

This Malaria Operational Plan has been approved by the U.S. Global Malaria Coordinator and reflects collaborative discussions with the national malaria control programs and partners in country. The final funding available to support the plan outlined here is pending final FY 2017 appropriation. If any further changes are made to this plan it will be reflected in a revised posting.



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## U.S. PRESIDENT'S MALARIA INITIATIVE



**PRESIDENT'S MALARIA INITIATIVE**

**ETHIOPIA**

**Malaria Operational Plan FY 2017**

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## ABBREVIATIONS and ACRONYMS

ACT	Artemisinin-based combination therapy
ANC	Antenatal care
API	Annual parasite incidence (malaria cases/1,000 population)
APTS	Accountable Pharmaceutical Transactions and Services
CB	Community-based
CDC	Centers for Disease Control and Prevention
DDT	Dichloro-diphenyl-trichloroethane
EFETP	Ethiopian Field Epidemiology Training Program
EPHI	Ethiopian Public Health Institute
EC	Ethiopian calendar
EUV	End-use verification
FELTP	Field Epidemiology and Laboratory Training Program
FMHACA	Food, Medicine and Health Care Administration and Control Authority
FMOH	Ethiopian Federal Ministry of Health
FY	Fiscal year
GHI	Global Health Initiative
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
GoE	Government of Ethiopia
G6PD	Glucose-6-phosphate dehydrogenase
HDA	Health development army
HDAMA	Health Development and Anti-Malaria Association
HEP	Health extension package (or pProgram)
HEW	Health extension worker
HMIS	Health management information system
HSDP	Health Sector Development Plan
HSS	Health systems strengthening
HSTP	Health Sector Transformation Plan
iCCM	Integrated community case management
IDSR	Integrated Disease Surveillance Report
IPTp	Intermittent preventive treatment for pregnant women
IRS	Indoor residual spraying
ITN	Insecticide-treated mosquito net
LLIN	Long-lasting insecticidal net
MCST	Malaria Control Support Team
M&E	Monitoring and evaluation
MIP	Malaria in pregnancy
MIS	Malaria Indicator Survey
MNCH	Maternal Neonatal and Child Health
MOP	Malaria Operational Plan
NFM	New Funding Model
NGenIRS	Next Generation Indoor Residual Spraying Project
NGO	Non-governmental organization
NMCP	National Malaria Control Program
NMSP	National Malaria Strategic Plan
ORHB	Oromia Regional Health Bureau

PEPFAR	President's Emergency Plan for AIDS Relief
PFSA	Pharmaceutical Funds Supply Agency
PHCU	Primary Health Care Unit
PHEM	Public Health Emergency Management
PMI	President's Malaria Initiative
PPE	Personal protective equipment
RA	Resident Advisor
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
RHB	Regional Health Bureau
SBCC	Social and behavioral change communication
SM&E	Surveillance, monitoring, and evaluation
SNNPR	Southern Nation & Nationalities Peoples' Region
TFM	Transitional Funding Mechanism
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USG	United States Government
WHO	World Health Organization

## I. EXECUTIVE SUMMARY

When it was launched in 2005, the goal of the President's Malaria Initiative (PMI) was to reduce malaria-related mortality by 50% across 15 high-burden countries in sub-Saharan Africa through a rapid scale-up of four proven and highly effective malaria prevention and treatment measures: insecticide-treated mosquito nets (ITNs); indoor residual spraying (IRS); accurate diagnosis and prompt treatment with artemisinin-based combination therapies (ACTs); and intermittent preventive treatment of pregnant women (IPTp). With the passage of the Tom Lantos and Henry J. Hyde Global Leadership against HIV/AIDS, Tuberculosis, and Malaria Act in 2008, PMI developed a U.S. Government Malaria Strategy for 2009–2014. This strategy included a long-term vision for malaria control in which sustained high coverage with malaria prevention and treatment interventions would progressively lead to malaria-free zones in Africa, with the ultimate goal of worldwide malaria eradication by 2040-2050. Consistent with this strategy and the increase in annual appropriations supporting PMI, four new sub-Saharan African countries and one regional program in the Greater Mekong Subregion of Southeast Asia were added in 2011. The contributions of PMI, together with those of other partners, have led to dramatic improvements in the coverage of malaria control interventions in PMI-supported countries, and all 15 original countries have documented substantial declines in all-cause mortality rates among children less than five years of age.

In 2015, PMI launched the next six-year strategy, setting forth a bold and ambitious goal and objectives. The PMI Strategy 2015-2020 takes into account the progress over the past decade and the new challenges that have arisen. Malaria prevention and control remains a major U.S. foreign assistance objective and PMI's Strategy fully aligns with the U.S. Government's vision of ending preventable child and maternal deaths and ending extreme poverty. It is also in line with the goals articulated in the Roll Back Malaria (RBM) Partnership's second generation global malaria action plan, *Action and Investment to defeat Malaria (AIM) 2016-2030: for a Malaria-Free World* and WHO's updated *Global Technical Strategy: 2016-2030*. Under the PMI Strategy 2015-2020, the U.S. Government's goal is to work with PMI-supported countries and partners to further reduce malaria deaths and substantially decrease malaria morbidity, towards the long-term goal of elimination.

Ethiopia was selected as a PMI focus country in fiscal year (FY) 2008.

This FY 2017 Malaria Operational Plan presents a detailed implementation plan for Ethiopia, based on the strategies of PMI and the National Malaria Control Program (NMCP). It was developed in consultation with the Federal Ministry of Health (FMOH), NMCP, Oromia Regional Health Bureau (ORHB), and with the participation of national and international partners involved in malaria prevention and control in the country. The activities that PMI is proposing to support align with the National Malaria Strategic Plan (NMSP 2014-2020) and build on investments made by PMI and other partners to improve and expand malaria-related services, including the Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund) malaria grants. This document briefly reviews the current status of malaria control policies and interventions in Ethiopia, describes progress to date, identifies challenges and unmet needs to achieving the targets of the NMCP and PMI, and provides a description of activities that are planned with FY 2017 funding.

The proposed FY 2017 PMI budget for Ethiopia is \$38 million. PMI will support the following intervention areas with these funds:

### **Entomologic monitoring and insecticide resistance management:**

Insecticide resistance in Ethiopia is a concern and Ethiopia is currently updating its national resistance monitoring and management strategy. The goals are to minimize insecticide selection pressure, ensure vector control interventions are guided by evidence, develop and implement a national plan for insecticide resistance monitoring and management, and provide timely analysis and interpretation of data. From 2014-2016, PMI supported entomological resistance monitoring of 11 insecticides from 4 insecticide classes in 8 permanent sites and mosquito behavior studies in 3 sites. The insecticide resistance monitoring test results show that local vectors are generally resistant to dichloro-diphenyl-trichloroethane (DDT) and pyrethroids. With FY 2017 funds, PMI plans to continue the support of insecticide resistance surveillance and support the coordination of insecticide resistance data for more timely reporting and analysis of data.

### **Insecticide-treated nets (ITNs):**

As per the NMSP 2014-2020, the FMOH conducted a mass campaign in 2015, distributing 29.6 million long-lasting insecticidal nets (LLINs) to protect all Ethiopians living in areas with ongoing malaria transmission, representing 60% of the total population. The Global Fund contributed the majority of the LLINs with PMI supporting the remaining gap. PMI cumulatively procured over 20 million LLINs between 2008 and 2015. With FY 2015 and FY 2016 funds, PMI plans to procure 6.2 million LLINs for distribution to high risk communities to replace lost nets and protect new households and new household members. With FY 2017 funds, PMI plans to procure an additional 4 million LLINs for distribution as part of Ethiopia's 2018 universal coverage campaign. PMI also plans to support the development of a LLIN distribution tracking system and ensure all LLINs are reaching their intended users.

### **Indoor residual spraying (IRS):**

The FMOH's NMSP aims to provide 100% IRS coverage as a key malaria prevention measure in areas where malaria burden is high and in highland fringe areas with the potential for malaria outbreaks. According to the NMSP's malaria stratification, which is based upon annual parasite incidence, about 17% of the population in the country will be targeted annually for IRS. PMI has been implementing IRS in Ethiopia since 2008 and has supported a comprehensive range of IRS-related activities, including targeting and enumeration of areas for IRS operations, improved logistical planning and support, environmental compliance monitoring, entomological surveillance, and technical assistance and operational support. The PMI-supported IRS program protected between 1 million to 2.9 million people annually since its launch. In 2015, PMI supported the spraying of 704,945 structures and protected 1,655,997 people from malaria in 36 districts of Oromia Region, achieving a 99.5% coverage rate. With FY 2017 funding, PMI will continue to support safe and effective IRS implementation within 36 high burden districts in the Oromia Region, in addition to continuing to provide limited IRS support to 34 graduated districts.

### **Malaria in pregnancy (MIP):**

The FMOH's NMSP does not support IPTp with sulfadoxine-pyrimethamine due to the relatively low intensity of malaria transmission in most of Ethiopia. Malaria in pregnancy in Ethiopia is addressed through improving prompt access to diagnostics and treatment, prioritization of LLIN use by pregnant women, and enhanced social and behavior change communication (SBCC) activities targeting pregnant women in malaria endemic areas. With FY 2016 funds, PMI will provide pre-service training for midwives and health extension workers (HEWs) to improve malaria case management services for

pregnant women. With FY 2017 funds, PMI will continue to strengthen malaria case management of pregnant women at both the facility and community levels and ensure access to LLINs.

### **Case management:**

The NMSP aims for robust coverage of high quality diagnostic and treatment services universally, especially at public sector health facilities in rural areas in order to diagnose 100% of suspected malaria cases within 24 hours of fever, and treat all confirmed cases according to the national guidelines. Since the launch of PMI, a total of 6.24 million RDTs and 12.34 million ACT treatment doses have been procured. In addition, in collaboration with regional and district health offices, PMI has supported health worker training, mentoring and supervision for quality malaria diagnosis using microscopy, and the management of malaria at district-level health centers and community-level health posts through integrated community case management (iCCM). Coordinating with Global Fund, no additional procurement of ACTs with FY 2017 funding is planned. With FY 2017 funds, PMI plans to procure 513,000 RDTs and other non-ACT antimalarials, will continue to strengthen case management activities in the public and private sector in microscopy strengthening, and will conduct therapeutic efficacy monitoring.

### **Health systems strengthening and capacity building:**

As outlined in the NMSP, substantial resources are needed to strengthen health systems and to provide capacity building for malaria control in Ethiopia. PMI has historically strengthened the health systems in Ethiopia through support to pharmaceutical management and logistics systems, including quantification of malaria commodities (through the micro-plan), strengthening routine malaria surveillance systems, and building the capacity of health staff through both pre-service and in-service training. Additionally, PMI has supported the training of Ethiopian Field Epidemiology Training Program (EFETP) residents in outbreak investigation and response. With FY 2017 funds, PMI will provide coordination support for ORHB as well as nationally, EFETP training and pre-service training of HEWs for malaria prevention and control activities.

### **Social and behavior change communication (SBCC):**

In the NMSP 2014–2020, the SBCC objective states that “*By 2020, all households living in malaria endemic areas will have the knowledge, attitudes and practices towards malaria prevention and control.*” In order to achieve this objective, the NMSP will utilize HEWs, health development armies (HDAs), and model family households to deliver SBCC interventions. In 2013, through the USAID/Ethiopia Local Capacity Development program, PMI initiated and supported two local organizations’ community-based malaria SBCC activities that targeted school children and religious leaders. In addition, starting in July 2015, PMI funded SBCC activities that utilized an integrated campaign platform, which organizes health messaging including malaria in a coherent and coordinated way through multiple channels to support community-based health workers. With FY 2017 funds, PMI plans to continue supporting SBCC capacity building, coordination, message harmonization, and school-based SBCC activities that promote malaria prevention and control with a focus on migrant populations.

### **Surveillance, monitoring and evaluation (SM&E):**

According to the NMSP, high priority malaria SM&E activities through 2020 for Ethiopia include: national household surveys such as the Malaria Indicator Survey (MIS), strengthening surveillance data

management capacity, supporting routine surveillance in 40 districts in Oromia, monitoring LLIN durability, conducting annual program review meetings to examine malaria data, and bi-annual supportive supervision. PMI has historically provided substantial financial resources and technical assistance for many of these SM&E activities, including support for Ethiopia's Public Health Emergency Management (PHEM) system, the MIS in 2007 and 2011, and the recently completed 2015 MIS. PMI's ongoing support to routine malaria surveillance aims to enhance reporting from rural health posts where half of all malaria morbidity is detected and treated. The annual micro-plan collects comprehensive malaria burden and commodities quantification data. With FY 2017 funds, PMI will continue to strengthen the PHEM system and epidemic reporting as well as the national malaria micro-plan.

### **Operational research (OR):**

PMI has supported OR in Ethiopia to address key program bottlenecks especially in building the evidence to improve *Plasmodium vivax* case management. Through FY 2014, PMI has supported operational research projects including assessments of drug adherence, glucose-6-phosphate dehydrogenase deficiency prevalence, malaria serology studies exploring relationships between school-based children and community malaria prevalence by RDT and microscopy and health facility-based surveillance, and the role of serology in MIS in low transmission settings. With FY 2015 and 2016 funding, PMI is planning operational research projects to evaluate targeted mass drug administration and reactive case detection on malaria transmission and elimination in Ethiopia, hematologic monitoring to assess the safety of the use of primaquine radical cure for *P. vivax*, and monitoring mosquito and human behavior to better understand malaria transmission in agricultural development areas in Ethiopia. No OR is planned with FY 2017 funding.

## II. STRATEGY

### 1. Introduction

When the President's Malaria Initiative (PMI) was launched in 2005, its goal was to reduce malaria-related mortality by 50% across 15 high-burden countries in sub-Saharan Africa through a rapid scale-up of four proven and highly effective malaria prevention and treatment measures: insecticide-treated mosquito nets (ITNs); indoor residual spraying (IRS); accurate diagnosis and prompt treatment with artemisinin-based combination therapies (ACTs); and intermittent preventive treatment of pregnant women (IPTp). With the passage of the Tom Lantos and Henry J. Hyde Global Leadership against HIV/AIDS, Tuberculosis, and Malaria Act in 2008, PMI developed a U.S. Government Malaria Strategy for 2009–2014. This strategy included a long-term vision for malaria control in which sustained high coverage with malaria prevention and treatment interventions would progressively lead to malaria-free zones in Africa, with the ultimate goal of worldwide malaria eradication by 2040-2050. Consistent with this strategy and the increase in annual appropriations supporting PMI, four new sub-Saharan African countries and one regional program in the Greater Mekong Subregion of Southeast Asia were added in 2011. The contributions of PMI, together with those of other partners, have led to dramatic improvements in the coverage of malaria control interventions in PMI-supported countries, and all 15 original countries have documented substantial declines in all-cause mortality rates among children less than five years of age.

In 2015, PMI launched the next six-year strategy, setting forth a bold and ambitious goal and objectives. The PMI Strategy 2015-2020 takes into account the progress over the past decade and the new challenges that have arisen. Malaria prevention and control remains a major U.S. foreign assistance objective and PMI's Strategy fully aligns with the U.S. Government's vision of ending preventable child and maternal deaths and ending extreme poverty. It is also in line with the goals articulated in the Roll Back Malaria (RBM) Partnership's second generation global malaria action plan, *Action and Investment to defeat Malaria (AIM) 2016-2030: for a Malaria-Free World* and WHO's updated *Global Technical Strategy: 2016-2030*. Under the PMI Strategy 2015-2020, the U.S. Government's goal is to work with PMI-supported countries and partners to further reduce malaria deaths and substantially decrease malaria morbidity, towards the long-term goal of elimination.

Ethiopia was selected as a PMI focus country in fiscal year (FY) 2008.

This FY 2017 Malaria Operational Plan (MOP) presents a detailed implementation plan for Ethiopia, based on the strategies of PMI and the National Malaria Control Program (NMCP) strategy, specifically, the Federal Ministry of Health's (FMOH) National Malaria Strategic Plan (NMSP) (2014-2020). The FY 2017 MOP was developed in consultation with the FMOH and NMCP, and with the participation of national and international partners involved in malaria prevention and control in the country. PMI activities proposed in this MOP support the NMSP and build on earlier investments PMI made and other partners to improve and expand malaria-related services, including the Global Fund to Fight AIDS, Tuberculosis, and Malaria (Global Fund) malaria grants. This document briefly reviews the current status of malaria control policies and interventions in Ethiopia, describes progress to date, identifies challenges and unmet needs to achieving the targets of the NMCP and PMI, and provides a description of activities that are planned with FY 2017 funding.

## 2. Malaria situation in Ethiopia

### Seasonality, weather, geography, and climate

In Ethiopia, the interaction of mountainous terrain with variable winds, seasonal rains, and ambient temperatures creates diverse micro-climates for malaria transmission. Ethiopian weather is also influenced by tropical Indian Ocean conditions and global weather patterns, including *El Niño* and *La Niña*. When a micro-climate creates local puddles, flooding conditions, and warm ambient temperatures that persist for several weeks within a malarious area with low population immunity, the resulting *Anopheles* mosquito proliferation may cause focal malaria transmission to accelerate, sometimes explosively. In Ethiopia, malaria is highly seasonal in many communities, but may have nearly constant transmission in some other areas; at the district level, malaria outpatient caseloads may vary several-fold from year to year in an “unstable” epidemic-prone transmission pattern. Peak malaria transmission occurs between September and December in most parts of Ethiopia, after the main rainy season from June to August. Certain areas experience a second minor malaria transmission period from April to June, following a short rainy season from February to March. January and July typically represent low malaria transmission seasons in most communities. Since peak malaria transmission often coincides with the planting and harvesting season, and the majority of malaria burden is among older children and working adults in rural agricultural areas, there is a heavy economic burden in Ethiopia. Although historically Ethiopia has been prone to periodic focal and widespread malaria epidemics, malaria epidemics have been largely absent since 2004, after the scale up of malaria control interventions.

### Vector species and abundance

*Anopheles arabiensis*, a member of the *An. gambiae* complex, is the primary malaria vector in Ethiopia, with *An. funestus*, *An. pharoensis*, and *An. nili* as secondary vectors. The sporozoite rate for *An. arabiensis* has been recorded to be as high as 5.4%. The host-seeking behavior of *An. arabiensis* varies with the human blood index collected from different areas ranging between 7.7% and 100%. *An. funestus*, a mosquito that prefers to feed exclusively on humans, can be found along the swamps of the Baro and Awash rivers and shores of lakes in Tana in the North and the Rift Valley areas. *An. pharoensis* is widely distributed in Ethiopia and has shown high levels of insecticide resistance, but its role in malaria transmission is unclear. *An. nili* can be an important vector for malaria, particularly in Gambella Regional State. Detailed information on the basic ecology and distribution of these vectors in Ethiopia is provided in the FY 2008 MOP. Insecticide resistance among these vectors has become an important issue, with implications for vector control strategies.

### Parasite prevalence, altitude strata, and annual parasite incidence (API):

*Plasmodium falciparum* and *P. vivax* are the major malaria parasites in Ethiopia, with several recent therapeutic efficacy trials documenting that ACTs and chloroquine continue to have adequate effectiveness for treating these pathogens, respectively. To date, there have been no major problems detected yet with emerging drug resistance, or with counterfeit or substandard antimalarial drugs in Ethiopia; however, constant vigilance is needed regarding these important issues that have adversely affected the malaria control programs of many other countries.

Typical human and mosquito behavior results in most malaria parasite transmission occurring indoors during nighttime hours within rural households within the lowlands and middle elevations, and only

occasionally in the highland fringe areas of Ethiopia greater than 2,000 meters above sea level. Malaria transmission may also sometimes occur outdoors during nighttime work or social activities, or may be associated with temporary overnight travel to other districts in malarious areas. Recent published and unpublished reports indicate an increased malaria incidence among migrant laborers in various parts of the country, most importantly in the northwest development corridors of the country bordering Sudan and South Sudan. Many Ethiopian communities have low and unstable malaria transmission patterns that result in low host immunity and significant clinical malaria illness risk after malaria infections, increased tendency for rapid progression to severe malaria, and propensity for malaria epidemics affecting all age groups. The epidemiology of malaria in Ethiopia, therefore, contrasts with that of many other countries in Africa with high malaria transmission where malaria morbidity and mortality mainly affect young children. Emerging data from episodic special outbreak investigations and unpublished anecdotes from Ethiopian malaria partners suggest that older boys and men may be at special risk for malaria from occupational and travel-related factors such as engaging in seasonal migrant farm work.

The 2007 Malaria Indicator Survey (MIS) indicated that parasite prevalence (as measured by microscopy) in Ethiopia was 0.7% and 0.3%, respectively, for *P. falciparum* and *P. vivax* below 2,000 meters altitude. The 2011 MIS indicated that 1.3% were positive for malaria using microscopy and 4.5% were positive for malaria using RDTs below 2,000 meters, with only 0.1% prevalence above 2,000 meters elevation. *Plasmodium falciparum* constituted 77% of infections detected below 2,000 meters elevation. The 2011 MIS demonstrated a remarkable demarcation of malaria risk at an altitude of 2,000 meters, with a 13-fold higher malaria prevalence at lower altitudes compared to higher elevations. There was essentially no *P. falciparum* detected by microscopy among persons surveyed within households having measured elevations above 2,000 meters in the 2011 MIS. The 2015 MIS data indicated that parasite prevalence in Ethiopia was 0.5% by microscopy and 1.2% by RDTs for areas below 2,000 meters and less than 0.1% prevalence above 2,000 meters.

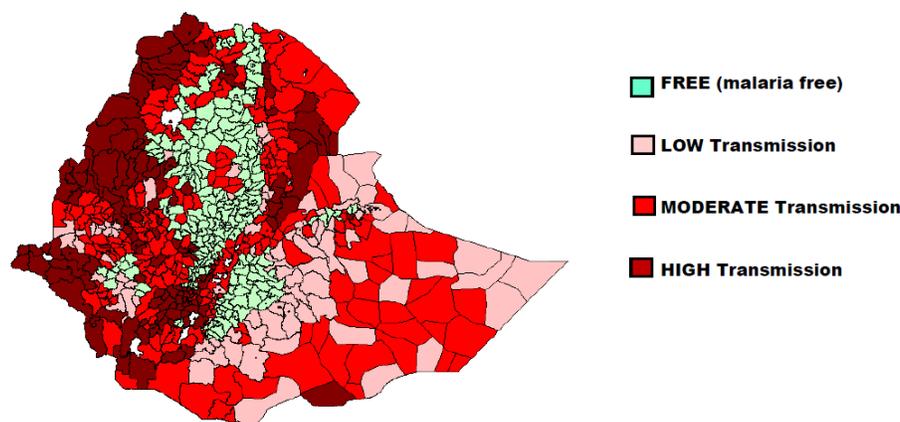
In 2014, the FMOH updated the country's malaria risk strata based upon malaria API, calculated from microplan data from more than 800 districts, with strata as shown and defined in Table 1. A malaria risk map from this API analysis is shown in Figure 1, showing areas with malaria transmission risk by API classified as High ( $\geq 100$  cases/1,000 population/year), Medium ( $\geq 5 - < 100$ ), Low ( $> 0 - < 5$ ), and Malaria-Free ( $\sim 0$ ). Areas with the highest malaria transmission risk as stratified by district API appear to be largely in the lowlands and midlands of the western border with South Sudan and Sudan, with additional high transmission areas in or near the Rift Valley, which extends from the southwest of the country to the northeast. Many densely populated highland areas were newly classified as malaria-free (API=0), including the capital city of Addis Ababa.

**Table 1: Malaria risk stratification of districts and planned interventions based on annual parasite incidence, Ethiopia 2014**

Strata	API cases/1,000 population	Elevation (m)	Population		Districts		Interventions					
			Total	%	No.	%	LLIN	IRS	LC	Case Management	Surveillance	SBC C
FREE	0	≥ 2000m asl	33,639,639	40%	290	35%	-	-	-	X	X	X
LOW	>0 AND <5	< 2000m asl	11,153,499	13%	101	12%	X	X*	Wa	X	X	X
MODERATE	≥5 AND <100		28,410,564	34%	287	34%	X	-	Wa	X	X	X
HIGH	≥100		11,023,284	13%	157	19%	X	X	Wa	X	X	X
Grand Total			84,226,986	100%	835	100%						

\*32% of low-risk population in highland fringe areas will be covered by IRS to ensure protection of this segment from anticipated epidemics. 68% of at risk population in low transmission will be covered by LLINs; WA: where applicable; LC: larval control; SBCC: Social behavior change communication (Data sources: PHEM and micro-planning 2013). (Note that PMI does not currently provide funding support for larviciding activities in Ethiopia.)

**Figure 1: Malaria risk map of districts by annual parasite incidence, Ethiopia, 2014**



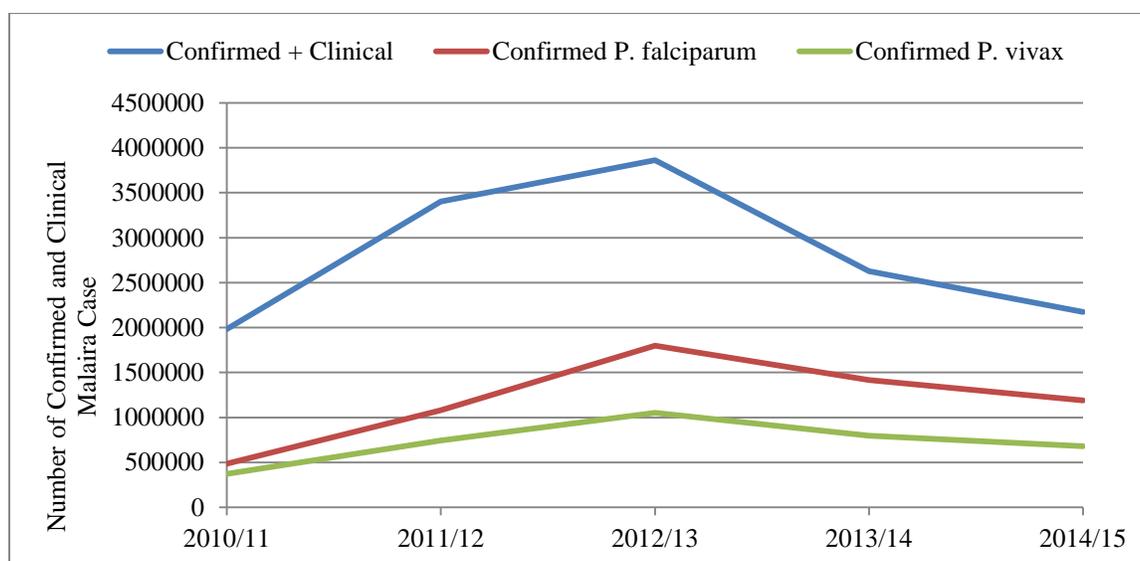
**Malaria surveillance systems and malaria trends:**

Since 2004, Ethiopia’s health systems for case management and surveillance have been greatly strengthened. There are three major overlapping and complementary Ethiopian health facility-based surveillance systems that provide information about malaria trends: the health management information system (HMIS) data, published in the annual Health and Health Related Indicator Report; the Public Health Emergency Management (PHEM) system data, published in the FMOH’s Annual Review Meeting report; and the unpublished annual malaria commodity micro-planning survey of district health offices.

Between July 2013 and June 2014, the HMIS received malaria morbidity and mortality reports from 3,338 facilities (96%) out of the total public sector infrastructure of 156 hospitals and 3,335 health centers. This represents both a five-fold increase of health facilities and malaria reporting since 2004,

and has facilitated the expansion of primary health service coverage to 94.5% of the population. In the twelve-month interval from mid-2013 until mid-2014, HMIS reported a total of 2,383,010 malaria illnesses including 1,256,611 outpatient *P. falciparum* malaria illnesses; 16,326 malaria admissions from *P. falciparum*; and fewer than 450 malaria deaths from these public health facilities, representing 5%, 2.4%, and <2.5% of outpatient visits, inpatient admissions, and inpatient deaths, respectively, from all causes for all age groups. For children under five years of age, there were 324,203 malaria outpatient visits (includes both *P. falciparum* and *P. vivax*), 5,103 inpatient malaria admissions (includes *P. falciparum* or unconfirmed malaria, but does not include *P. vivax* cases), and fewer than 122 (<2.4%) inpatient malaria deaths. For the first time in over fifteen years, malaria deaths were not listed among the top ten causes of inpatient mortality for all age groups, and for children less than five years of age in Ethiopia. Triangulation with previous HMIS reports and with other data from the micro-plan and PHEM indicates that more than 80% of the outpatient and inpatient malaria burden in Ethiopia is among adults and children who are at least five years of age.

**Figure 2: Trend of malaria clinical and confirmed cases, 2010/2011 – 2014/2015**



Data source: Health and Health Related Indicators from 2003-2007 E. C.

The FMOH’s PHEM system receives similar reports as the HMIS but includes malaria health post data from district offices on a weekly basis; this PHEM surveillance system now reports around 91.5% completeness as published in the health sector development plan IV(HSDP IV) annual performance report. In 2014/2015, the annual performance report showed the total number of laboratory confirmed plus clinical malaria cases were 2,174,707 and 662 reported malaria deaths among all age groups which is 98% reduction compared to 41,000 deaths in 2006 (World Malaria Report 2008). Of those, 1,867,059 (85.9%) were confirmed by either microscopy or rapid diagnostic tests (RDTs); of which, 1,188,627 (63.7%) were *P. falciparum* and 678,432 (36.3 %) were *P. vivax*. Even though there is a significant reduction of malaria in 2014/15, compared to the previous year, the laboratory confirmation of malaria decreased from 92% to 86% in 2014/2015 (Figure 2). The *P. vivax* prevalence increased in 2014/15 (30% in 2013/14 to 36% in 2014/2015).

In 2016, PHEM data have shown an increase in malaria transmission relative to previous years. According to the most recent Epidemiological Bulletin from the Ethiopian Public Health Institute (EPHI), malaria cases are trending upwards and in fact have surpassed 2014 and 2015 case levels.

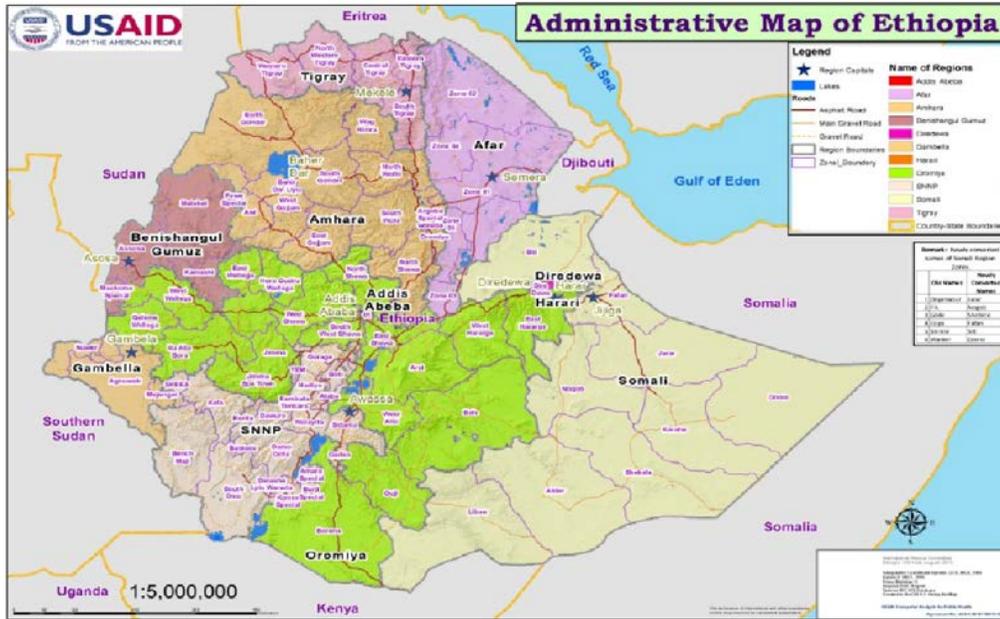
Moreover, EPHI reports this trend will likely continue throughout the year due to combination of drought and flooding (<http://www.ephi.gov.et/images/pictures/Weekly-Epidemiological-Bulletin-2016-22.pdf>). In response, the NMCP is strengthening supervision and engaging partners and stakeholders from national to district level. The NMCP has deployed teams of experts from the NMCP, RHBs and partners to these districts and neighbours to investigate potential causes and scope for further action. The FMOH and EPHI have a weekly update meeting at the state minister's office to review the status of epidemic diseases of which malaria is the priority currently. The weekly monitoring, reporting, and analysis for action are part of the system to respond to the upsurge. Availing the necessary intervention at the right place and time is part of the collaborative effort that PMI, NMCP and other partners have been conducting. The current upsurge is taken into consideration in our antimalaria drugs and RDT requirements and PMI will keep following the situation with the NMCP and PMI implementing partners.

The annual micro-planning survey provided about 99% reporting completeness from 16,786 public health facilities within malarious districts in the interval between July 2013 and June 2014. There were 3,558,360 total malaria cases, including 3,259,119 laboratory-confirmed and 299,241 presumed (i.e., clinically treated) malaria cases. There were 2,286,589 laboratory-confirmed *P. falciparum* outpatient malaria cases, and 972,530 outpatient *P. vivax* cases. In the same reporting period, there were 10,365,782 patients who were examined (i.e., malaria laboratory-tested) for malaria and a calculated total of 10,665,023 suspected malaria cases (note that “suspected” cases were formerly termed “fever cases” per WHO) and 32,530 malaria hospitalizations. The annual micro-planning survey results for 2014/15 have not yet been completed but are expected before the end of the fiscal year.

### **3. Country health system delivery structure and Ministry of Health (MoH) organization**

Ethiopia operates under a federal system of government. Administratively, the country is divided into regional states, zones, districts (*woredas*), and communities/municipalities (*kebeles*) (see Figure 3). The official estimate for the total population is 92.23 million. There are about 835 districts with different levels of malaria risk in Ethiopia, with an estimated at-risk population of 50.5 million people as per the new stratification (see Table 1 above). However the estimates of at risk population from the official projected population size for the year 2016 is 55.3 million. The best available proxy for local malaria transmission risk in Ethiopia is household altitude below 2,000 meters (above sea level), since malaria is rarely transmitted at higher elevations (unless there are weather abnormalities and widespread epidemics). Many districts have variable topographical features, with some households within communities located above and below 2,000 meters. Due in part to household locations at various altitudes and distances from efficient malaria vector breeding sites, malaria risk is unevenly distributed within many districts and *kebeles*.

**Figure 3: Administrative zones and districts in Ethiopia**

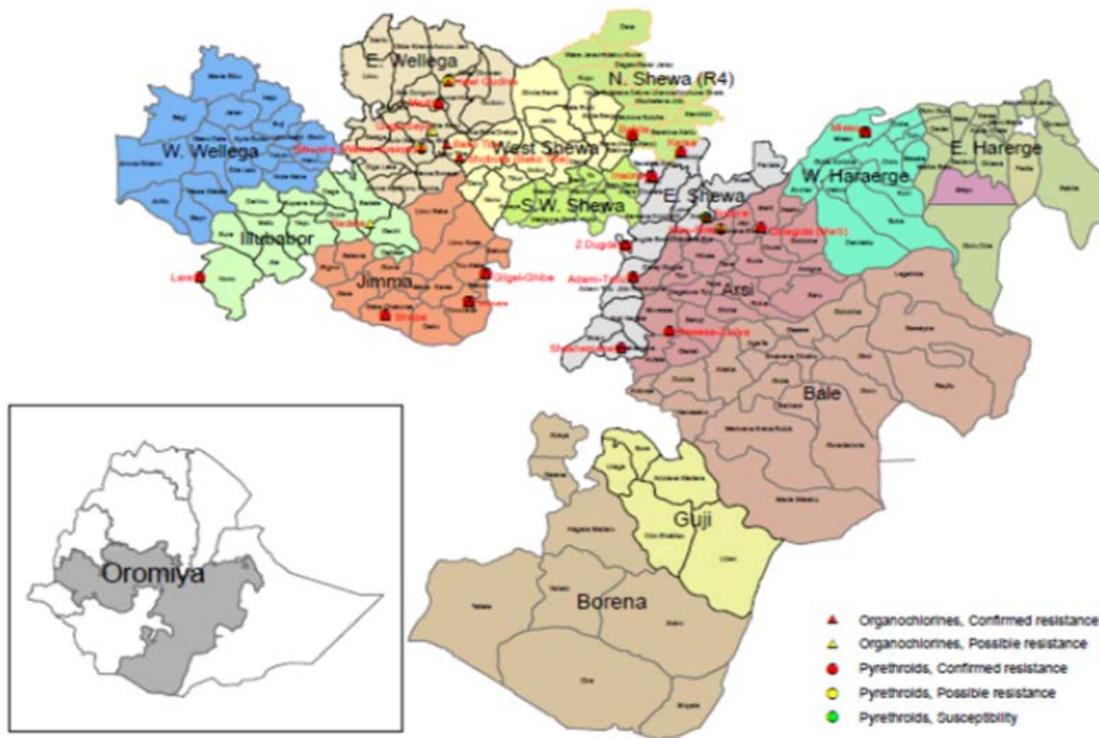


The health care service delivery system in Ethiopia has been re-organized into a three-tier system. The lowest tier is known as the Primary Health Care Unit (PHCU), which is composed of one district hospital (covering 60,000-100,000 people), health centers (1 per 25,000 people), and their five satellite health posts (1 per 5,000 people). The second tier is the General Hospital, covering a catchment population of 1-1.5 million people, and the third, tertiary health care level, is the Specialized Hospital, covering a population of 3.5 million people. All the regional states, including Oromia Regional Health Bureau (ORHB), share the same health system organizational structure. The health center provides comprehensive primary health care services and backup to the health posts by accepting referral cases, while district and general hospitals provide secondary health care. Health centers typically can provide inpatient services for up to two malaria patients, and they are equipped with injectable artesunate for severe malaria treatment.

According to the 2014/2015 HSDP IV annual performance report (FMOH), currently there are a total of 189 functional public hospitals, 3,547 functional health centers, and 16,447 health posts, and about 38,000 trained health extension workers (HEWs) in Ethiopia.

Oromia, Ethiopia's largest regional state (Figure 4), had a population of 34,575,008 million people in 2016 with 310 districts organized into 18 rural zones and 16 urban/zone level 'special towns' and 7,021 *kebeles*. According to a 2014/15 report, there were 53 hospitals, 1,320 functional health centers, and 6,519 health posts operated by the Government of Ethiopia (GoE) in Oromia Region. There are also 8 hospitals, 5 health centers and 115 health stations under other governmental organizations (e.g., teaching or armed services hospitals). In addition, there are 3 private hospitals and 1,639 private clinics of various levels.

**Figure 4: Zones, districts (*woredas*), and administrative areas within Oromia Regional State, Ethiopia 2014**



The typical health post is staffed by two HEWs delivering 16 selected health packages, including one health package on malaria [<http://cnhde.ei.columbia.edu/training/index.html>]. Health extension workers are paid FMOH staff; they undergo a one-year training program after having received a high school diploma, and usually originate from the communities they serve. The HEWs focus on preventive services; however, they also provide curative health care services for malaria, pneumonia, and diarrhea using the integrated community case management (iCCM) approach of evidence-based diagnostic and treatment algorithms. For malaria, HEWs have been trained to confirm and report malaria diagnoses among clinically evaluated acutely ill patients using malaria multispecies RDTs. Severe malaria cases are to be referred to the next appropriate health facility, with initial pre-referral management using rectal artesunate. The HEWs are encouraged to consider other diagnostic possibilities for patients who test negative by malaria RDT, and to avoid empiric treatment with antimalarials when malaria RDTs are available. The HEWs are also expected to supervise seasonal health activities, including social and behavior change communication (SBCC) and mass vaccination campaigns, participate in surveys and a range of other community health activities. The HEWs work closely with the health development army (HDA), a network of women that oversee up to five households to deliver malaria messages, to perform these tasks. HEWs are tasked with supporting long-lasting insecticidal net (LLIN) distribution activities through registering households and indicating their family size, keeping records of coverage, and tracking loss and damage through the regular household visits and/or from HDA reports. Additionally, HEWs have become more directly involved in supervising IRS spray teams and door-to-door mobilization for IRS. The FMOH envisages decentralizing IRS operations to the PHCU, where HEWs would be responsible for supervising the operations in their catchment area (*kebele*). The FMOH is scaling up this community-based (CB) IRS practice in a stepwise approach. Currently, HEWs are

primarily responsible for organizing and executing IRS operations in 6 of 36 PMI-supported IRS districts.

#### **4. National malaria control strategy**

The malaria NMSP for the years 2014–2020 was finalized in August 2014, which was envisioned to be aligned with the next five-year health sector transformation plan (HSTP) 2015/16–2019/20 and submitted along with the Concept Note for the Global Fund New Funding Model (NFM) application. The updated malaria strategic plan was developed following the MIS 2011 and the national malaria program review as well as in response to discussions and recommendations following a consultative meeting with key in-country and international malaria stakeholders as a part of the Global Fund’s NFM. The following goals and objectives are set out in the new NMSP.

##### **Goals:**

- By 2020, to achieve near zero malaria deaths (no more than one confirmed malaria death per 100,000 population at risk) in Ethiopia.
- By 2020, to reduce malaria cases by 75% from baseline of 2013.
- By 2020, to eliminate malaria in selected low transmission areas.

##### **Strategic Objectives:**

1. By 2020, all households living in malaria endemic areas will have the knowledge, attitudes and practice towards malaria prevention and control.
2. By 2017 and beyond, 100% of suspected malaria cases are diagnosed using RDTs or microscopy within 24 hours of fever onset.
3. By 2015 and beyond, 100% of confirmed malaria cases are treated according to the national guidelines.
4. By 2015 and beyond, ensure and maintain universal access of the population at risk to at least one type of globally recommended anti-vector intervention.
5. By 2020, achieve and sustain zero indigenous transmission of malaria in 50 selected districts.
6. By 2020, 100% complete data and evidence will be generated at all levels within designated time periods to facilitate appropriate decision-making.

The NMSP (2014-2020) takes into account the findings of the 2007 and 2011 MIS, which measured the coverage and utilization of key malaria interventions by at-risk populations. Community empowerment and social mobilization are therefore given high priority among the malaria control strategies in the new Plan. Similarly, malaria diagnosis, case management, disease surveillance and epidemic control are geared to serve Ethiopia’s goal of shrinking malaria endemicity and achieving zero indigenous transmission in selected districts by 2020. The Ethiopian national guidelines for malaria diagnosis and treatment, vector control, and malaria epidemic detection and response that were last updated in 2012 are available on the FMOH website.

#### **5. Updates in the strategy section**

Although much of Ethiopia remains at risk of malaria, routine surveillance data from the last decade have noted decline in malaria outpatient morbidity and inpatient mortality trends. Based on this progress and to achieve the NMSP’s strategic goal of eliminating malaria in select low transmission areas by

2020, in May 2015, the FMOH in collaboration with partners and stakeholders, held a two-day workshop to learn from in-country and other country experiences and to help build consensus on the way forward. To translate this plan into action, the NMCP has drafted a National Malaria Elimination Guideline that introduced a new concept called “optimization of malaria interventions.” The principle is enhancing and advancing the control interventions in terms of quality, targeting, and utilization. During optimization, emphasis is given to ensuring and sustaining political commitment at all levels including community engagement, strengthening human resources, and sustaining a constant supply of malaria commodities. The Ministry has selected 209 low malaria burden districts for optimization.

Ongoing discussions are occurring with the FMOH to coordinate pre-elimination activities together with other donor-supported projects that continue to help shrink the malaria transmission map in Ethiopia. The draft FMOH elimination guideline outlines the specific activities in a phased approach, starting from optimization of existing activities to pre-elimination, to elimination, and preventing reintroduction of cases in targeted elimination districts. In summary, in the “optimization” phase, current control interventions will be strengthened, with emphasis given to improving access to LLINs and case management services, surveillance, stock management and capacity building activities at the district level to further reduce cases. In this phase, primaquine will be used for radical cure of *P. vivax* and single, low-dose primaquine for gametocytocidal activity against *P. falciparum*, where appropriate. In the elimination phase, introduction of new interventions are planned, such as active case detection, targeted MDA, and more sensitive diagnostic tools to identify reservoirs.

## **6. Integration, collaboration, and coordination**

### **Maternal, neonatal and child health, family planning, and reproductive health:**

Following the first National Family Fertility Survey conducted in 1990, the USG started supporting the FMOH in the delivery of key maternal, neonatal and child health (MNCH), family planning, and nutrition services at the community level including expanded immunization, family planning, essential nutrition actions, malaria prevention, control and case management, promotion of antenatal care (ANC), and water, sanitation and hygiene. These interventions are delivered through health centers, health posts, and households and focus on rural, peri-urban, and hard-to-reach populations. To date, the program has trained over 60,000 community health volunteers, provided assistance to over 15,000 HEWs, and has reached over 32 million people (35% of the Ethiopian population) in 301 districts in 8 of the country’s 9 regional states and parts of Somali Region. Under the Feed the Future Initiative, the USG will also continue to integrate health, agriculture, and humanitarian assistance and livelihood sector platforms to maximize impact on nutrition.

Most of PMI’s support to these activities is being implemented through partners supporting the rural HEWs and the recently scaled up HDA at community levels with a multi-agency collaborative approach using Global Health Initiative (GHI) and United States Agency for International Development (USAID) processes and structures. PMI uses this platform to reach the most at-risk communities in malaria diagnosis and treatment, epidemic detection and response, and also to promote best practices in malaria case management by HEWs at health posts, including use of iCCM clinical algorithms.

### **PEPFAR, GHI, and other USG programs:**

PMI is working with President’s Emergency Plan for AIDS Relief (PEPFAR) within the GHI framework through USAID and Centers for Disease Control and Prevention (CDC) structures, to

harmonize the Ethiopia FY 2017 Country Operational Plan, with the USAID Health team's Operational Plan for Family Health and Infectious Diseases to ensure the respective plans complement and strengthen each other. Thus, at this time, approximately 15% of PMI's budget is allocated to 'wrap around' activities with PEPFAR, i.e., either through the co-funding of an award or by leveraging resources that have been established through previous PEPFAR support (e.g., laboratory infrastructure strengthening overlapping with HIV and tuberculosis diagnosis, malaria SBCC harmonization with other health messages, pharmaceutical system and supply chain strengthening, and pharmaceutical quality management). PMI also has had important cooperative malaria LLIN hang-up projects with U.S. Department of Defense Combined Joint Task Force-Horn of Africa, and has other malaria prevention projects with Peace Corps and CDC (i.e., Field Epidemiology Laboratory Training Program (FELTP), known as EFETP in Ethiopia) within the GHI context.

### **Coordination with other partners:**

The Malaria Control Support Team (MCST) provides coordinated malaria technical support to the national and regional programs and is comprised of members of the FMOH, donors and international organizations, including PMI, governmental and non-governmental organizations (NGOs), and academia. The primary task of the MCST is to support the FMOH and regional health bureaus (RHBs) through ongoing technical assistance, resource mobilization, support to epidemic preparedness and response, and malaria pre-elimination. The MCST provides a common forum to share roles and responsibilities, avoid duplication and discuss technical and programmatic issues and priorities.

Part of the MCST is the Technical Advisory Committee, which includes the main malaria stakeholders in the country, i.e., FMOH, EPHI, Ethiopian universities, Malaria Control and Evaluation Partnership in Africa, Malaria Consortium, PMI, UNICEF, WHO, etc. PMI is also a member and currently the co-chair of the Technical Advisory Committee, representing a technical core of the MCST which advises the FMOH on policy and program implementation issues, providing technical assistance on an ad hoc basis, and assisting with malaria program integration issues. PMI has also been instrumental in the development and finalization of the NMSP 2014-2020, five Global Fund proposals (Rounds 7, 8 and 10, Round 2 Rolling Continuation Channel, and Transitional Funding Mechanism (TFM)) as well as the NFM concept note, and the development and updating of in-country guidelines and strategies. Non-PMI funded malaria partners and other health donors as well as experts from the Global Fund were consulted to inform this FY 2017 MOP document.

In addition, PMI is supporting coordination of malaria research stakeholders, academia and FMOH to fill the gap between the implementation of emerging malaria knowledge and research and the adoption of best malaria practices by researchers, practitioners, policymakers, and organizations involved in the prevention and control of the disease. Resolving this gap would serve to increase the benefits of quality research to improve prevention and control, and avoid duplication of efforts and waste of resources.

## **7. PMI goal, objectives, strategic areas, and key indicators**

Under the PMI Strategy for 2015-2020, the U.S. Government's goal is to work with PMI-supported countries and partners to further reduce malaria deaths and substantially decrease malaria morbidity, towards the long-term goal of elimination. Building upon the progress to date in PMI-supported countries, PMI will work with NMCPs and partners to accomplish the following objectives by 2020:

1. Reduce malaria mortality by one-third from 2015 levels in PMI-supported countries, achieving a greater than 80% reduction from PMI's original 2000 baseline levels.
2. Reduce malaria morbidity in PMI-supported countries by 40% from 2015 levels.
3. Assist at least five PMI-supported countries to meet the World Health Organization's (WHO) criteria for national or sub-national pre-elimination.<sup>1</sup>

These objectives will be accomplished by emphasizing five core areas of strategic focus:

1. Achieving and sustaining scale of proven interventions
2. Adapting to changing epidemiology and incorporating new tools
3. Improving countries' capacity to collect and use information
4. Mitigating risk against the current malaria control gains
5. Building capacity and health systems towards full country ownership

To track progress toward achieving and sustaining scale of proven interventions (area of strategic focus #1), PMI will continue to track the key indicators recommended by the RBM Monitoring and Evaluation Reference Group as listed below:

- Proportion of households with at least one ITN
- Proportion of households with at least one ITN for every two people
- Proportion of children under five years old who slept under an ITN the previous night
- Proportion of pregnant women who slept under an ITN the previous night
- Proportion of households in targeted districts protected by IRS
- Proportion of children under five years old with fever in the last two weeks for whom advice or treatment was sought
- Proportion of children under five with fever in the last two weeks who had a finger or heel stick
- Proportion receiving an ACT among children under five years old with fever in the last two weeks who received any antimalarial drugs
- Proportion of women who received two or more doses of IPTp for malaria during ANC visits during their last pregnancy

## **8. Progress on coverage/impact indicators to date**

Since the launch of PMI, Ethiopia has conducted three national household surveys (MIS 2007, 2011, and 2015) to track the impact and outcomes of malaria control investments to date (Table 2). Although the most recent 2015 ITN ownership results failed to reach set targets, a slight improvement was noted in ITN ownership since 2011. Notably, ITN use in children under five years old and pregnant women who own an ITN was much improved, the proportion of households protected by an ITN or IRS remained above 70%, the proportion of women with malaria knowledge improved, and malaria prevalence by microscopy continued to remain very low at <1%.

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<sup>1</sup>[http://whqlibdoc.who.int/publications/2007/9789241596084\\_eng.pdf](http://whqlibdoc.who.int/publications/2007/9789241596084_eng.pdf)

**Table 2: Evolution of key malaria indicators in Ethiopia from 2007-2015**

Indicator	2007, MIS		2011, MIS		2015, MIS	
	National <2000m	Oromia <2500m	National <2000m	Oromia <2000m	National <2000m	Oromia <2000m
% Households with at least one ITN	65.3	41	54.8	43.7	63.6	58.5
% Households with at least one ITN for every two people	36.6	21.4	23.6	17.3	31.7	31
% Children under five (U5) who slept under an ITN the previous night	41.2	23.6	38.0	26.5	45.3	41
% of children U5 who slept under an ITN that <b>own</b> an ITN the previous night	60.0	56.5	64.7	55.4	69.5	70
% Pregnant women who slept under an ITN the previous night	42.5	28.7	34.7	26.7	44.3	41.7
% Pregnant women who slept under an ITN that <b>own</b> an ITN the previous night	66.2	73.9	63.8	64	73.9	81.2
% Households protected by at least one ITN or IRS	-	-	71.7	63.7	70.5	67.1
% Households sprayed in past 12 months	20.0	12.5	46.6	43.0	28.8	29.8
% Women age 15-49 years who had heard of malaria	79.5	68.6	71.3	68.7	68.4	67.4
% Women age 15-49 years who recognized fever as malaria symptom	50.8	31.6	76.0	71.3	74.6	77.9
% Women age 15-49 years who reported mosquito bite as a cause of malaria	41.1	32.0	71.2	73.2	74.6	82.8
% Women age 15-49 years who reported that ITNs prevent malaria	38.2	22.6	63.4	65.5	77.1	81.2
% Children under five years old with fever in the last two weeks	24.0	21.5	19.7	15.4	15.7	10.7
% Children under five years old with fever in the last two weeks for whom advice or treatment was sought	16	NA	51	NA	38.1	NA
% Children under five years old with fever in the last two weeks who received any antimalarial drugs	11.9	6.6	32.6	38.8	32.9	35
% Children under five years old who took an antimalarial drug the same or next day	4.8	1.3	8.5	13.8	19.6	17.9
Prevalence of malaria by microscopy (%)	0.9	0.3	1.3	0.5	0.5	0.3

**Table 3: Routine surveillance data from PHEM and micro-plan sources, 2010-2015**

	<b>PHEM</b>			<b>Micro-Plan</b>		
	Total Malaria Cases	Confirmed Malaria Cases	Deaths	Total Malaria Cases	Confirmed Malaria Cases	Deaths
2010/2011	2,607,206	2,142,207	254	7,061,913	2,907,095	NA
2011/2012	3,384,589	1,793,833	291	5,538,405	3,654,690	NA
2012/2013	3,862,735	2,851,897	213	4,995,110	4,192,490	NA
2013/2014	2,627,182	2,210,298	662	3,558,360	3,259,119	NA
2014/2015	2,174,707	1,867,059	NA	NA	NA	NA

NA: Not available

Although malaria remains among the leading causes of Ethiopian outpatient morbidity and inpatient admissions, it is declining as a relative cause of inpatient mortality, especially among children under five years of age, according to HMIS data. Although there still remains discrepancies in the malaria data between the different systems and data sources, the malaria situation in Ethiopia appears to be stable and steadily improving, albeit recent reports of focal case build-ups (see Table 3 above). Access to prompt rational malaria case management—including near-universal laboratory-based diagnosis in remote rural areas—has improved dramatically over the last decade. Concurrently, routine surveillance systems continue to improve its accuracy and completeness in documenting public sector health facility malaria morbidity and mortality. These increasingly credible surveillance data from strengthened health information and PHEM systems will be essential to guide malaria control and elimination efforts.

## **9. Other relevant evidence on progress**

N/A

### III. OPERATIONAL PLAN

PMI supports all elements of the NMCP's national malaria strategy in Ethiopia except larviciding and larval source management and aligns with GoE's HSTP (2015 - 2020) and NMSP (2014–2020). PMI's support strategy for Ethiopia has evolved since PMI began its activities in FY 2008, but remains consistent with the USG's updated PMI, and USAID global health strategies, and with country strategies within the US Embassy/Addis Ababa and USAID/Ethiopia. PMI funding is targeted to fill gaps in activities that are not already supported by the FMOH, Global Fund, or other donors. PMI support has been flexible and responsive to the FMOH's evolving needs, including the occasional reprogramming of resources to provide critical malaria commodities that were not adequately funded by other sources. Additionally, PMI has provided considerable technical support and expertise for FMOH through malaria technical experts within CDC/Atlanta, USAID/Washington, and the various implementing partners and collaborative support with the Global Fund, academia, and international development organizations.

Beginning in FY 2008, funding limitations required PMI to initially focus support primarily within the Oromia Regional State, based upon earlier evidence that Oromia Regional State had the highest relative malaria burden and gaps in malaria services compared to other regional states. Initially, there was substantial funding from the Global Fund and availability of other malaria partners to support most malaria-related activities in the other regional states. However, it was later evident that several other regional states, including Southern Nations, Nationalities, and Peoples' Region (SNNPR), had consistently higher malaria burdens compared to Oromia Regional State. The availability of increased PMI funding for malaria activities since 2010 and progress made in Oromia Region allowed PMI to progressively support additional NMCP activities outside of Oromia Regional State, including procurement of malaria commodities to fill periodic, national gaps.

#### 1. Vector monitoring and control

##### NMCP/PMI objectives

Insecticide based vector control remains a key component of malaria prevention and control in Ethiopia. The NMSP (2014–2020) vector control objective is “to ensure and maintain universal access of the population at risk to at least one type of globally recommended anti-vector intervention by 2015 and beyond,” which is in line with PMI's vector control objective. The two major vector control interventions implemented to prevent malaria in Ethiopia are targeted IRS of houses and distribution of LLINs. IRS is targeted to areas where malaria burden is high and highland fringe areas with epidemic risk. The LLIN policy is to achieve and maintain universal coverage of the population residing in malaria risk areas through mass campaigns and continuous distribution, to achieve and maintain LLIN use levels above 80% by all age groups through SBCC activities.

The MIS 2015 results continue to highlight the sustained, yet below target ITN ownership outcomes in Ethiopia. There are likely several factors to account for the findings. According to a PMI-supported study in five districts in Jimma zone, the barriers for use were shape of the nets, low risk perception due to seasonality of malaria, saving nets for future use, decreased awareness, negligence and perceived low efficacy of LLINs. However, the largest barrier to LLIN use is the insufficient availability of LLINs at the household level and lack of a LLIN distribution tracking system down to the users.

According to the FMOH's new NMSP malaria risk stratification based upon API from 2013 microplanning data, 60% of the population is residing in malaria risk areas (i.e., below 2000 meters

above sea level). This translates to 60% of the population in the country that needs to have access to LLINs. Primary distribution occurs through the PHCU, specifically health posts, where an average of one LLIN per two people is distributed to all target households every three years in campaigns to attain universal coverage. As coverage gaps start to appear after the campaign, subsequent continuous distribution of LLINs, mainly through community-based HEWs, is planned to ensure all malaria-affected families are protected by LLINs. This continuous distribution of LLINs by HEWs will replace worn out/deteriorated or lost nets and cover new households and new household members in all targeted malaria affected communities. It is mainly handled by the health extension program (HEP) in collaboration with the HDA (a network of one model mother representing five households) and local authorities. Health extension workers receive technical assistance and supervision from the district health offices and health centers. Health extension workers identify and confirm the need for LLINs through their routine household visits and from HDA reports. The continuous distribution needs are based on 8% and 20% loss of LLINs in the first and second year after the mass distribution campaign, respectively. These assumptions were used nationally to plan for LLIN needs in 2016 and 2017.

On the other hand 17% of the country's total population is targeted for IRS, specifically the highland fringe areas where the risk of malaria is low (13% of total population) but risk of epidemics is higher, and the areas at lower altitudes with the highest malaria burden (13% of total population). Due to the varied topography and heterogeneity of malaria transmission in the country and within districts, not all communities in a specific district are targeted for spraying. Specific IRS-targeted communities are selected based on malaria case load, altitude (< 2000 meters), presence of nearby *Anopheles* breeding sites, agriculture and water development practices, epidemic records, and other economic or social factors. In general, PMI does not conduct blanket spraying in supported districts in Ethiopia but works closely with the FMOH for sub-district targeting of spraying based on the criteria outlined above.

Malaria transmission in Ethiopia is seasonal, lasting for about three months after the main rainy season, from September to November. Depending on the residual life of the insecticide used and timing of spray operations, one spray round per year could give the required protection against malaria. IRS remains one of the long-standing malaria control tools in the country, and the FMOH is implementing IRS in all regions of the country annually. Implementation of IRS following the new stratification has not been achieved to date; it requires further effort from the FMOH and RHBs to fully and effectively realign their programs. In 2015, the FMOH has conducted spraying in more than 5.4 million structures inhabited by more than 13.8 million people.

Regular insecticide resistance monitoring in selected sites throughout the country is one of the objectives of the NMSP which is aimed to provide critical information to develop or revise insecticide policy and implement insecticide resistance management.

#### **a. Entomologic monitoring and insecticide resistance management**

##### *Progress since PMI was launched*

PMI started supporting insecticide resistance monitoring studies on four insecticide classes in 2008 in five sites in Oromia. High dichloro-diphenyl-trichloroethane (DDT) resistance and decreased susceptibility to deltamethrin in the local populations of *An. gambiae* s.l. was observed at all five sites. Based on these preliminary results, the FMOH recognized the need to expand testing nationwide. From 2008 through 2011 PMI supported resistance monitoring in 15 sites in the country including Oromia. Other stakeholders (WHO and EPHI) joined PMI in insecticide resistance monitoring and the total sites

for insecticide monitoring reached 35 in 2011. Site selection was coordinated among stakeholders and resistance monitoring results were shared with the FMOH for decision making. Results from different sites and different stakeholders were consistent and the local malaria vectors exhibited high levels of DDT and pyrethroid resistance. On the basis of results from sites supported by PMI, WHO, and EPHI, the FMOH decided to discontinue using DDT for IRS in 2010 followed by discontinuation of pyrethroid use for IRS in 2012. A decision was also made against the use of only one insecticide for IRS across the country. Instead the program will use more than one class of insecticide for the IRS program in Ethiopia (i.e., different insecticides will be used in different geographic locations based on insecticide resistance test results). To this effect the FMOH in collaboration with partners has finalized development of an insecticide resistance monitoring and management strategy, which is on the verge of dissemination.

*Progress during the last 12-18 months*

In 2014 and 2015, PMI continued supporting entomological resistance monitoring of 11 insecticides from 4 insecticide classes in 8 permanent sites and mosquito behavior studies in 3 sites. The insecticide resistance monitoring test results are consistent with previous year's results, which showed that local vectors are fully resistant to DDT and pyrethroids. Results show local *An. arabiensis* exhibits resistance in three sites and shows the possibility of resistance in two sites out of eight sentinel sites tested for malathion. It further shows resistance to bendiocarb in one site and possibility of resistance in another site. From this monitoring it was seen that pirimiphos-methyl, fenitrothion, and propoxur demonstrated 100% efficacy against local malaria vectors in all eight sentinel sites representing six regional states of the country. Insecticide resistance monitoring results from the eight sites are presented in Table 4.

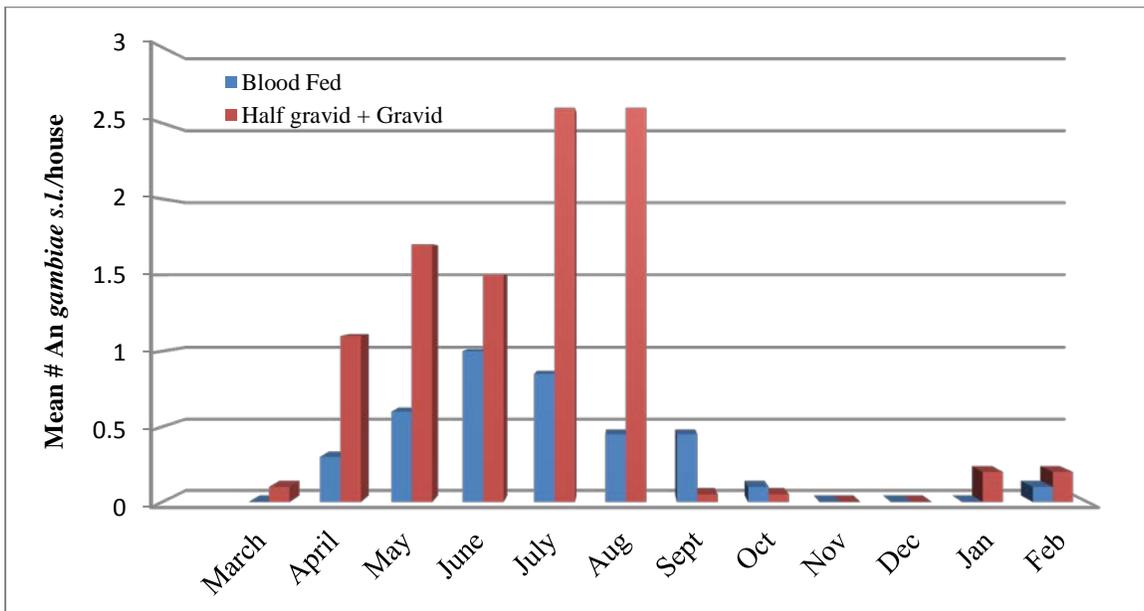
**Table 4: Summary of PMI-supported insecticide resistance tests in 2015**

Insecticide	% Mortality							
	District/Region							
	Halaba/ SNNPR	Omonada/ Oromia	ZwaiDugda/ Oromia	Chewaka/ Oromia	Bahirdar/ Amhara	Alamata/ Tigray	Amibara/ Afar	Lare/ Gambella
DDT	25	4	ND	14	11	40	48	24
Lambda- cyhalothrin	21	9	ND	54	11	35	35	24
Deltamethrin	43	32	32	49	25	57	49	11
Fenitrothion	100	100	100	100	100	100	100	100
Malathion	96	83	ND	96	43	100	100	88
Pirimiphos- methyl	100	98	100	100	100	100	100	100
Propoxur	100	100	100	100	99	100	100	100
Bendiocarb	100	95	100	100	87	100	100	100
Permethrin	25	22	13	20	9	89	61	28
Etofenprox	43	50	ND	10	9	53	79	86
Alpha- cypermethrin	16	4	ND	17	17	80	70	ND

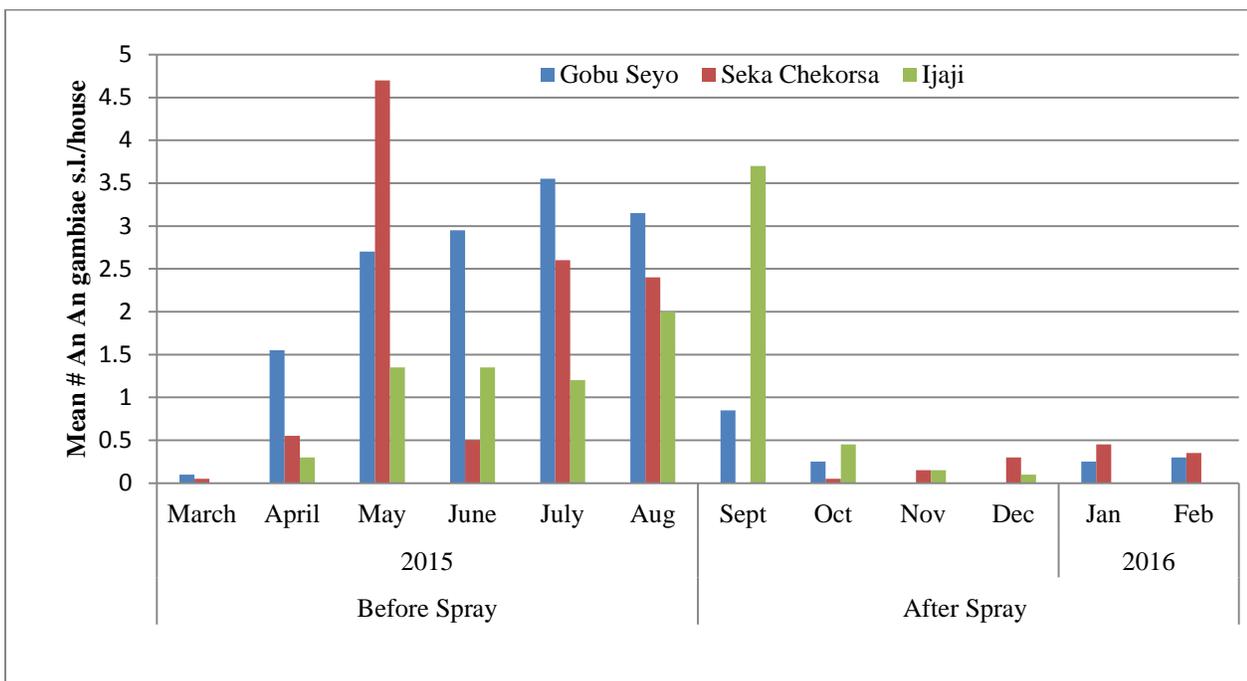
\*ND indicates tests not done

PMI supported a malaria vector density and behavioral study in two intervention sites (Gobu Seyo and Seka) and one control site (Ijaji) to understand the abundance, seasonal patterns, biting behavior, and parity rates of *Anopheles* mosquitoes, which helps to assess the impact of IRS on entomological indicators. The results from March to December 2015 of this year-round behavioral monitoring showed that indoor resting density and human biting rates of *An. gambiae* s.l. dropped after IRS in both intervention sites but increased and peaked in September in the control site. In Gobu Seyo, an intervention site, the *An. gambiae* s.l. indoor resting density markedly reduced after spraying as shown by the number of blood fed, half-gravid and gravid mosquitoes collected from indoors using pyrethrum spray collections (Figure 5). It further showed that the main vector started proliferation in the month of April and reached its peak at variable times for different sites between May and September (Figure 6) which will help to inform the timing of PMI's spray campaign. However, as these results were obtained from a single year, further collections are needed to understand year-to-year variation.

**Figure 5: *An. gambiae* s.l. indoor resting density in Gobu Seyo intervention site pre-spray (March to August 2015) and after spray (September 2015 to February 2016)**



**Figure 6: Trend of *An. gambiae* s.l. over time for Seka Chekorsa, Gobu Seyo and Ijaji study sites**



PMI supported wall cone bioassay tests to assess the quality of IRS within seven days after spraying which subsequently continued monthly to monitor the decay rate of pirimiphos-methyl and bendiocarb (the two sprayed insecticides) in four districts (Tiro Afeta, Chewaka, Bako Tibe, and Shebe Sombo) using laboratory-reared susceptible mosquitoes. Results from wall cone bioassays for IRS quality assurance immediately after spraying show a mortality rate ranging from 90% to 95.8% for bendiocarb

and 100% for pirimiphos-methyl. The performance of bendiocarb is below the acceptable range as no mosquito survival is expected shortly after spraying. The monthly monitoring of bendiocarb and pirimiphos-methyl decay rates showed different performances on different wall types and at different locations. Average mortality of susceptible mosquitoes was 88.1% five months after spraying with pirimiphos-methyl and 58.3% four months after spraying with bendiocarb. Additional details are provided in Tables 5 and 6 below.

**Table 5: Results of wall bioassays for decay rate of pirimiphos-methyl**

Time	Tiro Afeta (July 2015 – Feb 2016)				Chewaka (July 2015 – Feb 2016)				
	% Mortality								
	Susceptible			Mean	Susceptible				Mean
	Mud	Dung	Painted		Mud	Dung	Painted	Paper	
M0	100	100	100	100	100	100	100	100	100
M1	100	100	100	99.2	98.4	100	100	100	99.6
M2	100	98.3	98.3	99.4	62.5	73.3	100	100	83.9
M3	81.7	77.3	89.2	82.7	61	63.3	89.7	84.4	74.6
M4	89.3	76.6	87.5	84.5	60.1	69.3	91.9	ND	73.8
M5	93.7	74.2	79.6	82.5	92.4	98.1	90.5	ND	93.7
M6	83.9	78.9	76.0	79.6	57.1	58.3	54.1	ND	56.6
M7	73.8	68.4	62.6	68.3	45.8	36.2	59.8	ND	47.3

\*ND indicates tests not done. Time (in Months)

**Table 6: Results of wall bioassays for decay rate of bendiocarb**

Time	Shebe Sombo (Aug - Dec 2015)			Bako Tibe (Aug - Dec 2015)			
	% Mortality						
	Susceptible		Mean	Susceptible			Mean
	Mud	Painted		Mud	Dung	Painted	
M0	95	100	98.8	90	100	100	96.7
M1	82.5	100	81.9	53.3	93.3	92.2	79.6
M2	60.6	99.2	79.9	61.7	66.7	99.2	75.9
M3	41.7	94.6	68.1	5.9	83.5	87.6	59
M4	39.9	100	70	7.6	52.6	79.3	46.5

\*ND indicates tests not done. Time (in Months)

To collect additional information, PMI, in collaboration with Addis Ababa and Jimma Universities, is supporting monitoring of insecticide decay rates in experimental huts in Sokoru and Ziway. Since October 2015, monitoring has been performed on four insecticide formulations (bendiocarb 80% 0.4g/m<sup>2</sup>, propoxur 2g/m<sup>2</sup>, propoxur 1g/m<sup>2</sup> and pirimiphos-methyl 1g/m<sup>2</sup>) on four different wall types (rough mud, smooth mud, dung, and painted). Results from six months post-spraying showed

pirimiphos-methyl on mud walls was still killing over 80% of mosquitoes and propoxur 2g/m<sup>2</sup> was killing over 80% of mosquitoes on dung and painted walls.

In 2015, PMI continued supporting capacity building activities in entomological monitoring. Accordingly 34 health workers representing all regions of the country and FMOH staff were trained in basic malaria entomology. PMI is working closely with Addis Ababa, Jimma, and Mekelle Universities to build local capacity in entomological monitoring. Initial efforts were also made to expand this support to Gonder, Jigjiga and Arbaminch Universities. PMI is conducting insecticide resistance monitoring in collaboration with these universities. PMI supported Jimma University in equipping its molecular biology laboratory, vector biology field site, and insectary. Through PMI support, Jimma University has developed the capacity to undertake molecular identification of vector species, biochemical assays to determine resistance mechanisms, blood meal analysis, and calculation of entomological inoculation rates.

For additional details on the methodologies used and results seen from entomological monitoring work in Ethiopia in 2015, see the “Ethiopia 2015 Entomological Monitoring Final Report” on PMI.gov.

### Plans and justification

With FY 2017 funds PMI will maintain the FY 2016 level of insecticide resistance and entomological monitoring support and will continue to work closely with the FMOH, ORHB, EPHI, and local universities. The objective of this support is to monitor and ensure the effectiveness of vector control interventions being implemented in the country. In collaboration with partners, PMI will continue monitoring the density and behavior of malaria vectors over time to document vectors’ responses to interventions and inform decision making. PMI will continue supporting insecticide resistance monitoring in collaboration with local universities. Currently Jimma and Addis Ababa Universities are capable of identifying mechanisms of resistance to help determine the operational impact of resistance. Monitoring quality of IRS through wall cone bioassays and decay rates of different insecticides on different wall types will also be supported.

Malaria elimination has become a key focus of the FMOH, and capacity building of entomology experts is a crucial area that PMI can support. The FMOH has already completed the development of an insecticide resistance management plan, which calls for 25 sentinel sites for insecticide resistance monitoring. Although PMI will only directly support data collection in eight of these sentinel sites, PMI will support the coordination of and data compilation from all sites through seconding a qualified staff member to the FMOH or EPHI.

### Proposed activities with FY 2017 funding: (\$704,000)

- **Entomological monitoring:** Insecticide resistance monitoring will be conducted in eight surveillance sites to continue documenting the evolving resistance status of the vector after changes in the insecticide being used. Vector behavior and density study will be carried out in three sites in different ecological zones to detect any change in mosquito behavior, particularly outdoor biting changes, in response to the changes in the insecticide used for IRS. Insecticide residual life monitoring will be conducted to obtain additional evidence to help inform the selection of the best insecticide for use in Ethiopia, including new insecticides that are expected to come onto the market in the next 1-3 years. (\$540,000)

- **Entomological capacity building:** PMI will provide assistance to the FMOH and EPHI in national level malariology and vector control training. PMI will support the refurbishment of the EPHI insectary which will enable EPHI to provide critical entomological information, training of vector control/entomological staff and support the regional health bureaus in verifying and conducting routine entomological monitoring. PMI will continue supporting six local universities with the aim of building capacity for entomological monitoring and insecticide resistance testing. (\$135,000)
- **Entomological technical assistance:** Provide two technical assistance visits from CDC/Atlanta for training, planning, and monitoring entomological activities. (\$29,000)

#### **b. Insecticide-treated nets**

##### Progress since PMI was launched

Between FY 2007 and FY 2014, PMI procured a total of 20,673,120 LLINs, which were distributed to malaria-risk communities. Since 2012, PMI LLIN distribution expanded to other regions beyond Oromia and has focused on high risk areas nationally. Distributions of LLINs for both PMI and Global Fund were based on a nationwide micro-plan supported by PMI in collaboration with the RHBs and FMOH and other malaria partners in the country since 2011. The micro-planning exercise that PMI has supported collects district- and *kebele*-level data on the number of malaria cases and key malaria commodities including LLINs. Each annual micro-planning meeting compiles records of the number of LLINs previously distributed within the last three years, and documents LLINs that are more than three years old and thus need to be replaced. The micro-plan estimates the 12-month need and gap of LLINs based on district-level sub-populations with malaria risk (generally by *kebele*), malaria morbidity, and LLIN data. In addition to replacement of LLINs, the number of gap filling nets was calculated by quantifying the number of new households (resulting from population growth rates) and malaria-affected households that never received nets in previous distributions.

##### Progress during the last 12-18 months

The FMOH's Global Fund NFM proposal identified the need for 29,584,492 LLINs in 2014-2015 to achieve universal coverage. The resources available from Global Fund (22.7 million LLINs) and PMI (FY 2013 and FY 2014 funding for 6.8 million LLINs) provided the total requirement in 2015-2016.

In early 2015, PMI procured and delivered 4.3 million LLINs (a portion of the 6.8 million LLINs) using FY 2013 and FY 2014 funds; these were distributed to high risk malaria districts in Oromia, Amhara, and Tigray Regions. The remaining 2.5 million LLINs were delivered at the end of 2015 (with FY 2014 funding). All 6.8 million nets were distributed via mass distribution campaigns. An additional 1 million LLINs were procured (FY 2014 funding) for continuous distribution in 2016. The procurement of an additional 3.2 million LLINs, planned for using FY 2015 funding, has been pushed back as there were adequate LLINs in country for the 2015 universal campaign. FMOH uses micro-plan data for distribution of LLINs for both PMI and Global Fund procured LLINs in the country.

**Table 7: LLIN gap analysis**

Calendar Year	2016	2017	2018
Total Targeted Population	55,323,603	56,610,601	57,923,967
<b>Continuous Distribution Needs</b>			
Channel #1: Health Extension Workers	3,076,757	6,878,038	0
<i>Estimated Total Need for Continuous</i>	3,076,757	6,878,038	0
<b>Mass Distribution Needs</b>			
2018 mass distribution campaign	0	0	23,390,781
<i>Estimated Total Need for Campaigns</i>	0	0	23,390,781
<b>Total calculated need: routine and campaign</b>	<b>3,076,757</b>	<b>6,878,038</b>	<b>23,390,781</b>
<b>Partner Contributions</b>			
ITNs carried over from previous year	3,587,570	510,813	2,583,805
ITNs from MOH	0		
ITNs from Global Fund	0	0	unknown*
ITNs from Other Donors	0	0	0
ITNs planned with PMI funding	0	8,951,030	8,000,000†
<b>Total ITNs Available</b>	<b>3,587,570</b>	<b>9,461,843</b>	<b>10,583,805</b>
<b>Total ITN Surplus (Gap)</b>	<b>510,813</b>	<b>2,583,805</b>	<b>(12,806,976)</b>

\*2018 GF funding is not yet known; application to be submitted in 2017 to address this gap

† Procurement planned with FY 2016 and FY 2017 funds

The above gap analysis (Table 7) uses the official total population size from the Central Statistical Agency and assumption that 60% of the population lives in malaria-endemic areas and are targeted. The HEW-based continuous distribution channel quantifies the LLIN gap at 8% and 20% plus the population growth for 2016 and 2017, respectively. Assuming a three-year lifespan for each net, the nets that were distributed in 2015 and earlier should be replaced by the end of 2018 through mass campaign. The total nets needed by the end of 2018 to cover the 57.9 million people at risk is 32.1 million LLINs. Available nets from 2016 and 2017 continuous distribution were deducted from the total need of 32.1 million which makes the LLINs need for 2018 mass campaign 23,390,781. The losses of 8% and 20% from 2016 and 2017 continuous distribution, respectively, were also factored.

The NFM states that given no local evidence for the loss rate of nets, the continuous distribution calculated net loss was based on the RBM Harmonization Working Group recommendation of 8%, 20%, and 50% in the first, second, and third year of distribution, respectively. FMOH believes that the 2015 mass campaign will establish a foundation for the beginning of continuous annual distribution efforts that will require about 8% of LLINs distributed in 2015 plus the population growth (3,076,757) to be replaced in 2016, and 20% of LLINs distributed in 2015 plus the population growth (6,878,038) to be replaced in 2017, accounting for net deterioration/loss and adjustment for population growth for

continuous distribution. As the Global Fund has never fully funded the LLIN requirements for the country, PMI will continue to fill this gap.

PMI is currently conducting a longitudinal LLIN durability assessment in conjunction with the 2015 mass distribution campaign. Baseline data was collected in June 2015 from 1,839 households with 9,541 members. The average number of household size was 5.2 people. In these households, data were collected for a total of 3,406 LLINs. Data will continue to be collected at various intervals for a total of 36 months.

### Plans and justification

PMI supports the FMOH policy and distribution plans of LLINs to the most at-risk communities in significant malaria transmission areas as per NMSP 2014-2020 malaria stratification. In addition to the LLIN procurement and distribution, PMI in collaboration with FMOH and other in-country stakeholders, will continue to conduct the national micro-planning for LLIN needs assessment and to inform the distribution. PMI will support replacement of worn LLINs as well as gap filling households or household members missed by the recent mass campaign with pipeline along with FY 2017 funding. A major challenge still remains in ensuring LLIN distribution to households in the absence of a tracking and monitoring system for LLINs. PMI will expand support for LLIN distribution using HEWs to ensure delivery to the household level. To ensure that all procured LLINs reach the end-user, PMI will support the NMCP and Pharmaceutical Funds Supply Agency (PFSA) in developing a LLIN distribution tracking and monitoring system as well as invest in distribution costs to lower levels. In addition, PMI is conducting a national baseline survey on malaria communication. Once the level of non-use of LLINs and behavioral factors leading to non-use have been identified, evidence-based behavioral interventions will be designed to increase net use in the coming years (see SBCC section). In addition, PMI will advocate for the implementation of NMCP's strategy that prioritize pregnant women and children during LLIN distribution coupled with SBCC activities for better targeting of these vulnerable populations.

### Proposed activities with FY 2017 funding: (\$15,520,000)

- **ITN procurement:** PMI will support procurement of 4,000,000 LLINs for the 2018 universal coverage campaign. (*\$11,520,000*)
- **ITN distribution and tracking:** PMI will assist districts to transport LLINs from district level to health posts and communities, at approximately \$1/LLIN. All activities will be coordinated with the local authorities and HEWs in order to ensure that engagement of targeted districts is maximized, LLINs are distributed before the malaria transmission season, and communities are educated to use LLINs properly and care for them appropriately. PMI will support the NMCP and PFSA in coordinating and designing a LLIN tracking system. (*\$4,000,000*)
- **ITN-related communication activities:** PMI will continue to support the implementation of evidence-based and coordinated SBCC activities at the community level in malarious areas to increase the knowledge, attitudes, and practices towards malaria prevention and control including LLINs. (*see SBCC section*)

### **c. Indoor residual spraying**

#### *Progress since PMI was launched*

The PMI-supported IRS program in Ethiopia has expanded significantly from its initial coverage of 316,000 structures in 2008, peaking at 858,657 structures sprayed in 2011 (Figure 7, Table 8). Since 2008, PMI has been providing targeted IRS to high malaria burden *kebeles* in PMI-supported districts according to the national guidelines. PMI's IRS coverage increased from 19 districts in 2008 to 50 districts in 2011. Through a graduation process PMI and ORHB started in 2011, 24 districts were graduated from IRS in 2012 and 10 new high malaria burden districts were identified and included in PMI IRS support, resulting in a total of 36 districts receiving full IRS support. All of these 36 districts are located in the western part of Oromia and all had high malaria burden when they were selected. PMI has continued to provide full IRS support in these 36 districts achieving over 99% coverage by spraying 710,000 structures and protecting more than 1.6 million people each year.

Graduated districts continue receiving minimal support for micro-planning, supportive supervision, and IRS equipment to fill gaps. For the districts to be considered for graduation the burden of malaria should be low; the districts should have sufficient financial resources and technical expertise to run IRS on their own; and should possess adequate storage facilities, equipment, and supplies. Hence, the bulk of IRS-related financial and programmatic support is taken over by the graduated districts. The rationale for this graduation approach is that as districts build capacity through extended PMI support over two to three years, they will gain the ability to sustain IRS operations with their own resources, and PMI funds could support IRS at the national level or in other districts. This model has shown to be effective: the 24 graduated districts achieved a 97% IRS coverage rate in 2015, spraying 462,224 structures and protecting 1,418,100 people.

Based on a request from the FMOH, PMI has piloted, evaluated, and supported the implementation of community-based (CB) IRS using HEWs since 2012 (implemented in one district in 2012 and six from 2013-2016). The involvement of HEWs in IRS as part of the CB IRS strategy, as indicated in the NMSP (2014-2020), further underscores expanding the use of the HEP in the implementation of IRS. The performance of the CB IRS approach was evaluated in 2013 and 2014 to assess if it met the required quality and environmental compliance standards. The evaluation findings were positive; it concluded that CB IRS could be an alternative approach to the district-based IRS operations and could be more sustainable in the long run. PMI's CB IRS program is considered to be a model for government-supported community-based IRS nationwide.

From the initiation of PMI-supported IRS in 2008 (Table 8), ensuring robust environmental compliance practices were implemented has been a main area of focus. Environmental compliance training was made compulsory as part of the overall IRS operations training for all personnel participating in IRS. Storage facilities for insecticide, IRS equipment, and materials for dealing with insecticide-contaminated waste were made available in all districts that receive PMI support for IRS. Previously built evaporation tanks to contain DDT effluent waste were totally decommissioned and soak pits were built in all districts receiving IRS support. Considerable efforts were made to remove obsolete DDT from PMI-supported sites. Through PMI's efforts, capacity has been created in Ethiopia for the handling of obsolete insecticide, which the country can tap into when needed.

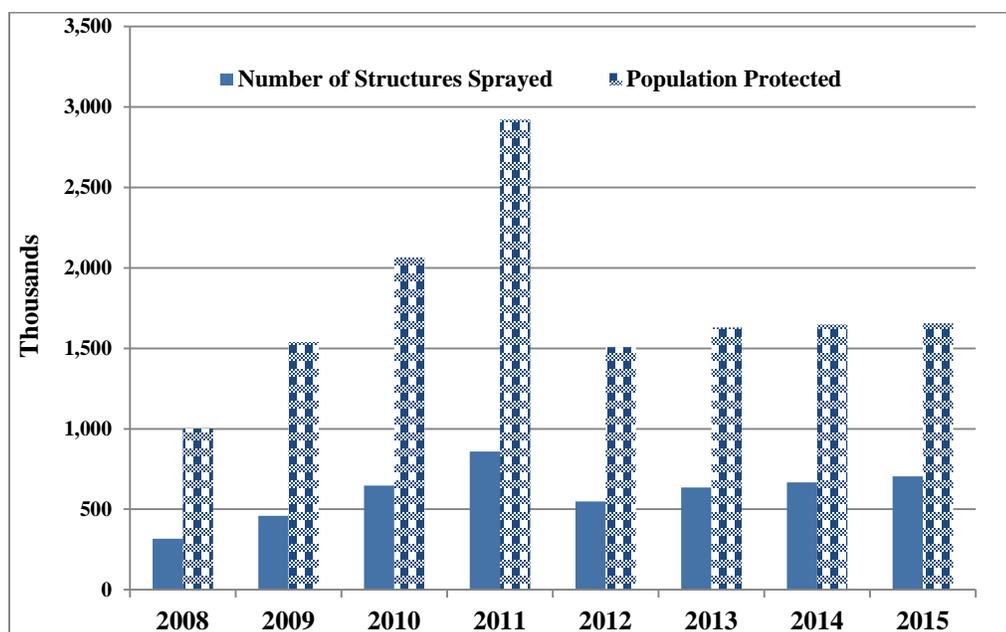
**Table 8: PMI-supported IRS activities (2008-2018)**

Year	Number of Districts Sprayed	Insecticide Used	Number of Structures Sprayed	Coverage Rate (%)	Population Protected
2008	19	DDT	316,829	92.0	1,000,526
2009	23	DDT	459,402	91.8	1,539,163
2010	30	Deltamethrin	646,870	96.5	2,064,389
2011	50	Deltamethrin + Bendiocarb	858,657	98.6	2,920,469
2012	36	Deltamethrin + Bendiocarb	547,421	98.8	1,506,273
2013	36	Bendiocarb	635,528	99.6	1,629,958
2014	36	Bendiocarb	667,236	99.5	1,647,099
2015	36	Bendiocarb (28 districts) + Pirimiphos-methyl CS (8 districts)	704,945	99.5	1,655,997
2016*	36	Pirimiphos-methyl CS	~708,258	TBD	~1,665,815
2017*	36**	TBD	~710,000	TBD	~1,700,000
2018*	36**	TBD	~710,000	TBD	~1,700,000

\* Represents projected targets based on national strategic plan and/or discussions with the NMCP.

\*\* In 2017, ten low malaria burden districts from the currently supported districts will graduate from full IRS support and ten new districts with high malaria risk will be identified to receive IRS support.

**Figure 7: IRS results in PMI-supported districts of Oromia Region, Ethiopia, 2008-2015**



*Progress during the last 12-18 months*

**IRS Operations:** In 2015, PMI supported the spraying of 704,945 structures and protected 1,655,997 people from malaria in 36 districts of Oromia Region, achieving a 99.5% coverage rate. The insecticide used in PMI-supported districts in 2015 was bendiocarb in 28 districts and pirimiphos-methyl (Actellic

CS) in 8 districts. The use of pirimiphos-methyl CS in eight districts was on a pilot basis to gain experience to advise future use, as per the FMOH guidance in 2014. The effectiveness and its activity on different wall types were communicated to the FMOH and they accepted its use in all 36 PMI-supported districts for 2016. Further, the FMOH showed an interest in using pirimiphos-methyl CS in the government spray program in the future. In 2015, a total of 2,845 people (18.5% female) were trained to effectively deliver IRS operations. Technical support was provided to the graduated districts in IRS planning and identification of resource gaps for their 2016 IRS campaign.

Community-Based IRS: In 2015, PMI continued supporting CB IRS in six districts. Through PMI support these six CB IRS districts achieved comparable results to the district-based model in terms of coverage and quality of spraying. In the 2015 CB IRS districts, 178,742 (99.9%) structures were sprayed and 409,183 people were protected, about a 6% increase from 2014. In addition, wall bioassays conducted in the CB IRS districts were found to be comparable to the district-based IRS districts in 2015.

Obsolete DDT Removal: Significant progress was made in 2015 and early 2016 to remove 115 tons of obsolete DDT and DDT-contaminated waste from PMI-supported districts. Environmental health and safety specialists were subcontracted to support the safe repackaging, export, and disposal of DDT. A comprehensive training on DDT waste removal was conducted in October 2015; in total 56 people were trained (including staff from the FMOH and Ministry of Environment) to serve as technicians and supervisors to support this process. DDT was repackaged in 46 sites throughout PMI-supported districts following the training and shipped to a central store in Addis Ababa. In June 2016, 101,600 kg of obsolete DDT had been shipped out of Ethiopia and arrived in Poland for proper incineration and in July 2016, PMI received documentation that all 101,600 kg of DDT has been successfully incinerated. The remaining contaminated cartons were awaiting shipment in 1-2 months' time.

External Environmental Assessment: An external environmental compliance evaluation of PMI-supported IRS operations was conducted in eight districts in 2015. It was reported that PMI-supported IRS was largely compliant with PMI's *Best Management Practices for Indoor Residual Spraying*. Some issues to be addressed include: need for medical checkups for spray operators and proximity of offices and residential houses to IRS stores at the district level. PMI is working with the respective districts to seek solutions to the challenges noted.

Next Generation Indoor Residual Spraying Project (NGenIRS): Ethiopia is confirmed as a country for the UNITAID-funded NGenIRS Project in 2016. This market intervention project includes a short term co-payment schedule to accelerate the reduction of price for long-lasting IRS insecticides. The price reduction will enable Ethiopia to expand coverage of effective, long-lasting IRS from baseline levels, and participation in the NGenIRS Project confirms Ethiopia's commitment to do so.

### Plans and justification

With FY 2017 funds, PMI will maintain the FY 2016 level of IRS support and will continue supporting IRS operations in 36 districts (10 new and 26 old districts) through close collaboration with the FMOH, ORHB, and other partners. PMI will continue providing minimal support and monitor the status of malaria situation in the 34 (24 old and 10 new) graduated districts using health facility and micro-planning information. In addition, through discussions with ORHB, PMI will determine how best to expand PMI's CB IRS implementation beyond the original six districts. With FY 2017 funding, approximately 710,000 structures will be sprayed with full support from PMI in 36 districts, protecting approximately 1.7 million people. PMI will continue to focus on high malaria burden districts in Oromia

and support environmental compliance activities. IRS operations and environmental compliance trainings will also be delivered with the ultimate goal of building local capacity in IRS operations.

Proposed activities with FY 2017 funding: (\$10,400,000)

- **IRS operations:** PMI will continue to support ORHB in planning, implementing, and evaluating IRS in 36 districts to cover about 710,000 structures and protect more than 1.65 million people. Minimal support will be provided to the 34 graduated districts in the form of planning assistance, supervision, and environmental compliance. (\$4,432,000)
- **Procurement of insecticide, IRS equipment and personal protective equipment (PPE):** PMI will procure long-lasting insecticide (with support from the NGenIRS project) for all 36 PMI-supported districts. The exact allocations and specifications of insecticides will be determined upon completion and review of the 2016 and 2017 IRS activities. IRS equipment and PPE will also be procured based on IRS microplanning results and gap analyses. (\$5,500,000)
- **IRS training:** PMI will support in-service training at federal and regional levels to increase FMOH's, ORHB's, and district health offices' capacity in planning, management, and leadership of IRS operations. PMI will enhance their supervision skills, and also focus training on key aspects such as environmental compliance and poison control. (\$468,000)

## 2. Malaria in pregnancy

NMCP/PMI objectives

The Ethiopian FMOH's NMSP (2014-2020) does not support IPTp with sulfadoxine-pyrimethamine because of the relatively low intensity of malaria transmission in most of Ethiopia, and the anticipated minimal expected benefits compared with high costs. Malaria in pregnancy (MIP) in Ethiopia is addressed through: 1) improving prompt access to care and treatment in the iCCM context at rural health posts and at health centers, 2) prioritizing the use of LLINs by pregnant women within households, and 3) enhanced SBCC activities and outreach for pregnant women.

In the recent 2014/15 Ethiopia HSDP IV Annual Performance Report, ANC coverage (at least one visit) was 96.9% and ANC coverage (at least four visits) was 67.9% nationwide. This is an increase from the 2011 Demographic and Health Survey which noted that for Ethiopia as a whole, only 34% of mothers received antenatal care from a health professional for their most recent birth in the five years preceding the survey. The median duration of pregnancy at the time of the first antenatal visit was last shown to be 5.2 months. Increasing ANC coverage is also one of the FMOH's priorities, and is supported by USAID/Ethiopia MNCH, family planning, and reproductive health funding. From the last published Integrated Disease Surveillance Report (IDSR) (2008-2009), pregnant women accounted for 1.7% of all reported outpatients with malaria (14,864/1,104,157), 2.9% of reported malaria hospitalizations (574/20,130), and 1.7% of reported inpatient malaria deaths (10/585). Since that time, the IDSR was folded into the PHEM system and specific MIP morbidity and mortality data were no longer published. In a study by Newman *et al.*, a cross-sectional survey of placental parasitemia at a stable (high) malaria transmission site in the sparsely populated Gambella Regional State noted 6.5% prevalence, whereas three other sites in unstable (i.e., low) transmission settings noted only 2.5% prevalence. Because of the

relatively low prevalence of malaria infection during pregnancy, IPTp has not been implemented in Ethiopia.

National malaria guidelines were updated in 2012 by the FMOH to include pregnancy-specific treatment guidelines. Consistent with WHO guidance, these guidelines recommend oral quinine for uncomplicated *P. falciparum* malaria in the first trimester, and oral artemether-lumefantrine for the second and third trimesters. For uncomplicated mono-species *P. vivax* malaria, oral chloroquine is recommended in all trimesters. As primaquine is contraindicated during pregnancy, the FMOH's recent adoption of primaquine radical cure should eventually prevent relapses from occurring during pregnancy as more women would have been adequately treated prior to pregnancy. A policy of providing weekly chloroquine suppression for pregnant women presenting with vivax malaria has been discussed but not yet adopted. For severe malaria, IV artesunate for inpatient treatment is recommended. Recent PMI-supported in vivo monitoring studies have documented that *P. vivax*-infected persons in Ethiopia experience an average of two but up to eight recurrent infections within the following 12 months. Such illness relapses could be especially harmful to pregnant and breastfeeding women who are unable to take primaquine, have impaired immunity, an impaired nutritional status, and an increased risk of progression to severe or complicated malaria illnesses.

There are few, if any, LLIN distributions via ANC clinics in Ethiopia, except through a small project that overlaps with PEPFAR. Distribution of LLINs via ANC is not part of the FMOH malaria control strategy. Approaches used by the FMOH to target pregnant women are to: scale-up universal LLIN coverage and encourage pregnant women to use LLINs; and ensure availability of prompt diagnosis and treatment of clinical malaria cases during pregnancy at health facilities. The LLIN replacement scheme presented in the NMSP is the policy framework for continuous LLIN distribution primarily through the HEP. Nearly all LLINs are distributed by HEWs through mass campaigns every three years and they are instructed to make sure that pregnant mothers and children less than five years of age have preferential access to LLINs in these mass campaigns and educate communities to give priority to pregnant mothers and children, in case LLINs are not sufficient to cover the entire family. The recent MIS 2015 results showed that household ownership of LLINs is still inadequate, but use amongst pregnant women who own an ITN was above 80%. Significant investments are being made to strengthen the distribution process and track LLINs to the household level. Optimizing community-based distribution through HEWs has the potential benefit over ANC distribution channels to reach more pregnant women including those not seeking ANC services and more broadly women of reproductive age earlier in pregnancy.

#### Progress since PMI was launched

In Ethiopia, 97.4% of women had at least one antenatal care visit and 23.1% of births were attended by a skilled provider. The most important barrier to access to health services that women of childbearing age mentioned is availability of transport to a facility, followed by lack of money and distance to a health facility, according to the 2011 MIS. Based on the MIS 2007 and 2011, 43% and 35% of pregnant women slept under an LLIN, respectively. A major focus of ANC programs in Ethiopia is providing expanded access to quality healthcare through health centers and health posts, where, since 2008, PMI supported projects to promote prompt access to diagnostic and treatment services for pregnant women and to identify and preferentially distribute LLINs to pregnant women in rural communities. PMI has been supporting pre-service training of midwives and HEWs, and thus contributed to the graduation of 18,927 midwives and HEWs between 2013 and 2015.

There are no new surveillance data from IDSR since 2009 concerning trends in the specific burden of malaria amongst pregnant women or neonates, but as mentioned above, the relatively complete malaria surveillance data shows the malaria situation has been steadily improving. The Health and Health Related Indicators Report from HMIS data documented “female” malaria outpatient morbidity from *P. falciparum* in 2011-2012 and 2013-2014 of 775,052 and 470,390 respectively. These HMIS surveillance reports indicate that “female” morbidity—predominantly of women of childbearing age—has also declined since 2011, along with the general population.

#### Progress during the last 12-18 months

PMI provided technical support to update the FMOH’s malaria diagnosis and treatment guidelines. These guidelines were reinforced through trainings of HEWs through iCCM rollout that were completed in late 2015 that also discussed malaria prevention and case management in pregnancy. Minor updates to these guidelines were made in early 2015, partly with PMI technical support. Social behavior change communication messages and training are being developed based on these guidelines. The implementation guidelines based on the updated NMSP are under development.

#### Plans and justification

PMI continues to support the current FMOH policies that address pregnant women’s special needs through malaria prevention and control, and improving prompt access to malaria diagnosis, and appropriate care and treatment services. Although IPTp itself is not part of the national strategic plan, with FY 2017 funding, PMI will support maternal and perinatal protection from malaria with focused ANC services and safe motherhood and adolescent reproductive health through an emphasis on anemia management and the prompt diagnosis and management of acute malaria in pregnant women. To implement these activities, PMI has leveraged the resources of other USAID programs, particularly those supported by USAID/Ethiopia MNCH, family planning, and reproductive health funds, and will ensure that health providers counsel mothers on early detection of anemia and illnesses with fever, the importance of iron and folate supplementation, as well as using a LLIN during pregnancy. This activity will be closely coordinated with PMI support for case management strengthening and supportive supervision for health care workers at health centers and HEWs at health posts. In addition, PMI will continue support for pre-service trainings for midwives and HEWs to improve malaria case management services for pregnant women.

There has been increased interest in Ethiopia concerning MIP from both the FMOH and Global Fund in recent months. The FMOH’s updated NMSP (2014-2020) mentions a plan to assess the burden of MIP in a stable transmission area and to explore the possibility of targeted IPTp activities in high risk regions. PMI will continue to work with the FMOH to identify and review all available MIP surveillance data, and to encourage the future routine collection, analysis, and publication of disaggregated MIP data once again into the FMOH’s annual surveillance reports. These enhanced surveillance and operational research efforts would aim to provide an appropriate evidence basis for any possible future health policy changes related to MIP in Ethiopia. Although PMI will allocate funds toward proposed activities, the bulk of related-MIP funding is covered under case management activities.

#### Proposed activities with FY 2017 funding: (\$200,000)

- **Strengthening case management of MIP:** PMI will support the case management of MIP, nationally, as part of an overall package of integrated activities focusing primarily in the areas of MNCH, family planning and reproductive health, and malaria. This is a comprehensive program

that will provide an infrastructure for malaria prevention activities targeting pregnant women through improved management and performance of the health systems, increased service delivery across the PHCU's continuum of care, and improved household community health practices and health seeking behaviors. (\$200,000).

### **3. Case management**

#### **a. Diagnosis and treatment**

##### NMCP/PMI objectives

The NMSP 2014–2020 aims for universal access to prompt malaria diagnosis and highly effective treatment services for the entire Ethiopian population, whether living in malaria-free or malaria endemic areas. The NMSP strategic objective for malaria diagnosis specifies that by 2017, 100% of suspected malaria cases are diagnosed using a RDT or microscopy within 24 hours of fever onset. The FMOH's policy is for microscopy to be the primary means of malaria diagnosis at hospitals and health centers, and for malaria RDTs to be the diagnostic method at rural health posts. The NMSP aims to train all HEWs in RDT testing and laboratory professionals in malaria laboratory diagnosis and provide all health posts with RDTs and health centers and hospitals with microscopy and other malaria laboratory commodities and conduct routine external quality assurances.

The NMSP states that ACTs should be available at all public health facilities to treat all *P. falciparum* infections, whereas chloroquine continues to be first-line treatment for *P. vivax* cases. Oral quinine remains the treatment of choice for uncomplicated *P. falciparum* for pregnant mothers during the first trimester of pregnancy, children under five kilograms body weight, and as second line for treatment failures. Rectal artesunate should be available at rural health posts for pre-referral, and parenteral artesunate or artemether (alternate) should be available at health centers and hospitals for the treatment of severe malaria. The introduction of dihydroartemisinin-piperaquine as second-line treatment for non-complicated *P. falciparum* and possibly to target mobile populations is being considered. The NMSP promotes primaquine for radical cure of *P. vivax* and also single, low-dose primaquine for gametocytocidal activity against *P. falciparum*, where appropriate.

The NMSP aims to train 100% of the HEWs in the necessary skills to properly assess, classify, and manage malaria as per iCCM guideline and protocols. The MIS 2011 survey suggests that about 29% of people initially receive care for febrile illnesses through the private sector. However, the capacity of the private sector to manage malaria well is limited, and lacks a trained and competent health workforce, updated tools, and malaria commodities (i.e., ACTs, RDTs, microscopy tools, as well as rectal and IV artesunate).

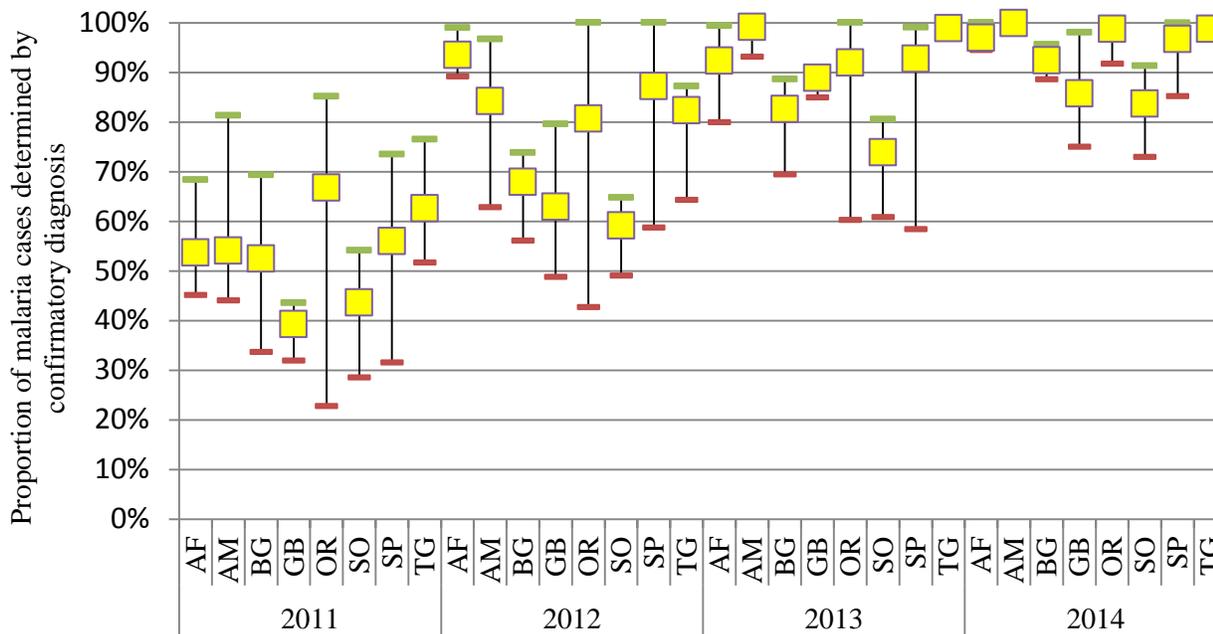
Through U.S. Government support, the GoE has recognized the importance of the private sector as a source of health care for many people. This is evidenced by the recent establishment of public-private partnerships in health units in the FMOH; inclusion of representatives from the private health sector in development of new licensing and quality standards by the country's health regulatory agency; inclusion of the private health sector as one of the six pillars in the country's new vision for primary health care; and recognition of the new private health facility associations. Health facilities that are involved in the partnership will only charge consultation and diagnosis fees and will not charge patients for free commodities received from the government. The private health sector benefit by obtaining free commodities and supplies for diseases of public health importance through the host government's

supply chain management system thus increase demand for care and in turn will provide health information to districts and regions. However, much work is still needed to improve outreach, collaboration, support, and regulation with the private sector, and there is no formal platform to share national malaria guidelines or best practices.

Progress since PMI was launched

In line with Ethiopia’s long-standing policy that all patients with suspected malaria should receive a confirmatory diagnostic test before treatment with an antimalarial is prescribed, the FMOH has scaled up quality-assured diagnostic testing at both health facility and community level with support from PMI and the Global Fund. An analysis of micro-plan data indicates that Ethiopia has made significant progress in scaling-up diagnostic testing for malaria: the percentage of all suspected malaria cases reported that were confirmed by either RDT or microscopy increased from 59% in 2011 to 97% in 2014, leaving only 299,241 presumed malaria cases (i.e., those cases that were clinically treated without laboratory confirmation). Figure 8 shows the rapid progress in malaria confirmatory testing in Ethiopia. In Oromia Region, confirmatory testing has increased from 67% in 2011 to 99% in 2014.

**Figure 8: Trends in proportion of malaria cases tested with RDT or microscopy from 2011-2014, by region (micro-plan data)\***



\*Red and green lines represent the minimum and maximum proportion of malaria case confirmatory diagnosis in the districts of the regions and the yellow box represent most of the districts (i.e., 50% of malarious districts) in confirmatory testing rates.

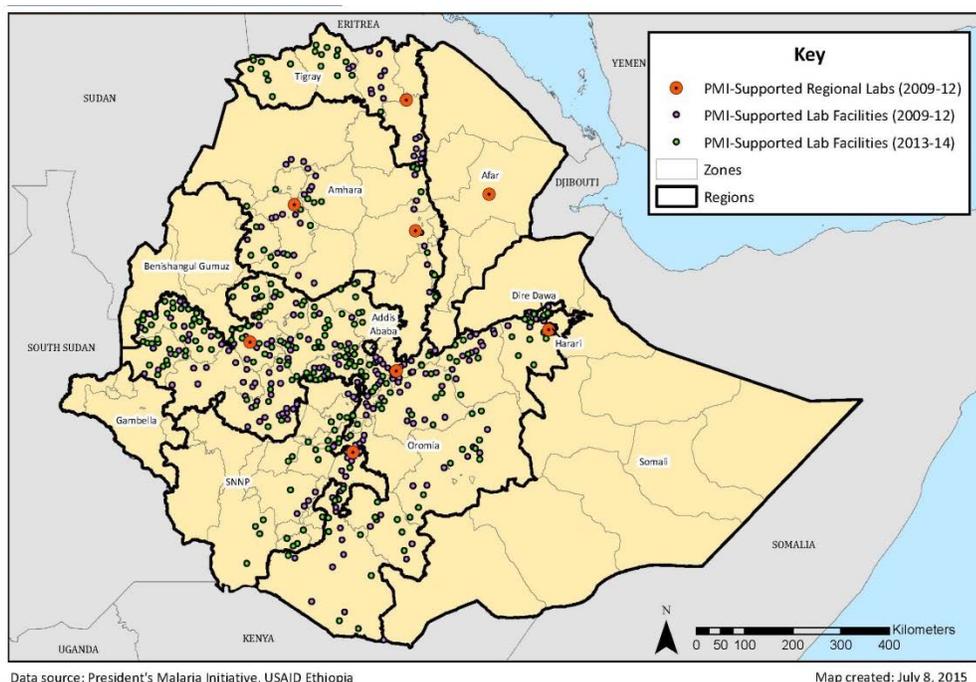
From 2008 through 2016, PMI procured 6.24 million RDTs, and 12,346,630 ACT treatments, 153,000 artesunate suppositories, and 336,000 vials of parenteral artesunate. The Global Fund and Millennium Development Goal pooled funds have also provided sufficient quantities of ACTs and RDTs for the malaria program at the national level, although focal stockouts and drug expiry issues still exist in the periphery.

In order to achieve NMSP targets of universal coverage of quality diagnosis at health centers, PMI has supported procurement of 1,158 microscopes, laboratory supplies, and reagents to scale up quality assurance systems for malaria microscopy. PMI also supported the training of 2,594 workers in malaria microscopy and 20,726 health workers in malaria treatment, and provided supervision of HEWs management of the sick child through iCCM, including performance of RDTs for managing acute febrile illnesses.

To date, PMI-supported quality assurance (QA) and quality control (QC) activities in 1,002 health facilities which has largely been focused on microscopy in health centers, regional reference laboratories and hospitals, including supportive supervision of microscopy and RDT testing processes to minimize common errors (Figure 9). Though PMI has focused more on microscopy QA, the RDT QA has been supported through integrated trainings and supportive supervision to HEWs. In addition, Ethiopia participated in a pilot assessment of dried tube specimens for assessing RDT performance. While it has shown promising results, PMI is not currently pursuing this and will continue to monitor the development of positive control wells to improve RDT QC in the future.

PMI has supported private-public partnerships in collaboration with PEPFAR, in order to improve private sector case management of malaria. Working together with the regional health bureaus and 92 private health facilities in four regional states, including Oromia Regional State, PMI supported increased access to quality malaria services, including diagnostic testing and free antimalarial treatment to the clients in the private sector.

**Figure 9: PMI-supported laboratory facilities from 2009-2014**



Progress during the last 12-18 months

The FMOH’s 2015 HSDP IV annual review meeting report, which reported on PHEM data (July 2014-June 2015), stated that “out of the total 2,174,707 malaria cases reported 1,867,059 (85.9%) were confirmed by either microscopy or RDT, out of which 1,188,627 (64.0%) were *P. falciparum* and

678,432 (36.0%) were *P. vivax*.” Although there are some differences in completeness and representativeness of these surveillance data, it is evident that the majority of malaria cases are now being laboratory confirmed.

PMI supported in-service training of 1,155 HEWs for integrated malaria case management to ensure that malaria-specific updates for technical materials and guidelines are provided to U.S. Government-supported HEW training and capacity building programs, including MCH-funded activities. In 2015, PMI supported several rounds of microscopy training complemented by onsite supportive supervision and mentorship. PMI currently supports training and supervision of malaria diagnosis in 706 health centers with laboratories in malarious areas in Oromia. In 2015, PMI supported several laboratory strengthening activities for malaria microscopy including quality improvement, purchasing laboratory equipment and additional supplies, supportive supervisions for treatment processes, and projects to improve private sector case management.

In order to reach more health facilities, PMI has built the capacity of EPHI to establish a national malaria slide bank, which will be used for training as well as proficiency testing. Through FY 2015, 9,178 standard slides have been produced. In addition, capacity of eight regional laboratories was built to cascade training and supervision to peripheral laboratories. PMI has provided technical and logistic support to ORHB to deliver integrated supportive supervision for malaria, HIV, and tuberculosis to an additional 150 health facilities currently not supported by PMI. PMI also leverages resources to conduct supportive supervision of HEWs through iCCM from other health programs.

In addition, PMI has supported the training of 736 laboratory personnel on an integrated malaria-HIV laboratory diagnosis and QA/QC system. Furthermore, 15 laboratory supervisors from regional reference laboratories have received training of trainers from all regional states. These supervisors are now planning to cascade basic trainings in all regional states of Ethiopia using funds from GoE and technical assistance from PMI. To improve the pre-service training of laboratory professionals and medical students on malaria diagnosis and treatment, training was provided to 44 university instructors from 8 major universities. In addition, PMI has supported the WHO malaria microscopy accreditation course for 12 laboratory professionals from regional and national laboratories; 8 were certified as level 1 and the rest were level 2.

During the past 12 months, 792 health facilities were involved in an external QA scheme of the target 1,022 facilities mainly health centers, hospitals, and the regional laboratory in Oromia as well as hospitals and regional laboratories in other regions. It has been recognized that there is insufficient human and financial resources to support all facilities in malarious areas, therefore, facilities that score greater than 80% using the WHO checklist on four successive rounds of mentoring and supervision will be considered “graduated” so that additional facilities can be enrolled to the program. To date, 205 health facilities have graduated. PMI will have a strategy in place that ensures minimum support for graduated facilities via series of less frequent but continuous supportive supervisory visits. Currently PMI is assessing 20% of graduated facilities (i.e., about 40 health centers) using a standardized checklist to understand and focus our minimum support towards identified needs. The plans are to refine this approach and scale-up to reach all graduated facilities.

Progress has been made in expanding supportive supervision to more health facilities in Oromia Regional State, with 71% of the facilities (706/990) in malarious areas having received support. In addition, PMI will work to assist regional states to strengthen sub-regional reference laboratories and support hospital laboratory staff to supervise nearby facilities that are not currently receiving supportive supervision. In Ethiopia there are a total of 3,547 health centers and 189 hospitals with microscopy

diagnostic capacity; 75% of these facilities are in malarious areas, as of 2015. The large number of health facilities has posed challenges to scaling up external quality assurance to all facilities, as it requires skilled human resources and logistics to reach all facilities. In addition, there are gaps in timely supply of quality reagents and laboratory supplies and maintenance of microscopes and laboratory equipment.

In 2016, 88 private for-profit health facilities and four worksites will be supported to provide quality malaria case management. PMI will also support updating maps of workplace clinics that provide services to clients at the small and large scale farms and factories in malarious areas in Amhara, Oromia, Tigray, and SNNP Regional States.

PMI supported a therapeutic efficacy study that was completed in December 2014 after enrolling 399 patients for chloroquine or artemether-lumefantrine with or without primaquine in patients with *P. vivax* infection. The risk of treatment failure at day 42 was 18.7% following chloroquine, 1.2% after chloroquine + primaquine, 29.9% after artemether-lumefantrine and 5.9% after artemether-lumefantrine + primaquine; overall  $p < 0.001$ . At the end of follow-up, the incidence rate of *P. vivax* was 2.19 episodes/person year for patients treated with chloroquine compared to 0.43 for chloroquine + primaquine (rate ratio: 5.1;  $p < 0.001$ ) and 2.3 episodes/person year for artemether-lumefantrine compared to 0.5 for artemether-lumefantrine + primaquine (rate ratio: 6.4;  $p < 0.001$ ). These data suggest that broader use of primaquine combination therapy should greatly reduce *P. vivax* recurrences within 42 day and by over five-fold during the subsequent year. Based on this and previous studies, PMI has been involved in writing a policy brief for inclusion of primaquine for radical treatment of *P. vivax* malaria to be implemented in elimination districts without G6PD testing. Currently the policy is approved and a circular is being sent out to the regions for implementation. PMI is also planning to evaluate this implementation and inform future use in other endemic areas.

PMI will conduct therapeutic efficacy monitoring of artemether-lumefantrine and dihydroartemisinin-piperaquine for *P. falciparum* and chloroquine and dihydroartemisinin-piperaquine for *P. vivax* in the fall of 2016. Five sites have been proposed for the study. PMI will be supporting two sites and the others will be supported by the Global Fund and WHO. The protocol has been finalized and currently under review by relevant institutional review boards.

*Commodity gap analyses*

**Table 9: RDT gap analysis**

<b>Calendar Year</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>RDT Needs</b>			
Total country population	92,206,005	94,351,001	96,804,127
Population at risk for malaria	55,323,603	56,610,601	58,082,476
PMI-targeted at-risk population	55,323,603	56,610,601	58,082,476
Total number of projected fever cases*	11,226,814	11,518,711	11,818,197
Percent of fever cases tested with an RDT*	47%	47%	47%
<b>Total RDT Needs**</b>	<b>6,068,093</b>	<b>6,225,863</b>	<b>6,387,736</b>
<b>Partner Contributions</b>			
RDTs carried over from previous year	0	2,331,907	4,509,620
RDTs from Government	0	0	0
RDTs from Global Fund	5,400,000	7,243,576	0
RDTs from Other Donors	0	0	0
RDTs planned with PMI funding	3,000,000	1,150,000	513,000
<b>Total RDTs Available</b>	<b>8,400,000</b>	<b>10,735,483</b>	<b>5,022,620</b>
<b>Total RDT Surplus (Gap)</b>	<b>2,331,907</b>	<b>4,509,620</b>	<b>(1,365,116)</b>

\*Based on Microplan 2014 data with a 2.6% annual population growth adjustment (percent fever cases tested with an RDT is also per the 2014 Microplanning data)

\*\*Added 15% adjustment factor for underreporting of negative results, newly constructed HCs that will not have microscope and or HCs with non-functional microscopes

**Table 10: ACT gap analysis**

<b>Calendar Year</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>ACT Needs</b>			
Total country population	92,206,005	94,351,001	96,804,127
Population at risk for malaria	55,323,603	56,610,601	58,082,476
PMI-targeted at-risk population	55,323,603	56,610,601	58,082,476
Total projected number of Pf malaria cases*	2,564,640	2,631,321	2,699,735
<b>Total ACT Needs**</b>	<b>2,692,872</b>	<b>2,762,887</b>	<b>2,834,722</b>
<b>Partner Contributions</b>			
ACTs carried over from previous year	150,000	1,757,128	2,917,841
ACTs from Government	0	0	0
ACTs from Global Fund	4,300,000	2,523,600	0
ACTs from Other Donors	0	0	0
ACTs planned with PMI funding	0	1,400,000	0
<b>Total ACTs Available</b>	<b>4,450,000</b>	<b>5,680,728</b>	<b>2,917,841</b>
<b>Total ACT Surplus (Gap)</b>	<b>1,757,128</b>	<b>2,917,841</b>	<b>83,119</b>

\*Per micro plan 2014 data plus projected 10% increase in malaria cases projected for 2016 (Projection was calculated as per completed microplan 2015 data from Benishangul-Gumuz and Gambella).

\*\*For 2017 and 2018, calculated increases reflect a projected 2.6% annual increase in population.

### Plans and justification

PMI plans to regularly reassess the commodity availability and distribution using data and information gathered from various sources (e.g., the Integrated Pharmaceutical Logistics System and micro-plan) and monitor the procurement and distribution of commodities through the established malaria commodity technical working group. The commodity gaps identified and not covered by the Global Fund and the Millennium Development Goal basket funds may be provided by PMI.

PMI will continue HEWs and health worker training/mentoring and supportive supervision to ensure early laboratory diagnosis and prompt treatment of all reported and confirmed malaria cases. Priority will be given to the HEWs working in remote hard-to-reach malarious areas especially in development areas. HEW training will be conducted as part of iCCM training and specific training for clinicians will be conducted at regional levels.

Emerging data from episodic outbreak investigations and available epidemiological reports from routine surveillance suggest that older boys and men may now have special risks for malaria transmission from occupational and travel-related activities such as performing seasonal internal migrant farm work. Therefore, in addition to current private sector support for health facilities and clinics, PMI will continue

to work with the FMOH, RHBs, and private sector employers. With FY 2015 funds, PMI plans to support an assessment of prevention and control strategies for migratory workers especially in western part of the country where sesame farms and traditional gold mining are prevalent.

The FMOH recognizes that PMI provides a comprehensive and robust QA/QC system support for malaria laboratories and has requested that PMI support the introduction of microscopy QA/QC in at least one health center in each district. Building on lessons learned, the districts and regions may scale up to other health facilities. PMI envisions scaling up this support to all 706 facilities in Oromia by 2017. Outside of Oromia Regional State, PMI also plans to provide enhanced facility-based supportive supervisions to 162, 94, 41, and 16 health centers in Amhara, SNNPR, Tigray, and Dire Dawa Regional States, out of 784, 572, 165, and 17 total facilities, respectively.

The total number of health facilities (health centers and hospitals) in malarious areas of Ethiopia is estimated to be 2,802. To date PMI has procured 1,158 microscopes that were provided to 1,058 health facilities (health centers and hospitals); the remaining 100 were provided to the national reference laboratory and to 8 regional reference laboratories to support training and external quality assurance activities. The procurement of microscopes is based on a facility assessment that will be conducted once the facilities are selected by the RHBs.

PMI will build capacity of EPHI and regional reference laboratories to repair microscopes already in facilities. To promote standardization, PMI tries to ensure that malaria microscopes have similar formats and capabilities and will provide limited number of microscopes, spare parts, critical supplies, and reagents for malaria microscopy.

PMI will continue to support therapeutic efficacy monitoring including testing for markers of artemisinin resistance to complement Global Fund-supported efforts.

*Proposed activities with FY 2017 funding: (\$5,510,000)*

- **Procurement of RDTs:** PMI will procure and distribute 513,000 multi-species RDTs to support FMOH/ORHB to scale-up RDT use at the health post level. This will help meet the total projected need of the country. (\$380,000)
- **Procurement of laboratory equipment and supplies:** PMI will procure 190 microscopes and laboratory kits and spare parts for laboratories that conduct malaria microscopy. (\$400,000)
- **Support for QA system for malaria laboratory diagnosis and case management at the health facility level:** Technical and programmatic support to 700 health facility laboratories and clinics in Oromia and 300 health centers in other regional states mainly targeting high burden and malaria pre-elimination districts will be continued. Operational support will be provided to districts and all regional reference laboratories in Ethiopia as well as major regional hospitals to conduct QA/QC activities and program monitoring. These will include support for refresher trainings and supervision for both laboratorians and clinicians. In addition, training and accreditation will be provided to laboratory supervisors. With FY 2017 funds, these activities will be expanded to an additional 200 health facility laboratories in Oromia and other regional states, in addition to the QA support for the 1,000 existing facilities. Selection of the facilities will be done in consultation with the RHBs and PMI will also support the baseline assessment of

each facility before initiating activities. In addition, EPHI's biomedical maintenance capacity will be strengthened. (\$2,000,000)

- **Procurement of antimalarials for *P. vivax* treatment:** PMI will support the procurement and distribution of the entire estimated national need for chloroquine and primaquine (i.e., 1 million treatments of chloroquine and 100,000 doses of primaquine). (\$530,000)
- **Antimalarial drug therapeutic efficacy monitoring:** PMI will support assessments of the effectiveness of currently used first-line and potential second-line antimalarial drugs for both *P. falciparum* and *P. vivax* in two sites in order to detect and mitigate possible emergence of drug resistance. (\$200,000)
- **Provide support for training, ongoing supervision and monitoring of malaria diagnosis and treatment:** Support for supervision and monitoring of malaria case management including MIP at primary healthcare units in Oromia, Amhara, SNNPR, and Tigray Regional States will be continued. In addition, community level case management, including MIP, through health posts in the developing regions namely Gambella, Benishangul-Gumuz, Somali, and Afar, will be supported. It is expected that this support will cover all health centers and health posts in malarious areas in approximately 240 districts. Health centers and health posts will receive technical support. Health workers, including HEWs, will receive in-service training on revised malaria case management including MIP guidelines, on-site supervision, and ensuring that case management reporting is complete and accurate. MIP-related communication support will be provided to health service providers to enhance interpersonal communication and counseling skills on malaria prevention and control during pregnancy. Support also includes provision of appropriate and standardized MIP-related communication materials and job aids; training on communicating with pregnant women on LLIN use and dangers of malaria in pregnancy. (\$1,300,000)
- **Private sector support to case management:** PMI will work with the FMOH and RHBs to create an enabling policy and working environment for malaria prevention and control in private sector health services including in developmental areas in Oromia, Amhara, Benishangul-Gumuz, and Gambella Regions. PMI will be supporting the finalization of directives and implementation guidelines for better engagement of private health facilities to provide quality services at national and regional level. PMI will also provide technical assistance for planning, implementation, management, and monitoring and evaluation of comprehensive malaria services to clients at the private facilities (formal and informal), large farms, and factories in malarious areas and increase access to quality malaria prevention and control services, including diagnostic testing and free antimalarial treatment to the clients seeking care in the private sector. (\$700,000)

## **b. Pharmaceutical management**

### NMCP/PMI objectives

The NMCP's goals of universal access to effective malaria case management requires best practices of pharmaceutical management and robust supply chains of malaria diagnostic and treatment commodities.

The FMOH and PMI have been working to address multiple supply chain problems within all levels of the national drug management system, including malaria commodity bottlenecks, stockouts, and expiry.

In 2005, the FMOH developed a Pharmaceutical Logistics Management Plan and later in 2007 created the PFSA. Through PEPFAR and Global Fund support, the FMOH radically redesigned the governance, policies, and infrastructure of the existing logistics system, establishing drug distribution regional hubs to directly supply health centers, health posts, and hospitals. Although PFSA began managing malaria commodities initially in 2011, the FMOH determined PFSA did not have the necessary capacity and issued a directive that all malaria procurements would be done by UNICEF and distributed through each of the RHBs, leaving all other commodities (i.e., HIV, family planning, essential medicines, etc.) under the management of PFSA. During this time, PMI supported distribution of antimalarial medicines to the health facility level, primarily through the provision of technical assistance to regional health bureaus and health centers. As of November 2015, however, FMOH issued a new mandate requiring *all* commodities from all donors, including antimalarials, to be distributed through PFSA. For LLINs, once at the district level, they are then distributed down to the household level through the HEP.

The Ethiopian Food Medicine Healthcare and Administration and Control Agency (FMHACA), organizationally under the FMOH, is responsible for regulating and registering medicines and ensuring the safety and quality monitoring of all medicines. It is also responsible for establishing and implementing QA systems for the country, including post-marketing drug quality monitoring, creating public awareness on quality assured medicines, and taking legal and regulatory actions for fraudulent drugs.

### *Progress since PMI was launched*

PMI has historically supported antimalarial drug management systems strengthening largely at hospital and health center levels. In addition PMI also supported PFSA and FMHACA in strengthening the pharmaceutical supply chain system and antimalarial drug quality assessments, respectively.

In support of the antimalarial drug management system and pharmaceutical supply chain strengthening, PMI has been implementing several interventions in selected facilities. These interventions included antimalarial drug management support through rational drug use, Continuous Result Monitoring System, supporting the establishment of Drug Therapeutic Committees, establishing Drug Information Centers and conducting end-use verification (EUV) surveys.

PFSA is currently providing pharmaceutical service for the public and private health facilities through seventeen regional-level hubs throughout Ethiopia. Until 2011, PMI has imported and distributed most of its malaria commodities (including ACTs) for Oromia Regional State through UNICEF. Since 2012 PMI has been procuring drugs including ACTs for national coverage and handing them over to PFSA for management and distribution.

With PMI support, micro-planning meetings with participants from all malaria-affected *woredas* and zones in Oromia Region were conducted annually since 2009 and in all regional states since 2011 to determine the annual requirements of ACTs, RDTs, and LLINs at the district level. The micro-plan is updated when distributions of commodities to the zones and districts occur. The ACT and RDT requirements were determined based on malaria cases diagnosed and treated from previous years at health facilities and health posts of each *woreda*. The results have subsequently been used to calculate the needs of pediatric and adult tablets of chloroquine to treat *P. vivax* malaria, and to prioritize and rationalize malaria commodity distributions throughout the year.

Micro-plans, while a valuable annual activity, do not provide perfect estimates of resource and commodity requirements; specifically, they have not accounted for existing inventories or expiry dates

of medicines or RDTs. Ultimately, in an epidemic-prone setting such as Ethiopia, redistribution of resources among or between districts may be needed to meet local needs that could not have been accurately forecasted from available data. Such flexible redistribution plans or processes are typically not available. Although mandated again to manage all commodities, including malaria commodities, the PFSA has yet to fully develop the necessary capacity to meet the dynamic demands of the malaria transmission season or to respond promptly to urgent malaria medication stockouts.

PMI-funded pharmaceutical facility baseline assessment surveys and ongoing reports reveal continued supply chain problems for malaria drugs in all regional states. There continue to be focal shortages and stockouts of ACTs (especially pediatric doses), parenteral artesunate, and chloroquine, expired drugs and near-expiring RDTs, weak inventory control tools, inadequate medication records, and poorly organized and inadequate storage facilities. Data from the most recent EUV exercise in January 2016 that assessed facilities in SNNPR, Benishangul- Gumuz, Amhara, Tigray, Harari and Somali Regions as well as Dire Dawa (n = 21) shows that 71% of the health facilities surveyed would be able to treat uncomplicated malaria (have at least 1 AL formulations) based on stock at facilities on the day of visit. In addition, 52% of the health facilities are able to treat *P.vivax* malaria patients with chloroquine in line with national malaria guidelines. However, 90% to 95% stockouts of pediatric formulations of artemether-lumefantrine; 48% stockouts of chloroquine; 59% stockouts of parenteral quinine; and 41% of facilities were stocked out of parenteral artesunate on the day of the visit to health facilities.

#### *Progress during the last 12-18 months*

PMI supported PFSA by embedding qualified personnel within their facilities, and providing resources for the development of standard operating procedures and forms for the quantification, requisition, drug exchange/transfer, and management of malaria commodities. In addition, PMI has improved malaria commodity management in 190 public health facilities (114 in Oromia and 76 in other regional states). These included health centers supported through training and supportive supervision. As per a request from ORHB, malaria drug management data is now reported to the ORHB bi-monthly for 52 facilities in Oromia, including data on availability and expiry of antimalarial drugs, staff availability and capacity, and accurate reporting of antimalarial drug consumption. The data allows for monitoring and tracking of PMI- and ORHB-supported distribution of malaria commodities to health facilities and re-distribution of over-stocked drugs to districts with pending stockouts or shortages. Currently the PMI program provides direct technical support to 180 health facilities, 10 regional health bureaus, and 32 zonal, and 140 district health departments.

In support of the FMHACA, PMI conducted a rapid assessment of six regional FMHACA laboratories to strengthen post-marketing drug quality monitoring. Currently all compendial tests are conducted at the central laboratory. PMI plans to decentralize the capacity to regional laboratories. In FY 2014, the fifth round of drug sampling and laboratory confirmatory testing was completed. The results indicated that of the total 285 antimalarial samples subjected to compendial testing, only one sample of chloroquine injection failed the assay test. In addition, post-market surveillance has revealed that registration status of available antimalarial drugs has improved slightly from 41% (of 254) in 2013 to 66.7% (of 285) in 2014.

In 2015, PMI continued supporting the post-market drug quality monitoring program to include four out of six regional FMHACA branch laboratories and further improved the regulatory capabilities of FMHACA. PMI also ensured that the activities are coordinated with other U.S. Government implementing partners and in-country stakeholders in a context of a changing Pharmaceutical Logistics Management Plan and the nascent establishment of the PFSA. Additionally, through support from PMI

and PEPFAR, the national reference laboratory under FMHACA achieved ISO-17025 accreditation, demonstrating a higher level of quality including employment of standard operating procedures and an overall laboratory quality system. ISO certification enables the laboratory to conduct various analytical pharmacopeial testing procedures for human drugs.

With FY 2016 funding, PMI will continue to support FMOH and all regional states in Ethiopia in the micro-planning process for malaria commodities. PMI will continue to support PFSA particularly as the transition of malaria commodities from RHBs are incorporated in the Integrated Pharmaceutical Logistics System, a system designed to ensure availability and minimize wastage of pharmaceuticals. PMI also supported the ORHB to develop legislation to establish a system for Transparent and Accountable Pharmaceutical Transactions and Services (APTS). APTS is a comprehensive intervention that introduced a transparent and accountable way of managing medicine transactions with the goal of achieving improved availability, reduced wastage/expiry, improved revenue and quality of pharmacy services including appropriate storage, stock recording, proper review of prescriptions, and appropriate dispensing of medicines including antimalarial drugs. As part of the implementation, APTS tools including financial vouchers, receipts and dispensing registers were developed, and ORHB received support to prepare a “Directive for the Redistribution of Excess and Near Expiry Antimalarial Drugs between Public Health Facilities” within the region. In addition, PMI supported the development a drug management handbook for HEWs in the local language, Afaan Oromo.

PMI supported strengthening drug quality and safety monitoring capacities at FMHACA via post-marketing surveillance activities, including use of Minilabs<sup>®</sup>. The Minilabs<sup>®</sup> are portable kits used to collect drug samples and provide preliminary field testing, through thin-layer chromatography, on the quality of sampled medicines throughout the public and private sector markets, customs check points, airports, and border ports of entry. Currently, there are seven sampling sites. Samples that fails preliminary screening are sent to Product Quality Assessment Directorate Laboratory for confirmatory compendia testing. If failures on a specific lot are confirmed, all product from that lot will be pulled and subsequent punitive and/or regulatory action should take place.

#### Plans and justification

The emerging capacities of PFSA and FMHACA provide an opportunity to assume more responsibility for the pharmacy supply chain and antimalarial drug quality monitoring in the future, respectively. Strengthening pharmaceutical and malaria commodity supply chains will be a long term PMI investment. The micro-planning will continue to be supported as it currently provides the most comprehensive data to inform procurement of ACTs, RDTs, and LLINs. Strengthening antimalarial drug supply management will also be needed throughout Ethiopia through a closer working relationship with PFSA. There will be an ongoing need to ensure quality of antimalarial drugs in Ethiopia to support quality malaria care and treatment in partnership with FMHACA.

#### Proposed activities with FY 2017 funding: (\$650,000)

- **Antimalarial drug management and strengthening PFSA capacity:** PMI will provide support to PFSA to coordinate and design the best approach to sustain and support full integration of malaria commodities into the Integrated Pharmaceutical Logistics System. In addition, PMI will support improving malaria commodities quantification, requisition, drug exchange/transfer, and expiry tracking/disposal. PFSA’s capacity will also be built to procure, prepare, and distribute quality reagents such as Giemsa solution for malaria diagnosis. PMI will continue to support antimalarial drug management through rational drug use, supporting the establishment of Drug

Therapeutic Committees, establishing Drug Information Centers and conducting EUV surveys. In addition, PMI plans to support APTS activities in Oromia Regional State. (\$400,000)

- **Strengthening drug quality monitoring:** PMI will continue to strengthen FMHACA’s drug quality assurance program by:
  - Supporting post-market drug quality monitoring in eight collection sites in all regional states.
  - Training FMHACA staff centrally and at the five regional laboratories on quality control testing of antimalarials.
  - Strengthening the GoE’s central and regional quality control laboratories through training, technical assistance, sample collection, supportive supervision, and supply of equipment and reagents to FMHACA laboratories.
  - Strengthening regional regulatory offices that are responsible for regulating the retail drug outlets such as pharmacies and drug stores.
  - Conducting public awareness on fraudulent antimalarials.
  - Improving data use and subsequent policy and regulatory measures. (\$250,000)
  
- **Micro-planning surveys for estimating annual requirements and for assisting with distribution of malaria commodities:** With FY 2017 funding, PMI will continue to support FMOH through micro-planning meetings with participants from all malaria-affected *woredas* and zones in Ethiopia to determine the requirements of ACT treatments, RDTs, and LLINs at the district level. PMI-supported micro-plan activities will be increasingly integrated with and harmonized with PFSA and FMOH’s *woreda*-based planning activities in the future. (*see SM&E section*)

#### 4. Health system strengthening and capacity building

PMI supports a broad array of health system strengthening activities which cut across intervention areas, such as training of health workers, supply chain management and health information systems strengthening, drug quality monitoring, and NCMP capacity building (see Table 11 below).

##### NMCP/PMI objectives

The FMOH’s NMSP (2014-2014) envisions a strengthened health system including adequate number of well qualified and committed health workers to support malaria control efforts nationwide. It also recognizes insufficient technical support and capacity building as well as shortages of human resources and turnover of experienced staff as major weaknesses in the health system of Ethiopia. The HEP has over 38,000 trained HEWs based at health posts, and these are assisted by many thousands of local volunteers within the HDA that together address many of the malaria health needs of their rural communities; the HDA workers typically focus on SBCC activities.

Ethiopia faces many challenges related to human resources for health service delivery, including the shortage of skilled health workers and high turnover of health professionals especially in remote and inaccessible health facilities where malaria is prevalent. Despite PMI and other donors’ support, the NMCP has limited capacity in human resources and has not been able to effectively coordinate with PMI implementing partners and other partners in their many malaria-related activities. The high turnover rate of FMOH staff and limited human resources capacities of RHBs, districts, and health facilities

including health posts are commonly mentioned as challenges. In addition, FMOH/NMCP, EPHI, and ORHB identified coordination of implementing partners as a major challenge.

PMI buys into a USAID-funded program to support the efforts of the Ethiopian government in improving and retaining a skilled health workforce for service delivery of key health services including malaria. This program involves both pre- and in-service trainings and has four key result areas:

- Improve Human Resource for Health management
- Increase availability of midwives, anesthetists, HEWs, and other essential health workers
- Increase quality of health worker training
- Program learning and research

The FMOH has documented a shortage of malariologists and epidemiologists experienced in managing community-wide and very large-scale malaria epidemics and complex health emergencies. Ethiopia began its own FELTP, known locally as the EFETP, in October 2008 with technical assistance from CDC as a two-year, full-time, postgraduate competency-based training program consisting of about 25% class work and 75% field residency. The EFETP training is an in-service training program for PHEM health workers, who typically are already working (and continue to work) at zonal or regional health bureau offices. Trainees are closely supervised and provide epidemiologic service to the FMOH. Graduates of EFETP will receive a Master's Degree in Public Health and Field Epidemiology over a two-year training period. The program will join the African Field Epidemiology Network and work through the Ethiopian Public Health Association and EPHI. PMI has provided support to two EFETP residents annually since 2011 to enhance their training and expertise in malaria and related outbreaks of acute febrile illness that can be confused with malaria. The current PHEM surveillance system manager at the Amhara Regional Health Bureau is a recent EFETP program graduate, as was the incident manager for the recent Ebola preparedness activities in Ethiopia in 2014-2015.

### **Peace Corps Ethiopia**

The U.S. Peace Corps has been active in Ethiopia for over fifty years with a few interruptions. The Peace Corps has provided many malaria-relevant activities and services over the years, including some educational programs for school-aged children and health promotion projects at the community level. Recently, PMI and Peace Corps developed a cooperative program entitled "Stomp out Malaria," originally piloted by Peace Corps in Senegal. The Peace Corps volunteers work in the areas of health, education, and environment which all contribute to malaria prevention efforts. There are now over 250 Peace Corps volunteers in Ethiopia who have sufficient knowledge of malaria and of PMI's programs to help provide PMI-developed resources to HEWs and other district-level officials. They have also participated in World Malaria Day activities in Ethiopia. Peace Corps volunteers have helped with LLIN distributions in some communities, and have helped to promote LLIN use through programs aimed at school-aged children.

**Table 11: Health systems strengthening (HSS) activities**

<b>HSS Building Block</b>	<b>Technical Area</b>	<b>Description of Activity</b>
<b>Health Services</b>	Case Management	PMI supports a QA system for malaria laboratory diagnosis and provides ongoing supervision, training, and monitoring of malaria case management at health facility level. PMI provides health centers, national and regional labs with microscopes, and supplies for malaria diagnosis and training purposes.
<b>Health Workforce</b>	Health Systems Strengthening	PMI supports pre-service training of HEWs and midwives to strengthen malaria case management at PHCU level.
<b>Health Information</b>	Monitoring and Evaluation	PMI provides support for malaria surveillance, monitoring and evaluation, training and mentoring of EFETP residents.
	Operational Research	PMI provides training and TA support for in-country malaria operational research.
<b>Essential Medical Products, Vaccines, and Technologies</b>	Case Management	PMI supports improved forecasting and distribution of malaria commodities such as LLINs, ACTs and RDTs through microplanning. In addition PMI strengthens drug quality monitoring and supports regulatory actions. PMI also supports pharmaceutical supply chain management strengthening activities for storage and rational use of antimalarial drugs.
<b>Health Finance</b>	Health Systems Strengthening	PMI provides technical assistance to support private health facilities to improve malaria case management through linkages with public sector and leveraging commodities for malaria prevention and control.
<b>Leadership and Governance</b>	Health Systems Strengthening	PMI supports coordination of PMI implementing partners, joint supervision with the regional health bureaus and NCMP, and coordination and dissemination of malaria research activities.

*Progress since PMI was launched*

Over the past eight years, PMI has helped train thousands of Ethiopians. In FY 2015, PMI supported training for 2,845 IRS spray personnel and 789 and 3,179 health workers in malaria diagnosis and treatment, respectively. As these trainings are part of a broader set of HSS activities, deliverables specific to malaria outcomes are not necessarily direct. Although this is a challenge, training inputs are primarily around strengthening various aspects of the health system. Ultimately, this will contribute to the development of a more competent and qualified workforce. The FMOH Human Resource for Health strategy was released in June 2010. PMI has contributed through supporting pre- and in-service training for HEWs, midwives, and other healthcare workers, to include best practices in malaria diagnosis and treatment and prevention of malaria among pregnant mothers and newborns.

In 2011, three Ethiopian FETP residents supported a comprehensive evaluation of PMI's ten epidemic detection sites. In late 2012, three FETP residents (along with a CDC Epidemic Intelligence Service

Officer) participated in a *P. vivax* therapeutic efficacy trial with chloroquine versus AL with or without primaquine. Another FETP resident has completed a project that investigates the feasibility of using dried tube specimens of standard concentrations of previously laboratory-cultured *P. falciparum* as a reagent to assess the quality of malaria RDTs and the performance of health care workers in performing RDTs in field conditions (oral presentation at ASTMH 2013). Another resident presented data at the Atlanta CDC Epidemic Intelligence Service conference in 2014 concerning a cluster of 10,000 acute febrile illnesses in an Ethiopia city that all tested negative by malaria laboratory tests, but was determined to be the first documented dengue fever outbreak in Ethiopia.

### Progress during the last 12-18 months

During 2015, PMI supported training of 2,860 midwives, 2,033 HEW level IV, 2,659 HEW level III, and 298 other essential health workers (emergency medical technicians and bio-medical technicians). Moreover, FMOH has been supported to develop the Human Resource for Health strategic plan and draft policy and to train 754 managers at RHBs. Malaria case management training was provided for 25 instructors at Harar Regional Health Science College and malaria diagnosis and treatment curricula for 16 health education institutions was developed and distributed. Again, during this period refresher trainings have been provided to 50 HEW instructors. Similarly, the iCCM training module was developed for HEWs Level III. In addition PMI provided technical assistance and taught at FMOH's malariology training for 150 district level malaria officers.

In the past nine months the Ethiopian FETP has expanded to include 8 universities and over 180 residents. PMI is committed to continuing to provide training for the FETP program, and five EFETP residents have been selected to focus on malaria activities and to receive additional mentorship and training opportunities. In 2016, a workshop was conducted to bring those five EFETP together for specialized training and discussion. Several residents are finalizing protocols to investigate the epidemiology of malaria in various parts of Ethiopia or to evaluate malaria intervention coverage. A network connecting former EFETP graduates with interest in malaria was also created to encourage communication and engagement from EFETP currently assigned within the MOH throughout the country.

The U.S. Peace Corps has been involved in a wide range of SBCC activities, including participation at World Malaria Day meetings. PMI provided 1,000 LLINs directly to Peace Corps for outreach activities in 2015, designed for static displays at youth camps to demonstrate proper use of LLINs at the household level within communities at malaria risk. PMI assisted with malaria trainings of Peace Corps volunteers at various locations throughout Ethiopia and are coordinating with Peace Corps to expand their malaria related activities. PMI is currently working with Peace Corps to establish a third year program where Peace Corps volunteers with interest and experience in malaria can work with malaria organizations. Both the Peace Corps volunteers and EFETP residents provide valuable opportunities to identify and evaluate malaria prevention challenges on the community level and for capacity building of malaria specific skills and knowledge.

### Plans and justification

While it is beyond the ability of PMI to address the system-wide capacity issues, there are several areas within the NMCP and RHBs where capacity can be strengthened with PMI assistance, including through pre- and in-service refresher trainings. The health systems strengthening and capacity building activities supported by PMI are in line with the FMOH's strategies, and support remaining gaps in training and human resources. PMI will continue supporting the coordination of malaria activities through seconding

dedicated staff to ORHB. Gaps in coordination of insecticide resistance and entomological surveillance activities at the national level was identified as a key bottleneck and PMI plans to second staff at FMOH or EPHI to fill this gap. PMI will continue supporting third year Peace Corps volunteers to enhance malaria SBCC in remote rural communities. PMI will continue to support EFETP which continues to build epidemiological capacity and strengthens the quality and use of PHEM data.

Proposed activities with FY 2017 funding: (\$730,000)

- **Coordination support for ORHB and NMCP:** Support joint planning, coordination, supportive supervision, and review activities with all malaria stakeholders in ORHB and at national level. (\$250,000)
- **Pre-service training of HEWs:** As a major nationwide health program, HEP requires substantial investment in human resources, health infrastructure, and provision of equipment, supplies and commodities, as well as other operating costs. The pre-service training of HEWs is a one-year training which includes coursework as well as field work to gain practical experience. HEWs carry out and promote 16 preventive health actions in which malaria prevention and control is included. (\$200,000)
- **Field Epidemiology and Laboratory Training Program:** PMI will continue to support three to five EFETP residents to support human resources for health development among epidemiologists and to strengthen the PHEM epidemic detection system and malaria surveillance including development of weekly bulletins. (\$250,000)
- **Malaria prevention activities by Peace Corps:** PMI will support three third year Peace Corps volunteers and provide small grants for malaria projects to strengthen the community level malaria prevention activities working with HEWs in hard-to-reach areas such as Gambella and Benishangul-Gumuz. Malaria-focused volunteer field activities in remote settings include: training teachers, school children, and community mobilizers and conducting community-based SBCC activities in collaboration with HEWs on LLIN use, improving early treatment-seeking and treatment compliance. (\$30,000)

## 5. Social and behavior change communication

NMCP/PMI objectives

The importance of prevention, health promotion, and SBCC were highlighted in the Ethiopian HSTP 2016-2020. Social behavior change communication is designated under the strategic theme “*Excellence in health service delivery*” of the HSTP, which refers to the promotion of good health practices at individual, family, and community levels.

Social and behavior change communication’s role in achieving NMCP objectives in malaria control across interventions is clearly stated in the NMSP 2014–2020. The SBCC objective in the NMSP states: “By 2020, all households living in malaria endemic areas will have the knowledge, attitudes and practices towards malaria prevention and control.” In achieving this objective, the NMSP focused on utilization of HEWs, with the support of HDAs and model family households. Despite the absence of a malaria-specific communication strategy, the recent national health promotion and communication strategy 2016-2020, which will be endorsed by the Ministry soon, is expected to provide a guide for all

areas of health including malaria prevention and control. This strategy document will give details of malaria communication approaches and implementation at various levels.

According to the NMSP, the strategies for community empowerment and mobilization include:

- conducting integrated refresher training on malaria SBCC for HEWs
- developing and integrating the malaria communication strategy into the national health promotion and communication strategy
- increasing the use of supportive mass media
- integrating malaria prevention and control into school programs
- conducting advocacy to gain strong commitment of the local leaders in malaria elimination districts
- producing and distributing information, education, communication SBCC materials
- conducting orientation workshops for HDAs on community mobilization including iCCM services and its importance
- conducting formative research on knowledge, attitudes, and practices of malaria prevention and control

Social behavior change communication activities through mass media and rural communications campaigns and supporting community-level change agents like HDAs, religious leaders, and school children can be applied in an integrated fashion for malaria interventions (e.g., LLINs, IRS, early diagnosis and treatment compliance). For communications activities related to RDTs and ACTs in particular, PMI will work with health providers at different levels of the health system to strengthen their interpersonal communication skills.

#### *Progress since PMI was launched*

Since 2009, PMI has provided assistance to the FMOH to carry out malaria-related SBCC activities. Working with the regional, zonal, and district offices as well as the HEP, including HDAs, PMI has delivered critical SBCC activities.

Through PMI's earlier support to SBCC, net utilization among pregnant women increased from 21% at baseline to 54% at end line and use by children under five years of age increased from 26% to 54% according to the project endline report. The number of households accepting IRS increased from 39% in 2009 to 58% in 2012. In Oromia, caregivers who sought treatment for their children under five years of age rose from 54% to 57%. Eighty percent of respondents reported that malaria is a preventable disease, 74% knew LLINs provided protection against malaria infection, 63% were aware that malaria is transmitted through a mosquito bite, and 87% acknowledged the importance of children under five years of age seeking prompt treatment. Generally, there were significant improvements in malaria prevention and control knowledge in the communities PMI was targeting. This effort in SBCC was complemented by hang-up campaigns in collaboration with the U.S. military that targeted the most vulnerable groups, i.e., pregnant women and children under five years of age.

Since 2014, PMI initiated and supported two local organizations' community-based malaria SBCC activities, as part of the USAID/Ethiopia Local Capacity Development program. These community-based malaria SBCC activities have been implemented in selected zones of Oromia and Amhara Regions. PMI's support to these activities is intended to complement and support national malaria SBCC activities through capacity building of selected schools and faith-based organizations in high malaria transmission areas. Harmonized malaria messages (eight essential malaria actions and four do-

able actions) developed by PMI are utilized and SBCC-related activities are conducted in coordination with HEWs.

### Progress during the last 12-18 months

In 2015-2016, PMI implemented malaria SBCC activities in 125 primary schools in 5 districts in Amhara Region. These activities involved school-based peer education sessions, which reached 36,191 students. These students then reach out to their families and neighborhood to educate them about malaria prevention and control interventions. In addition, 343 school-based literature competitions on malaria were organized, which reached 42,390 school communities. In collaboration with Amhara RHB, 25,000 malaria information booklets, 18,000 malaria stickers, and 4,000 posters were distributed to the target communities. Through mass mobilization events during “Malaria Week” students were able to mobilize close to 150,000 individuals, educating them on different malaria prevention and control activities they should be undertaking in their communities.

In PMI-supported districts in Amhara, many community members migrate seasonally to other areas during the harvest period, which usually coincides with the malaria transmission season. Upon returning home, these seasonal workers become sources of imported cases, contributing (in some cases significantly) to the existing malaria burden. According to information from Amhara RHB, approximately 33% of total malaria cases in nine districts are imported cases from other development areas. Cognizant of this problem, students are informed to report to their teachers about migrant workers in their neighbourhood upon their return. Then teachers will report to HEWs for appropriate diagnosis and treatment to be provided through home visits. Accordingly, 188 migrant workers were identified by students and linked to health post services for malaria testing and treatment. Results have shown that 78 (41%) were positive for malaria, with 56 (72%) due to *P. falciparum*, 20 (26%) due to *P. vivax*, and two mixed cases.

PMI also supported SBCC activities in Oromia Region, which focused on building the capacity of local schools and religious institutions to conduct SBCC activities targeting malaria prevention and control interventions. During the past 12 months, 116 schools and 84 religious institutions have been involved in the malaria SBCC program; 556 lead facilitators were trained from schools and religious leaders; and 60,711 students were reached through peer education sessions, which enabled them to reach an additional 38,473 households in the target area. In addition, 39,000 SBCC resources were distributed; 72 schools and 21 faith-based organizations received various support; 46 meetings and reviews sessions were held at different levels; and 101 supportive supervision sessions were undertaken.

A mid-line rapid assessment was undertaken using lot quality assurance survey methodology and results indicated that the SBCC interventions resulted in significant improvements. From baseline (January 2014) to mid-line (June 2015), LLIN use increased for all household members from 38% to 62%, LLIN use among children less than five years of age improved from 66% to 74%; care-seeking within 24 hours from 20% to 35%; and IRS acceptance from 74% to 100%. Appropriate use of antimalarials decreased from 91% to 86%. The reasons for this decline will be explored by investigating behavioral factors.

Since July 2015, PMI has conducted an SBCC rapid assessment, which identified 17 organizations working on malaria SBCC; designed an Integrated Communication Platform for integrated communications campaigns; conducted an SBCC material mapping exercise which identified 21 malaria-related materials in need of harmonization; supported capacity strengthening of 247 key

individuals from 63 organizations on SBCC; designed a social mobilization strategy to enhance the work being done through the HEP; and distributed 43,000 Malaria Day posters.

In February 2016, the FMOH, through a joint consultative process, developed a National Advocacy, Communication and Social Mobilization guide for Malaria Elimination (2016-2030). This guide utilizes a conceptual framework to understand the dynamics of factors underpinning the spread of malaria and identifies key domains of influence at the individual, household, community, organization, and general socio-economic levels. Rigorous analysis of each of the malaria elimination phases (Optimization, Pre-elimination, Elimination and Prevention of reintroduction) was done to determine the most relevant advocacy, communication, and social mobilization needs for each domain of influence.

### Plans and justification

PMI will continue to support SBCC activities focusing on affected communities in high malaria transmission districts (157 districts) to complement and support national malaria SBCC strategies. In addition, very specific and targeted SBCC activities in low transmission areas will be carried out to encourage early diagnosis and prompt treatment as well as sustaining LLIN utilization.

### Proposed activities with FY 2017 funding: (\$1,250,000)

- **Coordination, capacity building, and mass media for SBCC:** PMI will build capacity within national and regional health bureaus, *woredas*, and PHCUs as well as local institutions, including NGOs, community-based organizations, and faith-based organizations to coordinate, plan, manage, implement, and evaluate health SBCC programs and interventions. In addition, technical assistance will be provided to review/update SBCC messages, tools, and identify effective channels of communication for different epidemiological settings and target groups. PMI will also support mass media activities at the national and regional levels utilizing TV, radio, and print media. Furthermore, a national health education and resource center will be supported, which includes a malaria hotline and other mass media resources. (\$225,000)
- **Community-based SBCC for LLINs, IRS, and case management, including MIP:** PMI will continue to support the implementation of evidence-based and coordinated SBCC activities at the community level in malarious areas to increase the knowledge, attitudes, and practices towards malaria prevention and control. Specific community level approaches include social mobilization using social events, entertainment education and social and religious gatherings, mobilizing school communities as change agents and other social networks. This includes community radio, community conversation, live drama, music, traditional dances and holidays, as well as LLIN demonstrations in social gatherings and at local markets. These mass mobilization activities will complement the support to HEWs focused on a house to house IPC approaches with training and providing tools to mobilize the community. As part of community mobilization, HDAs are required to identify pregnant women in their neighborhood and conduct regular pregnant mothers' conferences to raise awareness about safe pregnancy and delivery. PMI will utilize this platform by supporting HEWs with MIP communication tools and materials (e.g. flip charts, posters and bill boards) on use of LLINs and seeking early diagnosis and treatment of malaria. For low transmission areas specific SBCC activities will include: messaging to ensure high level of awareness for early diagnosis and prompt treatment as well as sustaining LLINs utilization. In addition, Health Extension Workers will carry out social mobilization activities with HDAs for mobilize communities to become actively involved in identification of migrant workers and

patients with malaria sign and symptoms and facilitating testing through HDA/HEW channels. (\$525,000)

- **Community-based SBCC in Oromia Region:** PMI will continue to support a local university to carry out community-based SBCC activities in five *woredas* of Oromia Region. PMI will continue to target communities through schools and local media. This will help to reinforce and complement the HDAs community-based interpersonal behavioral change interventions. (\$200,000)
- **Community-based SBCC in Amhara Region:** PMI will continue to support a local organization to carry out community-based SBCC activities in five *woredas* of Amhara Region. PMI will continue to target communities through schools and local media. This will help to reinforce and complement the HDAs community-based interpersonal behavioral change interventions. PMI will also continue to support communities for identification of migrant workers in order to link them with HEWs for malaria test and treat services. (\$300,000)

## 6. Surveillance, monitoring, and evaluation

### NMCP/PMI objectives

The FMOH's NMSP (2014-2020) highlights the need for ongoing M&E and emphasizes the constant need for detection and response to focal and widespread malaria epidemics. The NMSP describes the M&E framework and its four key areas: 1) monitoring the operational aspects of the program and measuring impact, outcome, or process indicators to ensure that the activities are yielding desired results and moving the program towards achieving its operational targets and objectives; 2) monitoring changes in epidemiological indicators resulting from the activities implemented; 3) appropriately interpreting results and informing revisions in policies or strategies, when needed, to help ensure progress; and 4) documentation of progress towards malaria elimination. In addition to the malaria morbidity and mortality impact indicators, they have added elimination specific indicators to monitor the proportion of previously malarious *kebeles* reporting no malaria cases for 24 months and number of *woredas* with zero locally transmitted cases of malaria.

In 2009, the PHEM surveillance system was developed to cover the entire country, encompassing reporting from health posts, health centers, and hospitals. The PHEM aims to be a weekly multi-disease reporting system that collects a range of malaria indicators, mostly related to outpatient malaria morbidity. As of May 2016, the PHEM surveillance reporting includes 91.5% of districts throughout Ethiopia (EPHI weekly epidemiological bulletin) by aiming to provide weekly reports from all health facilities, including health posts, through district health offices. EPHI is currently publishing weekly epidemiological data using PHEM reports (<http://www.eph.gov.et/images/pictures/Weekly-Epidemiological-Bulletin-2016-22.pdf>). The PHEM depends on accurate and timely information reported from HEWs and health facilities, therefore building capacity at the health post and center levels is essential. Malaria cases are reported by two age groups (less than and more than five years of age) including clinical malaria (outpatient and inpatient), and confirmed malaria by species. Assuming that improved IRS coverage and LLIN use will continue to reduce malaria transmission, the focus of malaria control and elimination will increasingly turn towards enhancing surveillance with the aim of halting ongoing transmission, investigating all cases, and preventing re-introduction of transmission in previously malaria-free areas.

Ethiopia currently has a paper-based data collection system, which is used at the health facility level, containing data that have not yet been optimally analyzed or used for decision-making and resource allocation at the local and regional levels. Consequently, Ethiopia's FMOH is in the process of revising the HMIS, while making some reporting electronic. This revised HMIS, which includes a total of 106 indicators and is primarily supported via funds from PEPFAR and the Global Alliance for Vaccines and Immunization, aims to provide one standardized set of health indicators nationally. HMIS reports quarterly from health centers and hospitals at the district level. Data reporting from health facilities have issues in completeness, quality, and timeliness. HMIS reports are usually not published for one or two years after they are collected. There are only two malaria-specific indicators in the HMIS:

- Malaria cases reported per 1,000 population, disaggregated into clinical and confirmed cases, with the latter further disaggregated by species, i.e., *P. falciparum*/other, among:
  - children under five years of age,
  - people at least five years of age
- Malaria case fatality rate among:
  - children under five years of age [inpatients]
  - people at least 5 years of age [inpatients]

Malaria epidemics in Ethiopia have been documented since the 1930s. A catastrophic malaria epidemic in 1958 was responsible for an estimated 3 million clinical cases of malaria and 150,000 malaria deaths. Since 1958, major epidemic years have occurred approximately every five to eight years (Tulu, A. N. "Malaria", In: Kloos, H. and Zein, A. Z., *The Ecology of Health and Disease in Ethiopia*, 1993, West View Press Boulder, San Francisco, Oxford, pp. 341-352). Current methods for epidemic detection in Ethiopia rely on passive case detection of clinically diagnosed cases at health posts and health centers. In this system, the median weekly clinically diagnosed malaria cases over the previous five years are charted. Thresholds are set by either the third quartile (second highest number from the five previous years' data for that week) or double the previous year's number of cases in that week. If the number of cases in a given week exceeds the set threshold, the health worker is to report a potential epidemic. A rapid assessment team is then dispatched to confirm that an epidemic exists or is threatening, establish the cause and scale of the epidemic, and identify local capacity to respond. The national malaria guidelines (third edition, January 2012) recommend presumptive mass fever treatment with ACTs for fever cases if the test positivity rate is  $\geq 50\%$ . A stock of 15-20% of ACTs is to be held at the regional level for epidemic response. If there is potential for continued transmission, IRS will be implemented. For this reason, all districts with a potential for epidemics are advised to reserve a stock of insecticide for epidemic response and spraying operations would begin following either a three- or six-day training period for local spray operators.

### *Progress since PMI was launched*

Since the 2008 launch of PMI in Ethiopia, it has provided substantial support for SM&E strengthening activities including support for large household surveys (e.g., the MIS 2007, MIS 2011, MIS 2015), data analysis, and strengthening routine surveillance systems.

PMI supports the PHEM system. This support has been targeted to enhance reporting from rural health posts where half of all malaria morbidity is detected and treated, and to enable reporting of indicators on a weekly basis. In the past, PMI had supported the collection of comprehensive, timely malaria

surveillance data in ten sentinel sites. This support included data analysis, training, and supervisory support.

PHEM and HMIS report to different directorates within FMOH, have separate staffing and reporting structures, and serve different functions. There are no plans to integrate them at this time. Reporting completeness has rapidly improved for both PHEM and HMIS. PHEM reporting completeness is now around 91.5% as of May 2016, and HMIS completeness was 85-95% in 2014/15.

Besides the PHEM and HMIS, malaria micro-planning is a third source of data that collects information from all malarious districts nationwide, aggregated from both health centers and health posts. For the last three years (2013-2015), reporting completeness was at 99%, representing the most comprehensive morbidity data available to supplement the PHEM and HMIS routine surveillance systems; however, it only occurs once a year. Of note, microplanning reporting is at such a high rate relative to PHEM data because PMI historically has not had access to the PHEM although recently, that is starting to change. Unfortunately, HMIS data is not considered accurate at this time. Although there are currently three separate sources of reported malaria cases and deaths, the systems have differing attributes and coverage (Table 12). With improving coverage of PHEM and HMIS systems, the differences in the annual reported number of malaria cases are decreasing between the three sources.

Data from microplanning activities is used for quantification and forecasting antimalarial commodity needs, which is based on health facility level morbidity data for each district in malarious areas. These data are different from the data collected by the EUV surveys. EUV data are collected at one point in time and in only a fraction of health facilities. The primary objective of EUV activities is to inform the PMI commodities team on general ACT and RDT availability at a regional level, on a real-time basis. This helps avoid immediate stockouts, as it enables the PMI headquarters commodity team to mobilize both emergency commodity funds (i.e., for the procurement of needed commodities) and/or access to PMI's ACT buffer stock. A secondary objective of the EUV is to inform the relevant GoE stakeholders such as PFSA, about gross or systemic issues along the supply chain continuum, contributing to the technical support already provided by PMI's implementing supply chain partners. Therefore, there is both an immediate use of the data and a longer-term, health-system strengthening purpose.

**Table 12: Malaria surveillance system attributes, public sector, Ethiopia**

Surveillance System	Reporting Frequency	Facilities Reporting	Publications	Comment
Health Management Information System (HMIS)	Quarterly	Hospitals, Health Centers	Annual (Health and Health-Related Indicators)	Most complete for inpatient malaria reporting and inpatient deaths; some stratification of data by gender and for children
Integrated Disease Surveillance System (IDSR)	Monthly	Hospitals, Health Centers	Annual (Health and Health Related Indicators, until 2009)	IDSR malaria data have not been reported since 2009; folded into PHEM
Public Health Emergency Management (PHEM) System	Weekly	Hospitals, Health Centers, and Health Posts	Annual (Annual Review Meeting Report, and World Malaria Report)	Timely, complete, designed for outbreak detection; began in 2009 building upon former IDSR system; PHEM is the primary data source for Annual Review Meeting and the WHO World Malaria Reports, and Global Fund 2014 NFM application
Micro-plan	Annual	Hospitals, Health Centers, Health Posts	Not for public distribution but used for programming	Began national collection in 2010; Includes number of persons tested and suspected malaria (clinical plus tested malaria), includes commodities data, most complete available reporting as of 2013, not stratified by age or gender; data are reported and analyzed by district while accounting for health facilities in the district

Guidelines for malaria epidemic prevention and control were updated in 2012 with support of PMI and are available on the FMOH’s website. These guidelines detail the human vulnerability factors, including population movement, as well as meteorological factors, such as rainfall, temperature, and humidity, that affect the occurrence of epidemics. The guidelines include setting detection thresholds at the health post level and strategies for mapping malaria micro-foci or micro-clusters.

*Progress during the last 12-18 months*

PMI has been coordinating surveillance strengthening efforts through the existing PHEM system. Over the past year rapid reporting systems to strengthen PHEM reporting of malaria cases from the health post to the health centers have been rolled out in 10 districts in Oromia with plans to scale-up to 30 additional districts. PMI’s experience with implementing rapid reporting to enable epidemic detection in Oromia and the lessons learned was recently published in a peer-reviewed journal (Yukich *et. al.*, 2014).

With malaria elimination targets set for 209 districts by 2020, PMI has been providing technical assistance with drafting the elimination strategy, plans, and district selection process including refining

the criteria and contributing data from the micro-plan. PMI and the FMOH co-sponsored a pre-elimination conference in May 2015 to share malaria activities and tactics that are relevant to pre-elimination both from Ethiopia and from several other countries including Sri Lanka, Senegal, and Zambia. In-depth discussions with local and international experts from WHO Global Malaria Program, Malaria Control and Evaluation Partnership in Africa, and Global Fund addressed many technical and operational aspects of implementing malaria elimination (e.g., human resource and capacity, surveillance systems, M&E plan, and case management and vector control needs). PMI is working with the NMCP to develop an elimination district planning tool to help the NMCP identify gaps in order to achieve optimization of malaria intervention activities in the selected malaria elimination districts.

A MIS survey was conducted in Ethiopia in late 2015 with PMI financial and technical support. The MIS data has been collected, compiled, and analyzed with support from PMI. The results highlighted in Table 2 (pg 20) show sustained LLIN ownership, although still below set targets and continued low prevalence of malaria.

**Table 13: Surveillance, monitoring, and evaluation data sources**

Data Source	Survey Activities	Year								
		2010	2011	2012	2013	2014	2015	2016	2017	2018
National-level Household surveys	Demographic Health Survey*		X				X			
	Malaria Indicator Survey (MIS)		X				X			
	EPI survey*			X						
Health Facility and Other Surveys	School-based malaria survey		X	X	X					
	Health facility survey*		X							
	SPA survey*					X				
	EUV survey					X	X	X	X	
Malaria Surveillance and Routine System Support	Support to malaria surveillance system	X	X	X	X	X	X	X	X	X
	Support to Micro-plan	X	X	X	X	X	X	X	X	X
	Support to HMIS*									
Therapeutic Efficacy monitoring	In vivo efficacy testing			X				X		X
Entomology	Entomological surveillance and resistance monitoring	X	X	X	X	X	X	X	X	X
	LLIN durability monitoring						X	X	X	
Other malaria-related evaluations	Serology/G6PD surveys					X	X <sup>+</sup>			
Other Data Sources	Malaria Impact Evaluation					X	X			

\* Not PMI-funded;

**Table 14: Routine surveillance indicators**

Indicators	Value	Comments
<b>1. Total number of reported malaria cases</b> (Data source: PHEM)	2,174,707	PHEM data for July 2014 to June 2015, i.e. Ethiopian FY (FMOH's 2015 HSDP IV annual review meeting report)
<b>Total diagnostically confirmed cases</b>	1,867,059	
<b>Total clinical/presumed/unconfirmed cases</b>	307,648	
<i>If available, report separately for outpatients and inpatients</i>		
Outpatient number of reported malaria cases	NR	Disaggregated report is not available
Diagnostically confirmed	NR	
Clinical/presumed/unconfirmed	NR	
Inpatient number of reported malaria cases	NR	
Diagnostically confirmed	NR	
Clinical/presumed/unconfirmed	NR	
<b>2. Total number of reported malaria deaths</b> (Data source: PHEM)	662	
Diagnostically confirmed	NR	Disaggregated report is not available
Clinical/presumed/unconfirmed	NR	
<b>3. Malaria test positivity rate – outpatients</b> (Data source: Microplan data 2014)	31.4%	Microplan data for 2015 are not yet available
Numerator: Number of outpatient confirmed malaria cases	3,259,119	
Denominator: Number of outpatients receiving a diagnostic test for malaria (RDT or microscopy)	10,365,782	
<b>4. Completeness of monthly health facility reporting</b> (Data source: PHEM)	91.5%	<a href="http://www.ephi.gov.et/images/pictures/Weekly-Epidemiological-Bulletin-2016-22.pdf">http://www.ephi.gov.et/images/pictures/Weekly-Epidemiological-Bulletin-2016-22.pdf</a>
Numerator: Number of monthly reports received from health facilities	NR	
Denominator: Number of health facility reports expected (i.e., number of facilities expected to report multiplied by the number of months considered)	NR	

NR: not reported

### Plans and justification

PMI will continue to strengthen PHEM reporting of malaria cases from the health post to the health centers in selected districts with plans to scale-up to 30 districts. PMI will continue to work with HEWs, HEW supervisors, and health workers to collect timely, quality surveillance data in selected districts to improve routine malaria surveillance systems and timely detection of epidemics and response. Quality assurance of data collection and capacity building of the HEWs will be facilitated by HEW supervisors who will receive HEW supervisor training to conduct integrated supervisions and regular field visits in 300 districts in 8 regional states. PMI's support and engagement with the EFETP program has also provided additional opportunities to strengthen the PHEM system.

PMI will continue supporting the national malaria commodities micro-planning exercise which gives a nearly complete picture of the national malaria burden and commodities needs. The micro-planning exercise has helped PMI, Global Fund, and the FMOH to quantify the country's total commodity needs (all antimalarials, RDTs, and LLINs) at the district level, and to plan commodity procurement and distribution. This is the only data source that provides over 97% completeness of data on commodity availability and need at the national level. It also provides comprehensive malaria morbidity data which can be triangulated to the HMIS and PHEM annual data.

With malaria elimination goals, PMI will continue to provide technical assistance and support to the FMOH in augmenting their SM&E systems to meet the specific programmatic needs to monitor elimination efforts. Building on the elimination conference in May 2015, PMI will continue to engage with the FMOH as they design a strategic approach and outline the specific activities that will be pursued in the elimination districts. PMI will continue to work closely with the FMOH to ensure that new elimination specific activities that will be undertaken with Global Fund support (e.g., the roll out of single dose primaquine and reactive case detection activities) are adequately evaluated as to inform future strategies for Ethiopia and other countries pursuing elimination (see operational research section).

PMI will continue to support periodic household surveys to monitor national progress on malaria intervention coverage.

### Proposed activities with FY 2017 funding: (\$976,000)

- **Strengthening PHEM system and epidemic detection and response:** Strengthening the PHEM system and improving reporting of malaria cases from the health post to the health centers in selected districts in Oromia. PMI will support the FMOH, RHBs, and malaria pre-elimination districts to address data management capacity gaps to capture all malaria cases reported, compile them, analyze and prepare reports and use that information for programmatic purposes at regional, zonal, district, and facility levels. Currently PMI is collaborating with EPHI to design a training and supportive supervision program that will be rolled out to the districts and health facilities to capacitate surveillance officers to effectively collect, organize, analyze, and use malaria data for decision making at all levels. This also includes reporting of outbreaks and epidemics if they occur in those facilities and districts. (\$800,000)
- **National malaria commodities micro-plan:** PMI will continue to support annual assessments of malaria commodity gaps and malaria morbidity from all malaria endemic districts (note: this activity is separate from the EUV). (\$166,000)

- **SM&E technical assistance:** One TDY to provide technical assistance for SM&E activities including pre-elimination planning. (\$10,000)

## 7. Operational research

### NMCP/PMI objectives

The FMOH's NMSP (2014-2020) envisions the need for operational research studies to guide program decisions. Some of the priority areas for OR include studies to detect insecticide and antimalarial drug resistance, and to improve the effectiveness of antimalarial interventions, while anticipating program needs related to pre-elimination activities. Priority areas for PMI Ethiopia OR are informed by the PMI strategy and the PMI OR priorities. NMCP research priorities come from National Malaria Strategic Plans. PMI has also sponsored various conferences involving universities and EPHI, the lead agency for medical research within FMOH, and partners to learn about ongoing research and to harmonize PMI Ethiopia's OR priorities with FMOH research goals. PMI, in conjunction with the FMOH, also supported a conference in May 2015 bringing together the FMOH, donors, WHO, NGOs, and other stakeholders to discuss plans to discuss the selection of target elimination districts and the specific steps needed to achieve the goal of eliminating malaria from the selected low transmission districts by 2020. As Ethiopia embarks on implementing new elimination-specific strategies and policies (e.g., rolling out single dose primaquine for falciparum malaria, radical cure of vivax, and reactive case detection activities), there is an opportunity to rigorously evaluate these various interventions.

### Progress since PMI was launched

Results from a completed OR study that assessed seroprevalence in schools showed a wider prevalence range than microscopy for both *P. falciparum* (0-50% vs 0-12.7%) and *P. vivax* (0-53.7% and 0-4.5%), respectively. Overall, 11.6% (688/5,913) were *P. falciparum* seropositive and 11.1% (735/6,609) *P. vivax* seropositive; compared to 1.0% and 0.5% microscopy positive, respectively. Such studies could help determine transmission intensity within discrete communities in Ethiopia. PMI is also supporting an OR study to assess the utility of conducting serologic testing using previously collected dried blood spots from the 2011 MIS to provide information on collection of additional biomarkers in household surveys in settings where malaria transmission is very low and/or seasonal. Due to delays in procurement of the needed reagents, the laboratory testing is scheduled for summer of 2016.

The feasibility of using the dried tube specimen method for preserving *P. falciparum* parasites for use as QC samples for RDTs was assessed in 2013 and the results published in January 2015. The study noted that for all the time points evaluated, dried tube specimens stored at both the reference laboratory and health facility were reactive on RDTs stored under the recommended temperature and under field conditions, and the dried tube specimens without malaria parasites were negative. They concluded that the dried tube specimen method can be used under field conditions to supplement other RDT QC methods and assess health worker proficiency in Ethiopia and possibly other malaria-endemic countries.

### Progress during the last 12-18 months

PMI recently supported an OR study performed at EPHI which analyzed the genotypic prevalence of glucose-6-phosphate dehydrogenase (G6PD) deficiency among 1,585 dried blood spots obtained from the MIS 2011. The only G6PD deficient genotype detected was G6PD\*A (A376G, 8.71%) with no samples positive for the clinically significant A- or Mediterranean variants, therefore suggesting a low

expected frequency of drug-induced anemia from primaquine antimalarial therapy among Ethiopians. This study supported the single, low-dose primaquine for *P. falciparum* treatment policy adoption.

Operational research activities supported with PMI FY 2015 and 2016 funds include: 1) Evaluation of targeted mass drug administration and reactive case detection on malaria transmission and elimination in Ethiopia, 2) Hematologic monitoring to assess the safety of the primaquine radical cure for *Plasmodium vivax* roll-out, and 3) Monitoring outdoor biting of mosquitoes and human behavior in agricultural development areas in Ethiopia.

**Table 15: PMI-funded operational research studies**

<b>Completed OR Studies</b>			
<b>Title</b>	<b>Start date</b>	<b>End date</b>	<b>Budget</b>
G6PD variant survey	Jan 2014	March 2015	\$90,000
School based seroprevalence <sup>2</sup>	Oct 2011	Sept 2013	\$200,000
Field assessment of dried tube specimens for RDT quality control and proficiency testing <sup>3</sup>	Jan 2013	July 2013	\$10,000
<b>Ongoing OR Studies</b>			
<b>Title</b>	<b>Start date</b>	<b>End date</b>	<b>Budget</b>
Malaria serology as a MIS biomarker	March 2014	Oct 2016	\$70,000
<b>Planned OR Studies FY 2015/2016</b>			
<b>Title</b>	<b>Start date (est.)</b>	<b>End date (est.)</b>	<b>Budget</b>
Evaluation of targeted mass drug administration and reactive case detection around an index case on malaria transmission and elimination in Ethiopia	Apr 2017	Sept 2019	\$800,000
Hematologic monitoring to assess the safety of the primaquine radical cure for Plasmodium vivax roll-out	Oct 2016	Sept 2018	\$300,000
Monitoring outdoor biting of mosquitoes and human behavior in agricultural development areas in Ethiopia	Sep 2017	Aug 2018	\$50,000

Plans and justification

No OR is proposed with FY 2017 funds.

Proposed activities with FY 2017 funding: (\$10,000)

- **Technical assistance for OR:** One TDY from CDC epidemiologist will be provided to support previously funded OR activities. (\$10,000)

<sup>2</sup> Ashton R *et. al.* Geostatistical modeling of malaria endemicity using serological indicators of exposure collected through school surveys. *Am J Trop Med Hyg.* 2015 Jul;93(1):168-77.

<sup>3</sup> Tamiru A *et. al.* Field assessment of dried Plasmodium falciparum samples for malaria rapid diagnostic test quality control and proficiency testing in Ethiopia. *Malaria Journal.* 2015 Jan 21;14:11

## 8. Staffing and administration

Two health professionals serve as Resident Advisors (RAs) to oversee PMI in Ethiopia, one representing CDC and one representing USAID. In addition, four Foreign Service Nationals (FSNs) work as part of the PMI team (two Senior Malaria Technical Advisors, one Malaria Advisor, and one Program Manager). All PMI staff members are part of a single interagency team led by the USAID Mission Director or his/her designee in Ethiopia. The PMI team shares responsibility for development and implementation of PMI strategies and work plans, coordination with national authorities, managing collaborating agencies and supervising day-to-day activities. Candidates for RA positions (whether initial hires or replacements) will be evaluated and/or interviewed jointly by USAID and CDC, and both agencies will be involved in hiring decisions, with the final decision made by the individual agency.

The PMI interagency professional staff work together to oversee all technical and administrative aspects of PMI, including finalizing details of the project design, implementing malaria prevention and treatment activities, monitoring and evaluation of outcomes and impact, reporting of results, and providing guidance and direction to PMI implementing partners.

The PMI lead in country is the USAID Mission Director. The day-to-day lead for PMI is delegated to the USAID Health Office Director and thus the two PMI RAs, one from USAID and one from CDC, report to the USAID Health Office Director for day-to-day leadership, and work together as a part of a single interagency team. Technical expertise housed in Atlanta and Washington complements PMI programmatic efforts.

The two PMI RAs are physically based within the USAID health office but are expected to spend approximately half of their time with and providing TA to the NMCPs and implementing partners, including time in the field monitoring program implementation and impact.

The number of locally-hired staff and necessary qualifications to successfully support PMI activities either in Ministries or in USAID will be approved by the USAID Mission Director. Because of the need to adhere to specific country policies and USAID accounting regulations, any transfer of PMI funds directly to Ministries or host governments will need to be approved by the USAID Mission Director and Controller, in addition to the U.S. Global Malaria Coordinator.

### Proposed activities with FY 2017 funding: (\$2,050,000)

- **CDC staffing:** Salary support for one CDC RA. (\$450,000)
- **USAID staffing and management:** Support to five staff members, including one USAID senior RA and four FSNs based at the USAID Mission within the U.S. Embassy in Addis Ababa, Ethiopia. The support includes all work-related expenses (e.g., salaries, benefits/ICASS, travel, supplies, etc.), and Mission-based expenditures, including USAID Mission expenses incurred in the direct implementation of PMI activities. (\$1,600,000)

**Table 1: Budget Breakdown by Mechanism****President's Malaria Initiative – Ethiopia  
Planned Malaria Obligations for FY 2017**

<b>Mechanism</b>	<b>Geographic Area</b>	<b>Activity</b>	<b>Budget (\$)</b>	<b>%</b>
GHSC-PSM	National	Procurement and distribution of LLINs, RDTs, laboratory equipment and supplies, chloroquine and primaquine; support for national commodities' micro-planning	\$16,996,000	45%
TBD - IRS Project	Oromia/National	IRS insecticide procurement; IRS operations; Entomological monitoring and capacity building; and IRS national level technical assistance	\$11,075,000	29%
CDC IAA	National	In-country staffing and management; TDYs; and FELTP	\$749,000	2%
SBCC- Health JHU-CCP	National	Coordination and capacity building support; Community-based SBCC for LLINs, IRS, ACTs, and case management	\$750,000	2%
APS-JU	Oromia	APS for local implementation of SBCC campaigns	\$200,000	1%
APS-HDAMA	Amhara	APS for local implementation of SBCC campaigns	\$300,000	1%
TBD	Oromia/ National	Strengthening case management of MIP; Support for QA system for malaria laboratory diagnosis; Therapeutic efficacy monitoring; Support for ongoing supervision and monitoring of malaria diagnosis and treatment; and Expanding HEWs pre-service training	\$3,900,000	10%
AIDS Free	National	Strengthening PFSA pharmaceutical management capacity	\$400,000	1%

USP PQM	National	Strengthening drug quality monitoring	\$250,000	1%
SMMES	National	Coordination support for ORHB & NMCP; Strengthening PHEM system and epidemic response	\$1,050,000	3%
Peace Corps	National	Support Peace Corps work on malaria at community level for three third year PCVs	\$30,000	0%
PHSP	National	Private sector support to case management	\$700,000	2%
USAID	National	Staffing and administration	\$1,600,000	4%
Total			<b>\$38,000,000</b>	<b>100%</b>

**Table 2: Budget Breakdown by Activity**

**President's Malaria Initiative – Ethiopia  
Planned Malaria Obligations for FY 2017**

Proposed Activity	Mechanism	Budget (\$)		Geographic Area	Description
		Total	Commodity		
<b>PREVENTIVE ACTIVITIES</b>					
<b>VECTOR MONITORING AND CONTROL</b>					
<b>Entomologic monitoring and insecticide resistance management</b>					
Entomological monitoring	TBD - IRS Project	540,000		National	Support for resistance monitoring in eight sites including vector behavior, quality assurance, and insecticide decay rate monitoring.
Entomological capacity building	TBD - IRS Project	135,000		National	Support for coordination of national insecticide resistance monitoring activities, vector control training and insectary.
Entomological technical assistance	CDC IAA	29,000		National	Provide two TDYs from CDC/Atlanta for training, planning, and monitoring entomological activities.
<b>Subtotal Ento monitoring</b>		704,000	0		
<b>Insecticide-treated Nets</b>					
LLIN procurement	GHSC - PSM	11,520,000	11,520,000	National	Provide 4,000,000 free LLINs to districts to distribute through health facilities, HEWs and other networks.

LLIN distribution from districts to health posts	GHSC - PSM	4,000,000		National	LLIN distribution from districts to health posts.
<b>Subtotal ITNs</b>		15,520,000	11,520,000		
<b>Indoor Residual Spraying</b>					
IRS operations	TBD - IRS Project	4,432,000		Oromia Region	Implementation and supervision support for IRS operations in 36 districts and 34 graduated districts.
Procurement of insecticide, IRS equipment, and PPE	TBD - IRS Project	5,500,000	5,500,000	Oromia Region	Procurement of insecticide, spray equipment and PPE for IRS activities.
IRS training	TBD - IRS Project	468,000		National	In-service training at federal, regional, and district levels to increase capacity in planning, management, and leadership of IRS operations.
<b>Subtotal IRS</b>		10,400,000	5,500,000		
<b>SUBTOTAL VECTOR MONITORING AND CONTROL</b>		26,624,000	17,020,000		
<b>Malaria in Pregnancy</b>					
Strengthening case management of MIP	TBD	200,000		National	Support malaria case management of pregnant women in high transmission areas.

<b>Subtotal Malaria in Pregnancy</b>		200,000	0		
<b>SUBTOTAL PREVENTIVE</b>		<b>26,824,000</b>	<b>17,020,000</b>		
<b>CASE MANAGEMENT</b>					
<b>Diagnosis and Treatment</b>					
Procurement of RDTs	GHSC - PSM	380,000	380,000	National	Procurement and distribution of 513,000 RDTs to support FMOH/ORHB efforts to scale-up RDT use at the health post level.
Procurement of laboratory equipment and supplies	GHSC - PSM	400,000	400,000	National	Procurement of laboratory equipment and supplies (e.g. microscopes), and including logistics systems support.
Support for QA system for malaria laboratory diagnosis and facility case management	TBD	2,000,000		National	Support for refresher training, supervision and mentoring for lab technicians and clinicians, lab QA/QC activities, and accreditation for laboratory supervisors in 200 new facilities and continued support to the existing 1,000 facilities.
Procurement of chloroquine and primaquine	GHSC - PSM	530,000	530,000	National	Procurement of chloroquine and primaquine to meet the national need (1M treatments of chloroquine and 100,000 treatments of primaquine).

Therapeutic efficacy monitoring	TBD	200,000		National	Support for TES in two sites covering <i>P. falciparum</i> & <i>P. vivax</i> .
Support for ongoing supervision and monitoring of malaria diagnosis and treatment including MIP	TBD	1,300,000		National	Support for health worker supervision, training and mentoring for management of malaria at health centers and health posts; collaboration with Zonal and District Health Offices.
Private sector support to case management	PHSP	700,000		Amhara, Oromia, Benishangul-Gumuz & Gambella Regions	Work with RHBs and private health facilities/farms/mining companies in focus areas to increase access to quality malaria services.
<b>Subtotal Diagnosis and Treatment</b>		5,510,000	1,310,000		
<b>Pharmaceutical Management</b>					
Strengthening PFSA pharmaceutical management capacity	AIDS Free	400,000		National	Integrate malaria commodities into existing Integrated Pharmaceuticals Logistics System and improve management of malaria commodities, quantification, drug exchange/transfer, and expiry tracking
Strengthening drug quality monitoring	USP PQM	250,000		National	Support FMHACA for monitoring post-market antimalarial drug quality, and building laboratory capacity at regional and national levels.
<b>Subtotal Pharmaceutical Management</b>		650,000	0		
<b>SUBTOTAL CASE MANAGEMENT</b>		6,160,000	1,310,000		
<b>HEALTH SYSTEM STRENGTHENING / CAPACITY BUILDING</b>					

Coordination support for ORHB & NMCP	SMMES	250,000		National/Oromia Region	Support joint planning, coordination, supervision and review activities with all malaria stakeholders in ORHB/national level. Includes two secondments one at ORHB & one at NMCP.
Pre-service training of HEWs	TBD	200,000		National	Pre-service training of HEWs and midwives to ensure that malaria will be focused in pre-service training for management of malaria at community level.
Field Epidemiology & Laboratory Training Program	CDC IAA	250,000		National	Support for applied epidemiology and laboratory training for three to five residents.
Peace Corps malaria prevention activities	Peace Corps	30,000		National	Support Peace Corps work on malaria at the community level for three third year PCVs.
<b>SUBTOTAL HSS &amp; CAPACITY BUILDING</b>		730,000	0		
<b>SOCIAL AND BEHAVIOR CHANGE COMMUNICATION</b>					
Coordination and capacity building for SBCC	SBCC-Health JHU-CCP	225,000		National	National and regional level coordination, policy/guideline and tool review/development for malaria SBCC.
Community-based SBCC for LLINs, IRS, ACTs, case management including MIP	SBCC-Health JHU-CCP	525,000		National	Dissemination and implementation of various SBCC approaches through a variety of community platforms in high and low transmission areas
Community-based SBCC	APS-JU	200,000		Oromia Region	Community-based SBCC through schools for prevention and control of malaria in Oromia Region.

Community-based SBCC	APS-HDAMA	300,000		Amhara Region	Community-based SBCC through schools for prevention and control of malaria in Amhara Region. Includes support for expansion into other migratory areas.
<b>SUBTOTAL SBCC</b>		1,250,000	0		
<b>SURVEILLANCE, MONITORING, AND EVALUATION</b>					
Strengthening PHEM system and epidemic response	SMMES	800,000		National	Strengthening the Public Health Emergency Management system; strengthen reporting of malaria cases from the health post to the health centers in hotspot districts to strengthen malaria epidemic detection and response. Includes case notification & investigation in pilot elimination districts.
National malaria commodities micro-plan	GHSC - PSM	166,000		National	Support annual malaria commodity micro-planning, including reliance upon weekly data from PHEM system.
M&E technical assistance	CDC IAA	10,000		National	One TDY to support surveillance, monitoring, and evaluation activities.
<b>SUBTOTAL SM&amp;E</b>		976,000	0		
<b>OPERATIONAL RESEARCH</b>					
OR technical assistance	CDC IAA	10,000		National	One TDY to support ongoing operational research.
<b>SUBTOTAL OR</b>		10,000	0		
<b>IN-COUNTRY STAFFING AND ADMINISTRATION</b>					
CDC Staffing and management	CDC IAA	450,000		National	Salary and benefits of in-country CDC PMI staff (1).

USAID Staffing and management	USAID	1,600,000		National	Salaries and benefits of in-country USAID PMI staff (1 PSC and 4 FSNs); ICASS support of CDC PMI staff; administrative costs (2% at \$760,000).
<b>SUBTOTAL IN-COUNTRY STAFFING</b>		2,050,000	0		
<b>GRAND TOTAL</b>		<b>38,000,000</b>	<b>18,330,000</b>		