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CARTER CENTER

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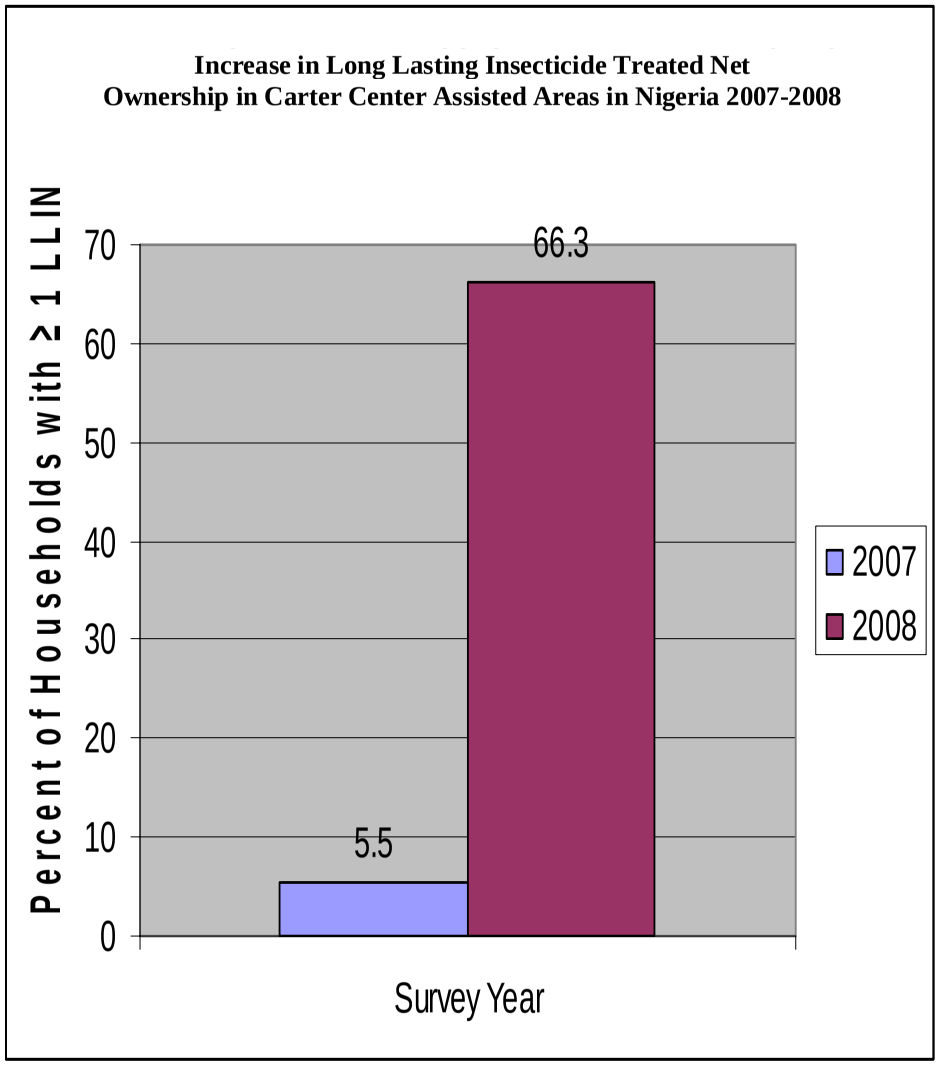
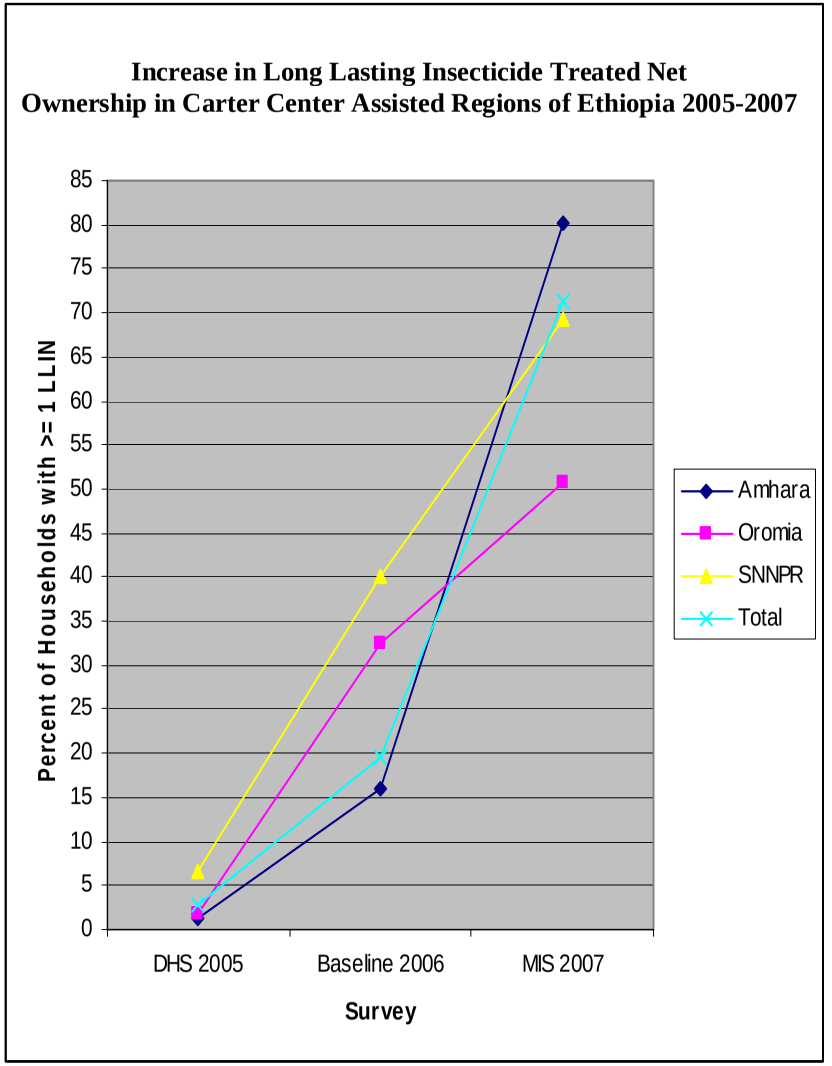
2008 Summary
Malaria Program
The Carter Center
Atlanta, GA

September 2009

The Carter Center Assisted Malaria Control Program
Ethiopia & Nigeria


Increase in Long Lasting Insecticide Treated Net
Ownership in Carter Center Assisted Areas in Nigeria 2007-2008
Percent of Households with ≥ 1 LLIN
0
10
20
30
40
50
60
70
66.3
5.5
Survey Year
2007
2008


Increase in Long Lasting Insecticide Treated Net
Ownership in Carter Center Assisted Regions of Ethiopia 2005-2007
Percent of Households with >= 1 LLIN
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
DHS 2005
Baseline 2006
MIS 2007
Survey
Amhara
Oromia
SNNPR
Total

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INTRODUCTION AND OVERVIEW

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

Approximately 90 percent of the one million deaths from malaria each year occur in Africa. Twenty percent of all deaths in African children under five years of age are thought to be due to malaria, and overall malaria constitutes 10 percent of the continent's disease burden. Malaria impacts individuals and, in turn, communities and countries. Malaria infection in adults who have survived childhood is not usually fatal since the patient has some acquired immunity, although pregnant women are at great risk. Serious illness from malaria typically takes place during the late rainy season which coincides with peak agricultural productivity. Malaria infection therefore leads to reduced agricultural output. Highly malarious countries are among the very poorest in the world, and typically have very low rates of economic growth.

The Carter Center's involvement in malaria control grew from the idea of integrating control of malaria with lymphatic filariasis elimination in Nigeria[*]. In Africa, the same anopheline mosquitoes that transmit lymphatic filariasis also transmit malaria. Insecticide treated nets are one of the most important prevention tools for malaria and should also be useful as an adjunct to annual mass drug administration (MDA) in the filariasis elimination program. The early interest in insecticidal net distribution was based on the theory that shared resources should result in cost reductions and that protection from the mosquito vectors would reduce transmission of both diseases simultaneously, hastening elimination of lymphatic filariasis (LF).

A dedicated Malaria Program at The Carter Center was launched in Ethiopia in February 2006. The Ethiopian Minister of Health, Dr. Tedros Adhanom Ghebreyesus, requested The Carter Center to 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 (LLINs) throughout 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 success of the national control program. Since 2006, the program has built on existing Carter Center programmatic networks in parts of Ethiopia while working closely with the Ministry of Health's (MOH) extensive malaria control program at national, regional and local levels.

Today, the Center's effort in malaria control can be grouped into five principal activities: 1) Program Implementation, 2) LLIN Provision, 3) Behavior Change Communication, 4) Monitoring and Evaluation and 5) Operational Research.

[*] Blackburn et al, Am J Trop Med Hyg 75(4); 650-655, 2004

Below is a brief overview of these activities being implemented in Ethiopia and/or Nigeria:

1) Program Implementation: In Ethiopia, the Center has created two innovative programs, MALTRA in Amhara and MALONCHO in SNNPR, Oromia, Beneshangul Gumuz and Gambella, which have integrated malaria prevention and control activities with trachoma and onchocerciasis disease control programs, respectively. The integrated approach in both programs uses locally identified leaders and community volunteers to assist health workers (including health extension workers) in the delivery and collection of important information regarding disease prevention and LLIN ownership and use.

2) LLIN Provision: As of December 2008, the Center has provided a total of 3,200,000 LLINs. Three million of these LLINs were the Center's contribution to the Ethiopian national campaign to provide 20 million LLINs by August 2007. In Nigeria, we provided 200,000 LLINs for our operational research on malaria and lymphatic filariasis. The Carter Center has also partnered with the Nigerian MOH to assist them in distributing more than 226,240 additional nets purchased through other sources.

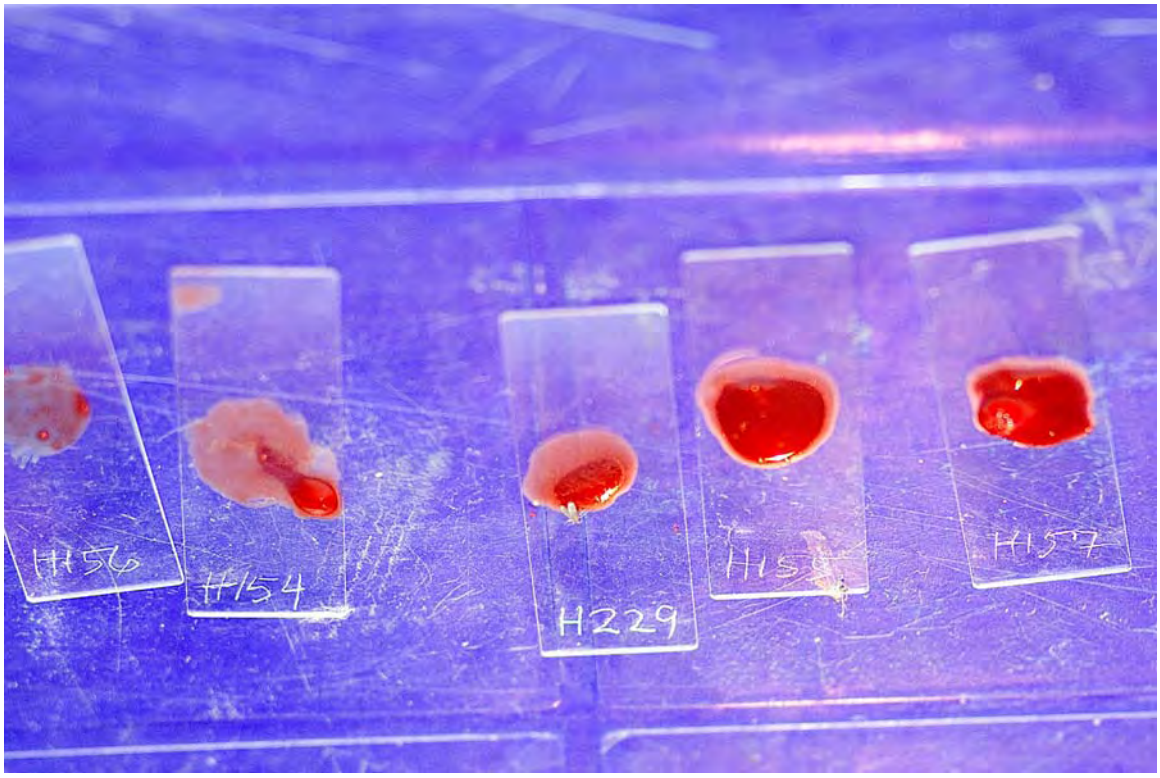
3) Behavior Change Communication: The Center reviewed several knowledge, attitude and practice studies in Ethiopia from which we identified several commonly held misconceptions regarding malaria and its transmission. We created key behavior change communication messages that address those misconceptions and provide each person with doable actions that he/she can implement: 1) Sleep under an LLIN every night all year long, 2) Give priority for LLINs to pregnant women and children under five years old, 3) Properly hang and care for (wash and mend) your LLIN, and 4) Seek prompt medical attention for any febrile illness. These messages were an integral part of the major media campaign undertaken in the Amhara region of Ethiopia prior to azithromycin distribution for trachoma during MALTRA Week, a dedicated period when all health workers within a defined geographical area are focused on drug distribution and health education. These messages are also highlighted during the distribution of ivermectin within the MALONCHO areas. Similar malaria messages are under consideration for behavior change communication in Nigeria.

4) Monitoring and Evaluation: In Ethiopia, the Center is partnering with the MOH to help assess progress toward meeting its target malaria control goals. We managed two representative surveys to estimate decrease in malaria prevalence and increase in LLIN ownership and use, and provided additional support to the MOH through training in data management and epidemic recognition for Regional and Zonal level health staff. The Center is also using the integrated format of the MALONCHO project to assist with measuring the penetration of the program. Community-directed ivermectin distributors (CDDs) are collecting household LLIN net ownership information across the Center's Community Directed Treatment with Ivermectin[†] (CDTI) target areas, to identify any gaps in net delivery and replacement needs. Additionally, the MALONCHO annual

[†] ***Ivermectin (Mectizan®) is donated by Merck & Co. See Annex 1.***

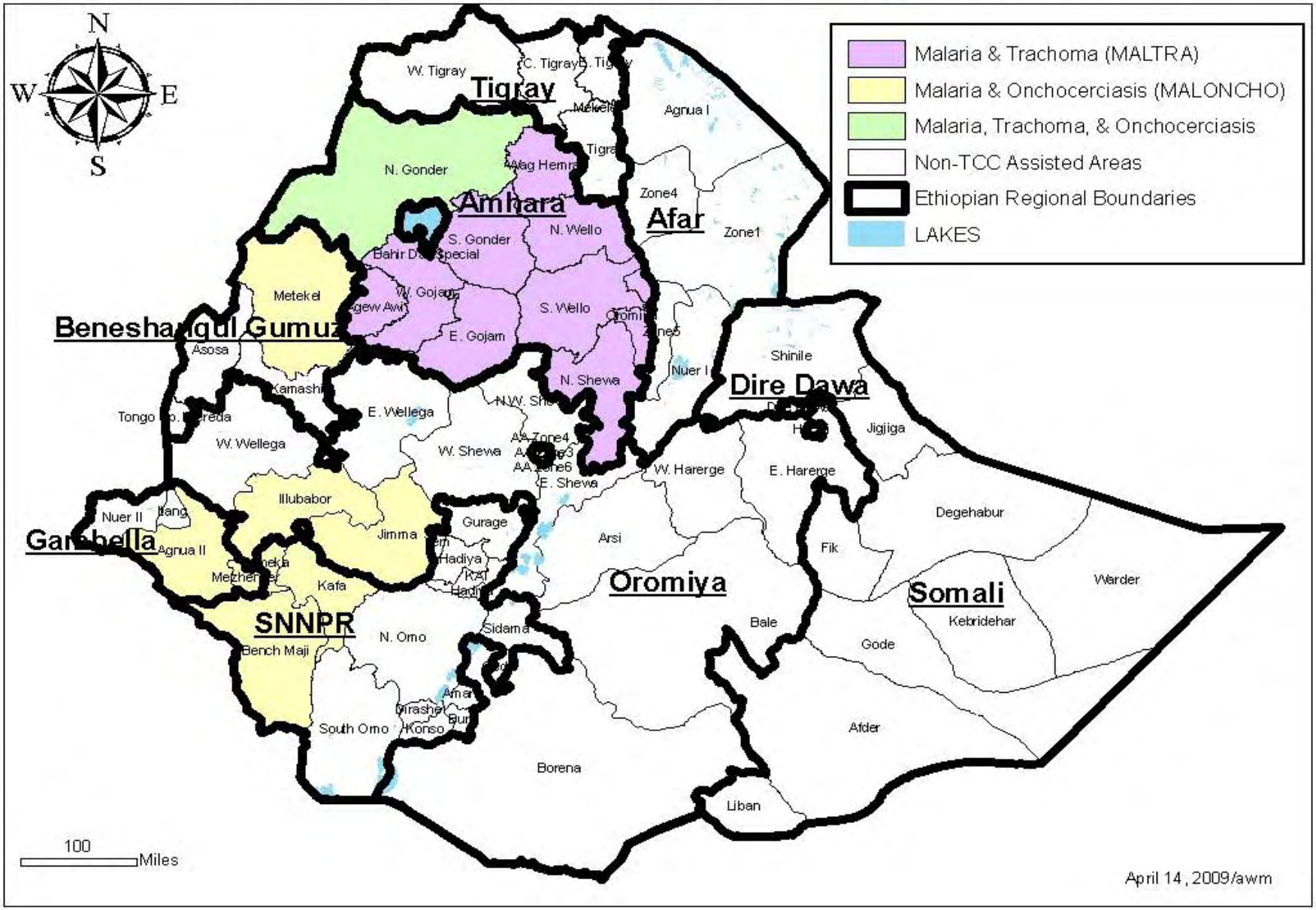
Ongoing Community Assessments are collecting information on net use and malaria knowledge. The MALTRA project is reviewing similar strategies in Amhara.

5) Operational Research: The Center is currently engaged in three research activities in the two countries. In Ethiopia, we are partnering with the MOH and other partners to assess the coverage of malaria interventions and treatment-seeking behavior as well as the prevalence of malaria in all ages. This has been accomplished via a Baseline Survey in 2006-2007 and a Follow-up Survey conducted in late 2007, for which analysis continued in 2008. The first of these surveys was integrated with a trachoma survey in Amhara region. Additionally in Ethiopia, we are conducting LLIN durability studies annually to review the rate of insecticide loss and the physical deterioration of LLINs. In Nigeria, through both malaria and LLIN distribution surveys, the Center is assessing various malaria and LLIN coverage indicators while also comparing different distribution strategies. The Nigerian research projects are looking at the impact of LLINs on both malaria and lymphatic filariasis.



Blood samples collected during a night survey in a lymphatic filariasis endemic area.
Aryc W. Mosher, Nigeria, April 2008

The Carter Center Assisted Areas & Integrated Programs in Ethiopia



ETHIOPIA

Country background

Malaria transmission in Ethiopia is seasonal and unstable. The transmission patterns and intensity vary greatly over the country due to the large diversity in altitude, rainfall and population movement. In most malaria-endemic countries, children under five years of age and pregnant women are most vulnerable to malaria, as others have sufficient protective immunity. However, Ethiopia is prone to periodic epidemics which can have a profound impact on people of all ages. Due to the unstable transmission and lack of acquired immunity, older children and adults are also at high risk of severe disease or death. In high transmission years, several million clinical malaria cases are reported from health facilities. Malaria is one of the leading causes of morbidity and mortality for both outpatients and admissions in 2007-2008, accounting for about 12 percent of the total out-patient visits and 10 percent of the total admissions.

Controlling malaria is the Ethiopian Minister of Health's number one priority. The national program's goals are 1) vector control to reduce malaria transmission, and 2) prompt diagnosis and treatment. These are being accomplished by an aggressive comprehensive malaria control program that targeted provision of LLINs to the estimated 50 million persons at risk of malaria in Ethiopia between 2006 and 2008, selective indoor residual spraying with DDT and other insecticides, and increased availability of diagnosis and treatment with free artemisinin combination therapy through health facilities and a new network of health extension workers.

In its partnering with the MOH of Ethiopia, The Carter Center began two malaria integration strategies in areas assisted by the Center in Ethiopia:

1. MALONCHO-integrated malaria and onchocerciasis.
2. MALTRA-integrated malaria and trachoma.

Malaria is present in all of the zones where we currently work on onchocerciasis and trachoma in Ethiopia (see map, page 5), although only a proportion of kebeles (villages) are classified as 'malarious' by expert knowledge. The integrated project strategies are coordinated through the collaborative efforts of The Carter Center, Regional Health Bureaus, Zonal Health Departments and Woreda Health Offices. Both use already existing village-based health infrastructures with Carter Center assistance, so that malaria control is integrated within a multi-disease intervention package.

Program Implementation

MALONCHO

The MALONCHO program is currently operating in ten zones across the regions of Amhara (North Gondar), Beneshangul Gumuz (Metekel), Gambella (Itang, Agnua, and parts of Mezhenger), Oromia (Illubabor and Jimma) and SNNPR (Kaffa, Sheka and Bench Maji) for a total population of about 3.1 million.

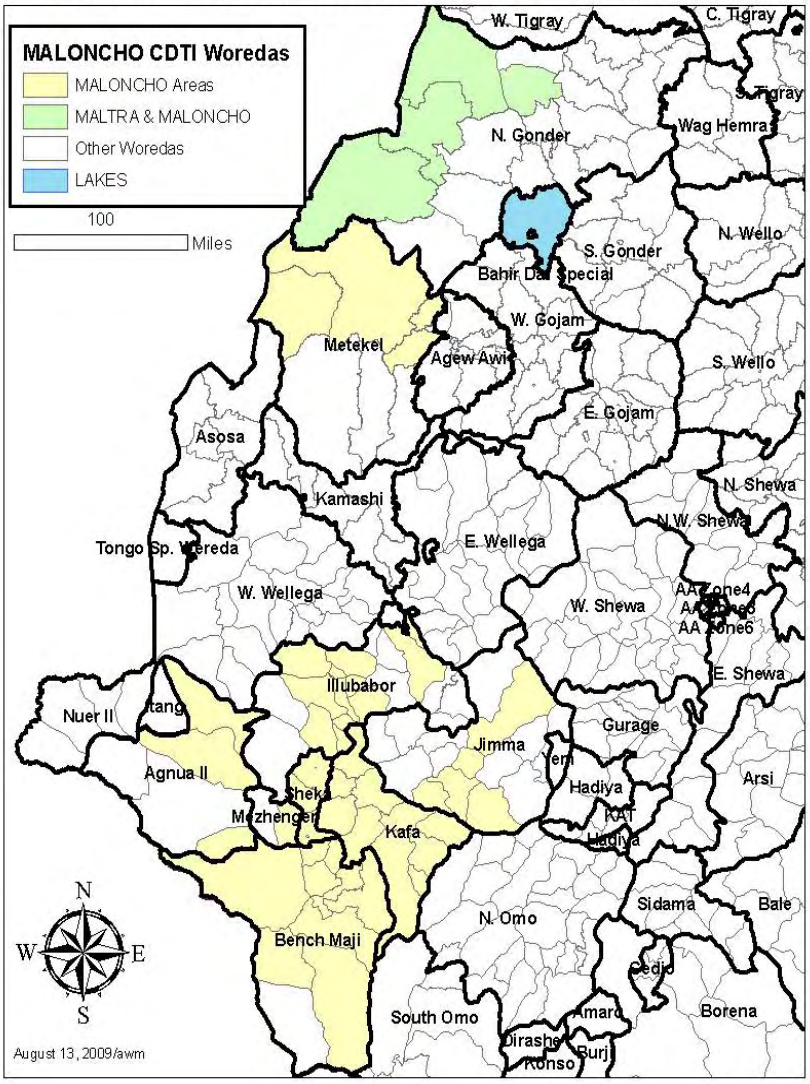
The program aims to create strong supportive links between the established CDTI approach of the onchocerciasis control program on the one hand, and preventive health messages and activities for reducing risk to malaria in Ethiopia on the other. The program is organized on a district by district (woreda) basis.

The CDTI program format uses community identified distributors as the key players in assisting the importation and acceptance of health messages and activities to communities. An integrated approach to malaria and onchocerciasis can benefit from the two opportunities for community interaction:
1) Household registration and
2) Drug (ivermectin*) distribution which is often done house-to-house.

In 2008, over 2,983,000 persons received treatment with ivermectin and were provided with health education.

** Ivermectin (Mectizan®) is donated by Merck & Co., Inc. See Annex 1.*

Carter Center Assisted MALONCHO Woredas in Ethiopia



MALTRA

The MALTRA program is taking place within all ten zones of the Amhara region which has been divided into two operational areas (West and East Amhara) with a total population of around 20 million.

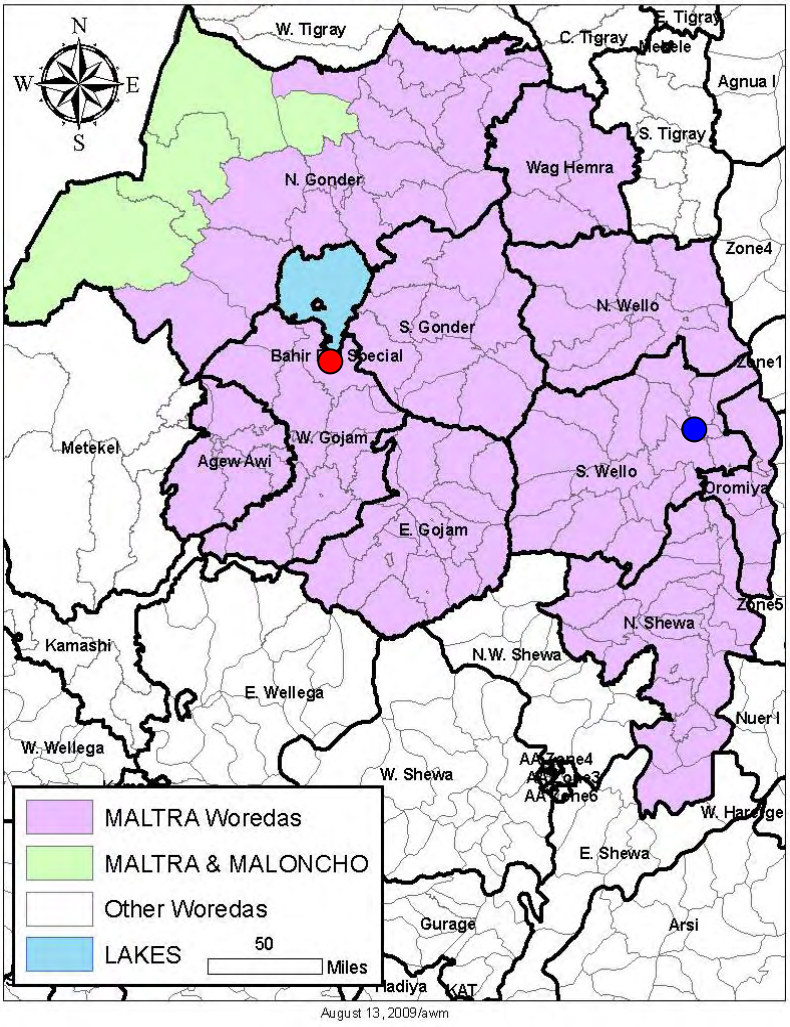
The regional MALTRA coordination office is located in the state capital and seat of the Regional Health Bureau, Bahir Dar (red dot on map). There are an additional 10 zonal project coordinators assigned to provide technical and logistic support to the respective zonal health departments. A sub-regional office in Dessie (blue dot on map) coordinates activities in the five eastern zones of the region.

MALTRA training for community volunteers and teachers, woreda health officers and health extension workers is conducted via a cascade approach with the training of trainers co-coordinated by Carter Center staff. Two "MALTRA weeks" are planned per year in Amhara: one in October or November for West Amhara and the second in April for East Amhara. During these "MALTRA weeks", communities are saturated with health education messages for both malaria and trachoma via mass media and schools, while health workers distribute azithromycin* and refer anyone with fever for malaria diagnosis and treatment.

In 2008, nearly 12,632,000 persons received treatment with azithromycin.

**Azithromycin (Zithromax®) is donated by Pfizer Inc for treatment and prevention of trachoma. See Annex 1.*

Carter Center Assisted MALTRA Woredas in Ethiopia



LLIN Provision

In 2008, the Center did not provide or distribute any additional LLINs in Ethiopia. Work continued on assessing the impact of the three million LLINs distributed in 2007. (See pages 9-10).

Behavior Change Communication

Message Delivery: Based on review of available studies, the Center previously developed 'do-able messages' on malaria prevention for households, with additional background information for community

workers. Since the specific target population will be the households receiving the LLIN, the messages need to lead to actions to be carried out by the heads of households.

Four messages were chosen for behavior change communication in 2008. They are as follows:

1) Sleep under an LLIN every night all year long.
2) Give priority for LLINs to pregnant women and children under five years of age.
3) Properly hang and care for (wash and mend) your LLIN.
4) Seek prompt medical attention for all febrile illness.

MALONCHO

Within the MALONCHO project, messages and activities are brought to the targeted communities via the CDDs. Each CDD provides ivermectin annually to a small group of households in his/her community. The CDD training during 2008 included malaria training and behavior change communication messages to be provided during treatment. CDDs documented the number of LLINs per household as reported by the head of household.

MALTRA

Launching MALTRA Week I: The official launch of MALTRA Week I was Monday November 17, 2008, at a ceremony arranged by the Ethiopian Lions. Present were Ethiopian President Girma, the regional presidents of Amhara and Tigray states, the head of the regional health bureaus of Amhara and Tigray states, President and CEO of the International Trachoma Initiative Ibrahim Jabr and a contingent of Ethiopian Lions and Carter Center staff. The President hosted a state reception that evening. Forty-six woredas were included within the MALTRA Week I campaign. Approximately 6,280,000 persons are estimated to have been reached.

Mass Media Campaign: Prior to the launching of MALTRA Week I, communities were sensitized through local radio, woreda administration, woreda health office, and Carter Center's zonal coordinators. Those living along accessible roads were visited by a mobile video-van. The video-van conducted health education sessions for 54 straight days throughout the target area, focusing on larger towns and peri-urban areas. The videos shown focused on the four key messages of malaria through humorous, culturally appropriate skits. It is estimated that the video-van addressed hundreds of thousands of people in that period.

The mobile mass media van announces the behavior change messages in a rural village along the main road in North Gondar.
Aryc W. Mosher, September 2008

Monitoring and Evaluation

Malaria Indicator Survey: In November-December 2007, we managed the Ethiopia National Malaria Indicator Survey (MIS 2007) on behalf of the MOH in collaboration with the Central Statistics Agency, Malaria Control and Evaluation Partnership in Africa (MACEPA) and Program for Alternative Technology in Health (PATH), The President's Malaria Initiative (PMI at CDC/USAID), WHO, UNICEF, the Centre for National Health Development in Ethiopia, and the Malaria Consortium. The MIS 2007 was a large nationally representative survey of coverage of key malaria interventions, treatment-seeking behavior, anemia prevalence in children less than six years of age, malaria prevalence in all age groups, malaria knowledge among women, and indicators of socioeconomic status. In MIS 2007, there were 8,178 households sampled nationwide in 319 clusters situated below 2,500m in altitude. Over-sampling was done in two regions (Amhara and Oromia) and will enable more precise assessment of our activities.

The MIS 2007 results are compared below to the findings of the household Baseline Survey conducted by The Carter Center in November 2006 - February 2007 in the three main Carter Center assisted regions of Amhara, Oromia and SNNPR. Analysis of both the Baseline Survey and the MIS 2007 continued during 2008. The table in Annex 4 shows the sample size and details for each survey. We also compare these two surveys' results to the DHS 2005 survey which measured net ownership before large scale up of the program. We then give some summary national results for the MIS 2007.

Comparison to Baseline Survey and DHS:

The Baseline Survey sampled 5,708 households in 224 clusters in the three main Carter Center assisted regions. In the MIS 2007, there were 5,730 households sampled in 267 clusters in these three regions. The change in net ownership is shown in the adjacent Table.

Amhara and SNNPR regions increased their net ownership (proportion of households with at least one LLIN) by 79.0% and 62.7%, respectively, since 2005. In Oromia region, net ownership increased by 48.9% compared to 2005. In malarious areas of these three regions, the mean LLIN per household increased from 0.3 to 1.2. The proportion of persons (all ages) sleeping under a LLIN increased from 15.3% in 2006 to 34.5% in 2007 with slightly higher rates for children under five and pregnant women.

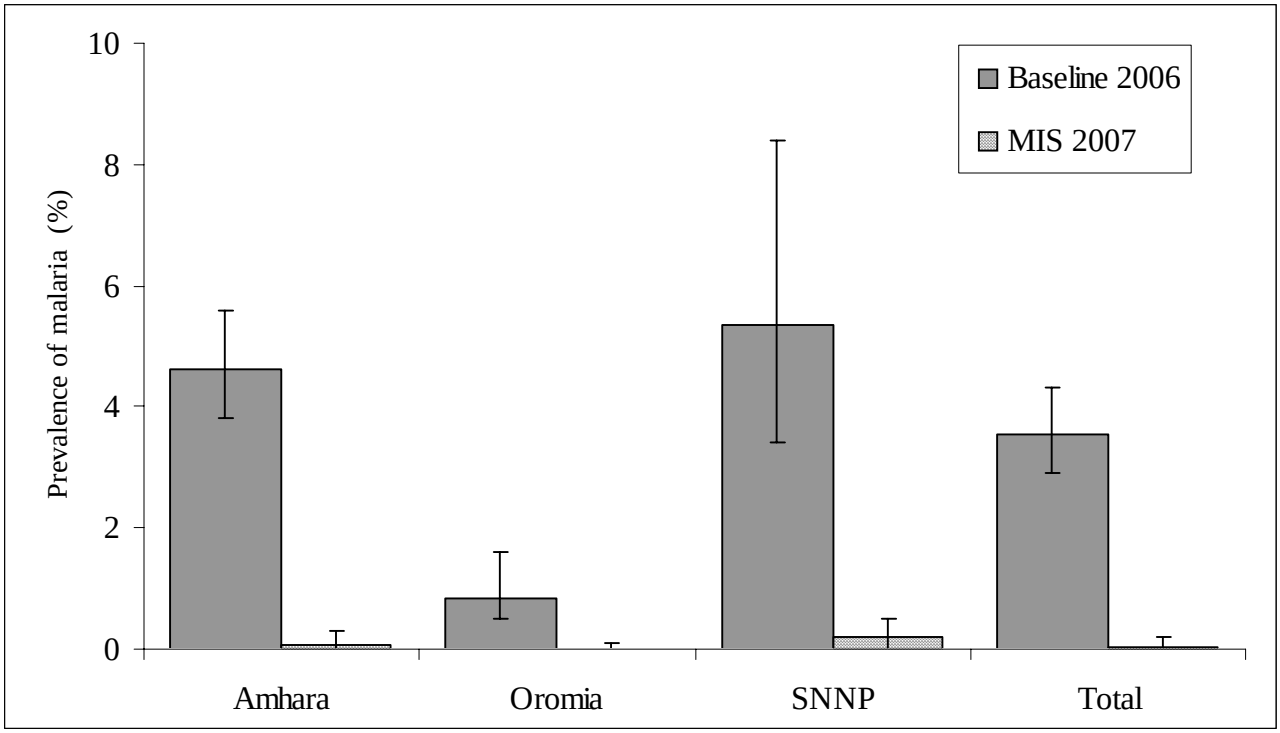
Increase of LLIN Ownership in Carter Center Assisted Areas 2005-2008

Region	Percent & (Confidence Intervals) Households with ≥ 1 LLIN		
	DHS 2005*	Baseline 2006	MIS 2007
Amhara	1.3 (0.1-1.7)	16.1 (12.1-21.2)	80.3 (71.6-86.8)
Oromia	1.9 (1.5-2.3)	32.5 (17.4-52.3)	50.8 (36.8-64.7)
SNNPR	6.6 (5.7-7.6)	40.1 (23.8-58.9)	69.3 (52.3-82.2)
Total	2.9 (2.6-3.2)	19.6 (15.5-24.5)	71.2 (64.7-77.1)

** DHS-Demograhic Health Survey in 2005 measured ITN not LLIN*

Prevalence of malaria was assessed in MIS 2007 but not in the DHS 2005. Therefore, reduction in prevalence can only be estimated by comparison with the Center's baseline survey (shown in figure below). In each region and overall, the prevalence of malaria by blood slide was significantly lower in MIS-2007 than it was at the Baseline Survey.

Decrease in Malaria in Three Carter Center-Assisted Regions of Ethiopia, 2006-2007



National MIS 2007 results:

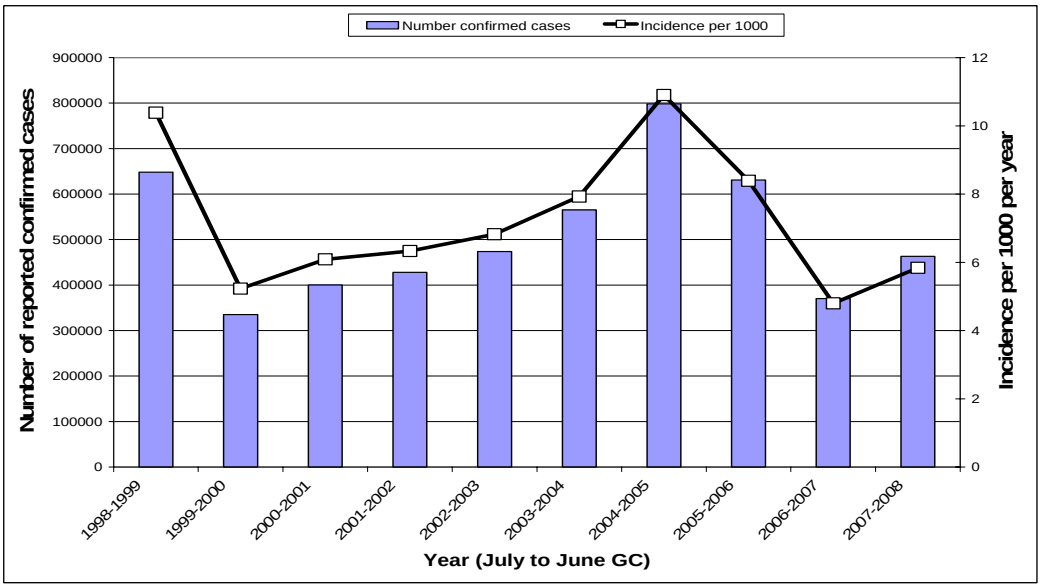
In MIS 2007, the total number of persons residing in the 8,178 sampled households was 34,755. A total of 10,578 blood slides and 4,846 anemia tests were done. The nationwide prevalence of malaria parasitemia by microscopy was 0.7% (0.5% *P.falciparum*; 0.2% *P.vivax*). In areas below 2,000m, the prevalences were 0.9% (0.7% and 0.3%) respectively. Among children under five years of age, 5.5% had moderate or severe anemia (<8g/dl); this proportion rose to 6.6% in areas below 2,000m.

In households owning nets, MIS 2007 showed that an average of 60% of children under five years of age had slept under an ITN the night preceding the survey, both overall and in areas below 2,000m. In areas below 2,000m, 65.7% of pregnant women in households with at least one ITN had used it the night preceding the survey. (Report of the Ethiopia National Malaria Indicator Survey, FMOH 2008).

Nationally, net ownership and use in MIS 2007 can be compared with the national estimate from the DHS survey of 2005, in which nets were classified as ITN (not LLIN). The ITN ownership by household increased nearly eighteen-fold between 2005 and 2007 (from 3.4% to 53.3% percent of households owning at least one). In areas below 2,000m (at higher risk of malaria), 65.6% of households now own at least one ITN (mostly LLIN). While only 1.5% of children under five years of age were reported to have slept under an ITN the night preceding the survey in DHS 2005, this percentage was estimated in the MIS 2007 to be up to 33.1% nationwide and 41.5% in areas below 2,000m.

Routine surveillance data: We have assembled all available routinely-reported malaria data both nationally for the last ten years (see Figure) and by region and zone for the last five years, and are assisting the FMOH in the interpretation and use of this data for targeting and assessing interventions as well as encouraging the collation of woreda level data.

Ethiopia annual number and incidence /1000 population of reported confirmed malaria cases, 1998-1999 to 2007-2008



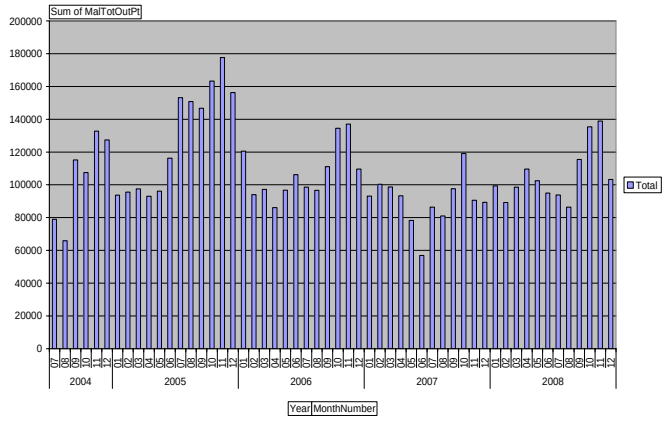
Ethiopia, Health and Health Related Indicators Annual Reports.
Note: data for 2007-2008 are provisional.

Although the number of reported confirmed malaria cases nationally has declined markedly since 2004-2005, there are indications of a slight upswing in outpatient case numbers for the most recent reporting year (2007-2008). This may be due to increased reporting, increased availability of care or treatment seeking, or an increase in malaria transmission.

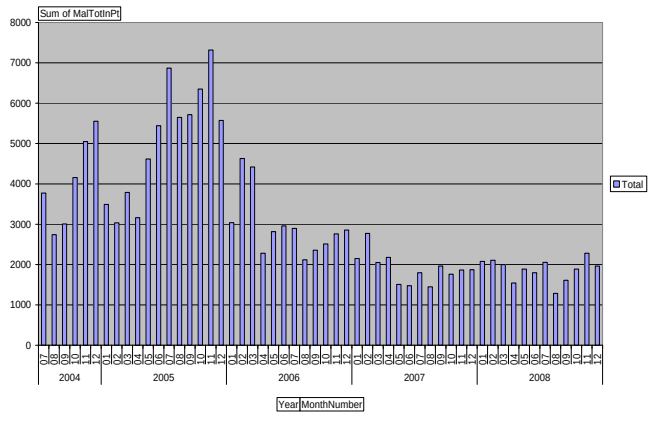
An important alternative source of data is the Integrated Disease Surveillance and Response System which reports monthly by zone. Up to the end of 2008, the monthly data shows that reported outpatient malaria cases (clinical plus confirmed) do not show a marked decline, whereas inpatient cases have been reduced, suggesting that there are fewer critical malaria cases but a similar number presenting for treatment.

Number of Malaria Cases Reported to Health Facilities and Hospitals, Ethiopia
July 2004-April 2007

Outpatients



Inpatients



Data management training: In August 2008, two back-to-back courses for 10-12 participants each on managing routine malaria surveillance data were held at the Nazareth Malaria Training Centre. Participants were drawn from regional and zone level malaria and health data management staff in SNNPR region (Kaffa, Sheka, Bench Maji and Sidama zones) and Oromia region (Jimma and Illubabor zones). TCC staff members based in these regions and from the national office also attended.

Using available data sources, the participants learned how to use Excel and other simple computer tools to assess, clean and chart data from their local regions, understand the importance of regular surveillance, estimate malaria incidence using population data, and compare monthly and annual incidence between zones and regions over time.

A major topic in the course was the definition of 'epidemic': "The occurrence in a community or region of cases of an illness, clearly in excess of normal expectancy". The emphasis was on use of past data in order to define what is normal in a given area and time period.

Dr. Patricia Graves works with zonal level health officials to increase their ability to manage data that passes though their offices during training in Nazareth, Ethiopia.
Photo Credit: Aryc W. Mosher August 2008

Survey Comparison on Mean LLIN per Household: Currently, the program has three methods to assess the mean number of LLINs per household in Oromia and SNNPR.

1) *Malaria Indicator Survey:* Described above.

2) *CDD Household Registration Log Books:* Within the MALONCHO program areas, CDDs annually review their household registration logs as they record the distribution of ivermectin. In 2008, CDDs were requested to add the number of LLINs per household, as identified by the head of household.

3) *Ongoing Community Assessment***:** Within the MALONCHO program areas, a sample of households is selected annually to survey the impact and coverage of the onchocerciasis program. In 2008, heads of households were asked additional questions on net ownership.

The following table shows the mean LLIN per household as determined by the CDD Household Registration Log Books for the regions of Oromia and SNNPR (1.4 and 1.7, respectively) are supported by the findings from the MIS. Both means from the CDD Log Books fall within the 95% confidence intervals from the MIS for both regions. Additionally, at the zonal level of assessment, the mean LLIN

per household in the zones of Jimma and Bench Maji from the On-going Community Assessment (1.5 and 1.4, respectively) also fall within the 95% confidence intervals of both the MIS and the CDD Log Books.

Three Way Comparison of Mean LLIN per Household in Ethiopia (Oromia & SNNPR)

Survey	Region	Zone	No. Villages	No. Persons	No. HH	LLINs						
								Regional Estimates		Zonal Estimates		
						No. LLINs	HH w 0 LLINs	Mean LLIN	95 % CI	Mean LLIN	95 % CI	No. Villages <1 Mean LLINs
CDD RLB	Oromia	Illubabor	1,644	322,423	71,738	85,334		1.4	(1.4-1.5)	1.4	(1.3-1.4)	624
		Jimma	1,663	344,624	70,331	96,627				1.5	(1.4-1.5)	370
		Sub Total	3,307	667,047	142,069	181,961						994
	SNNPR	Bench Maji	905	467,010	116,753	143,564		1.7	(1.6-1.7)	1.5	(1.4-1.6)	332
		Kaffa	737	231,584	48,247	79,207				1.8	(1.7-1.9)	140
		Sheka	387	146,072	34,779	65,589				2.0	(1.9-2.1)	64
		Sub Total	2,029	844,666	199,779	288,360						536
Survey Total			5,336	1,511,713	341,848	470,321						1,530
MIS	Oromia	Illubabor	3	337	73	41	44	1.4	(1.2-1.5)	1.4	(1.2-1.6)	2
		Jimma	2	115	27	17	14			1.3	(1.0-1.6)	1
		Sub Total	5	452	100	58	58					3
	SNNPR	Bench Maji	5	504	124	160	31	1.7	(1.5-1.8)	1.7	(1.4-2.0)	0
		Kaffa	3	377	78	17	65			1.3	(1.0-1.6)	3
		Sheka	2	209	50	76	3			1.6	(1.4-1.8)	0
		Sub Total	10	1,090	252	253	99					3
Survey Total			15	1,542	352	311	157					6
OGCA	Oromia	Jimma	25	1,450	234	348	42			1.5	(1.4-1.6)	2
	SNNPR	Bench Maji	27	1,376	249	341	53			1.4	(1.3-1.5)	5
Survey Total			52	2,826	483	689	95					7

MIS= *Malaria Indicator Survey* conducted in January 2008
CDD RLB= *Community Directed Distributors Registration Log Books* conducted in March-August 2008
OGCA= *On-Going Community Assessment* conducted August-December 2008
* Estimated for the CDD RLB based on zonal level estimates of persons per HH from the MIS (Illubabor, 4.4; Jimma, 4.9; Bench Maji, 4.0; Kaffa, 4.8; Sheka, 4.2)

Through the comparison of each survey, one can determine that the CDD Registration Log Books are more robust in providing detailed information with regard to managing community nets needs. From the data collected through the CDD Log Books, we can identify over 1,500 villages that have a mean LLIN per household that is less than one. This would indicate that there are households within those villages that did not receive any LLINs. Continued improvement on the use of the CDD Log Books (including actual number of households per community, use and physical state of the LLIN) might provide unparalleled ability by the program to manage replacement and gap filling LLINs as they become available from various sources.

Community Directed Distributor documenting the distribution of Ivermectin and LLIN ownership within his Log Book.

Operational Research:

LLIN hanging on poles above a bed in Amhara, Ethiopia.
Photo credit: Dr. Stephen Smith, September 2007.

LLIN Durability: In 2007, The Carter Center supplied three million long lasting insecticidal nets (LLIN) which were distributed in Amhara (1.26 million), Oromia (990,000) and SNNP (750,000) regions of Ethiopia. 'Long-lasting' means that the insecticide on the nets persists through at least 20 washes, and if washed relatively infrequently, the LLIN should not need to be retreated with insecticide during their lifetime (unlike previous generations of insecticide-treated nets which needed retreating every six months). However, although the lifetime of an LLIN is estimated as to be three to five years, the durability of nets in practice in real world conditions is not known. Nets in actual use are exposed to smoke, embers from fires, heat from indoor cooking, animals (goats, cats, rats, mice), small children who may soil the bed, and snags from bedframes and sharp sticks. If the net fabric deteriorates quickly into dirty rags that are not used, then it makes no difference whether the insecticide persists on them since it will be discarded.

Therefore, we decided to collect (and replace) some of the distributed LLIN at intervals, and assess them for 1) ability to kill mosquitoes; 2) insecticide concentration remaining; 3) amount of damage. This is an ongoing project being done in collaboration with Dr. Stephen Smith of U.S. Centers for Disease Control and Prevention (CDC). Full results from an assessment of nets collected three to six months after distribution are available. In addition, preliminary results on insecticide concentration are available for nets collected after up to 18 months of use.

When LLINs are new, they are expected to have between 41 and 69 mg (55 +/-25%) of deltamethrin insecticide per square meter The minimum effective concentration is 10 mg/sq m.

Two hundred nets were collected in 2007 for Phase 1 of this study (after three to six months of use), from four different sites. Tests with susceptible and wild caught mosquitoes on a sample of 32 nets showed that all exceeded the WHO standard of killing >80% of the mosquitoes exposed to them for three minutes, and all but three of the nets killed 100% of mosquitoes. The insecticide concentration was within the target range in 94% of the nets. The net damage assessment showed that only 43% of the nets were undamaged after only six months in the field, and the average number of holes per net was 4.2. Even at this early stage, 7% of the nets had large (>10cm) holes, with an average of 0.08 of such holes per net. There was no sign of any mending on the nets.

For Phase 2 (220 nets collected from 11 sites after up to 18 months of use), the insecticide concentration remained at effective levels in the majority of nets. Only seven nets out of 220 (3%) had inadequate levels (less than 10 mg/sq m of deltamethrin remaining). The damage assessments and mosquito bioassay tests on these LLINs from Phase 2 are still under way in Ethiopia, using locally caught mosquitoes for the latter. The results will be very informative for deciding when these nets need to be replaced.

2009 ETHIOPIA RECOMMENDATIONS

MALONCHO

1) Submit paper on net ownership and use comparing three sources of information (net registers, ongoing monitoring survey, MIS 2007)

MALTRA

1) Enhance the provision of malaria treatment at MALTRA weeks by using multi-species RDTs and ensuring supplies of RDTs and drugs in all malarious kebeles
2) Improve malaria information and communication activities through the enhanced health education strategy

GENERAL

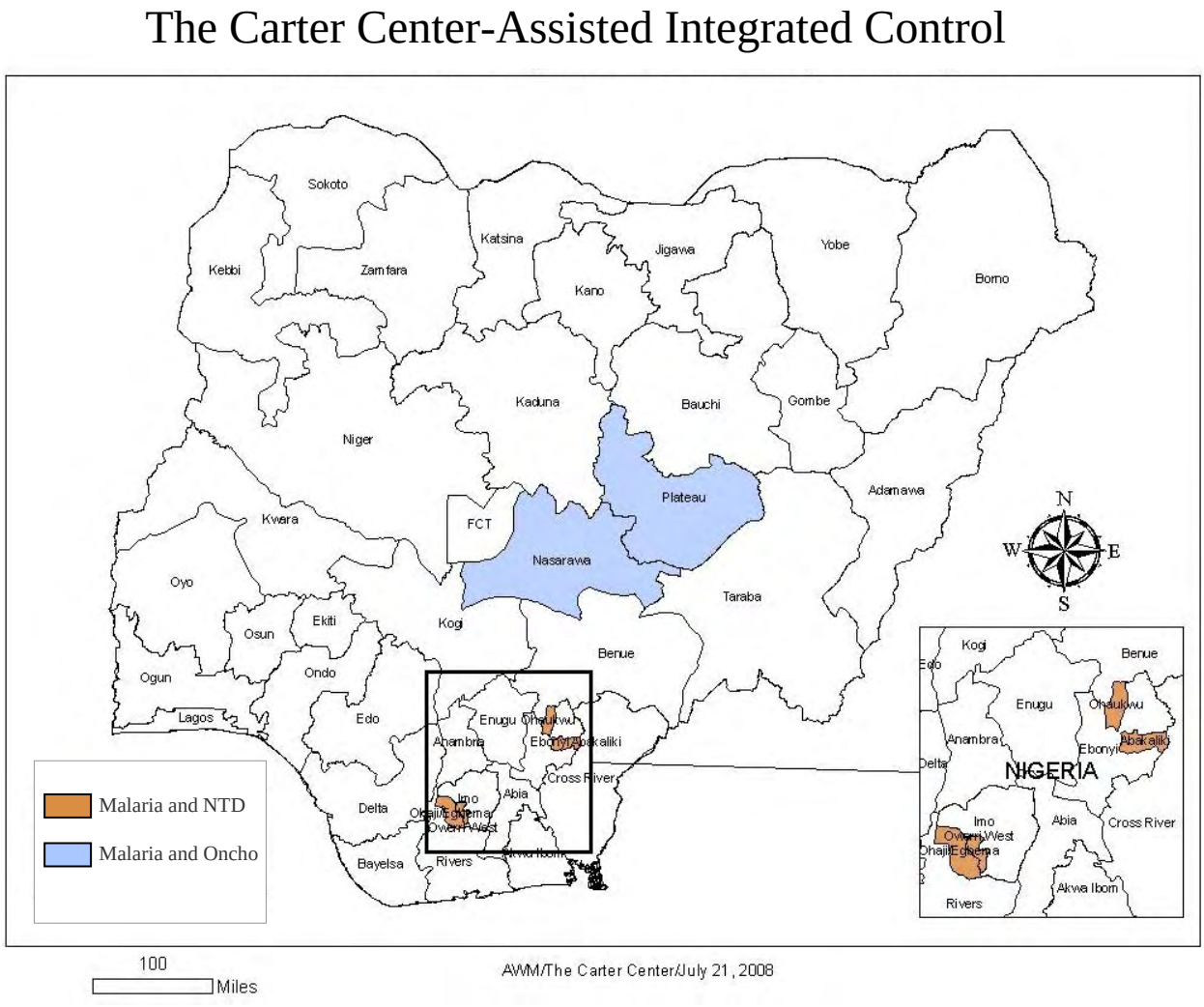
1) Supply replacement nets and fill gaps where needed
2) Test replacement strategies for nets through schools or other processes
3) Promote net care (mending) and use through revised messages
4) Finish and submit the MIS 2007 papers
5) Obtain the Heath Extension Program database of kebeles classified by malariousness and use it together with zone level data to prioritize and plan activities
6) Assist with revision of the epidemic manual
7) Participate in risk mapping process with MACEPA and others
8) Provide summaries of IDSR data to Public Health Emergency Management Section of MOH
9) Reach parity in LLIN coverage between Amhara, SNNPR and Oromia in Carter Center assisted areas

”Pick me!” Villagers wanting to be chosen to answer a question on malaria prevention behavior during the Mass Media Compaign in Amhara, Ethiopia Photo credit: Aryc W. Mosher, September 2008

NIGERIA

Country Background

In Africa, the same anopheline mosquitoes that transmit lymphatic filariasis (LF) also transmit malaria. Insecticide treated bed nets (ITNs) are one of the most important prevention tools for malaria and should also be useful as an adjunct to mass drug treatment in the LF elimination program. With this in mind, The Carter Center partnered with the Nigerian Ministry of Health and linked ITN distribution with mass drug administration (MDA) programs LF, a neglected tropical disease (NTD), on a pilot basis beginning in 2004. Sharing resources will result in cost reductions, and protection from the mosquito vectors will reduce transmission of both diseases simultaneously. Having ITNs, particularly long lasting insecticidal nets (LLINs), distributed free of charge and at scale (full population coverage) in Plateau and Nasarawa States is likely to be an effective way to protect from resurgence of LF after MDA with ivermectin/albendazole is halted. Logistical systems have been developed to enable distribution of insecticidal nets during MDA for LF/onchocerciasis.



Program Implementation

The Carter Center program in Nigeria has pioneered the concept of integrated mass treatment in which the logistics of an MDA program are shared across several programs, including malaria. The program in Plateau and Nasarawa states is built on an infrastructure and logistics system that delivers annual combination ivermectin/albendazole treatments with health education for lymphatic filariasis (LF) to the entire population. The partners include Nigeria's FMOH, state governments, and the ministries of health of Plateau and Nasarawa. The program began in 1999 with integrated river blindness (RB) interventions and urinary schistosomiasis, expanding into LF in 2000. Interventions now also include trachoma, Vitamin A deficiency, and malaria.

LLIN Provision

Since 2004, 262,242 ITNs have been distributed (most during MDA) in Plateau and Nasarawa. For the first 3 years, these donated nets were conventionally impregnated (insecticidal action lasting less than one year), not LLINs (insecticidal action lasting up to five years, or the lifespan of the net itself). We have adopted a policy to retreat the conventional nets (using retreatment sachets) during MDA, but funding for the kits has been limited, and moreover, the process of reimpregnation is complicated and not easily done during the MDA treatment exercise. The Federal Government of Nigeria donated 100,000 LLIN in 2007 but has not donated nets since. In 2008, due to a shortage of nets, only 8,358 LLINs were distributed in Plateau and Nasarawa States, just 4% of the 2008 annual distribution objective of 206,667.

Nigeria: 2008 ITN Distribution Results
Plateau & Nasarawa States

State (Local Government Area)	Cummultive ITNs Distributed	ITN Distribution Objective	Local Government Population Total
Plateau (Jos North)	500	145,765	1,480,170
Nasarawa (Wamba)	7,858	60,902	779,506
Total	**8,358**	**206,667**	**2,259,676**

Yearly Net Distribution
2004-2008

Year	Nets Distributed
2004	38,620
2005	18,447
2006	64,547
2007	96,270
2008	8,358
Total	**226,242**

An additional 200,000 nets were distributed free of charge though the efforts of state and local MOH personnel, utilizing volunteer village health workers active in the onchocerciasis and lymphatic filariasis control programs in seven states of SE Nigeria. The distribution program is supported in part by a grant from the Bill & Melinda Gates Foundation. (The Gates Foundation does not support the purchase of ITNs in Plateau and Nasarawa states).

In the future, we will distribute only LLINs to avoid the logistical problems and cost of re-treatment of other types of bednets.

Global Fund Round 8 Application:

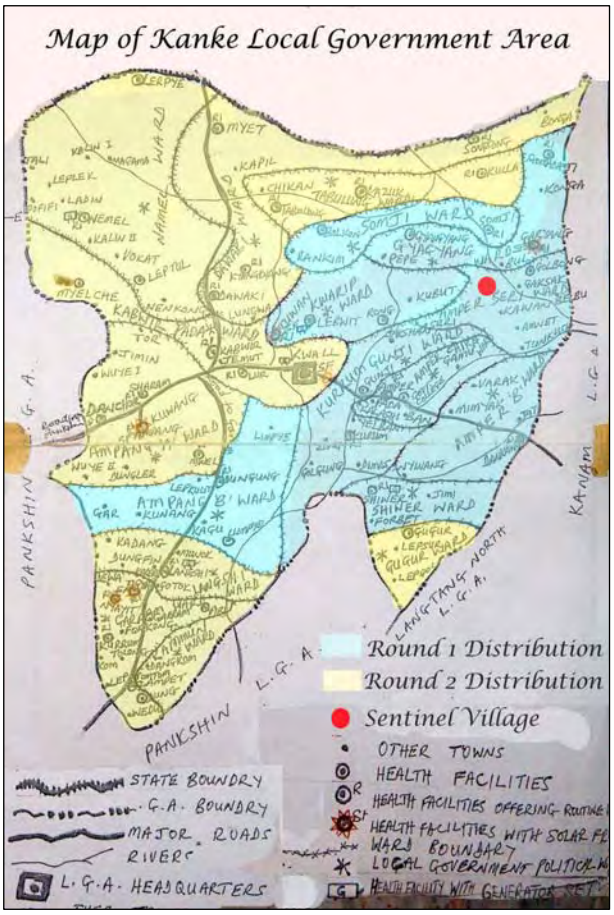
Nigeria has received limited funds from the Global Fund for ITN or LLIN purchase, most recently in Round 2 in 2004. There is now a push to scale up net coverage in Nigeria, and the country submitted a large grant application under Round 8 for about $600 million in June 2008 which was successful. Together with other funders, Nigeria now has gained support for full net coverage nationwide. The Carter Center anticipates participating in the distribution of a large influx of LLINs across the nine states where we are assisting programs.

Behavior Change Communication:

In 2008, the Center did not engage in in-depth assistance to the MOH of Nigeria with the development of Behavior Change Communication messages. In 2009, the Center will consider making a greater contribution in this area.

Monitoring and Evaluation:

In 2008, the Center did not engage in in-depth assistance to the MOH of Nigeria with regard to monitoring and evaluation of national malaria control efforts. However, the Center may be invited to expand its role through our anticipated involvement with LLIN distribution via Nigeria's successful Global Fund application for 2010.



Operational Research

Kanke Project

Kanke is a small Local Government Area (LGA) in Plateau State of Nigeria. It is composed of approximately 18 principal wards and a population of about 89,500 persons. Kanke has approximately 13,161 households (6.8 persons per household) and 43,300 sleeping spaces (3.29 sleeping spaces per household). Only a small total of LLINs (5,414) have been distributed to date, leaving 37,886 sleeping spaces without nets.

Clarke Mosquito Control has joined with The Carter Center in an effort to provide enough LLINs to enable full protective coverage of all households for Kanke. Clarke is launching an employee and partner fund raising effort to collect the necessary funds, along with their own corporate contribution of $100,000, to meet the costs of this project. The official launching of the Clarke fund raising was January 2009.

Gates Study in South East Nigeria

A study is under way in two states in southeast Nigeria (Ebonyi and Imo) to assess whether LLINs can overcome the stagnation of LF programs in *Loa loa* endemic areas where MDA is impossible due to the possibility of severe adverse reactions to the drugs in *Loa loa* infected individuals, in addition to assisting with malaria control. The goal is to demonstrate whether LLINs alone can interrupt LF transmission and control malaria and what level of coverage with nets is required to achieve this.

The study has two arms:
(Group A) two LGAs provided with LLINs only to vulnerable groups (children under five and pregnant women)
(Group B) two LGAs provided with LLINs for full population coverage.

The Gates Foundation is providing support for the purchase of LLINs for this study.

Household surveys: A baseline household malaria survey was conducted in the four LGAs in November-December 2007 (before nets), and a follow up survey conducted in November-December 2008. Surveys will also be done in 2009 and 2010.

The baseline survey in 2007 aimed to:
1) obtain baseline data on malaria, anemia and net coverage in each LGA;
2) assist in matching LGAs for the two study arms; and
3) assist planning of net distribution policy by assessing numbers of sleeping spaces.

The follow up survey in 2008 aimed to:
1) determine whether the appropriate level of net ownership and use had been achieved;
2) determine whether any impact on malaria prevalence or anemia; and
3) increase householders' knowledge and attitudes about malaria.

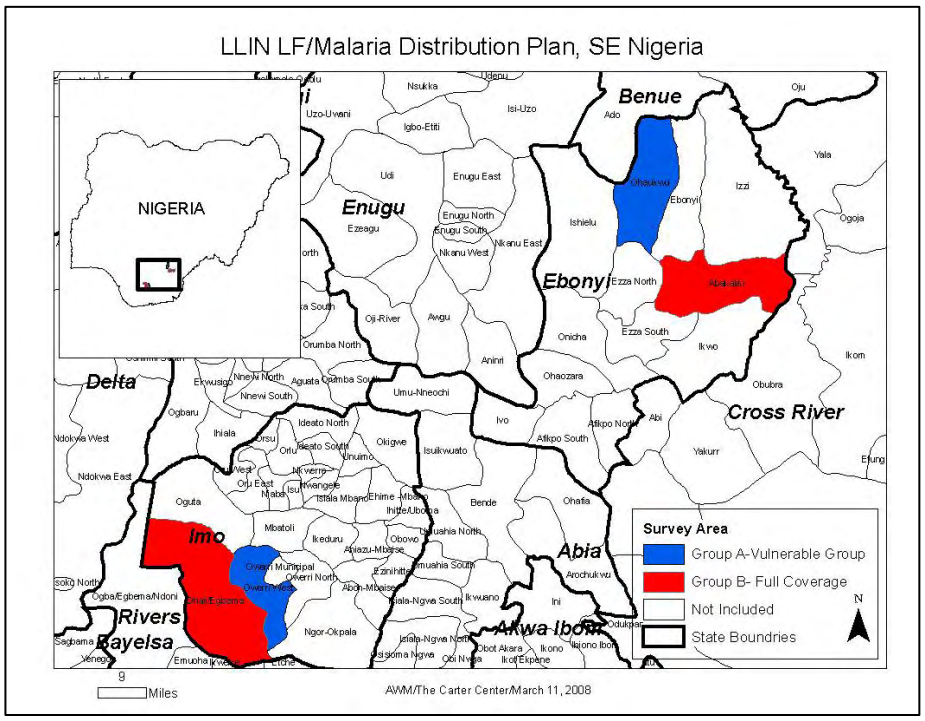
2007 survey: Overall, 60 clusters (15 per LGA) with 968 households in which 5,197 people lived were surveyed. 1,371 people were eligible for blood tests, including 526 children less than ten years old who were eligible for anemia testing. The mean number of persons per household was 4.4 with a mean of 3.1 sleeping spaces. The mean number of vulnerable sleeping spaces (occupied by a pregnant woman and/or a child under five) was 1.1 per house with a vulnerable person. Net coverage was extremely low, with only 5.4%of households having one or more nets (most were LLINs). One LGA (Ohaji Egbema) had no nets in the sampled households in 2007. Overall 43.1% of people were positive for malaria by rapid diagnostic test in 2007 and the mean haemoglobin in children under 10 years was 9.6 g/dl.

Average numbers of sleeping spaces observed in the 2007 survey were used to plan net distribution in 2008 to achieve the desired average number of nets per household in each study arm (one per household in group A; three per household in group B).

LLIN Distribution: In April and May 2008, the Nigerian Ministry of Health (MOH) and the Carter Center provided 200,000 LLIN for the study. The four LGAs were randomly divided into two study groups: Group A focusing on distribution to vulnerable groups (children under five years of age and pregnant women) and Group B focusing on distribution to the whole household.

The distribution was carried out within 935 villages of the targeted LGAs (Oweri West and Ohaji/ Egbema of Imo State and Abakaliki and Ohaukwu of Ebonyi State). Of the 200,000 LLINs provided, 180,390 (90.2%) are documented as having been delivered to more than 96,240 households.

Within Group A (Ohaukwu and Oweri West LGAs), 13,720 pregnant women and 59,271 children under five years of age will benefit from the 48,151 LLIN distributed within their LGAs. The distribution, within Group A, achieved an average ownership of 1.2 LLIN per household. The goal was to achieve on average *one* LLIN per household.



Within Group B (Abakaliki and Ohaji/Egbema LGAs), 246,235 persons will benefit from the 132,239 LLIN distributed within their LGAs. The distribution, within Group B, achieved average ownership of 2.4 LLIN per household. The goal was to achieve on average *three* LLIN per household.

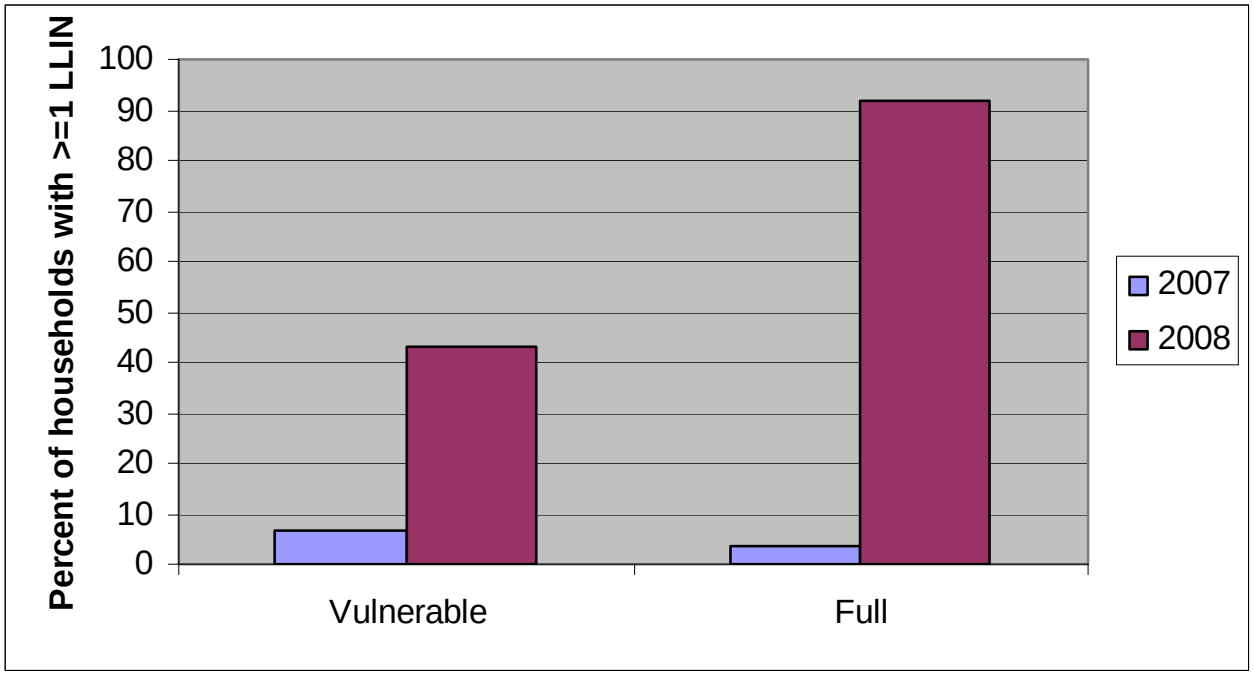
The biggest challenge to the distribution process was creating a workable definition of *household* that was consistently understood and followed by frontline distribution staff within Group B (full coverage). The lack of compensation for village volunteers created some challenges in completing the distribution of the LLINs and/or its accompanying documentation paperwork in some areas.

A review of the distribution records indicated that an additional 46,976 LLINs were needed (8,431 within Group A; 38,545 within Group B) to meet the study's aims of one per household in Group A and three per household in Group B. A further 40,000 nets were ordered in 2008 and will arrive in 2009 for distribution.

Women lining up in Owerri West, Nigeria for LLINs made available to households with vulnerable persons. Photo credit: Aryc W. Mosher, April 2008

2008 survey: The second household survey was conducted in November 2007. Overall, 58 clusters with 1,078 households in which 5,234 people lived were surveyed. 1,435 people were eligible for blood tests, including 633 children less than ten years old who were eligible for anemia testing. Survey analysis is still underway: nevertheless, a large increase in the ownership of LLINs is apparent in each group below (also see Figure on Page ii at the beginning of this document).

Net Ownership in Group A (Vulnerable) and Group B (Full Coverage) Households 2007 and 2008 Surveys



NIGERIA 2009 RECOMMENDATIONS

Plateau and Nasarawa states:

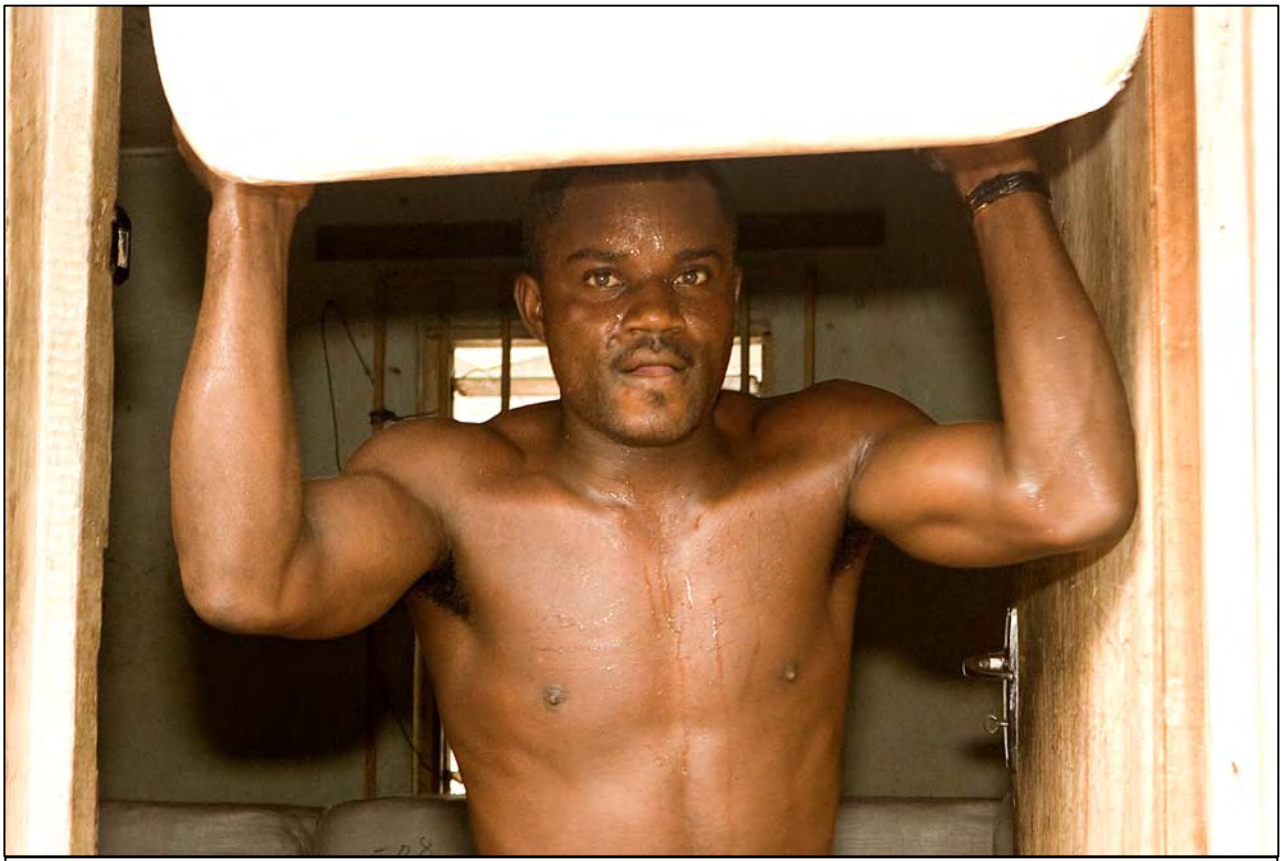
1) Distribute Clarke Duranets in Kanke Local Government Areas
2) Obtain commitments for nets from Global Fund or other sources
3) Develop strategies for integration of LLIN distribution with MDA

South East

1) Submit results of first two household surveys (net distribution, prevalence) for publication
2) Distribute additional 40,000 nets
3) Obtain commitments for move nets from Global Fund or other sources
4) Conduct third household survey

Nigeria general

1) Develop key messages for net use and care
2) Liaise with Roll Back Malaria on net and message delivery



Loading of LLINs in Owerri, Nigeria for transportation to Ebonyi, Nigeria. Each bale of 100 LLINs weighs approximately 100 lbs. Photo credit: Aryc W. Mosher, April 2008

List of Acronyms

ADO-Annual Distribution Objective
ATO-Annual Treatment Objective
BCC-Behavior Change Communication
CDC-Centers for Disease Control and Prevention
CDD-Community Directed Distributors
CDTI-Community Directed Treatment with Ivermectin
EPHTI-Ethiopia Public Health Training Initiative
GFATM 2-Global Fund for AIDS, TB and Malaria Round 2
GFATM 5-Global Fund for AIDS, TB and Malaria Round 5
HEW-Health Extension Worker
IEC-Information Education and Communication
IRS- Indoor Residual Spraying
ITN-Insecticide Treated Nets
LF-Lymphatic Filariasis
LGA-Local Government Area
LLIN-Long-Lasting Insecticidal Nets
M and E (M & E)-Monitoring and Evaluation
MACEPA-Malaria Control and Evaluation Partnership in Africa
MALONCHO-Malaria and Onchocerciasis (Carter Center integrated program)
MALTRA-Malaria and Trachoma (Carter Center integrated program)
MDA-Mass Drug Administration
MIS-Malaria Indicator Survey
MOH-Ministry of Health
PATH- Program for Alternative Technology in Health
PMI-The President's Malaria Initiative
PSI-Population Services International
SNNPR-Southern Nations, Nationalities and People's Region
TCC-The Carter Center
UNICEF-United Nations International Children's Emergency Fund
USAID-United States Agency for International Development
WB-World Bank
WHO-World Health Organization

ANNEX 1: THE NEGLECTED TROPICAL DISEASES
(Trachoma, Onchocerciasis and Lymphatic Filariasis)

TRACHOMA and its control

Trachoma is the world's leading 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. 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 ultimately blindness.

Effective control of trachoma can be achieved by the SAFE strategy, where SAFE stands for the four components of the strategy. They are:

1) Surgery on eyelids to correct advanced stages of the disease
2) Antibiotics to treat active eye infection (predominantly oral azithromycin (Zithromax) donated by Pfizer Inc and given once per year)
3) Facial cleanliness, achieved through **f**ace washing, to prevent disease transmission
4) Environmental improvements to increase access to clean water and improved sanitation (building latrines to reduce fly breeding on faeces).

ONCHOCERCIASIS and its control

Human onchocerciasis is an infection caused by the worm parasite *Onchocerca volvulus* that causes chronic skin and eye lesions. The worms live under the skin in nodules. Onchocerciasis is transmitted by *Simulium* blackflies that breed in fast flowing rivers and streams – hence the common name "river blindness". The World Health Organization estimates that approximately 37.2 million people are infected and 770,000 are blinded or severely physically 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 ultimate blindness.

Periodic mass treatment with ivermectin (Mectizan®, donated by Merck and Co., Inc.) prevents eye and skin disease caused by *O. volvulus* and may also be used to reduce or interrupt transmission of the disease. Delivery of Mectizan® is through Community Directed Treatment with Ivermectin (CDTI). In this process, volunteer Community Drug Distributors (CDDs) serve their own communities and kinship networks once per year. Applying this strategy enables the affected communities to have shared responsibility in the planning, execution, monitoring, evaluation, and reporting process of the control activities.

ANNEX 2: PUBLICATIONS AND ABSTRACTS

Papers published in 2008

1) 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.

2) 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.

3) Ngondi J, Gebre T, Shargie EB, Graves PM, Ejigsemahu Y, Teferi T, Genet A, Mosher AW, Endeshaw T, Zerihun M, Messele A, Richards FO Jr and Emerson PM (2008). Risk factors for active trachoma in children and trichiasis in adults: a household survey in Amhara Regional State, Ethiopia. *Trans Roy Soc Trop Med Hyg* 102(5):432-8.

4) 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.

5) 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. In press* .

Abstracts presented at ASTMH 2008

1) Patricia M Graves[a*], Frank O Richards[a], Jeremiah Ngondi[a,b], Paul M Emerson[a], Estifanos Biru Shargie[c], Tekola Endeshaw[c], Pietro Ceccato[d], Yeshewamebrat Ejigsemahu[c], Aryc W Mosher[a], Afework Hailemariam[e], Mulat Zerihun[c], Tesfaye Teferi[c], Berhan Ayele[c], Ayenew Mesele[c], Gideon Yohannes[c], Abate Tilahun[c], Teshome Gebre[c] , Daddi Jima[e], Tedros Adhanom Ghebreyesus[e]
a. The Carter Center, Atlanta, GA, USA; b. University of Cambridge Department of Public Health and Primary Care, Cambridge, United Kingdom; c. The Carter Center, Addis Ababa, Ethiopia;
d. International Research Institute for Climate and Society, Columbia University, New York, USA
e. Ministry of Health, Addis Ababa, Ethiopia.

Individual, household, and environmental risk factors for malaria infection in Amhara, Oromia and SNNP regions of Ethiopia.

Malaria remains a serious and unstable health problem in Ethiopia. We assessed malaria infection in relation to age, altitude, rainfall, socioeconomic factors and coverage of control measures in Amhara, Oromia and SNNP regions of Ethiopia in Dec 2006-Jan 2007, before completion of net distribution scale-up. Surveys were conducted in 224 randomly selected clusters of 25 households in malarious areas (overall sample of 27 884 people in 5 708 households, the majority of which were located below 2000m). In 11,538 blood slides examined, malaria prevalence in persons of all ages was 4.1% (95% CI 3.4 to 4.9%) overall and 4.2% at altitudes below 2000m, with 56.5% of infections being *Plasmodium falciparum.* At least one mosquito net or one long-lasting insecticidal net (LLIN) was present in 37.0% (95% confidence interval [CI] 31.1 to 43.3%) and 19.6% (95% CI 15.5 to 24.5%) of households, respectively. In multivariate analysis (N=11 437) for risk of parasitaemia, significant protective factors were: number of LLINs per household (odds ratio $[OR]_{\text{per additional net}}$=0.60; 95% CI 0.40 to 0.89), living at higher altitude ($OR_{\text{per 100m}}$=0.95; 95% CI 0.90 to 1.00), and household wealth ($OR_{\text{per unit increase in asset index}}$=0.79; 95% CI 0.66

to 0.94). Malaria parasite prevalence was positively associated with the peak monthly rainfall in the year before the survey ($OR_{\text{per additional 10mm rain}}$=1.10; 95% 1.03 to 1.18).

2) Daddi Jima[1], Jimee Hwang[2], Asefaw Getachew[3], Hana Bilak[4], Estifanos Biru Shargie[3], Teshome Gebre[3], Gashu Fentie[3], Adam Wolkon[2], Scott Filler[2], Richard Reithinger[5], Paul M Emerson[6], Tekola Endeshaw[3], Aryc W Mosher[6], Frank O Richards[6], Eskindir Tenaw[7], Ambachew Medhin[8], Khoti Gausi[9], John Miller[4], Judith Robb-McCord[4], Richard Steketee[4], Patricia M Graves[6], Zerihun Tadesse[1], Tedros Adhanom Ghebreyesus[10]
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[9]World Health Organization, Harare, Zimbabwe, [10] Minister of Health, Addis Ababa, Ethiopia

Achievements in Malaria Control in Ethiopia— Results from Malaria Indicator Survey, 2007

Malaria is a leading health problem in Ethiopia with 68% of its 75 million citizens at risk. The 2005 Demographic Health Survey (DHS) showed low levels of malaria prevention measures and treatment coverage. In 2006, the ministry of health launched a major initiative to scale up interventions, which included the distribution of nearly 20 million long-lasting insecticidal nets (LLIN), targeted indoor residual insecticide spraying, universal access to artemisinin combination therapy (ACT), and the training of 24,000 village-based health extension workers to enhance personal protection, health-seeking behavior, and case management. A cross-sectional national Malaria Indicator Survey was conducted during the major malaria transmission season (October-December, 2007) to assess intervention coverage and malaria and anemia prevalence. Using probability proportional to size sampling, 319 enumeration areas (EA) were selected. Each EA was mapped using a Global Positioning System and 25 households (HH) per EA were randomly selected for interview with a personal digital assistant based questionnaire. Analyses were weighted by selection probability. Nationally, HH ownership of nets increased from 6% in 2005 to 56% (N=7621). For HHs in areas of altitude <2000m, ownership was 69% and for the highly malarious regions (Afar, Benishangul-Gumuz, and Gambella) it ranged from 73-88%. Most (>95%) surveyed nets were LLINs. In 2005, net use by children under 5 years was 2%; it is now 35% in all HHs (n=5225), and 59% in HHs with a net (n=3206). In the twelve months preceding the survey, 14.2% of all HHs had been sprayed. Among children under 5 years, 22.3% reported fever in the two weeks prior to the survey. Of these, 15.4% sought medical attention within 24 hours of onset of fever and 9.5% took an antimalarial (of which 42.6% were ACTs). Although, malaria prevalence by microscopy for all ages was low, 0.7% (1.7% by Parascreen®), there was substantial regional variability ranging from 8.9% (20.7% by Parascreen®) in Benishangul-Gumuz to 0% by both tests in Addis Ababa. Anemia (Hg< 8.0 g/dL) was found in 5.5% of children under 5 years and was associated with malaria parasitemia (OR =3.9, 95% CI: 1.4-10.7). Compared to the 2005 DHS, the improvement in coverage with LLINs is remarkable. Continued investment into malaria control efforts are needed to maintain the encouraging progress towards achieving the Abuja targets and Roll Back Malaria goals in Ethiopia.

3) Aryc W Mosher[1], Moses Katabarwa[1], Teshome Gebre[2], Estifanos Biru Shargie[2], ,Abate Tilahun[2], Patricia M Graves[1], Frank O Richards[1],
[1]The Carter Center, Addis Ababa, Ethiopia, [2]The Carter Center, Atlanta, GA,

Impact of increased numbers of Community Directed Distributors on successful distribution of ivermectin in Ethiopia, 2007.

The collaboration between the Ethiopian Ministry of Health, the Carter Center and the African Program for Onchocerciasis Control (APOC) on ivermectin (Mectizan ™ (donated by Merck & co) distribution in onchocerciasis endemic communities in southwestern Ethiopia has been on-going since 2001. The joint effort utilizes the community-directed treatment with ivermectin (CDTI) approach which allows communities or kinship groups to identify community members (Community Directed Distributors or CDD) as the key players in

coordinating and distributing the treatment once per year. During 2007, approximately 32,270 CDDs provided ivermectin treatment to more than 2.6 million persons in 52 woredas (districts) within the two regions of Oromiya and SNNPR. The number treated represents coverage of nearly 92% of the 2.9 million who were eligible. To assess if the number of persons for whom a CDD is responsible has an influence on the treatment coverage of those eligible, the reporting forms from the 52 woredas were reviewed and the calculated ratios of persons per CDD to percent eligible persons treated were compared. Regression analysis showed a significant negative relationship (-.0001798, p value: 0.013) between the two. As the number of persons per CDD increases, the level of coverage achieved for eligible persons decreases. In order for the Carter Center assisted CDTI project areas to increase its abilities to achieve 100% coverage, and to meet the APOC recommended coverage of 1 CDD/ 100 persons, an additional 9,240 CDDs would be needed.

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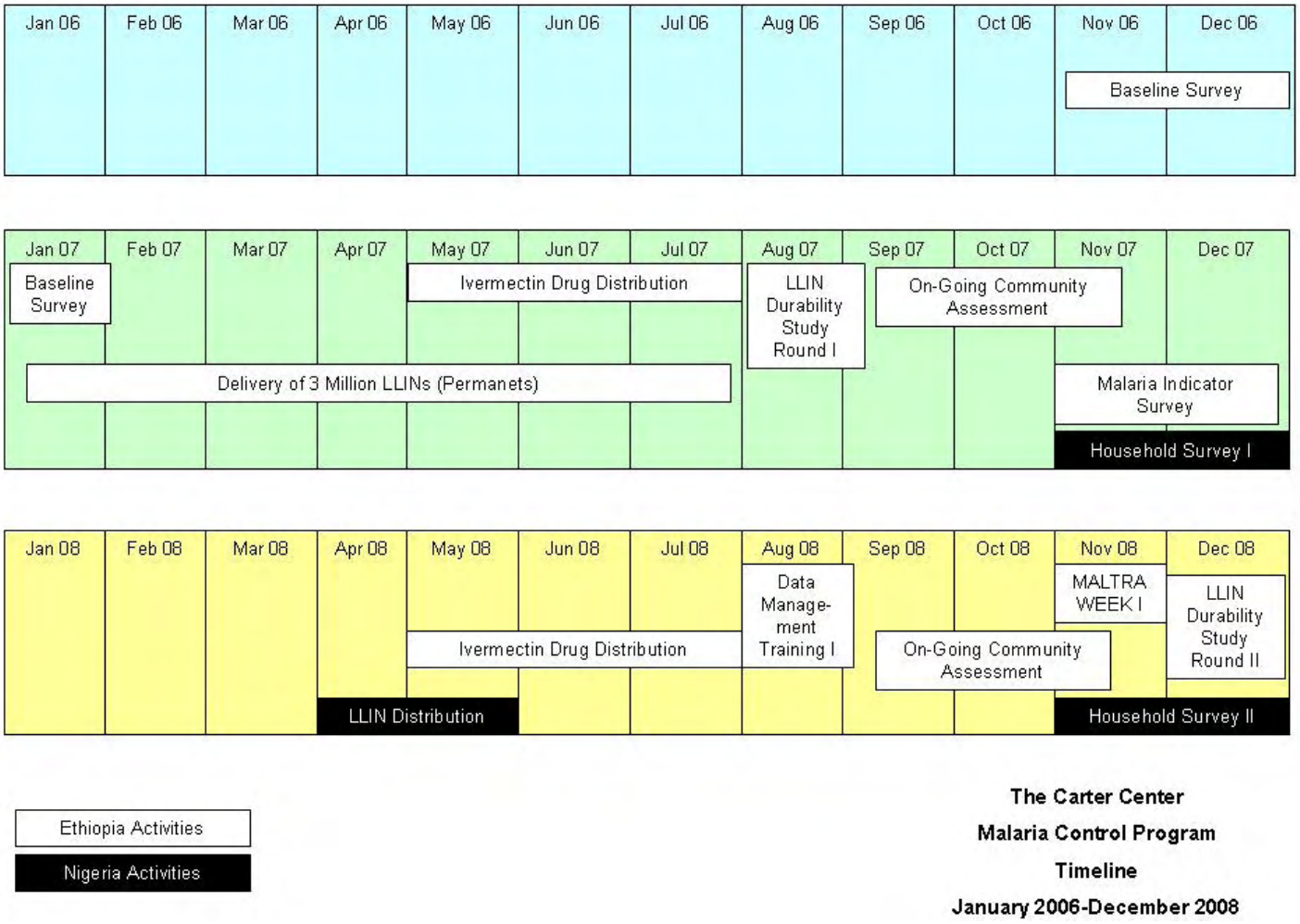
Rapid increase in coverage with long-lasting insecticidal nets in Amhara, Oromia and SNNP regions of Ethiopia.

To contribute to the rapid scale-up of malaria control interventions in Ethiopia, The Carter Center assisted in procurement and distribution of 3 million long-lasting insecticidal nets (LLINs) in three regions of Ethiopia (representing 81% of the country's total population) where there are also ongoing onchocerciasis and trachoma control programs. Distribution was accomplished by ministry of health and local administrative staff, with the assistance of local trachoma and onchocerciasis workers. Baseline and follow up representative coverage surveys in malarious areas in the three regions of Amhara, Oromia and SNNPR were conducted in 5,708 and 2,550 households, respectively, of which the majority were located below 2000m. The proportion of households in these areas possessing at least one net increased from 37.0% (95% confidence interval (CI) 31.1 to 43.3%) to 72.8% (95% CI 64.8 to 80.7%) in less than one year, while the proportion possessing at least one LLIN increased from 19.6% (95% CI 15.5 to 24.5%) to 68.3% (95% CI 59.2% to 77.5%). The mean number of LLIN per house increased from 0.3 (95% CI 0.2 to 0.4) to 1.2 (95% CI 1.0 to 1.5). The proportion of persons sleeping under an LLIN the previous night went from 15.3% (95% CI 12.0 to 19.2%) to 34.5% (95% CI 27.3 to 41.6%) overall, from 17.4% (95% CI 13.6 to 22.0%) to 38.9% (95% CI 29.8 to 48.1%) for children under 5 years, and from 18.9% (95% CI 14.0 to 25.0%) to 37.4% (95% CI 25.5 to 49.3%) for pregnant women. These increases in net coverage and use were statistically significant. To build further on these encouraging gains and decrease the burden of malaria, health extension workers, community ivermectin distributors (for onchocerciasis) and trachoma community workers will be identifying remaining gaps in net coverage and the factors associated with use or non-use of mosquito nets. Appropriate educational materials are being developed to intensify promotion of proper use and care of LLIN.

ANNEX 3: MALARIA CONTROL PROGRAM TIMELINE



ANNEX 4: PUBLICATIONS AND ABSTRACTS

Survey Comparison Chart					
	Baseline Survey	**Malaria Indicator Survey**			
Who	The Carter Center/Ethiopian Ministry of Health	The Carter Center, EMOH, MACEPA, CDC/USAID/PMI, UNICEF, WHO, ESA			
Sample	AM, OR, SN malarious	All areas <2500m (intended)	All areas <2500m	AM,OR,SN	AM,OR,SN malarious
Purpose	Baseline line information on risk factors for malaria, malaria prevalence, and access to and use of nets in areas with primary focus by TCC	• to measure the coverage of malaria control services including ITNs, IRS and antimalarial medicines used for treatment of febrile children, including • to measure the prevalence of fever, malaria parasitaemia and anaemia (HB <8g/dl) among children <5yrs of age, and malaria parasitaemia among populations >5 yrs at the household level • to implement standardized, representative household survey methods • to strengthen the capacity of the National Malaria Control Programme and local agencies involved in order to facilitate the implementation of surveys of this type in the future • to establish a baseline for <5 Mortality from women's brith history and obtain data on malaria knowledge			
When	December 2006-January 2007	October 2007-January 2008			
Where	Amhara, SNNPR and Oromia	All Regions and Zones,			
Cluster Definition and Sampling	Primary sampling unit is kebele. Random selection of Kebeles from eligible malarious (<10%) woredas. Random selection of 5 State Teams from list in each kebele. Selection of 5 HHs (25HHs total per cluster) in each State Team using random direction method	Primary sampling unit is Census Enumeration Area (EA). Random selection of EAs from list in three strata: <1500m rural, <1500m urban, >1500m. Simple random selection of 25 HH from all HH in each EA mapped using PDA			
Number of Regions	3	9 regions and 2 urban areas			
Number of Zones	29				
Number of Woredas	126				
Number of Clusters	224	342	319	266	105
Number of HHs	5,708		8,618	5730	2550
Number of Persons	28,494	34,755			
Number Persons Tested for Malaria (Slide/ParaScreen)	12,212	RDT 10,578; slide 10,007			
Selection for Blood Test	All persons in even numbered households	Children under 6 in all HH and all persons in every 4th HH			
Survey domains and strata	Oromia and SNNPR Regional Estimates; Zonal Estimates Amhara (10), Area Estimates CDTI/Non-CDTI Oromia and SNNPR	National Estimate Oromia Regional Estimate; Zonal Estimates Amhara (10), Area Estimates CDTI/Non-CDTI Oromia and SNNPR			
Oversampling for TCC needs	Oversampling in Amhara and in CDTI areas of Oromia and SNNPR: 16 clusters in each zone Amhara; 16 clusters in CDTI areas of Oromia (8)/SNNPR (8); 48 clusters in non-CDTI areas of Oromia (24) /SNNPR (24)	Oversampling in Amhara and Oromia regions12 clusters in each zone Amhara, including N Gondar CDTI (2) and non-CDTI (10); 15 clusters in CDTI areas of Oromia (5) /SNNPR (10); 98 clusters in non-CDTI areas of Oromia; 33 clusters in non-CDTI areas of SNNPR; 11 clusters in Gambella (4 CDTI/7 non-CDTI); 18 clusters in Benishangul Gumuz (2 CDTI/16 non-CDTI)			
Method	Paper forms entered manually with CSPRO and analysed in SPSS and STATA	Personal digital assistants (PDAs) - electronic entry into Access and analysed with SAS and STATA			

ANNEX 5: GATES STUDY IN SOUTH EAST NIGERIA

Distribution of 200,000 LLINs in Imo and Ebonyi States, Nigeria, April-May 2008

Distribution Summary by LGA

State	LGA	Group (Full/Priority)	Num. Health Centers	Num. Villages	Num. Households (HH)	Num. People in HH	Num. Children <5	Num. Pregnant Women	Num. LLINs Given	Sum Village Remaining LLIN Need	Ratio Persons Per LLIN*	Ration LLIN per HH	Average Num. Persons per HH
Ebonyi	Abakaliki	Group B (Full Coverage)	16	182	17,517	86,996	-	-	50,380	(11,339)	1.73	2.88	4.97
Ebonyi	Ohaukwu	Group A (Vulnerable)	40	428	27,372	136,666	39,061	8,896	31,984	(5,433)	1.50	1.17	4.99
Imo	Ohaji/Egbema	Group B (Full Coverage)	26	214	38,604	173,601	-	-	81,859	(27,206)	2.12	2.12	4.50
Imo	Owerri West	Group A (Vulnerable)	17	111	12,750	58,278	20,210	4,824	16,167	(2,998)	1.55	1.27	4.57
Total			**99**	**935**	**96,243**	**455,541**	**59,271**	**13,720**	**180,390**	**(46,976)**	**1.85**	**1.87**	**4.73**

** For Full Coverage, ratio calculated using Num. People in HH. For Vulnerable, ratio calculated using sum of Children <5 and Pregnant Women*

Distribution Summary by State

State	Num. Health Centers	Num. Villages	Num. Households (HH)	Num. People in HH	Num. Children <5	Num. Pregnant Women	Num. LLINs Given	Sum Village Remaining LLIN Need	Ratio Persons Per LLIN*	Ration LLIN per HH	Average Num. Persons per HH
Ebonyi	56	610	44,889	223,662	39,061	8,896	82,364	(16,772)	1.64	1.83	4.98
Imo	43	325	51,354	231,879	20,210	4,824	98,026	(30,204)	2.03	1.91	4.52
Total	**99**	**935**	**96,243**	**455,541**	**59,271**	**13,720**	**180,390**	**(46,976)**	**1.85**	**1.87**	**4.73**

Distribution Summary by Coverage Group

Group (Full/Priority)	Num. Health Centers	Num. Villages	Num. Households (HH)	Num. People in HH	Num. Children <5	Num. Pregnant Women	Num. LLINs Given	Sum Village Remaining LLIN Need	Ratio Persons Per LLIN*	Ration LLIN per HH	Average Num. Persons per HH
Group B (Full Coverage)	42	396	56,121	260,597	-	-	132,239	(38,545)	1.97	2.36	4.64
Group A (Vulnerable)	57	539	40,122	194,944	59,271	13,720	48,151	(8,431)	1.52	1.20	4.86
Total	**99**	**935**	**96,243**	**455,541**	**59,271**	**13,720**	**180,390**	**(46,976)**	**1.85**	**1.87**	**4.73**

Percent of 200,000 LLINs documented as being distributed: ***90.2%***

Prepared by: Aryc W. Mosher, Assistant Director, Malaria Control Program, The Carter Center/Altanta *Revision Date: 8/12/2009*