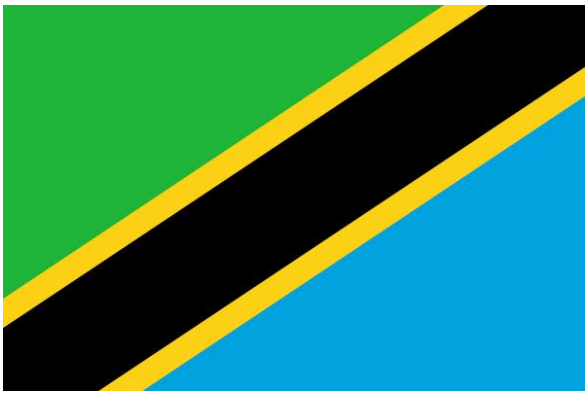
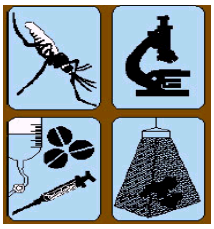


Summary of Five Household Surveys to Monitor Population-level Coverage and Impact of Malaria Interventions in Tanzania, 2007–08



National Malaria Control Programme

2009

Summary of Five Household Surveys to Monitor Population-level Coverage and Impact of Malaria Interventions in Tanzania, 2007–08

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Forward

This report summarizes the main findings of five independent household surveys of malaria interventions conducted on the Tanzania Mainland between October 2007 and September 2008. In November of 2008 the National Malaria Control Programme (NMCP) and the U.S. President's Malaria Initiative (PMI) convened a 2-day meeting in Dar es Salaam to facilitate presentation of the methods and results of all five surveys.

Household surveys are especially relevant in malaria endemic settings for measuring coverage of interventions that primarily target the household level, such as insecticide-treated nets (ITNs), and for understanding patterns of antimalarial use among target populations. Each survey served a specific role at the time it was planned and implemented in 2007-08. Nevertheless, in the spirit of Roll Back Malaria's efforts to improve harmonization of large household surveys, NMCP and PMI brought together investigators of the five surveys to discuss the findings in an open forum.

The results in this summary document provide population-level coverage and impact data immediately preceding the national campaign to distribute free long lasting insecticidal bednets (LLINs) for all children under five years of age (officially launched in May 2009) and another campaign for free distribution of LLINs to cover all remaining sleeping spaces (estimated launch date early 2010).

This document is meant to serve as a single source document for the major findings from all five surveys. Specific details concerning methods (including sampling and questionnaire design) more extensive results will need to be pursued from the full reports of each individual survey.

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Executive Summary

Background

The Government of Tanzania's second National Malaria Medium Term Strategic Plan (NMMTSP) seeks to reduce the burden of malaria by 80% between 2007 and 2013 from 2007[1]. To accomplish this goal, it lays out core impact and outcome indicators and a number of numerical targets, including the following:

- 80% of children under 5 years of age with fever receiving appropriate treatment within 24 hours of onset of fever by 2013
- 80% IPTp2 uptake for pregnant women by 2013
- 80% of currently pregnant women sleeping under ITNs by 2013
- 80% of children under five sleeping under ITNs by 2013
- 80% of households owning at least one ITN by 2013

Measurement of the impact and outcome indicators is dependent on conducting periodic representative household/population surveys. Between October 2007 and September 2008, five large-scale household malaria surveys were implemented on Mainland Tanzania, including the **Tanzania HIV/AIDS and Malaria Survey** (THMIS); the **National Institute for Medical Research** (NIMR) survey; the **Population Services International** (PSI) survey; the **National Malaria Control Program** (NMCP); and the **Tanzania National Bednet Strategy** survey (NATNETS).

Survey findings were presented at a dissemination workshop sponsored by the National Malaria Control Program in Dar es Salaam on 26-27 November 2008. This report summarizes the findings, including updates and further analyses conducted after the dissemination workshop and presents programmatic and analytic recommendations for program implementers and researchers.

Findings

Ownership of insecticide-treated nets (ITN). There was considerable variation among the surveys in the proportion of households that owned at least one ITN, ranging from 29% to 57%, with a median of 45%. Household ownership of at least one ITN will have to approximately double to reach the 2013 targets and increase even more to reach the target of 80% ownership of at least two ITNs.

Use of bednets by young children and pregnant women. The proportion of children under five years of age reported to have slept under an ITN did not vary significantly across four of the five surveys, with a median of approximately 40%. Three surveys measured bednet use by pregnant women: median use of ITNs by pregnant women was 30%. Both groups will have to double ITN use to reach the 80% target for 2013. Of special note for the program is that while both net ownership and net use by priority groups has increased overall, the proportion of use within households that own an ITN actually declined between 2004 and 2007 among both under fives (from 69 to 55%) and pregnant women (from 71 to 59%). In addition, further analysis of the 2007-08 THMIS household data set revealed that more than a quarter (27%) of the ITNs found in the survey were reported not to have been used the night before.

Executive Summary

Use of Intermittent Preventive Treatment in pregnancy. Two surveys asked about preventive malaria treatment during pregnancy and reported the percentages of births for which the mother took at least one dose of sulfadoxine-pyrimethamine (SP) (IPTp-1) to prevent malaria and at least two doses (IPTp-2). Similar results were found in both surveys: approximately half of the women reported having received at least one dose of SP, but less than a third reported having received at least two doses. Effective coverage of IPTp will have to triple to reach the national target of two doses by 2013.

Prompt and effective treatment. Two surveys measured treatment received by children under five years of age who had had a recent episode of fever. The national program calls for 80% of such children taking artemisinin-based combination therapy (ACT) within 24 hours of onset of fever. Fewer than one in seven children (13%) received prompt treatment with ACT, or approximately one-sixth of the national target for 2013. Children who were taken to a public health facility were more likely to receive ACT than children taken elsewhere for advice or treatment. Children taken to non-public health facilities were five times more likely to receive another antimalarial drug rather than ACT.

Parasitemia and anemia. Three surveys measured prevalence of parasitemia and anemia in children 6-59 months of age and all three surveys reported statistically different findings. Parasitemia prevalence ranged from 11% to 18% and anemia prevalence (HB < 8g/dL) ranged from 3% to 8%. There is no immediately obvious explanation for the different findings among the surveys.

Recommendations

Programmatic implications. The survey findings clearly show the need for increasing both supply of and demand for prevention and treatment goods and services. Not only must the national program continue with its plans to distribute more treated nets, but more effective behavior change is needed to convert ITN ownership to ITN use. More than one in four ITNs already distributed were reported not to have been used by anyone in the household, let alone young children or pregnant women. This has tremendous cost implications, especially as the program seeks to increase net ownership from one to two ITNs per household. IPTp uptake is constrained by a number of factors, including stock-outs of medications, late initiation of antenatal care (which limits the opportunity to receive two doses a month apart) and perhaps even reticence of service providers to strongly promote two doses of SP. While ACT therapy for fever in young children has been rolled out nation-wide, a quarter of the children taken to public health facilities for advice or treatment of fever received no antimalarial medication at all. Moreover, few children taken to non-public facilities received ACT therapy for fever and a quarter of children with fever were never taken to any facility. Cost and access may influence parents' ability to seek treatment for sick children or to purchase appropriate medications at private facilities.

Implications for research and monitoring and evaluation. The National Malaria Control Program Monitoring and Evaluation (M&E) Plan for 2008-2013 will harmonize indicators and integrate data from multiple sources. This should reduce the number of overlapping surveys and the potential for conflicting results. To facilitate more widespread use of the information collected in the five recent large-scale malaria surveys, cleaned original data sets and methodological details should be made

available to all malaria partners for further analysis. Further analyses should be conducted to go beyond the standard reporting indicators – for example, to explore the relationships among the outcome and impact indicators. The NATNETS survey reported negative associations between net use and malaria infection (children who slept under an ITN were 40% less likely to have malaria parasites than children who did not sleep under an ITN). Other further analyses, such as comparing parasitemia with recent fever, especially untreated fever, could yield an indication of the proportion of malaria infections that are symptomatic as well as the proportion of childhood fever due to causes other than malaria. Demonstrating the efficacy of prevention and treatment should inform advocacy to encourage service providers to promote uptake of those interventions and demand creation among parents and families.

Background

Half of the world's population is estimated to be at risk of malaria, with nearly a million deaths from malaria in 2006 alone. Forty-five of the 109 countries endemic for malaria are in Africa[2].

In Tanzania, *P. falciparum* malaria, which is spread by the Anopheles mosquito, is the leading cause of death among children under the age of five years[3]. Malaria transmission fluctuates with the weather and peaks in Tanzania during and immediately following the two rainy seasons from October through January and from March through May[4].

Young children are especially susceptible to malaria as they have not yet acquired immunity to the parasite[5]. Pregnant women are also particularly vulnerable because their immunity to the parasite is suppressed during pregnancy and the parasite often infects the placenta – leading to maternal anemia, stillbirth, spontaneous abortion, and low birth weight [6].

Malaria control efforts in Tanzania focus on four WHO recommended strategies -- preventive measure (insecticide treated bednets; intermittent preventive treatment in pregnancy, and indoor residual spraying) and curative care (prompt and effective treatment of children with malaria symptoms). The National Malaria Control Program (NMCP) tracks a number of indicators to monitor and evaluate program efforts, including uptake of program intervention as well as impact indicators such as parasitemia (presence of malaria parasites in the blood) and anemia.

Between October 2007 and September 2008, five large-scale household malaria surveys were implemented on Mainland Tanzania. This report summarizes their findings around four groups of malaria control indicators, including three outcome (coverage) indicators and two core impact indicators.

Outcome indicators:

Bednets

Used correctly, bednets offer protection from mosquito bites and thereby reduce the transmission of malaria. While all bednets can offer some degree of protection for the people sleeping under them, insecticide-treated nets (ITN) are especially effective. ITNs provide dual protection by acting as a physical barrier to block mosquito bites and as a chemical barrier to either repel or kill mosquitoes that land on the net. Studies have shown that full coverage with ITNs can reduce all-cause child mortality by 18% (range 14-29%) and reduce episodes of malaria illness by 50% (range 39-62%)[7]. ITNs also help reduce maternal morbidity and low birth weight deliveries[8].

Background

Intermittent Preventive Treatment in Pregnancy

Treating all pregnant women, whether or not they have symptoms of malaria with intermittent preventive treatment in pregnancy (IPTp) reduces anemia in the woman herself and the risk of a low birth-weight delivery. The regimen for IPTp currently recommended by the World Health Organization (WHO) is at least two doses of sulfadoxine-pyrimethamine (SP) given to pregnant women after quickening (the first fetal movements felt by the mother) in the second and third trimesters during routine antenatal care visits[9]. However, as resistance to SP is growing in much of sub-Saharan Africa, there is new, ongoing research into the efficacy of this drug for IPTp and the safety of other more effective medications for use in pregnancy.

Prompt and Effective Treatment

To reduce morbidity and mortality from malaria, young children should be treated as soon as symptoms (usually fever) appear. Moreover, it is important that they receive the correct medication. In much of sub-Saharan Africa, the malaria parasite has developed resistance to older medications such as chloroquine, amodiaquine and sulfadoxine-pyrimethamine. Consequently, Tanzania has changed its treatment guidelines to prescribe artemisinin-based combination therapies (ACTs)[10].

Impact indicators:

Parasitemia and Anemia

The desired impacts of malaria control interventions are fewer new infections and reduced severity of the malaria cases that do occur. Both are assessed through blood tests. Parasitemia (presence of malaria parasites in the blood) indicates active malaria. Anemia can have multiple causes, among them acute episodes or repeated bouts of malaria. For malaria monitoring and evaluation purposes, anemia is defined as a hemoglobin measurement of less than 8g/dL[11]. Measuring the change in prevalence of parasitemia and anemia over time provides important information on impact of program interventions on malaria transmission[12].

Methodology

Between October 2007 and September 2008, five large-scale household surveys were implemented in Tanzania to measure outcome and impact indicators related to malaria control interventions. The surveys differed in their specific objectives and indicators collected, timing relative to peak malaria transmission seasons, sampling methods (see Table 1). The surveys, listed according to chronological order of implementation, include:

- The **Tanzania HIV/AIDS and Malaria Survey** (THMIS)[13] was designed to measure behavior related to HIV/AIDS and malaria as well as malaria parasitemia and anemia among children age 6-59 months[14]. It utilized two-stage sampling from the 2004-2005 Tanzania Demographic and Health Survey sampling frame. Data were collected from October 2007 to February 2008, using a paper questionnaire in Kiswahili from 8,497 households containing approximately 43,900 men, women and children[15]. Data collectors received 17 days of training.

- The **National Institute for Medical Research** (NIMR) survey[16] was designed to determine baseline coverage and use of ITNs prior to a planned universal scale-up and to measure knowledge, attitudes and practices regarding malaria prevention and control. It used two-stage sampling without replacement and a sampling frame of households. Twenty-one districts, one representing each mainland region, were randomly selected for the survey. One rural and one urban ward were selected in each district. Households were selected using a list of random numbers. Data were collected from February-March 2008, using a Kiswahili paper questionnaire. The head of household or any adult representing the head of household was interviewed in 9,320 households containing approximately 46,600 men, women and children. Data collectors attended three days of training.

- The **Population Services International** (PSI) survey[17] was designed to monitor and evaluate a social marketing program focusing on young children. It used two-stage sampling with replacement and a sampling frame of enumeration areas (EAs) in areas covered by the program. Sampling was restricted to households with at least one child under five. In each EA, the first household was selected randomly and the remainder were selected systematically. Data were collected from March-May 2008, using PDAs with a Kiswahili questionnaire. The sample included 1,821 principal caregivers of children under five; the sampled households contained approximately 9,200 men, women and children. Data collectors received two weeks of training.

- The **National Malaria Control Program** (NMCP) survey was designed to monitor the National Malaria Medium-Term Strategic Plan. It was the most recent round of biennial surveys conducted under the Roll Back Malaria initiative and going back to 2001. Twenty-one malaria epidemic prone districts were purposively selected to be representative of the 21 regions and the eco-epidemiological strata of malaria in mainland Tanzania. Four health facilities were selected from each district (1 hospital, 1 health center, 2 dispensaries). Two communities were selected for each facility and 50 households interviewed in each community. Questionnaires were based on the Malaria Indicator Survey. Data were collected in June 2008, using a paper questionnaire in Kiswahili from 8,400 households containing approximately 42,000 men, women and children. Data collectors were trained for five days.

- The **Tanzania National Bednet Strategy survey** (NATNETS)[18], implemented by the Ifakara Health Institute and London School of Hygiene and Tropical Medicine (IHI/LSHTM) was designed to measure ITN ownership and use by children at the district and national levels, and use of ITNs by pregnant women, prevalence of anemia and malaria and knowledge and use of different voucher schemes to

Methodology

purchase ITNs at the national level. It used two-stage cluster random sampling using the 2008 President's Office Regional Administration and Local Government list of Districts, Wards, and Vitongoji for mainland Tanzania[19]. Data were collected from July-September 2008, using a PDA with a Kiswahili questionnaire from 7,200 households containing approximately 36,000 men, women and children. In addition to the household interviews, health facilities and women attending antenatal clinics were also surveyed. Data collectors attended 14 days of training.

Table 1. Survey Designs 2007-2008

Survey	Indicators	Sample	Timing
Tanzania HIV/AIDS and Malaria Survey (THMIS)	▪ Bednets ▪ IPTp ▪ Prompt treatment ▪ Parasitemia (RDT) ▪ Anemia	Mainland and Zanzibar, all households	Oct. 2007-Feb. 2008 (During, immediately after peak transmission season)
National Institute for Medical Research (NIMR)	▪ Bednets	Mainland, all households	Feb.-March 2008 (Preceding to beginning of peak transmission season)
Population Services International (PSI)	▪ Bednets	Social marketing program area, only households with child(ren) < 5	March-May 2008 (During peak transmission season)
National Malaria Control Program (NMCP)	▪ Bednets ▪ Prompt treatment ▪ Parasitemia (RDT) ▪ Anemia	Mainland sentinel districts, all households	June 2008 (Immediately following peak transmission season)
Tanzania National Bednet Strategy (NATNETS)	▪ Bednets ▪ IPTp ▪ Parasitemia (RDT) ▪ Anemia	Mainland, all households	July-Sept. 2008 (Outside peak transmission season)

Sample sizes for the various indicators are presented in Appendix 1.

Findings: Bednets

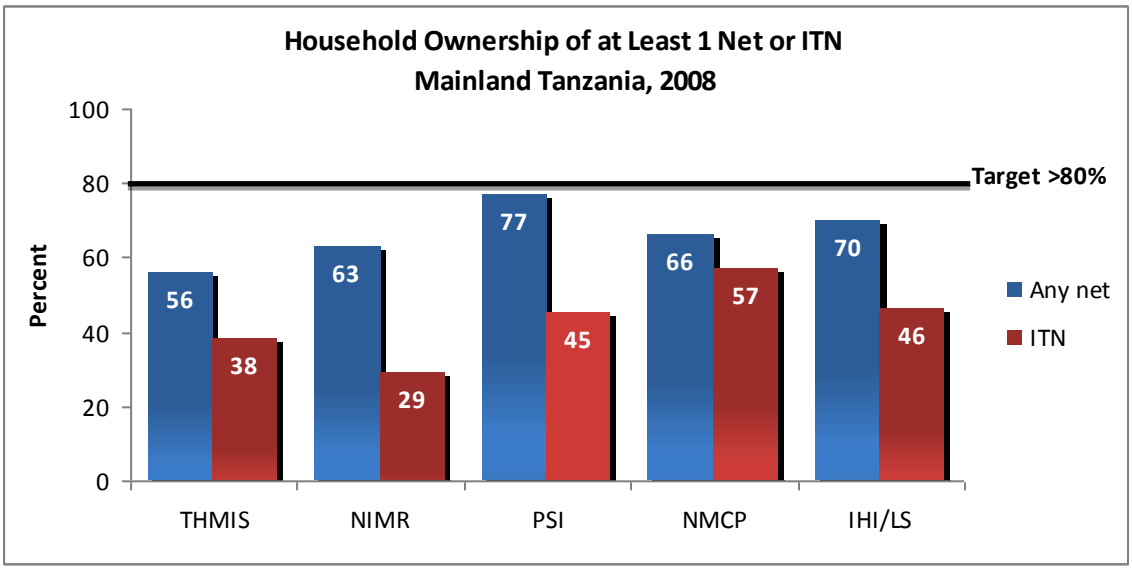
Core indicators for ITNs recommended by the Roll Back Malaria (RBM) Partnership include proportion of households with at least one ITN; proportion of children under five years old who slept under an ITN the previous night; and proportion of pregnant women who slept under an ITN the previous night[20]. The Tanzania NMCP has set targets of 80 percent coverage for each of these indicators as part of the current (2008-2013) mid-term plan. While all bednets sold in Tanzania since 2002 (apart from a small number of illegal imports) are bundled with a treatment kit or are factory pre-treated, a sizeable proportion of these (approximately 45%[21]) are not regularly re-treated. While not as effective as ITNs, these bednets still offer/provide some protection to individuals who sleep under them. All surveys conducted in

Findings: Bednets

Tanzania between October 2007 and September 2008 collected corresponding information regarding ownership and use of any bednet as well as ownership and use of ITNs.

Ownership of nets. All five surveys found substantially lower household ownership of ITNs than the NMCP target of 80 percent set for 2013. Estimates of household ownership of at least one ITN (Figure 1; see Appendix 1 for sample sizes) ranged from a low of 29 percent of all households in the NIMR survey to a high of 57 percent in the NMCP survey. Household reporting ownership of any net also varied between surveys from 56 percent in the THMIS to 77 percent in the PSI survey. Note that for comparability with the other four surveys, the findings from THMIS throughout this report pertain to Mainland Tanzania and do not include Zanzibar.

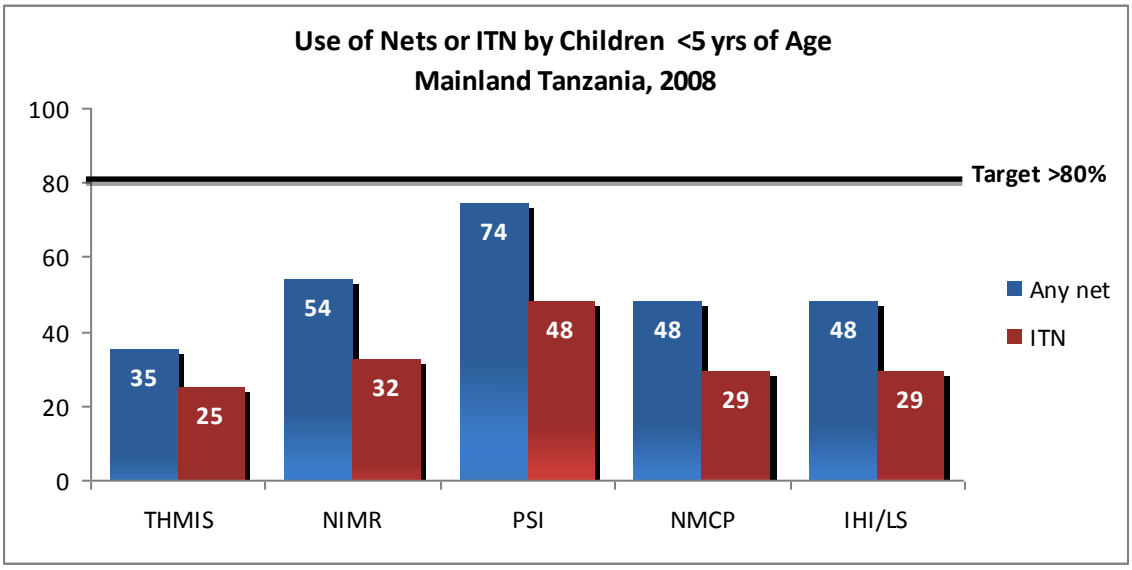
Figure 1



Use of Bednets by young children. The proportion of children under five years of age reported to have slept under an ITN (Figure 2; see Appendix 1 for sample sizes) did not vary significantly across the THMIS, NIMR, NMCP and NATNETS surveys, despite the difference in timing (the THMIS and NIMR were conducted during peak transmission season, the NMCP and NATNETS during the dry season). These four surveys report levels of net use of between 35 and 54 percent for any type of net and between 25 and 32 percent for ITNs. The PSI survey reported a comparatively high percentage of children using any net (74 percent) or an ITN (48 percent). Note that all surveys found that ITN use by young children was significantly less than the 2013 target level of 80 percent.

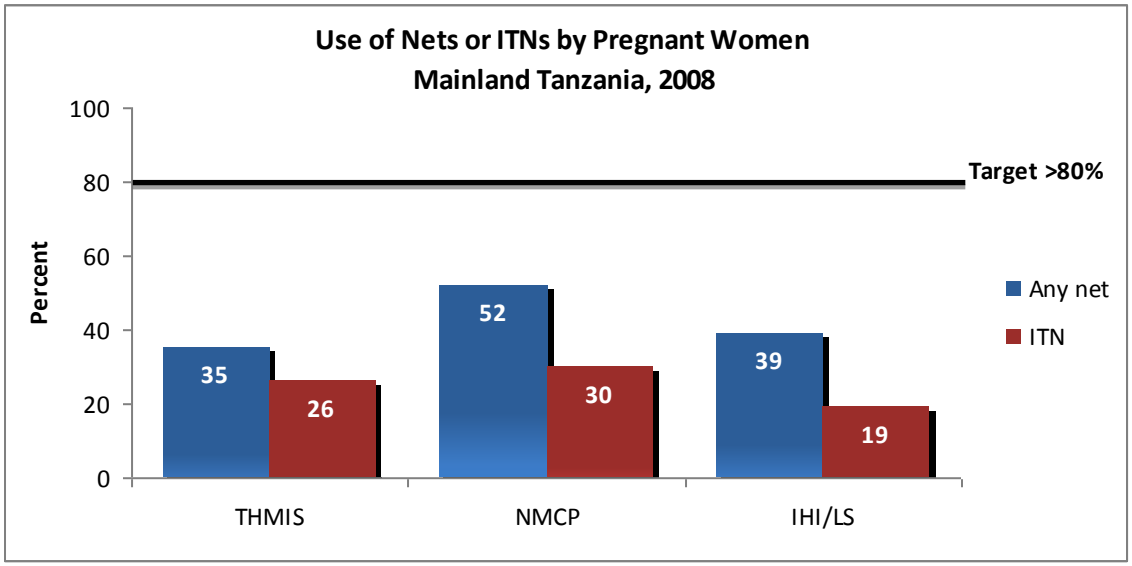
Findings: Bednets

Figure 2



Use of Bednets by pregnant women. Three surveys collected data on use of ITNs by pregnant women (Figure 3; see Appendix 1 for sample sizes). The NMCP survey, conducted immediately following the peak transmission season, showed higher use of ITNs (30 percent) and any net (52 percent) by pregnant women than the other surveys. The NATNETS survey, conducted during the dry season, showed lower ITN use and greater use of any net by pregnant women than the THMIS survey, implemented during peak transmission season; however, the THMIS estimate of ITN use is within the statistical confidence interval of the NATNETS estimate. Note that all estimates of ITN use among pregnant women are less than half of the NMCP target of 80 percent.

Figure 3



Findings: Bednets

Discussion

Seasonal, geographic, programmatic and chronological factors may account for some of the variability in estimates of net use found among the five large-scale surveys conducted between October 2007 and September 2008. The RBM guidelines recommend that surveys collect information on net use during the rainy season as household members are more likely to use bednets when transmission is perceived to be at its highest. Three surveys were conducted during the rainy season, one immediately following the end and one well after the rainy season had finished. Net use may vary geographically because of climatic differences in presence of malaria as well as programmatic factors such as access to affordable bednets. While there was some overlap in districts sampled, no two surveys covered exactly the same districts and the NATNETS sample was comparatively less urban than the other surveys.

During the 12 months from the beginning of the first survey to the end of the last survey, malaria control programs were distributing nets and carrying out behavior-change communications efforts to increase net ownership and use[22]. This could certainly have affected both household ownership and use of nets. Moreover, the PSI survey included only households containing at least one child under five years of age and only areas where their programs operate. This could have contributed to the higher reports of bednet use among young children in that survey.

It is important to note that although there are differences in the household ownership and use of ITNs, a clear picture does emerge: coverage needs to increase in order to achieve the RBM targets by the end of 2012. Household ownership of ITNs falls short of 80 percent coverage in all surveys. While household ownership of any net is much closer to achieving this target, untreated nets do not provide the same level of protection as an ITN. More importantly, ITN use by both priority populations – children under five years of age and pregnant women – is far from 80 percent.

Recommendations for Further Analysis

It is clear that use of ITNs by young children and pregnant women is too low, as the national program acknowledged in its 2008 (Round 8) proposal to the Global Fund for universal coverage, scheduled for implementation in 2010. What is not clear from the standard indicators presented above is the reason for low usage – is it due to household not owning an ITN or is it due to target group not using the ITN even though one is available? This distinction is programmatically important – failure to own a net speaks to the need for both wider distribution as well as behavior-change communication to promote net acquisition. Failure to use a net that the household already owns demonstrates the need for behavior-change communication to promote net use. Even the household ownership indicator does not indicate the proportion of households with young children and/or pregnant women who own at least one ITN. Therefore, we strongly recommend further analysis of all four surveys to include the following additional indicators:

- Percentage of target households with children under five years of age and/or a pregnant woman that own at least one ITN
- Percentage of the target population (children under five, pregnant women) sleeping under an ITN the night preceding the survey among households which own at least one ITN

Findings: Bednets

Table 2 below compares the findings of the Tanzania 2004 DHS and the 2007-08 THMIS for the ITN ownership and use indicators under various definitions. Note that both ITN *ownership* indicators increased between 2004 (DHS) and 2007 (THMIS); the rate of increase was slightly higher when the indicator was restricted to only target households (with children under age five and/or a pregnant woman). Clearly, the malaria control program is making progress in distributing treated nets.

On the other hand, the ITN *usage* indicators do not present a consistent story. Use of ITNs by children under five and pregnant women among all households increased appreciably (from 16 to 26% for U5s and from 16 to 27% for pregnant women. However, when the analysis is restricted to households that owned an ITN, usage appears to have declined appreciably between 2004 and 2007 among both under fives (from 69 to 55%) and pregnant women (from 71 to 59%). This unexpected result clearly requires further analysis and explanation. Whereas the increase in overall net usage is attributable to wider ITN distribution, these figures may suggest that increasing numbers of households who have received nets are failing to use them.

Further analysis of the 2007-08 THMIS household data set revealed that more than a quarter (27%) of the ITNs found in the survey were reported not to have been used the night before by anyone in the household. NATNETS is analyzing their household surveys to determine who in the household uses nets and who uses the "best" nets in terms of condition of the net and its treatment status. These findings that pregnant women and young children whose households own a net may not consistently use them, call for additional research to guide the design of appropriate new program approaches, particularly with regard to behavior change.

Findings: Bednets

Table 2

Outcome Indicator	Definition	2004 DHS		2007-08 THMIS	
		%	N	%	N
Proportion of households with at least one ITN	Number of households that own at least one ITN/Number of households surveyed	23	9,735	39	8,497
Proportion of households with a pregnant woman or children under 5 with at least one ITN	Number of households with a pregnant woman or child < 5 that own at least one ITN/Number of households with a pregnant woman or child <5 surveyed	24	5,676	46	5,104
Proportion of children under five years old who slept under an ITN the previous night	Number of children under 5 years old who slept under an ITN the previous night/Total number of children under 5 years who slept in surveyed households the previous night	16	8,360	26	7,514
Proportion of children under five years old who slept under an ITN the previous night among households with at least one ITN	Number of children under 5 years old who slept under an ITN the previous night/Total number of children under 5 years who slept in surveyed households with at least one ITN the previous night	69	1,938	55	3,532
Proportion of pregnant women who slept under an ITN the previous night	Number of pregnant women who slept under an ITN the previous night/Total number of pregnant women who slept in surveyed households the previous night	16	1,082	27	846
Proportion of pregnant women who slept under an ITN the previous night among households with at least one ITN	Number of pregnant women who slept under an ITN the previous night/Total number of pregnant women who slept in surveyed households with at least one ITN the previous night	71	242	59	381

Findings: Intermittent Preventive Treatment

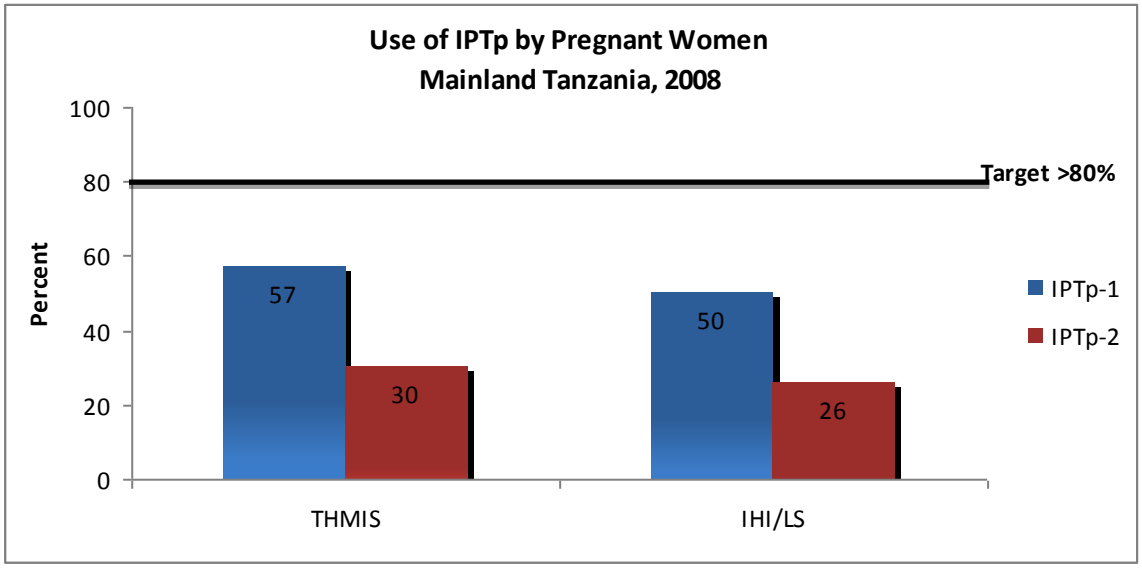
Two surveys – THMIS and NATNETS – asked about malaria treatment during pregnancy. THMIS asked women who had had a live birth in the last two years, about their last pregnancy. NATNETS asked about live births going back to 2003 but restricted analysis to women who had delivered in the last two years[23]. Two indicators were reported: THMIS considered a woman to have received IPTp-2 if she had received 2 or more doses of SP/Fansidar and at least one of those doses during an ANC visit. NATNETS considered a woman to have received IPTp-2 if she stated that the drug used was SP/Fansidar, regardless of source of the medication.

Use of Intermittent Preventive Treatment in pregnancy

Findings: Intermittent Preventive Treatment

Similar patterns of IPTp-1 and IPTp-2 were reported by the two surveys (Figure 4; sample sizes in Appendix 1): reported use of IPTp-1 was nearly twice that of IPTp-2 in both surveys. The THMIS found slightly higher use levels than the NATNETS survey. Compliance with the recommended regimen of two to three doses of SP (IPTp-2) is well below half the RBM target of 80 percent[13]; even IPTp-1 use fails to reach the RBM target.

Figure 4



Discussion

THMIS estimates of IPTp use are higher than the statistical confidence intervals around the NATNETS estimates (analyses not shown). It is important to note the differences in the survey samples. TMIS found that urban women were more likely to receive IPTp-2 than their rural counterparts (42 versus 28 percent). The NATNETS survey report does not disaggregate findings by residence; however, the NATNETS sample was less urban than the THMIS sample (9 versus 22 percent), which would tend to lower the overall IPTp estimate. This suggests that the lower IPTp coverage estimates in NATNETS may be due at least in part to differences in the urban-rural composition of the survey samples.

Recommendations for Further Analysis

Both THMIS and NATNETS agree on two key findings: first, that coverage of the first dose of SP is still well below the 80 percent target, and second that only half of the women who received a first dose went on to the second dose. Stock-outs of SP may be a major factor: NATNETS found that only 71 percent of RCH facilities had SP on hand at the time of the survey, higher than the 59 percent observed in 2007 but lower than levels reported in 2006 and 2005 (74 percent and 85 percent, respectively). Further analysis of the NATNETS facility data could assess the relationship between availability of IPTp at the clinic and its uptake among currently-pregnant women.

Findings: Intermittent Preventive Treatment

ANC coverage in Tanzania is nearly universal, but number and timing of ANC visits could influence a woman's ability to receive the recommended two SP doses, which must be taken after quickening and a month apart. NATNETS found that 98 percent of women with a pregnancy in the last year reported at least one ANC visit, comparable to the THMIS report of 97 percent and slightly higher than the 2004 DHS report of 94 percent of the births in the five years prior to the survey. Neither the NATNETS nor THMIS household survey probed for number of ANC visits; the DHS questionnaire included number of ANC visits and their timing. The 2004 DHS found that in a third of the births, the women did not make their first ANC visit until the sixth month or later, effectively limiting their ability to receive two IPT doses. This is corroborated by NATNETS facility surveys of antenatal care users, which found that the late attendance to clinic by pregnant women reduces the opportunity to deliver second dose IPTp under the existing regimen[24]. Further analysis of the DHS could yield insights into the impact of number and timing of ANC visits on partial and full IPTp coverage. It also may be useful to undertake qualitative research among pregnant women and ANC providers to ascertain other barriers to IPTp (especially IPTp-2) uptake.

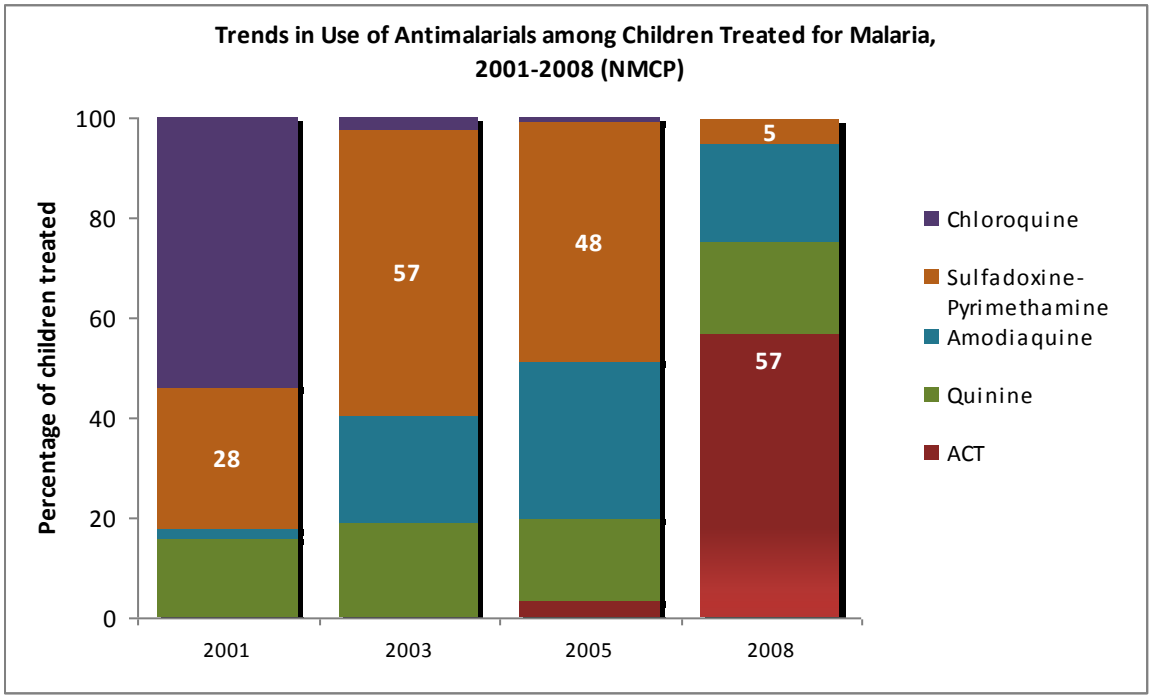
Findings: Prompt and Effective Treatment

RBM "Core Indicators" to monitor prompt diagnosis and effective treatment[13] include the proportion of children under 5 years old who had a fever in the previous 2 weeks who received any antimalarial treatment and the proportion of children under 5 years old who had a fever in previous 2 weeks who received recommended antimalarial treatment according to national policy within 24 hours from onset of fever. On Mainland Tanzania, the recommended treatments are artemisinin-based combination therapies (ACT) and/or Quinine for severe malaria.

Over the last decade, there has been a rapid change in the type of antimalarials used as more effective treatments became available. In 2001, Tanzania changed its malaria treatment policy from chloroquine to SP as the first line drug for the treatment of acute malaria episodes. NMCP data presented in Figure 7, show that chloroquine use virtually disappeared between 2001 and 2003, and SP use doubled. In 2004, the National Malaria Control Program replaced SP with Artemisinin-based combination therapy (ACT) as first line treatment for *P. falciparum* malaria and began to roll out nation-wide implementation down to the health facility level in early 2007[25]. NMCP data for 2008 show that ACT accounted for more than half of malaria treatment and SP had dropped to last place (Figure 5).

Findings: Prompt and Effective Treatment

Figure 5



Source: NMCP[26]

Treatment with antimalarials

Roughly comparable proportions of children under 5 years of age with fever were reported to have received some antimalarial treatment (THMIS 56 percent; NMCP 52 percent) (Figure 6). However, the THMIS found that relatively fewer of these children received ACT, and that more than half of all children receiving any treatment received non-recommended medications. Considerably lower proportions of children with fever received prompt treatment with any drug (Figure 7) – THMIS reported that a third (34 percent) of children with fever were treated within the same or next day, while NMCP found a fourth (24 percent) with prompt treatment. A distinct minority received ACT – the recommended treatment – in a timely manner (NMCP 13%; THMIS 14%).

Findings: Prompt and Effective Treatment

Figure 6

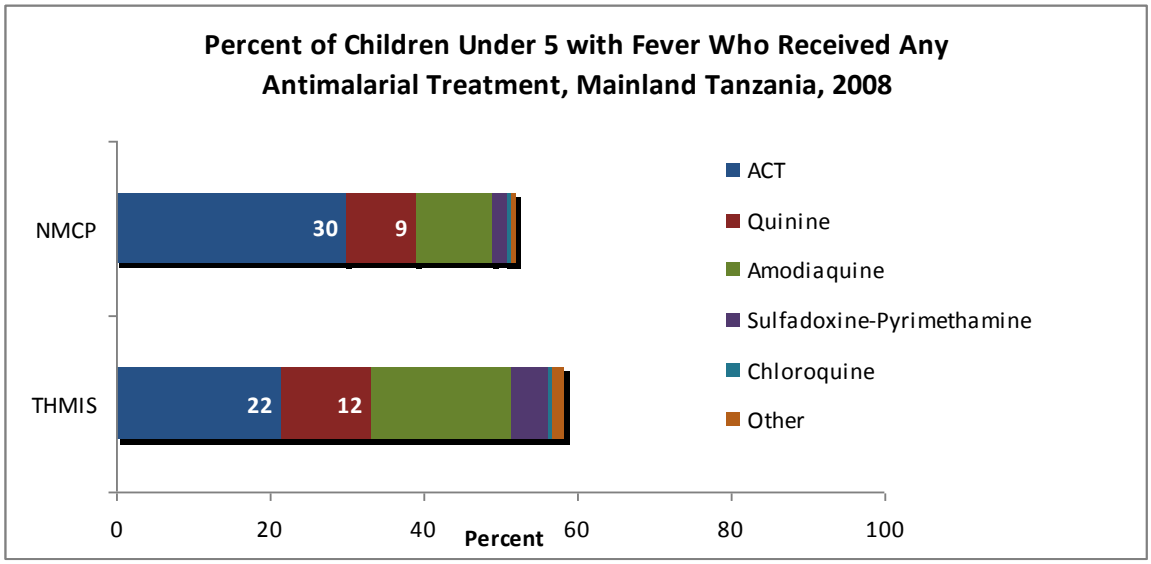
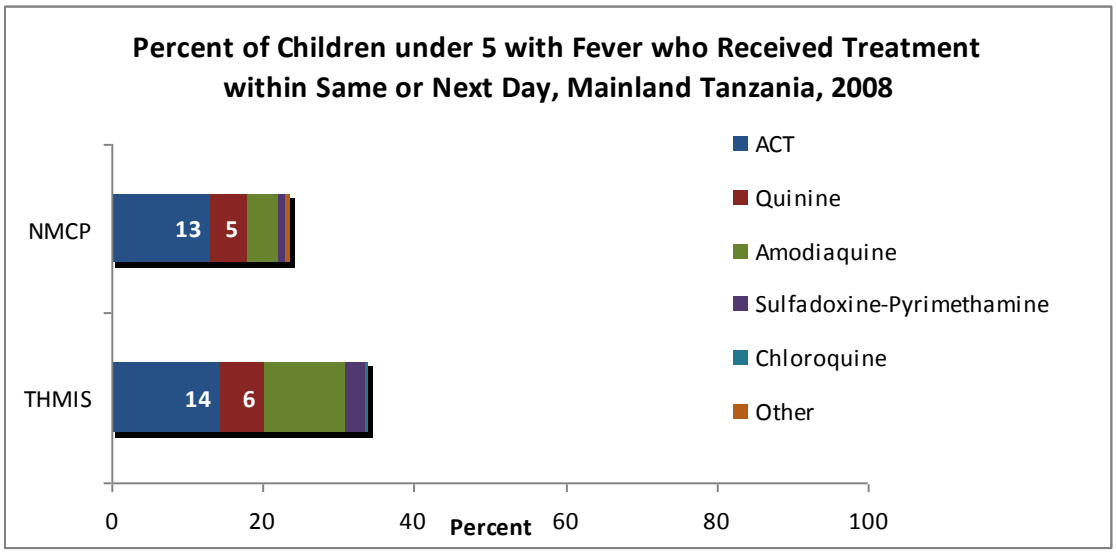


Figure 7



Discussion

The reasons behind the differences between the two surveys are not immediately apparent, but both surveys convey the same messages to program implementers:

- not enough children are receiving treatment;
- many of the children who are treated do not begin in a timely manner; and
- too many children are receiving ineffective drugs

Findings: Prompt and Effective Treatment

Recommendations for Further Analysis

Few children began treatment within 24 hours of appearance of symptoms. THMIS probed for both timing and place of first consultation; treatment should be disaggregated by these two factors. The substantial numbers of children receiving antimalarial medications other than ACT, especially as reported in the THMIS, warrant further study. None of these medications is supposed to be dispensed by public facilities. THMIS probed for source of advice or treatment, and whether the family already had the drug at home when the child became ill. While the questionnaire did not link specific drugs with their sources, it is possible to compare type of medications by source of treatment. Table 3 below presents the percentages of children under age 5 with fever who had not been taken in for advice or treatment, been seen at a public facility (hospital, health center and/or dispensary) or been seen at another location or provider (including private providers and pharmacies, NGO facilities, village health posts, CBD workers and traditional practitioners), as well as the percentages of children receiving various kinds of antimalarial medications.

Half (49%) of the children with fever were taken to a public health facility and a quarter (26%) were taken to another location or provider. Twenty-five percent of the children with fever were not taken to any provider or facility for advice or treatment. Nearly all (86%) of the children who received ACT had also been seen at a public facility. However, only a little more than a third (38%) of the children who were taken to a public facility received ACT, nearly as many received Amodiaquine, Quinine or Fansidar as received ACT, and 26% received no antimalarial medication at all. Moreover, only a small proportion of children seen at other locations received ACT and over half received other antimalarial medications.

Table 3. Source of treatment and drugs taken for fever, children under age 5
Secondary analysis, THMIS, Mainland Tanzania

	Source of treatment for fever			
	None	Public facility	Other	Total
All children < 5 with fever	**25%**	**49%**	**26%**	**100%**
% receiving ACT	3%	38%	9%	21%
% receiving Amodiaquine	11%	17%	27%	18%
% receiving Quinine	7%	15%	20%	12%
% receiving Fansidar	3%	4%	8%	5%

Additional research among parents and providers could be undertaken to learn who is providing non-ACT antimalarial medications to young children and why. Further analysis of the 2006 Service Provision Assessment Survey (TSPA) should be conducted to assess the available of ACT vs. other front-line antimalarials at both government and non-government facilities.

Findings: Impact - Parasitemia & Anemia

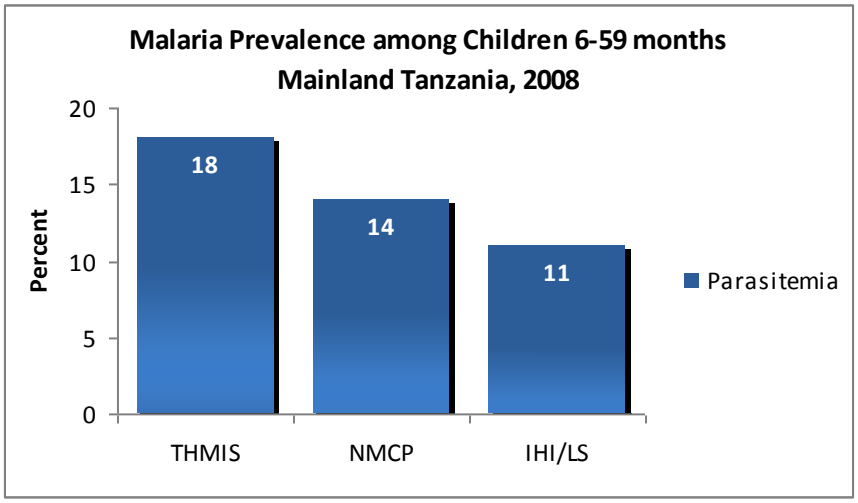
The RBM "Core Indicators" include parasitemia prevalence and anemia as measures of impact. Both are measured with blood tests among children ages 6-59 months. Parasitemia – the presence of malaria parasites in the blood - demonstrates the proportion of young children with malaria infection[27]. Anemia associated with malaria is defined as a hemoglobin measurement of less than 8 g/dL[28]. Three surveys – THMIS, NMCP and NATNETS – collected data on these indicators. THMIS and NMCP disaggregated the indicators geographically and by child's age.

Parasitemia

The three surveys showed statistically significant differences in prevalence of parasitemia. THMIS reported the highest prevalence of malaria infection (18 percent), and NATNETS the lowest prevalence (11 percent), and the NMCP survey figures were between the other two surveys (14 percent). There was no overlap in the statistical confidence intervals of the THMIS and the NATNETS survey estimates[29]; similarly, the NMCP estimates fall outside the statistical confidence intervals of both survey estimates. Figure 8 presents the findings.

The THMIS and NMCP reports disaggregated parasitemia prevalence by age. Parasitemia rates (Table 1) are virtually identical in all age groups except 48-59 months. The reasons behind these patterns are not immediately obvious and may reflect differences in the age and geographic distributions of the survey samples.

Figure 8



Anemia

As with parasitemia, the three surveys showed statistically significant differences in prevalence of anemia. THMIS reported the highest prevalence of anemia (8 percent), NATNETS the lowest prevalence (3 percent), and the NMCP survey figures were between the other two surveys (6 percent anemia). There was no overlap in the statistical confidence intervals of the THMIS and the NATNETS survey

estimates and the NMCP estimates fall outside the statistical confidence intervals of both survey estimates. Figure 9 presents the findings.

The THMIS and NMCP reports disaggregated anemia prevalence by age. In contrast to parasitemia, THMIS reported higher anemia prevalence than NMCP among the two youngest age groups. Again, the reasons behind these patterns are not immediately obvious.

Figure 9

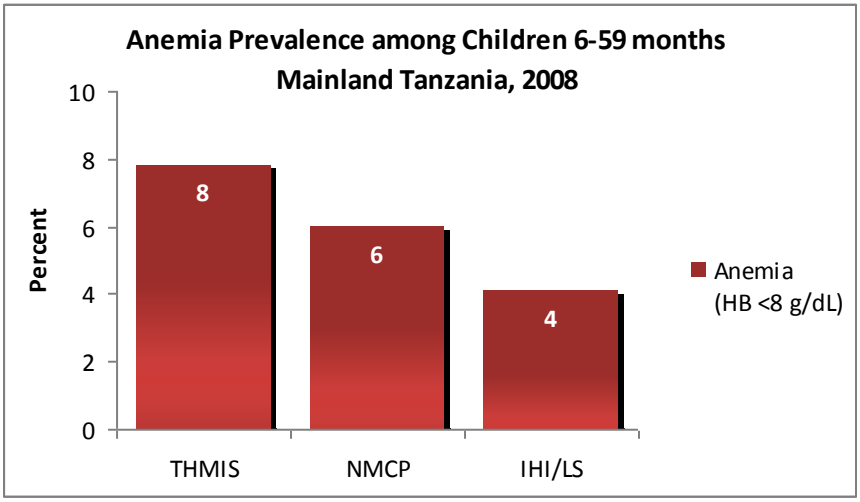


Table 4. Parasitemia and anemia prevalence by age in months, Mainland Tanzania

	Parasitemia		HB <8 g/dl	
Months	**THMIS**	**NMCP**	**THMIS**	**NMCP**
6-11	9%	9%	10%	8%
12-23	14%	14%	12%	10%
24-35	21%	20%	8%	8%
36-47	20%	21%	5%	5%
48-59	21%	18%	3%	3%

The NATNETS report used urban/rural stratification for parasitemia and anemia for children. Significantly higher malaria prevalence was found in rural and semi-urban areas than in urban settings and among children who were reported not to be sleeping under an ITN. There were no statistically-significant differences in anemia prevalence.

Findings: Impact - Parasitemia & Anemia

Table 5. Parasitemia and anemia prevalence among children under five by residence and use of ITN, NATNETS Survey

	Parasitemia		HB <8 g/dl	
Residence	**Prevalence**	**p value**	**Prevalence**	**p value**
Rural	16%		4%	
Semi-Urban	7%		4%	
Urban	1%	<.001	2%	.2
Use of an ITN				
Yes	7%		3%	
No	12%	<.01	3%	.9

Discussion

The clear and consistent inter-survey variability in parasitemia and anemia prevalence could be due to differences in timing of the three surveys. The RBM Guidelines explicitly note that seasonality can affect malaria infection and recommend that measurement of parasitemia prevalence should be conducted toward the end of the rainy season when transmission is at its highest[13]. THMIS was conducted during peak transmission season, when malaria should have been most prevalent. The NMCP survey occurred directly after peak transmission and the NATNETS survey occurred one month after the peak transmission season ended. Timing may explain much, if not most, of the differences in reported parasitemia. To the extent that anemia is closely tied to active malaria infection, the same explanation may apply to the differences in anemia estimates. Thus estimates of parasitemia and anemia follow the expected trend: rising during peak malaria transmission season and diminishing during the dry months.

Recommendations for Further Analysis

Within each survey, cross-tabulations of parasitemia and anemia could assess the association between health status and malaria infection. Findings of higher rate of anemia among children with parasitemia would also strengthen the hypothesis that between-survey differences reflect seasonal differences in malaria transmission. Further analyses should also be conducted to assess the association between prevention interventions and parasitemia. All three surveys collected data on both bednet use by young children and parasitemia; negative associations between net use and malaria infection, as shown in the NATNETS survey, can demonstrate the efficacy of the intervention. Comparing parasitemia with recent fever, especially untreated fever, could yield an indication of the proportion of malaria infections that are symptomatic as well as the proportion of childhood fever due to causes other than malaria.

General Recommendations

To facilitate further analysis and more widespread use of the information collected in the five recent large-scale malaria surveys, cleaned original data sets and methodological details should be made available to all malaria partners for further analysis. Ideally, all surveys would be archived in a centralized location. Survey findings, including further analyses, should be disseminated beyond the national level to regional and local stakeholders. It would also be advantageous to bring malaria stakeholders together to discuss different questions that they have regarding their programs and how the data currently available in Tanzania could help to answer those questions.

The optimal time to collect malaria indicators is during or towards the end of the peak transmission season (i.e. the rainy season)[30]. To reliably track changes over time, surveys should be conducted at the same time every year. Some indicators have a shorter reference period than others and therefore can be measured more frequently. For example, bednet use is measured for the night before the interview and prompt and effective treatment of childhood fever has a two-week reference period; both could be tracked annually (or even more often) to measure short- and longer-term impact of program activities such as mass distribution or communication campaigns. On the other hand, IPTp use is based on completed pregnancies; to yield a sufficiently-large sample size of completed pregnancies, a two-year reference period is needed for a national sample and a longer reference period may be needed for smaller levels of disaggregation. This means that changes in IPTp cannot be reliably tracked more often than every two years (annual surveys would have overlapping reference periods). Parasitemia can be eliminated through proper treatment and could change rapidly. However, anemia is often the result of multiple causes and eliminating malaria infections alone may not be sufficient for hemoglobin levels to recover quickly. Children under age 3 show the highest prevalence of anemia, but tracking changes by child's age requires large sample sizes. Finally, the effects of local or district-level interventions may be too small to be captured on a nationally representative survey.

Efforts also should be made to improve the quality of routine health information systems (RHIS) and increase their use for monitoring and evaluating malaria programs, both in their own right and as an adjunct to population-level surveys. In the case of IPTp, high quality RHIS data can provide a real-time proxy for program coverage. Given that ANC coverage is already nearly universal, increases in program uptake greater than the rate of population growth should translate into increased population coverage. Similarly, as confirmatory clinical testing becomes more widespread and more reliable, RHIS diagnostic data have the potential to track seasonal and geographic variations in malaria transmission. However, such data should be calibrated against population surveys and interpreted with caution: increasing use of health facilities for childhood fever could also increase the numbers of positive clinical diagnoses of malaria in the absence of changes in the underlying infection rates.

The malaria control program should be encouraged to triangulate data from all sources – surveys, RHIS, sentinel sites and other clinical and community-level sources including special data collection efforts such as facility-based client intercept interviews and small cluster surveys or Lot Quality Assurance Sampling (LQAS). Data should be geo-coded and linked to maps to identify geographical patterns of malaria and intervention programs. Real-time data are vital in detecting short-term operational issues

in malaria programs, detect program shortcomings and successes and help explain why a program is or is not achieving its expected outcomes and impacts.

The National Malaria Control Program Monitoring and Evaluation (M&E) Plan for 2008-2013 will harmonize indicators and integrate data from multiple sources including standard monthly service reports, national surveillance systems, periodic population-based household surveys at the national and sub-national levels, sentinel surveillance of mosquitoes and facility surveys. The recommendations described above support the national M&E plan and evidence-based advocacy, decision-making and program implementation.

Appendix 1

Indicators and sample sizes

Indicator	Denominator	Survey	Sample size
Household ownership of at least one net or ITN	Household	THMIS*	8,269
		NIMR	9,166
		PSI*	1,821
		NMCP	8,332
		NATNETS	6,922
Use of nets or ITN by children < age 5	Children under age 5 years	THMIS	7,319
		NIMR	14,409
		PSI	2,528
		NMCP	9,186
		NATNETS	5,701
Use of nets or ITN by pregnant women	Pregnant women	THMIS	823
		NMCP	545
		NATNETS	731
Use of IPTp by pregnant women	Pregnancies in last two years	THMIS	2,967
		NATNETS	2,418
Prompt treatment of fever	Children < 5 with fever in last two weeks	THMIS	1,320
		NMCP	2,140
Parasitemia, Anemia	Children under age 5 years, with blood sample collected	THMIS	6,211
		NMCP	7,772
		NATNETS	5,442

* Weighted sample size, Mainland only

**Restricted to households with children < age 5

Appendix 2

National Malaria Control Programme

2007-08 Household Survey Results Dissemination & Workshop
26-27 November 2008

Malaria remains a significant public health problem for Mainland Tanzania and continues to place a heavy toll on an overburdened healthcare system. In an effort to reverse this situation, the Government of Tanzania through the National Malaria Control Programme has developed a new five year National Malaria Medium-Term Strategic Plan (2008 – 2013) to rapidly scale-up coverage levels of the major malaria interventions. The core strategies include (a) Malaria Diagnosis and Treatment and (b) Malaria Prevention. Key support strategies include strengthening program monitoring and evaluation (M&E) and malaria surveillance.

Tanzania's approach is to work with donors and partners who have committed themselves both financially and technically to scale-up access to insecticide treated nets (ITNs), the deployment of indoor residual house-spraying (IRS) in selected districts, treatment with artemisinin-based combination therapy (ACT), and intermittent preventive therapy for pregnant women (IPTp). As resources for these interventions increase across Tanzania, results on population coverage indicators and impact on malaria prevalence and anemia will require consistent monitoring.

Nationally representative, household surveys are a cornerstone of M&E for malaria control strategies. Over the past 12 months (October 2007 to present), an unprecedented number of large, household surveys have been conducted in Tanzania. While different sampling and data collection methods were used across all five surveys, each one provides useful information to guide malaria control policy and planning. The individual surveys include:

Data collection	Institution	Survey	# Households
Oct 07 – Feb 08	National Bureau of Statistics (NBS)	THMIS	8,500
Feb – Mar 08	National Institute of Medical Research (NIMR)	ITN Coverage/Use	9,166
Mar – May 08	Population Services International (PSI)	Household	1,500
May – Jul 08	National Malaria Control Programme (NMCP)	RBM Survey	8,500
Jul – Sep 08	Ifakara Health Institute (IHI)/ London School of Hygiene & Tropical Medicine (LSHTM)	TNVS Household	7,200

In an effort to establish the best estimates for coverage indicators and status of parasitemia and anemia, particularly as more resources are allocated to Tanzania, the NMCP wishes to convene a workshop where results of the above surveys may be presented and discussed.

Meeting Objectives:

- To convene partners and donors interested in establishing valid estimates of Tanzania's current malaria intervention coverage and impact indicators
- To review survey findings on current status of coverage indicators in Tanzania
- To discuss a harmonized M&E framework for malaria control as Tanzania scales up its program in light of Roll Back Malaria's Monitoring and Evaluation Reference Group (MERG) strategy for conducting nationally representative household surveys

Output:

- One concise document that summarizes:
  - current status of Tanzania's coverage and impact indicators as of late 2008
  - areas of consensus/consideration for developing a harmonized strategy to guide future implementation of household surveys for malaria M&E in Tanzania

Appendix 2

National Malaria Control Programme
2007-08 Household Survey Results Dissemination & Workshop
26-27 November 2008

Day 1: Wednesday, 26 Nov

9:00 AM	Registration
9:30 – 9:45 AM	**Welcome** *Alex Mwita, NMCP Manager* *Ritha Njau, WHO Representative*
9:45 – 10:00 AM	**Overview of NMCP's M&E framework** and role of household surveys *Presenter: Renata Mandike, NMCP M&E Team Leader*
10:00 – 10:10 AM	**Meeting Objectives and Methods** *Presenter: Peter McElroy, U.S. President's Malaria Initiative and CDC-Tanzania*
10:10 – 10:45 AM	**Survey Methods** *Co-chairs: Pasiens Mapunda, CEEMI and Tanya Marchant, IHI/LS* *Presenter: Kesheni Senkoro, NIMR*
10:45 – 11:15 AM	**Tea Break**
11:15 – 11:50 AM	**Bednet Ownership and Use Estimates** *Co-chairs: Nick Brown, NMCP and Ritha Njau, WHO-Tanzania* *Presenter: James Kajuna, PSI*
11:50 AM – 12:25	**IPTp Coverage** (20 minute presentation by one person + 15 minute Q&A for panel of representatives from NBS, IHI/LS, NMCP) *Co-chairs: MW Marero, NMCP and TK Mutabingwa, Seattle Biomedical Reseach Inst.* *Presenter: Tanya Marchant*
12:30 – 1:30 PM	**Lunch**
1:30 – 2:00 PM	**Treatment of Children with Fever** *Co-chairs: Alex Mwita, NMCP and Elizeus Kahigwa, IHI* *Presenter: Sigsbert Mkude, NMCP*
2:00 – 2:30 PM	**Parasitemia and Anemia Prevalence** *Co-chairs: Hugh Reyburn, Joint Malaria Programme and Zul Premji, MUHAS* *Presenter: Fabrizio Molteni, RTI*

Appendix 2

2:30 – 2:45 PM **Trends in Coverage/Biomarker Estimates 2001–08**
Co-chairs: Hugh Reyburn, Joint Malaria Programme and Zul Premji, MUHAS
Presenter: Fabrizio Molteni, RTI

2:45 – 3:15 **Tea Break**

3:15 – 4:00 PM **General Discussion**
Chair: Alex Mwita, NMCP Manager

Day 2: Thursday, 27 Nov

8:30 – 8:45 PM **Summary of Previous Day**
Presenter: Dawne Walker, Measure Evaluation

8:45 – 9:15 PM **Malaria Indicator Survey (MIS)** as systematic, internationally comparable approach to coverage estimates and biomarker data collection, WHO/AFRO, RBM MERG
Chair: Rick Steketee, MACEPA
Presenter: Charles Paluku, WHO-AFRO

9:15 – 9:30 AM **Plans for 2009-10 DHS** and whether coverage data alone or coverage plus biomarker data should be collected
Chair: Rick Steketee, MACEPA
Presenter: Laurie Liskin, Measure DHS

9:30 – 10:00 AM **General Discussion of MIS and DHS future timelines**
Chair: Alex Mwita, NMCP Manager

10:00 – 10:40 AM **Harmonizing Malaria Household Survey Needs and Timing**
Chair: Peter McElroy, PMI
Presenter:Renata Mandike, NMCP

10:40 – 11:00 PM **Closing Remarks**
Alex Mwita, NMCP

Meeting adjourned

Notes and References

[1] United Republic of Tanzania, Ministry of Health and Social Welfare, National Malaria Control Programme. *Medium Term Malaria Strategic Plan 2008 – 2013*. February, 2008

[2] World Health Organization. 2008. *The World Malaria Report, 2008*. Available online at: http://malaria.who.int/wmr2008/malaria2008.pdf

[3] President's Malaria Initiative. 2008. *Malaria in Tanzania*. Available online at: http://www.fightingmalaria.gov/countries/profiles/tanzania.html

[4] Since mosquitoes need standing water to breed, there are more mosquitoes and thus higher malaria transmission during the rainy season than during the dry season.

[5] D'Alessandro, U. et al. 1995. *Mortality and morbidity from Malaria in Gambian children after introduction of an impregnated bednet program*. Lancet, 345(8948), 479-483.

[6] Schulman, C.E., and E.K. Dorman. 2003. *Importance and prevention of malaria during pregnancy*. Transactions of the Royal Society of Tropical Medicine and Hygiene, 97.

[7] Schellenberg, J.R. et al. 2001. *Effect of large-scale social marketing of insecticide-treated nets on child survival in rural Tanzania*. Lancet, 357 (9264), 1241-1247.

[8] Ter Kuile, F.O., et al. 2003. *Reduction of malaria during pregnancy by permethrin-treated bed nets in an area of intense perennial malaria transmission in western Kenya*. American Journal of Tropical Medicine and Hygiene, 68 (Suppl. 4) 50-60.

[9] Roll Back Malaria, World Health Organization. 2003. *Reducing the burden of malaria in pregnancy*. Available online at: http://www.who.int/malaria/rbm/Attachment/20040713/MeraJan2003.pdf.

[10]World Health Organization. *The World Malaria Report, 2008*.

[11] The criterion for malaria-associated anemia differs from severe nutritional anemia (<7g/dL) and the medical definition of severe anemia (<5g/dL).

[12] Carneiro, I., Roca-Feltrer A., Schellenberg, J. 2005. *CHERG estimates of the burden of malaria morbidity in Africa in children under the age of five years.* Available online at: http://www.who.int/child_adolescent_health/documents/pdfs/cherg_malaria_morbidity.pdf

[13] Tanzania Commission for AIDS (TACAIDS), Zanzibar AIDS Commission (ZAC), National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), and Macro International Inc. 2008. *Tanzania HIV/AIDS and Malaria Indicator Survey 2007-08.* Dar es Salaam, Tanzania: TACAIDS, ZAC, NBS, OCGS, and Macro International Inc.

[14] HIV/AIDS indicators were also collected, as well as household characteristics, fertility histories and other individual characteristics.

[15] Including both Mainland Tanzania and Zanzibar. For comparison purposes with other surveys, results reported pertain only to Mainland Tanzania.

Notes and References

[16] Mboera, L.E.G., Mayala, B.K., Senkoro, K.P., Magesa, S.M., Kitua, A.Y., Nkya, T., Kitau, J., Nkya, G.M., Mbilu, T., Manga, C., Kabula, B.I., Emidi, B., Kalinga, A.K., Emmanuel, E. and Kaluwa, B. (2008). *Mosquito net Coverage and Utilisation in Tanzania*. National Institute for Medical Research, Dar es Salaam, Tanzania.

[17] Kajuna J and Miller J. Social Marketing Research Series (SMRS), Monitoring PSI/Tanzania Key Malaria Indicators: Household Survey. PSI/Tanzania, June, 2008.

[18] Marchant T, Bruce J, Nathan R, Mponda M, Sedekia Y, Hanson K. Monitoring and evaluation of the Tanzanian National Net Strategy Report on 2008 NATNETS household, facility services, and facility users surveys. Ifakara Health Institute, London School of Hygiene and Tropical Medicine, February 24, 2009.

[19] Examination of the final samples found that the NATNETS sample tended to be less urban than the other surveys.

[20] Roll Back Malaria Partnership, *Guidelines for Core Population-Based Indicators*. January 2009. Measure Evaluation. Calverton, MD.

[21] Nick Brown, Tanzania National Insecticide Treated Nets (NATNETS) Programme, personal communication 8/30/2009.

[22] During the time period when the surveys were conducted the NMCP planned to distribute approximately 1.1 million ITNs and re-treat approximately 6.5 million nets.

[23] The findings from pregnant women surveyed at the antenatal clinics were not included in the final report.

[24] The antenatal schedule for delivery of IPTp recommends delivery of the first dose at the *second* antenatal visit. See Marchant *et al* (2008). Individual, facility and policy level influences on national coverage estimates for intermittent preventive treatment of malaria in pregnancy in Tanzania. *Malaria Journal* **7**: 260. Available at http://www.malariajournal.com/content/7/1/260.

[25] NMCP Strategic Plan 2008-2013.

[26] Tanzania National Malaria Control Program. 2001-2008. *Antimalarials used 2001-2008.*

[27] THMIS used the Paracheck Pf™ rapid diagnostic blood test was used to detect malaria, and NATNETS used the PARAHIT® rapid diagnostic test. NATNETS also prepared thick film blood slides for future testing.

[28] Compared to severe nutritional anemia which uses the < 7 g/dL cutoff and the medical cutoff of severe anemia at < 5 g/dL.

[29] The NATNETS survey prepared thick blood film slides for microscopy in addition to using Rapid Diagnostic Tests (RDT); the microscopy results are not included in the final report.

[30] IPTp, asked of recent completed pregnancies, should be insensitive to survey timing.