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CARTER CENTER

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SUMMARY PROCEEDINGS

4th ANNUAL MALARIA CONTROL PROGRAM REVIEW
Ethiopia and Nigeria

Held on March 8, 2013 at
The Carter Center, Atlanta, Georgia

OCTOBER 2013

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ACRONYMS

ACT	Artemisinin-based Combination Therapy
ACSM	Advocacy, Communication and Social Mobilization
AMFm	Affordable Medicine Facility – Malaria
BCC	Behavior Change Communication
CDC	Centers for Disease Control and Prevention
CDDs	Community Directed Distributors
CI	Confidence Interval
CORPS	Community-Owned Resource Persons
FMOH	Federal Ministry of Health
FCT	Federal Capital Territory (Nigeria)
HEW	Health Extension Worker
IEC	Information, Education and Communication
IDSR	Integrated Disease Surveillance and Response
IPTp	Intermittent Preventive Treatment of malaria for Pregnant women
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Nets (both conventional nets and long-lasting nets)
LF	Lymphatic Filariasis
LGA	Local Government Area
LLIN	Long-Lasting Insecticidal Nets
M&E	Monitoring and Evaluation
MACEPA	Malaria Control and Evaluation Partnership in Africa
MCP	The Carter Center Malaria Control Program
mf	Microfilariae
MalTra weeks	Malaria and Trachoma weeks (Carter Center integrated activity involving mass drug administration for trachoma, and malaria testing and treatment for people with fever)
MDA	Mass Drug Administration
MIS	Malaria Indicator Survey
MOU	Memorandum of Understanding
MOH	Ministry of Health
NMCP	National Malaria Control Program
NTD	Neglected Tropical Disease
PATH	Program for Alternative Technology in Health
RBM	Roll Back Malaria Program
RDT	Rapid Diagnostic Test
SMC	Seasonal Malaria Chemoprophylaxis
SNNPR	Southern Nations, Nationalities and People's Region
TCC	The Carter Center
U5	Children under 5 years of age
ZPC	Zone Project Coordinator (Ethiopia program)

ACKNOWLEDGEMENTS

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Photo 1. 2012 Carter Center malaria program review participants (March, 2013).

Photo 2. National conference to stop malaria and lymphatic filariasis in Nigeria (March, 2012).

Photo 3. Workshop for malaria elimination project in Amhara Region, Ethiopia (February, 2013).

EXECUTIVE SUMMARY

The Carter Center's (TCC) Malaria Control Program (MCP) provides support to national malaria programs in Ethiopia and Nigeria, with a particular focus on delivering and monitoring activities at the grassroots level. MCP activities can be classified into three main categories: programmatic interventions, monitoring and evaluation, and operational research (See Annex 1 for a history and more detailed overview of the MCP). The MCP works to develop better strategies for distributing and encouraging the use of long-lasting insecticidal nets (LLINs), and is exploring ways that malaria interventions can be coordinated with mass drug administration (MDA) for neglected tropical diseases (NTDs) (See Annex 2), with added benefits for all disease programs working in an integrated manner. These strategies capitalize on TCC's established expertise in helping governments to mobilize community volunteers for large-scale community-based drug distribution campaigns to control and eliminate NTDs. The MCP strives to produce the highest quality data to inform decision-making and to advance the global malaria elimination objective by testing the potential to interrupt transmission when existing tools are implemented at scale, and in new ways.

In keeping with its principle of starting with the most difficult places first, the MCP focuses on Nigeria and Ethiopia. These two nations, which together account for over one quarter of sub-Saharan Africa's population, are critical to the success of the global program to control and eliminate malaria. In both countries, TCC provides support to the national program for planning and implementing key malaria interventions, and evaluating progress towards national targets. Each country presents different challenges for malaria control. For example, Ethiopia has unstable seasonal malaria with substantial spatial and inter- and intra-annual variation. *Plasmodium vivax* infections, which require radical cure of dormant liver stage parasites, account for 30-40% of malaria cases in Ethiopia. Ethiopia has made great progress in the scale-up of prevention and control activities: the national program distributed nearly 46 million LLINs in areas at risk for malaria between 2004 and 2012 and, in 2012, achieved over 70% coverage of targeted households with IRS and provided 9 million doses of malaria treatments to health facilities in the public health system. The Ethiopian national plan sets forth the goal of elimination of malaria within specific geographical areas by 2015. In Ethiopia, TCC MCP assists the following regional states: Amhara, Oromia, Southern Nations Nationalities and People's Region (SNNPR), and Beneshangul Gumuz, with Amhara being the primary focus. Nigeria, in contrast to Ethiopia, experiences stable year-round transmission with seasonal peaks throughout most of the country. Nearly all malaria infections in Nigeria, which alone accounts for an estimated 25% of Africa's malaria burden, are caused by *Plasmodium falciparum*. Since 2009, the primary focus of the Nigerian National Control Program (NMCP) has been the completion of mass LLIN distribution campaigns in each of the nation's 36 states and Federal Capital Territory. Only three state-level campaigns remained to be completed at the end of 2012, allowing the NMCP to devote more attention to the expansion of interventions designed to improve case management and routine surveillance, as well as routine LLIN distribution strategies. During this period of intense scale-up of LLIN coverage, the Carter Center's approach in Nigeria has been to prioritize activities related to LLIN distribution and increasing LLIN use in the nine states supported by TCC: Abia, Anambra, Delta, Ebonyi, Edo, Enugu, Imo, Nasarawa and Plateau.

In Nigeria, TCC has been working with partners in the Federal Ministry of Health to establish strong collaborations between the malaria and lymphatic filariasis (LF) programs. There are

many compelling arguments for the co-implementation of malaria and LF activities in Nigeria and in other African countries where the two diseases are co-endemic. Primary among these is the fact that both diseases are transmitted by the same *Anopheles* mosquito. Thus interventions such as LLIN distribution and other vector control activities can lead to significant reductions in the transmission of both diseases. In addition, increasing awareness that LLINs can prevent the sequalae of LF (skin problems, swollen legs, enlarged scrotum in men, and the associated stigma) is likely to result in increased LLIN use. This may be particularly the case in places like Nigeria where malaria is extremely common but the case fatality rate among adults is relatively low. Adults, especially adult males, may dread the prospect of being infected with LF much more than they fear malaria. Increased collaboration between LF and malaria programs has the potential to accelerate the scale-up of interventions for both diseases, as well as to increase programmatic cost effectiveness and cost efficiency. In March 2012, The Carter Center co-sponsored a two-day meeting, hosted by FMOH, to explore the shared opportunities between the national malaria and LF programs. The conference was chaired by former head of state General Dr. Yakubu Gowon and attended by over 200 people including Federal and State Ministry personnel, non-governmental development organizations (NGDOs), partner organizations, donor agencies, and the mass media (see Frontispiece Photo 2, p. v). The conference resulted in the establishment of a technical working group on malaria and LF collaboration and the development of operational guidelines for co-implementation.

The fourth annual review of The Carter Center MCP was convened on March 8, 2013, at TCC headquarters in Atlanta. Participants in the meeting joined staff from TCC and the Ethiopia and Nigeria Ministries of Health (MOH) to discuss the successes and challenges experienced by the Malaria Control Programs in each country during the 2012 calendar year, and to recommend concrete actions and measurable objectives for 2013. The review focused on Nigeria and Ethiopia country-specific progress reports from TCC's field offices and MOH partners. This year's review meeting also included talks on historical and current examples of efforts to eliminate malaria at the national or sub-national levels. Historians of public health discussed lessons that can be learned from past malaria eradication and elimination efforts (both the successes and the failures), while TCC staff presented on the potential opportunities to employ mass drug administration for malaria and on a proposed malaria elimination project to be launched in 2013 in the Amhara region of Ethiopia.

Among those present was Dr. Adetokunbo O. Lucas of Nigeria, who was recently awarded the Jimmy and Rosalynn Carter Humanitarian Award by the National Foundation for Infectious Diseases (NFID). Also represented were The Bill & Melinda Gates Foundation, Malaria Control and Evaluation Partnership in Africa (PATH/MACEPA), the Centers for Disease Control and Prevention (CDC), International Public Health Advisors, The Lions Club of Ethiopia, Malaria Foundation International, Emory University, Johns Hopkins University, Colby College, Tulane University, and the University of Notre Dame. Dr. Frank Richards (Director of TCC's Malaria, Onchocerciasis, Lymphatic Filariasis and Schistosomiasis Control Programs) and Dr. Paul Emerson (Co-Director of the MCP and Director of TCC's Trachoma Control Program) co-chaired the meeting.

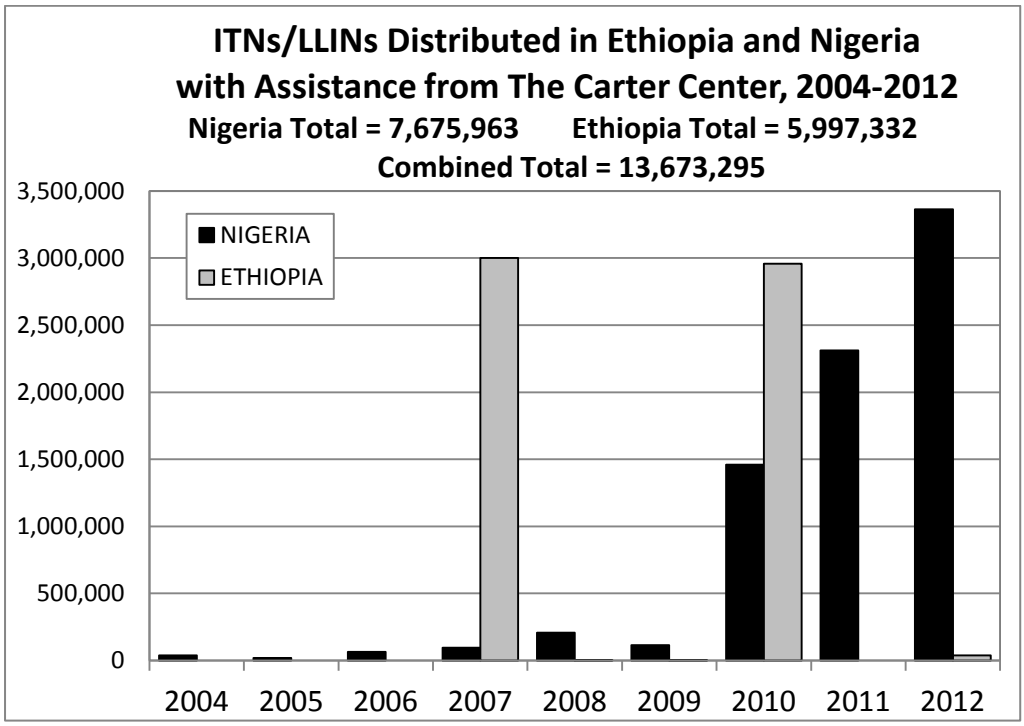

Figure 1. Annual number of ITNs/LLINs distributed in Ethiopia and Nigeria with assistance from The Carter Center, 2004-2012.

SUMMARY OF COUNTRY PRESENTATIONS

Ethiopia

The 2012 progress report on the malaria activities of the Ethiopia FMOH was presented by Ms. Hiwot Solomon, the national malaria program focal person. The Ethiopia National Strategic Plan for Malaria sets forth the following goals to achieve by 2015: 1) Malaria elimination within specific geographical areas with historically low malaria transmission, and 2) Near zero malaria transmission in the remaining malarious areas of the country. Ms. Solomon described the specific strategies that Ethiopia is employing to reach these goals: community empowerment and mobilization through the health extension worker (HEW) program and a recently introduced "Health Development Army," diagnosis and case management (including the provision of free artemisinin-based combination therapies [ACTs] and rapid diagnostic tests [RDTs] at the community health post level), surveillance, health systems strengthening, and capacity building. She also discussed the national strategy for epidemic preparedness and response. Some key accomplishments of 2012 included: the distribution of nearly 6.2 million LLINs through replacement campaigns and emergency response systems, the provision of indoor residual spraying (IRS) to 4,383,819 households in IRS-targeted districts (73% of target, up from 57.2% in 2011), training on new malaria diagnosis and treatment guidelines for health center staff, the distribution of 9 million doses of ACT and 17.9 million RDT kits, and the launch of studies on insecticide resistance. In 2012, approximately 3.4 million cases of malaria (both confirmed and clinically diagnosed) were reported in Ethiopia.

Ms. Solomon also presented the results of the National Malaria Indicator Survey (MIS) conducted in Ethiopia in 2011. The results indicated that gains in key malaria interventions and reductions in parasite prevalence following the scale-up of malaria control activities in 2006-2007 have been sustained. The results indicate that more than half (55.2%) of households have at least one mosquito net of any type and that nearly half (46.6%) of surveyed houses <2000m were sprayed with IRS in the past 12 months. Overall, 38.2% of children under 5 years (U5) and 35.3% of pregnant women reported sleeping under a net the previous night. Among households owning at least one net, approximately two-thirds of children U5 (64.5%) and pregnant women (64.2%) slept under a net the night before the survey. Nationwide parasite prevalence remained at around 1% in both 2007 (0.9%, 95% CI 0.5%-1.3%) and 2011 (1.3%, 95% CI 0.7%-1.8%).

Dr. Zerihun Tadesse, Country Representative for the Carter Center's Ethiopia office, summarized TCC-supported malaria control activities in Ethiopia. In 2012, the MCP in Ethiopia primarily provided support to the FMOH and the Regional Health Bureaus for malaria control activities conducted in Amhara, Oromia, Southern Nations Nationalities and People's Region (SNNPR), and Beneshangul Gumuz regions. This support consisted of routine monitoring of LLIN ownership and use, supportive supervision to improve the quality of case management and epidemic monitoring, training of health workers on malaria diagnostics and treatment and, in Amhara, mass screening and treatment of fever cases in the context of MDA campaigns for trachoma (MalTra weeks). Including training for MalTra week campaigns, an estimated 8,204 health workers received malaria training in 2012, and a total of 44,698 cases of malaria were treated through MalTra weeks. TCC also supported surveillance efforts in Amhara through the recent deployment of an enhanced surveillance system (ESS) that enabled prompt responses to several outbreaks within the region in 2012. Dr. Tadesse also presented the Amhara-specific results of the 2011 National MIS.

Dr. Gregory Noland, Carter Center Malaria Epidemiologist, presented on a malaria elimination demonstration project to be conducted in the Amhara Region of Ethiopia, in collaboration with the Federal Ministry of Health (FMOH), the Amhara Regional Health Bureau (ARHB), the Malaria Control and Evaluation Partnership in Africa (MACEPA) and TCC. The goal of this project is to support the FMOH's goal of sub-national malaria elimination through the rapid reduction of transmission leading to elimination by 2015 in select districts of the Amhara regional state. Dr. Noland explained the criteria for the selection of specific districts and reported on the first steering committee meeting for the project, which was held February 6-8, 2013 in Bahir Dar, Ethiopia. He discussed the interventions proposed by the steering committee, as well as the plans for a baseline survey to be conducted in April-May 2013.

Nigeria

Dr. Nnenna Eizegwe, Director of the National Malaria Control Program (NMCP) in Nigeria, gave an update on the status of malaria control activities in Nigeria. She began by showing the results of a recent risk mapping exercise that indicates a shift from hyperendemic malaria transmission to mesoendemic transmission since 2000 in Nigeria. She presented results from the 2010 National Malaria Indicator Survey to illustrate progress-to-date towards key national malaria targets, as well as the work that still remains to be done. From 2008 to 2010, the proportion of households owning at least two insecticide-treated nets (ITNs) increased from 8.0% to 41.5%, and the proportion of children under-five who slept under a net the previous

night increased from 5.5% to 29.1% (and from 49.8% to 59% among children U5 in households owning at least one net), but neither indicator has reached the national target of ≥80%. The Nigerian malaria control strategy focuses on four primary interventions: LLINs, IRS, effective case management, and malaria prevention in pregnancy. The strategy also involves a number of cross-cutting strategies including: advocacy, communication and social mobilization (ACSM); procurement and supply chain management; monitoring and evaluation (M&E); program management; and intersectoral collaboration. In her discussion of 2012 activities and accomplishments, Dr. Eizegwe focused primarily on the components of the strategy that align with The Carter Center's current activities and priorities: the national mass LLIN distribution campaign; routine distribution of LLINs through a variety of mechanisms, including community-directed distributors; national malaria surveillance activities; and ongoing work to develop formal collaborations between malaria and LF programs at all levels of the health system.

A key accomplishment for the Nigeria NMCP in 2012 was the distribution of over 6 million LLINs in seven states, bringing the total number of LLINs distributed since 2009 as part of the nation-wide scale-up to 51,703,880 (81.8% of total national target). Other select accomplishments included the release of the report on results of the 2010 National Malaria Indicator Survey (MIS)[1], a national meeting on the integration of malaria and LF programs (co-hosted with The Carter Center), the development of draft standard operating procedures for routine LLIN distribution and the integration of malaria and LF program activities, the submission of a work plan for the use of a 25 million USD Phase 2 grant from the Global Fund, training of community volunteers and patent medicine vendors on appropriate case management for malaria, the launch of a pilot Seasonal Malaria Chemoprophylaxis (SMC) project in two states, and successful advocacy efforts to increase funding for malaria control provided by both the Federal and State governments in Nigeria. Efforts are on-going to improve national malaria surveillance reporting systems and to introduce a national insecticide resistance management plan.

Mr. Adamu Sallau, Director of malaria control for the Carter Center's Nigeria office, reported on TCC's activities in Nigeria during the 2012 calendar year. In this year, The Carter Center provided support for the distribution of 3.4 million LLINs in Imo, Abia and Edo states, the greatest number of LLINs distributed with assistance from TCC to date in a single year. This brings the total number of LLINs distributed with TCC support in Nigeria to 7,675,963. In addition to supporting LLIN distribution activities, staff from the TCC Nigeria office participated in technical working groups organized by the NMCP for survey management, and for the development of national strategies for continuous LLIN distribution and collaborations between the malaria and LF programs. TCC also provided support for malaria surveillance in Plateau and Nasarawa states. Mr. Sallau described the current status of surveillance in Plateau state, where 36% of *registered* public and private health facilities currently participate in surveillance reporting. He discussed the challenges for consistent and timely reporting of malaria case data, including the impact of extended health worker strikes in 2012.

Dr. Amy Patterson, Assistant Director of The Carter Center's malaria control program, described TCC's strategies for engaging community-directed distributors of treatments for NTDs in malaria control activities, and presented preliminary results from pilot community-directed activities in Ebonyi and Plateau states.

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[1] *The 2010 Nigeria MIS report is available on-line at: http://measuredhs.com/pubs/pdf/MIS8/MIS8.pdf*

Conclusions and Recommendations

Drs. Hopkins, Richards and Emerson led the final session during which recommendations were proposed for each of the countries and for the Carter Center's MCP generally.

RECOMMENDATIONS

General Recommendations

1. Apply lessons learned from other Carter Center-assisted elimination programs to malaria elimination.
2. Lead the way in testing innovative strategies that are not part of the current global approach to malaria elimination. These include starting with the most challenging places first and, potentially, the evaluation of mass drug administration for malaria.
3. Focus on monitoring impact, in addition to process and intermediate outcomes.
4. Use data to mobilize rapid responses to problems, and develop feedback loops to provide recognition for good work
5. Presentation of Data and Activities at Future Program Review Meetings
    a) Begin with a summary of the recommendations from the previous year to allow audience to evaluate progress towards those goals
    b) Create one graph to track malaria cases (rates), deaths (rates) and intervention coverage (LLIN ownership, IRS, TX coverage) since 2006 (or before depending on availability of data). Where possible, differentiate between Pv and Pf
    c) When reporting on net use, always present % of nets used last night (and ever), along with % of persons using nets last night.

Ethiopia Recommendations

1. Conduct elimination demonstration project in Amhara, subject to available funds
    a) Develop approach for testing added benefits of ivermectin for mosquito control in the context of routine MDA for onchocerciasis
    b) Describe seasonal migration patterns in N. Gondar zone and assess potential significance for malaria elimination efforts
    c) Examine mosquito populations (abundance, biting and resting behaviors, insecticide resistance, etc), in collaboration with CDC (or other identified partner)
    d) Begin to develop approach for addressing *P. vivax*
2. Increase delivery of malaria interventions during MalTra weeks through improved pre-campaign sensitization, improved training of those responsible for fever screening and, potentially, modifications to the process for screening and testing at MalTra delivery sites.
3. Continue to strengthen surveillance in Amhara Region and utilize data for programmatic responses.
4. Conduct research to understand why LLIN use remains below targets (potentially including a modified “do-er/non-do-er” analysis to identify differences between people who always use nets, sometimes use nets, formerly used nets, and who never use nets). Design interventions to address concerns identified.

Nigeria Recommendations

1. Complete LLIN distribution campaign in Delta state
2. Expand, evaluate and report on CDD Malaria Activities in Plateau state:
    a) BCC
    b) LLIN distribution to cover every sleeping space in Plateau state
    c) LLIN monitoring
3. Support strengthening and expansion of malaria surveillance in TCC-supported states and begin obtaining information on mortality
4. Continue to support collaboration between National Malaria Control and LF Elimination Programs
5. Provide technical assistance for the development of BCC strategies and routine LLIN distribution for other TCC-assisted states (if assistance is requested and as time and funding permit)

Ethiopia National Malaria Control Program

Presented by Ms. Hiwot Solomon, National Malaria Programme Focal Person, Federal Ministry of Health, Ethiopia

Malaria is one of the leading causes of morbidity and mortality in Ethiopia. An estimated 55.7 million people (68% of the population) are at risk for malaria and approximately 80% of the 736 *woredas* (districts) in Ethiopia are considered "malarious". Malaria transmission is generally seasonal and unstable, though patterns and intensity of transmission vary throughout the country due to differences in altitude, rainfall and population movement. Protective immunity in Ethiopian populations is relatively low due to unstable transmission and, unlike large parts of sub-Saharan Africa, all age groups are at risk of infection and disease. *P. falciparum* accounts for 65-75% of infections, while *P. vivax* accounts for 25-35%. *P. ovale* and *P. malariae* are rare.

The goals of the 2010-2015 National Strategic Plan for Malaria Prevention, Control and Elimination in Ethiopia are:

1. By 2015, achieve malaria elimination within specific geographical areas with historically low malaria transmission.
2. By 2015, achieve near zero malaria transmission in the remaining malarious areas of the country.

The specific strategies to achieve these goals are summarized below. Key components of malaria control program are implemented by different units in the Federal Ministry of Health.

Community Empowerment and Mobilization. Community empowerment relies upon the Health Extension Program (HEP), which was created in 1993 to address the primary health care needs of Ethiopians and to establish effective and responsive health delivery systems in rural areas. The HEP is a defined package of basic preventative and selected high-impact curative health services targeted at the household level. It relies upon Health Extension Workers (HEWs)—salaried government staff stationed to village health posts—who diagnose, treat and/or refer disease within the community. The HEP is further supplemented by the new Health Development Army initiative that seeks to expand best practices at large scale at the grass-roots level and is achieved through networks of "model families" in each community. The objectives of community empowerment and mobilization are: 1) 100% of people living in malarious areas will recognize the importance of using an LLIN, having their house sprayed, and seek treatment within 24 hours of fever onset and 2) 100% of health posts in malarious *kebeles* (villages) will provide the full HEP package.

In 2012, HEWs received training for multi-species rapid diagnostic tests (RDTs) for malaria, integrated refresher training (IRT) including a 4-day dedicated malaria module, and integrated community case management (ICCM) training. Additionally, posters and brochures promoting use of long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), adherence to treatment and the importance of early treatment-seeking behavior were developed and distributed.

Diagnosis and Case Management. FMOH promotes a policy of universal confirmatory diagnosis using multi-species RDT at health posts and microscopy at health centers and hospitals, combined with free malaria prevention and control services. In 2012, approximately 17.9 million RDTs were procured and distributed in Ethiopia (Table 1). Artemisinin-based combination therapy (ACT), specifically artemether-lumefantrine (Coartem®), has been the first line treatment for uncomplicated *P. falciparum* malaria since 2004, and more than 9 million doses were distributed in 2012 (Table 1). Chloroquine remains the first line drug for treatment of *P. vivax*, however primaquine can be used for radical treatment of *P.*

vivax in non-malarious areas. First line treatment for severe malaria is intravenous quinine. Patients presenting to health posts with signs of severe malaria can be given rectal artesunate or intramuscular artemether as pre-referral treatment. In 2012, staff from 375 health centers received training on malaria diagnosis and treatment guidelines.

Table 1. Quantities of rapid diagnostic tests (RDT) and artemisinin-based combination therapy (ACT) distributed in Ethiopia, by year.

	RDTs Distributed	ACTs Distributed
2009	2,900,000	8,100,000
2010	8,000,000	10,400,000
2011	20,000,000	11,000,000
2012	17,900,000	9,000,000

Prevention. The main vector control activities implemented in Ethiopia are LLINs, IRS, and environmental control. The LLIN objectives are to ensure that 100% of households in malarious areas own at least one LLIN per sleeping space, and that at least 80% of people at risk of malaria use LLINs.

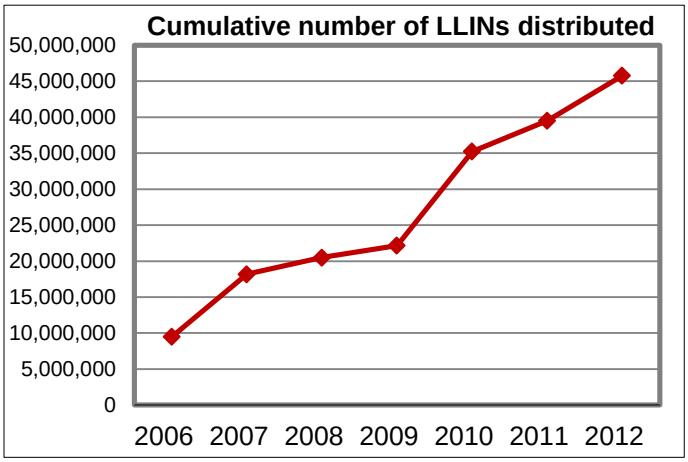

Figure 2. Cumulative number of LLINs distributed in Ethiopia, by year.

Figure 2 illustrates that more than 45 million nets have been distributed in Ethiopia through 2012. Multiple mechanisms are used to ensure all families in malaria-affected areas can protect themselves from malaria including: free mass distribution of LLINs to all households in malarious areas still in need of LLINs (catch-up); replacement of old ineffective LLINs with new free LLINs through the HEP and campaigns (keep-up); free distribution of LLINs during emergencies; subsidized nets for other households, especially in urban areas through market priming/social marketing.

IRS is currently targeted to epidemic-prone areas and malaria-affected communities with low access to the health care system. In 2012, a total of 4,383,819 households (73.1% of targeted households) were sprayed with IRS—an increase over past years' performance (Figure 3). The goal was to reach 70% of targeted households by 2011 and 90% by 2013. Training is underway to facilitate decentralized IRS operation at the health post level. Insecticide resistance studies are also being conducted to provide evidence-based recommendations for changing IRS chemicals. Larval control activities using temephos (Abate®) were also conducted in urban centers, near irrigation projects and in areas

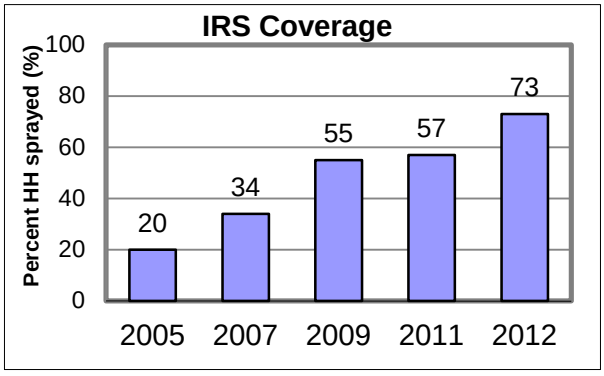

Figure 3. Percentage of targeted households in Ethiopia that received IRS, by year.

with limited and well-known breeding habitats.

Surveillance and Epidemic Control. A high quality surveillance system with reach into all communities is an essential intervention strategy to achieve the goals and objectives in this malaria strategic plan in Ethiopia. The objectives are that 100% of health facilities in epidemic prone areas adhere to the national epidemic and response plan; and 100% of health facilities and *woreda* health offices use epidemic monitoring charts, based on confirmed cases. The capacity in data collection and analysis has improved in recent years, and reporting completeness is now approximately 80%. In 2012, approximately 3.4 million cases of malaria (both confirmed and clinically diagnosed) were reported. Figure 4 illustrates the trends in malaria cases over the past decade.

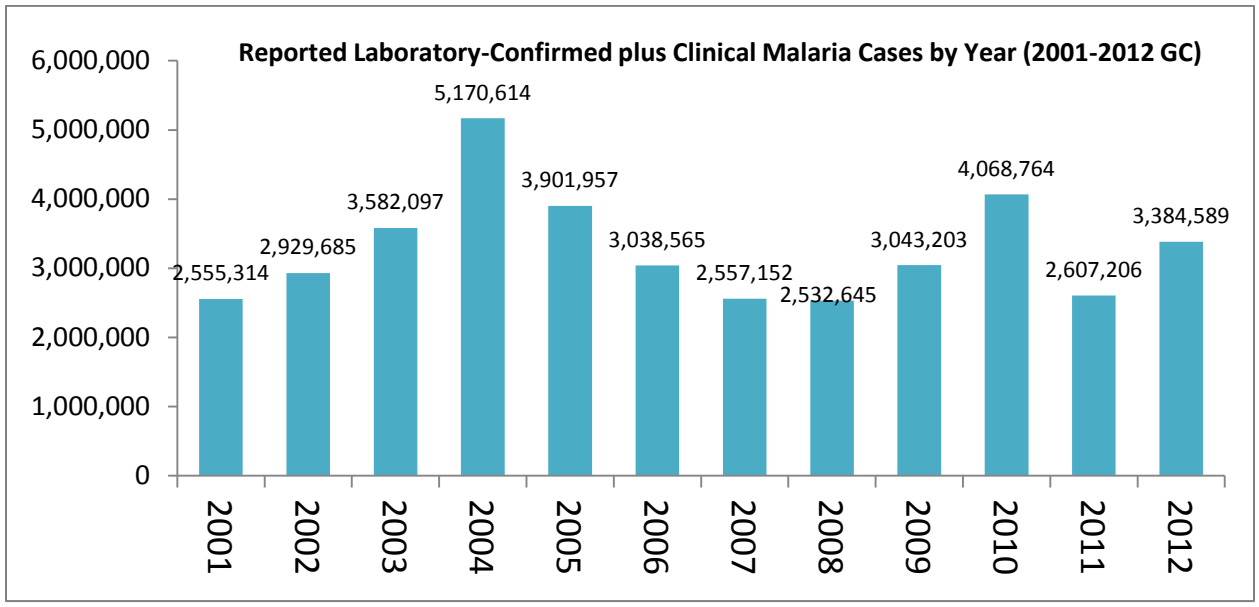

Figure 4. Reported total number of malaria cases (laboratory confirmed plus clinically diagnosed) per year in Ethiopia, 2001-2012.

Health systems strengthening and capacity building. All strategies for malaria control, prevention and elimination in Ethiopia will be supported by cross-cutting measures that include: monitoring and evaluation, human resource development, financial management and linkages with overall development strategy, procurement and supply chain management and operational research.

2011 Malaria Indicator Survey (MIS) Results. The Ethiopian National Malaria Indicator Survey 2011 report was officially released on September 4th, 2012. The MIS is a large, nationally representative survey of coverage of key malaria control interventions, treatment-seeking behavior, malaria prevalence, anemia prevalence in children under 5 years of age (U5), malaria knowledge among women, and indicators of socioeconomic status. The survey was conducted by the Ethiopian Health and Nutrition Institutes/Ministry of Health in collaboration with multiple partners. The survey sampled 10,444 households from October to December 2011 in 440 enumeration areas (EAs) randomly selected from all EAs within the country. The report focuses on results from areas below 2,000m (n=5,819 households), since these areas are considered malaria-endemic and are preferentially targeted for malaria control interventions.

As shown in Table 2, nearly half (46.6%) of households <2000m were covered by indoor residual spraying (IRS) of insecticide in 2011. This was a significant increase over IRS coverage in 2007 (20.0%). However, the proportion of households <2000m that owned at least one net (of any type) declined from 68.9% in 2007 to 55.2% in 2011, while the proportion that owned more than one net (of any type) declined from 38.3% to 23.9%. These declines are attributed to deterioration of nets, which have an average lifespan of 3 years, suggesting the need for greater emphasis on net replacement (or "keep up") strategies in Ethiopia. Among all surveyed households, 38.2% of children U5 and 35.3% of pregnant women reported sleeping under a net last night. However, approximately two-thirds of children U5 (64.5%) and pregnant women (64.2%) in households <2000m owning at least one net reported sleeping under a net last night—values essentially unchanged from 2007, when 60.2% of children U5 and 64.3% of pregnant women reported sleeping under a net the previous night.

Table 2. Comparison of key results from 2007 and 2011 Malaria Indicator Surveys, Ethiopia (areas <2000m).

	2007	2011
Percentage of households sprayed with IRS in the past 12 months	20.0	46.6
Percentage of households that own at least one net	68.9	55.2
Percentage of households that own more than one net	38.3	23.9
Percentage of children U5 who slept under a net the previous night (in households with at least one net).	60.2	64.5
Percentage of pregnant women who slept under a net the previous night (in households with at least one net).	64.3	64.2
Percentage of children U5 with a fever in the two weeks preceding the survey	24.0	19.7
Percentage of children with a fever who took an anti-malaria drug within 24 hrs.	11.9	32.6

The percentage of children U5 who reported a fever in the two weeks declined slightly between 2007 (24.0%) and 2011 (19.7%), while the proportion of those with fever who took an anti-malaria drug within 24 hours of fever onset increased significantly between 2007 (11.9%) and 2011 (32.6%).

Malaria prevalence by microscopy in individuals living in areas <2000m was 1.3% (95% CI 0.7%-1.8%) in 2011, a non-significant increase versus 2007 (0.9%, 95% CI 0.5%-1.3%). *P. falciparum* accounted for 77% of infections and *P. vivax* accounted for 23%. In areas 2000m-2500m, malaria prevalence by microscopy was 0.1%, 10-fold lower than in areas <2000m.

The Carter Center Ethiopia Malaria Program Progress Report

Presented by Dr. Zerihun Tadesse, Country Representative, The Carter Center Ethiopia

The Carter Center Ethiopia Malaria Control Program provides assistance for malaria control and elimination activities to the Federal Ministry of Health (FMOH) of Ethiopia and the Regional Health Bureaus of Amhara, Oromia, SNNPR and Beneshangul Gumuz (Figure 5). TCC support is provided through the following activities: assist the scale up of malaria prevention measures such as net ownership and use; support community-based diagnostic and treatment services; enhance surveillance systems; assist in monitoring and evaluation; and conduct operational research. These activities will help evaluate the impact of the national programs and TCC activities and will inform the global malaria elimination agenda.

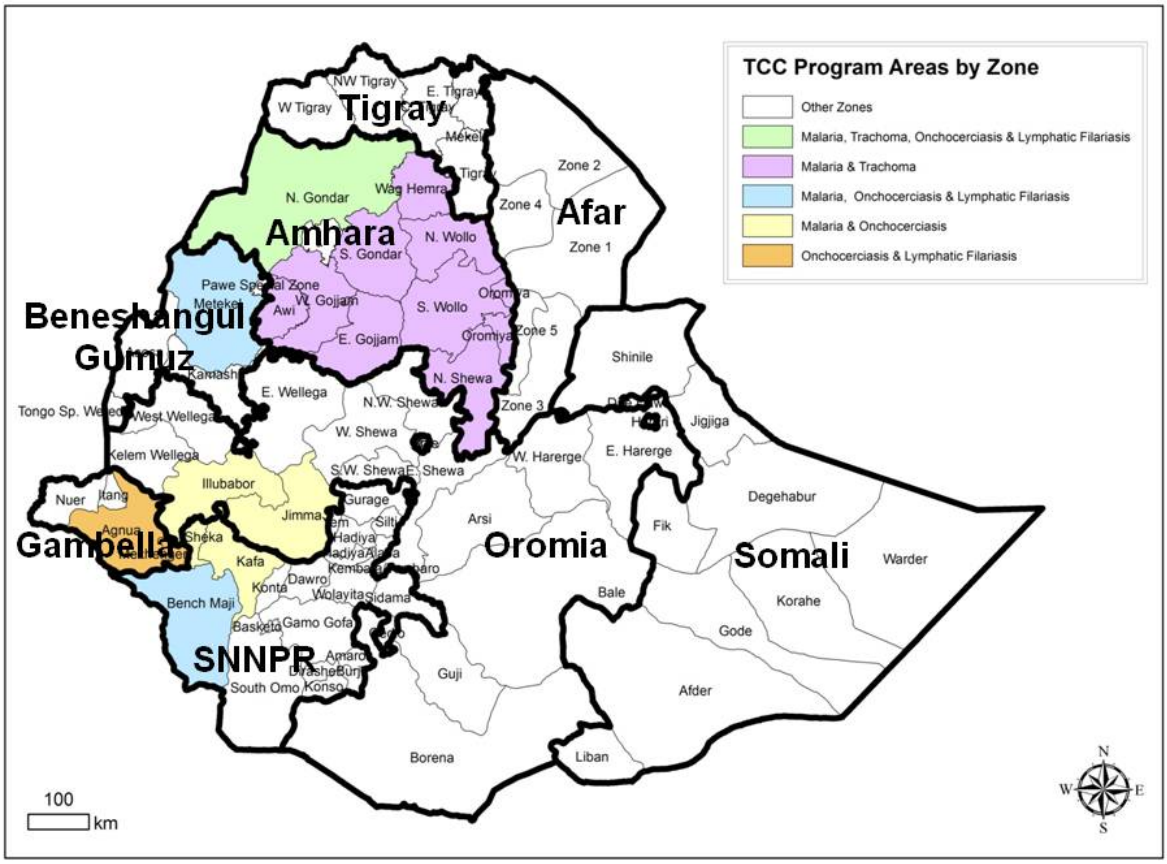

Figure 5. Map of Ethiopia showing The Carter Center-assisted areas for malaria, trachoma, onchocerciasis, and lymphatic filariasis support by region and zone.

2011 Malaria Indicator Survey (MIS) Results, Amhara Region. TCC provided technical, financial, and administrative assistance for the 2011 national Malaria Indicator Survey (MIS). This included support for oversampling in Amhara Region in order to yield estimates of malaria prevalence and intervention coverage that are statistically representative of the region. In contrast to the national estimates (results presented in previous Section), which were powered to include a <2000m altitude strata, the regional level estimates were powered for precision to areas <2500m. For comparison purposes, data shown

below include areas <2500m for both national (n=10,444 households) and Amhara Regional (n=893 households) estimates.

The percentage of households owning at least one ITN increased from 16.1% as measured in a 2006 TCC-supported baseline survey[2] to 72.5% in 2007 and 69.7% in 2011 (Figure 6). Over this same period, malaria prevalence (by microscopy) significantly declined from 4.6% in 2006 to 0.6% in 2007 and 0.8% in 2011.

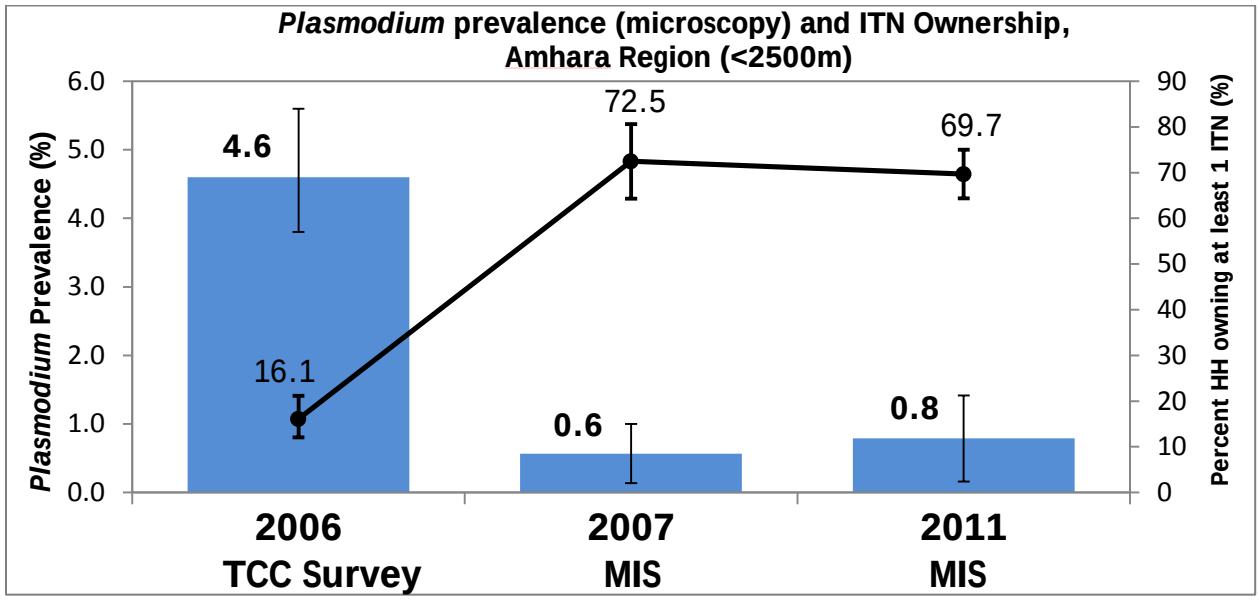

Figure 6. Mean *Plasmodium* prevalence by microscopy (bars) and household ITN ownership (line) in Amhara region (areas less than 2500m), Ethiopia. Error bars show 95% confidence intervals.

The proportion of households owning at least one ITN was significantly greater in Amhara compared to the national estimates for both 2007 and 2011 (Table 3). While the proportion of households owning at least two ITNs was also significantly higher in Amhara versus nationally, only 33.0% of households in Amhara and 20.5% nationally owned more than one net in 2011. These were significant declines compared to Amhara (43.8%) and national (29.7%) estimates in 2007. The mean number of nets per household also declined between 2007 and 2011 for both Amhara (1.3; vs. 1.1) and nationally (0.9; vs. 0.7).

Table 3. Household (HH) net ownership in Amhara Region and nationally, Ethiopia (areas <2500m).

	% of HH owning at least 1 ITN (95% CI)		% of HH owning at least 2 ITNs (95% CI)	
	2007 MIS	**2011 MIS**	**2007 MIS**	**2011 MIS**
Amhara	72.5 (64.3-80.6)	69.7 (64.3-75.0)	43.8 (37.5-50.1)	33.0 (28.7-37.4)
National	53.3 (47.4-59.2)	46.9 (43.8-50.1)	29.7 (25.4-33.9)	20.5 (18.5-22.4)

[2] *Shargie et al., 2010. Rapid increase in ownership and use of long-lasting insecticidal nets and decrease in prevalence of malaria in three regional States of Ethiopia (2006-2007).* J Trop Med. *2010; doi:10.1155/2010/750978.*

Reported ITN use the night prior to the survey among all children <5 years old in Amhara significantly increased from 14.5% in 2006 to 48.8% in 2007 and 44.7% in 2011 (Figure 7a). However, when restricted only to those living in households owning nets, net use among children <5 years old decreased from 80.6% in 2006 to 61.9% in 2007 and 59.4% in 2011 (Figure 7b). Net use among children <5 years in households owning nets was similar between Amhara and nationally in 2007 and 2011, whereas net use among all children <5 years was greater in Amhara in both 2007 and 2011 versus nationally. Similar trends were observed among pregnant women (data not shown).

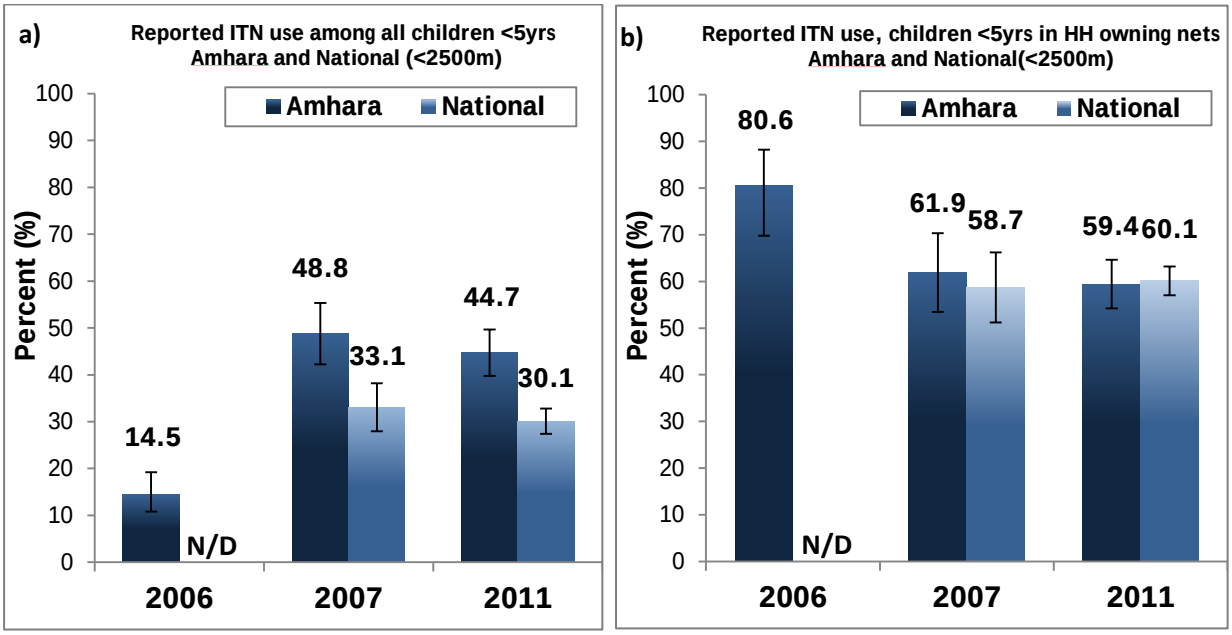

Figure 7a,b. Reported ITN use the night before the survey among children under 5 years in all households (a, left) and in households owning at least one net (b, right) in Amhara region and in Ethiopia overall. "N/D" indicates no data.

LLIN Distribution. TCC has assisted with the distribution of 5,997,332 LLINs in Ethiopia since 2007 (Figure 1, p. 3), with the majority of nets being distributed during mass distribution and replacement campaigns in 2007 (3,000,000) and 2010 (2,958,817), respectively. Recent distributions include nets provided during operational research, net replacement campaigns, and epidemic response activities (see "Response to Surveillance Data" section).

Surveillance Support. In December 2011, in collaboration with the Amhara Regional Health Bureau, TCC helped to deploy an Enhanced Surveillance System (ESS) in all 10 zones of Amhara Region to assist in collection, analysis and response to passive malaria surveillance data. The system consists of an Excel-based platform into which TCC zone project coordinators (ZPCs) enter data aggregated by district that is obtained from zonal ARHB weekly malaria reports. The system provides an interactive 'dashboard' display with district-level resolution for multiple malaria surveillance indicators (e.g. number of health facilities reporting, number of outpatients, number of suspected malaria cases, number tested by slide and RDT, number of confirmed cases by species, number of malaria inpatients, and number of inpatient malaria deaths). A total of 4,465 health facilities across 167 districts are expected to report through the ARHB system.

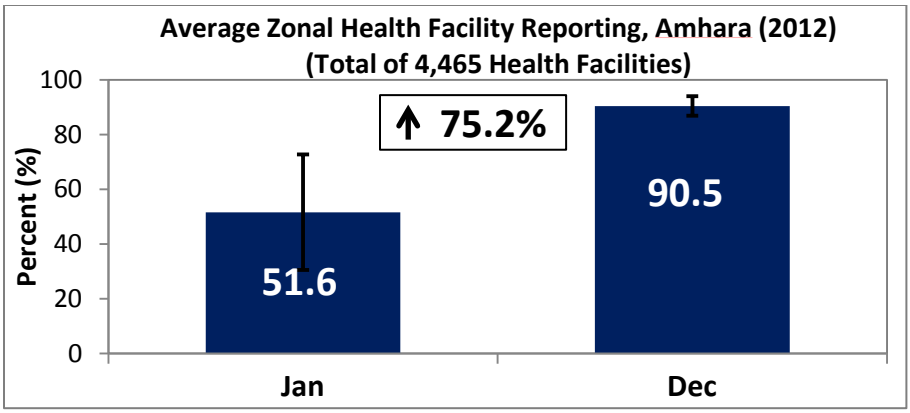

Figure 8. Average zonal health facility reporting in Amhara region, Ethiopia.

Since implementation, there has been a 75.2% improvement in health facility reporting (Figure 8), as average health facility reporting within zones improved from 51.6% in January 2012 to 90.5% in December 2012.

A total of 1,127,241 cases of malaria were reported within Amhara in 2012. Of these, 87.2% were confirmed by RDT or microscopy. As shown in Figure 9a, the five zones of West Amhara accounted for 93.1% of the Region's malaria burden. West Gojjam zone reported the greatest number of cases (404,926)—nearly double the number in the next most affected zone, North Gondar (225,818). A biphasic transmission pattern was observed in the zones with highest transmission in 2012 (Figure 9b). This is often attributed to the minor (February-March) and major (June-September) rainy seasons, with a greater proportion of the February-March cases occurring in the more mountainous east-side of Amhara.

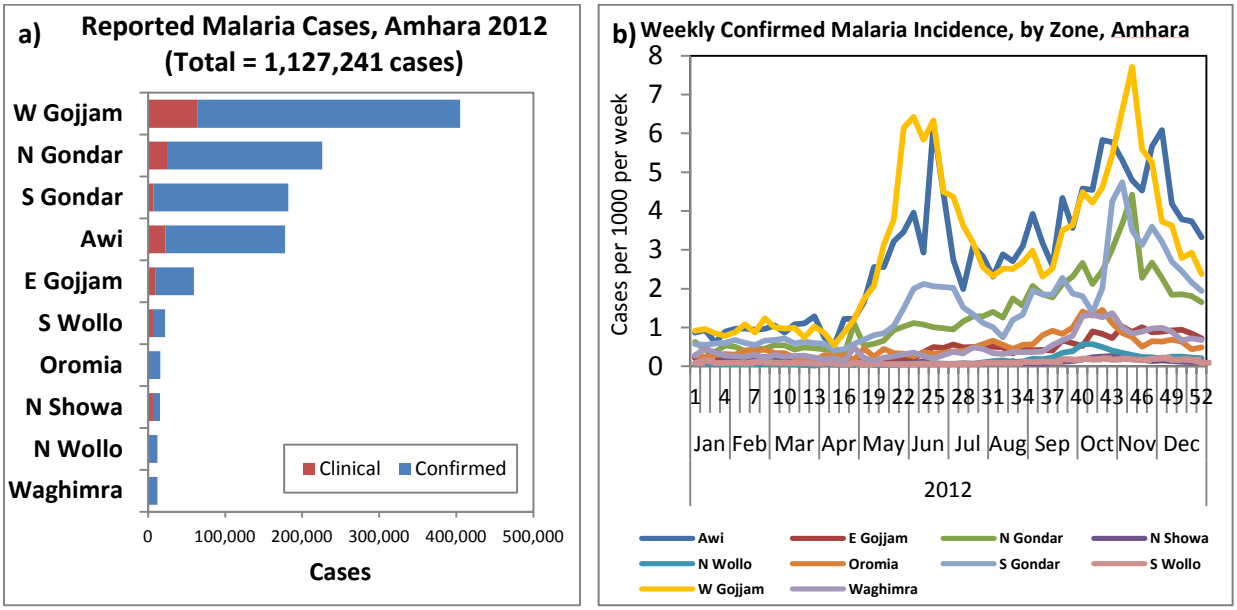

Figure 9a,b. Total number of reported clinical and confirmed (microscopy or RDT) malaria cases in Amhara region, Ethiopia, 2012, by zone (a, left); weekly incidence of confirmed malaria cases in Amhara region, 2012, by zone (b, right).

Response to Surveillance Data. Analysis of ESS data prompted several malaria outbreak investigations in Amhara in 2012. While it is difficult to compare incidence from 2012 to previous years due to the significant increase in reporting and lack of historical district-level data, these alerts were driven by zone-level year-to-year comparisons and examination of district level trends from available data. TCC and ARHB investigated a rapid increase in cases across 11 districts in west Amhara beginning in May 2012. Emergency meetings were held with officials at regional, zone, and district level to form a joint plan of action. Mass fever screen, test and treat (MSAT) campaigns were conducted in 75 villages in June 2012 in accordance with national epidemic response guidelines. Out of 508,621 persons screened, 19,247 (3.8%) were identified as febrile and were tested for malaria by RDT. Of those tested, 8,367 (43.5%) were positive for *Plasmodium* infection, with 74.1% of cases due to *P. falciparum*. House-to-house MSAT was conducted by district health officers, with assistance from HEWs and the Health Development Army (HDA). In addition, TCC and ARHB officials visited health facilities to ensure adequate supply of RDTs and anti-malaria drugs, and directed IRS supplies and supplemental LLINs to the affected communities. HEW and HDA personnel provided behavior change communication (BCC) messages on malaria prevention and control.

TCC also helped to co-ordinate responses to suspected malaria outbreaks during the main transmission season, including a focal outbreak in Wonberma district of West Gojjam zone, where 16,854 confirmed malaria cases were reported over a four week period in October and November. The response focused on 14 *kebeles* with an estimated population of about 70,000 persons, and coincided with the west Amhara MalTra Week campaign (annual mass fever screen, RDT-test and treatment for malaria coupled with mass distribution of azithromycin[3] for trachoma control), which took place the first week of November. Incidence was reduced by 81.9% from 49.4 cases per 1000 the second week of November to 8.9 cases per 1000 the second week of December. In the affected areas, a total of 32,210 febrile cases were tested by RDT, of which 21,297 (66.1%) were positive (79.6% *P. falciparum*; 20.4% *P. vivax*). Only four deaths were reported during this outbreak. This lower fatality rate vis-à-vis past malaria epidemics may be due to the use of rectal and intravenous artesunate by local health providers as pre-referral treatment for severe malaria according to recently updated malaria treatment guidelines. As before, FMOH, RHB and TCC officials were available locally to ensure that health facilities had adequate stock of RDTs and ACTs. IRS spraying with Propoxur was performed in early December to prevent further resurgence in cases.

Malaria diagnosis and treatment. In 2012, 13.7 million people were screened for fever in the context of MalTra Weeks in Amhara Region (Table 4). Of these, 90,591 persons (0.7%) presented with fever and were tested for malaria by RDT. A total of 44,771 persons (49% of those tested) were RDT-positive, yielding an overall prevalence of RDT-confirmed malaria of 0.3%. Test positivity (56%) and prevalence (0.6%) were higher in West Amhara compared to East Amhara (11%, 0.02% respectively). Persons with positive tests were offered immediate treatment with ACTs or chloroquine according to FMOH treatment guidelines. Since 2008, a cumulative total of 236,672 persons have been treated during MalTra Weeks. A total of 116,018 RDTs, 82,390 doses of ACTs and 4,067 doses of chloroquine were supplied to the health facilities throughout Amhara through MalTra Week campaigns in 2012. Cumulative totals supplied to health facilities since 2009 include 998,523 RDTs, 1,285,913 doses of ACTs, and 448,118 doses of chloroquine.

[3] *Azithromycin (Zithromax®) is donated by Pfizer, Inc.*

Table 4. Summary of MalTra Week campaigns in Amhara Region, Ethiopia, 2012.			
	MalTra Week VIII—East Amhara (May 2012)	**MalTra Week IX—West Amhara (November 2012)**	**TOTAL FOR 2012**
Number of people attending	6,193,022	7,514,787	13,707,809
Number with fever (%)	13,222 (0.2%)	77,369 (1.0%)	90,591 (0.7%)
Number RDT-positive (% of tested)	1,397 (11%)	43,374 (56%)	44,771 (49%)
Prevalence of malaria	0.02%	0.6%	0.3%
Number treated with ACT	855	35,512	36,367
Number treated with chloroquine	520	7,811	8,331
# of persons referred	9,525	33,815	43,340

Information, education and communication (IEC). MalTra weeks also provide an opportunity to disseminate health education messages related to malaria prevention and control. In 2012, health education was offered to the 13,707,809 people who attended MalTra Week campaigns in east and west Amhara, as well as 1,087,180 persons who received mass distribution of ivermectin[4] for onchocerciasis control in portions of Amhara, Oromia, SNNPR, and Beneshangul Gumuz regions. However, a coverage survey conducted immediately after MalTra IX indicated that only 45.4% of the 1,050 persons surveyed reported receiving malaria health education during MalTra. To address this gap, MalTra training materials will be revised in order to improve delivery of malaria education components beginning with MalTra XI (November 2013). An additional 12,624 households received education on LLIN care and use and malaria treatment seeking behavior during separate household LLIN assessments (see Monitoring and Evaluation, below), while 38,896 children received similar messages during school-based assessments. The Carter Center also disseminated 18,873 posters, flyers, and banners with malaria education messages in 2012.

Strengthen health worker capacity. In 2012, TCC zone project coordinators, in collaboration with FMOH and regional officials, conducted monthly supportive supervision activities at 754 health posts, 650 health centers, and 384 district health offices across TCC-assisted regions of Ethiopia. A total of 8,204 health workers were trained in RDT use and malaria case management.

Monitoring and evaluation. TCC helps conduct ongoing assessment of LLIN ownership, use and care at both the community and school levels in Amhara, SNNPR, Oromia and Beneshangul-Gumuz regions of Ethiopia. Evaluation teams are comprised of TCC zone project coordinators, woreda health officers, and health extensions workers. In

Table 5. Routine household (HH) surveys of net ownership, care, and utilization in Amhara (n=10,463 households), 2012.	
% HH owning at least 1 LLIN	84%
% HH with at least 1 LLIN per sleeping space	64%
% HH with some or all LLINs needing repair	38%
% HH in which all LLINs were hanging at appropriate height	38%
% HH where all members slept under LLINs the previous night	31%

[4] *Ivermectin (Mectizan®) is donated by Merck & Co.*

Amhara, a total of 10,463 households were assessed in 2012. As shown in Table 5, household net ownership was high (84%), but not sufficient to cover all sleeping spaces (64%). More critically, only 31% of households reported that all members slept under an LLIN the previous night, and only 38% of households were found to have LLINs hanging at appropriate height. Nets appeared to be in good condition however, as only 38% of households owned nets that were in need of repair.

School-based assessments evaluated net ownership and utilization for 38,896 students in 227 (3.2%) schools in Amhara. While 82% of students reported that their household owned at least one LLIN, only 43% of students reported sleeping under a LLIN the previous night.

Operational Research. TCC and Malaria Control and Evaluation Partnership in Africa/Program for Appropriate Technology in Health (MACEPA/PATH) have recently partnered to support FMOH and ARHB in a malaria elimination learning project in eight districts of Amhara (see following Presentation).

Support to FMOH and Regional Health Bureaus. In addition, TCC regularly participates in national-level committees and meetings such as the Malaria Control Support Team and Technical Advisory Committee, and the Regional Malaria Commodity Follow-up Steering Committee, and *ad-hoc* committees to revise the National Strategic Plan for Malaria Prevention, Control and Elimination. TCC regularly provides vehicles for FMOH activities and for response to reported malaria outbreaks, support for IRS transport and application as an epidemic response measure, and financial support for training and meetings at the regional levels.

Malaria Elimination Demonstration Project in Amhara

Presented by Dr. Gregory Noland, Epidemiologist, Malaria Control Program, The Carter Center

The Carter Center's MCP recently entered into a collaborative partnership between FMOH, ARHB and the Malaria Control and Evaluation Partnership in Africa (MACEPA) to develop, implement and evaluate a comprehensive malaria elimination strategy in selected areas of Amhara Region, Ethiopia. The project aims to advance the FMOH goal of malaria elimination within specific geographical areas with historically low malaria transmission by 2015. Based on TCC's belief that elimination efforts should start in the hardest areas first, the project also includes districts across a range of malaria transmission intensities. The lessons learned and data generated from this project are expected to support the National Malaria Prevention and Control Strategic Plan to scale up malaria elimination activities in every region of the country and thus advance the ultimate goal of nation-wide malaria elimination in Ethiopia.

The project will initially focus on eight districts encompassing a range of low, medium, and high transmission intensity strata defined by recent trends in passive surveillance (Table 6). Districts in North Gondar zone (which are classified as very high transmission intensity) were also selected because these districts receive annual mass drug administration (MDA) of ivermectin for onchocerciasis and there is interest in evaluating ivermectin as a potential tool for malaria control.

Table 6. Districts selected for collaborative elimination project in Amhara Region, Ethiopia.

Malaria Transmission Intensity	Zone	Districts	Population (est. 2013)	# Health Facilities	Max. Weekly Confirmed Malaria Incidence, 2012 (cases per 1000)
Very High (+ Oncho. area)	North Gondar	Metema	121,963	23	38.2
		Gendawuha	24,542	6	27.0
High	West Gojjam	Bahir Dar Zuriya	202,119	41	10.2
		Mecha	323,355	56	8.2
Medium	South Wollo	Tehuledere	130,400	37	0.4
		Kalu	206,516	51	0.6
Low	East Gojjam	Awabel	134,492	42	1.2
		Aneded	100,901	23	0.8
Totals			**1,244,288**	**279**	

A memorandum of understanding (MOU) was signed by all partners in January 2013. This was followed by a two-day Steering Committee meeting held in Bahir Dar, Ethiopia, February 6-8, 2013 during which representatives from all partners discussed the project governance, activities and plans (see Frontispiece Photo 3, p. vi). The project will be led by FMOH, ARHB and its constituent infrastructure.

The first major activity of the project will be a district-level "mini-MIS" that determines coverage and use of core malaria interventions, treatment seeking behavior and adherence to anti-malaria drugs in each of the target districts, as well as malaria prevalence as measured by RDT. This is currently planned to take place in April and May in order to determine net and other commodity needs in advance of the major transmission season, which begins as early as August in parts of Amhara. Full results of the survey will inform the selection of specific intervention packages within the selected districts and guide progress toward elimination.

The planned intervention package will include the continued scale up of existing tools paired with evaluation of new tools. Data from the recent MIS survey show that major malaria prevention measures

(LLIN coverage and utilization; IRS coverage) have not yet reached target thresholds, indicating the need to further support these core interventions. The project also aims to incorporate innovative approaches for malaria elimination that may include: robust surveillance systems capable of detecting clusters of cases in real-time; reactive case detection with potential MDA in areas surrounding index cases; mass screen, test, and treat activities; evaluation of ivermectin MDA on malaria incidence; and potential evaluation of novel drugs or drug formulations to target transmissible (gametocytes) and dormant (*P. vivax* hypnozoites) forms of the parasite in humans. The partners also recognize that entomologic parameters are of key importance in an elimination effort (insecticide resistance, population and age structures, feeding and resting habits), but will rely on other in-country institutions for such work.

In general, a stepwise approach for intervention package has been outlined that consists of:

Step 1: Improving surveillance.

Step 2: Identifying hot-spot areas and taking steps to reduce transmission intensity through mass test and treat and/or mass drug administration.

Step 3: Moving to case investigation by tracking all confirmed cases and testing and treating around index cases.

Step 4: Preventing re-introduction.

Some of the recognized challenges facing malaria elimination efforts in Amhara include:

- *P. vivax*. In order to achieve the FMOH goal of malaria elimination, the project should include strategies that target all "malarias"—including *P. vivax*. This is complicated by the lack of information on prevalence of G6PD deficiency in Ethiopia, precluding immediate use of primaquine for curative treatment of hypnozoites. Partners agreed that the timetables for *P. vivax* elimination will be different than for *P. falciparum*, but that the project should plan for strategies attacking both parasites.
- Migrants. Amhara, in particular North Gondar zone, is a fertile area with a large influx of migrant farm workers each agricultural season. Officials stated that these workers overwhelm the local health infrastructure, and that existing prevention methods (LLINs, IRS) may not be suitable for such populations. As many migrant workers come from areas of very low transmission, they may have little protective immunity, and furthermore may carry parasites back to their home areas, thus fueling parasite transmission throughout the region. The elimination effort must consider the needs and suitable interventions for such special populations.
- Asymptomatics. While the true proportion of asymptomatic infections is not known, recently published models suggest that it is expected to be high in low transmission areas such as Ethiopia. Current detection methods (RDT, microscopy) likely fail to detect the majority of asymptomatic infections, so strategies such as MDA will be necessary to treat the infectious reservoir in humans.

Nigeria National Malaria Control Program Report

Presentation by Dr. Nnenna Ezeigwe, National Coordinator, National Malaria Control Program, Federal Ministry of Health

Background

Nigeria alone accounts for a quarter of the malaria burden in Africa. Over 90% of the population (>160 million people) is at risk for malaria infection and approximately 50% of the population will experience at least one episode each year. Malaria accounts for an estimated 67% of all health facility attendance and is responsible for ~30% of deaths among children and 11% of maternal mortality in Nigeria. The social and economic burdens of malaria are also significant: malaria reduces the GDP of Nigeria by approximately 1% annually and is the leading cause of absenteeism. The annual costs associated with the disease are estimated at approximately 3 billion USD.

Malaria is endemic in Nigeria, with seasonal peaks during the rainy season. There are three main transmission zones. In the southern part of the country, malaria is endemic and perennial, with active transmission for 7-12 months of the year. The majority of the northern part of the country is characterized by endemic and seasonal transmission, with a transmission season of 4-6 months. The northeastern-most corner of the country has epidemic or strongly seasonal malaria, with transmission for 1-3 months of the year. Results from a recent risk mapping exercise suggest a gradual shift from hyperendemic to mesoendemic epidemiological patterns since 2000.

The vision of the Nigerian National Malaria Control Program (NMCP) is a malaria-free Nigeria. The 2009-2013 NMCP Strategic Plan set ambitious targets of 80% of households owning at least two insecticide-treated nets (ITN), 80% of children under-five and pregnant women sleeping under an ITN, 100% of pregnant women attending antenatal care (ANC), receiving at least two doses of intermittent-preventive therapy (IPTp), and a 50% reduction in malaria morbidity and mortality.

Nigeria has made considerable progress in scaling up coverage with key interventions outlined in the national strategic plan. The country plans to complete its nation-wide mass LLIN distribution campaign in May of 2013, and thus the NMCP has begun efforts to scale up other components of the national strategy, including routine LLIN distribution systems (the “Keep Up” phase), malaria surveillance, insecticide resistance and drug quality monitoring, and access to prompt, effective and affordable treatment.

The impact of the scale-up of all components of the national strategy on malaria and anemia prevalence will be measured in future years through comparisons with data from the 2010 National Malaria Indicator Survey, the results of which were officially released in 2012. At the time of this survey, 42.0% (95% CI: 37.8%-46.2%) of children younger than five years of age tested positive for malaria by microscopy and 51.5% were positive by RDT (95% CI: 47.1%-55.9%). In this same age group, 71.6% were anemic (Hg <11g/dl), and 12.6% had severe anemia (Hg <8g/dl).

Nigerian National Malaria Control Strategy: Progress update

The Nigerian NMCP strategic plan focuses on four primary interventions: long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), effective case management, and malaria prevention in pregnancy.

The plan also focuses on a number of cross-cutting strategies including: advocacy, communication and social mobilization (ACSM); procurement and supply chain management; monitoring and evaluation; program management; and intersectoral collaboration.

During the 2012 malaria program review meeting, the presentation by the Nigerian NMCP focused on the elements of the strategy that overlap with current Carter Center primary activities in Nigeria.

Long-lasting Insecticidal Net Distribution: Scaling up for Impact (SUFI)
In 2009, the NMCP embarked upon the largest national LLIN campaign conducted in any country to date, with a target distribution of 64 million LLINs in approximately 32 million households across 36 states plus the Federal Capital Territory (FCT). The NMCP strategy calls for the distribution of two LLINs per household through stand-alone mass campaigns designed to saturate states with LLINs as rapidly as possible. The campaigns are conducted by a variety of different partner organizations, in collaboration with the state Ministries of Health, using a standard implementation guide and toolkit, and with oversight by the NMCP.

Mass campaigns were conducted in nine states in 2009, an additional seven states in 2010, 12 states plus FCT in 2012. In 2012, the NMCP oversaw the distribution of over 6 million LLINs in seven[5] states (Figure 10), bringing the total number of LLINs distributed since 2009 to 51,703,880 (80.7% of the total national target). As of March 2013, campaigns had been completed in all but four states: **Delta**[6], Kogi, Osun and Oyo. These four states together are targeted to receive just under 7 million LLINs. Replacement campaigns are also scheduled for Sokoto and Ogun states for 2013; the NMCP plans to distribute approximately 2.5 million LLINs in each state, in addition to those received during the initial mass campaigns.

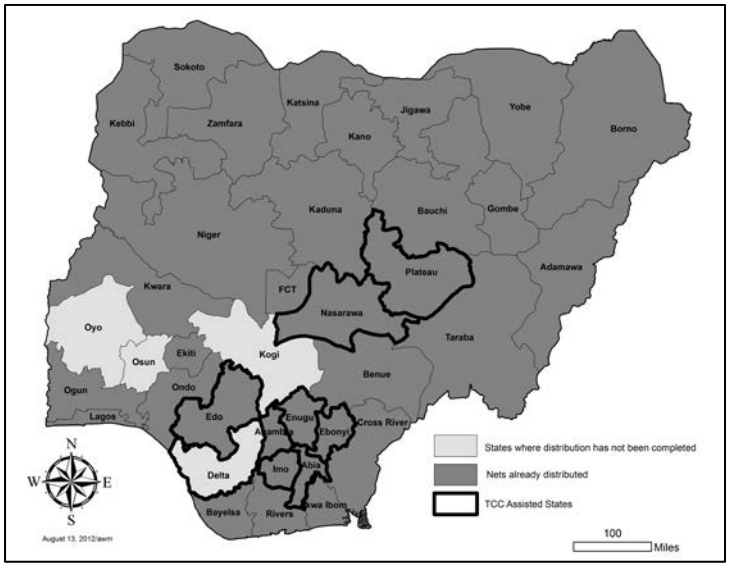

Figure 10. Status of state LLIN mass distribution campaigns in Nigeria (as of March 2013).

[5] *In some states the campaign was conducted in multiple "waves" and thus these states are represented in the counts of state campaigns for multiple years.*
[6] *Note: **Bold font** is used to indicate states that are assisted by The Carter Center.*

Some of the challenges experienced during the national LLIN distribution campaign include: funding and procurement delays at the national, state and LGA levels; loss of nets from warehouses; LLINs in warehouses approaching their expiration dates before they could be distributed; crowd management at distribution points and warehouses; and continued low net use despite significant increases in net ownership. The valuable lessons learned and the strategies developed to address these challenges will be applied to future LLIN distribution activities, both in the context of routine distribution and mass campaigns.

Results from the 2010 National Malaria Indicator Survey, when compared to data from earlier time points, highlight the progress that has been made toward achieving national targets for LLIN ownership and use (See Figure 11), and illustrate the work that remains to be done to fully achieve those targets. In 2010, 41.5% of households, nationwide, owned at least two ITNs; 29.1% of children under five in all households slept under an ITN the previous night; and 59% of children under five slept under an ITN in households owning at least one ITN. Regional comparisons of net ownership reveal considerable variability in the percentage of households owning at least two nets, with the highest coverage in the Northeast (over 60%) and much lower rates of ownership in the Southeast and Southwest regions where mass campaigns have not yet been completed, as one would expect. When it comes to net use, persons between the ages of five to fourteen, males and urban residents appear to be less likely to use nets than others. Regional differences in net use seem to primarily reflect differences in net ownership as use is lowest in the regions with lowest ownership.

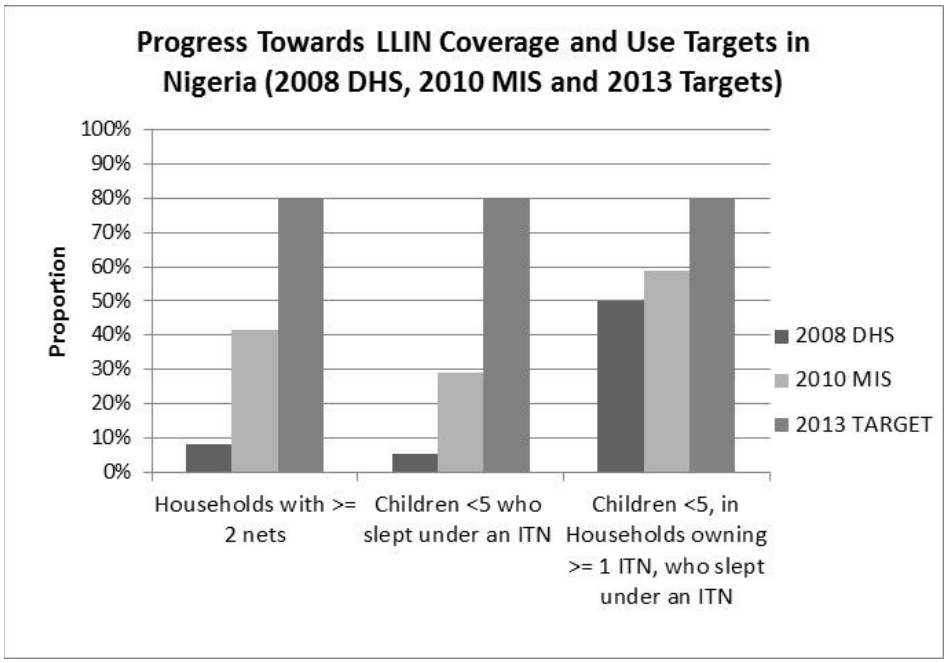

Figure 11. Progress toward LLIN Coverage and Use Targets in Nigeria (2008, 2010 and 2013 targets).

In order to be able to sustain the gains achieved through the mass distribution campaigns and further scale-up net ownership to achieve universal coverage (2 LLINs per household), the Nigerian NMCP is in the process of finalizing the national strategy for continuous routine LLIN distribution. The proposed strategy calls for distribution through the following channels: immunization clinics, antenatal care clinics, school-based distributions, community-based distributions, Maternal Newborn and Child Health Weeks (MNCHWs) and the commercial retail sector. The NMCP estimates that it will be necessary to

distribute ~97 million LLINs in 2013 and 100,000,000 LLINs in 2014 through these channels, as well as through additional mass campaigns, to achieve universal coverage.

The NMCP is also implementing a plan for monitoring and managing insecticide resistance. Sentinel sites will be established for this purpose.

Case Management and Intermittent Preventive Therapy in Pregnancy (IPTp)
In 2011, Nigeria launched the first phase of the Affordable Medicines Facility-malaria (AMFm) program. AMFm enables countries to purchase first-line malaria treatments at significantly reduced costs and to pass those cost savings on to patients at both public and private sector facilities. As the result of this program, artemisinin-based combination therapies (ACTs) are now provided at no cost at some public health facilities, and the NMCP is engaged in continuous efforts to expand the number of facilities with consistent and adequate stock of RDTs and ACTs. Furthermore, the NMCP and its partner organizations are training Community-Oriented Resources Persons (CORPS) to use RDTs and to treat malaria appropriately with free ACTs based on either clinical signs or the results of a diagnostic test. The NMCP is working with Proprietary Patent Medicine Vendors to increase opportunities for the sale of efficacious malaria treatments at subsidized costs. According to malaria surveillance data from 2012, ~42% of all malaria cases captured by the surveillance system (see below) were treated with ACTs.

The NMCP is also working with partner organizations to launch a pilot study of Seasonal Malaria Chemoprophylaxis (SMC) in two states of northern Nigeria.

National Malaria Surveillance
Malaria case data in Nigeria are reported by each state through the Integrated Disease Surveillance and Response (IDSR) system. However, given the low availability of RDTs nationwide, these data primarily capture clinical malaria (fever cases) rather than confirmed malaria. Additionally, IDSR reporting by private health facilities is very poor. Given this, the NMCP has introduced a separate program-specific Roll-Back Malaria (RBM) reporting system in select health facilities. These health facilities are provided with RDTs to allow for the reporting of confirmed cases. This RBM system has been introduced in all 36 states plus the Federal Capital Territory and includes 11,610 public health facilities (~51% of all public health facilities) and 6,434 private health facilities (~5%). Some key indicators reported by these facilities on a monthly basis are listed below:

- # of children under five with fever who receive a diagnostic test
- # of children under five with confirmed uncomplicated malaria treated with ACTs
- # of children under five treated with ACTs on basis of fever only
- # of persons 5-36 years and 36+ years with fever who receive a diagnostic test
- # of persons 5-36 years and 36+ years with confirmed uncomplicated malaria treated with ACTs
- # of pregnant women receiving IPT1 & 2 (data from HMIS reports)

In 2012, this RBM surveillance system captured 13,166,487 malaria cases (confirmed and unconfirmed), which accounted for 25% of hospital attendance. Of those, 42% (n=5,579,123) were treated with ACTs. A total of 4,787 malaria-attributable deaths were reported through this system, but it is important to note that this is not a measure of the total number of deaths due to malaria in Nigeria as data are reported by only a small proportion of health facilities and many persons may die of malaria without ever seeking care from an authorized public or private facility.

Plans for improving surveillance reporting in the future include developing modalities for capturing data from a greater proportion of private facilities, engaging secondary and tertiary facilities to improve data reporting and introducing an electronic data reporting system (DHIS2).

Collaboration between Malaria and LF Programs in Nigeria

During 2012, the NMCP was actively engaged in a number of different activities designed to increase collaboration between the national malaria and lymphatic filariasis programs in Nigeria, and thus maximize potential synergies between the two programs. Given the fact that both diseases are transmitted by the same vector in Nigeria, and LLINs are an effective strategy for both, this is a natural partnership. By pooling resources (knowledge, technical capacity, experience, workforce, funds, etc.), it should be possible to accelerate the scale-up of interventions for both diseases. A few of the specific potential benefits for the malaria control program include: access to the large network of existing community volunteers who are involved in MDA for LF; additive or multiplicative increases in net use as the result of integrated behavior change messages that emphasize that sleeping inside a net can protect you from big legs and big scrotum as well as malaria; and additional reductions in anemia (due to reductions in soil-transmitted helminth infections as the result of MDA).

In March 2012, the FMOH hosted a conference attended by the NMCP and the National Lymphatic Filariasis Elimination Program to explore the opportunities for co-implementation that would benefit both malaria and LF programs. The conference, co-sponsored by TCC, was chaired by former head of state General Dr. Yakubu Gowan and attended by over 200 people including Federal and State Ministry personnel, non-governmental development organizations (NGDOs), partner organizations, donor agencies, and the mass media (see Frontispiece Photo 2, p. v). As a result of the commitment mobilized by the meeting, the FMOH organized a stakeholders' meeting and established a technical working group to develop operational guidelines for the collaboration. The technical working group prepared a rough draft of these guidelines in 2012 and plans to finalize them in 2013. The goal is to begin implementing collaborative and co-implemented activities at the sub-national levels before the end of 2013.

National and Sub-National Commitment to the Malaria Control Program in Nigeria

The Federal Government of Nigeria substantially increased the budget allocated for malaria control in the appropriation bill passed in 2012. A number of states have also systematically increased funding for malaria control, including Katsina, Borno, Niger, Lagos, Rivers, Yobe and **Ebonyi** (a TCC-supported state)**.** In addition, the NMCP and its partners are engaged in high-level advocacy at the sub-national level to mobilize additional resources for malaria control.

The Carter Center Malaria Control Program: Nigeria Progress Report

Presentation by Mr. Adamu Sallau, Director, Malaria Control Program, The Carter Center, Nigeria

The Carter Center-Assisted Malaria Control Program in Nigeria: Priorities and Activities

The priorities of the Carter Center's (TCC) Malaria Control Program (MCP) in Nigeria are to provide assistance to the federal and state Ministries of Health for their malaria activities and to demonstrate the effectiveness of innovative approaches to malaria control in order to reduce and eventually eliminate malaria transmission in nine states assisted by TCC: Abia, Anambra, Delta, Ebonyi, Edo, Enugu, Imo, Nasarawa, and Plateau (Figure 12). Malaria control activities in Nigeria have been integrated with TCC's other disease control and elimination programs since 2004 when TCC began distributing insecticide treated bed nets (ITNs) in the context of mass drug administration (MDA) in Plateau and Nasarawa states. TCC formally launched its Nigeria malaria control program in 2010. Integration has continued to be a defining characteristic of TCC's malaria activities, with particular emphasis on the effectiveness of LLINs for both malaria control and lymphatic filariasis (LF) elimination (see following section "National Malaria-LF meeting").

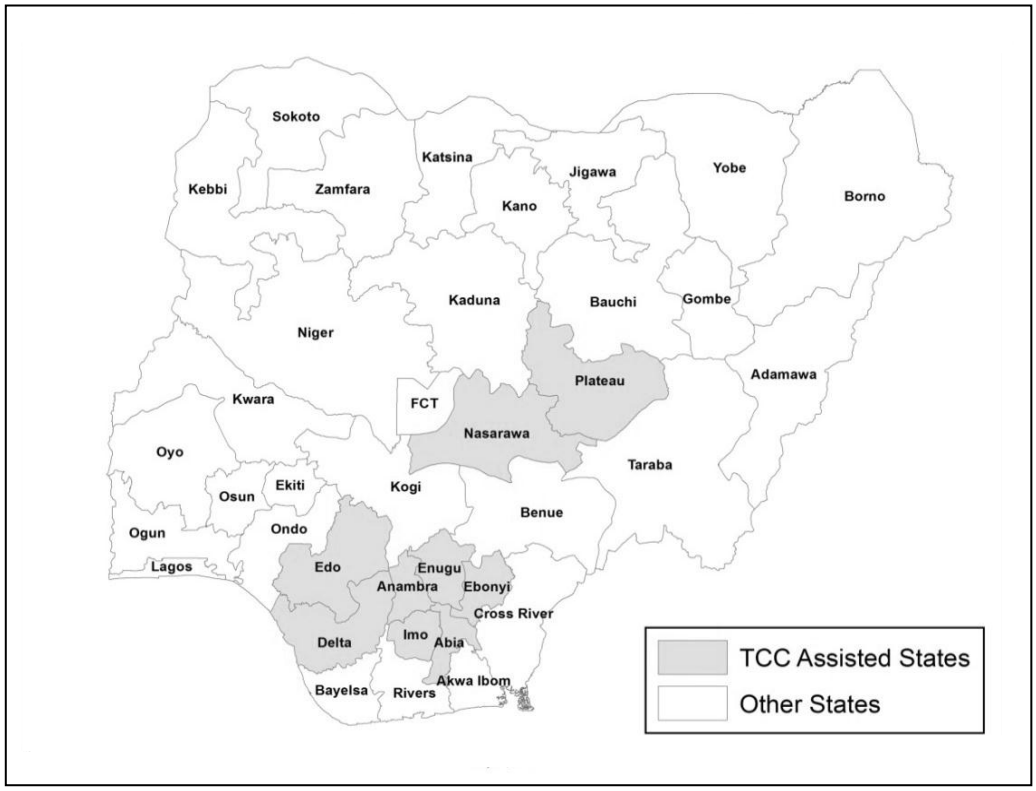

Figure 12. The nine Carter Center-assisted states in Nigeria.

To date, programmatic interventions in Nigeria have focused on the distribution of LLINs in the context of both routine on-going distribution and nationwide campaigns, as well as on behavior change communications (BCC) interventions to encourage the use and appropriate care of LLINs. TCC is finding innovative ways to engage the volunteer community-directed distributors (CDDs) who conduct MDA for

other disease programs in malaria control activities, including LLIN distribution, monitoring and BCC. TCC's monitoring and evaluation activities include routine process evaluations as well as large-scale surveys to assess malaria and anemia prevalence, net ownership, and net use. TCC Nigeria also provides assistance with post-campaign evaluations of LLIN distributions, and provided support for a National Malaria Indicator Survey conducted in 2010. Innovative pilot projects and operational research activities conducted in Nigeria have included a study of the effectiveness of different net distribution strategies on malaria and LF transmission, a study on the cost-effectiveness of integration, and a pilot demonstration of a community-based behavior change communications intervention. The specific activities conducted in 2012 in each of the categories described above are presented in detail here.

Programmatic Interventions

LLIN Distribution

Between 2004 and 2012, TCC Nigeria provided support (technical and financial) for the distribution of a total of 7,675,963 insecticide-treated nets[7] in six states of Nigeria (Plateau, Imo, Abia, Ebonyi, Edo, and Enugu), through a combination of mass statewide campaigns conducted as part of the national scale-up and a number of smaller localized campaigns conducted as part of routine distribution or operational research projects (Figure 13). Out of the nine TCC-assisted states in Nigeria, all but one have now completed their statewide campaigns. The last remaining state, Delta, is scheduled to complete its campaign in May of 2013.

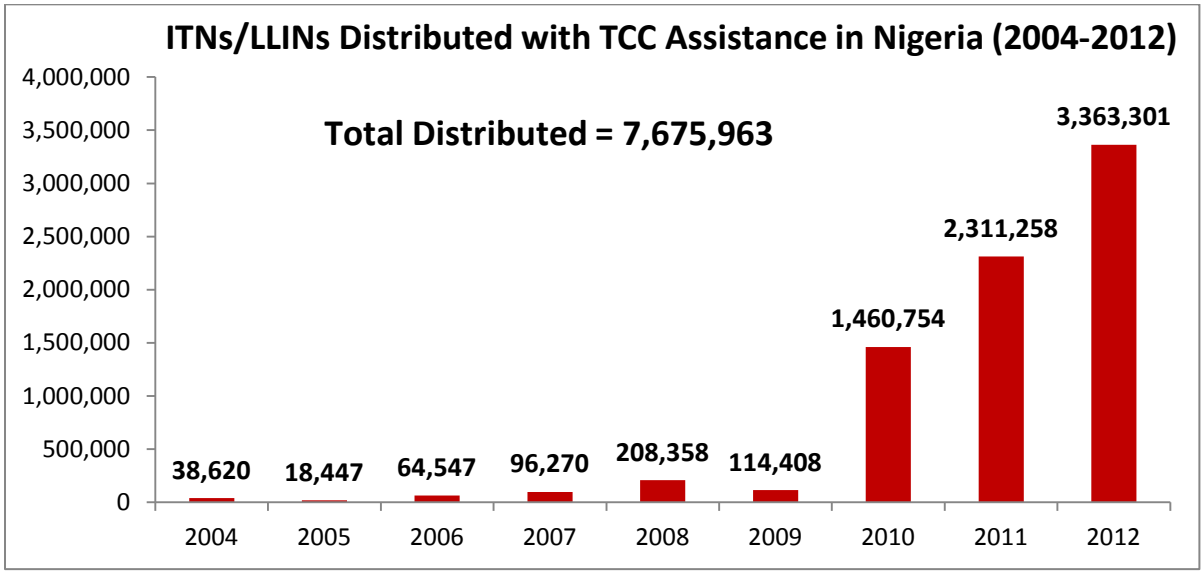

Figure 13. Annual number of insecticide treated nets (ITNs) distributed in Nigeria with support from The Carter Center between 2004 and 2012.

[7] *All nets distributed since 2006 have been LLINs. However, the nets distributed prior to 2006 were insecticide-treated nets that required periodic re-treatment.*

Out of the cumulative total of LLINs distributed with TCC assistance, 3,319,046 were distributed in 2012, in the context of mass distribution campaigns in Imo (1,451,209 LLINs, 78.8% of state target), Abia (710,530 LLINs, 54.9% of state target) and Edo (1,157,307, 78.8% of state target). This is the greatest number of nets distributed with TCC support in a single year to date. TCC provided financial support to cover training costs, technical support for all phases of the campaigns in these states and vehicles, and also transported supplies. In addition, The Carter Center coordinated advocacy visits by former head of state General Yakubu Gowon to each state to encourage the timely release of funds for the campaigns by state and local governments. TCC worked closely with the state and federal MOH to resolve any challenges encountered during the distributions.

With the national LLIN campaign coming to an end, TCC's Nigeria office is now turning its attention to developing innovative, effective and sustainable strategies for routine distribution of LLINs at the community level. These distributions will provide nets to those households that were missed during the mass campaign, as well as provide a mechanism for replacing nets that are too worn to be used and distributing nets for all children born since the campaign. In 2012, the Nigeria program piloted a community based LLIN monitoring and distribution strategy, using CDDs, with the goal of covering every sleeping space in Kanke LGA of Plateau state. During this activity, 339 CDDs distributed 44,455 Duranet brand LLINs donated by Clarke Mosquito Control to a total of 17,985 households in 288 communities. Data on net needs were collected by CDDs in the context of MDA activities in all LGAs to inform future distribution activities. Engaging CDDs in malaria control activities will not only facilitate the rapid scale-up of continuous distribution at the community level, but also ensures that we can preserve the valuable community volunteer system even beyond the point at which NTD programs stop mass drug administration activities.

Behavior Change Communications (BCC) for malaria and LF

In 2011, TCC assisted the Ebonyi state Roll Back Malaria (RBM) program with the implementation of a new community-based behavior change communication strategy that was designed to increase rates of consistent and appropriate bed net use and care following the completion of the mass LLIN distribution campaign. The strategy, which was piloted in six sentinel villages of Ebonyi state, was informed by social behavioral theory and addressed a wide range of the possible determinants of net use. The messages employed in the context of this project emphasized the effectiveness of bed nets for preventing the manifestations of LF as well as malaria. Nigerian adults who consider malaria episodes as a minor illness (due to their having developed a degree of immunity to the infection) may have greater fear of developing "big legs" or enlarged scrotum. Thus it is possible that messages linking bed nets to LF prevention will be more effective at encouraging universal net use by all members of the population, especially adult men.

In 2012, the Nigeria team worked to modify the materials and strategy used in Ebonyi for the planned scale-up of BCC activities in Plateau state, using the existing network of CDDs. As part of these efforts, the staff conducted 16 focus groups in three different communities (one rural, one urban, and one semi-urban) in order to develop a better understanding of factors that influence net use in this context, to identify key messages for use in future BCC activities and to obtain feedback on existing BCC visual aids to inform the development of culturally-appropriate and context-specific materials for use in Plateau state. Four focus group discussions were conducted with individuals representing each of the following groups: boys aged 14-18, women aged 18-35, women aged 40-50 and men aged 35-50.

The focus group discussions suggested answers to a number of important questions raised by past surveys conducted in Plateau state: 1) what might explain lower net use among people 10-20 years of

age, compared to other age groups?; and 2) what might explain non-net-use among the subset of people with access to nets who do not use them? With regards to the first question, participants' responses suggested that net use may be lower among adolescents because they were not prioritized during net distribution and thus have limited access to nets. They also indicated that this could be due to the strong emphasis on women and young children as vulnerable groups during net distribution and health education activities, either because households give priority to those groups when there are not enough nets to go around or because adolescents think they are not at risk and do not want to be considered weak or vulnerable. There is a perception that young people think nets are "uncool" and do not want their friends (or boyfriends/girlfriends) to know that they use them. Finally, young people may have difficulty using a net because they come home late at night, when other household members are already asleep, and they do not want to disturb others by their efforts to prepare their nets for sleeping. Factors suggested to explain why some people who have access to nets still do not use them include concerns about safety of insecticides, low perceived risk when mosquito populations are low (dry season), perceptions that nets are uncomfortable to sleep under and a hassle to use, discordant attitudes towards net use among people who share a sleeping space, and perceived invulnerability due to beliefs that malaria is primarily a disease that threatens *other* types of people who are fundamentally different from themselves according to key characteristics (age, socio-economic status, rural v. urban residence, etc.), that certain people have "strong blood" or that drinking alcohol before bed has protective effects.

The focus group data highlights specific gaps in malaria and LLIN knowledge, and in skills required to use and care for LLINs appropriately. While people seem to generally know that malaria is transmitted by mosquitoes and that malaria can be prevented by sleeping inside an LLIN, less widespread is the knowledge that malaria has symptoms other than fever, that LF is also transmitted by mosquitoes and can be prevented by sleeping inside a net, that LLINs are different from ITNs and don't need to be retreated, and that LLINs can be washed. Additionally, participants in several different focus groups expressed concern about the safety of LLINs, citing stories they had heard about children who died after either chewing on an LLIN or being put down to sleep inside one. People indicated that they did not know how to hang a net over a mat on the floor or ground, how to wash an LLIN properly or how to negotiate net use with a sleeping space partner who does not want to use a net.

Key messages identified for emphasis during future BCC activities in Plateau state include the following:

- Everyone is susceptible to malaria – not only women and children.
- Mosquito nets can protect you from the disease that causes big legs and swollen scrotum (LF).
- Help your family members use their nets (remind them, pull down the sides of nets for those who arrive home late at night, pull down and tuck in the sides of nets over people who have fallen asleep without them).
- Mosquito nets have advantages in addition to protecting you from malaria and LF, including keeping your skin beautiful, providing privacy, making your room look nice, protecting you from snakes and biting insects, protecting you from debris that falls from the ceiling, and showing that you are a responsible person who cares about and takes care of his family.
- You can hang an LLIN over any sleeping space, even a mat on the floor or ground.
- LLINs do not need to be retreated and can be washed. Wash your net no more than 3-4 times a year, using ordinary soap like Lux or Duck soap.
- LLINs are safe to sleep inside.

Engagement in FMOH and NMCP Activities at the National Level

In March 2012, TCC co-sponsored a two-day meeting, hosted by FMOH, to explore the shared opportunities between the national malaria and LF programs. The common link between malaria and LF is the *Anopheles* mosquito, which is the vector for both parasites in Nigeria. The conference was chaired by former head of state General Dr. Yakubu Gowon and attended by over 200 people including Federal and State Ministry personnel, non-governmental development organizations (NGDOs), partner organizations, the Bill & Melinda Gates Foundation and donor agencies, and the mass media (see Frontispiece Photo 2, p. v). The meeting focused on identifying areas of programmatic synergy, and promoting active collaboration to improve efficiency and increase the impact of both programs. Integrated efforts could accelerate the scale-up of long lasting insecticidal net (LLIN) and mass drug administration interventions, with increased reductions in attributable-morbidity and transmission for both diseases. As a result of the commitment mobilized by the meeting, the FMOH organized a stakeholders' meeting and established a technical working group to develop operational guidelines for the collaboration. The technical working group prepared a rough draft of these guidelines in 2012 and plans to finalize them in the spring of 2013. The goal is to begin implementing collaborative and co-implemented activities at the sub-national levels before the end of 2013.

In addition, TCC participated in technical working groups at the national level that were tasked with the development of standard operating procedures for the collaboration between malaria and LF programs and the national strategy for continuous routine LLIN distribution. TCC representatives also participate in the NMCP's Integrated Vector Management, Social Mobilization-Communication-Advocacy (SMCA) and Monitoring and Evaluation technical working groups.

Monitoring and Evaluation

Routine Monitoring of Program Activities

In addition to continuous routine monitoring of the inputs and outputs associated with TCC's programmatic activities, TCC's Nigeria offices conduct periodic surveys to evaluate the malaria program's effects on intermediate outcomes such as malaria knowledge and attitudes, bed net ownership and use, and bed net maintenance, as well as its ultimate impact on malaria prevalence and anemia. In October-November 2012, TCC conducted a malaria indicator survey in Plateau state in order to assess the effects of the mass LLIN distribution campaign conducted in the state in 2010. A total of 80 clusters (census enumeration areas or, in the case of large areas, segments thereof) were systematically selected for participation, and all households in each cluster were included in the survey. The final sample comprised 1,837 households in 76 clusters (4 clusters were inaccessible due to road conditions or security threats). All children less than 10 years of age were tested for malaria and anemia, and persons of all ages in every third household were tested for malaria. A total of 5,773 persons were tested for malaria, and 3,319 children under-10 were tested for anemia. Data entry, cleaning and analysis are currently underway.

Malaria Surveillance in TCC-Assisted States

TCC provides support to the MOH in several states (Plateau, Nasarawa and Ebonyi) to facilitate the consistent collection and reporting of routine malaria surveillance data. During the 2012 program review meeting, surveillance data from Plateau state were presented in detail to illustrate the current state of surveillance reporting. Of the 884 registered health facilities in Plateau state (757 public and

127 private), 318 (36%) are expected to report routine malaria data on a monthly basis through the RBM reporting system. This subset of facilities is prioritized to receive RDTs and ACTs. However, only 255 (29%) of these facilities currently receive RDTs and only 510 (7%) of the 7072 health workers in the public facilities have received training on the correct use of RDTs. The NMCP introduced a new RBM reporting template in January 2012, which is harmonized across states and includes information on malaria cases (clinical and confirmed, inpatient and outpatient) and deaths, stratified according to the following categories: children under-five, persons older than five and pregnant women.

Figure 14 shows the malaria case data reported by the 318 health facilities during 2012. The MOH does not currently record the percentage of facilities that submit reports each month (reporting fraction) so it is not possible to assess the completeness of this data. However, due to an extended state-wide health worker strike from June to December of 2012, it can be assumed that the proportion of facilities reporting, at least during that period, was quite low. Thus, the ability to use these data to draw conclusions about either the total number of malaria cases or the trends in malaria case burden is limited. These data were presented primarily to highlight the great need for efforts to strengthen current surveillance reporting, as well as to expand the system to include a higher proportion of facilities.

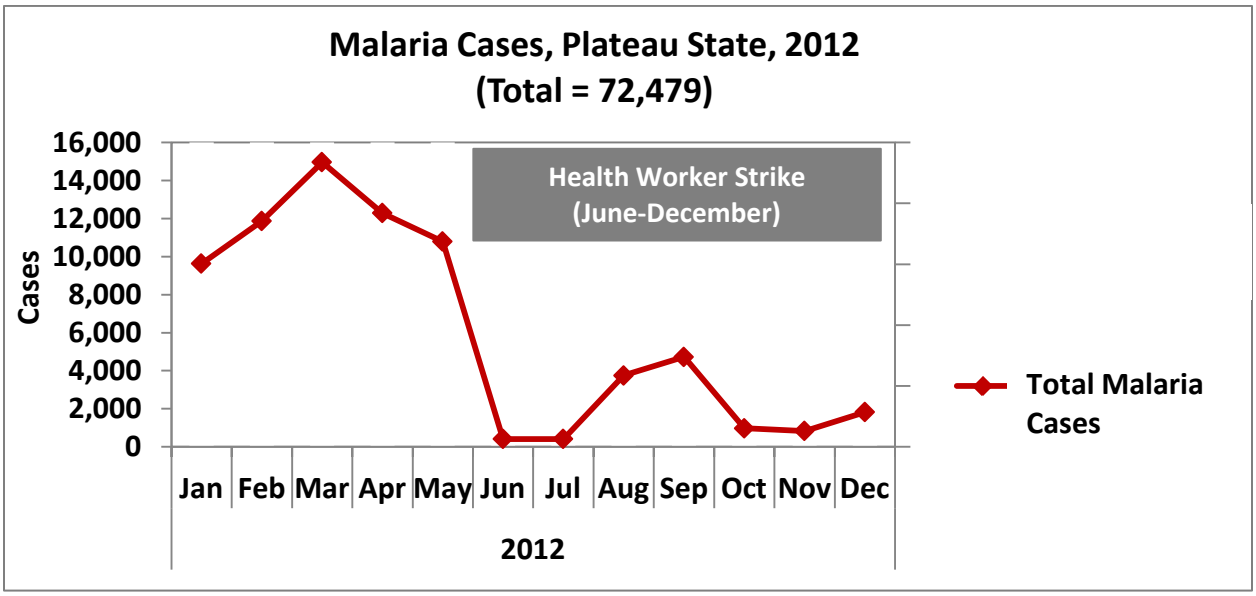

Figure 14. Reported Malaria Cases from 318 Health Facilities Included in the RBM surveillance system for Plateau State (January 2012-December 2012).

Future Plans

In 2013, TCC Nigeria office plans to support the mass LLIN distribution campaign in Delta state, expand the malaria control activities of CDDs in Plateau state (BCC, routine "keep-up" LLIN distribution, LLIN monitoring), support efforts to strengthen and expand malaria surveillance in TCC-supported states, continue to facilitate increased collaboration between ML and LF programs at all levels of the health system, and provide technical assistance for the development of BCC strategies and routine LLIN distribution mechanisms in other TCC-assisted states (as requested).

Mobilizing CDDs for Malaria Control Activities in Plateau State

Presentation by Dr. Amy Patterson, Assistant Director of Malaria Control Program, The Carter Center, Atlanta

Now that Nigeria is reaching the end of its national LLIN distribution campaign to scale-up LLIN ownership, TCC is turning its attention to developing innovative systems to maximize LLIN coverage and use by providing nets for individuals in need after the completion of mass campaigns, and replacing nets as they wear out. To this end, and as part of the national efforts to maximize potential synergies between malaria and LF program activities, TCC piloted a project in Plateau state in 2012 that mobilized Community Directed Distributors (CDDs) for malaria control in the context of annual mass drug administration (MDA) activities. CDDs engaged in bed net monitoring and distribution in 2012 and, in 2013, will begin to conduct community-based behavior change communications (BCC) activities to encourage appropriate use and care of LLINs.

There are many compelling arguments for the co-implementation of malaria and LF activities in Nigeria. Primary among these is the fact that both diseases are transmitted by the same *Anopheles* mosquito. Thus interventions such as LLIN distribution and other vector control activities can lead to significant reductions in the transmission of both diseases. In addition, increasing awareness that LLINs can prevent the sequelae of LF (skin problems, swollen legs, enlarged scrotum in men, and the associated stigma) is likely to result in increased LLIN use. This may be particularly the case in places like Nigeria where malaria is extremely common but the case fatality rate among adults is relatively low. Adults, especially adult males, may dread the prospect of being infected with LF much more than they fear malaria.

Increased collaboration between LF and malaria programs has the potential to accelerate the scale-up of interventions for both diseases, as well as to increase cost effectiveness and cost efficiency. There are also advantages specific to each disease program, many of which are directly related to the potential engagement of CDDs. For the malaria program, which is increasingly looking to community-based systems for the delivery of interventions, collaboration with the LF program provides an opportunity to engage a strong and extensive existing network of community volunteers rather than having to build a parallel system from the ground up. Malaria staff can also benefit from the extensive knowledge and experience of LF program staff who have been involved in community-directed and community-delivered interventions for many years. As for the specific advantages for LF, in addition to the direct reductions in transmission resulting from LLINs, giving CDDs responsibilities related to one of the leading causes of death in Nigeria (malaria) has the potential to increase participation in MDA for LF and other neglected tropical diseases. It also may enhance already positive attitudes towards CDDs, encouraging communities to provide additional support and recognition for these volunteers, and thus strengthening the entire system and perhaps reducing CDD attrition. Finally, as NTDs are eliminated from communities and MDA activities stop, engaging CDDs in malaria activities provides a way to sustain the network of volunteers, an extremely valuable community resource that the NTD community has invested much time, effort and money in developing over the years.

There are a number of opportune moments to integrate malaria control activities within the established protocol for community-directed MDA, including the annual pre-MDA census, MDA campaigns themselves and ongoing health education for neglected tropical diseases. The strategy adopted by the TCC in Plateau state takes advantage of each of these opportunities.

LLIN Monitoring During the Annual MDA Census in Plateau State

During the annual MDA census, CDDs visit all of the households in their communities to record the number, sex, and age of household members. In 2012, the census register used in Plateau state was modified to also include information on bed net ownership, number of sleeping spaces and bed net needs. In places targeted to be the first to receive a planned behavior change intervention as part of a gradual state-wide scale up of behavior change communications (BCC), CDDs also collected information on net use and care.

LLIN ownership and need data were reported for a total of 365,566 households in 3,140 (98%) of the 3,189 villages with CDDs in 15 of the 17 local government areas (LGAs) in Plateau state. Given extended health worker strikes and the challenges associated with conducting census activities in urban areas with high population density, two large and predominantly urban LGAs (Jos North and Jos South) had not yet submitted LLIN register data at the time of the program review meeting.

The LLIN register data indicate that the average household size in Plateau is 7.2 persons, that there is an average of 4.8 sleeping spaces per household and that 1.6 persons, on average, share a sleeping space. A total of 1,108,196 additional LLINs would be required to ensure that every sleeping space in the areas that reported data is covered by a net. This total does not reflect the net needs of villages without CDDs (<10% of villages according to best estimates available at the time of the review meeting) or of the two large LGAs that did not report data. These LGAs, with a projected combined population of 917,558, account for ~23% of the total state population. Thus, it can be estimated that approximately 1.5 million LLINs would be needed to achieve coverage of all sleeping spaces in the state. Reported net needs varied greatly between LGAs (Range: 15,475-203,527).

LLIN Distribution during the MDA Campaign in Plateau State

There were limited quantities of LLINs available for routine distribution and mop-up in Plateau state in 2012, and thus it was not possible to conduct statewide LLIN distribution during MDA. However, a generous donation of 50,000 Duranet brand LLINs from Clarke Mosquito Control made it possible to distribute a sufficient number of LLINs to cover every sleeping space in one LGA (Kanke). CDDs distributed a total of 44,096 LLINs (97.8% of the target) to 15,284 households in 230 communities of Kanke LGA during MDA. When CDDs went house-to-house to administer LF MDA, they distributed an LLIN voucher to each household, specifying the number of nets each household was entitled to according to the census register data.

Integrated Behavior Change Communications (BCC)

CDDs already provide basic health education on NTDs, including LF. Systematic efforts to integrate messages about malaria and LF have the potential to greatly increase appropriate LLIN use and care.

In 2012, the TCC Nigeria staff worked to modify a successful BCC strategy employed in the context of a pilot study in Ebonyi state for scale-up in Plateau state using CDDs. The intervention consists of tailored BCC and skills building activities delivered in the context of periodic home visits, community events (demonstrations, drama performances, net mending and washing days, workshops to teach people how to build portable frames for hanging nets) and mobilization of community and religious leaders. During home visits, CDDs monitor LLIN ownership, use and care, providing a less expensive and more regular way to monitor these indicators compared to large-scale household surveys. TCC staff used data from

focus groups conducted in Plateau state (see preceding section for details) to inform the development of flip charts for use during these BCC activities. The launch of BCC activities in Kanke LGA is scheduled for the spring of 2013, followed by a phased in scale-up in other LGAs as funding permits.

Potential Additional Opportunities for Engaging CDDs in Malaria Control

It may also be possible to engage CDDs in activities such as active case detection and referral for malaria, community based case management or seasonal malaria chemoprophylaxis (SMC), and treatment with ivermectin to reduce mosquito populations[8]. However, careful consideration must be given to the fact that these activities would dramatically change the nature of the CDD position from a temporary volunteer activity requiring 1-2 short periods of intensive work each year to a year-round part-time job without pay.

Challenges for Engaging CDDs in Malaria Control

There are a number of anticipated challenges for engaging CDDs in continuous routine malaria control activities which must be seriously considered and addressed. The first is that increasing the workload and time demands on CDDs, while preserving the volunteer nature of the CDD position, may be associated with decreased motivation and increased attrition. Additionally, CDDs are supervised by MOH staff at the LGA and health facility levels. Extended health worker strikes such as the one experienced in Plateau state in 2012 will make it difficult to ensure adequate supervision of CDDs and also present challenges for complete and consistent reporting of data from census registers and BCC home visit registers. Additional challenges are associated with the fact that peak malaria season, when CDDs would ideally be conducting the most intensive malaria control activities, coincides with peak farming periods. Since many CDDs are farmers, this introduces competing demands on their time.

Despite these challenges, TCC's experience suggests that the advantages of integrating malaria control with existing CDD activities far outweigh the potential disadvantages and efforts are underway to continue the scale-up of these activities in TCC-supported states.

[8] *Ivermectin has mosquitocidal properties when mosquitoes bite individuals recently treated with the drug.*

Annex 1: Overview of Malaria Disease, the History of The Carter Center Malaria Control Program, and Malaria Program Priorities

The Disease

Malaria is a parasitic disease caused by the single-celled organism *Plasmodium,* which infects the human liver and red blood cells. It is transmitted from person to person by the bite of the *Anopheles* mosquito, which bites only at night. Of the species of malaria that affect humans (*P. falciparum, P. vivax, P. malariae, P. ovale* and *P. knowlesi*), the most severe disease and highest mortality are caused by *P. falciparum*. The typical intermittent fevers of malaria are caused by the repeated cycles of parasite replication inside red blood cells, which ultimately result in the rupture of the red blood cells, releasing parasites into the blood stream to then invade other cells. Repeated malaria infections lead to severe anemia, especially in children and pregnant women. Malaria is preventable and treatable; there is no reason that anyone should die from malaria.

Approximately 90% of the estimated 655,000 deaths caused by malaria each year occur in Africa. Twenty percent of all deaths in African children less than five years of age are thought to be due to malaria. Overall, malaria constitutes 10% of the continent's disease burden. Malaria infection in adults is not usually fatal because the patient has some acquired immunity, but fever and anemia resulting from malaria place an enormous economic burden on families, communities, and countries. Pregnant women are also at great risk. Serious illness from malaria typically takes place during the late rainy season, which coincides with peak agricultural productivity and therefore leads to reduced agricultural output. Malaria is also responsible for high rates of school and work absences, which have important short- and long-term social and economic impacts. Highly malarious countries are among the very poorest in the world, and typically have very low rates of economic growth.

History of the Carter Center's Involvement in Malaria Control

The Carter Center's (TCC) involvement in malaria control grew from the idea of integrating control of malaria with lymphatic filariasis (LF) elimination in Nigeria[9], and from a review of malaria by the International Task Force for Disease Eradication[10]. In Africa, the same anopheline mosquitoes that transmit LF also transmit malaria. Insecticide treated bed nets are one of the most important prevention tools for malaria and are also effective as a complement to annual mass drug administration in the filariasis elimination program. TCC's early interest in insecticidal net distribution was based on the theory that shared resources would result in cost reductions and that protection from the mosquito vectors would reduce transmission of both diseases simultaneously, hastening the elimination of LF. Given this, The Carter Center began integrating insecticidal net distribution with mass drug administration in the context of its lymphatic filariasis and onchocerciasis programs in Nigeria in 2004. In June 2010, The Carter Center Malaria Control Program (MCP) in Nigeria was formally established and began to expand its assistance to the national program in malaria control. Since the official launching of the MCP, The Carter Center has assisted the Ministry of Health (MOH) and its other partners in the

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[9] *Blackburn et al., Successful integration of insecticide-treated bed net distribution with mass drug administration in Central Nigeria (2006),* Am J Trop Med Hyg*, 75(4): 650-655.*

[10] *World Health Organization, 2007. Meeting of the International Task Force for Disease Eradication — 12 May 2006.* Weekly Epidemiol Rec *82(4): 25—30.*

planned nation-wide scale-up of malaria control activities, with a focus on the mass distribution of long-lasting insecticidal nets (LLINs).

A dedicated Carter Center MCP was launched in Ethiopia in February 2006. Then Ethiopian Minister of Health, Dr. Tedros Adhanom, requested that TCC join his country's national effort to provide protection to all 50 million Ethiopians at risk for malaria through an ambitious plan to distribute long lasting insecticidal nets in all malarious areas by the end of 2007. The Carter Center was also asked to help in national efforts to monitor and evaluate the progress and effectiveness of the national control program. Since 2006, the program has built on TCC's existing programmatic networks in parts of Ethiopia while working closely with the MOH Malaria Control Program at national, regional, and local levels.

The Carter Center Focus on Malaria Control

The Carter Center's efforts in malaria control can be grouped into four focal areas:

1) Program Implementation and Interventions (treatment, net distribution and behavior change communications);
2) Monitoring and Evaluation;
3) Operational Research; and
4) Supporting the integration of disease program activities to maximize potential synergies and increase cost-effectiveness, with a particular focus on collaborations between malaria and lymphatic filariasis programs.

Program Implementation

To date, implementation has focused primarily on insecticidal bed net distribution, behavior change communications (BCC), and case detection and treatment (in Ethiopia).

LLIN Provision

Between 2004 and 2012, TCC assisted with the distribution of a total of 13,656,058 LLINs in Nigeria and Ethiopia (see Figure 1, page 3).

In Nigeria, between 2004 and 2012, 7,658,726 LLINs were distributed with TCC's assistance. Of these, 7,052,954 were distributed through mass campaigns conducted in six states: Plateau (December 2010), Ebonyi (February 2011), Enugu (March 2011), Imo (July 2012), Abia (August 2012) and Edo (August 2012). An additional 255,000 LLINs were distributed in four Local Government Areas (LGAs) of southeast Nigeria from 2008 to 2010 as part of an operational research project funded by the Bill & Melinda Gates Foundation. The remainder were distributed in Plateau and Nasarawa states in collaboration with the state Ministries of Health through small-scale routine distributions between 2004 and 2012.

In Ethiopia, TCC purchased and assisted with the distribution of three million LLINs in 2007 as part of the Ethiopian national campaign to provide 20 million LLINs by August 2007. In 2010, Ethiopia began a series of campaigns to replace worn out nets and provide LLINs to households that had not received any during the first campaign. The TCC Ethiopia MCP provided technical and financial assistance for the LLIN distribution and replacement campaigns in East Amhara, where 1,156,345 LLINs were distributed, and in the Southern Nations, Nationalities and People's Region (SNNPR), where 1,802,472 LLINs were distributed. An additional 37,295 LLINs were distributed with TCC support in 2012 through a combination of planned replacement campaigns and responses to epidemics. In the context of operational research concerning net durability between 2007-2009, 1,220 LLINs were distributed by TCC

in Ethiopia to replace those collected for examination of physical durability, bioassays and measurement of residual insecticide.

Behavior Change Communication

In both Ethiopia and Nigeria, TCC has helped to develop a set of key behavior change communication messages that attempt to address common misperceptions about malaria or malaria control measures, and provide clear, action-oriented prompts to encourage the adoption of recommended behaviors. In Ethiopia, these messages have been disseminated using a number of different channels, including radio and television spots, films, posters, brochures/pamphlets, theater, t-shirts and caps, and mass education sessions. Malaria health education is provided during azithromycin[11] distribution for trachoma and mass testing and treatment of malaria cases (MalTra Weeks). Malaria messages are also highlighted during the distribution of ivermectin for onchocerciasis control. In Nigeria, health education for malaria has been provided in association with the distribution of insecticide treated nets, as well as in the context of an intensive, community-based behavior change intervention in Ebonyi state. In 2012, the Nigeria staff conducted a series of focus groups in Plateau state to inform the modification of the materials used in Ebonyi for use by community drug distributors in Plateau. Malaria messages in Nigeria emphasize the fact that bed nets can protect people from both lymphatic filariasis and malaria since the two diseases are transmitted by the same vector there.

Malaria Case Detection and Treatment

Provision of malaria treatment takes place in Ethiopia in the context of Malaria and Trachoma (MalTra) Week campaigns. All community members who present for azithromycin treatment for trachoma are asked if they have had a fever in the past few days. Those with fever are subsequently tested for malaria using a rapid diagnostic test (RDT), and offered free treatment according to the national treatment guidelines. Between 2008 and 2012, 236,672 cases of malaria were treated in the context of MalTra Weeks.

Monitoring and Evaluation

Monitoring and Evaluation (M&E) conducted by the MCP focuses primarily on two types of activities:

1) Routine monitoring and evaluation of specific Carter Center-supported interventions, and
2) Providing assistance to National Malaria Control Programs and Ministries of Health for the evaluation of malaria control activities at the national or state/regional levels through large-scale surveys and routine surveillance.

Monitoring and Evaluation in Ethiopia

TCC provides support to the MOH of Ethiopia to help assess progress towards target malaria control goals. Periodic large-scale household surveys play an important role in evaluating the effectiveness of the scale-up of malaria control activities in Ethiopia. Since the initiation of the Malaria Control Program in Ethiopia, TCC has managed two representative household surveys to estimate changes in malaria prevalence, as well as LLIN ownership and use. One of these was the first national Malaria Indicator Survey (MIS) conducted in 2007. In 2011, The Carter Center provided technical and financial support for the second national MIS.

In 2009, TCC conducted a review of the Integrated Disease Surveillance and Response (IDSR) data from mid-2004 to mid-2009 to assess the control program's effectiveness, as well as to inform decisions

[11] *Azithromycin (Zithromax®) is donated by Pfizer Inc*

about stratification of data for analysis and targeting of interventions. The Carter Center has played an active role in the development of new standardized guidelines for epidemic monitoring in Ethiopia and is currently engaged in efforts to enhance the quality of malaria surveillance data in Amhara Region. These activities have resulted in dramatic increases in the proportion of health facilities submitting surveillance reports each week, have allowed MOH staff in Amhara region to visualize changes in malaria incidence in real time and have facilitated the rapid identification of and response to case build-ups and potential epidemics.

TCC also engages in supervision and training activities designed to strengthen the M&E capacity of health workers at all levels of the health system. In 2010, TCC assisted the Federal Ministry of Health of Ethiopia with a series of systematic supportive supervision activities in the regions we support. The Carter Center's staff members have facilitated trainings in data management and epidemic recognition for regional and zonal level health staff.

TCC also collects information on malaria in the context of routine activities conducted by its malaria, trachoma, and onchocerciasis programs. When zone project coordinators are alerted about potential increases in reported malaria cases or stock outages of malaria treatments and diagnostic tests, they communicate this information to MOH officials at the district, zone, and regional levels. Malaria indicators have been integrated with mass drug administration coverage surveys conducted by the trachoma program, and the MalTra Week reports provide estimates of malaria prevalence, at two points of time each year. The Ethiopia office has also introduced a series of routine LLIN assessments, conducted both in schools and at the household level, which are conducted by TCC's zone project coordinators on a monthly basis in order to obtain routine data on net use and care. In areas served by the Carter Center's River Blindness Control Program, community-directed distributors of ivermectin collect household LLIN ownership information in order to identify gaps in net delivery and determine net replacement needs. Additionally, ongoing community assessments conducted in these areas include information on net use and malaria knowledge.

Monitoring and Evaluation in Nigeria

In Nigeria, TCC provided assistance for a national Malaria Indicator Survey (MIS) conducted in late 2010 and also participated in monitoring and evaluation activities associated with mass LLIN distribution campaigns in Plateau, Nasarawa, Ebonyi and Enugu states in 2010 and early 2011. TCC conducted additional large-scale baseline household surveys in two of the nine Carter Center-supported states (Plateau and Abia) in 2010 in order to obtain state-level data that could be used to evaluate the scale-up of malaria control activities in those states. A follow-up survey was carried out in Plateau state in 2012 to assess changes in key malaria indicators since the completion of the mass LLIN distribution campaign in that state in 2010. As the Abia state campaign was not completed until 2012, a follow-up survey has not yet been completed there. The Carter Center provides financial and technical support for routine surveillance activities in Plateau state and is currently working to adapt the enhanced surveillance system introduced in Ethiopia in 2011 for use in Nigeria. TCC has initiated conversations with the MOH to learn how The Carter Center can best further assist the federal and state governments with monitoring and evaluation activities.

Operational Research

TCC has been involved in three operational research projects in Nigeria and Ethiopia. Two studies are on-going, both in Ethiopia. The third, conducted in southeast Nigeria, was completed in 2011.

LLIN studies

In Ethiopia, we are concluding a series of multi-year LLIN durability studies, with both *Permanet*® (Vestergaard Frandsen) and *Duranet*® (Clarke Mosquito Control), to review the retention of insecticide, insecticidal activity and the physical deterioration of LLINs.

In Nigeria, with the support of the Bill & Melinda Gates Foundation, TCC completed a study designed to compare the effectiveness of two different net distribution strategies (universal distribution and distribution to vulnerable groups only) on both malaria and LF.

Diagnostic studies

We have evaluated different rapid tests for the diagnosis of malaria in Ethiopia by comparing them with the results of microscopy conducted in health facilities as well as the results obtained by expert microscopists.

Annex 2: Neglected Tropical Diseases (Trachoma, Onchocerciasis and Lymphatic Filariasis)

TRACHOMA and its control

Trachoma is the world's leading infectious cause of preventable blindness. The World Health Organization estimates that 6 million people are blind due to trachoma, most of whom are women, and another 540 million are at risk of blindness or severe visual impairment. Blinding trachoma is caused by repeated infections of the conjunctiva (lining of the eye and eyelid) by the bacterium *Chlamydia trachomatis.*

Trachoma is transmitted from person to person through discharge from the eyes and nose of infected individuals, which may be passed to others on hands, towels or clothing, or by flies which are attracted to ocular and nasal discharge. Repeated infections lead to scarring of the conjunctiva which deforms the eyelid margin, causing eyelashes to turn inward and rub against the cornea. This condition, called *trichiasis*, causes severe pain and abrades the cornea, leading to other infections, opacity, and frequently to blindness.

Effective control of trachoma can be achieved using the SAFE strategy which consists of the following four components:

1) **S**urgery on eyelids to correct advanced stages of the disease;
2) **A**ntibiotics to treat active eye infection (predominantly oral azithromycin in the form of Zithromax®, donated by Pfizer Inc), which are given once per year during mass distributions;
3) **F**acial cleanliness, achieved through face washing, to prevent disease transmission; and
4) **E**nvironmental improvements to increase access to clean water and improved sanitation (building latrines to reduce fly breeding on feces).

ONCHOCERCIASIS and its control

Human onchocerciasis is an infection caused by the parasitic worm *Onchocerca volvulus* that causes chronic skin and eye lesions. The worms live under the skin in nodules. Female adult worms release microfilariae (mf), which are tiny embryonic worms that exit the nodules and swim under the skin, where they cause inflammation. The mf can also enter the eye and cause visual damage or even blindness. Onchocerciasis is transmitted by *Simulium* black flies that breed in fast-flowing rivers and streams, hence its common name, "river blindness". The black flies ingest the mf, which then develop over several days into infectious larvae and are then able to be transmitted to another person when the fly bites again. The World Health Organization estimates that approximately 37.2 million people are infected and 770,000 are blinded or severely visually impaired in the endemic countries, where 123 million (99% in Africa) live at risk of the disease.

The disease is chronic and non-fatal, but causes a wide spectrum of skin lesions, from intense itching to gross changes in skin elasticity. This results in hanging groins, lizard-like skin appearance, and color changes, such as patchy depigmentation ("leopard skin"). The most severe manifestations are those associated with damaged eye tissues, leading to serious visual impairment and, ultimately, blindness.

Periodic mass treatment with ivermectin (Mectizan®, donated by Merck) kills the mf and prevents eye and skin disease caused by *O. volvulus* and may also be used to reduce or interrupt transmission of the disease. Delivery of ivermectin in Africa is done by community volunteers called Community Drug Distributors (CDDs). CDDs serve their own communities and kinship networks once per year by providing the ivermectin tablets. Applying this strategy enables the affected communities to have

shared responsibility in the planning, execution, monitoring, evaluation, and reporting processes of the disease control activities.

LYMPHATIC FILARIASIS and its control

Lymphatic filariasis (LF) in Africa is caused by *Wuchereria bancrofti*, a filarial worm that is transmitted in rural and urban areas by *Anopheles* and *Culex sp*. mosquitoes respectively. The adult worms live in the lymphatic vessels and cause dysfunction, often leading to poor lymphatic drainage. Clinical consequences include swelling of limbs and genital organs (lymphedema and "elephantiasis") and painful recurrent attacks of acute adenolymphangitis.

Transmission occurs when the female adult worms release microfilariae (mf), which are tiny embryonic worms that circulate in blood at night, when the vector mosquitoes bite. The mf are picked up by mosquitoes, develop over several days into infectious larvae, and are then able to be transmitted to other people when the mosquitoes bite again.

The mf are killed by annual, single-dose combination therapy, with either: Mectizan® (donated by Merck) and albendazole (donated by GlaxoSmithKline); or diethylcarbamazine (DEC) and albendazole. Annual mass drug administration (MDA) prevents mosquitoes from being infected and, when given for a period of time (estimated to be five to six years), can interrupt transmission of *W. bancrofti* (which has no animal reservoir, so the transmission cycle is dependent on infecting humans). Annual treatment is not possible in areas co-infected with the worm *Loa loa* since severe adverse events may take place if the *Loa loa* worms are killed and unmasked to the immune system. In *Loa loa* endemic areas, The Carter Center has demonstrated that long-lasting insecticidal bed nets (LLIN) can interrupt LF transmission in the absence of MDA.

In the regions of Nigeria supported by The Carter Center, *Anopheles* mosquitoes transmit both LF and malaria, making the two diseases prime candidates for integrated interventions, including LLIN distribution and health education activities.

Annex 3: The Challenges of Disappearing Malaria: Lessons from the WHO Malaria Eradication Programme, 1955-1969

Presented by Dr. Randall Packard, Johns Hopkins University, Baltimore, MD

Remarkable successes in reducing the global burden of malaria have raised the possibility that malaria can be eliminated from many parts of the world. This optimism resembles that which led the WHO to launch the Global Programme for Malaria Eradication in the 1950s. While the Programme failed to achieve its goal, malaria was eliminated in a third of the countries in which it was attempted. Moreover, many other country programs came close to achieving elimination only to see malaria return. Both the successes and near-successes are important to examine, for they provide lessons about the challenges that face malaria elimination programs as they come near to achieving their goals and enter into what D.A. Henderson called "the realm of the last inch".

Successes: Taiwan and Romania

Taiwan initiated its elimination program in 1952. At the time there were roughly 800,000 cases in the country. By 1957 a combination of indoor residual spraying (IRS) and case treatment lowered the number of cases to around 600 at a cost of US$1.5 million or $1.96 per case prevented. The Taiwan program then entered the consolidation phase, hoping to identify and treat the last cases of malaria in the country. It took another 6 years and $1.2 million, or $2,158 per case prevented, to achieve this goal. During this period the malaria program examined over 5 million slides, of which only 1,023 or 1/5,198 slides examined were positive. 91% of the cases identified were asymptomatic. Finding the last cases required the creation of an immense surveillance network, which included the health services, the military, school screening programs, and an army of volunteers who served in malaria vigilance units. It also required the periodic adjustment of surveillance methods to cope with "the evasive nature of disappearing malaria." Finally, eliminating malaria did not end the costs of control, for it was necessary to continue monitoring the population to prevent the reintroduction of malaria.

Romania's story was similar to that of Taiwan. Reducing malaria from 2,000 cases per 100,000 to just over 5 cases per 100,000 took just four years. But getting from 5 cases/100,000 to 0 cases took ten more years. Romania began the consolidation phase with mass screening campaigns, but quickly shifted to passive case detection. This was possible because of the effectiveness of its primary health care system and the absence of many asymptomatic cases. Like Taiwan, Romanian authorities were constantly adapting their surveillance methods to meet changing epidemiological conditions. Continued investments in malaria research were also necessary to deal with the special problems associated with disappearing malaria.

Lessons from Taiwan and Romania:

1. Elimination takes longer and costs more than expected
2. Elimination requires extensive surveillance systems to identify and eliminate infections
3. Surveillance systems need to reflect local epidemiological and infrastructural conditions
4. Surveillance measures must adapt to changing epidemiological conditions
5. Continued investments in malaria research are important
6. Malaria elimination is not the end of the road

Failures: Highland Madagascar and Swaziland:

Failed efforts to eliminate malaria in the highlands of Madagascar and in Swaziland provide additional lessons about the challenges of disappearing malaria. Malaria elimination in highland Madagascar,

using a combination of DDT spraying and the treatment and prevention of cases with chloroquine (CQ), began in 1949. By 1960, malaria was nearly eliminated and spraying was discontinued. A network of CQ distribution centers was set up to identify and treat the remaining cases of malaria. These centers operated until 1979, but no active case finding was carried out. During this period small outbreaks of malaria were observed, but others went unnoticed. In addition, the *Anopheles funestus* mosquito, which had been the primary vector for malaria before the spraying campaign began, re-established itself in the highlands. The malaria situation deteriorated further in the late 70s as a result of the worldwide economic recession. National income dropped 40% and debt levels rose. The IMF was called to negotiate new loans and recommend financial policies aimed at stabilizing the economy. These policies included a decrease in governmental expenditures and currency devaluation. In the wake of these policies, the government shut down the CQ centers. At the same time devaluation contributed to a 40% increase in the cost of CQ. Malaria cases grew in number, unchecked by the now depleted health system. In 1986-1988 the disease returned with a vengeance, hitting a population that had become virtually immunologically naïve as a result of decades of prior protection. An estimated 30,000 people died from the disease.

In Swaziland, malaria was nearly eliminated by the early 1950s. Infection levels were near zero. At that point the Colonial Development Corporation introduced citrus and sugar estates into the previously malaria infested lowveld areas of the country along the Mozambique border. The estates struggled to acquire labor from inside Swaziland and resorted to recruiting workers from Mozambique, where there were no malaria control programs in operation. This led to the reintroduction of malaria parasites into the country. The absence of active surveillance meant that cases went unnoticed and malaria became re-established in the country.

Lessons from Madagascar and Swaziland:

1. Elimination of malaria requires constant vigilance
2. Passive detection of cases is insufficient
3. Bad economic decisions can undermine malaria control programs
4. Malaria control creates economic opportunities, but new opportunities can undermine control if not well planned
5. Failure to maintain elimination, once achieved, can have disastrous consequences.

Together these historical cases raise questions about the current preparedness of national control programs to move to elimination.

1. Are programs able to adapt rapidly to face the changing epidemiology of disappearing malaria?
2. Are programs prepared for the time and resources it will take to eliminate malaria?
3. Are they prepared for the cost of maintaining elimination?
4. Will political will wane with early success?
5. Have elimination programs prepared for the possible impact of changing financial circumstances and patterns of social and economic development?

The overriding lessons of these four cases are:

1. Programs need to be prepared for the long haul
2. Investments in surveillance, research, and health systems strengthening need to begin early
3. Flexibility and adaptability are essential
4. Well designed elimination programs can be undermined by conflicting development programs and economic policies
5. The cost of failure can be very high

Annex 4: Historical Perspectives on the Control of Endemic and Epidemic Malaria in Africa

Presented by Dr. James L.A. Webb, Jr., Colby College, Waterville, ME

Although it is frequently stated in the scientific literature that tropical Africa did not participate in the global malaria eradication program of the 1950s and 1960s, the historical record is replete with projects to control malaria and to develop eradication protocols in all of the ecological zones of tropical Africa with the intention of scaling-up these efforts to achieve eradication. The initial interventions were based principally on indoor residual spraying (IRS), and from 1957 onward interventions were based on both IRS and mass drug administration (MDA).

A consideration of the historical record thus allows one to appreciate that the approach of The Carter Center, to focus on the poorest of the poor, has some historical antecedents. Indeed, in the immediate aftermath of the first Conference on African Malaria in Kampala in 1950, there was a dramatic and highly contested expansion of focus from the control of malaria in urban areas, plantation, and mining areas to rural Africa. The goal was to find protocols for the eradication of malaria in rural areas that could be scaled up. Many of the rural areas in which the malaria pilot eradication programs were set up were relatively remote and not served by healthcare professionals.

The first pilot malaria eradication projects achieved impressive successes and dramatically reduced the transmission of malaria through the use of IRS with synthetic insecticides. The projects, however, were unable to meet and sustain their goal of zero transmission. Many of the projects turned to combinations of IRS and MDA. When the combinations of IRS and MDA proved unable to interrupt fully the transmission of malaria, the pilot projects were shut down. (For a study of the pilot malaria eradication projects in Liberia, see James L.A. Webb, Jr., "The First-Large Scale Use of Synthetic Insecticide in Tropical Africa, 1945-1962: Lessons from Liberia," Journal of the History of Medicine and Allied Sciences, vol. 66, no. 3 (2011), 347-376.)

The inability to interrupt fully the transmission of malaria was based in part on the selection pressures that the synthetic insecticides placed on the anopheline vectors. Resistance to the insecticides DDT, DLD, BHC, and HCH was extensive, although not universal. The results of the experiments with MDA, including mixing antimalarials into table salt (sodium chloride) for universal use and the distribution of pyrimethamine and chloroquine (alone or with primaquine) through a range of distribution processes, were judged overall to be unimpressive. In combination with IRS, antimalarial drugs could drive rates of infection extremely low, but not to the point of fully interrupting transmission.

In some areas, the near complete interruption of transmission had been achieved for several years, and the acquired immunities of the communities had degraded. Thus when the programs were shut down, particularly in areas in which chloroquine was not readily available, epidemic malaria struck the once-protected communities and the medical consequences were not investigated.

Annex 5: MCP Publications and Abstracts since 2007

Publications

1) Endeshaw T, Graves PM, Ayele B, Mosher AW, Gebre T, Ayalew F, Genet A, Mesfin A, Shargie EB, Tadesse Z, Teferi T, Melak B, Richards RO and Emerson PM. (2012) Performance of Local Light Microscopy and the ParaScreen Pan/Pf Rapid Diagnostic Test to Detect Malaria in Health Centers in Northwest Ethiopia. *PloS One*. 7(4): e33014. doi:10.1371/journal.pone.0033014.

2) Jima D, Wondabeku M, Alemu A, Teffera A, Awei N, Deressa W, Adissie A, Tadesse Z, Mosher AW, Richards FO and Graves PM. (2012) Analysis of malaria surveillance data in Ethiopia: what can be learned from the Integrated Disease Surveillance and Response System? *Malaria Journal*. 11:330.

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5) Shargie EB, Ngondi J, Graves PM, Getachew A, Hwang J, Gebre T, Mosher AW, Ceccato P, Endeshaw T, Jima D, Tadesse Z, Tenaw E, Reithinger R, Emerson PM, Richards FO, and Ghebreyesus TA. (2010). Rapid increase in ownership and use of long-lasting insecticidal nets and decrease in prevalence of malaria in three regional states of Ethiopia, 2006-2007. *Journal of Tropical Medicine.* Volume 2010, Article ID 750978, 12 pages doi:10.1155/2010/750978.

6) Endeshaw T, Graves PM**,** Shargie EB, Gebre T, Ayele B, Yohannes G, Zerihun M, Genet A, Melak B, Kebede A, Jima D, Tadesse Z, Ngondi J, Mosher AW, Richards FO, and Emerson PM. (2010). Comparison of Parascreen Pan/Pf, Paracheck Pf and light microscopy for detection of malaria among febrile patients, Northwest Ethiopia. *Trans Roy Soc Trop Med Hyg.* 104: 467-474.

7) Jima D, Getachew A, Bilak H, Steketee RW, Emerson PM, Graves PM, Gebre T, Reithinger R, Hwang J, and the Ethiopia Malaria Indicator Survey Working Group. (2010). Malaria Indicator Survey 2007, Ethiopia: coverage and use of major malaria prevention and control interventions. *Malaria J.* 9: 58.

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9) Graves PM, Richards FO, Ngondi J, Emerson PM, Shargie EB, Endeshaw T, Ceccato P, Ejigsemahu Y, Mosher AW, Hailemariam A, Zerihun M, Teferi T, Ayele B, Mesele A, Yohannes G, Tilahun A, and Gebre T. (2009). Individual, household, and environmental risk factors for malaria infection in Amhara, Oromia and SNNP regions of Ethiopia. *Trans Roy Soc Trop Med Hyg.* 103(12):1211-20.

10) Shargie EB, Gebre T, Ngondi J, Graves PM, Mosher AW, Emerson P, Ejigsemahu Y, Endeshaw T, Olana D, WeldeMeskel A, Teferra A, Tadesse Z, Tilahun A, Yohannes G, Hopkins DR, and Richards FO. (2008). Malaria prevalence and mosquito net coverage in Oromia and SNNPR regions of Ethiopia. *BMC Public Health.* 8: 321.

11) Endeshaw T, Gebre T, Ngondi J, Graves PM, Shargie EB, Ejigsemahu Y, Ayele B , Yohannes G, Teferi T, Messele A, Zerihun M, Genet A, Mosher AW, Emerson PM, and Richards FO. (2008). Evaluation of microscopy and ParaScreen rapid diagnostic test for the detection of malaria under operational field conditions: a household survey in Amhara, Oromia and Southern Nations, Nationalities and Peoples' Regions of Ethiopia. *Malaria J.* 7:118.

12) Emerson PE, Ngondi J, Shargie EB, Graves PM, Ejigsemahu Y, Gebre T, Endeshaw T, Genet A, Mosher AW, Zerihun M, Messele A, and Richards FO. (2008). Integrating an NTD with one of "The Big Three": combined malaria and trachoma survey in Amhara Region of Ethiopia. *PLOS Neglected Tropical Diseases.* 2(3): e197.

Abstracts presented at ASTMH 2012

Noland GS, Kibret S, Sata E, Bezabih B, Tuafie AM, Tadesse Z, Graves PM, Emerson PM and Richards FO. *Surveillance as an intervention for malaria: response to potential outbreaks identified through district level surveillance in Amhara Region, Ethiopia.*

Patterson AE, Sallau A, Emukah E, Nkwocha O, Nwankwo, L, Opara G, Echebima A, Otozi R, Onyia M, Ozaki M, Emerson PM, Richards FO and Graves PM. *Evidence-based Behavior Change Communications Enhance Long-lasting Insecticidal Net Uptake and Utilization in Southeast Nigeria.*

Abstracts presented at ASTMH 2010

Patricia M. Graves, Emmanuel Emukah, Aryc W. Mosher, Jeremiah Ngondi, Emmanuel Miri, Obiezu Josephine, Okpala T. Njideka, Njoku Chidi, Nwordu Kenrick, Obasi Andrew, Frank O. Richards. *Reduction in anemia in children under ten years of age after distribution of long-lasting insecticidal nets (LLIN) for control of malaria and lymphatic filariasis in four local government areas (LGAs) in Southeast Nigeria.*

Stephen C. Smith, Aprielle Brackery, Gedeon Yohannes, Patricia M. Graves, Tekola Endeshaw, Estifanos B. Shargie, Aryc W. Mosher, Paul M. Emerson, Teshome Gebre. *Monitoring the durability of long-lasting insecticidal bednets in rural Ethiopia.*

Gedeon Yohannes Anshebo, Stephen C. Smith, Aprielle Brackery, Damtew Yadeta, Patricia M. Graves, Tekola Endeshaw, Teshome Gebre, Paul M. Emerson. *Bioassay testing with permanet-2 long lasting insecticidal net samples collected after 3 to 32 months of use in Ethiopia demonstrates persistence of insecticide on nets but reduced killing effect in wild type* Anopheles arabiensis*.*

Abstract presented at APHA 2010

Tamica Moon, Julie Gutman, Emmanuel Emukah, Patricia M. Graves, Nkwocha Omeni, Nwankwo Lawrence, Gift Opara, Adaku Echebima, Rita Otozi, Mgbodichi Onyia, Frank O. Richards. *Exploring factors that influence the use of bednets in southeastern Nigeria.*

Abstract presented at ASTMH 2009

Jimee Hwang, Patricia M. Graves , Richard Reithinger, Asefaw Getachew, Hana Bilak, Estifanos Biru Shargie, Jeremiah Ngondi, Aryc W. Mosher, Adam Wolkon, Eskindir Tenaw, S. Patrick Kachur, Daddi Jima. *Mother's knowledge of malaria predicts child's ITN use and fever treatment—Malaria Indicator Survey, Ethiopia, 2007.*

Abstract presented at MIM 2009 Nairobi.

Stephen C. Smith, Aprielle Brackery, Paul M. Emerson, Tekola Endeshaw, Patricia M. Graves, Estifinos Biru, Gedeon Yohannes, Teshome Gebre. *Physical and insecticidal deterioration of bednets after 3 - 6 months household use in rural Ethiopia.*

Abstracts presented at ASTMH 2008

Patricia M. Graves, Frank O. Richards, Jeremiah Ngondi, Paul M. Emerson, Estifanos Biru Shargie, Tekola Endeshaw, Pietro Ceccato, Yeshewamebrat Ejigsemahu, Aryc W. Mosher, Afework Hailemariam, Mulat Zerihun, Tesfaye Teferi, Berhan Ayele, Ayenew Mesele, Gideon Yohannes, Abate Tilahun, Teshome Gebre, Daddi Jima, Tedros Adhanom Ghebreyesus. *Individual, household, and environmental risk factors for malaria infection in Amhara, Oromia and SNNP regions of Ethiopia.*

Daddi Jima, Jimee Hwang, Asefaw Getachew, Hana Bilak, Estifanos Biru Shargie, Teshome Gebre, Gashu Fentie, Adam Wolkon, Scott Filler, Richard Reithinger, Paul M. Emerson, Tekola Endeshaw, Aryc W. Mosher, Frank O. Richards, Eskindir Tenaw, Ambachew Medhin, Khoti Gausi, John Miller, Judith Robb-McCord, Richard Steketee, Patricia M. Graves, Zerihun Tadesse, Tedros Adhanom Ghebreyesus. *Achievements in malaria control in Ethiopia— Results from Malaria Indicator Survey, 2007.*

Aryc W. Mosher, Moses Katabarwa, Teshome Gebre, Estifanos Biru Shargie, Abate Tilahun, Patricia M. Graves, Frank O. Richards. *Impact of increased numbers of community directed distributors on successful distribution of ivermectin in Ethiopia, 2007*.

Estifanos Biru Shargie, Patricia M. Graves, Asefaw Getachew, Jimee Hwang, Frank O. Richards, Paul M. Emerson, Teshome Gebre, Aryc W. Mosher, Tekola Endeshaw, Yeshewamebrat Ejigsemahu, Afework Hailemariam, Eskindir Tenaw, John Miller, Ambachew Medhin, Jeremiah Ngondi, Daddi Jima, Zerihun Tadesse, Tedros Adhanom Ghebreyesus. *Rapid increase in coverage with long-lasting insecticidal nets in Amhara, Oromia and SNNP regions of Ethiopia.*

Abstracts presented at ASTMH 2007

Paul M. Emerson, Yeshewamebrat Ejigsemahu, Estifanos Biru, Patricia Graves, Jeremiah Ngondi, Asrat Genet, Teshome Gebre, Tekola Endeshaw, Aryc W. Mosher, Frank O. Richards. *Integrating one of the NTDs with one of the big three. An integrated malaria indicator, parasite prevalence, trachoma indicator and trachoma prevalence survey in Amhara national regional state, Ethiopia.*

Patricia M. Graves, Yeshewamebrat Ejigsemahu, Estifanos Biru, Aryc W. Mosher, Jeremiah Ngondi, Teshome Gebre, Tekola Endeshaw, Paul M. Emerson , Afework Hailemariam, Frank O. Richards. *Can river blindness village workers improve the quality of LLIN distribution? A mosquito net coverage and malaria prevalence survey in Oromiya and SNNP regions of Ethiopia, 2006-2007.*

Annex 6: List of Participants

Bill & Melinda Gates Foundation
Dr. David Brandling-Bennett
Dr. Alan Magill

Centers for Disease Control and Prevention
Dr. Denise Allen
Dr. Achuyt Bhattarai
Dr. Anthony Fiore
Dr. Julie Gutman
Dr. Kimberly Lindblade
Dr. John MacArthur
Dr. Peter McElroy
Dr. Alex Rowe
Dr. Laurence (Larry) Slutsker
Dr. Robert Wirtz

Colby College
Dr. James Webb, Jr.

Emory University
Dr. Peter Brown
Dr. Mary Galinski
Dr. Uriel Kitron
Dr. Deborah McFarland
Ms. Cheryl Moore
Dr. Kristin Phillips
Dr. Mari Webel
Dr. Sita Ranchod-Nilsson

Ethiopia
Dr. Zebideru Zewdie - Amhara Regional Health Bureau
Ms. Hiwot Solomon Taffese - Ministry of Health
Dr. Zerihun Tadesse - The Carter Center
Mr. Abate Tilahun - The Carter Center
Mr. Aseged Taye Zeleke - The Carter Center
Mr. Mulat Zerihun Lemu - The Carter Center

International Public Health Advisors
Ms. Jessica Rockwood

Johns Hopkins University
Dr. Randall Packard

Lions International - Ethiopia
The Honorable Dr. Tebebe Y. Berhan

Nigeria
Dr. Joel Akilah - National Malaria Control Programme, Federal Ministry of Health
Dr. Bridget Okoeguale - Federal Ministry of Health
Dr. Nnenna Ezeigwe - National Malaria Control Programme, Federal Ministry of Health
Dr. Abel Eigege - The Carter Center
Dr. Emmanuel Emukah - The Carter Center
Dr. Adetokunbo Oluwole Lucas
Dr. Emmanuel Miri - The Carter Center
Mr. Adamu Sallau Keana - The Carter Center

PATH – MACEPA
Dr. Richard Steketee

Tulane University
Dr. Thomas Eisele

University of Notre Dame
Dr. Edwin Michael

The Carter Center Atlanta
Ms. Sarah Bartlett
Ms. Rebecca Brookshire
Ms. Kelly Callahan
Mr. Don Denard
Dr. Paul Emerson
Dr. Darin Evans
Mr. Walker Griffith
Dr. John Hardman
Ms. Madelle Hatch
Ms. Alicia Higginbotham
Dr. Donald R. Hopkins
Ms. Lauri Hudson-Davis
Dr. Moses Katabarwa
Mr. Jonathan King
Ms. Nicole Kruse
Mr. Aryc Mosher
Mr. Oz Nelson
Dr. Gregory Noland
Ms. Amy Patterson
Ms. Lindsay Rakers
Dr. Frank Richards
Ms. Alethia Sanon
Mr. Randall Slaven
Ms. Emily Staub
Mr. Craig Withers

Annex 7: Malaria Program Review Meeting Agenda

4th Annual Malaria Program Review March 8, 2013		
8:00	**Shuttle pickup at hotel**	
8:30 – 9:00	**Continental breakfast**	
 9:00 – 9:05 9:05 – 9:15	Morning session Welcome and introductions Overview	Dr. Paul Emerson (chair) Dr. Donald Hopkins Dr. Frank Richards
9:15 - 9:35 9:35- 9:45	Ethiopia National Malaria Activities Report *Discussion*	Ms. Hiwot Solomon (FMOH)
9:45 - 10:15 10:15 - 10:30	Carter Center Ethiopia Malaria Program Progress Report *Discussion*	Dr. Zerihun Tadesse
10:30 – 10:55	**Photo and Coffee Break**	
10:55 – 11:10 11:10 - 11:20	Malaria Elimination Demonstration Project in Amhara *Discussion*	Dr. Greg Noland
11:20 –11:40	Discussion and Recommendations for Ethiopia	Dr. Paul Emerson (chair)
11:40-11:55 11:55-12:05	Mass Drug Administration: Opportunities for Malaria *Discussion*	Dr. Paul Emerson
12:05-12:25 12:25-12:40	The Challenges of Disappearing Malaria: Lessons from the WHO Malaria Eradication Programme, 1955-1969 *Discussion*	Dr. Randall Packard (Johns Hopkins University)
12:40 – 2:00	**Lunch**	
	Afternoon Session	Dr. Frank Richards (chair)
2:00 – 2:20 2:20 – 2:35	Historical Perspectives on the Control of Endemic and Epidemic Malaria in Africa *Discussion*	Dr. James Webb (Colby College)
2:35-2:55 2:55-3:05	Nigeria National Malaria Control Program Report *Discussion*	Dr. Nnenna Ezeigwe (NMCP)
3:05-3:20	**Coffee Break**	
3:20-3:50 3:50-4:05	Carter Center Nigeria Malaria Program Progress Report *Discussion*	Mr. Adamu Sallau
4:05-4:20 4:20-4:30	Mobilizing CDDs for Malaria Monitoring and LLIN Distribution in Plateau State *Discussion*	Dr. Amy Patterson
4:30-4:50	Discussion and Recommendations for Nigeria	Dr. Frank Richards (chair)
4:50– 5:05	Summary Discussion and Closure	Dr. Donald Hopkins
5:05	**Session Adjourned**	
5:05- 6:30	**Reception at The Carter Center, hosted by the Emory University Institute for Developing Nations**	
6:45	**Shuttle departs for hotel**	