rural and poorest populations [28]. No trend was found between these variables. Nonetheless, ANC's are still considered the best platform for delivery of malaria prevention for pregnant women.

Two countries--DRC and Nigeria--merit attention for their increased equity, particularly as these are countries with some of the greatest malaria burden. Low coverage rates of IPTp in DRC[24] and Nigeria[25], with their large at risk populations (and which account for more than 40% of estimated global malaria deaths) had equity improvements in all four equity indices. In addition, the equity ratios for these countries were relatively high (DRC ITN PWCR: 2.89; RUCR: 1.7, IPTp PWCR: 3.0; RUCR 1.6) (Nigeria ITN PWCR: 4.6; RUCR: 2.3, IPTp PWCR: 1.2; RUCR 1.3). Results from this analysis indicate that these countries are making improvements in both the scale up of coverage to vulnerable women, and the equitable distribution of MiP interventions. This is significant because in order to

[23] The determinants for low ANC attendance in Angola and Nigeria were not examined and are beyond the scope of this study.
[24] The 2012 World Malaria Report states that from 2009-2011only 22% of pregnant women in 16 malaria endemic countries received IPTp 2 doses (not necessarily at ANC's). This was attributed in part to low coverage rates Nigeria and DRC.
[25] Determining factors of low uptake in Nigeria are examined by Akinleye, et al.

attain international malaria targets, substantial mortality reductions in these countries are needed [5].

Policy Implications

Ten of the countries in this analysis are among the top 15 most malaria-burdened countries (based on case incidence) in the world [39]. The sample also includes 11 countries out of the top 15 with the highest rate of malaria mortality[26][39]. This indicates that this analysis is relevant to current discussions of malaria control scale up and coverage distribution. It is possible that these countries met the inclusion criteria not as a coincidence but because their high malaria burden they have been given increased attention from the RBM partnership for data collection.

This analysis and the review of literature suggest that publically available population survey MiP indicators are now more comparable than prior to 2010. However, to accurately depict need and/or progress within the country, external funding agencies should consider using similar indicators. For example, some entities in the malaria control partnership use the IPTp "any S/P Fansidar" in their reports which generally provides a greater rate of coverage than "IPTp 2, 1 at ANC". This may result in a lower prioritization of funding for pregnant women if it appears scale up of coverage has already occurred.

Finally, in light of the notable increases of intervention coverage, and also the improvements in equity of coverage, it may be the right time to increase the focus on achieving more "equitable" coverage to the most vulnerable populations versus simply striving to attain "equal" coverage [24] within a country.

Limitations

This analysis is not a comprehensive review of all MiP program interventions across sub-Sahara Africa, but rather a small sampling of 15 countries, and only 2 of the 3 recommended MiP interventions. Other sub-Saharan countries were not included because of incomplete data, no IPTp policy or appropriate surveys were not found for comparison after SUFI began. A lack of data in a malaria endemic country may indicate a weak health infrastructure within the country and need for increased consideration by global malaria partnerships.

[26] This is the number of reported deaths that were confirmed as malaria; there are some countries in Africa which are not represented even though their rates are similar due to insufficient health infrastructure for accurate diagnosis of cause of death or reporting.

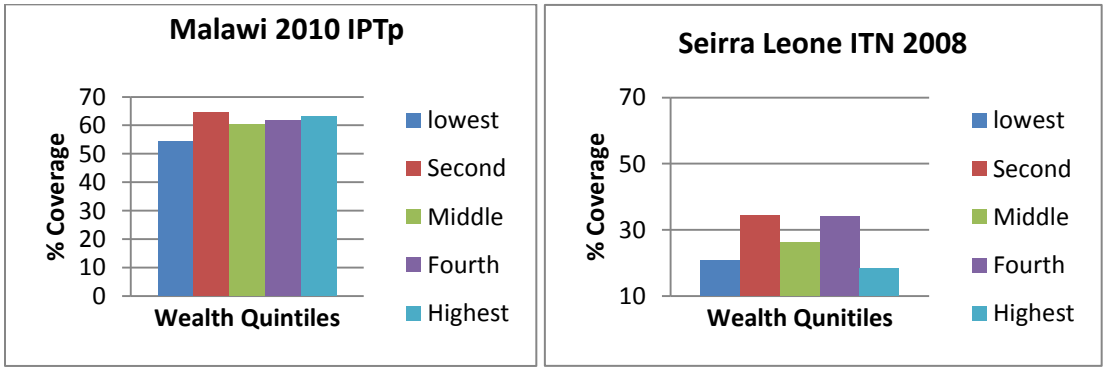
There are a number of limitations endemic to nationally representative household surveys some of which include: they may be underestimates of current IPTp coverage due to relying on recall over the past two years [52]; respondents may feel that a failure to report use of interventions may have negative consequences for them such as exclusion from future free net distribution [34]; and comparing surveys over time may simply reflect better record keeping and surveillance rather than actual comparative increases in coverage. These weaknesses are inherent in any study using these data sets.

Another limitation in this study is that only the richest and poorest quintiles are examined. Barat (2004) examined differences in access to treatment between the least poor quintile and the poorest quintile and found significant difference in rates of coverage. A similar situation can be found in this analysis. When one looks at the IPTp coverage in Malawi in 2010 it appears that using the second poorest quintile would have given a far different conclusion: that equity had actually been achieved. The same is true of ITN coverage in Sierra Leone in 2008. See Figure 8.

Finally, this study did not include examination of the correlations between urban and wealthy populations or poor and rural in that they may act as confounding factors. Furthermore, some large urban centers, such as Nairobi, Kenya exist outside of high malaria transmission zones where MiP interventions are not as crucial.

As countries move closer toward equitable distribution of prevention resources for MiP, these limitations will need to be addressed. However, the concern of this study was to examine if some malaria endemic countries had indeed moved toward that goal.

Figure 9: Comparison within wealth quintiles (Malawi 2010, Sierra Leone 2008)



Conclusion

This analysis supports previous research suggesting that the achievement of high and equitable coverage of malaria control en route to elimination is a realistic, if still distant, goal. Achievement of that objective will require that interventions are provided to those bearing the greatest burden of the disease. The results above indicate that equitable distribution for ITNs is occurring in many countries and while IPTp scale up has occurred more slowly, there has also been notable improvement. However, in order to achieve and maintain elimination, countries and their global partners must make solid and continuing commitments to improving the health infrastructure [24] through which malaria control interventions are most effectively delivered.

Toward that end, further research could explore the service delivery policies, practices, strengths and weaknesses of the malaria endemic countries which have improved levels of equity within the RBM framework, in order to determine what program implementation methods achieve the greatest equity. This is an essential component needed to guide the development of best practices to meet global malaria reduction targets [34].

Appendix A

Country	Survey 1	Survey 2	ITN 1	ITN 2	ITN % Change in coverage	Propor-tional Change	IPTp 1	IPTp 2	IPTp % Change in coverage	Propor-tional Change
Angola	MIS 2007	MIS 2011	22.0%	25.6%	3.6%	1.16	2.5%	17.5%	15%	7.00
Burkina Faso	MICS 2006	DHS 2010	23.3%	44.5%	21.2%	1.91	1.3%	10.6%	9%	8.15
DR Congo	DHS2007	MICS 2010	7.0%	42.6%	35.6%	6.09	5.1%	21.0%	16%	4.12
Kenya	MIS 2007	MIS 2010	39.8%	41.4%	1.6%	1.04	12.5%	25.4%	13%	2.03
Liberia	DHS 2007	MIS 2011	31.0%	40.2%	9.2%	1.30	12.4%	49.6%	37%	4.00
Madagascar	DHS 2008	MIS 2011	46.2%	71.5%	25.3%	1.55	6.4%	19.5%	13%	3.05
Malawi	DHS 2004	DHS/MIS 2010	14.7%	49.4%	34.7%	3.36	42.9%	60.1%	17%	1.40
Mozambique	MIS2007	DHS 2011	7.3%	19.5%	12.2%	2.67	18.9%	18.6%	0%	0.98
Nigeria	DHS 2008	MIS 2010	4.8%	33.6%	28.8%	7.00	4.9%	13.2%	8%	2.69
Senegal	DHS 2005	DHS2010	8.5%	36.0%	27.5%	4.24	9.2%	38.6%	29%	4.20
Sierra Leone	DHS 2008	MICS 2010	27.2%	27.6%	0.4%	1.01	10.3%	41.4%	31%	4.02
Tanzania	DHS 2005	DHS 2010	15.6%	56.9%	41.3%	3.65	21.7%	26.3%	5%	1.21
Uganda	DHS 2006	DHS 2011	10%	46.9%	36.9%	4.69	16.2%	24.5%	8%	1.51
Zambia	MIS 2006	MIS 2010	24.5%	45.9%	21.4%	1.87	56.5%	69.4%	13%	1.23
Zimbabwe	DHS 2005	DHS 2010	3.2%	9.6%	6.4%	3.00	6.3%	7.3%	1%	1.16

Country	ANC 1	ANC 2	ANC % Change in coverage	Sample Size 1	Sample Size 2	(Millions) Disbursement 1	Disbursement 2
Angola	79.8%	80%	0%	2,973	8,589	17.4	30.3
Burkina Faso	85.0%	94.9%	10%	7,316	17,087	0.1	51.3
DR Congo	85.3%	87.0%	2%	9,995	12,851	12.28	70.24
Kenya	86.5%	85.8%	-1%	6,111	5,749	18.57	71.81
Liberia	79.3%	95.3%	16%	7,092	3,975	0.46	21.08
Madagascar	86.3%	86.3%	0%	17,375	8,169	26.74	86.34
Malawi	93%	94.7%	2%	11,698	2,891	0	29.4
Mozambique	87.9%	90.6%	3%	5,612	13,745	21.49	47.27
Nigeria	57.7%	57.5%	0%	15,486	6,344	48.15	59.29
Senegal	87.4%	93.3%	6%	6,655	15,688	11.29	17.5
Sierra Leone	86.9%	93.0%	6%	7,374	13,359	6.05	8.51
Tanzania	94.3%	95.9%	2%	10,329	10,139	22.25	95.95
Uganda	93.5%	94.9%	1%	8,531	8,674	27.75	54.85
Zambia	93.7%	94%	0%	7,242	4,009	6.35	20.48
Zimbabwe	94.2%	89.9%	-4%	8,907	9,171	3.86	20.19

Appendix B

ITN **Country**	Absolute increase	Absolute Increase POOR %	Absolute Increase WEALTHY%	PWCR Survey 1	PWCR Survey 2	**PWCR S2 /S1**	Increased Equity for Poorest	Absolute Increase RURAL%	Absolute Increase URBAN%	RUCR Survey 1	RUCR Survey 2	**RUCR S2 /S1**	Increased Equity for Rural
Angola	3.6%	-9.1	14.1	1.6	0.4	**0.3**	no	-1.9	13.3	1.78	0.87	**0.5**	no
Burkina Faso	21.20%	35.6	-8.2	0.2	1.0	**6.2**	yes	30.9	-6.7	0.33	1.20	**3.6**	yes
DR Congo	35.6%	32.6	38.5	0.3	0.7	**2.9**	yes	36.4	33.4	0.58	0.98	**1.7**	yes
Kenya	1.6%	10.9	5.5	1.0	1.1	**1.1**	yes	2.8	-4.8	0.93	1.13	**1.2**	yes
Liberia	9.2%	N/A	N/A	N/A	N/A	**N/A**	n/a	8.9	8	0.96	0.99	**1.0**	yes
Madagascar	25.3%	35.5	3.7	1.1	1.7	**1.6**	yes	25.8	23	0.90	0.97	**1.1**	yes
Malawi	34.7%	48.4	9.3	0.2	1.3	**7.1**	yes	37.9	11.8	0.42	1.21	**2.9**	yes
Mozambique	12.2%	N/A	N/A	0.6	N/A	**N/A**	n/a	9	21	0.91	0.56	**0.6**	no
Nigeria	28.8%	33.9	12	0.5	2.1	**4.6**	yes	33.7	11.5	1.07	2.40	**2.3**	yes
Senegal	27.5%	38	8.5	0.4	2.5	**6.6**	yes	30.6	22.3	0.79	1.19	**1.5**	yes
Sierra Leone	0.4%	2.5	11.3	1.1	0.8	**0.7**	no	16.9	33.1	1.34	0.84	**0.6**	no
Tanzania	41.3%	52.1	3.8	0.1	1.1	**14.7**	yes	49.3	7.6	0.25	1.27	**5.0**	yes
Uganda	36.9%	40.4	29.3	0.4	1.0	**2.5**	yes	37	32.5	0.38	0.82	**2.2**	yes
Zambia	21.4%	31.3	2.2	0.6	1.5	**2.5**	yes	26.7	11.8	1.47	1.78	**1.2**	yes
Zimbabwe	6.4%	11.5	3.9	0.1	1.0	**11.7**	yes	7.9	2.5	0.36	1.17	**3.2**	yes

N/A= No data available

PWCR= Poor/Wealthy Coverage Ratio

RUCR = Rural/Urban Coverage Ratio

IPTp Country	Absolute increase %	Absolute Increase POOR %	Absolute Increase WEALTHY%	PWCR Survey 1	PWCR Survey 2	**PWCR S2 /S1**	Increased Equity for Poorest	Absolute Increase RURAL%	Absolute Increase URBAN%	RUCR Survey 1	RUCR Survey 2	**RUCR S2 /S1**	Increased Equity for Rural
Angola	15.0%	7.8	18.8	0.0	0.3	**0.0**	no	9.8	26	0.4	0.4	**1.0**	no
Burkina Faso	9.3%	6.9	18.3	0.8	0.4	**0.5**	no	7.4	19.2	0.4	0.4	**0.9**	no
DR Congo	15.9%	17.9	10.6	0.4	1.1	**3.0**	yes	16.8	13.5	0.6	1.1	**1.6**	yes
Kenya	12.9%	10.9	13.6	0.5	0.7	**1.2**	yes	11.8	16.5	1.0	0.9	**0.8**	no
Liberia	37.2%	44.4	23.8	0.5	1.2	**2.5**	yes	43.7	27	0.6	1.2	**2.1**	yes
Madagascar	13.1%	12.9	15.5	0.9	0.8	**1.0**	no	12.6	20.6	1.0	0.7	**0.7**	no
Malawi	17.2%	15.2	9.7	0.7	0.9	**1.2**	yes	18.6	8.1	0.8	1.0	**1.2**	yes
Mozambique	-0.3%	N/A	N/A	0.5	N/A	**N/A**	n/a	-0.3	-2.8	0.56	0.61	**1.1**	yes
Nigeria	8.3%	3	15.2	0.1	0.2	**1.2**	yes	7.8	10.8	0.5	0.6	**1.3**	yes
Senegal	29.4%	19.9	36.2	0.5	0.5	**1.1**	yes	26.4	34.6	0.7	0.8	**1.0**	yes
Sierra Leone	31.1%	25.7	41.2	0.8	0.7	**0.8**	no	29.4	35.2	0.8	0.8	**1.0**	no
Tanzania	4.6%	6.3	2	0.6	0.8	**1.3**	yes	5.2	2	0.7	0.8	**1.2**	yes
Uganda	8.3%	11.4	8.9	0.7	0.8	**1.3**	yes	7.6	12.3	0.9	0.8	**0.8**	no
Zambia	12.9%	13.6	16.1	0.7	0.8	**1.0**	yes	12.7	14	0.8	0.8	**1.0**	no
Zimbabwe	1.0%	2.1	4.5	4.8	1.5	**0.3**	no	0.6	2.2	2.3	1.5	**0.6**	no

N/A= No data available

PWCR= Poor/Wealthy Coverage Ratio

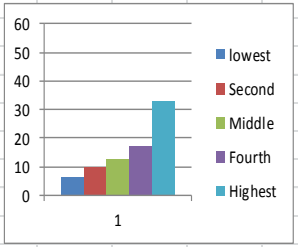
RUCR = Rural/Urban Coverage Ratio

Appendix C

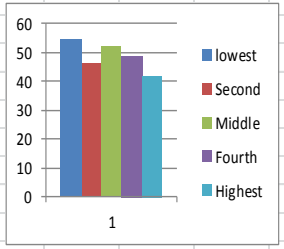
Sample Worksheet

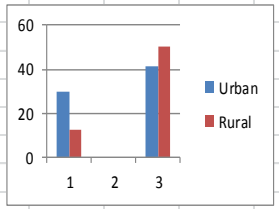
Malawi

ITN	DHS 2004		
Wealth Quintile			
lowest	6	Urban	29.8
Second	9.6	Rural	12.4
Middle	12.6		
Fourth	17		
Highest	32.6		
	14.7%		

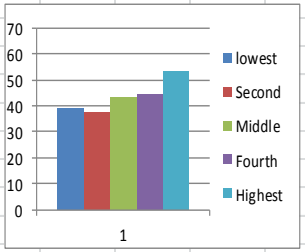


ITN	DHS 2010		
Wealth Quintile			
lowest	54.4	Urban	41.6
Second	46.4	Rural	50.3
Middle	52.2		
Fourth	48.5		
Highest	41.9		
	49.4%		
Poor	48.4		
Rich	9.3		

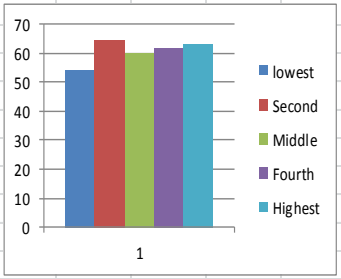


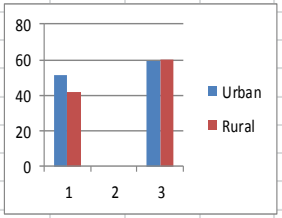


IPTp	2004		
Wealth Quintile			
lowest	39	Urban	51.1
Second	37.6	Rural	41.7
Middle	43.7		
Fourth	44.4		
Highest	53.5		
	42.9		



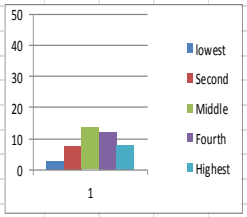
IPTp	2010		
Wealth Quintile			
lowest	54.2	Urban	59.2
Second	64.5	Rural	60.3
Middle	60.3		
Fourth	61.7		
Highest	63.2		
	60.1		
Poor	15.2		
Rich	9.7		



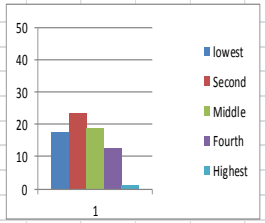


Senegal

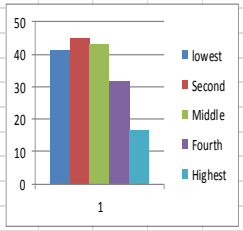
ITN	2005 DHS		
Wealth Quintile			
lowest	3	Urban	9.9
Second	7.7	Rural	7.8
Middle	13.6		
Fourth	12.1		
Highest	7.9		
	8.5		

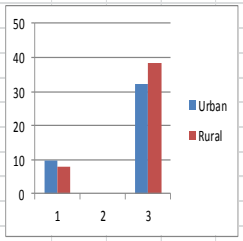


ITN	2006 MIS		
Wealth Quintile			
lowest	17.5	Urban	11.6
Second	23.5	Rural	19.6
Middle	18.9		
Fourth	12.7		
Highest	1.2		
	17.2		

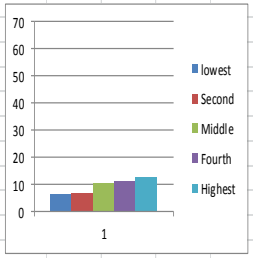


ITN	2010 DHS		
Wealth Quintile			
lowest	41	Urban	32.2
Second	45	Rural	38.4
Middle	42.9		
Fourth	31.5		
Highest	16.4		
	36		
	Poor	38	
	Rich	8.5	

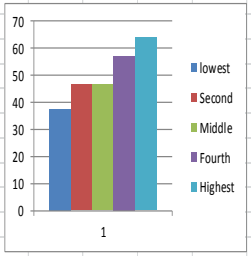




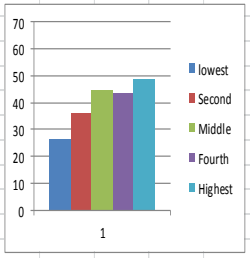
IPTp	2005		
Wealth Quintile			
lowest	6.3	Urban	11.1
Second	6.8	Rural	8
Middle	10.2		
Fourth	11		
Highest	12.4		
	9.2		

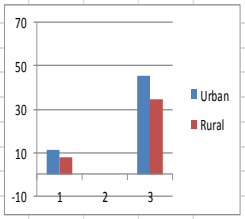


IPTp	2006		
Wealth Quintile			
lowest	37.5	Urban	54.9
Second	46.5	Rural	46.2
Middle	46.6		
Fourth	57.1		
Highest	64		
	49.3		



IPTp	2010		
Wealth Quintile			
lowest	26.2	Urban	45.7
Second	35.8	Rural	34.4
Middle	44.6		
Fourth	43.3		
Highest	48.6		
	38.6		
poor	19.9		
Rich	36.2		





Appendix D: Country Notes

Angola was the only country examined with a greater urban (59%) population than rural (41%)[27]. Thus, looking solely at urban to rural comparisons may not be an accurate comparison. However, a shift from greater rural coverage to greater urban coverage as was seen may actually indicate a more equitable distribution. (An analysis of urban transmission rates would be needed.) The switch is also observed in a change from greater coverage in the wealthiest populations for both ITN and IPTp coverage. This may not indicate a more equitable distribution trend for the poorest populations but since urban dwellers tend to be ranked higher in wealth quintiles due to the way wealth quintiles are measured it may indicate a greater distribution to the most vulnerable population. However, while IPTp use increased by 15% (non-equitable increase) ITN coverage for the poorest segments fell by 9% (wealthy increase by 14%). Angola was the only country to have a decrease in coverage for the poor.

Angola's health infrastructure was severely damaged in the war which ended in 2002. It was one of the first 3 countries in the PMI[28]. Scale up may be limited by facility availability.

Burkina Faso The ITN indicator in S1 (Burkina Faso MICS: 2006) is household ownership of net and not use by pregnant women. The second survey provided percentage of pregnant women that slept under an ITN the night preceding the survey. ITN use by pregnant women in 2010 was evenly distributed across wealth quintiles a result of much higher proportional increases for lowest wealth quintiles and a greater distribution in rural areas. Because the data for IPTp was complete the country was not excluded.

For the IPTp indicator, while increase of coverage for all groups was seen, there was a substantial increase for the wealthiest and urban populations.

Democratic Republic Congo Looking strictly at the ratios it is difficult to grasp the improvement made in the most vulnerable populations of the DR Congo. Although ITN distribution to the poorest quintile did not surpass that of the highest; that of the 2nd quintile came very close (46% coverage to 48% of Q5). Of the countries studied, DRC had the second highest absolute increase in ITN coverage which was

[27] World Bank: Density and Urbanization, Angola
[28] PMI. Angola: Malaria Operational Plan FY 2012

evenly distributed with a closing of the gap between rural/urban rich/poor. Notable is that there are only 3 years between surveys. DRC contributes to a large percentage of global malaria deaths (with Nigeria they compose 40% of deaths attributed to malaria), has the 2nd largest population in Africa, and of the sampled countries DRC has the lowest GNI. Conflict ended there in 2003 but conflict in neighboring countries has spilled over into DRC.

For IPTp, priority in scale up of coverage was given to both rural and poorest populations. There is a fee for the ANC package.

Program and service delivery barriers include: poor donor coordination as an obstacle to implementing effective ITN program, lack of efficient distribution (size, infrastructure failings) and record keeping. There are frequent stock outs of SP. [29]

Kenya Started at a high coverage level (40%) but did not demonstrate a notable increase of coverage in ITN from 2007 to 2010. However, although growth was small they did re-prioritize distribution and improve equity with coverage increases to both the poorest and rural groups.

IPTp: While there is increased absolute coverage observed, the gap between rural and urban coverage also increased. The middle quintile obtained an almost 3 fold increase in IPTp coverage. There is a low public demand for IPTp per PMI reports.

Kenya has varied transmission within country and by season. There has been a decline in the overall malaria burden but malaria incidence remains 3 times greater in rural areas.[30]

Liberia ITN1 survey reports only pregnant women who slept under "any net", thus category "any net" versus "ITN" was used to provide consistency between surveys. (Difference between any net and ITN is 1.2 percent.)

The data is incomplete for IPTp as well. First survey records only took "any SP/Fansidar". Second survey notes 2+ doses at ANC. Liberia had the greatest absolute increase (37%) in IPTp coverage (50%). S2 showed that IPTp coverage was greater than ITN coverage (40%).

Looking at "any SP/Fansidar" in 2011 there is an increase of 50.8% in use. Urban and rural coverage are equal. If we use the 49.6% figure (2+ visits at ANC) we see a

[29] PMI Malaria Operational Plan 2013
[30] Ibid.

higher rural vs. urban usage. Liberia has an evenly disbursed rural and urban population.

Conflict ended in 2003. Poor supply chain, stocks outs, late presentation to ANC were all barriers to scale up.[31]

Madagascar At 46% (2009) and 71% (2011) ITN use by pregnant women, was highest in Madagascar. Coverage is only slightly greater for urban communities with a slight lessening in the gap over the 2 year period. There was a notable priority of scale up ITN coverage for the lowest quintile and rural populations.

Coverage of IPTp was evenly distributed in the first survey and this pattern continued more or less in the second, the end result being a 13% absolute increase but failure to increase coverage to poor populations and worsening gap between rural and urban in 2011. Madagascar had the shortest time period (2 years) between surveys.

Malawi This was the only country in the sample with a higher IPTp coverage percentage than ITN. (Liberia also had this finding but the indicator available for bed net was "any net" and not ITN). IPTp coverage increased by 15.2% for the poor versus a 9.7% increase for wealthiest quintile, placing it second only to Zambia in IPTp coverage (60%). Notes on 2010 MIS and DHS: The DHS survey was conducted in the dry season, and the MIS in the rainy. MIS report 54% of pregnant women sleeping under ITN compared with DHS survey reporting 43%. At six years this was the greatest survey gap in the study.

Mozambique Decrease of RUCR from .91(ITN1) to .56 (ITN2) indicates priority of distribution changed for the worse while absolute coverage increased. In 2007 Urban coverage was 2X greater. Wealth quintile information not available for S1

Example of mixing data reports: The PMI MOP FY12 used the 2009 AIDS indicator survey versus theDHS2011. Thus, for IPTp 2 (1 at ANC) the Mozambique PMI MOP12 looked at 2+doses and found increase in coverage. This study looked at "at least one dose at ANC visit" and found a negative absolute increase.

Nigeria As one of two countries that account for 40% of malaria deaths globally any improvement in coverage is bound to have a substantial impact. There was 29% absolute increase in ITN coverage, and an 8% IPTp increase. While the poor and

[31] Ibid.

rural benefited in ITN coverage, neither group did so in IPTp coverage. Nigeria is Africa's most populous country.

Senegal Received the greatest 2 year funding average but did not improve IPTp coverage. Re-prioritization was made in ITN coverage but not found in IPTp (29.4% absolute increase). Delivery of IPTp is targeted to the wealthier and urban populations (IPTp2 the poorest had 19.9% and wealthiest quintile having 36.2% coverage), with the same gap observed in S1 and S2.

Sierra Leone In IPTp2 Sierra Leone made great strides in their overall or absolute coverage of both urban and rural (35% each) coverage. While the URCR is still less than one. This is especially interesting when the level of funding is factored in. Sierra Leone received the lowest 2 year funding average (1.62 mil).

Tanzania From 2005 to 2010 Tanzania had the highest absolute increase in ITN (41.3%) coverage. It was also the recipient of the second highest funding disbursement.

The DHS surveys in the sample include data from Zanzibar which has a different burden from mainland Tanzania.

Uganda Has the greatest gap between urban (15%) and rural (85%) populations followed closely by Malawi. Urban rates of coverage continues through both S1 and S2 to outpace rural growth in coverage but ITN was equal across all wealth quintiles and only slightly greater for the wealthiest in IPTp2 (poorest= 26.2% Q5 = 31.3).

Zambia Presents a question of priorities. Rural coverage of ITN was consistently higher than urban coverage. The gap between the lowest and highest quintiles and rural and urban coverage remained almost the same. At 70% coverage, Zambia has the highest IPTp coverage in the study but there was no change in urban to rural distribution of IPTp and no change or slightly worsening gap between richest and poorest in IPTp service delivery. As mentioned above Zambia's surveys ask about IPTp use in the last 5 years versus the last 2.

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