

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 2018 appropriation. If any further changes are made to this plan it will be reflected in a revised posting.



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PRESIDENT'S MALARIA INITIATIVE

ETHIOPIA

Malaria Operational Plan FY 2018

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ABBREVIATIONS and ACRONYMS

ACT	Artemisinin-based combination therapy
AL	Artemether-lumefantrine
ANC	Antenatal care
API	Annual parasite incidence
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
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
HCMIS	Health commodities management information system
HDA	Health development army
HEP	Health extension package (or program)
HEW	Health extension worker
HLC	Human landing collection
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
IPLS	Integrated Pharmaceutical Logistics System
IPTp	Intermittent preventive treatment for pregnant women
IRS	Indoor residual spraying
ITN	Insecticide-treated mosquito net
LSI	Look Ahead Seasonality Index
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
RA	Resident Advisor
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
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
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 U.S. Government's 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 Sub-region 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 focus 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 bold and ambitious goals 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 focus 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 2018 Malaria Operational Plan (MOP) 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, Ethiopian Public Health Institute (EPHI), and regional health bureaus, 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 2018 funding.

The overarching goals of the PMI Program in Ethiopia include: 1) Increasing PMI support especially for vector control in high burden districts in high burden regions, 2) Continued ITN procurement and distribution to support ITN universal coverage, 3) Continued procurement of antimalarials to address national gaps, and 4) National level surveillance strengthening along with district level support in low

malaria burden districts to assist in achieving subnational elimination. The proposed FY 2018 PMI budget for Ethiopia is \$32 million. PMI will support the following intervention areas with these funds:

Entomological monitoring and insecticide resistance management:

Insecticide resistance in Ethiopia is a concern and Ethiopia has updated 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 2018 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 2014-2016, distributing 29.6 million long-lasting insecticidal nets (ITNs) 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 ITNs with PMI supporting the remaining gap. PMI cumulatively procured over 23 million ITNs between 2008 and 2015. With FY 2015, and FY 2016 funds, PMI plans to procure 10.4 million ITNs for distribution to high risk communities to replace worn out nets and protect new households and new household members. With FY 2017 funds, PMI will procure an additional 3.6 million ITNs for distribution as part of Ethiopia's 2018 rolling mass campaign. With FY 2018 funds, PMI plans to procure an additional 2,113,000 million ITNs for distribution as part of Ethiopia's universal coverage campaign. PMI also plans to continue supporting the development and implementation of a ITN distribution tracking system to ensure all ITNs 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 new FMOH malaria risk stratification, 14.8% of the country's total population is targeted for IRS as compared to 17% in the 2014 stratification. 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 2016, PMI supported the spraying of 715,541 structures and protected 1,688,745 people from malaria in 36 districts of Oromia Region, achieving a 99.7% coverage rate. With FY 2018 funding, PMI will continue to support safe and effective IRS implementation within 40 high burden districts in the Oromia, Gambella, and Benishangul-Gumuz Regions, in addition to continuing to provide limited IRS support to 60 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 ITN use by pregnant women, and enhanced social and behavior change communication (SBCC) activities targeting pregnant women in malaria endemic areas. PMI supports pre-service training for midwives and health extension workers (HEWs) to improve malaria case management services for pregnant women. With FY 2018 funds, PMI will continue to strengthen malaria case management of pregnant women at both the facility and community levels by improving the overall performance of primary health care units and ensuring access to ITNs. PMI has supported the development of a new malaria case management training manual, which includes malaria in pregnancy. Social behavior change communication messages are being developed based on these guidelines.

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. The national treatment guidelines have recently been revised to include both single dose primaquine to reduce transmission of *P. falciparum*, and radical cure primaquine to reduce the relapse of *P. vivax* malaria. Since the launch of PMI, a total of 9,240,000 RDTs and 15,046,630 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 or RDTs with FY 2018 funding is planned, as there will be no unmet commodity gaps. With FY 2018 funds, PMI will procure 192,857 treatments of chloroquine and 250,000 vials of injectable artesunate, 190 microscopes and laboratory kits for microscopy, and continue to strengthen case management activities in the public and private sector as well as strengthen microscopy capacity.

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 and elimination 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 malaria outbreak investigation and response. With FY 2018 funds, PMI will provide health systems coordination, 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, PMI initiated and supported

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 2018 funds, PMI plans to continue supporting SBCC capacity building, coordination, message harmonization, and school-based SBCC activities that promote malaria prevention.

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 42 districts and 7 town administrations in Oromia, monitoring ITN 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 system and the MISs in 2007, 2011, and 2015. 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 2018 funds, PMI will continue to support and strengthen national surveillance systems, district level supervision to monitor data quality in the elimination districts, the national malaria micro-plan, and conduct a household survey to estimate malaria intervention coverage.

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 2015-17 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 2018 funding.

Pre-elimination:

Ethiopia has recently declared malaria elimination efforts in 239 selected districts located in 6 different regions. PMI collaborated with the Ethiopia NMCP to develop an elimination operational assessment tool. This tool was adopted by the MOH for use in all selected elimination districts and will be used in 2017 to evaluate district-level health system's readiness for elimination activities and provide information to target initial elimination efforts. PMI will continue to strengthen district-level surveillance data quality and capacity for data use in elimination districts as the foundation for eventual case-based reporting. Additionally, PMI will focus prevention efforts on districts in Western Ethiopia with high rates of malaria. These districts are often the source of malaria transmission to low-

transmission malaria districts due to agricultural migrant workers and other migrant and mobile populations.

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 Sub-region 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 focus countries, and all 15 original countries have documented substantial declines in all-cause mortality rates among children less than five years of age.

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This FY 2018 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 2018 MOP was developed in consultation with the FMOH, NMCP, and Ethiopian Public Health Institute (EPHI) 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 2018 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. In addition, some 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 resultant 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 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. 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 in lowlands and middle elevations, and only occasionally in the highland fringe areas of Ethiopia greater than 2,000 meters above sea level (asl). 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 asl. The 2011 MIS indicated that 1.3% of individuals 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 meter elevation. *Plasmodium falciparum* constituted 77% of infections detected below 2,000 meters. 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 2017, the FMOH updated the country's malaria risk strata based upon malaria annual parasite incidence (API), calculated from micro-plan 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 (≥ 100 cases/1,000 population/year), moderate ($\geq 5 - < 100$), low ($> 0 - < 5$), and malaria-free (~ 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. Many densely populated highland areas were newly classified as malaria-free (API=0), including the capital city of Addis Ababa. Based on the current stratification, the proportion of the population at risk of malaria is about 60% (see Table 1) with 54 (6.4%) *woredas* having high transmission.

Table 1: Malaria risk stratification of districts and planned interventions based on annual parasite incidence, Ethiopia 2017

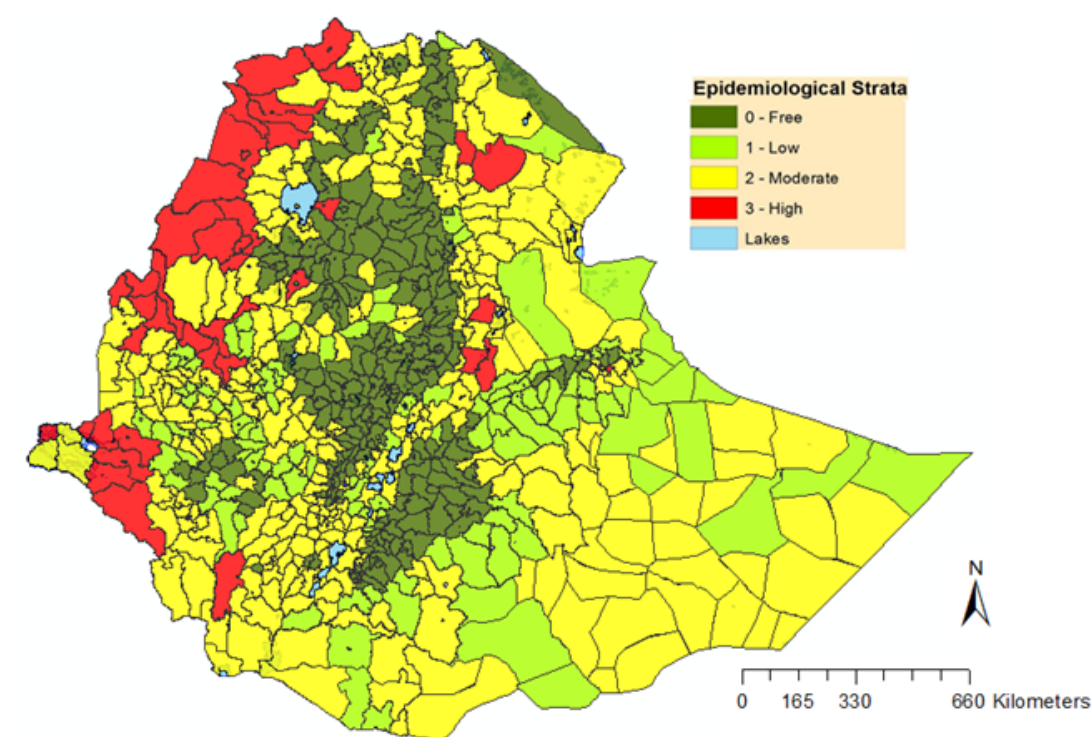
Malaria Strata	API (case/1,000)	Elevation (m)	Population (2017)	% Population	No. of Woreda	% Woreda	Interventions					
							ITN	IRS	Larval Control	Case Mx	Surveillance	IEC/ BCC
FREE	0	>= 2000 asl	37,083,083	40.3%	280	33.1%	-	-	-	X	X	X
LOW	>0 & <5	< 2000 asl	17,115,269	18.6%	146	17.3%	X	X*	WA	X	X	X
MODERATE	>=5 & <100		34,782,644	37.8%	365	43.2%	X	X**	WA	X	X	X
HIGH	>=100		3,036,580	3.3%	54	6.4%	X	X	WA	X	X	X
Total			92,017,576	100%	845	100%						

*Only 32% of at risk population in highland fringe/epidemic-prone areas will be covered by IRS

**Only 28.2% of districts relatively at boundary of high strata will be considered from moderate

WA: where applicable; asl: above sea level

Figure 1: Malaria risk map of districts by annual parasite incidence, Ethiopia, 2017



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.

The most recent, publicly available malaria case data was published in the FMOH's Annual Review Meeting report from PHEM data spanning the twelve-month interval between mid-2015 until mid-2016. It reported a total of 2,320,135 malaria illnesses including 1,325,409 laboratory confirmed *P. falciparum* malaria illnesses, 707,901 laboratory confirmed *P. vivax* malaria illnesses, and 286,825 clinical malaria cases. Mixed infections were counted as *P. falciparum* and there was no report of *P. ovale* or *P. malariae* from the routine health information system. Five hundred and ten deaths were reported due to malaria.

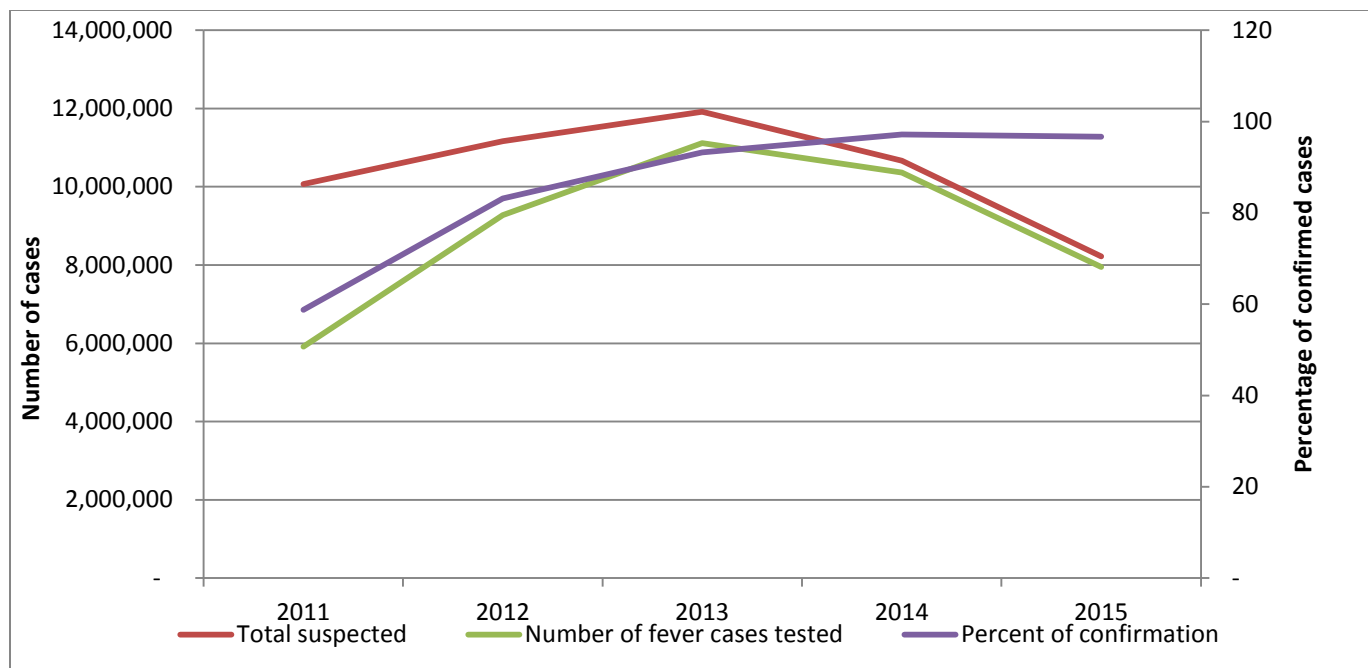
The FMOH's PHEM system receives similar reports as the HMIS but includes malaria health post data from district offices on a weekly basis; this PHEM surveillance system now reports around 91.5% completeness as published in the health sector development plan IV (HSDP IV) annual performance report. In 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 estimated 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. 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 that 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, Regional Health Bureaus (RHBs) and partners to these districts and neighbors 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 antimalarial drugs and RDT requirements and PMI will keep following the situation with the NMCP and PMI implementing partners.

According to the annual micro-plan for the year 2014/15, there were 2,440,262 total malaria cases, including 2,168,541 laboratory-confirmed and 271,721 presumed (i.e., clinically treated) malaria cases. There were 1,578,813 laboratory-confirmed *P. falciparum* outpatient malaria cases, and 589,728 outpatient *P. vivax* cases. In the same reporting period, there were 7,950,545 patients who were examined (i.e., malaria laboratory-tested) for malaria and a calculated total of 8,222,266 suspected malaria cases (note that "suspected" cases were formerly termed "fever cases" per WHO), and 19,182 malaria hospitalizations. The trends in malaria over the past five years have shown a decline in malaria cases and an increase in confirmation of cases (Figures 2a and b). Triangulation with previous HMIS

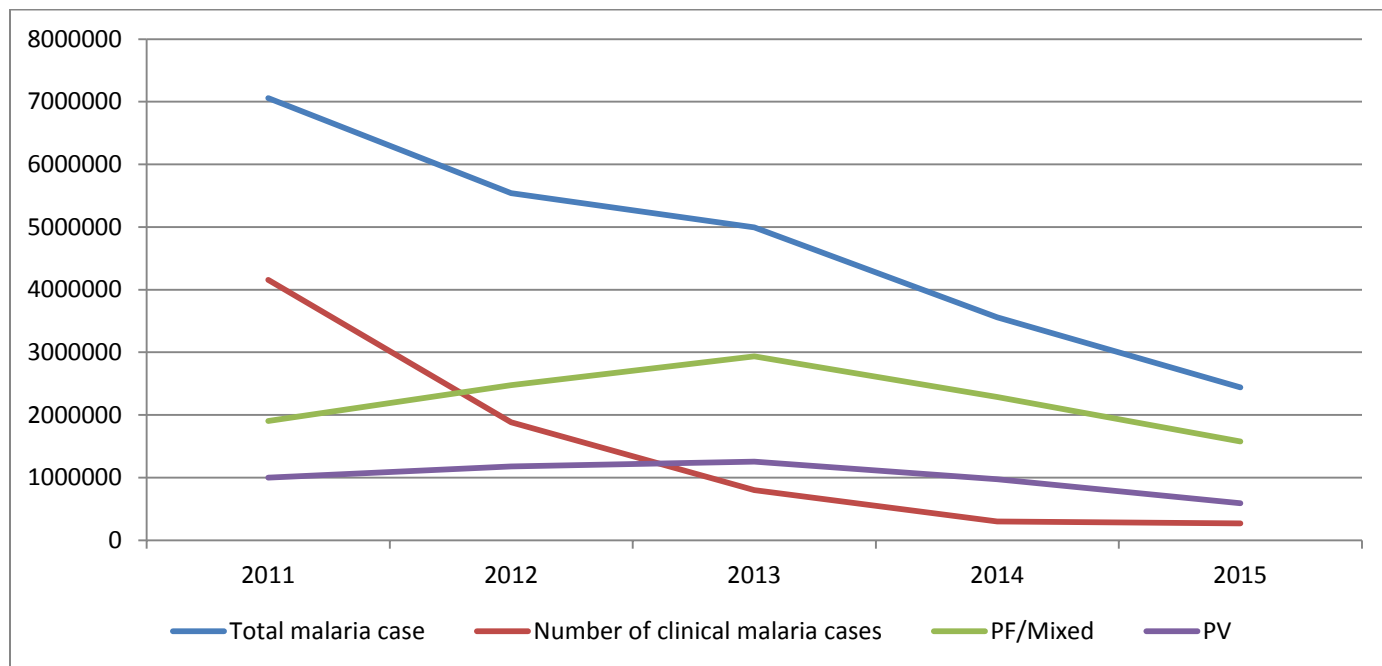
reports and with other data from the micro-plan and PHEM indicates that more than 80% of the malaria burden in Ethiopia is among adults and children who are at least five years of age.

Figure 2a: Trends in proportion of malaria cases tested with RDT or microscopy from 2011-2015



Data source: Micro-plan data

Figure 2b: Trends in number of malaria cases tested and confirmed from 2011-2015 disaggregated by species

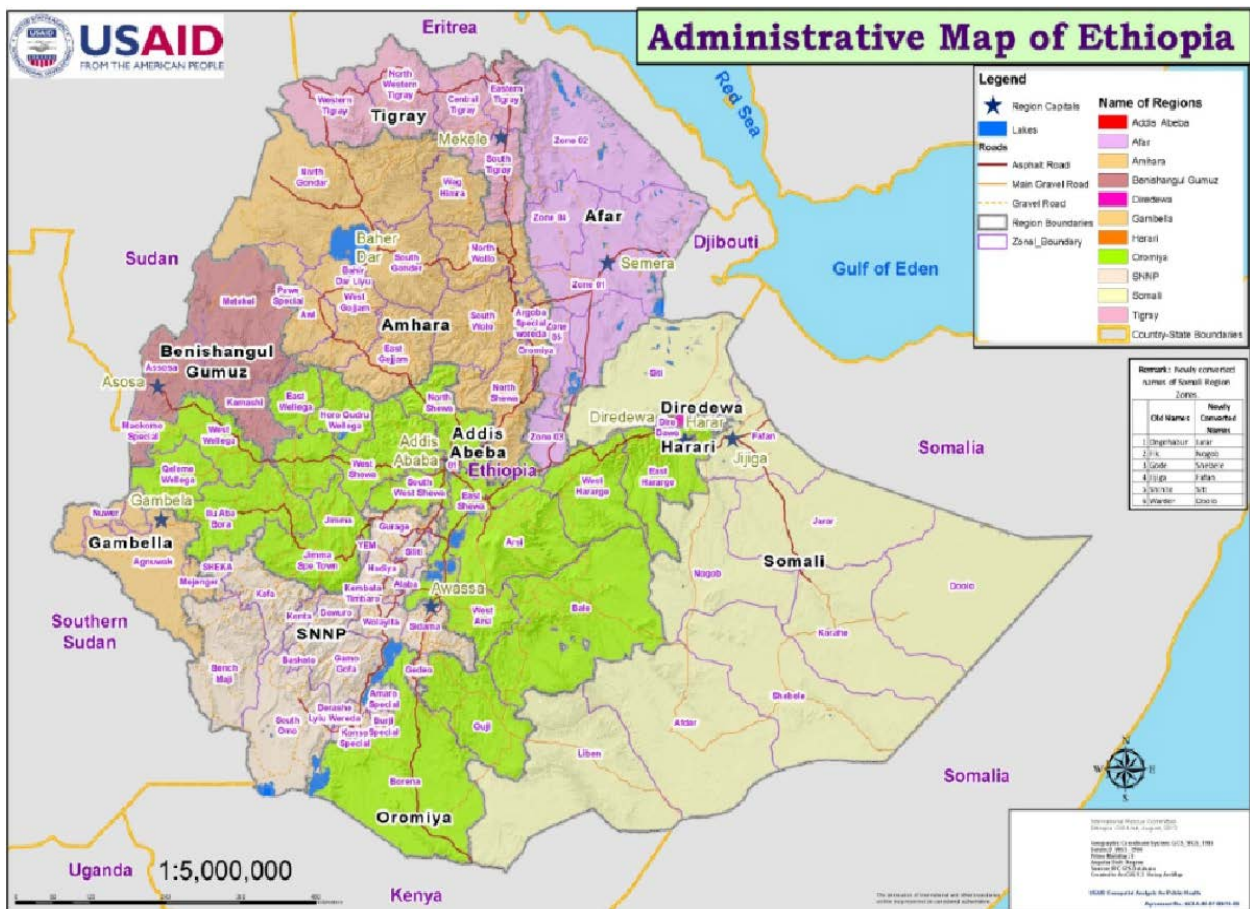


Data source: Micro-plan data

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 565 districts with malaria risk in Ethiopia (out of 845 total districts), with an estimated at-risk population of 54.9 million people as per the new stratification (see Table 1 above). The best available proxy for local malaria transmission risk in Ethiopia is household altitude below 2,000 meters asl, 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 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, 16,447 health posts, and about 38,000 trained health extension workers (HEWs) in Ethiopia.

The typical health post is staffed by 2 HEWs delivering 16 selected health packages, including 1 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 in children less than five years of age using the integrated community case management (iCCM) approach of evidence-based diagnostic and treatment algorithms. Community case management of malaria for adults and children over five years of age (which constitute >80% of malaria cases) is also conducted by HEWs who 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 (ITN) 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 40 PMI-supported IRS districts.

4. National malaria control strategy

The 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 current 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 current 2014-2020 NMSP.

Goals:

- By 2020, to achieve near zero malaria deaths (no more than 1 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. 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. The NMSP is being updated for years 2017-2020 to incorporate MIS 2015 findings and the most recent Global Fund funding request application, submitted in May. The proposed goals and objectives for the 2017-2020 NMSP include:

Goals:

- By 2020, to achieve near zero malaria deaths in Ethiopia (*near zero malaria death is defined as no more than 1 confirmed malaria death per 100,000 population at risk*).
- By 2020, to reduce malaria cases by 40% from baseline of 2016.
- By 2030, to eliminate malaria from Ethiopia.

Strategic Objectives:

1. By 2020, all households living in malaria endemic areas will have the knowledge, attitudes and practice to adopt appropriate health-seeking behavior for 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 2017 and beyond, 100% of confirmed malaria cases are treated according to the national guidelines.
4. By 2017 and beyond, ensure that the population at risk of malaria has universal access to one type of globally recommended vector control intervention.
5. By 2020, malaria elimination program will be implemented in 239 districts.
6. By 2020, 100% complete data and evidence will be generated at all levels within the nationally designated time periods to facilitate appropriate decision-making.

5. Updates in the strategy section

The Ministry has officially declared malaria elimination efforts for selected 239 low malaria burden districts. 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. Current control interventions will be strengthened, with emphasis given to improving access to ITNs, case management and case detection services, surveillance, stock management and capacity building activities at the district level to further reduce cases.

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 U.S. Government 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 U.S. Government will also continue to integrate health, agriculture, and humanitarian assistance and livelihood sector platforms to maximize impact on nutrition.

Most of PMI's activities support 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 U.S. Government 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 2018 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 ITN 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, United Nations Children's Fund (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, Global Fund proposals as well as the NFM concept note, and the development and updating of in-country guidelines and strategies. PMI collaborates closely with Global Fund to improve ongoing malaria activities such as ITN distribution methodologies and supply chain evaluation as well as conducting joint commodity gap analyses to plan for future commodity procurement needs. PMI worked with partners in 2017 to support the NMCP in conducting an Ethiopia National Malaria Program Review evaluation for the past five years, which included a desktop information review and field validation exercises. PMI also provides technical support to EPHI for malaria evaluation and research activities (e.g., the MIS 2015 data analysis and methodology development for the 2017 post-ITN campaign assessment). Non-PMI funded malaria partners and other health donors, as well as experts from the Global Fund, were consulted to inform this FY 2018 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, avoid duplication of efforts and waste of resources, and inform future research needs.

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 focus 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 focus 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 focus countries, achieving a greater than 80% reduction from PMI's original 2000 baseline levels.
2. Reduce malaria morbidity in PMI focus countries by 40% from 2015 levels.

3. Assist at least five PMI focus countries to meet the WHO's criteria for national or sub-national pre-elimination.¹

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 Roll Back Malaria 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 of age 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 of age with fever in the last two weeks for whom advice or treatment was sought
- Proportion of children under five of age with fever in the last two weeks who had a finger or heel stick
- Proportion receiving an ACT among children under five years of age 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%. Table 3 shows the change in key malaria indicators reported through routine surveillance systems from 2011-2016. Figure 4 shows the trend in key routine based malaria indicators over time.

¹ http://whqlibdoc.who.int/publications/2007/9789241596084_eng.pdf

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

Indicator	MIS 2007 (<2000m)	MIS 2011 (<2000m)	MIS 2015 (<2000m)
% Households with at least one ITN	65.3	54.8	63.6
% Households with at least one ITN for every two people	36.6	23.6	31.7
% Children under five (U5) who slept under an ITN the previous night	41.2	38.0	45.3
% of children U5 who slept under an ITN that own an ITN the previous night	60.0	64.7	69.5
% Pregnant women who slept under an ITN the previous night	42.5	34.7	44.3
% Pregnant women who slept under an ITN that own an ITN the previous night	66.2	63.8	73.9
% Households protected by at least one ITN or IRS	-	71.7	70.5
% Households sprayed in past 12 months	20.0	46.6	28.8
% Women age 15-49 years who had heard of malaria	79.5	71.3	68.4
% Women age 15-49 years who recognized fever as malaria symptom	50.8	76.0	74.6
% Women age 15-49 years who reported mosquito bite as a cause of malaria	41.1	71.2	74.6
% Women age 15-49 years who reported that ITNs prevent malaria	38.2	63.4	77.1
% Children under five years old with fever in the last two weeks	24.0	19.7	15.7
% Children under five years old with fever in the last two weeks for whom advice or treatment was sought	16	51	38.1
% Children under five years old with fever in the last two weeks who received any antimalarial drugs	11.9	32.6	32.9
% Children under five years old who took an antimalarial drug the same or next day	4.8	8.5	19.6
% Prevalence of malaria by microscopy	0.9	1.3	0.5

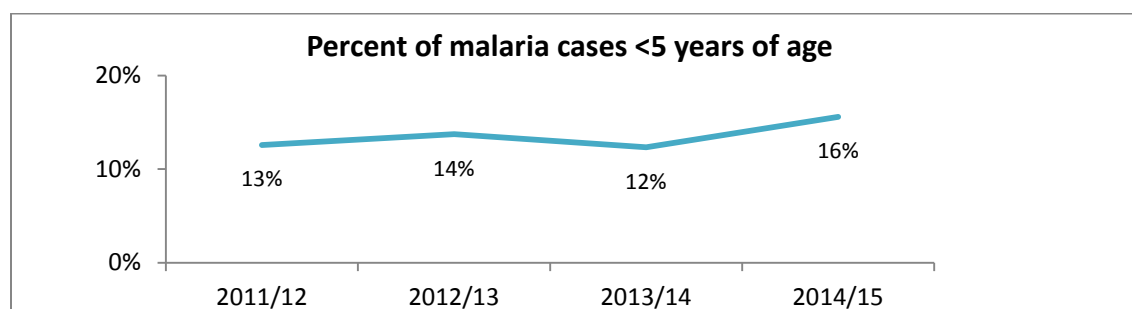
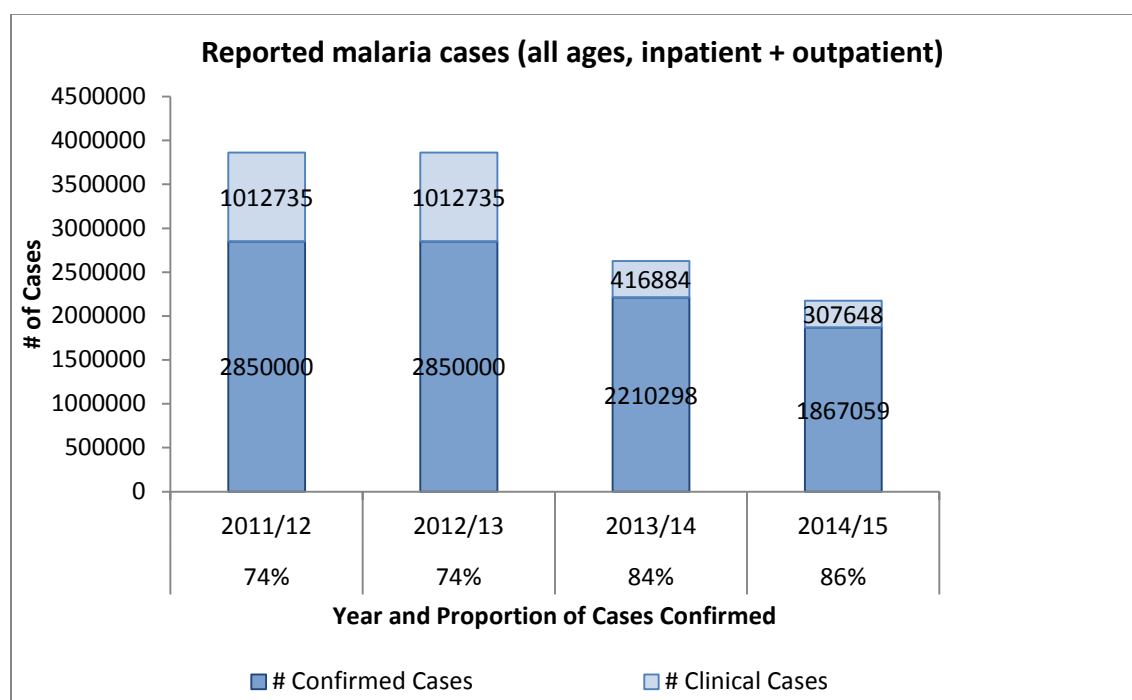
Table 3: Key malaria indicators reported through routine surveillance systems, 2011–2016

Indicator	2011-2012*	2012-2013*	2013-2014*	2014-2015*	2015-2016**
Total # Cases	5,538,405	4,978,703	3,558,360	2,440,262	2,320,135
Total # Confirmed Cases	3,654,690	4,192,490	3,259,119	2,168,541	2,033,310
Total # Clinical Cases	1,883,715	802,620	299,241	271,721	286,825
Total # <5 Cases	NA	NA	NA	NA	NA
Total # inpatient malaria deaths	NA	NA	NA	104	510
Data Completeness* (%)	100%	100%	99%	NA	NA
Test Positivity Rate (TPR)	39.4%	37.7%	31.4%	27%	NA

* Micro-plan data

** PHEM data reported in Ethiopia Annual Review Meeting

Figure 4: Trends in key routine surveillance malaria indicators, 2011–2015



Data Source: Ethiopia Ministry of Health and Health Related Indicators Reports of HMIS data

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 larval source management, including larviciding. PMI's support aligns with Government of Ethiopia's (GoE) HSTP (2015–2020) and the draft NMSP (2017–2020). PMI's support strategy for Ethiopia has evolved since PMI began its activities in FY 2008, but remains consistent with the U.S. Government's updated PMI, and USAID global health strategies, and with country strategies within the U.S. 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 evidence at that time showing 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, especially Gambella and Benishangul-Gumuz regional states, had consistently higher malaria burden 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 beyond Oromia Regional State to meet national program gaps and increase our focus on the highest burden regions in Ethiopia.

1. Vector monitoring and control

NMCP/PMI objectives

Insecticide based vector control remains a key component of malaria prevention and control in Ethiopia. The draft NMSP (2017–2020) vector control objective is “to ensure that the population at risk of malaria has universal access to one type of globally recommended vector control intervention by 2017 and beyond,” which is in line with PMI's vector control objectives. The two major vector control interventions implemented to prevent malaria in Ethiopia are the IRS of houses and the distribution of ITNs. As stated in the current NMSP, the draft NMSP 2017-2020 IRS policy involves targeting areas where malaria is high or where there is a risk of epidemics, such as highland fringe areas. The proposed ITN policy is to achieve and maintain universal ITN coverage of the population residing in malaria risk areas through “catch-up” campaigns and to achieve and maintain ITN use levels above 80% by all age groups through SBCC activities.

The MIS 2015 results continue to highlight the sustained levels of ITN ownership in Ethiopia, but ownership and use levels are still below target levels. 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 the 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 ITNs. However, the largest barrier to ITN use is the insufficient availability of ITNs at the household level compounded by the

lack of a ITN distribution tracking system down to the users.

According to the FMOH's draft NMSP 2017-2020 malaria risk stratification based on API from 2015 micro-plan data, 60% of the population is residing in malaria risk areas (i.e., below 2000 meters asl). This translates to 60% of the population in the country that needs to have access to ITNs. Primary distribution occurs through the PHCU, specifically health posts, where an average of one ITN per two people is distributed to all target households every three years in campaigns to attain universal coverage. The ITNs distribution campaign is mainly handled by the health extension workers (HEWs) in collaboration with the HDA and local authorities. HEWs receive technical assistance and supervision from the district health offices and health centers. HEWs identify and confirm the need for ITNs through their routine household visits and from HDA reports. In its revised NSP (2017-2020), NMCP has recently revised its ITN distribution strategy and has removed the continuous (catch-up) distribution mechanism. With the change in the NMCP ITNs distribution approach, in this MOP PMI will shift its support from continuous distribution to now only include campaign distribution needs, which in fact will be implemented through HEWs. The Ministry does not have a specific continuous distribution strategy to prioritize women and children. However, all households in malarious areas are targeted for ITNs so pregnant women and children will be covered under the campaigns, and the HEWs are instructed to prioritize pregnant women and children under five years of age in case there happens to be insufficient number of ITNs for the community. PMI is continuing to engage the NMCP in discussions regarding the potential need for continuous distribution channels. Current discussions with the NMCP has focused on possible continuous distribution channels to target most vulnerable groups in high malaria burden areas for continuous distribution. At which time the NMCP finalizes and possibly adopts a continuous distribution approach, PMI will revisit this approach and how best to support the national plans.

According to the new malaria risk stratification, 14.8% of the country's total population is targeted for IRS as compared to 17% in the 2014 stratification. 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. There are instances of having foci of high malaria burden communities within low or medium malaria burden districts. Hence, 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 (except in Gambella and Benishangul-Gumuz where transmission could be as long as six months) after the main rainy season usually lasting 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 annually implementing IRS in all regions of the country. Implementation of IRS following the new stratification has not been achieved to date and it requires further effort from the FMOH and RHBs to fully and effectively realign their programs. In 2016, the FMOH has conducted spraying in more than 5.27 million structures inhabited by more than 13.15 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. Entomological 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 resistance 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). PMI continued supporting entomological monitoring including vector density and behavioral, insecticide susceptibility, mechanism of resistance and residual efficacy of insecticides after the spraying campaign. Further PMI has supported a study to determine the decay rate of three insecticides used for IRS on different wall types using experimental huts. In addition, the FMOH in collaboration with partners has developed national insecticide resistance monitoring and management strategy that was disseminated in June 2016.

Progress during the last 12-18 months

In 2016, PMI continued supporting entomological resistance monitoring of 7 insecticides from 4 insecticide classes in 11 sites and mosquito behavior studies in 3 sites. The insecticide resistance monitoring tests indicate resistance at an increased number of sites that remained consistent with previous year's results which showed that local vectors are fully resistant to DDT and permethrin. Unlike past years, however, susceptibility of vectors to deltamethrin was found in 1 of the 11 sites. Results show local *An. arabiensis* exhibits malathion resistance or possible resistance in 8 out of 11 sites tested for malathion. The results also showed resistance to bendiocarb in one site and identified the possibility of resistance in another site. Resistance and the possibility of resistance to pirimiphos-methyl were seen in one site each. The possibility of resistance to propoxur was also seen in 3 out of 11 sites. Insecticide resistance monitoring results from the 11 sites are presented in Table 4.

Table 4: Summary of PMI-supported insecticide resistance tests in 2016

Insecticide	% Mortality										
	District/Region										
	Omonada /Oromia	Nono /Oromia	Ziway /Oromia	Babile /Oromia	Bahirdar /Amhara	Metema /Amhara	Alamata /Tigray	Humera /Amhara	Arbaminch /SNNPR	Abobo /Gambela	Amibara /Afar
DDT	10	29	27	11	ND*	73.5	25	33	51	37	67
Deltamethrin	8	51.5	76	22	80.6	99.1	50	33.7	41	33	53
Malathion	83	100	98	96	72.8	81.9	96	25	100	95	95.7

Pirimiphos-methyl	98	100	99	85	100	100	92	100	100	100	100
Bendiocarb	80	98	100	100	100	100	97.3	100	100	98	99
Propoxur	100	95	94	100	97	100	100	100	100	100	100
Permethrin	5	52.7	57	16	79.4	89.9	26.7	69	84	20	68.4

*ND indicates tests not done; SNNPR: Southern Nation and Nationalities Peoples' Region

In previous years PMI supported 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 in 2016. The results of behavioral monitoring from June to December 2016 showed that *An. gambiae* s.l. indoor resting density from pyrethrum spray collection and human biting rates both markedly decreased after spraying in the intervention sites, but increased in the control site. In Gobu Seyo and Seka Chekorsa, the intervention sites, the *An. gambiae* s.l. indoor resting density markedly reduced after spraying (Figure 5). In comparison, the density of indoor resting *An. gambiae* increased and reached its peak in August at the Ijaji control site. From the control site, this monitoring effort further confirmed that the main vector density builds before the IRS operations are scheduled to occur which is August – September in the NMCP districts, mainly due to the short residual life of insecticide being used. In all PMI supported districts IRS takes place in June-July using insecticide with a longer residual life. The human landing collection from Gobu Seyo shows similar patterns of decline after spraying, while in Ijaji, the number of vector mosquitoes trying to bite humans has increased (Figure 6).

Figure 5: *An. gambiae* s.l. indoor resting density from pyrethrum spray collections in Ijaji control site and Gobu Seyo and Seka Chekorsa intervention sites (June to December 2016)

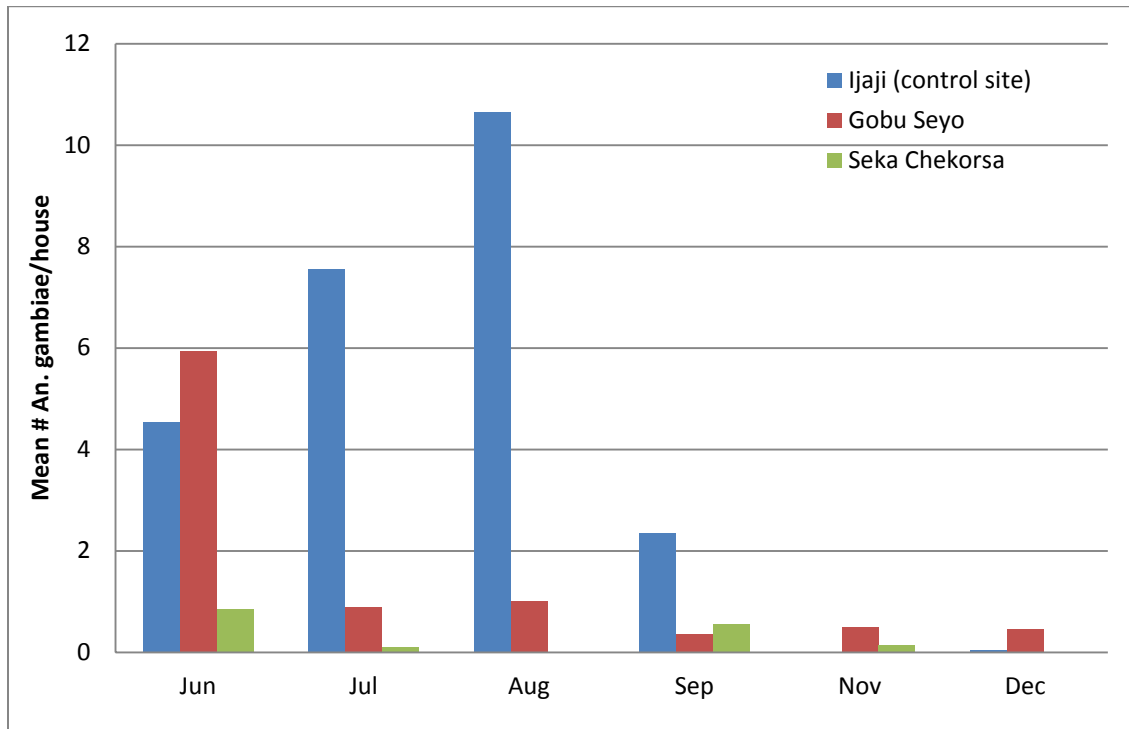
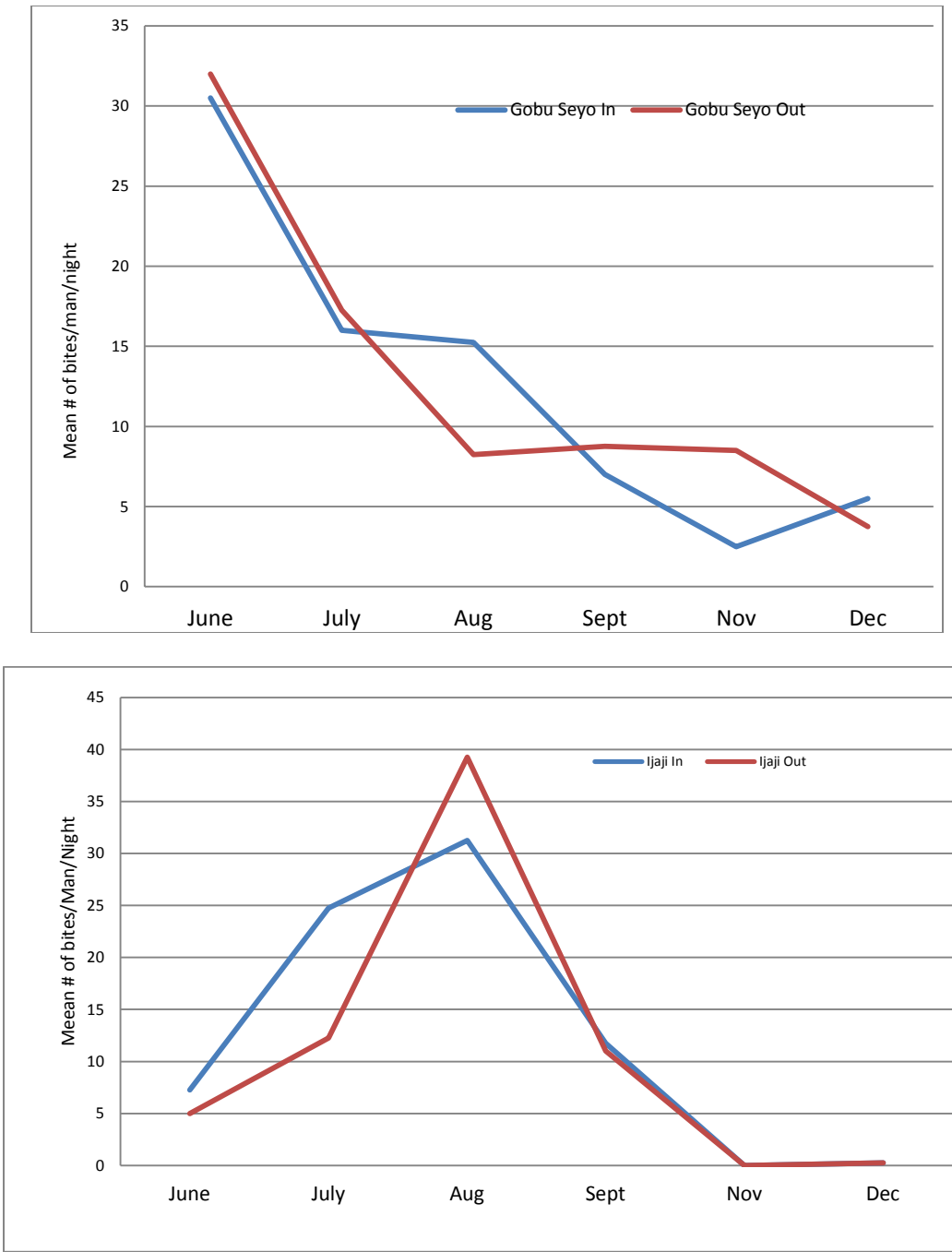


Figure 6: Trend in human landing collections of *An. gambiae* s.l. both indoor (blue) and outdoor (red) at Gobu Seyo intervention site and Ijaji control site (June to December 2016)



Molecular identification of *An. gambiae* s.l. were conducted using PCR on specimens randomly selected from ten study sites. The results of the molecular analysis showed that *An. arabiensis* was the only sibling species of the gambiae complex present at all the study sites. The West African kdr allele (L1014F) was found in 74% of populations of *An. gambiae* s.l. used for resistance testing.

A wall cone bioassay assessed the quality of IRS within seven days after spraying and continued monthly to monitor the decay rate of pirimiphos-methyl in four districts (Tiro Afeta, Chewaka, Bako Tibe, and Shebe Sombo) using laboratory-reared susceptible mosquitoes. The results from wall cone bioassays after spraying showed a mortality rate ranging from 98.3% to 100%. The monthly monitoring of pirimiphos-methyl decay rates showed different performances on different wall types and at different locations. Average mortality for the four sites was 78.1%, five months after spraying with pirimiphos-methyl, which is 10% less than previous year's performance for pirimiphos-methyl. Wall bioassay decay rate results for 2016 can be seen in Table 5a & 5b. For bendiocarb, the assessment from previous years have found that the performance was below the acceptable range and no cone bioassay test was conducted on bendiocarb this year as bendiocarb is no longer used by PMI-supported IRS districts.

Table 5a: Results of wall bioassays for decay rate of pirimiphos-methyl, Tiro Afeta and Shebe Sombo (June – November 2016)

Time (Month)	% Mortality							
	Tiro Afeta (June – Nov 2016)				Shebe Sombo (June – Nov 2016)			
	Dung	Mud	Painted	Mean	Dung	Mud	Painted	Mean
M0	98.7	100	100	99.6	100	100	100	100
M1	100	100	100	100	100	100	100	100
M2	90.5	100	100	96.8	93.5	91.3	99.4	95
M3	64.7	74.3	100	79.7	100	75.9	84.7	87
M4	Not done due to unrest in the country during this time							
M5	85.1	85.4	82.5	84.3	ND	68.3	63.1	65.7

*ND indicates tests not done.

Table 5b: Results of wall bioassays for decay rate of pirimiphos-methyl Chewaka and Bako Tibe (June – November 2016)

Time (Month)	% Mortality							
	Chewaka (June – Nov 2016)				Bako Tibe (June – Nov 2016)			
	Dung	Mud	Painted	Mean	Dung	Mud	Painted	Mean
M0	100	98.3	100	99.6	100	98.9	100	99.6
M1	98.4	93.4	100	97.3	94.9	96.7	100	97
M2	80.6	79.9	99.2	86.6	63.3	83.5	97.8	82
M3	81.7	73.8	96.8	84.1	62.3	78.3	96	79
M4	Not done due to unrest in the country during this time							
M5	78.3	77.4	99.1	84.9	61	74.8	97	77.6

CDC bottle bioassays with increasing intensity concentration were conducted in three sites (Amibara, Ziway Dugda and Nono) with pyrethroid insecticides (deltamethrin and permethrin). In all three sites,

the vector was resistant to permethrin at 1x and 2x (17- 83%); possibly resistant at 5x and 10x in Nono and possibly resistant at 5x at Amibara site but susceptible at 5x and 10x in Ziway Dugda site. The vector was also found to be resistant to deltamethrin at 1x and 2x in Nono site and possibly resistant at 1x and 2x in Ziway Dugda, 1x in Amibara, and 5x in Nono sites and susceptible at 5x and 10x in Ziway Dugda and Amibara sites. In all sites, mortality was 100% at 1x for deltamethrin after the vector was treated with piperonyl butoxide (i.e synergist-insecticide test), indicating that an oxidase mechanism of resistance is involved. For permethrin, vector mortality ranged from 86.8-100% at 1x after piperonyl butoxide treatment (Table 5c)

Table 5c: Results of CDC bottle assay resistance intensity and synergist (June – November 2016)

Region	District	Type of insecticide	% Mortality after 30 minutes (Dead/Exposed)			
			1X	2X	5X	10X
Oromia	Ziway Dugda	Permethrin (Intensity)	17 (16/94)	68.4 (65/95)	100 (94/94)	100 (81/81)
		Deltamethrin (Intensity)	91.4 (85/93)	96.7 (89/92)	100 (97/97)	100 (99/99)
		Deltamethrin + PBO	100 (99/99)			
		Permethrin + PBO	94.6 (87/92)			
	Nono	Permethrin (Intensity)	43.2 (41/95)	78.6 (66/84)	95.2 (80/84)	95.7 (88/92)
		Deltamethrin (Intensity)	87.8 (86/98)	89 (73/82)	97.5 (78/80)	100 (98/98)
		Deltamethrin + PBO	100 (80/80)			
		Permethrin + PBO	100 (90/90)			
Afar	Amibara	Permethrin (Intensity)	64 (48/75)	83.3 (50/60)	96.7 (58/60)	
		Deltamethrin (Intensity)	94.9 (75/79)	100 (59/59)	100 (60/60)	
		Deltamethrin + PBO	100 (60/60)			
		Permethrin + PBO	86.8 (66/76)			

To collect additional information, PMI collaborated with Addis Ababa, Jimma, Mekele, Arbaminch, Jigjiga and Gonder Universities to collect more key entomological indicators, including vector distribution and seasonality; vector feeding time and location; and vector resting behavior. Vector density, distribution, and seasonality were monitored for five months from July to November 2016 including pyrethrum spray catches, human landing collections (HLC), and CDC light traps. The results show varied vector density, distribution, and seasonality in different sites. Result from HLC (which is more productive) for different site is presented on Table 6 below. These sites are among IRS districts under government support in different regions.

Table 6: Human landing collection results from five sites in collaboration with local universities

Month	Total number of <i>An. gambiae</i> s.l. collected per site using human landing Collections in collaboration with local universities				
	Sile	Babile	Alemata	Goro	Metema
July	25	6	8	10	ND
Aug	9	0	0	323	4
Sept	5	35	7	333	ND
Oct	29	26	22	20	ND
Nov	71	81	9	ND	ND
Total	139	148	46	686	4

* ND Not done due to unrest during these months in these places

In 2016, PMI continued supporting capacity building activities in entomological monitoring. In collaboration with FMOH, PMI supported training was held for six days on entomological monitoring for 26 entomology assistance selected from six universities – Addis Ababa, Jimma, Mekele, Arbaminch, Jigjiga and Gonder Universities – to equip the participants with basic malaria entomology and monitoring.

Plans and justification

With FY 2018 funds PMI will maintain the FY 2017 level of insecticide resistance and entomological monitoring support and will continue to work closely with the FMOH, RHBs, 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 endorsed 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. FMOH has allocated funding for the establishment of sentinel sites, which will be operated by EPHI. Currently EPHI is finalizing a working document for a consultative meeting to establish roles and responsibilities among stakeholders. Stakeholders supporting the rest of the sites will be known after the consultative meeting.

Proposed activities with FY 2018 funding: (\$669,000)

- **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 to include foci investigations. PMI will continue supporting six local universities with the aim of building capacity for entomological monitoring and insecticide resistance testing. (\$100,000)
- **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 2017, PMI procured a total of 23.4 million ITNs, which were distributed to malaria risk communities. Since 2012, PMI ITN distribution expanded to other regions beyond Oromia focusing on malaria risk areas nationally. Through mass campaigns, 10,987,354 ITNs were distributed in 2014/2015 in 218 districts, covering 10.98 million people while the 2015/16 campaign covered 32.96 million people in 442 districts through the distribution of 18,327,668 ITNs. Continuous distribution was not implemented as originally planned and in the revised NSP, the Ministry has endorsed on-going rolling mass campaigns and private sector sale of ITNs to ensure ITN coverage.

The FMOHs NSP 2017–2020 aims to sustain the universal vector control coverage through ITN and /or IRS interventions in malaria risk areas where applicable. According to MIS 2015 in a household owning at least one net, use of net by children and pregnant women was 70% and 74%, respectively. Distributions of the ITNs procured by PMI and Global Fund were based on a nationwide micro-plan data supported by PMI in collaboration with the RHBs and FMOH and other malaria partners in the country since 2011. At annual micro-planning meetings, stakeholders compile records of the number of ITNs previously distributed within the last three years, and document the number of ITNs that are more than three years old and thus, need to be replaced. In addition to these replacement ITNs, 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 last ITN distribution campaign was conducted in 2015/16 and over 30 million ITNs were distributed to households in malaria risk areas throughout the country. Table 7 shows the ITN gap analysis for 2017-2020.

PMI is supporting an ITN durability study which collects data on net availability or attrition, use, physical integrity, bio-efficacy and the amount of insecticide remaining on a net. Preliminary results of the monitoring one-year post ITN distribution show the following: 27.9% attrition (i.e., 2,457 ITNs

were identified as campaign ITNs from the originally distributed and marked 3,406 ITNs); 67% of the nets were used the previous night; and 28% of the nets had any type of holes while 31.4% of those nets with holes were found not repairable.

Commodity gap analysis

Table 7. ITN Gap Analysis

Calendar Year	2017	2018	2019	2020
Total Targeted Population*	9,539,241	10,243,555	32,963,456	6,729,458
Mass Distribution Needs**				
2017 - 2020 mass distribution campaign	5,299,578	5,690,864	18,313,031	3,738,588
<i>Estimated Total Need for Campaigns</i>	5,299,578	5,690,864	18,313,031	3,738,588
Total Calculated Need: Continuous and Campaign	5,299,578	5,690,864	18,313,031	3,738,588
Partner Contributions				
ITNs carried over from previous year		6,000,422	4,773,991	408,001
ITNs from Government	0	0		
ITNs from Global Fund	0	0	10,313,013	0
ITNs planned with PMI funding***	11,300,000	4,464,433	3,634,028	2,113,000
Total ITNs Available	11,300,000	10,464,855	18,721,032	2,521,001
Total ITN Surplus (Gap)	6,000,422	4,773,991	408,001	(1,217,587)

Footnotes:

*The distribution of ITNs has been planned to cover the total population at risk (59,475,710) over a period of 2017-2019 mass distribution plan. The targeted population for ITNs distribution in 2017, 2018, 2019, and 2020 are the population in 85, 133, 443, and 64 identified districts for ITNs distribution.

** There is no continuous distribution channel in Ethiopia.

*** Out of the 11,300,000 ITNs planned to be procured by PMI in 2017, 5.3 million have been procured and the remaining 6 million ITNs is under procurement process.

****Source - the FMOH/Global Fund gap analysis result and the FY 2017 MOP.

Plans and justification

ITN quantification is based on the WHO recommendation of 1 net for 1.8 people and using *woreda* level micro-planning data. PMI supports the FMOH policy and distribution plans of ITNs to the most at-risk communities in significant malaria transmission areas as per the draft NMSP 2017–2020 malaria risk stratification. In addition to the ITN procurement and distribution, PMI in collaboration with FMOH and other in-country stakeholders will continue to conduct the national micro-planning for ITN needs assessment and to inform the distribution. Based on the draft Global Fund funding application by FMOH, Global Fund will meet the remaining gap for the 2019 mass campaign. A major challenge still remains in ensuring ITN distribution to households in the absence of a tracking and monitoring system

for ITNs. Unacceptable delays have been experienced in the distribution of ITNs after arrival at target districts for a variety of reasons provided by the district health authorities. In response, PMI will support the NMCP and Pharmaceutical Funds Supply Agency (PFSA) in developing an ITN distribution tracking and monitoring system (dashboard) as well as invest in distribution costs to lower levels. This proposed tracking plan is, therefore, to improve transparency and accountability of PMI and Global Fund- financed ITNs, and ultimately to ensure they reach intended beneficiaries. PMI will support this activity through engaging FMOH, regional health bureaus and other stakeholders. The plan is to increase visibility of distribution to the last mile, tracking distribution from central to the end user, where initial data will be collected through a pilot. The pilot will be a technology-based intervention in a few selected districts, conducted in 2018. Information from the pilot will be used to help inform development of scalable solutions for ITN distribution that are sustainable for our context. Implementing partners in Ethiopia have already developed a mobile application for commodity management that will be customized to track ITNs. Under this approach, data related to ITN transactions, balances, and quantities dispensed to households would be transmitted to a centralized server (assuming data connections at the user location) and will populate an ITN campaign dashboard to provide near real-time visibility into campaign progress from a supply chain perspective to users across the system (HEWs, District Health office and PFSA hubs). This dashboard would be available through the existing health commodities management information system (HCMIS) dashboard interface. In addition, PMI will advocate for the implementation of NMCP's strategy that prioritize pregnant women and children for ITNs coupled with SBCC activities. According to the NMSP, SBCC activities will be focusing on community empowerment and mobilization which will drive reaching the ITN utilization targets.

Proposed activities with FY 2018 funding: (\$7,583,000)

- **ITN procurement:** PMI will support procurement of 2,113,000 ITNs for the 2017-2020 rolling mass campaign. These ITNs will be procured by the end of 2019 and distributed in 2020 to replace ITNs distributed in the 2016/2017 covering populations in 64 districts. (\$5,470,000).
- **ITN distribution and tracking:** PMI will assist districts to transport ITNs from district level to health posts and communities, at approximately \$1/ITN. All activities will be coordinated with the local authorities and HEWs in order to ensure that engagement of targeted districts is maximized, ITNs are distributed before the malaria transmission season, and communities are educated to use ITNs properly and care for them appropriately. PMI will support the NMCP and PFSA in coordinating and designing a ITN tracking dashboard system. (\$2,113,000)
- **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 ITNs. (see SBCC section)

c. Indoor residual spraying

Progress since PMI was launched

Since 2008, PMI has been providing targeted IRS to high malaria burden *kebeles* in PMI-supported districts according to the national guidelines. 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 and Table 8). PMI's IRS coverage increased from 19 districts in

2008 to 50 districts in 2011. Through a graduation process that PMI and Oromia Regional Health Bureau (ORHB) started in 2011, 24 districts were graduated from full PMI support for IRS in 2012 and 10 new high malaria burden districts were identified and included that year, resulting in a total of 36 districts receiving full IRS support from 2012-2016. All of these 36 districts are located in the western part of Oromia and all had high malaria burden when they were selected.

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 and they will gain the ability to sustain IRS operations with their own resources while PMI funds could support IRS in other districts. This model has shown to be effective: the 24 graduated districts achieved a 91% IRS coverage rate in 2016, spraying 465,531 structures and protecting 1,322,269 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 CB IRS nationwide.

From the initiation of PMI-supported IRS in 2008 (Table 8), ensuring that 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 leverage when needed.

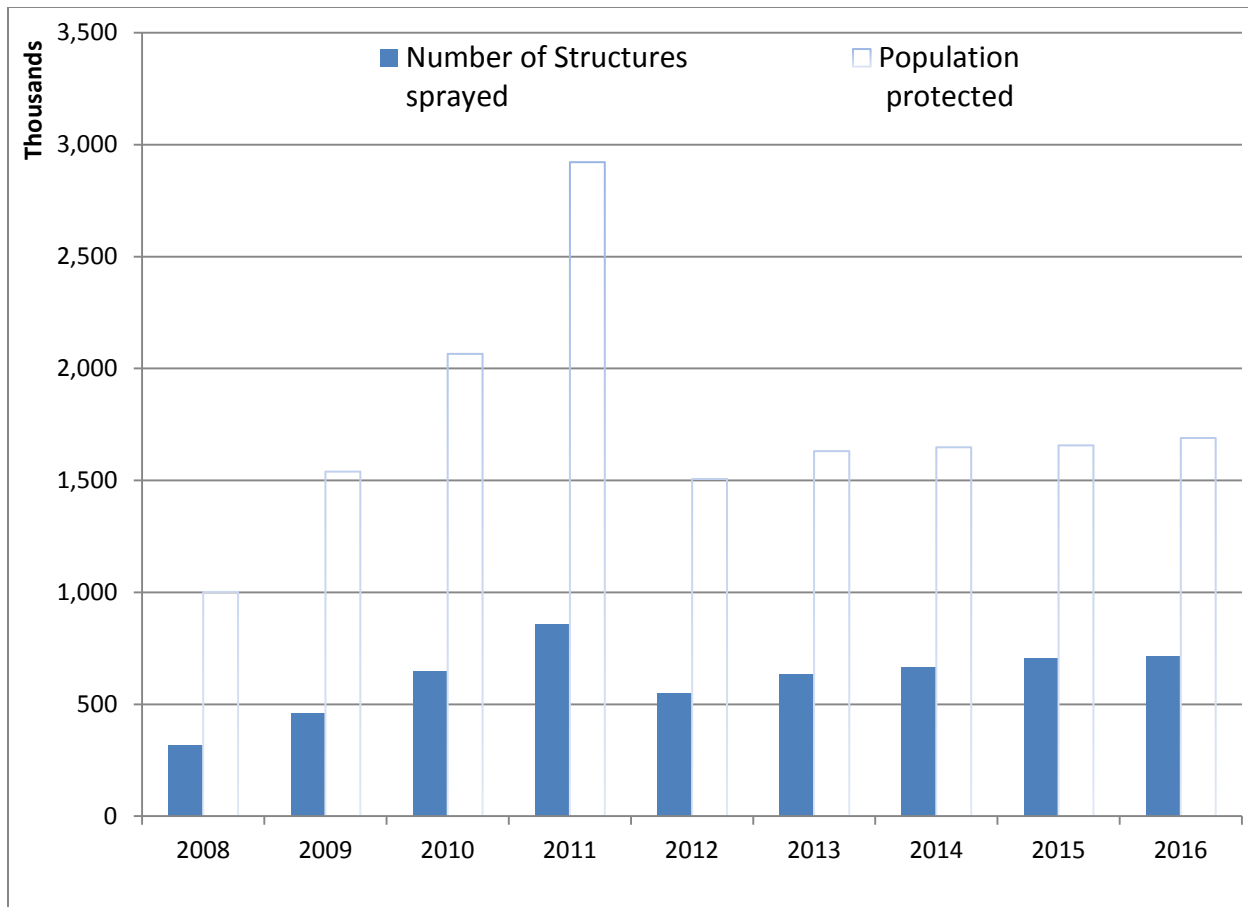
Table 8: PMI-supported IRS activities (2008-2019)

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	715,541	99.7	1,688,745
2017*	44	Pirimiphos-methyl CS	~787,700	TBD	~1,890,000
2018	40**	TBD	~787,700	TBD	~1,890,000
2019	40	TBD	~787,700	TBD	~1,890,000

* Represents projected targets based on the 2017 work plan and the national strategic plan.

** In 2018, 26 low malaria burden districts from the currently supported districts will graduate from full IRS support which make the total number of graduated districts sixty (34 old and 26 newly graduating districts). 26 new districts with high malaria risk will be identified to receive IRS support from Benishangul-Gumuz and possibly Gambella Regional States.

Figure 7: IRS results in PMI-supported districts of Oromia Region, Ethiopia, 2008-2016



Progress during the last 12-18 months

IRS Operations: In 2016, PMI supported the spraying of 715,541 structures and protected 1,688,745 people from malaria in 36 districts of Oromia Region, achieving a 99.7% coverage rate. The insecticide used in PMI-supported districts in 2016 was pirimiphos-methyl in all 36 districts. As per the FMOH guidance the use of pirimiphos-methyl CS was on a pilot basis to gain experience to advise future use. From the pilot, PMI communicated the effectiveness and activity of pirimiphos-methyl on different wall types to the FMOH and the Ministry accepted its use in all PMI-supported districts for 2016 and beyond. Further, the FMOH showed an interest in using pirimiphos-methyl CS in the government spray program in the future though recently decided to continue with bendiocarb and propoxur. In 2016, a total of 2,749 people (23% 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 2017 IRS campaign.

Community-Based IRS: In 2016, 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 2016 CB IRS districts, 181,657 (99.9%) structures were sprayed and 435,024 people were protected. In addition, wall bioassays conducted in the CB IRS districts were found to be comparable to the district-based IRS districts in 2016.

Obsolete DDT Removal: Significant progress was made between 2015-2017 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. In addition, all DDT-contaminated packaging and materials were shipped to Poland for incineration, which was completed in January of 2017.

Next Generation Indoor Residual Spraying Project (NGenIRS): Ethiopia has been participating in the UNTAID-funded NGenIRS Project since 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 enabled 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

Since the beginning of PMI in Ethiopia, the main support for IRS has been going to Oromia Region where the risk of malaria was the highest. Through concerted efforts for the last ten years it has become evident that malaria in Oromia has been markedly reduced except in few districts while the risk of malaria remains high in some parts of the country, specifically Benishangul-Gumuz and Gambella Regions. The MIS 2015 showed Gambella and Benishangul-Gumuz regions were the most malaria affected regions with 18.4% and 10.4% prevalence, respectively, amongst all ages using RDT whereas the national average was 1.2%. The PMI IRS policy and the draft NSP (2017-2020) underscores that high malaria burden areas be targeted for IRS. Accordingly, PMI is planning to increasingly target the high malaria risk districts in Benishangul-Gumuz and Gambella Regional States through graduating IRS supported districts in Oromia that have been receiving full support for many years. According to the new malaria risk stratification (draft NSP 2017-2020), most districts in Oromia are now classified as low malaria risk which do not require IRS intervention as the main vector control tool.

With FY 2018 funds, PMI will maintain the FY 2017 level of IRS support and will support IRS operations in 40 districts with a focus on high risk districts in the highest malaria risk regions. Specifically, IRS will be conducted in 20 districts in Benishangul-Gumuz, 10 districts in Gambella, and 10 districts in Oromia Regions. In these districts, approximately 788,000 structures will be sprayed and 1.9 million people protected. PMI, through close collaboration with the FMOH, RHBs, and other partners, will continue providing minimal support (roughly 10% of funding provided for fully supported districts) and will monitor the status of malaria in the 60 graduated districts using health facility and micro-planning data. In addition, through discussions with RHB, PMI will determine how best to expand PMI's CB IRS implementation in the new districts. With FY 2018 funding, there will likely be fewer structures sprayed due to the fact that the high burden districts are often less densely populated and logistical costs can increase given the distance between spray sites. The lower population size allows for IRS expansion to 40 high-risk districts. IRS operations, IRS environmental compliance assessment and environmental compliance trainings will also be delivered with the ultimate goal of

building local capacity in IRS operations.

Proposed activities with FY 2018 funding: (\$10,660,000)

- **IRS operations:** PMI will focus on high burden districts in high burden regions focusing on 20 districts in Benishangul-Gumuz, 10 districts in Gambella, and 10 districts in Oromia Regions. Minimal support will be provided to the 60 graduated districts in the form of planning assistance, supervision, and environmental compliance. (\$5,145,000)
- **Procurement of insecticide, IRS equipment and personal protective equipment:** PMI will procure long-lasting insecticide (with support from the NGenIRS project) for all 40 PMI-supported districts. The exact allocations and specifications of insecticides will be determined upon completion and review of the 2017 and 2018 IRS activities. IRS equipment and personal protective equipment will also be procured based on IRS micro planning results and gap analyses. (\$5,000,000)
- **IRS training:** PMI will support in-service training at federal and regional levels to increase FMOH's, RHB'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. (\$480,000)
- **Environmental compliance monitoring:** Support for an external environmental compliance assessment of Ethiopia's IRS activities. Insecticide distribution, use, storage, and disposal as well as insecticide tracking systems and/or tools will be monitored. (\$35,000)

2. Malaria in pregnancy

NMCP/PMI objectives

The Ethiopian FMOH's NMSP (2017-2020) 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 relatively high costs. Malaria in pregnancy (MIP) in Ethiopia is addressed through: 1) improving prompt access to care and treatment at all levels of the health system (health posts, health centers and hospitals), 2) prioritizing the use of ITNs by pregnant women within households, and 3) enhanced SBCC activities and outreach for pregnant women.

In the recent 2015/16 Ethiopia HSTP I Annual Performance Report, ANC coverage with at least one visit was 98.4% and full ANC coverage (at least four visits) was 76% nationwide. ANC coverage with at least one visit was 100% for all regions except Afar (93%), Gambella (68.4%) and Somali regions (51%). Full ANC coverage varies significantly between regions. Gambella is the lowest at 14.4% while Addis Ababa is the highest at 100%. Afar, Somali, Benishangul-Gumuz and Dire Dawa are below 60% while the remaining are above 60%. The 2016 DHS showed that 62% of women received at least one antenatal care from a health professional for their most recent birth in the five years preceding the survey. This has improved from 34%, which was noted in the 2011 DHS. The 2016 DHS also showed that 32% women had four or more of antenatal visits for their most recent live birth. Increasing ANC coverage is 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, however, the IDSR was folded into the PHEM system and specific MIP morbidity and mortality data were no longer published. A cross-sectional survey of placental parasitemia at a stable (high) malaria transmission site in the sparsely populated Gambella Regional State by Newman et al (2003) noted 6.5% prevalence, whereas three other sites in unstable (i.e., low) transmission settings noted only 2.5% prevalence. This study, the only study of placental parasitemia in Ethiopia, demonstrated relatively low prevalence of malaria infection during pregnancy and as a result, IPTp has not been implemented in Ethiopia.

The 2012 National Malaria Guidelines, consistent with WHO guidance, 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. For severe malaria, IV artesunate 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. Primaquine radical cure is contraindicated during pregnancy and WHO recommends weekly chloroquine prophylaxis until delivery and completing breastfeeding for pregnant women who have *Plasmodium vivax* infection. However, this has not been included in the national malaria guideline.

There are few, if any, ITN distributions via ANC clinics in Ethiopia, except through a small project that overlaps with PEPFAR. Distribution of ITNs 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 ITN coverage and encourage pregnant women to use ITNs; and ensure availability of prompt diagnosis and treatment of clinical malaria cases during pregnancy at health facilities. The ITN replacement scheme presented in the NMSP is the policy framework for continuous ITN distribution primarily through the HEP. Nearly all ITNs are distributed by HEWs through mass campaigns every three years. HEWs are instructed to make sure that pregnant mothers and children less than five years of age have preferential access to ITNs in these mass campaigns and educate communities to give priority to pregnant mothers and children in the event there are too few ITNs per household, resulting in an insufficient number of nets to cover the entire family.

Progress since PMI was launched

Based on the MIS 2007, 2011, and 2015, 43%, 35%, and 44.3% of pregnant women slept under an ITN, respectively. A major focus of ANC programs in Ethiopia is providing expanded access to quality healthcare through health centers and health posts, where PMI supported projects since 2008 promoting prompt access to diagnostic and treatment services for pregnant women and in identifying and preferentially distributing ITNs to pregnant women in rural communities. PMI has been supporting pre-service training of midwives and HEWs, and thus, contributed to the graduation of 10,591 midwives and 16,859 HEWs between 2013 and 2017.

There is no new surveillance data from IDSR since 2009 concerning trends in the specific burden of malaria amongst pregnant women, 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 2014-2015 at 775,052 and 405,490, respectively. These HMIS surveillance reports indicate

that “female” morbidity—predominantly of women of childbearing age—has also declined since 2011, along with that of the general population.

Progress during the last 12-18 months

PMI has supported the development of a new malaria case management training manual, which includes MIP. Social behavior change communication messages are being developed based on these guidelines. PMI has supported malaria prevention and treatment efforts since January 2017 in Tigray, Amhara, Oromia, and Southern Nation and Nationalities Peoples’ (SNNP) major Regions, and since May 2017, in Gambella, Benishangul-Gumuz, Afar and Somali Developing Regions. These activities aim to improve the overall performance of PHCUs with malaria-specific outcomes, mainly related to pregnancy and malaria case management at the health post level.

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 2018 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. PMI 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 an ITN 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.

PMI will continue to work with the FMOH to identify and review all available 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 efforts would aim to provide an appropriate evidence basis for any possible future health policy changes related to MIP in Ethiopia.

Proposed activities with FY 2018 funding: (\$300,000)

- **Strengthening case management of MIP in major regional states:** PMI will support the case management of MIP as part of an overall package of integrated activities focusing primarily in the areas of MNCH, family planning and reproductive health, and malaria within Ethiopia’s major regions which include Tigray, Amhara, Oromia and SNNPR. These are comprehensive programs 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. (\$100,000)
- **Strengthening case management of MIP in developing regional states:** PMI will support the case management of MIP as part of an overall package of integrated activities focusing primarily in the areas of MNCH, family planning and reproductive health, and malaria within Ethiopia’s four developing regions (Gambella, Afar, Benishangul-Gumuz and Somali). (\$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 will be 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 quality assured diagnostic commodities at all health facilities. In addition, routine quality assurance of diagnosis and treatment practices will be conducted.

The NMSP states that ACTs, specifically artemether-lumefantrine (AL) 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, and as second line for treatment failures. Although rectal artesunate has been recommended for pre-referral treatment at rural health posts, it has not been widely implemented and faces challenges of drug expiry due to limited demand by HEWs and caretakers bypassing the rural health posts when the child has severe disease. Parenteral artesunate or artemether (alternate) should be available at health centers and hospitals for the treatment of severe malaria. The NMSP recently recommended primaquine for radical cure of *P. vivax* and also single, low-dose primaquine for gametocytocidal activity against *P. falciparum* (Table 9). Regarding implementation, single dose primaquine will be deployed all over the country while primaquine radical cure will be started in the elimination targeted *woredas* and then will be scaled up to remaining parts of the country. A circular detailing these changes in the treatment policy (i.e., on single-dose primaquine for *P. falciparum* as well as primaquine for radical cure of *P. vivax* malaria) has been distributed to all facilities in August 2016. In addition, all projected primaquine needs have already been procured and distributed to facilities using Global Fund resources and is currently in use for *P. falciparum*. The wide-scale implementation of radical cure primaquine for vivax malaria is projected to occur after the PMI-funded systematic evaluation of the safety of Ethiopia’s approach of radical cure without G6PD testing with intensified follow up in the elimination districts has been completed.

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 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. Private health facilities that are involved in the partnership will only charge consultation and diagnosis fee and will not charge patients for free commodities received from the government. The private health sector benefits by obtaining free commodities and supplies for diseases of public health importance through the GoE’s supply chain management system thus increasing demand for care and in turn will provide health information to districts and regions. MISs from 2007 to 2015 suggested that about 24.1-36.4% of people initially receive care for febrile illnesses through the private sector. However, the capacity of the private sector to

manage malaria is limited due inadequate competency of the health workforce, limited access to updated guidelines and malaria commodities (i.e., ACTs, RDTs, microscopy supplies, as well as rectal and IV artesunate). Thus, much work is still needed to improve collaboration, support, and regulation with the private sector, and support to establish a formal platform to share national malaria guidelines or best practices.

Table 9. Status of Case Management Policy in Ethiopia

Status of Case Management Policy in Ethiopia according to updated treatment guideline 2012 and a circular indicating changes related to single dose and radical cure primaquine, dated August 1, 2016	
What is the first-line treatment for uncomplicated <i>P. falciparum</i> malaria?	Artemether-lumefantrine and single dose primaquine
What is the first-line treatment for uncomplicated <i>P. vivax</i> malaria?	Chloroquine and primaquine (14 days)
What is the second-line treatment for uncomplicated <i>P. falciparum</i> and <i>P. vivax</i> malaria?	Oral quinine
What is the first-line treatment for severe malaria?	IV/IM artesunate
In pregnancy, what is the first-line treatment for uncomplicated <i>P. falciparum</i> malaria in the first trimester?	Oral quinine
In pregnancy, what is the first-line treatment for uncomplicated <i>P. vivax</i> malaria in all trimester*?	Chloroquine
In pregnancy, what is the first-line treatment for uncomplicated <i>P. falciparum</i> malaria in the second and third trimesters?	Artemether-lumefantrine
In pregnancy, what is the first-line treatment for severe malaria?	IV/IM artesunate
Is pre-referral treatment of severe disease recommended at peripheral health facilities? If so, with what drug(s)?	First dose of IM artesunate (Health Centers)
Is pre-referral treatment of severe disease recommended for community health workers? If so, with what drug(s)?	Rectal artesunate (Health Posts)
If pre-referral rectal artesunate is recommended, for what age group? (note: current international guidelines do not recommend administering to those ≥ 6 years)	The guideline was updated to exclude those ≥ 6 years

Progress since PMI was launched

In 2011 Ethiopia adopted a policy that all patients with suspected malaria should receive a confirmatory diagnostic test before treatment with an antimalarial. FMOH has scaled up quality-assured diagnostic testing at both health facility and community level with support from PMI and the Global Fund. An

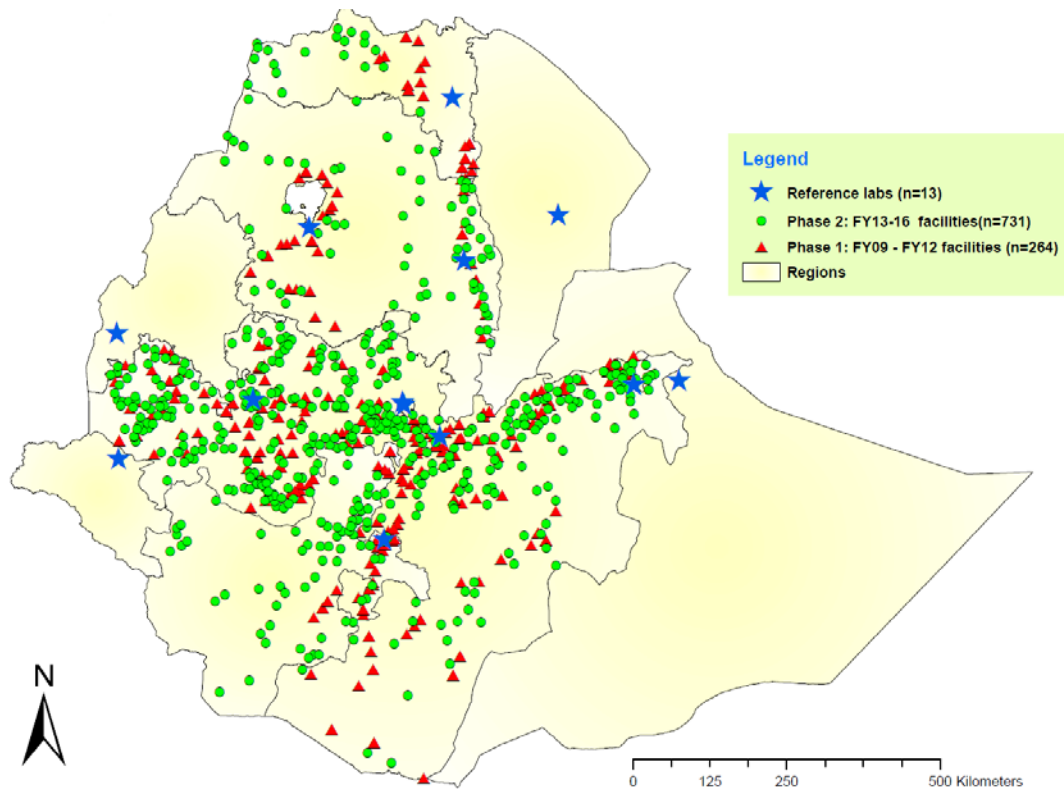
analysis of micro-plan data indicates that Ethiopia has made significant progress in scaling-up diagnostic testing for malaria: the percentage of all suspected malaria cases reported that were confirmed by either RDT or microscopy increased from 59% in 2011 to 97% in 2016, leaving only 271,721 presumed malaria cases (i.e., those cases that were clinically treated without laboratory confirmation). Figure 2 shows the rapid progress in malaria confirmatory testing in Ethiopia.

From 2008 through 2017, PMI procured 9,240,000 million RDTs, 15,046,630 ACT treatments, 7,025,000 chloroquine treatments, 153,000 artesunate suppositories, and 336,000 vials of parenteral artesunate. The Global Fund and MDG pooled funds have provided sufficient quantities of ACTs, chloroquine 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 1,094 microscopes, laboratory supplies, and reagents to scale up quality assurance systems for malaria microscopy. PMI also supported the training of all (3,519) laboratory professionals from 1,022 health facilities, 227 regional laboratory staff from 13 regional laboratories, all of the 243 graduating university students and 162 university laboratory instructors from 8 universities on malaria laboratory diagnosis and quality assurance. The capacity of university instructors for the pre-service training as well as in-service trainings was improved. From 53 zonal health departments and 30 district health offices having 2 to 3 malaria program managers, 337 were trained on malaria case management since 2009. Further, 21,451 health workers were trained in malaria treatment, as well as providing supervision of HEWs management of the sick child through iCCM training, including performance of RDTs for managing acute febrile illnesses.

To date, PMI supported quality assurance (QA) and quality control (QC) activities in 1,022 health facilities (Figure 8) 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. 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 this 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 supported increased access to quality malaria services, including diagnostic testing and free antimalarial treatment to the clients in the private sector.

Figure 8: PMI-supported laboratory facilities from 2009-2017



Progress during the last 12-18 months

The FMOH’s 2016 HSTP I annual review meeting report, which reported on PHEM data (July 2015-June 2016), stated that “out of the total 2,320,153 malaria cases reported 2,033,310 (87.6%) were confirmed by either microscopy or RDT, out of which 1,325,409 (65.2%) were *P. falciparum* and 707,901 (34.8%) 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 has assisted the revision of national malaria guidelines and malaria strategic plan to incorporate recent updates. A competency based malaria case management training manual was developed to improve the skills of health workers on clinical management of uncomplicated and severe malaria, malaria data recording and reporting, and appropriate utilization of malaria commodities supply chain forms. The manual has been pre-tested and approved by the Human Resource directorate of the FMOH. Training of trainers and cascade trainings are planned to be given to clinicians using Global Fund resources.

PMI supported onsite and offsite clinical training for 336 and 345 clinicians, respectively. In addition, PMI supported several rounds of microscopy training complemented by onsite supportive supervision and mentorship. PMI currently supports training and supervision of malaria diagnosis in 1,022 health

centers with laboratories in malarious areas in Ethiopia. Laboratory strengthening activities for malaria microscopy include quality improvement, purchasing laboratory equipment and additional supplies, supportive supervisions for treatment processes, and activities 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 2016, 10,742 standard slides have been produced. In addition, capacity of eight regional laboratories was built to conduct cascade training and supervision to peripheral laboratories. PMI has provided technical and logistic support to ORHB to deliver integrated supportive supervision for malaria, to additional 3 zones 6 *woreda* offices and 14 health facilities that reported an increase in the number of cases in 2016.

In addition, PMI has supported the training of 1,112 laboratory personnel on an integrated malaria-HIV laboratory diagnosis and QA/QC system. Additional three laboratory supervisors from regional reference laboratories have received training of trainers training. 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 57 laboratory and 107 clinical 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 and 8 were certified as level 1 and the rest as level 2.

During the past 12 months, 683 health facilities were involved in an external QA scheme of the target 1,022 facilities. 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, 243 health facilities have been graduated. PMI ensures minimum support for graduated facilities via less frequent but continuous supportive supervisory visits.

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 3,547 health centers and 189 hospitals with microscopy diagnostic capacity, of which 75% of the facilities are estimated to be in malarious areas as of 2016. 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.

PMI has provided support tools such as algorithms for fever management, dosing charts and conducted clinical mentoring and supervision in selected 162 health centers with high caseloads and remote location. In addition, PMI supported the development of malaria case management training manual for health centers and hospitals.

In 2016, 148 private for-profit health facilities have been 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 completed two therapeutic efficacy studies in 2010 and 2014. The vivax efficacy study completed in 2014 and recently published in May 2017 noted high rates of recurrent vivax parasitemia by day 42 in both the chloroquine and AL treatment arms while the addition of primaquine to either regimen significantly improved day 42 outcomes and resulted in a 5-fold reduction in the number of relapses experienced over a year ([Abreha et al., 2017](#)). A therapeutic efficacy monitoring study of artemether-lumefantrine and dihydroartemisinin-piperaquine for *P. falciparum* and chloroquine and dihydroartemisinin-piperaquine for *P. vivax* will be conducted in fall 2017 at two sites with financial support from PMI and the Global Fund. This planned efficacy study will incorporate resistance marker testing including Kelch 13 and plasmepsin as well as additional HRP2 deletion testing in any samples with discordant RDT and slide results likely to be conducted at CDC. The HRP2 deletion testing is contributing data to a larger FMOH/EPHI survey of several health facilities to investigate the occurrence of HRP2 deletion in areas bordering Sudan and Eritrea funded by WHO.

Table 10. PMI-funded TESs

Completed TESs		
Year	Site name	Treatment arm(s)
2009	Bulbula Health Center and Bishoftu Malaria Center	1. AL for vivax 2. CQ for vivax 3. AL for falciparum
2012	Bishoftu Malaria Center and Batu Health Center	1. AL for vivax 2. AL+PQ for vivax 3. CQ for vivax 4. CQ+PQ for vivax
Ongoing TESs		
Year	Site name	Treatment arm(s)
2017	*Pawe and Arbaminch Health Centers	1. AL for falciparum 2. DP for falciparum 3. CQ for vivax 4. DP for vivax
Planned TESs FY 2018		
Year	Site name	Treatment arm(s)
2019	TBD	AL for falciparum and CQ for vivax

TES: Therapeutic Efficacy Study; AL: artemether-lumefantrine; CQ: chloroquine; PQ: primaquine; DP: dihydroartemisinin-piperaquine; TBD: to be determined

*Because of the low prevalence, there are an insufficient number of cases in the previous sites to conduct TES within a reasonable time frame. There are an additional two sites where TES is conducted by EPHI using Global Fund resources.

Commodity gap analysis

Table 11: RDT Gap Analysis

Calendar Year	2017	2018	2019	2020
RDT Needs				
Total country population	92,017,576	94,410,033	96,864,694	99,383,176
Population at risk for malaria	54,934,493	56,362,790	57,828,222	59,331,756
PMI-targeted at-risk population	54,934,493	56,362,790	57,828,222	59,331,756
Total number of projected fever cases*	8,222,266	8,140,043	8,058,643	7,978,056
Percent of fever cases tested with an RDT****	52%	52%	52%	52%
Total RDT Needs*	4,489,357	4,444,464	4,400,019	4,356,019
Partner Contributions				
RDTs carried over from previous year	0	3,910,643	4,763,559	5,720,905
RDTs from Government	0	0	0	0
RDTs from Global Fund	5,400,000	5,297,380	5,357,365	5,472,611
RDTs from other donors				
RDTs planned with PMI funding	3,000,000**	0***	0	0
Total RDTs Available	8,400,000	9,208,023	10,120,924	11,193,516
Total RDT Surplus (Gap)	3,910,643	4,763,559	5,720,905	6,837,497
Footnotes: 8,222,266 is the total number of fever cases and is taken from micro-plan 2016 data which is clinical case + fever cases tested *The total number of fever cases have been adjusted considering the 1% annual reduction based on the fever trend of MIS 2007, 2011 and 2015 ** 3 million RDTs were procured in in 2017 in response to an emergency request from the FMOH. *** In the FY 2017 MOP, there was a plan to procure 513,000 RDTs in 2018. Due to the large surplus, PMI will no longer procure RDTs. **** 2013/14 micro-plan data The population growth rate was taken to be 2.6% for Ethiopia				

The number of malaria suspected cases was taken from the micro-plan 2015/2016 data, which is calculated by adding number of clinically treated cases with number of fever cases tested. The trend of fever was calculated from the finding of MIS 2007, 2011 and 2015. The anticipated decline in fever prevalence is 1% per year based on the decline in fever prevalence from 24%, 20% to 16% in MIS 2007, 2011 and 2015, respectively. The decline is expected to plateau and by 2020 it will be 12%. MIS 2015 and DHS 2016 show 38% and 35% of children with fever in the past two weeks sought treatment, respectively. This indicates the need to improve care-seeking behavior for individuals with fever. The primary barriers for care seeking seem to be a lack of knowledge and population perception about

fevers. Many individuals do not consider fever as a significant health threat. Access to health care and treatment does not seem to be a barrier in Ethiopia because of the health posts which are present at the community level and geographically distributed to make health care easily accessible. PMI has helped support HEWs by supporting pre-service and in-service training to improve competency among HEWs on the use of RDTs and antimalarial treatment and providing health education. PMI continues to work with the health system to stress the importance of testing all fevers for malaria and also to specifically teach health professionals how to mobilize the populations they work with and raise awareness to seek care with fever. PMI also supported social mobilization planning tool, school based malaria communication and development of advocacy, communication and social mobilization guide for malaria elimination. As 24% of the population goes to the private sector for fever management, PMI supports the private sector to provide quality assured malaria diagnosis and treatment services.

Table 12: ACT Gap Analysis

Calendar Year	2017	2018	2019
ACT Needs			
Total country population	92,017,576	94,410,033	96,864,694
Population at risk for malaria	54,934,493	56,362,790	57,828,222
PMI-targeted at risk population	54,934,493	56,362,790	57,828,222
Total projected number of <i>P. falciparum</i> malaria cases*	1,624,095	1,461,686	1,315,516
Total ACT Needs**	1,705,300	1,534,770	1,381,293
Partner Contributions			
ACTs carried over from previous year	0	994,700	1,056,016
ACTs from Government	0	0	0
ACTs from Global Fund	0	1,596,086	1,087,652
ACTs from other donors	0	0	0
ACTs planned with PMI funding	2,700,000	0	0
Total ACTs Available	2,700,000	2,590,786	2,143,668
Total ACT Surplus (Gap)	994,700	1,056,016	762,376
Footnotes: The source of the data is Micro-plan 2015. The population growth rate for Ethiopia is 2.6%/year *Total projected number of malaria cases are based on the 2015 micro-plan data with an assumption of 10% annual reduction per NMSP target **5% buffer is included **60-70% of the total projected number of malaria cases is due to <i>P. falciparum</i> and to be treated with AL			

Table 13: Chloroquine Gap Analysis

Calendar Year	2017	2018	2019
CQ Needs			
Total country population	92,017,576	94,410,033	96,864,694
Population at risk for malaria	53,278,177	56,362,790	57,828,222
PMI-targeted at-risk population	53,278,177	56,362,790	57,828,222
Total projected number of <i>P. vivax</i> malaria cases*	477,680	429,912	386,921
Total CQ Needs**	501,564	451,407	406,267
Partner Contributions			
CQ carried over from previous year	0	948,436	497,029
CQ from Government	0	0	0
CQ from Global Fund	0	0	0
CQ from Other Donors	0	0	0
CQ planned with PMI funding	1,450,000***	0	192,857
Total CQ Available	1,450,000	948,436	689,886
Total CQ Surplus (Gap)	948,436	497,029	283,619
Footnotes: The source of the data is the 2015 micro-plan. CQ: chloroquine The population growth rate for Ethiopia is 2.6%/year * Total projected number of <i>P. vivax</i> malaria cases is based on the 2015 micro-plan data with an assumption of 10% annual reduction per NMSP target. 5% buffer is included. *** PMI has procured 1.45 million CQ in response to emergency request from the FMOH.			

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 (IPLS) 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 MDG funds will be re-evaluated and possibly covered by PMI.

PMI will continue 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 remote high burden hard-to-reach malarious areas and elimination districts. 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 from occupational

and travel-related activities such as performing seasonal 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. PMI plans to support an assessment of prevention and control strategies for migrant workers especially in the development corridor 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 continuing the support for the existing 1,022 facilities and expanding to an additional 400 facilities by 2019.

PMI is planning to provide TA for case management training for clinicians, which will be supported by FMOH through GFATM.

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 2018 funding: (\$5,438,000)

- **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 fever case management at health center and hospital level:** Technical and programmatic support to 1,200 health facility laboratories and clinics 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, supervision, mentoring and auditing for laboratorians and clinicians. In addition, training and accreditation will be provided to laboratory supervisors. These activities will be expanded to an additional 200 health facility laboratories and clinics. 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 injectable artesunate:** PMI will support the procurement and distribution of the entire estimated national need for injectable artesunate (i.e., 250,000 vials of artesunate). (\$630,000)
- **Procurement of chloroquine for *P. vivax* treatment:** PMI will support the procurement and distribution of the entire estimated national need for chloroquine (i.e., 192,857 treatments of chloroquine). (\$108,000)
- **Provide support for training, ongoing supervision and monitoring of malaria diagnosis and treatment in major regional states:** Support for supervision and monitoring of malaria case management including MIP at PHCUs in Oromia, Amhara, SNNPR, and Tigray regional states. It is expected that this support will cover all health centers and health posts in malarious areas in

approximately 300 districts. Health workers, including HEWs, will receive in-service training on revised malaria case management guidelines, on-site supervision focusing on RDT EQA, and ensuring that case management reporting is complete and accurate. Malaria diagnosis and treatment in pregnancy is strengthened at health post level and also at ANC clinics in health centers (\$1,100,000)

- **Provide support for training, ongoing supervision and monitoring of malaria diagnosis and treatment in developing regional states:** Support for supervision and monitoring of malaria case management including MIP in the developing regions namely Gambella, Benishangul-Gumuz, Somali, and Afar. Health workers, including HEWs, will receive in-service training on revised malaria case management guidelines, on-site supervision focusing on RDT EQA, and ensuring that case management reporting is complete and accurate. Malaria diagnosis and treatment in pregnancy is strengthened at health post level and also at ANC clinics in health centers. (\$300,000)
- **Strengthen private sector malaria 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 the development economic corridor areas. 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 levels. 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)
- **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)

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 to ensure access to good quality 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 that lead to 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. Health extension workers based at health posts are supplied every two months through health centers. The supply is monitored by the health center workers and through monthly reports and request forms (i.e., health post monthly report and resupply form) that is designed for health post level use. 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 ITNs, 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 and other malfeasant activities related to medicines.

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 services for both 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, however, PMI has been procuring drugs, including ACTs, for national coverage.

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 intended to improve medicines availability, reduce wastage/expiry, and improve revenue. As part of the implementation, APTS tools – including financial vouchers, receipts and dispensing registers – were developed.

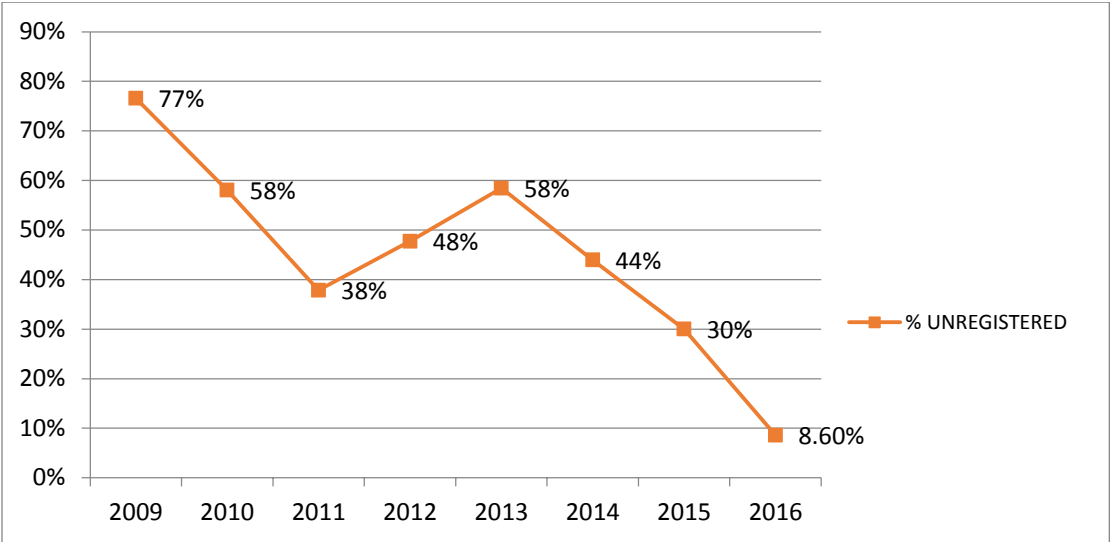
PMI supported strengthening drug quality and safety monitoring capacities at FMHACA via post-marketing surveillance activities, including use of Minilabs[®]. The Minilabs[®] are portable kits used to collect drug samples and provide preliminary field testing, through thin-layer chromatography, on the quality of sampled medicines at customs check points, airports, and border ports of entry. There are seven ports of entry where samples are tested. Any sample that fails this preliminary screening will not be permitted to enter the market but if the result is doubtful then it will be sent to Product Quality Assessment Directorate Laboratory for confirmatory compendial testing.

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.

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 pharmacopeia testing procedures for human drugs.

PMI has been supporting post-marketing surveillance of antimalarials since 2009, a total of 2,363 sample antimalarial drugs have been collected and tested from both public and private outlets. In summary, these surveillance assessments have shown: the presence of antimalarial medicines without marketing authorization, both locally manufactured and imported products, was 77% (315/410) in 2009, compared to 8.6% (14/163) in 2016 (Figure 9); the presence of substandard antimalarial medicines in the market from 12% (49/410) in 2009 to 1.8 % (3/163) in 2016. Based on findings from these surveys, FMHACA has taken regulatory steps, including the withdrawal/recall of primaquine and quinine, closure of select drug outlets, and social communication activities to increase public awareness about poor quality and counterfeited drugs.

Figure 9: Trend in proportion of sampled antimalarials failing compendial testing from select sites, Ethiopia from 2009–2016



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. Out of the 900 service delivery points (750 hospitals/health centers, 100 health posts, and 50 *woredas*) visited quarterly by U.S. Government program 80% are in malarious areas and are supported by PMI. These facilities are all over the country including emerging regions.

PMI has supported health facilities to ensure availability of AL. In fact, facility-level assessments have revealed significant increases in availability of ACTs at the facility level since IPLS integration began in 2016. For example, comparing the fourth quarter of FY 2016 to the first quarter of FY 2017, the percent of facilities experiencing stockout of all AL presentations declined from 9% (36/400) to 3% (12/400) at

health centers; from 25% (13/51) to 6% (3/51) at health posts; and from 39% (25/63) to 22% (9/63) at *woreda* health offices.

In support of FMHACA, PMI conducted a rapid assessment of six regional FMHACA laboratories to strengthen post-marketing drug quality monitoring. Currently, PMI strengthened the capacity of regional laboratories by training and seconding one analyst each at the four regional laboratories. In FY 2016, 163 antimalarials (37 AL, 12 chloroquine syrup, 35 quinine and 8 injectable artesunate) were collected and underwent compendial testing. Of the samples tested, three quinine solid oral dosage forms failed and were, in fact, found to be counterfeit (i.e., no active pharmaceutical ingredient found). Consequently, FMHACA took regulatory action of recalling the drugs from outlets where it was found and cancelled the outlets' licenses. In addition, FMHACA reported the finding to the WHO Alert system.

PMI also works to strengthen the supply chain for distribution of ITNs, which are currently distributed largely through parallel systems. An assessment was completed with support from PMI, which provided recommendation mainly to develop ITNs dashboard for system strengthening in ITN distribution and tracking. PMI supported the development of national malaria technical working group and is a core member. PMI continued supporting Look Ahead Seasonality Index (LSI), a model to calculate malaria commodity resupply needs accounting for seasonality, implementation in collaboration with PFSA. Currently it is being implemented in 10 (Bahir Dar, Shire, Mekelle, Gambella, Gondar, Adama, Dire Dawa, Jimma, Hawassa and Asossa) out of 17 hubs, and LSI indexes have been incorporated in the HCMIS warehouse management software. Based on supportive supervision data, compared to the previous quarter FY 2016 quarter four, the percent of facilities experiencing stockouts of artemether-lumefantrine (i.e., none in stock) declined from 9% to 3% at health centers (from 400 assessed health centers), and from 25% to 6% at health posts (from 51 assessed health posts). The results are due to the integration of malaria commodities in the IPLS, LSI, and the training and supportive supervision activities.

Plans and justification

The increasing mandate and 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. Support to the micro-plan exercise will continue, as it currently provides the most comprehensive morbidity and consumption data to inform procurement of antimalarials, RDTs, and ITNs. Additionally, micro-planning is necessary, considering the IPLS system is not implemented at full scale. PMI is providing ongoing support to the FMOH and PFSA for IPLS implementation at health facilities. Each quarter, the project will monitor various key IPLS indicators (including use of and quality of data in report and requisition form (RRFs) at 750 health facilities (including hospitals, health centers) with all regions represented and 80% in malarious areas. There is also a small sample of 100 health posts selected every quarter. PMI contributes a portion, but the system includes funding from other health programs. Data will be compiled and shared on a quarterly basis with relevant stakeholders. Malaria commodity availability will be assessed and on-the-job mentoring will be provided as part of the supportive supervision. The NMCP is planning to phase out micro-planning once there is a sufficiently robust and comprehensive malaria surveillance and logistics information management systems in place. 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. In addition to the post marketing surveillance support, PMI plans to build inspection

capacity at regional regulatory offices, to ensure the quality of antimalarial sold at the drug outlets. These will include training and mentoring of inspectors in four major regions (Amhara, Tigray, Oromia and SNNP) and two city administrations (Dire Dawa and Addis Ababa).

With FY 2018 funding, PMI will continue to support PFSA particularly as the transition of malaria commodities from RHBs are fully incorporated in the IPLS, a system designed to ensure availability and minimize wastage of pharmaceuticals. PMI will support the incorporation of the LSI system in all hubs and provide ongoing technical support to all 17 hubs till they can proficiently use the LSI on their own. APTS will also improve the quality of pharmacy services through facilitating appropriate storage, strengthening stock recording, enabling proper review of prescriptions, and increasing appropriate dispensing of medicines, including antimalarial drugs.

Proposed activities with FY 2018 funding: (\$1,900,000)

- **Strengthening PFSA pharmaceutical data management capacity:** PMI will continue to provide support to PFSA to coordinate and implement the best approach in data management to sustain and fully integrate malaria commodities into the IPLS and conduct EUV surveys. (\$400,000)
- **Antimalarial drug management and strengthening PFSA capacity:** 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 for malaria diagnosis. PMI will continue to support antimalarial drug management through supporting APTS activities in Oromia Regional State. (\$1,000,000)
- **Strengthening drug quality monitoring:** PMI will continue to strengthen FMHACA's drug quality assurance program through: supporting post marketing surveillance; strengthening regional laboratory and inspection capacity; implementing public awareness creation activities; and improving data use and subsequent policy and regulatory measures. (\$500,000)
- **Micro-planning surveys for estimating annual requirements and for targeting malaria commodities:** With FY 2018 funding, PMI will continue to support the FMOH through micro-planning meetings with participants from all malaria-affected *woredas* and zones in Ethiopia to determine the requirements of antimalarial treatments, RDTs, and ITNs 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.

NMCP/PMI objectives

The FMOH's NMSP (2017-2020) 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 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. 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.

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 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 epidemiology training program for health workers. Trainees are 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.

Peace Corps Ethiopia

The U.S. Peace Corps has been active in Ethiopia for over 50 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.

Progress since PMI was launched

Through FY 2017, PMI cumulatively supported training for 22,794, and 21,451, health workers in IRS operations and malaria diagnosis and treatment, respectively. As these trainings are part of a broader set of health systems strengthening (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. The strategy focuses on the HEW Upgrading Program, Health Information Technique, Integrated Emergency Surgical Officers program, Accelerated Midwifery Training Program and Anesthesia Initiative which will significantly improve health services. 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.

Ethiopia FETP residents have conducted numerous malaria research projects in Ethiopia providing data for decision makers and have made significant contributions to the PHEM surveillance system including developing weekly bulletins which include malaria data. For example, FETP residents have continued to evaluate ITN ownership and use to identify key issues and messaging needed to optimize ITN use in communities. The MOH FETP recently held the first Annual Ethiopia FETP Conference with the theme 'Addressing the Elimination of Malaria in Ethiopia through the Field Epidemiology Training Program.' Numerous malaria research projects were presented by FETP residents directly to an audience including government officials, academicians, and NGO partners. PMI has provided support to EFETP residents annually since 2008 to enhance their training and expertise in malaria and related outbreaks of acute febrile illness that can be confused with malaria. The EFETP has recently expanded to include over 400 residents from eight different universities, with PMI providing malaria-related mentorship, training, and technical assistance to create malaria expertise among these future public health leaders. To enhance the impact of PMI on mentoring and successfully training future malaria public health leaders, we have been focusing our support to three to five residents from each cohort through mentorship and professional growth activities. Former FETP residents currently hold leadership positions in the FMOH and their malaria experience make them valuable advocates for malaria prevention and control goals.

There are now over 125 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. Peace Corps volunteers have helped with ITN distributions in some communities, and have helped to promote ITN use through programs aimed at school-aged children. Recently, PMI has supported the creation of a third year volunteer opportunity for Ethiopia Peace Corps volunteers interested in an additional year of malaria experience with a PMI implementing partner.

Progress during the last 12-18 months

During 2016, PMI supported training of 2,230 midwives, 3,271 HEW level IV, 2,600 HEW level III, and 373 other essential health workers (emergency medical technicians, anesthesia and bio-medical technicians). Malaria case management training was provided for 164 instructors from 8 health colleges on malaria diagnosis and treatment. In addition, curricula for 16 health education institutions was developed and distributed. Similarly, the iCCM training module was developed for HEWs Level III. In addition, PMI has provided technical assistance and taught at FMOH's malariology training for FETP residents, district level malaria officers, and Peace Corps volunteers.

In the past 9 months, the Ethiopian FETP has expanded to include eight universities and over 400 residents. PMI has remained committed to continuing to provide training through the FETP program, and five EFETP residents per cohort have been selected to focus on malaria activities and to receive additional malaria-specific mentorship and training opportunities. In 2016, a workshop was conducted to bring those five EFETP residents together for specialized training and discussion. Technical assistance was provided to assist residents in finalizing protocols to investigate the epidemiology of malaria in various parts of Ethiopia or to evaluate malaria intervention coverage.

The U.S. Peace Corps has been involved in a wide range of SBCC activities, including participation at World Malaria Day meetings. PMI provides 1,000 ITNs directly to Peace Corps for outreach activities designed for static displays at youth camps to demonstrate proper use of ITNs at 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 has worked with Peace Corps to establish a third year program where Peace Corps volunteers with interest and experience in malaria can work with malaria organizations such as PMI implementing partners.

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. 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. PMI will continue supporting the coordination of malaria activities through seconding staff to RHBs. 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 with FY 2017 funding at EPHI to assist in accomplishing these goals. PMI will continue supporting third year Peace Corps volunteers to conduct a variety of malaria activities including supply chain management in remote rural communities. PMI will continue to support EFETP which builds epidemiological capacity and strengthens the quality and use of PHEM data and response activities. PMI will provide technical support and mentorship for five FETP malaria-focused residents in each cohort. Both the Peace Corps volunteers and EFETP residents provide valuable opportunities to identify and evaluate malaria prevention challenges at the community level and for capacity building of malaria-specific skills and knowledge.

Proposed activities with FY 2018 funding: (\$730,000)

- **Coordination support for select RHBs and/or NMCP:** Support joint planning, coordination, supportive supervision, and review activities with all malaria stakeholders at regional and national level. (\$200,000)
- **Pre-service training of HEWs:** PMI will support updating and standardizing malaria curricula at university level. Additionally, provision of pre-service training of HEWs, physicians, health officers, nurses and midwives to ensure that malaria will be focused in pre-service training for management of malaria. Pre-service training of health officers, nurses, and physicians will be supported by improving clinical teaching in the outpatient department setting, where the majority of uncomplicated malaria cases are managed. (\$250,000)
- **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 and response system and malaria surveillance including development of weekly bulletins. (\$250,000)

- Malaria prevention activities by Peace Corps:** PMI will support 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 Regional States. 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 ITN use, improving early treatment-seeking and treatment compliance. PMI will also continue to support a third year, malaria volunteer. (\$30,000)

Table 14: Health Systems Strengthening Activities

HSS Building Block	Technical Area	Description of Activity
Health Services	Case Management	PMI supports a QA system for malaria laboratory diagnosis and treatment. Support includes provision of ongoing supervision, training, and monitoring on malaria case management at health facility level. PMI also provides health centers, and national and regional labs with microscopes and supplies for malaria diagnosis and training purposes.
Health Workforce	Health Systems Strengthening	PMI supports pre-service training of HEWs, midwives, health officers, nurses, and physicians to strengthen malaria case management at PHCU level.
Health Information	Monitoring and Evaluation	PMI provides support for malaria surveillance, monitoring and evaluation, training and mentoring of EFETP residents and district level surveillance officers.
	Operational Research	PMI provides training and TA support for in-country malaria operational research.
Essential Medical Products, Vaccines, and Technologies	Case Management	PMI supports improved forecasting and distribution of malaria commodities such as ITNs, 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.
Health Finance	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.
Leadership and Governance	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.

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 2017–2020. 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.*” Community empowerment and mobilization will be the energy in driving the NMSP forward in order to reach the targets set for prevention measures. In order to achieve this objective, the NMSP focuses on utilization of HEWs, with the support of HDAs and model family households. Model families are families who have demonstrated behavior change, practiced 16 health extension packages and have improved uptake of high impact health behaviors. Despite the absence of a malaria-specific communication strategy, the recent national health promotion and communication strategy 2016-2020, provided a guide for all areas of health including malaria prevention and control. The objectives of this strategy are:

1. Guide and harmonize health education and communication interventions;
2. Improve knowledge, attitudes, and practices, including addressing barriers for behavior change and community empowerment;
3. Enhance community empowerment through capacity building of frontline workers/HEW, HDA/and community leaders by promoting the use of standardized community guidelines and manuals;
4. Promote and advocate for multi-sectoral involvement in addressing social determinants that affect health and for mainstream health promotion in sectors including influencing policy and legal support. Advocate for supportive enabling environments;
5. Enhance effective engagement and wide use of public, institutional, social, and community media and other new technologies for health communication programming in order to strengthen audience specific and need-based SBCC programs; and
6. Ensure effective implementation of the strategy through continuous monitoring, evaluation, and dissemination of best practices at different levels.

Major activities for community empowerment and mobilization include:

- Develop and integrate malaria communication strategy into the national communication strategy
- Increase the use of supportive mass media
- Integration of malaria prevention and control into school programs
- Conduct advocacy to gain strong commitment of the local leaders on malaria elimination districts
- Production and distribution of information, education, communication/behavior change communication materials

- Conduct orientation workshop for HDAs on community mobilization including iCCM

Social and 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., ITNs, IRS, early diagnosis and treatment compliance). For communications activities related to RDTs and ACTs in particular, PMI works with health providers at different levels of the health system to strengthen their interpersonal communication skills.

Small scale activities in PMI-supported districts have identified both barriers and facilitators of malaria-related behaviors. Barriers include characteristics of ITNs (e.g., preference for conical over rectangular), sleeping arrangements, seasonality of malaria - “no mosquitoes at this time so no need to sleep under the nets”, and accessibility factors such as insufficient number of ITNs. Facilitating behaviors that were identified include avoidance of the nuisance of mosquitoes, traditional sleeping patterns like those observed from mothers of newborns who preferentially sleep under light cloth (such as ITNs), and the HDA initiative where one household is networked to teach five households about preventive health practices including sleeping under ITNs.

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 implemented critical SBCC activities focused on increasing demand for ITNs and improving correct, consistent and sustained use of ITNs as well as improving treatment seeking behavior and increasing community awareness about malaria and its prevention and control. Additionally, PMI increased the awareness in the community about the effectiveness of IRS in order to reduce refusal of IRS or re-plastering of sprayed walls. The 2015 MIS results indicate that 68% of women in malarious areas have heard about malaria. Of those who had heard about malaria, 75% were aware that mosquito bites may cause malaria and recognized fever as a symptom of the disease. Seventy-seven percent knew that sleeping under mosquito nets could prevent malaria. Though the proportion of women ages 15–49 years who had heard about malaria was similar across 2007, 2011, and 2015, the proportion who recognized fever as symptom of malaria, who knew malaria is caused by mosquito bites, and who reported ITNs as a prevention method had increased in 2015 compared to 2007 and 2011.

There has been a slight increase in ITN use among children under five and pregnant women (38% and 35% measured in 2011 compared with 45% and 44% in 2015, respectively). However, the results show that ITN use by these population groups is almost similar. Among children with fever, 38% were taken to a health facility, provider, or pharmacy for advice or treatment. Treatment-seeking for fever is highest among children less than 12 months old, and there is a trend of decreasing treatment-seeking for fever as the child gets older.

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.

Starting from July 2015, PMI also supported an integrated SBCC activity implemented in four major

regions namely Oromia, Amhara, SNNP and Tigray. The support focused on malaria communication capacity building at national and regional levels; messaging and implementation of SBCC activities through integrated platforms and monitoring and evaluation (M&E) of malaria SBCC.

Progress during the last 12-18 months

In 2016-2017, PMI implemented malaria SBCC activities in 100 primary schools in 5 districts of Amhara Region. In targeted schools, 20,140 students completed 8 rounds of peer to peer sessions. Peer to peer education is a session whereby students educate themselves on malaria prevention and control using a malaria peer education manual. Usually a peer group consists of 10-12 students and the malaria peer manual has 8 sessions, which will be completed in 8 rounds. Religious leaders reported that they have reached close to 70,000 people on malaria communication in targeted areas. These students then reach out to their families and neighborhood to educate them about malaria prevention and control interventions. In this reporting period, 2,000 T-shirts, 4,000 posters, 25,000 leaflets and 3,000 stickers were prepared and distributed to the targeted beneficiaries. Twelve best performing schools were awarded for their outstanding performance on malaria communication. World malaria day and malaria week were celebrated in 122 *kebeles* (localities) and 125 schools. A midterm evaluation has been conducted for PMI SBCC activities in Amhara Region. This evaluation compared previously collected baseline results with midterm results. Findings of this evaluation have shown that 99% of study participants were aware that mosquito bites caused malaria, compared to 81% at baseline (and 77% from the MIS 2015). In MIS 2015, only 40% of the household population slept under an ITN the night before the survey, while the midterm evaluation in the PMI targeted districts with school and faith based malaria SBCC interventions showed 66% of the household population slept under an ITN the night before the survey. The findings of this study have also shown that 67% of pregnant women and 81% of children under five slept under an ITN the night before the survey, compared to 50% and 62% at baseline and 45% and 40% in the MIS 2015, respectively.

In PMI-supported districts in Amhara Region, 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 neighborhood upon their return. Then teachers will report to HEWs for appropriate diagnosis and treatment to be provided through home visits. In 2016, 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 2 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, 75 schools and 75 *kebeles* (localities) were included in the malaria SBCC activities. During this period 207 people were newly trained as “lead persons.” Lead persons are focal persons who took malaria basic training and will teach their constituencies in school and religious institutions. In addition to this, 152 individuals who had previously been trained received a refresher training. A total of 11,139 one-to-five network group leaders were trained and a total of 55,925 one-to-five member students discussed Essential Malaria Actions during their regular meeting. A one-to-five network is a structure whereby students are organized as a group of six where one is a leader and the other five are followers to learn malaria prevention and control measures. Through the

student peer education system, a total of 27,405 households received malaria messages. Forty-five small scale social mobilization campaigns were conducted in which 67,000 student and community members were involved. Malaria club members used a variety of communication approaches such as establishing malaria week in schools, using World Malaria Day to increase awareness, mobilizing students by using drama, music, songs, poems, and literature competitions with students conducting outreach to mobilize and educate communities on malaria prevention and treatment. A total of 25,821 communication materials such as posters and leaflets were distributed. A total of 132 mini-media materials were distributed for schools and religious institutions. Mini media materials include microphones and amplifiers so that students in malaria school clubs are able to reach the school community on malaria messages which includes education & entertainment.

Through an integrated health communication mechanism, PMI supported SBCC activities to strengthen the capacity of NMCP (national and regional) staff and organizations to design, implement, and monitor and evaluate malaria communication activities. PMI supported training for 101 (18% female) mid-level health program managers and experts on Leadership in Strategic Health Communication. PMI also supported recruitment of 16 local implementing partners that have a strong community level presence and provided SBCC training to 88 local implementing partners' *woreda* coordinators (15% female) in Amhara, Oromia and SNNP regions. Leadership in Strategic Health Communication training was provided for a total of 115 PHCU directors from 16 *woredas*. A University Consortium for SBCC was established with 15 universities. PMI supported a workshop to establish the consortium with 42 participants (12% female) from 15 universities and U.S. Government partners. PMI supported the development of multiple malaria guidelines including SBCC materials development, health and health system literacy, and public health emergency communication guidelines.

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 will be utilized in malaria elimination targeted districts only and 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. The objective of this guide is to assist in strengthening engagement and participation of individuals, families, communities and leaders in taking full responsibility and bringing meaningful behavioral change to achieve malaria elimination in Ethiopia by 2030.

Plans and justification

PMI will continue to support SBCC activities focusing on affected communities in malaria transmission districts to complement and support national malaria SBCC strategies. These mass mobilization activities will complement the support to HEWs focused on house to house interpersonal communication 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 billboards) on use of ITNs 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 of all fever cases and prompt treatment as well as sustaining ITN utilization. Increased SBCC in the targeted

pre-elimination districts is important, so PMI will continue to technically support the MOH as key SBCC issues to address in the pre-elimination districts are identified. In addition, HEWs will carry out social mobilization activities with HDAs for mobilizing communities to become actively involved in identification of migrant workers and patients with malaria sign and symptoms and facilitating testing through HEWs. PMI will conduct an assessment of socio-cultural perceptions, barriers and facilitators that influence malaria health service utilization and behavior in four regions (Oromia, Tigray, Amhara and SNNP) to identify social norms around priority health areas including patterns of malaria communication and household communication, which will guide the development of health communication materials.

Proposed activities with FY 2018 funding: (\$1,200,000)

- **Community-based SBCC for ITNs, 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. This activity is also supporting malaria communication capacity building and coordination at national, regional and community levels. 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 ITN demonstrations in social gatherings and at local markets. (\$1,000,000)
- **Community-based SBCC in Amhara Region:** PMI will continue to support community-based SBCC activities in five *woredas* of Amhara Region targeting 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. (\$200,000)

6. Surveillance, monitoring, and evaluation

NMCP/PMI objectives

The FMOH's NMSP (2017-2020) highlights the need for strong SM&E systems and emphasizes the constant need for detection and response to focal and widespread malaria epidemics in control districts and a robust surveillance system for real-time data using DHIS-2 in elimination districts. The current plan is to move only HMIS data into the DHIS-2 platform. No decision has been made about PHEM. PMI will investigate opportunities to support strengthening surveillance systems in elimination districts including the potential incorporation of a DHIS-2 Tracker for case-based reporting, if appropriate. DHIS-2 development, implementation and roll out are being supported by a consortium of donors. The Bill and Melinda Gates Foundation is the lead donor for the work and have formed a Data Use Partnership with the FMOH. USAID, Global Fund, and the Doris Duke Foundation are also providing significant financial support to this consortium. GAVI is also expected to become a financial supporting member of the group. PMI investments will be complementary to the existing support for DHIS-2.

The NMSP describes the SM&E core activity areas: 1) collect data actively and passively to 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; and appropriately interpreting results and informing revisions in policies or strategies, when needed, to help ensure progress; and 3) documentation of progress towards malaria elimination through case and foci investigation and classification. In addition to the malaria morbidity and mortality impact indicators, elimination specific indicators are included. In addition, FMOH has drafted an elimination surveillance manual that details the surveillance activities of each phases of elimination.

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 by aiming to provide weekly reports from all health facilities, including health posts, through district health offices. Though not regular EPHI publishes weekly epidemiological data using PHEM reports (<http://www.ephi.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 health 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 ITN 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. HMIS reports monthly and 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 people, 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 parasitologically confirmed cases at health posts and health centers. In this system, the median weekly parasitologically confirmed 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 25% 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, and MIS 2015), sentinel site data collection, 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 that included advanced data analysis training for 8 EPHI staff and M&E training for 52 health managers from seven regions. PMI's experience with implementing rapid reporting to enable epidemic detection in Oromia and the lessons learned was published in a peer-reviewed journal (Yukich *et. al.*, 2014).

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 these 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. Although there are currently three separate sources of reported malaria cases and deaths, the systems have differing attributes and coverage (Table 15). 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 are 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 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, refining the technical support already provided by PMI to strengthen the supply chain system. Therefore, there is both an immediate use of the data and a longer-term, health-system strengthening purpose.

Table 15: Malaria surveillance system attributes, public sector, Ethiopia

Surveillance System	Reporting Frequency	Facilities Reporting	Publications	Comment
Health Management Information System (HMIS)	Quarterly	Hospitals, Health Centers, Health Posts	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.

PMI has provided technical assistance for the selection of the elimination districts by 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).

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 show sustained ITN ownership, although still below set targets and continued low prevalence of malaria.

Progress during the last 12-18 months

PMI has been coordinating surveillance strengthening efforts through the existing PHEM system. Over the past year, PMI strengthened PHEM reporting of malaria cases from the health post to the health centers and support has been expanded to 20 districts in Oromia in 2016 covering 246 health centers and 1,247 health posts.

In 2016, PMI has supported training on malaria surveillance and data quality for 91 malaria focal persons from zone and *woreda* levels and 1,043 health center staff and 1,315 HEWs from 6 regions. GIS training for ten FMOH/NMCP and EPHI staff was conducted in 2016.

With malaria elimination targets now set for 239 districts by 2020, PMI has been providing technical assistance with drafting the elimination strategy, operational plans, and the surveillance and M&E plan. PMI in collaboration with the NMCP and EPHI developed an elimination district planning tool to help the NMCP identify gaps in resources in order to achieve optimization of malaria intervention activities in the selected malaria elimination districts.

Table 16: 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	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	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
	ITN durability monitoring						X	X	X	
Other malaria-related evaluations	Serology/G6PD surveys		X			X	X*			
Other Data Sources	Malaria Impact Evaluation					X	X	X*		

* Not PMI-funded

Table 17: Routine surveillance indicators

Indicators	Value	Comments
1. Total number of reported malaria cases	2,174,707	HMIS data for July 2014 to June 2015, i.e. Ethiopian FY 2007 (FMOH's 2016 HSTP I annual review meeting)
Total diagnostically confirmed cases	1,867,059	
Total clinical/presumed/unconfirmed cases	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	
2. Total number of reported malaria deaths (Data source: PHEM)	662	
Diagnostically confirmed	NR	Disaggregated report is not available
Clinical/presumed/unconfirmed	NR	
3. Malaria test positivity rate – outpatients (Data source: Micro-plan data 2015)	27%	Micro-plan data for 2016 are not yet available
Numerator: Number of outpatient confirmed malaria cases	2,168,541	
Denominator: Number of outpatients receiving a diagnostic test for malaria (RDT or microscopy)	7,950,545	
4. Completeness of monthly health facility reporting	NR	
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 42 districts and 7 town administrations. 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. 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 ITNs) at the district level, and to plan commodity procurement and distribution. This is the only data source currently 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 and the roll-out of the elimination planning tool, 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 and radical cure 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 and ITN durability monitoring.

Proposed activities with FY 2018 funding: (\$1,460,000)

- **Strengthening PHEM system and case reporting in elimination districts:** Strengthening the national PHEM system and improving reporting of malaria cases from the health post to the health centers focusing on *kebele*- and then case-based reporting in the elimination districts. PMI will support the FMOH, RHBs, and malaria 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 through the roll-out of the DHIS-2 platform. 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. As elimination districts encounter fewer number of cases, technical assistance for case investigation and foci investigation activities will be provided. (\$800,000)
- **Household survey:** Support will be provided to collect national-level, representative estimate of malaria intervention coverage indicators. This will leverage funding from other donors to

either integrate the malaria module into a mini-DHS planned for 2019 or to conduct a follow-on MIS. The mini-DHS is planned by the MOH and it is conducted as a mid-point survey between the larger DHS surveys, which are conducted every five years. For PMI, the mini-DHS would be a more cost effective approach to collect malaria intervention coverage estimates compared to a standalone MIS and is appropriate due to the low malaria prevalence rates in Ethiopia. The mini-DHS sample size was previously 9,150 households in 305 enumeration areas not aiming to collect mortality statistics. PMI will contribute along with other partners to supporting a comprehensive health survey. (\$300,000)

- **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). (\$350,000)
- **SM&E technical assistance:** One TDY to provide technical assistance for SM&E activities including elimination planning. (\$10,000)

7. Operational research

NMCP/PMI objectives

The FMOH's NMSP (2017-2020) 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 the NMSP. 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 sero-prevalence 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. The testing of these samples are occurring in the second quarter of 2017 along with the samples that were collected during the 2015 MIS leveraging Global Fund resources.

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* and primaquine radical cure for *P. vivax* 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 18: PMI-funded operational research studies

Completed OR Studies			
Title	Start date	End date	Budget
G6PD variant survey	Jan 2014	March 2015	\$90,000
School-based sero-prevalence	Oct 2011	Sept 2013	\$200,000
Field assessment of dried tube specimens for RDT quality control and proficiency testing	Jan 2013	July 2013	\$10,000
Ongoing OR Studies			
Title	Start date	End date	Budget
Malaria serology as a MIS biomarker	March 2014	Oct 2017	\$70,000
Planned OR Studies FY 2015/2016			
Title	Start date (est.)	End date (est.)	Budget
Evaluation of targeted mass drug administration and reactive case detection around an index case on malaria transmission and elimination in Ethiopia	March 2018	Sept 2020	\$800,000
Hematologic monitoring to assess the safety of the primaquine radical cure for Plasmodium vivax roll-out	September 2017	Sept 2019	\$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 2018 funds.

Proposed activities with FY 2018 funding: (\$10,000)

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

8. Pre-eliminationNMCP/PMI objectives

The Ethiopia NMCP's malaria elimination objectives include the elimination of malaria in selected low transmission areas by 2020 and the elimination of malaria from Ethiopia by 2030. Ethiopia has recently declared malaria elimination efforts in 239 selected districts, incorporating 6 different regions, starting in 2017. The criteria for enrolling districts for malaria elimination included selecting districts with low or moderate malaria transmission, availability of district level surveillance data, high coverage of vector control interventions, adequate access to treatment, less cross-border population movement, and logistical feasibility. To achieve elimination targets the Ethiopia FMOH will focus on engagement and governance at different levels by strengthening partnerships from the national to community level. A strong political commitment from the RHBs will be expected in all aspects of malaria prevention and control. Additional areas of focus in selected malaria elimination districts include maximizing health facility capabilities for active case detection and 100% case confirmation, community involvement and

ownership, private sector roles and partnerships, investigating mass drug administration approaches, and improving surveillance systems for case detection and reporting. The Ethiopia FMOH is currently finalizing a malaria elimination technical document to guide the implementation and SM&E of elimination activities.

Progress since PMI was launched

Since PMI was launched in Ethiopia, PMI has been supporting national malaria control and prevention efforts with case management, diagnostic support, surveillance strengthening, vector control, research activities, and commodity procurement and distribution. The PMI activities have contributed to significant malaria reduction in Ethiopia and have positioned Ethiopia for malaria elimination.

Progress during the last 12-18 months

Malaria elimination goals and specific efforts were launched in March, 2017. In preparation for malaria elimination activities, PMI collaborated with the Ethiopia NMCP starting in 2016 to develop a malaria elimination operational planning tool. This tool was adopted by the FMOH and EPHI for use in all selected elimination districts and will be used in 2017 to assess district level readiness for elimination activities and provide information to guide initial elimination efforts. PMI will also support efforts to conduct *kebele* level malaria risk stratification with the ultimate aim of providing technical support to developing a scalable platform to support case-based reporting, investigation, and response activities. PMI is supporting the development of an OR protocol to evaluate the role of reactive case detection compared to targeted mass drug administration.

Table 19: Pre-Elimination Activities

Technical Area	Description of Activity	Geographic Coverage
Prevention	Procurement and distribution of ITNs to help support universal coverage in Ethiopia and IRS support to the highest burden districts facilitating Global Fund resources to be allocated towards malaria elimination objectives.	National
Case management	Continuing ongoing support of laboratory diagnostic trainings and supervision and procurement of antimalarials and RDTs for quality, rapid case detection. Support for the roll-out of single dose primaquine to address falciparum gametocytes and radical cure primaquine for vivax malaria.	National
SBCC	The migrant worker OR will investigate key malaria challenges to be incorporated into malaria messaging for seasonal, mobile workers.	Benishangul-Gumuz
SM&E	Led development and supporting implementation of a malaria elimination planning tool for use in the 239 selected elimination districts. PMI will support surveillance systems strengthening, including the DHIS-2 roll-out, <i>kebele</i> -level stratification, and later case-based reporting from the health post to the health centers and case investigation and response in elimination districts.	Selected elimination districts
OR	PMI is supporting research to better understand malaria transmission among migrant workers. This population contributes to the ongoing transmission of malaria in low malaria districts. PMI will conduct a cluster randomized trial comparing reactive case detection to targeted mass drug administration to inform the NMCP's elimination strategy	Benishangul-Gumuz and selected elimination districts

Plans and justification

PMI will support the national elimination goals by foremost supporting control efforts throughout Ethiopia with a focus on the highest burden districts in the highest burden regions. PMI will ensure universal coverage of ITNs and access to case management services throughout the country in coordination with the FMOH and the Global Fund. Additionally, PMI will focus prevention efforts on districts in Western Ethiopia with high rates of malaria with provision of IRS with Actellic CS. These districts are often the source of malaria transmission to low malaria districts due to agricultural migrant workers and other mobile populations and must be addressed to make sub-national elimination a reality. PMI's focus on control efforts in the high transmission areas will ensure the success of Global Fund investments directed to the elimination districts. As improved surveillance capacity is a necessary step to achieve and document malaria elimination, PMI will be supporting improved surveillance capacity specifically within the elimination districts to assist with case detection and reporting. Active case detection will be possible after case-based surveillance and case investigations procedures are established. The HEWs and the HDA are expected to play an important role in active case detection efforts. With FY 2018 funds, PMI plans to support strengthening malaria surveillance in low transmission and elimination districts that would include both passive and active surveillance activities.

Proposed activities with FY 2018 funding: (\$0)

Support for elimination activities are allocated under the SM&E section.

9. 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, one or more Foreign Service Nationals work as part of the PMI team. All PMI staff members are part of a single interagency team led by the USAID Mission Director or his/her designee in country. 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 2018 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 Foreign Service Nationals. 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 2018**

Mechanism	Geographic Area	Activity	Budget (\$)	%
PSM – Supply Chain Contract	National	Procurement and distribution of LLINs, RDTs, laboratory equipment and supplies, chloroquine, primaquine, pre-referral and severe antimalarial drugs; support for national commodities’ micro-planning. Strengthening of drug management system capacity at regional, districts and health facilities	\$10,071,000	31.47%
TBD-IRS	Oromia, Benishangul-Gumuz & possibly Gambela Regions	IRS insecticide procurement; IRS operations; Entomological monitoring and capacity-building; and IRS national level technical assistance	\$11,265,000	35.20%
CDC IAA	National	In-country staff; administrative expenses, TDYs, entomology supplies and equipment; and FELTP	\$749,000	2.34%
SBCC- Health JHU-CCP	National	SBCC for LLINs, IRS, ACTs, and case management	\$1,000,000	3.13%
APS-HDAMA	Amhara	APS for local implementation of SBCC campaigns	\$200,000	0.63%
TBD	Oromia/ National	Support for QA system for malaria laboratory diagnosis and therapeutic efficacy monitoring	\$2,200,000	6.88%
TBD	National	PFSA strengthening, coordination and reporting commodity status	\$400,000	1.25%
USP PQM	National	Strengthen drug quality monitoring and support regulatory actions	\$500,000	1.56%
TRANSFORM PHCU	Major Regional States	Provide systems support for ongoing supervision, training and monitoring of malaria case management at health facility and post level	\$1,300,000	4.06%

TRANSFORM DRS	Developing Regional States	Provide systems support for ongoing supervision, training and monitoring of malaria case management at health facility and post level	\$400,000	1.25%
PHSP	Amhara, Oromia, Benishangul-Gumuz & Gambela Regions	Private sector support to malaria prevention and control activities including development corridor areas.	\$700,000	2.19%
TBD	National	Support for malaria monitoring and evaluation, technical assistance and operational research	\$1,100,000	3.44%
TBD	National	Coordination support, supervision and review activities with all malaria stakeholders in selected RHB/national level. Includes possible secondments to RHBs & at NMCP	\$200,000	0.63%
TBD	National	Updating and standardizing malaria curricula at university level. Additionally, provision of pre-service training of HEWs, physicians, health officers, nurses and midwives to ensure that malaria will be focused in pre-service training for management of malaria	\$250,000	0.78%
Peace Corps	National	PCVs malaria prevention activities	\$30,000	0.09%
TBD	National	Environmental compliance	\$35,000	0.11%
USAID Staffing & Administration	National	Staffing and administration	\$1,600,000	5.00%
Total			\$32,000,000	100%

**Table 2: Budget Breakdown by Activity
President's Malaria Initiative – Ethiopia
Planned Malaria Obligations for FY 2018**

Proposed Activity	Mechanism	Budget (\$)		Geographic Area	Description
		Total	Commodity		
PREVENTIVE ACTIVITIES					
VECTOR MONITORING AND CONTROL					
Entomologic monitoring and insecticide resistance management					
Entomological monitoring	TBD - IRS Project	540,000		National	Support for entomological monitoring in at least eight sites including resistance, vector behavior, quality assurance, and evaluation of vector control interventions.
Entomological capacity building	TBD - IRS Project	100,000		National	Support for coordination of national insecticide resistance monitoring activities, and vector control training including technical assistance to conduct foci investigations.
Entomological technical assistance	CDC IAA	29,000		National	Provide two TDYs from CDC/Atlanta for training, planning, and monitoring entomological activities
Subtotal Ento monitoring		669,000	0		
Insecticide-treated Nets					
LLIN procurement	GHSC - PSM	5,470,000	5,470,000	National	Provide 2,113,000 free LLINs to districts to distribute through health facilities, HEWs and other networks (difference in funding will be covered by existing pipeline).
LLIN distribution from	GHSC - PSM	2,113,000		National	LLIN distribution from districts to health posts

districts to health posts					
Subtotal ITNs		7,583,000	5,470,000		
Indoor Residual Spraying					
IRS operations	TBD - IRS Project	5,145,000		Oromia, Benishangul-Gumuz & possibly Gambela Regions	Implementation and supervision support for IRS operations in 40 districts and at least 60 graduated districts.
Procurement of insecticide, IRS equipment and PPE	TBD - IRS Project	5,000,000	5,000,000	Oromia, Benishangul-Gumuz & possibly Gambela Regions	Procurement of insecticide, spray equipment and PPE for IRS activities
IRS training	TBD - IRS Project	480,000		National	In-service training at federal, regional, and district levels to increase capacity in planning, management, and leadership of IRS operations.
Environmental compliance	TBD	35,000		National	External environmental compliance visit
Subtotal IRS		10,660,000	5,000,000		
SUBTOTAL VECTOR MONITORING AND CONTROL		18,912,000	10,470,000		
Malaria in Pregnancy					
Strengthening case management of MIP	TRANSFORM DRS	100,000		Developing Regional states	Support malaria case management with a focus on pregnant women in high transmission areas
Strengthening case management of MIP	TRANSFORM PHCU	200,000		Major Regional states	Support malaria case management with a focus on pregnant women in high transmission areas

Subtotal Malaria in Pregnancy		300,000	-		
SUBTOTAL PREVENTIVE		19,212,000	10,470,000		
CASE MANAGEMENT					
Diagnosis and Treatment					
Procurement of RDTs	GHSC - PSM	0	0	National	National-level RDTs needs will be met by the Global Fund.
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, following a facility baseline assessment on equipment needs.
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 techs and clinicians, lab QA/QC activities, and accreditation for laboratory supervisors in 200 new facilities with a focus on high-risk areas and continued support to the existing 1,000 facilities and regional health laboratories.
Procurement of ACTs		0	0		National-level ACT needs met by the Global Fund.
Procurement of injectable artesunate for treatment of severe malaria	GHSC - PSM	630,000	630,000	National	Procurement of 250,000 vials of injectable artesunate.
Procurement of chloroquine	GHSC - PSM	108,000	108,000	National	Procurement of 192,857 treatment doses of chloroquine to meet national needs.

Support for ongoing supervision and monitoring of malaria diagnosis and treatment including MIP (major regional states)	TRANSFORM PHCU	1,100,000		Major Regional States	Support for health worker supervision, training and mentoring for management of malaria mainly at health post level, focusing on appropriate RDT use.
Support for ongoing supervision and monitoring of malaria diagnosis and treatment including MIP (developing regional states)	TRANSFORM DRS	300,000		Developing Regional States	Support for health worker supervision, training and mentoring for management of malaria mainly at health post level, focusing on appropriate RDT use.
Private sector support to case management	PHSP	700,000		Amhara, Oromia, Benishangul-Gumuz & Gambela Regions	Work with RHBs and private health facilities/farms/mining companies in focus areas to increase access to quality malaria services.
Therapeutic efficacy monitoring	TBD	200,000		Sentinel sites	In vivo monitoring of first-line treatment for both falciparum and vivax malaria at two sites
Subtotal Diagnosis and Treatment		5,438,000	1,138,000		
Pharmaceutical Management					
Strengthening PFSA pharmaceutical management capacity	TBD	400,000		National	Continued support to existing Integrated Pharmaceuticals Logistics System, assist in implementation of the End Use Verification surveys, and provision of mentoring on stock management at the health post level.
Strengthening drug management capacity	GHSC - PSM	1,000,000		National	Support improving malaria commodities quantification, requisition, drug exchange/transfer, and expiry tracking/disposal as well as PFSA's capacity to procure and distribute malaria commodities. PMI will continue to support antimalarial drug management, conduct EUV surveys, and APTS activities in Oromia Regional State

Strengthening drug quality monitoring	USP PQM	500,000		National	Support FMHACA for monitoring post-market antimalarial drug quality, and building laboratory capacity at regional and national levels with great focus on national sustain strategy.
Subtotal Pharmaceutical Management		1,900,000	0		
SUBTOTAL CASE MANAGEMENT		7,338,000	1,138,000		
HEALTH SYSTEM STRENGTHENING / CAPACITY BUILDING					
Coordination support for selected RHBs & NMCP	TBD	200,000		National	Coordination support, supervision and review activities with all malaria stakeholders in selected RHB/national level. Includes possible secondments to RHBs & at NMCP.
Pre-service training of HEWs	TBD	250,000		National	Updating and standardizing malaria curricula at university level. Additionally, provision of pre-service training of HEWs, physicians, health officers, nurses and midwives to ensure that malaria will be focused in pre-service training for management of malaria.
Field Epidemiology & Laboratory Training Program	CDC IAA	250,000		National	Support for applied epidemiology and laboratory training for three to five residents per cohort.
Peace Corps malaria prevention activities	Peace Corps	30,000		National	Support Peace Corps work on malaria at the community level for 3 third year PCVs
SUBTOTAL HSS & CAPACITY BUILDING		730,000	0		
SOCIAL AND BEHAVIOR CHANGE COMMUNICATION					
Community-based SBCC for LLINs, IRS, ACTs, case management including MIP	SBCC-Health JHU-CCP	1,000,000		National	Dissemination and implementation of various SBCC approaches through a variety of community platforms in high and low transmission areas, with a focus on school-based delivery of malaria health education.

Community-based SBCC	APS-HDAMA	200,000		Amhara	
SUBTOTAL SBCC		1,200,000	0		
SURVEILLANCE, MONITORING, AND EVALUATION					
Strengthening PHEM system and epidemic response	TBD	800,000		National	Supporting surveillance systems strengthening, including the DHIS-2 roll-out, reporting of malaria cases from the health post to the health centers and case notification & investigation in low transmission districts.
Evaluation of malaria intervention coverage	TBD	300,000		National	Integration into mini-DHS or stand-alone MIS to collect malaria intervention coverage indicators.
National malaria commodities micro-plan	GHSC - PSM	350,000		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
SUBTOTAL SM&E		1,460,000	0		
OPERATIONAL RESEARCH					
OR technical assistance	CDC IAA	10,000		National	One TDY to support ongoing operational research
SUBTOTAL OR		10,000	-		
PRE-ELIMINATION					
SUBTOTAL PRE-ELIMINATION		0	0		
IN-COUNTRY STAFFING AND ADMINISTRATION					
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)
SUBTOTAL IN-COUNTRY STAFFING		2,050,000	-		
GRAND TOTAL		32,000,000	11,608,000		
<p>*Historical funding for commodities has been about \$18 million; we therefore plan on forward funding about \$6 million of prior year unobligated funds to procure various commodities by September 2019. Final quantities will be determined closer to procurement. This strategy will draw down on existing pipelines in preparation for FY 2019 MOP planning where we expect commodity needs to again reach historical levels of \$18 million.</p>					