THE PRESIDENT'S MALARIA INITIATIVE

Seventh Annual Report to Congress April 2013

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THE PRESIDENT'S MALARIA INITIATIVE

Seventh Annual Report to Congress | April 2013

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Executive Summary

"The United States will join with our allies to eradicate such extreme poverty in the next two decades . . . by saving the world's children from preventable deaths . . ."

– President Barack Obama, State of the Union, February 12, 2013

The past decade has seen unprecedented progress in malaria control efforts in most sub-Saharan African countries. As countries have scaled up insecticide-treated mosquito nets (ITNs), indoor residual spraying (IRS), improved diagnostic tests and highly effective antimalarial drugs, mortality in children under five years of age has fallen dramatically. It is now clear that the cumulative efforts and funding by the President's Malaria Initiative (PMI), national governments, The Global Fund to Fight AIDS, Tuberculosis and Malaria (The Global Fund), the World Bank and many other donors are working: The risk of malaria is declining. According to the World Health Organization's (WHO's) *2012 World Malaria Report*, the estimated annual number of global malaria deaths has fallen by more than one-third – from about 985,000 in 2000 to about 660,000 in 2010.

The U.S. Government's financial and technical contributions have played a major role in this remarkable progress. However, gaps in resources remain. If progress is to be sustained, committed efforts must continue. The theme for World Malaria Day 2013, and for the years leading up to the 2015 target date for the Millennium Development Goals, is "Invest in the future. Defeat malaria." To this end, PMI and partners continue to build on investments in malaria control and prevention and respond to challenges, such as antimalarial drug resistance, insecticide resistance and weak malaria case surveillance.

SAVING LIVES

Since PMI's launch in 2005, impressive gains in malaria control have been documented in PMI focus countries. To date, 12 of the original 15 PMI focus countries have data from paired nationwide surveys that were conducted since PMI activities began. All 12 countries have documented a decline in mortality rates among children under five years of age. These declines have ranged from 16 percent in **Malawi** to 50 percent in **Rwanda** (see Figure 1).

Although multiple factors are probably influencing the decline in under-five mortality rates, there is growing evidence that the scale-up of malaria prevention and treatment measures across sub-Saharan Africa is playing a major role in these unprecedented reductions in childhood mortality. PMI is carefully measuring the contribution of malaria control efforts to declines in mortality in PMI focus countries. Three impact evaluations have been completed to date in mainland Tanzania, Malawi and Angola. Six additional evaluations were started in fiscal year (FY) 2012. By 2015, evaluations will have been carried out in all 15 original PMI focus countries.

- The findings of the mainland **Tanzania** impact evaluation – which documented a 45 percent reduction in all-cause mortality among children under five between 2000 and 2010, due in large part to the scale-up of malaria control interventions, have been further supported by the findings of the 2012 Tanzania Malaria Indicator Survey. A 47 percent reduction in malaria prevalence was detected, from 18 percent in 2008 to 10 percent in 2012.

- In **Malawi**, malaria control interventions have achieved sufficient coverage to reduce malaria morbidity and mortality. Nationwide household surveys spanning the decade 2000–2010 show that all-cause mortality among children under five years of age fell by 41 percent. Not all reductions in child mortality are due to malaria interventions. However, mortality declines were greater in areas with higher risk of malaria. This strongly suggests that a major part of the decline was due to malaria control measures instituted by the Government of Malawi.

- In **Angola**, under-five mortality also declined, but the coverage of malaria control interventions was too low to have caused this decline. Angola has, however, made considerable strides in increasing population coverage of malaria prevention and treatment measures since it emerged from a 25-year-long civil war in 2002 that left much of the country's health infrastructure severely damaged.

SCALING UP MALARIA CONTROL INTERVENTIONS

Since PMI's inception, the efforts of national governments, together with PMI, The Global Fund, the World Bank, the U.K. Department for International Development (DFID) and many other donors, have resulted in a massive scale-up of malaria prevention and treatment measures across PMI focus countries (see PMI Contributions at a Glance). In FY 2012 alone, PMI:

- Protected over 30 million residents by spraying more than 7 million houses with insecticides

- Procured more than 21 million long-lasting ITNs

- Procured more than 4 million sulfadoxine-pyrimethamine (SP) treatments for intermittent preventive treatment for pregnant women (IPTp)

- Trained more than 27,000 health workers in IPTp

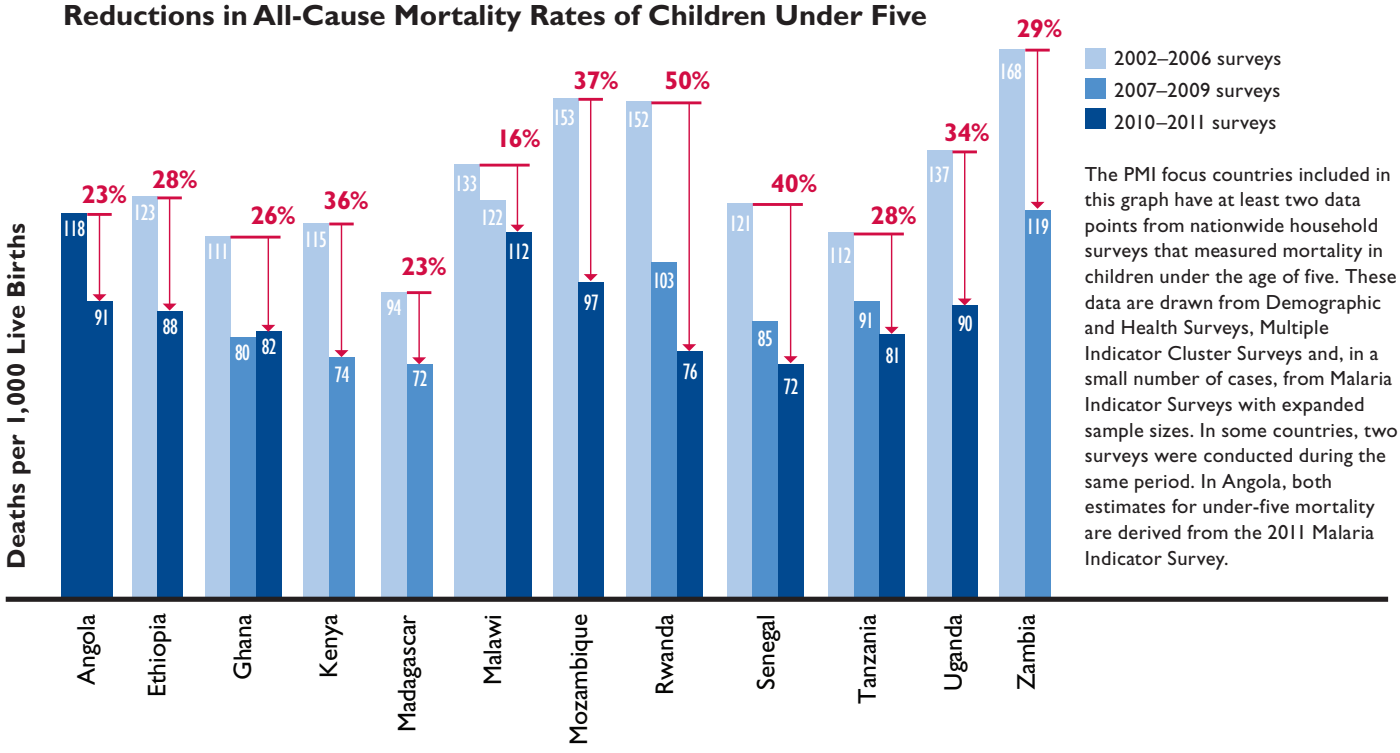
- Procured more than 72 million treatments of artemisinin-based combination therapy (ACT) and over 28 million rapid diagnostic tests (RDTs)

- Trained more than 39,000 health workers in treatment of malaria with ACTs and more than 28,000 health workers in laboratory diagnosis of malaria

In addition, PMI helped distribute more than 10 million long-lasting ITNs that had been procured by other partners, highlighting the well-established and productive col-

FIGURE 1

Reductions in All-Cause Mortality Rates of Children Under Five



The PMI focus countries included in this graph have at least two data points from nationwide household surveys that measured mortality in children under the age of five. These data are drawn from Demographic and Health Surveys, Multiple Indicator Cluster Surveys and, in a small number of cases, from Malaria Indicator Surveys with expanded sample sizes. In some countries, two surveys were conducted during the same period. In Angola, both estimates for under-five mortality are derived from the 2011 Malaria Indicator Survey.

PMI CONTRIBUTIONS AT A GLANCE

Indicator[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)[2]	Year 7 (FY 2012)	Cumulative
People protected by IRS (houses sprayed)	2,097,056 (414,456)	18,827,709 (4,353,747)	25,157,408 (6,101,271)	26,965,164 (6,656,524)	27,199,063 (6,693,218)	28,344,173 (7,004,903)	30,297,000 (7,127,040)	N/A[3]
ITNs procured	1,047,393	5,210,432	6,481,827	15,160,302	18,592,039	23,174,496	21,407,129	82,743,618 (62,133,406 distributed)
ITNs procured by other donors and distributed with PMI support	–	369,900	1,287,624	2,966,011	11,728,674	19,307,756	10,927,791	42,834,823
SP treatments procured	–	583,333	1,784,999	1,657,998	6,264,752	4,701,162	4,493,217	18,287,462 (13,455,244 distributed)[4]
Health workers trained in IPTp[5]	1,994	3,153	12,557	14,015	14,146	28,872	27,348	N/A[6]
RDTs procured	1,004,875	2,082,600	2,429,000	6,254,000	13,340,910	14,572,510	28,957,905	62,539,290 (38,019,883 distributed)[4]
Health workers trained in malaria diagnosis (RDTs and/or microscopy)	–	1,370	1,663	2,856	17,335	34,740	28,210	N/A[6]
ACT treatments procured	1,229,550	8,851,820	22,354,139	21,833,155	41,048,295	38,588,220	72,345,860	189,168,489 (136,330,819 distributed)[4]
ACT treatments procured by other donors and distributed with PMI support	–	8,709,140	112,330	8,855,401	3,536,554	6,993,809	950,239	28,092,273
Health workers trained in treatment with ACTs	8,344	20,864	35,397	41,273	36,458	42,183	39,797	N/A[6]

1 The data reported in this table are up-to-date as of September 30, 2012, and include all PMI focus countries and the Greater Mekong Subregion. In addition, during FY 2012, the U.S. Government provided support for malaria prevention and control activities in other countries. For data by country, see Appendix 2.
2 For Year 6, PMI transitioned from a calendar year to a fiscal year reporting schedule.
3 A cumulative count of people protected by IRS is not provided because most areas are sprayed on more than one occasion.
4 Amount was distributed to health facilities.
5 These figures include health workers who were trained in focused antenatal care in Rwanda, where IPTp is not national policy.
6 A cumulative count of individual health workers trained is not provided because some health workers were trained on more than one occasion.

laboration between PMI and other donors. In all PMI focus countries in Africa and the Greater Mekong Subregion, PMI supported health systems strengthening and capacity building, with a particular focus on pharmaceutical management, laboratory diagnosis, vector control and monitoring and evaluation (M&E).

These contributions, together with those of other partners, have led to dramatic improvements in the coverage of malaria control interventions in PMI focus countries. In countries where at least two comparable nationwide household surveys have been conducted since PMI activities were launched:

- Household ownership of at least one ITN increased from an average* of 36 to 60 percent (see Figure 2).
- Usage of an ITN the night before the survey increased from an average* of 22 to 43 percent for children under five years.
- Usage of an ITN the night before the survey more than doubled from an average* of 19 to 44 percent for pregnant women.
- The proportion of pregnant women who received two or more doses of IPTp for the prevention of malaria increased from an average* of 15 to 29 percent.

In addition to these improvements in ITN and IPTp coverage, PMI has continued to support IRS activities on an unprecedented scale; in FY 2012, more than 90 percent of houses targeted were successfully sprayed. This protected more than 30 million people in 16 countries. As a result of PMI's support for ITNs, IPTp and IRS, a large proportion of at-risk populations in PMI focus countries is now benefiting from highly effective malaria prevention measures. Furthermore, PMI has prioritized scaling up effective case management in all 19 focus countries in sub-Saharan Africa. Due to the weak health systems in many African countries, progress has been slower than with other malaria prevention and control interventions. Nonetheless, RDTs and ACTs are now widely available in health facilities and at the community level throughout PMI focus countries.

LEVERAGING PARTNERSHIPS FOR MALARIA CONTROL

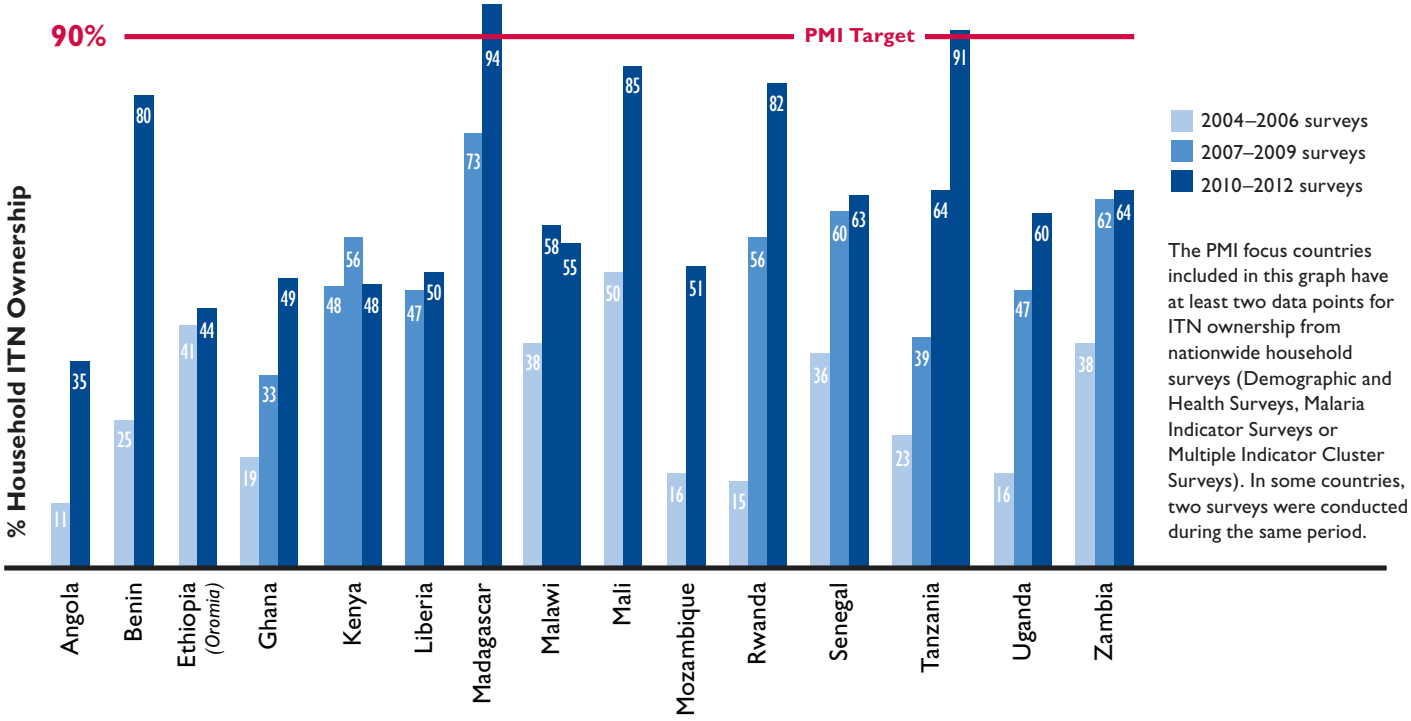
PMI coordinates its activities with a wide range of partner organizations, including national malaria control programs (NMCPs); multilateral and bilateral institutions, such as WHO, the United Nations Children's Fund (UNICEF), the World Bank, The Global Fund and DFID; private foundations, such as the Bill & Melinda Gates Foundation, William J. Clinton Foundation and UN Foundation; and numerous nonprofit and faith-based organizations. For example:

- PMI supported the Roll Back Malaria Harmonization Working Group to help six African countries (**Benin, Burkina Faso, Chad, Ethiopia, Niger** and **Zambia**) prepare their malaria proposals for the Global Fund's Transitional Funding

* defined as the median of the percent coverage

FIGURE 2

Increasing ITN Ownership



The PMI focus countries included in this graph have at least two data points for ITN ownership from nationwide household surveys (Demographic and Health Surveys, Malaria Indicator Surveys or Multiple Indicator Cluster Surveys). In some countries, two surveys were conducted during the same period.

Mechanism – all of which were successfully funded.

- PMI and DFID continued to collaborate closely in **Zambia**, where DFID has channeled funds through PMI for the procurement of commodities. In addition, PMI and DFID initiated discussions to develop partnerships in an additional four PMI focus countries (**Kenya, Malawi, Rwanda** and **Uganda**).

A health worker in Uganda holds up ACT treatments.

Credit: Bonnie Gillespie, Voices for a Malaria-Free Future

- Peace Corps volunteers in 14 PMI focus countries assisted with malaria control activities in FY 2012.

- To date, PMI has supported malaria activities through more than 200 nonprofit organizations, approximately one-third of which are faith based. These groups often have strong and highly effective bases of operations in underserved rural areas, where the burden of malaria is greatest.

- The ExxonMobil Foundation provided $500,000 to support PMI objectives in **Angola**, bringing its total contributions to PMI to $4.5 million since 2006. The foundation's support is for the scale-up of ACTs and IPTp through subgrants to nongovernmental and faith-based organizations in eight provinces where government health infrastructure is weak.

- In **Liberia**, PMI implemented IRS activities in partnership with the steel company Arcelor Mittal, which protected more than 5,900 residents in Grand Bassa and Nimba Counties. PMI provided training together with insecticides and spray tanks, while Arcelor Mittal covered the costs of spray personnel and operational expenses for the campaign.

PROMOTING RESEARCH AND INNOVATION

Research to support malaria control efforts and reduce the burden of malaria has been a high priority of the U.S. Government for many years. The U.S. Government malaria research effort involves the U.S. Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH) of the Department of Health and Human Services, the Naval Medical Research Center (NMRC) and the Walter Reed Army Institute of Research (WRAIR) of the U.S. Department of Defense (DOD) and the U.S. Agency for International Development (USAID).

While USAID does not directly conduct malaria research, it invested approximately $11 million in FY 2012 to support the development of new antimalarial drugs and malaria vaccines. USAID support of drug development has led to the approval and use of new treatments for malaria.

PMI uses operational research to help guide its program investments, make policy recommendations to NMCPs, and target interventions to increase their cost-effectiveness. This research focuses on program-relevant questions, complementing the more upstream vaccine and drug development work

PMI External Evaluation: Acting Upon Recommendations

In 2011, PMI commissioned an external evaluation of the first five years (FYs 2006–2010) of PMI's activities and performance. The evaluation report affirmed that PMI's planning, implementation, partnerships and funding have been key to global efforts to combat malaria. It stated that "[PMI] quickly re-oriented a problematic U.S. Government malaria program, took it to a large scale quickly, efficiently and effectively complemented the larger global malaria program, and contributed to the apparent reduction in child mortality." In addition, the evaluation team made policy and technical recommendations to guide programmatic improvements in the coming years. During FY 2012, PMI took specific steps to address the evaluation's recommendations, including:

- Conducting country-specific reviews of IRS investments with the involvement of external vector control experts to ensure PMI's resources maximize program effectiveness and achieve high results
- Establishing an interagency malaria in pregnancy working group to address operational and behavioral constraints to improving IPTp rates and other malaria in pregnancy interventions
- Hiring a PMI Operational Research Coordinator to oversee and provide leadership for the PMI operational research agenda, and designating a CDC Operational Research Lead to help coordinate the PMI operational research implemented by CDC

More details about PMI's response to the evaluation's recommendations regarding IRS, malaria in pregnancy and operations research are presented in this annual report. The full report and PMI's management response are available on the PMI website at http://pmi.gov/news/pressreleases/pmi_audit.html.

funded by NIH, DOD and USAID. PMI supports operational research studies on topics such as mosquito net durability; the effectiveness of combining interventions such as IRS and ITNs; and looking forward, the effect of insecticide resistance on ITN effectiveness, better use of diagnostics for accurate malaria treatment and the effectiveness of preventive treatment during pregnancy in an environment of increasing drug resistance.

Examples of PMI-supported operational research include:

- An assessment of the physical and insecticidal longevity of ITNs in eight PMI focus countries (**Angola, Benin, Kenya, Malawi, Mozambique, Rwanda, Senegal** and **Zambia**) indicated that many nets do not last the expected three years due to loss of physical integrity and will need to be replaced more frequently than anticipated to maintain high coverage.
- A study in **Zanzibar**, where the prevalence of malaria parasites has fallen to very low levels, showed that only 3 out of every 1,000 pregnant women who did not receive preventive treatment had evidence of placental malaria. This information will help the Ministry of Health decide whether it can discontinue its IPTp program.
- An evaluation of the effectiveness of door-to-door visits to promote ITN hang-up and usage in **Uganda** found no added benefit from the follow-up visits, suggesting that such visits may only be cost-effective in certain settings, such as communities without an established mosquito net culture.

STRENGTHENING HEALTH SYSTEMS AND BUILDING NATIONAL CAPACITY

PMI supports the strengthening of the overall capacity of health systems, both indirectly and directly. Reducing the burden of malaria in highly-endemic countries, where malaria typically accounts for 30 to 40 percent of outpatient visits and hospital admissions, enables overstretched health workers to concentrate on managing other childhood illnesses. In addition to providing support to malaria-specific activities, such as entomological monitoring and IRS, PMI helps build national capacity in a variety of cross-cutting areas that benefit both malaria and other health programs. This support includes strengthening supply chain management, laboratory diagnosis and M&E systems. In FY 2012, PMI efforts to strengthen health systems included:

- Building a cadre of ministry of health staff with technical skills in the collection, analysis and interpretation of data for decision-making and epidemiologic investigations through support to the CDC's Field Epidemiology and Laboratory Training Program in **Angola, Ethiopia, Ghana, Kenya, Mozambique, Nigeria, Rwanda, Tanzania, Uganda, Zimbabwe** and the **Greater Mekong Subregion (Burma)**
- Supporting supervision and training of health workers at all levels of the health system, including in the community
- Providing funds for strengthening supply chain management systems to ensure an uninterrupted supply of commodities (e.g., diagnostic tests and drugs) and to protect their quality and safety
- Collaborating with NMCPs and other partners to strengthen laboratory diagnosis of malaria and improve the overall quality of health care
- Supporting drug and insecticide-resistance monitoring systems

PMI also fosters country ownership by carrying out annual planning visits with NMCPs and their partners to collaboratively develop annual PMI Malaria Operational Plans that directly support national malaria control strategies and priorities.

CHALLENGES

In spite of the progress that has been documented in malaria control in Africa over the past 5 to 10 years, technical challenges remain, such as sustaining high ITN coverage, improving correct diagnosis and treatment of malaria and achieving IPTp coverage targets. The gains made thus far are fragile, and the global malaria partnership must remain vigilant to potential threats, such as:

- *Antimalarial Drug and Insecticide Resistance:* Resistance to artemisinin drugs has not yet

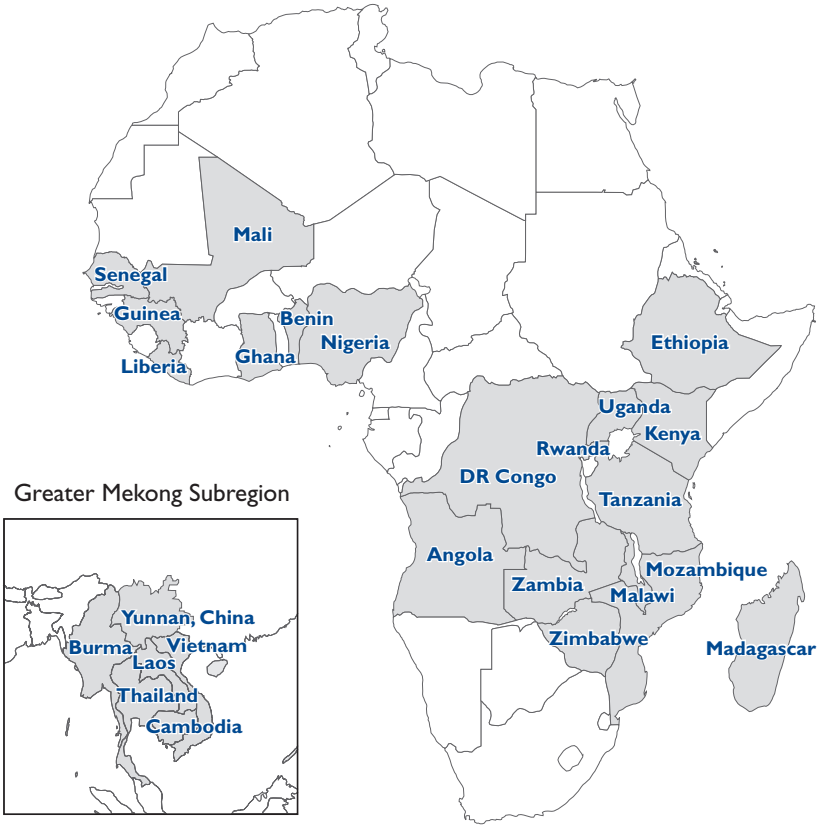
been documented in sub-Saharan Africa, but if this were to emerge and spread, it would represent a major setback for malaria control efforts on the continent. Resistance of the mosquito vector of malaria to pyrethroid insecticides, which are widely used for IRS and are the only recommended insecticides for ITNs, is already being reported from multiple sites in Africa. PMI, therefore, supports NMCPs to conduct regular monitoring and assessment of impact of both antimalarial drug and insecticide resistance. In addition, PMI is looking at other approaches, such as rotation of insecticides used for IRS, to delay the development of further resistance to pyrethroid insecticides and prolong their effectiveness on ITNs.

- *Malaria Case Surveillance:* With the rapid progress in increasing coverage of key interventions and reducing the malaria burden, malaria transmission patterns are changing. Yet tracking progress is a major challenge as malaria surveillance systems may detect only a small percentage of the true number of cases. Therefore, better monitoring of cases and improving data on diagnostics and case management is critical. Stronger malaria surveillance systems are also needed to enable a timely and effective malaria response in endemic regions and to identify and contain outbreaks. PMI invests in strengthening facility-based routine information systems across PMI focus countries.

- *Funding for Malaria Control:* Due to the worldwide economic recession, global support for malaria control has peaked and now seems to be leveling off. The $30 million increase in PMI funding from the U.S. Congress in FY 2012 and the announcement of a substantial increase in malaria support from the British Government through DFID will help meet some of the needs, but malaria control is a long-term challenge, and sustained external donor support will be critical to NMCPs' continued progress.

PMI is working together with other partners to overcome these and other challenges in program implementation. To defeat malaria, we must continue to invest in the malaria prevention and treatment interventions that have enabled the important gains thus far.

FIGURE 3
PMI-Supported Malaria Programs



In addition, USAID provides malaria funding to Burkina Faso, Burundi and South Sudan in Africa and the regional Amazon Malaria Initiative in Latin America (which includes Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru and Suriname).

The President's Malaria Initiative

In his 2013 State of the Union Address, President Barack Obama stated that "… the United States will join with our allies to eradicate such extreme poverty in the next two decades … by saving the world's children from preventable deaths …" Malaria is a major cause of childhood mortality in Africa, thus its prevention and control – which are a key focus of U.S. Government foreign assistance – contribute to the President's vision. PMI's goal is to reduce the burden of malaria and thereby help promote development on the African continent.

PMI, which was launched in June 2005 by President George W. Bush, represented a major five-year (FYs 2006–2010), $1.265 billion expansion of U.S. Government resources for malaria control. The Initiative is led by USAID and implemented together with the CDC. Based on the 2008 Lantos-Hyde United States Leadership against HIV/AIDS, Tuberculosis, and Malaria Act, which authorized a further increase of up to $5 billion in PMI funding for five more years, PMI's goal was broadened to achieve Africa-wide impact by halving the burden of malaria in 70 percent of at-risk populations in sub-Saharan Africa, i.e., approximately 450 million people. PMI includes 19 focus countries in Africa and 1 regional program in the Greater Mekong Subregion of Southeast Asia (see Figure 3).

PMI's efforts to reduce malaria mortality directly contribute to the goal to end preventable child deaths as articulated by the 2012 Call to Action and reaffirmed by A Promise Renewed, a joint global effort led by UNICEF and endorsed by the U.S. Government. In many sub-Saharan African countries, up to a third of pediatric outpatient visits and admissions are due to malaria. Reducing the level of malaria transmission has the dual effect of preventing mild cases of malaria from progressing to severe disease and death while unburdening the health system, so heath workers can focus their time and energy on other important childhood illnesses, such as pneumonia, diarrhea and malnutrition.

CHAPTER

Outcomes and Impact

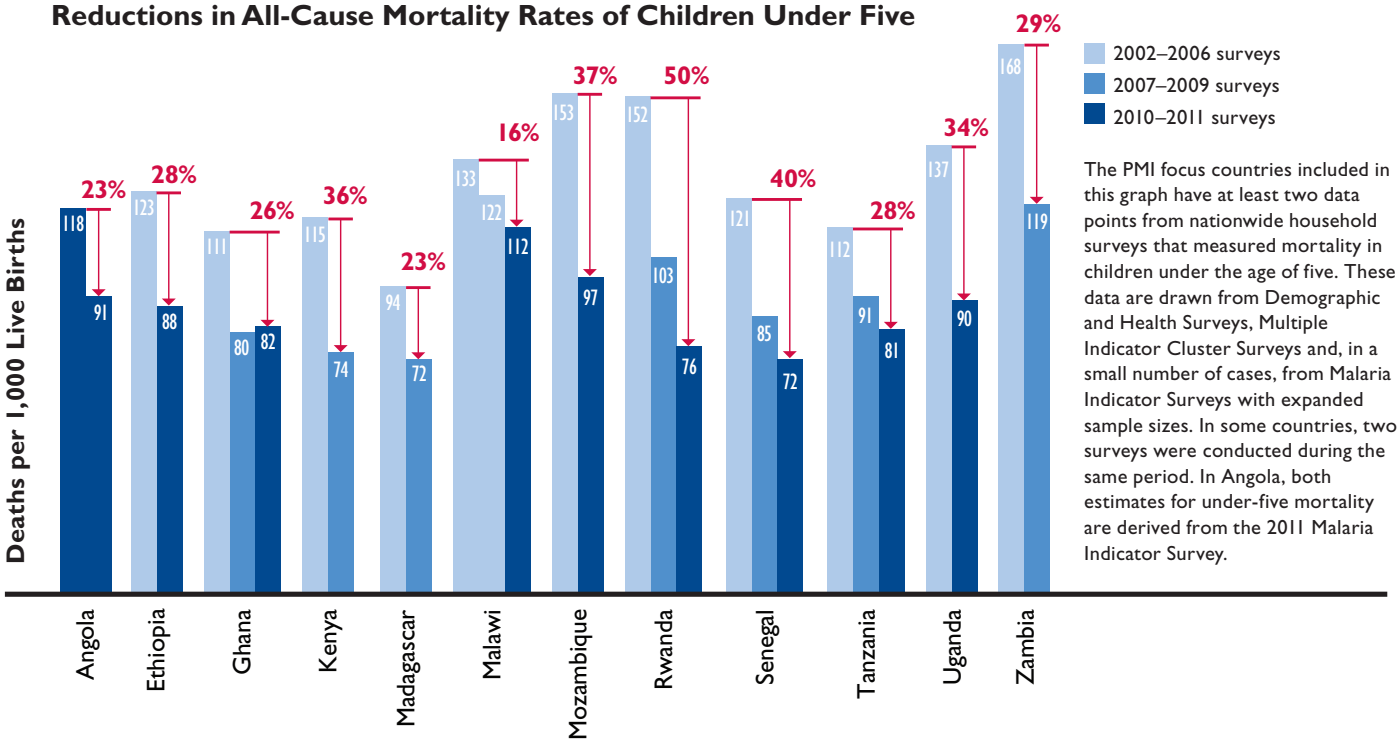
The unprecedented scale-up of malaria prevention and treatment interventions over the past 10 years in sub-Saharan Africa is having a major impact on malaria illnesses and deaths. According to the World Health Organization's (WHO's) *2012 World Malaria Report*, the estimated annual number of global malaria deaths has fallen by more than one-third – from about 985,000 in 2000 to about 660,000 in 2010. The President's Malaria Initiative (PMI) is working with Roll Back Malaria (RBM) partners to assess the contribution of malaria control efforts to declines in under-five mortality in PMI focus countries. Three impact evaluations have been completed to date – in mainland **Tanzania, Malawi** and **Angola** – and six additional evaluations were started in fiscal year (FY) 2012. By 2015, evaluations will have been carried out in all 15 original PMI focus countries.

HIGHLIGHTS

- Mortality rates among children under five years of age in 12 PMI focus countries with two or more nationwide household surveys that measured mortality have shown declines ranging from 16 percent (Malawi) to 50 percent (Rwanda).
- An RBM Partnership impact evaluation in Malawi, in which PMI played a leading role, provides evidence that malaria control interventions strongly contributed to the 41 percent reduction between 2000 and 2010 in mortality among children under five years of age.
- In Angola, the impact evaluation showed that under-five mortality declined, but the coverage of malaria control interventions was too low to have caused this decline. Angola has, however, made considerable strides in scaling up malaria control measures since it emerged from a 25-year-long civil war in 2002.
- The 2012 nationwide household survey in mainland Tanzania confirms the progress in malaria control reported in the PMI impact evaluation completed last year. Household ownership of at least one ITN increased from 39 percent in 2008 to 91 percent, and malaria prevalence fell even further from 18 percent in 2008 to just 10 percent.

FIGURE 1

Reductions in All-Cause Mortality Rates of Children Under Five



The PMI focus countries included in this graph have at least two data points from nationwide household surveys that measured mortality in children under the age of five. These data are drawn from Demographic and Health Surveys, Multiple Indicator Cluster Surveys and, in a small number of cases, from Malaria Indicator Surveys with expanded sample sizes. In some countries, two surveys were conducted during the same period. In Angola, both estimates for under-five mortality are derived from the 2011 Malaria Indicator Survey.

IMPACT IN PMI FOCUS COUNTRIES

Since accurate records on deaths are not kept in most countries in sub-Saharan Africa, the best way to monitor changes in overall child mortality rates is through nationwide household surveys, which are usually carried out every three to five years. To date, a total of 12 of the original 15 PMI focus countries have data from paired nationwide surveys The first of these surveys was conducted around the time PMI began activities in those 12 countries; the second, a follow-up survey, was conducted between 2008 and 2012. In all 12 countries, there has been a reduction in mortality rates in children under five years of age. The decline in under-five mortality rates ranged from 16 percent (**Malawi**) to 50 percent (**Rwanda**) (see Figure 1). PMI is participating in in-depth impact evaluations to ascertain the contribution of malaria control efforts to these declines in mortality, and there are strong indications that a substantial portion of these declines is due to malaria control.

MEASURING PROGRESS: PMI IMPACT EVALUATIONS

During FY 2011 and FY 2012, PMI worked with national malaria control programs (NMCPs) and international and in-country partners to complete impact evaluations of malaria control efforts in mainland **Tanzania, Malawi** and **Angola**. Similar evalua-

How PMI Evaluates Health Impact of Malaria Control Efforts

Due to the lack of malaria-specific mortality data in PMI focus countries and because malaria contributes to child mortality both directly and indirectly, PMI's impact evaluation uses all-cause child mortality to measure the impact of malaria interventions. This approach is recommended by the RBM Monitoring and Evaluation Reference Group, a working group of internationally recognized scientists and public health workers, and consists of four steps:

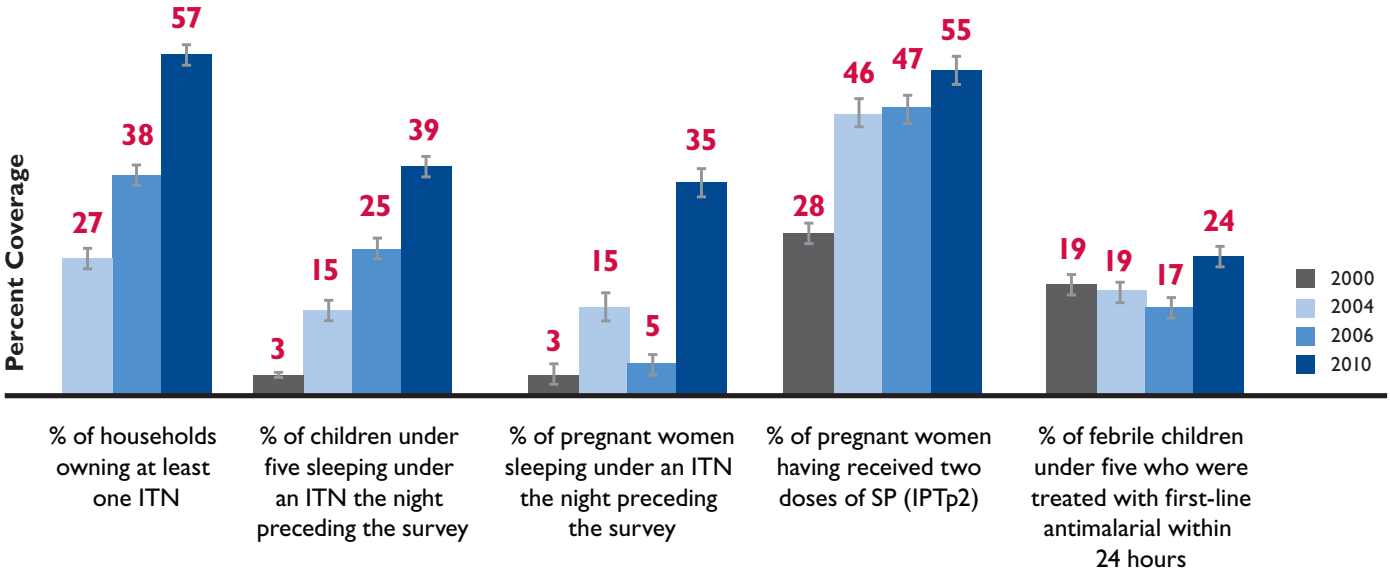
1. Determine if all-cause under-five mortality has declined.
2. Assess whether malaria control interventions have increased to a level at which impact can be expected.
3. Determine if malaria morbidity (i.e., malaria parasitemia or severe anemia) has fallen.
4. Examine if alternate explanations (e.g., improvements in immunizations, declines in rainfall) for the mortality reduction exist.

If the first three conditions are met and no other explanation for the reduction in all-cause under-five mortality can be identified, or the fall in mortality can only be partially explained by other factors, then it is reasonable to conclude that malaria control interventions resulted in the reduction in all-cause child mortality.

PMI ensures that evaluations are conducted in close coordination with national and international partners. In addition to working with NMCPs, PMI coordinates with members of the RBM Partnership, including WHO; the United Nations Children's Fund; The Global Fund to Fight AIDS, Tuberculosis and Malaria and nongovernmental organizations. Local research institutions and scientists are engaged wherever possible. PMI impact evaluations do not attempt to attribute impact to any specific intervention or organization. Rather, the emphasis is on the overall impact that has been achieved by the NMCP and its partners over the preceding decade.

FIGURE 2

Coverage of Malaria Control Interventions in Malawi (2000–2010)



tions were initiated in FY 2012 in **Ethiopia, Mozambique, Rwanda, Senegal, Uganda** and **Zanzibar**, and results will be available in FY 2013. The approach used builds on the methods of the original impact evaluation in Tanzania.

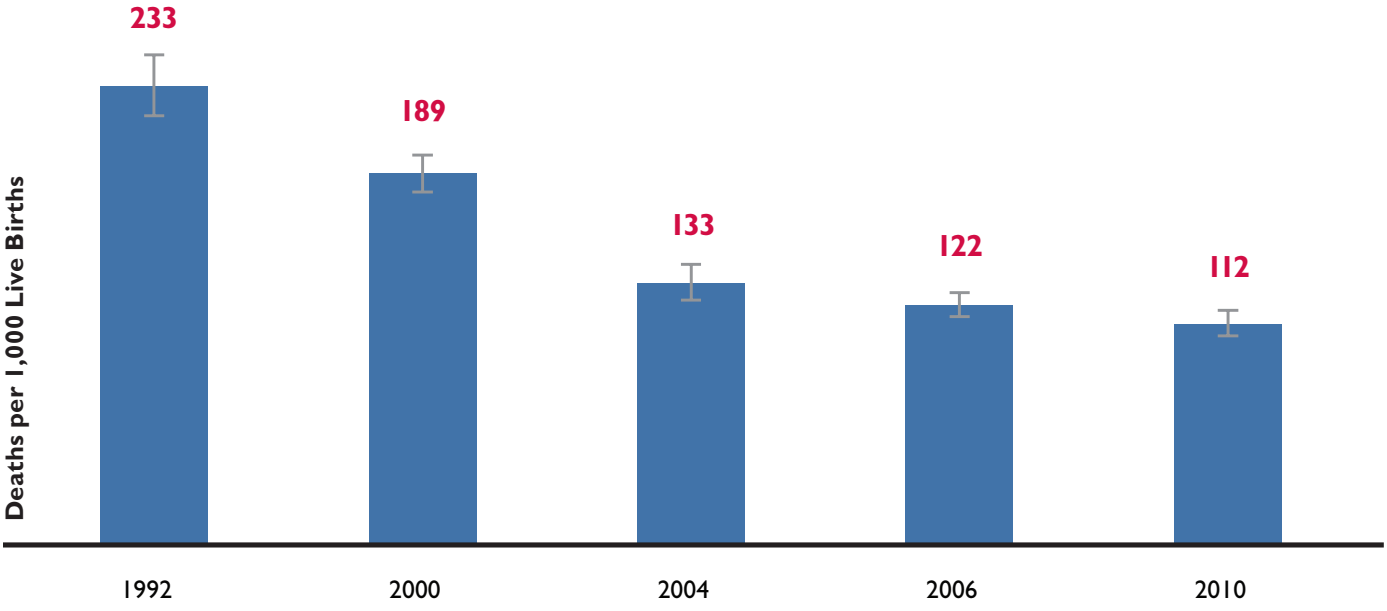
MALAWI IMPACT EVALUATION

Malaria is highly endemic in Malawi: 98 percent of the population is at risk of infection. Until recently, one-third of all outpatient visits and 40 percent of all hospital admissions of children under five were associated with malaria. The burden of malaria has strained the limited resources of the health care system. Fortunately, under the leadership of the NMCP and with support from donors, such as PMI, The Global Fund and others, a robust and far-reaching malaria control program has been implemented since 2000. Malawi has now reached an important milestone in its fight against the disease: Malaria control interventions have achieved sufficient coverage to reduce malaria morbidity and mortality.

Malawi's insecticide-treated mosquito net (ITN) distribution strategy has evolved from a small-scale social marketing program to one that ensures provision of free ITNs through antenatal care and Expanded Program for Immunization clinics nationwide. As a result, household ownership of ITNs doubled from 27 percent in 2004 to 57 percent in 2010 (see Figure 2). Malawi was the first country in sub-Saharan Africa to implement intermittent preventive treatment for pregnant women (IPTp), and it has now emerged as one of the top countries for

FIGURE 3

All-Cause Under-Five Mortality in Malawi (1992–2010)



coverage with two doses of sulfadoxine-pyrimethamine (SP). During 2000–2010, IPTp2 coverage increased from 29 to 55 percent.

Two key indicators of the impact of malaria control – malaria parasitemia and severe anemia in children under five years of age – have shown declines. Recent survey results show that malaria parasite prevalence declined in children 6–59 months old, falling from 43 percent in 2010 to 28 percent in 2012. In the age group most at risk for malaria symptoms, children 6–23 months old, the prevalence of severe anemia has declined by more than one-third – from 20 to 13 percent.

Successive nationwide household surveys spanning the decade of 2000–2010 show that all-cause mortality of children under five years of age dropped by 41 percent in Malawi (see Figure 3). Although not all decreases in all-cause under-five mortality are due to malaria interventions, mortality declines were greater in areas with higher risk of malaria. This strongly suggests that a major part of the decline was due to the Government of Malawi's malaria control measures. Furthermore, the Lives Saved Tool, a mathematical model, conservatively estimates that the scale-up of malaria control interventions (specifically ITNs and IPTp) between 2000 and 2010 prevented at least 21,600 deaths of children under five years of age.

ANGOLA IMPACT EVALUATION

In 2002, Angola emerged from a devastating 25-year civil war that left much of the country's infrastructure damaged or destroyed. Following the signing of the peace accords, there was a progressive expansion of the health care system and a broad increase in donor investment in health programs, including malaria. In spite of this, as late as 2005, artemisinin-based combination therapies, IPTp and ITNs were only beginning to be introduced.

Over the period of 2006–2011, malaria interventions were introduced and scaled up in Angola (see Figure 4). By 2011, household ownership of at least one ITN reached 35 percent, and about one-quarter of children under five and of pregnant women reported using an ITN. Coverage with two doses of SP (IPTp2) was 18 percent, and treatment of febrile children with a first-line antimalarial within 24 hours was 12 percent. Malaria parasite prevalence in the rainy season in children under five years of age showed a 36 percent relative decline from 21 to 14 percent over the period of 2006–2011. Severe anemia was only 4 percent in 2006 and did not change substantially by 2011. Although coverage of malaria prevention and treatment measures improved, coverage did not reach levels that would be expected to produce a substantial impact at the national level.

All-cause under-five mortality declined by 21 percent, from 117 deaths per 1,000 live births in the period prior to malaria control intervention scale-up (2003–2005) to 92 deaths per 1,000 live births (2009–2011). At a subnational level, the greatest reductions in all-cause under-five mortality were observed in the region with higher risk of malaria (see Figure 5). In 2006, household ownership of at least one ITN in the higher malaria risk region was 51 percent compared to the national ITN household ownership level of 27 percent.

MEASURING IMPACT: AN UPDATE ON TANZANIA

The findings of the mainland Tanzania impact evaluation – which documented a 45 percent reduction in all-cause mortality among children under five between 2000 and 2010, due in part to the scale-up of malaria control interventions – have been further supported by the findings of the 2012 Tanzania Malaria Indicator Survey. A 47 percent reduction in malaria prevalence was detected (using rapid diagnostic tests [RDTs]), from 18 percent in 2008 to 10 percent in 2012. In the Kagera Region, an area with high malaria prevalence and intensive malaria control efforts, including the scale-up of indoor residual spraying, malaria prevalence fell from 41 to just 8 percent over the period of 2007–2012. In 2012, the presence of at least one ITN in households at a national level was 91 percent, compared to less than 40 percent in 2008. This dramatic progress in malaria control in mainland Tanzania illustrates how a well-managed and well-funded program can achieve measurable results in a relatively short timeframe. Still, progress is often fragile, and control efforts may need to be continued for years before most countries in sub-Saharan Africa will be able to plan for malaria elimination.

FIGURE 4

Coverage of Malaria Control Interventions in Angola (2006–2011)

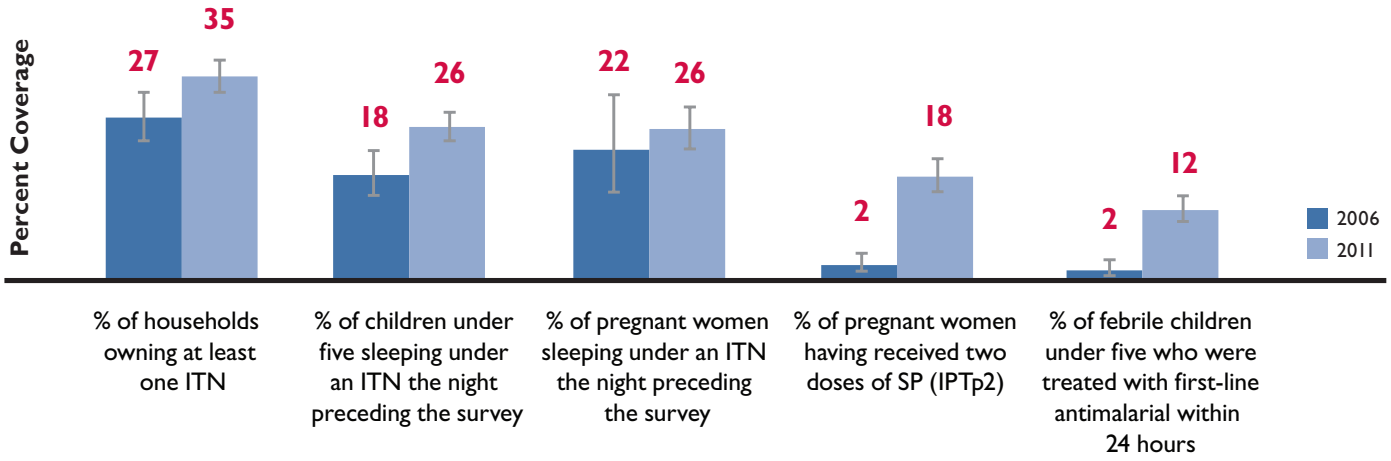
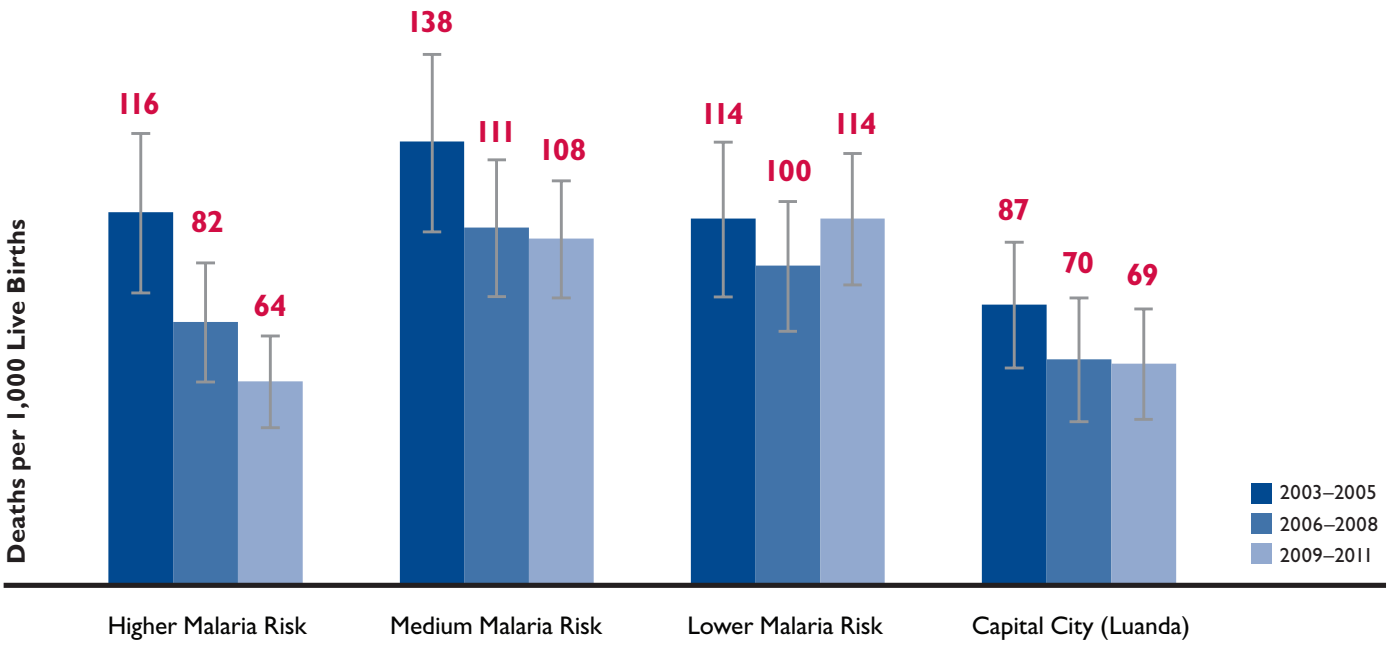


FIGURE 5

All-Cause Under-Five Mortality in Angola, by Malaria Epidemiologic Region (2003–2011)



LOOKING FORWARD

Evidence from in-depth evaluations of impact in Malawi and mainland Tanzania further confirms that scaling up malaria interventions has a substantial impact on reducing mortality among children under five years of age. Over the next few years, PMI will continue to support impact evaluations in its focus countries; by 2015, evaluations will have been carried out in all 15 original PMI focus countries. Each evaluation advances our understanding of health program evaluation at the national level. To ensure that the impact evaluations are scientifically rigorous and their findings are broadly accepted, PMI teams at the U.S. Agency for International Development and the U.S. Centers for Disease Control and Prevention have engaged partners, such as The Global Fund, RBM and a contingent of internationally recognized malaria scientists, in this effort.

Strengthening Routine Information Systems

In most sub-Saharan African countries, a major challenge in assessing the impact of malaria control interventions on malaria burden is the lack of quality routine malaria data (e.g., number of confirmed malaria cases, number of patients with malaria admitted to hospitals). For this reason, PMI is continuing to invest in improving the abilities of NMCPs to collect health facility data on malaria cases and deaths. In countries where there are strengthened facility data collection systems, such as Rwanda, Zambia and Zanzibar, PMI continues to invest in the capacity building of NMCP personnel, data quality assessments and use and dissemination of the data. Since 2006, PMI has invested over $18 million to support the strengthening of country monitoring and evaluation, routine systems and capacity. Some of the activities PMI supports are:

1. Assessments of information systems
2. Quality improvement of data collection and analysis
3. Training workshops and technical assistance for NMCP personnel
4. Development of databases and networks for storing and processing routine data

In addition to such direct country investments, PMI is working to leverage resources from other donor partners and initiatives, including The Global Fund to Fight AIDS, Tuberculosis and Malaria, the World Bank, U. K. Department for International Development, the Bill & Melinda Gates Foundation and the U.S. President's Emergency Plan for AIDS Relief. As a member of the RBM Monitoring and Evaluation Reference Group, PMI is also leading coordination efforts between partners who are working on routine systems strengthening activities.

In Tanzania, a clinician notes RDT results and treatment given when test results are positive. Accurate record keeping is essential to good disease surveillance.

Credit: Maggie Hallahan Photography

CHAPTER 2

Malaria Prevention

The tools to prevent malaria transmission are both cost-effective and technically proven. These measures include insecticide-treated mosquito nets (ITNs), indoor residual spraying (IRS) with insecticides and intermittent preventive treatment for pregnant women (IPTp).

Prevention – Insecticide-Treated Mosquito Nets

Long-lasting ITNs, which have a pyrethroid insecticide incorporated within or bound to the netting fibers during the manufacturing process, are the primary means for malaria prevention worldwide. High ownership and use of ITNs reduces all-cause mortality in children under five by about 20 percent and malarial infections among children under five and pregnant women by up to 50 percent. These community-wide results

PMI ITN SUMMARY

Indicator[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)[2]	Year 7 (FY 2012)	Cumulative[3]
ITNs procured	1,047,393	5,210,432	6,481,827	15,160,302	18,592,039	23,174,496	21,407,129	82,743,618 procured (62,133,406 distributed)
ITNs procured by other donors and distributed with PMI support	–	369,900	1,287,624	2,966,011	11,728,674	19,307,756	10,927,791	42,834,823 distributed

1 The data reported in this table are up-to-date as of September 30, 2012, and include all 19 PMI focus countries and the Greater Mekong Subregion. For data by country, see Appendix 2.
2 For Year 6, PMI transitioned from a calendar year to a fiscal year reporting schedule.
3 The cumulative count of ITNs procured and distributed takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year).

HIGHLIGHTS

- Household ownership of at least one ITN has increased from an average* of 36 to 60 percent in 15 PMI focus countries during the past seven years.
- Use of ITNs among children under the age of five has increased from an average* of 22 to 43 percent during the past seven years.
- To date, PMI has procured more than 82 million ITNs. In addition, PMI has funded the distribution of more than 42 million ITNs procured by other donors.

are achieved when ITN coverage is high (generally thought to be at least 65 percent) and are associated with greatly reduced populations of the mosquitoes that transmit malaria. As a result of this community effect, high levels of ITN coverage reduce the risk of malaria infections, even among those not using an ITN.

PMI'S ITN STRATEGY

In a 2007 position statement, the World Health Organization (WHO) recommended universal coverage of the entire population at risk for malaria with long-lasting ITNs, thus broadening its previous recommendation that targeted children under five years of age and pregnant women. In line with this recommendation, the President's Malaria Initiative (PMI) adopted the policy of reaching universal coverage with long-lasting ITNs, when this approach is consistent with the national strategy of focus countries and adequate resources exist to achieve universal coverage. Universal coverage is generally defined as one ITN per two persons. PMI supports ITN activities that strive to:

- Achieve universal coverage with long-lasting ITNs
- Sustain universal coverage during the coming years
- Ensure that all ITNs distributed are used appropriately and regularly
- Extend ITN longevity

ACHIEVING UNIVERSAL COVERAGE: MASS CAMPAIGNS

Mass ITN distribution campaigns are a proven means to quickly attain universal and equitable coverage with ITNs. This approach actually provides greater protection for pregnant women and children under the age of five years than campaigns targeting only these vulnerable groups. A push for universal coverage, with strong support from international partners and donors between 2009 and 2011, resulted in the delivery of more than 326 million long-lasting ITNs to sub-Saharan Africa.[1] Most countries in this region completed national or subnational universal campaigns designed to ensure that at least 80 percent of all persons living in malaria-endemic regions had access to an ITN. In spite of the enormous gains in ITN ownership and use (see Figures 1 and 2), no country in sub-Saharan Africa has yet achieved universal coverage, defined as 80 percent coverage of one ITN for every two persons.

In fiscal year (FY) 2012, mass campaigns were undertaken in many PMI focus countries. For example:

- In the **Democratic Republic of the Congo (DRC)**, PMI provided 2 million ITNs (nearly 40 percent of the total need) for a mass distribution campaign in Katanga Province, which was carried out between April and September 2012. Under the leadership of the national malaria control program (NMCP), PMI also supported a behavior change communication (BCC) campaign that reached approximately 300,000 people in nearly 200 villages in Katanga and South-Kivu Province with interpersonal communication and community radio networks to improve ITN use.
- **Malawi** completed a mass distribution campaign that provided 5.6 million ITNs to targeted areas. PMI contributed approximately 600,000 mosquito nets together with technical assistance for planning and implementing the campaign.

SUSTAINING UNIVERSAL COVERAGE: CONTINUOUS DISTRIBUTION

Mass campaigns alone are not sufficient to sustain universal coverage of ITNs. While the average effective life of an ITN de-

1 World Health Organization. *2012 World Malaria Report.*

* defined as the median of the percent coverage

Nigerian students receive mosquito nets to take home. School-based distribution of long-lasting ITNs can help sustain high coverage after campaigns.

Continuous Distribution of Mosquito Nets through Schools in Nigeria

In Nigeria, PMI has assisted Cross River State to pilot innovative ways to maintain high rates of household ITN ownership. The NMCP projected that after its universal campaign, coverage of at least one ITN per household would eventually drop to just 20 percent if ITNs were only distributed through ANC settings. But distributing ITNs through ANC settings *and* schools could sustain 75 percent coverage.

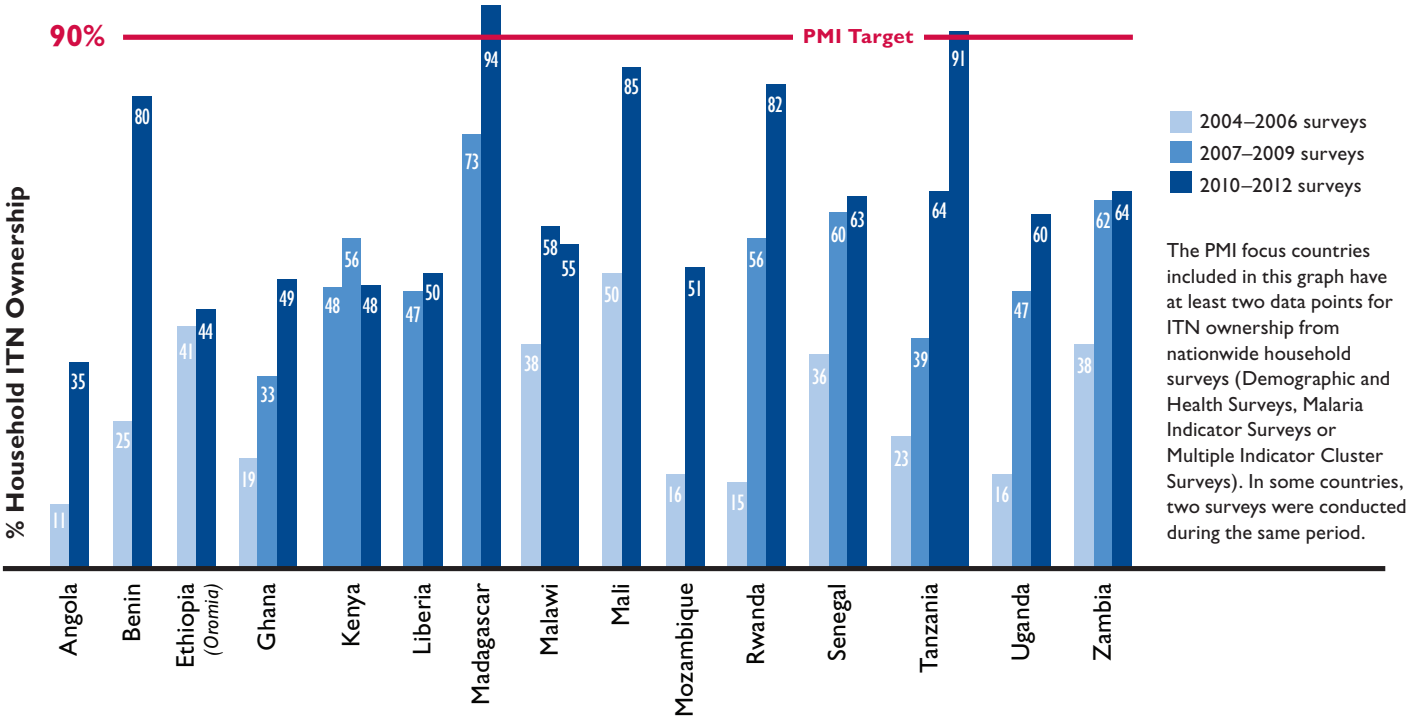
The school distribution pilot provided a practical way to introduce ITNs into homes since many elements were already in place: Students and their families were registered in the school system; schools had adequate storage facilities for ITNs; educators were highly motivated to take part in malaria prevention activities.

The pilot provided ITNs in four different grade levels, three years apart, in order to ensure that most households with children received at least one ITN every few years. Key government, education and health leaders were involved throughout the pilot. During monthly meetings, teachers were trained on correct ITN use.

In the first round, 88 public schools distributed 8,444 ITNs to students and teachers in Obubra Local Government Area, which has a total population of 185,000. PMI provided critical support for ITN procurement, logistics and implementation. The pilot reached all targeted school children with minimal logistical burden and no loss of ITNs. Keys to success included early and frequent engagement with all stakeholders; commitment from the educational sector and the ability to quantify ITNs, store bales of nets and train personnel using existing systems.

FIGURE 1

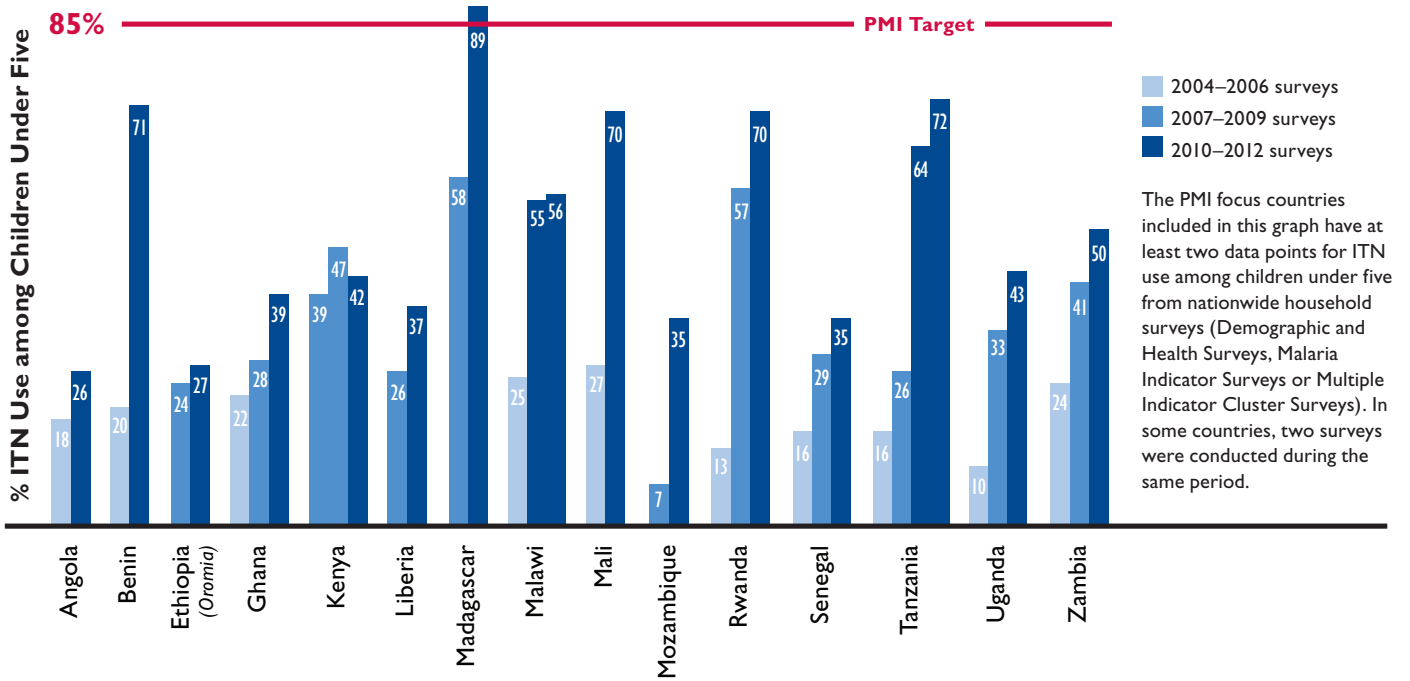
Increasing ITN Ownership



The PMI focus countries included in this graph have at least two data points for ITN ownership from nationwide household surveys (Demographic and Health Surveys, Malaria Indicator Surveys or Multiple Indicator Cluster Surveys). In some countries, two surveys were conducted during the same period.

FIGURE 2

Increasing ITN Use among Children Under Five



The PMI focus countries included in this graph have at least two data points for ITN use among children under five from nationwide household surveys (Demographic and Health Surveys, Malaria Indicator Surveys or Multiple Indicator Cluster Surveys). In some countries, two surveys were conducted during the same period.

pends on local conditions, Roll Back Malaria (RBM) recommends that countries plan to replace long-lasting ITNs after three years. Thus maintaining high ITN ownership over time requires a continuous input of mosquito nets into the community, both to provide for new members of the population and to replace worn out, damaged or lost ITNs. To keep ITN coverage at levels that provide a community effect requires the introduction of ITNs into the community through multiple distribution channels, including free delivery through routine services at health and other public sector facilities, as well as subsidized and commercially available ITNs. PMI is currently supporting operations research to evaluate the contribution of alternative distribution channels to maintain high, equitable coverage (see Research chapter).

In FY 2012, PMI focus countries used various continuous distribution methods to sustain universal coverage. For example:

- In Cross River State in **Nigeria**, PMI is engaging health and education sectors to test the feasibility of distributing ITNs through schools (see story in this chapter). PMI is also evaluating the use of existing community organizations and infrastructure to supply ITNs on a continuous basis.

- In **Senegal**, PMI assisted the NMCP to establish a new distribution system in 12 of the country's 14 regions, providing free ITNs to pregnant women attending routine prenatal care and subsidized ITNs for all other clients visiting health facilities. More than 95,000 ITNs were distributed through this system during the first three months of operations. PMI also funded an assessment to identify other potential channels to make subsidized ITNs widely available to the population and will begin piloting additional models in early 2013.

- In **Tanzania**, PMI supported the introduction of an electronic voucher (eVoucher) that is in the process of replacing the paper vouchers previously issued to pregnant women and caretakers of infants. Vouchers are redeemed at retail shops for a highly subsidized ITN at a cost of only $0.32 each. The eVoucher has improved operational efficiencies and redemption rates, thus increasing the number of mosquito nets being distributed to pregnant women and children.

PROMOTING REGULAR USE

During the past 7 years, 15 of the PMI focus countries where sufficient data are available have reported an increase in household ownership of at least one ITN from an average* of 36 to 60 percent (see Figure 1). During this same period, use of ITNs among children under the age of five increased from an average* of 22 to 43 percent (see Figure 2).

PMI focus countries have employed various techniques to promote regular use. For example:

- In **Liberia**, in addition to supporting targeted messaging at antenatal care (ANC) clinics to promote correct and consistent ITN use, PMI supported Liberia's mass distribution efforts. This included a three-month-long information and BCC campaign on ITN use. During the campaign "Take Cover under the Net," messages aired on community radio.

- In **Uganda**, community volunteers conducted home visits to assist with and encourage mosquito net use following a large-scale distribution campaign.

PMI is also conducting research to determine the most effective ways to promote regular use of ITNs. In **Uganda**, a PMI-supported study showed that in the context of high ITN awareness, community volunteer visits to each home to promote ITN use were not a cost-effective way to increase net use (see Research chapter). There are regions in Uganda with large gaps between mosquito net ownership and use. In those settings, PMI continues to support efforts to improve mass media and interpersonal communication interventions to increase use. Several studies have concluded that the number of ITNs available is a key determinant of use, and typically, in households that have achieved an ITN ownership ratio of one ITN for every two inhabitants, use is high.

* defined as the median of the percent coverage

For Ms. Maria Bhonzi, using long-lasting ITNs correctly and consistently ensures protection against bites from the Anopheles mosquitoes that transmit malaria.

Mass Distribution of ITNs Protects Families in Zimbabwe

Ms. Maria Bhonzi lives in a village in the Dotito area of Zimbabwe, with her husband and two young children, Marcia and Tendayi. Maria is pregnant with her third child. The family lives near the Chiutsa River, a major breeding site for mosquitoes. Ms. Bhonzi and her family are unable to afford a long-lasting ITN and regularly visit the local clinic to seek treatment for malaria.

This year, the Dotito area had a malaria outbreak, and two-year-old Marcia suffered her second malaria episode. Ms. Bhonzi lost working days in the field while caring for Marcia. When the family heard that the local clinic was distributing free ITNs, they went there and received two mosquito nets – one for the parents and another for their children.

In 2012, support from PMI enabled the Ministry of Health and Child Welfare to distribute 457,000 ITNs to families in seven of Zimbabwe's most malaria-prone districts. During the distribution, 2,595 community leaders and 865 village health workers were trained on correct ITN use. A total of 250,468 heads of household were also reached with messages on correct and consistent use of mosquito nets.

Ms. Bhonzi smiles and reports, "My children and I can now sleep peacefully with no mosquito bites, and this will protect us from malaria. The mosquito net is also killing and repelling mosquitoes that enter my house." She went on to say: "The recent net hang-up campaigns have made it easier for me to use and maintain the mosquito net."

A Senegalese woman receives ITNs from a volunteer during a mass distribution campaign in Kebemer Health District, Louga Region.

Credit: Pascal Zinzindohoue, PMI

EXTENDING ITN LONGEVITY

Studies have shown that long-lasting ITNs, initially thought to last up to five years, deteriorate more rapidly than expected under field conditions. PMI and partners are undertaking studies to estimate the effective life of ITNs more precisely. PMI field studies in **Rwanda** show that, after two years, more than 50 percent of original ITNs are no longer functional due to physical deterioration and/or loss of insecticide. Furthermore, ITN failure rates varied across Rwanda, highlighting the influence that behavior and culture have on the life of an ITN.

Extending the average life of ITNs could result in large savings over time. Manufacturers also continue to work on approaches to improve ITN durability (e.g., adding borders with stronger material on lower seams, testing new knitting patterns and introducing polypropylene material). PMI is supporting operations research to improve mosquito net care and repair at the household level to extend the viable life of ITNs (see Research chapter). PMI also continues to support studies to monitor mosquito nets under field conditions to document deterioration over time and eventually guide replacement policies in countries.

Prevention – Indoor Residual Spraying

PMI IRS SUMMARY

Indicator[1,2]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)[3]	Year 7 (FY 2012)
People protected by IRS	2,097,056	18,827,709	25,157,408	26,965,164	27,199,063	28,344,173	30,297,000
Spray personnel trained[4]	1,336	13,795	19,077	21,664	30,545	26,038	34,130
Houses sprayed	414,456	4,353,747	6,101,271	6,656,524	6,693,218	7,004,903	7,127,040

1 The data reported in this table are up-to-date as of September 30, 2012, and include 16 PMI focus countries (no IRS was carried out in DRC, the Greater Mekong Subregion, Guinea and Zimbabwe). For data by country, see Appendix 2.
2 A cumulative count of the number of people protected, personnel trained and houses sprayed is not provided because many areas were sprayed on more than one occasion.
3 For Year 6, PMI transitioned from a calendar year to a fiscal year reporting schedule.
4 Spray personnel are defined as spray operators, supervisors and ancillary personnel. These calculations do not include many people trained to educate residents about IRS and carry out community mobilization around IRS campaigns.

Indoor residual spraying (IRS) has been a powerful tool in combating malaria for more than 60 years. During door-to-door operations, the interior walls of houses are sprayed with a residual insecticide. Mosquitoes are either repelled from entering the house or are killed after coming into contact with a sprayed surface. IRS confers community protection when at least 80 percent of houses in a targeted area are sprayed. Now in its seventh year of IRS implementation, PMI continues to experience overwhelming acceptance of IRS from communities and their leaders. With PMI support, more than 7 million houses were sprayed in FY 2012, and, in each spray round, more than 90 percent of the targeted houses were sprayed. IRS operations supported by PMI protected 30 million people in FY 2012. The success of PMI's IRS operations is attributable to:

- Evidence-based selection of insecticides
- Timely, high-quality insecticide applications
- Capacity building of local personnel to carry out spray operations

HIGHLIGHTS

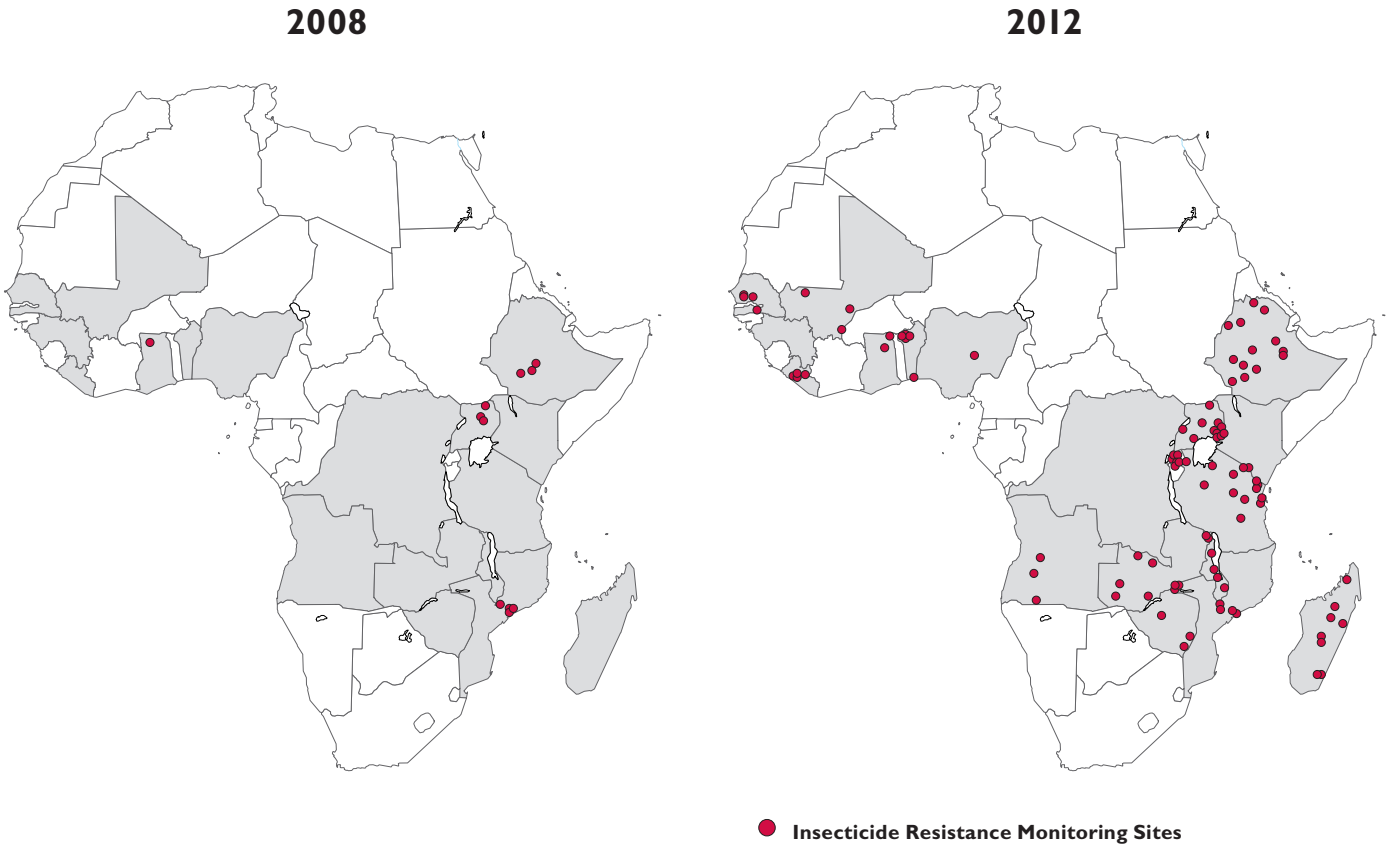
- In FY 2012, PMI supported the spraying of more than 7 million houses in 16 PMI focus countries, protecting over 30 million residents.
- PMI supported capacity building efforts by training more than 34,000 persons to carry out IRS operations.

EVIDENCE-BASED CHOICE OF INSECTICIDE

IRS relies on the use of insecticides to

FIGURE 3

Expansion of PMI-Supported Insecticide Resistance Monitoring Sites



which local mosquitoes are susceptible. WHO recommends four insecticide classes for IRS. When PMI was launched in 2005, there was evidence of emerging resistance to two of these classes in western Africa and sporadic resistance to one class in eastern Africa. As PMI support for IRS expanded from 3 countries in 2006 to 16 countries in 2012, PMI also expanded its efforts to collect data on insecticide resistance. Monitoring of insecticide resistance in local mosquito vectors is now carried out at nearly 100 sites across the 19 PMI focus countries in sub-Saharan Africa (see Figure 3). Data from these sites indicate that there have been notable increases in resistance to two of the four insecticide classes (pyrethroids and organochlorines) and rapidly increasing resistance to a third class (carbamates). PMI has responded to insecticide resistance in the following ways:

- Changing to insecticide classes to which the local malaria vector is susceptible (only 6 PMI focus countries used pyrethroids exclusively in 2012, compared to 10 in 2010)
- Continuing to expand efforts to collect and enter resistance data in a PMI resistance database and make results publically available via the Insecticide Resistance Mapper, an online tool used to view results from insecticide resistance studies (http://www.irmapper.com)
- Supporting testing to determine the biological basis of resistance to better inform insecticide selection
- Supporting development of country-specific insecticide resistance management plans

As malaria mosquito vectors have developed resistance to the lower cost and highly efficacious pyrethroids and organochlorines, PMI has had to shift to other classes of insecticides (carbamates and organophosphates), which are more expensive. In FY 2013 and beyond, PMI will continue to explore the possibility of retargeting IRS to achieve maximum impact (e.g., in areas with short transmission seasons, high proportions of indoor-biting or -resting mosquitoes and the highest malaria transmission levels).

The choice of insecticide for PMI-supported IRS activities is guided by country-specific evidence. Country examples of data-driven decision-making include:

- Utilizing in-country centers of excellence (e.g., the University of **Ghana's** Noguchi Memorial Institute, **Benin's** Entomological Research Center of Cotonou, and **Senegal's** University of Cheikh Anta Diop) to collect data on insecticide resistance and facilitate discussions between NMCP and in-country and external experts to reach consensus on which insecticide to use
- Supporting an operational research study in **Kenya** that resulted in a recommendation to use the insecticide bendiocarb for IRS campaigns in areas where mosquitoes have developed resistance to pyrethroid insecticides (see Research chapter)

TIMELY, HIGH-QUALITY APPLICATION OF INSECTICIDES

Precise timing is critical to the success of IRS operations. If applied too early, an insecticide may not remain effective during

The insectary-in-a-box is a cost-effective and quick solution to carry out entomological monitoring under difficult field conditions.

Mali Pilots Innovative 'Insectary-in-a-box'

In March 2012, a coup interrupted PMI-supported IRS activities. As a result, PMI had to proceed without the involvement of government partners. This affected entomological monitoring, a crucial activity that assesses whether the sprayed insecticide is killing malaria-transmitting mosquitoes. The PMI-supported partner had less than one month to build an insectary where it could rear mosquitoes and test their susceptibility to insecticides. The team developed an innovative solution to this dilemma – it converted a shipping container into an "insectary-in-a-box." The container was purchased locally for about $3,500 and was operational in a mere three weeks. Since the insectary was placed in the project's compound in Bamako, there was no need to buy land and construct a building, a process that can be both costly and time consuming.

The insectary is divided into three rooms: one for keeping adult mosquitoes; another for rearing mosquitoes from larvae and still another for completing morphological identification, dissection and susceptibility testing. The insectary is outfitted with air conditioners and humidifiers to maintain optimal conditions for the mosquitoes.

The insectary-in-a-box was originally developed in response to a crisis, but it can be used for several years. Since it is mobile, the insectary can be relocated so another organization could sustain it after the current project ends. In countries where there is no insectary to carry out entomological monitoring, the insectary-in-a-box model can be an easy-to-implement, cost-effective solution that results in improved quality of IRS.

IRS Innovations

During the past year, PMI introduced innovations to several of its spray programs. For example:

- A new, longer-lasting organophosphate insecticide came on the market and was used in PMI-supported IRS programs in both **Ghana** and **Zambia**. Entomological monitoring is ongoing to determine the actual duration of this insecticide's efficacy and whether its use will result in any cost savings.
- In **Mali**, PMI introduced the concept of a "container insectary" to conduct entomological monitoring in resource-poor settings. Instead of acquiring space in an existing building or constructing a new structure, PMI transformed a shipping container into a functional space to rear mosquitoes and test them for insecticide susceptibility (see story in this chapter).

the entire malaria transmission season; if applied too late, IRS operations may be disrupted by the seasonal rains that are associated with the upswing in malaria transmission. As the timing of heavy rains and peak malaria transmission may vary from year to year, PMI and its implementing partners have to be flexible in adjusting the launch of IRS operations. For example:

- Spraying in **Mali** was pushed back by one month in 2012, and may be pushed back again by a month in 2013 due to later onset of the malaria transmission season. The switch to a shorter-acting insecticide class required initiating the spray season as close to the start of the rains as possible in order to cover the entire transmission season. To allow spraying to continue through the rains, the hardest-to-reach areas and those most prone to flooding are targeted first.

The quality of insecticide application is also critical. The correct dosage of insecticides should be applied uniformly to surfaces. When mosquitoes rest on unsprayed and undertreated surfaces, they are not adequately exposed to the insecticide. Since nearly all insecticides used for IRS are colorless when applied to walls, it is difficult for spray operators to visually determine whether they sprayed the entire surface area. Therefore, PMI supports bioassay tests on a monthly basis to measure mosquito mortality rates on sprayed surfaces and detect any evidence of reduced mosquito mortality.

The results of these bioassays have practical implications. For example, in one country, when lower-than-expected mosquito mortality rates were detected immediately after spraying, PMI supported refresher training of spray operators. Within two weeks, mosquito mortality rates in bioassays rose to nearly 100 percent. In another country, when the efficacy of one insecticide was declining after two months, PMI explored confounding factors that could affect the quality of spraying, such as wall surface type. PMI is currently in communication with one manufacturer to explore whether an initial coat of water to smooth the wall surface could prolong the efficacy of the insecticide.

CAPACITY BUILDING TO IMPLEMENT IRS

An IRS campaign requires many hundreds of staff per country, and staff expertise must span disciplines, such as logistics, entomology and environmental management. PMI continues to rely on NMCPs, local health staff, research institutions and Ministries of the Environment. It also continues to build capacity with both traditional and nontraditional partners. For example, PMI is collaborating with 12 research institutions

This spray operator prepares to spray inside a house during the 2012 campaign in Angola. Training of operators and provision of protective equipment and clothing are important elements of IRS campaigns.

Credit: Abt Associates

Response to the PMI External Evaluation Report (February 2012)

The external evaluation of PMI recommended a strategic review of PMI's support for IRS. In response to this recommendation, PMI has taken the following steps:

- Initiated country-specific reviews of IRS investments with the involvement of external vector control experts to ensure PMI's resources maximize effectiveness and programs achieve high results
- Monitored evidence of IRS effectiveness in different epidemiologic settings to maximize public health impact
- Worked with WHO to develop insecticide resistance management policies and tools for IRS and ITNs in order to prolong their effectiveness
- Drafted IRS implementation guidance based on the best available scientific and technical evidence to date to help PMI teams as they make decisions with stakeholders related to IRS implementation
- Established an interagency IRS working group to strategically focus on improving PMI-supported IRS implementation

and 7 NMCPs to collect insecticide susceptibility data. In addition, PMI supported training of hundreds of entomology technicians in basic field techniques and dozens of entomologists in advanced testing methods across all focus countries. With PMI's support during FY 2012, over 34,000 local personnel were trained to carry out spraying operations, increasing in-country capacity for IRS. Furthermore, in many countries where PMI supports IRS, Ministries of the Environment now play a leading role in overseeing compliance with environmental regulations. Lastly, PMI encourages the formation of in-country IRS task forces, where stakeholders participate in decision-making around insecticide choice and spray targets.

Examples of how PMI helped build capacity for IRS in FY 2012 are below.

- In **Tanzania**, PMI collaborated with a vector control officer from the National Defense Forces to implement IRS in the Kagera Region. The vector control officer helped coordinate IRS activities in the region and is part of a team that trains IRS staff at the national level.

- PMI is supporting the refurbishment of an integrated vector control laboratory in **Rwanda** that will serve in malaria and other vector-borne disease control efforts. The laboratory will conduct insecticide resistance testing, rear mosquitoes for resistance bioassays, test for infection levels in the vector, characterize the source of mosquito blood meals and test pyrethroid levels on long-lasting ITNs. The laboratory will also provide capacity building and research space for entomologists for the Rwandan national malaria program and students from Rwanda's School of Public Health who are interested in entomology.

- In **DRC**, through the *Institut National de Recherche Bio-medicale* and the University of Kinshasa, 24 people from the provincial and national levels were trained in field entomology monitoring and surveillance in April 2012. Surveillance of insecticide resistance and mapping of malaria mosquito vectors have begun at four sentinel sites.

Prevention – Malaria in Pregnancy

PMI MALARIA IN PREGNANCY SUMMARY

Indicator[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)[2]	Year 7 (FY 2012)[3]	Cumulative
SP treatments procured[4]	–	583,333	1,784,999	1,657,998	6,264,752	4,701,162	4,493,217	18,287,462 procured[5] (13,455,244 distributed)
Health workers trained in IPTp[6]	1,994	3,153	12,557	14,015	14,146	28,872	27,348	N/A[7]

1 The data reported in this table are up-to-date as of September 30, 2012, and include 17 PMI focus countries (no IPTp in Ethiopia, Rwanda and the Greater Mekong Subregion). For data by country, see Appendix 2.
2 For Year 6, PMI transitioned from a calendar year to a fiscal year reporting schedule.
3 In FY 2012, 826,667 SP treatments were procured for Tanzania with funds from the Royal Embassy of the Kingdom of Netherlands.
4 In most countries, national governments and other donors meet SP needs for IPTp.
5 The cumulative count of treatments procured and distributed takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year).
6 IPTp is usually given as part of the FANC package of services.
7 A cumulative count of health workers trained is not provided because some health workers were trained on more than one occasion.

Malaria infection presents a serious threat to pregnant women, fetuses and infants in Africa causing maternal anemia, miscarriage and stillbirth, as well as low birth weight (which increases the risk of infant death). Each year in Africa, malaria in pregnancy is estimated to contribute to up to 10,000 maternal deaths and as many as 200,000 infant deaths.

PMI'S MALARIA IN PREGNANCY STRATEGY

PMI's strategy is in line with WHO's recommended multipronged approach for managing malaria in pregnancy. This entails (1) distribution and promotion of regular use of ITNs, (2) administration of IPTp, (3) prompt diagnosis and effective treatment of confirmed malaria cases and (4) prevention and treatment of maternal anemia. This is done primarily through integration with services provided as a part of focused antenatal care (FANC). FANC, a comprehensive package of ANC services, strives to ensure healthy pregnancies by identifying pre-existing health conditions; detecting complications early; promoting health and disease prevention, including delivering IPTp and ITNs; preparing for birth and planning for possible complications.

ITNs are an important method for prevention of malaria in the first trimester of pregnancy. PMI supports distribution of ITNs at ANC visits to provide ITNs to pregnant women as early as possible in pregnancy. In addition, PMI's support of universal coverage with ITNs should increase the proportion of nonpregnant women who own and sleep under an ITN when they first become pregnant.

IPTp involves the administration of the antimalarial drug sulfadoxine-pyrimethamine (SP) at ANC visits starting in the second trimester, and at least one month apart. FANC guidance recommends three ANC visits during the second and third trimesters (as well as one in the first trimester). Therefore, pregnant women should ideally receive at least three treatments with SP, delivered as directly observed treatment, during routine antenatal visits. Preventive treatment reduces the serious consequences of malaria during pregnancy, especially in a woman's first and second pregnancies when the risk of malaria-related complications is much higher than in subsequent pregnancies. Under routine program conditions, IPTp has been shown to be associated with a 26 percent reduction in low birth weight.[1]

HIGHLIGHTS

- ITN use among pregnant women has steadily increased in most PMI focus countries, from an average* of 19 to 44 percent. However, progress in coverage rates with IPTp2 has been slower, increasing from 15 to 29 percent, on average*.
- During FY 2012, PMI supported training for more than 27,000 health workers in IPTp.
- To date, PMI has procured more than 18 million SP treatments.
- Based on research supported in part by PMI, WHO revised its guidance to include IPTp with every ANC visit after quickening (first fetal movements).

Across all focus countries, PMI works to prevent malaria in pregnancy by:

- Increasing coverage of malaria in pregnancy interventions
- Contributing to global malaria in pregnancy policy
- Training health workers in IPTp and FANC
- Integrating malaria activities with maternal and child health (MCH) programs
- Supporting BCC to promote IPTp and use of ITNs during pregnancy

COVERAGE OF MALARIA IN PREGNANCY INTERVENTIONS

ITN use among pregnant women has steadily increased in most PMI focus countries since PMI launched, rising from an average* of 19 to 44 percent (see Figure 4). However, coverage rates for two doses of SP (IPTp2) have progressed more slowly, increasing from 15 to 29 percent, on average* (see Figure 5).[2]

There are a number of causes of low IPTp rates, including restrictive national guidelines, misinterpretation of guidance, incorrect provider practices and lack of SP at facilities. Nonetheless, some countries, such as **Ghana** and **Liberia**, have shown marked progress, with Ghana increasing the percentage of pregnant women who were appropriately provided with IPTp2 from 44 (2008) to 65 percent (2011).

A well-functioning supply chain management system is critical for ensuring the availability of the commodities needed to prevent and treat malaria in pregnant women, just as it is for all malaria commodities. In FY 2012, responding to SP needs not covered by other partners, PMI procured 5.3 million treatments of SP to help cover the needs of **Benin, DRC, Guinea, Liberia, Mali, Mozambique, Nigeria, Tanzania, Uganda** and **Zimbabwe**. In addition, PMI enhanced its quarterly tracking of SP stocks to ensure any shortages or stock-outs of SP were addressed immediately by NMCPs and malaria partners.

Although SP is no longer recommended for treatment of acute attacks of malaria, there are anecdotal reports that in some heath facilities, SP is used to treat malaria when artemisinin-based combination therapies (ACTs) are in short supply. This practice can be risky, resulting in inadequate treatment of malaria in areas with high SP resistance and in shortages of SP intended for use as IPTp. PMI is working to strengthen supply chains for ACTs to minimize the risk of this practice.

GLOBAL MALARIA IN PREGNANCY POLICY

PMI is actively involved in the development and implementation of malaria in pregnancy policies as a core member of the RBM Malaria in Pregnancy Working Group, which

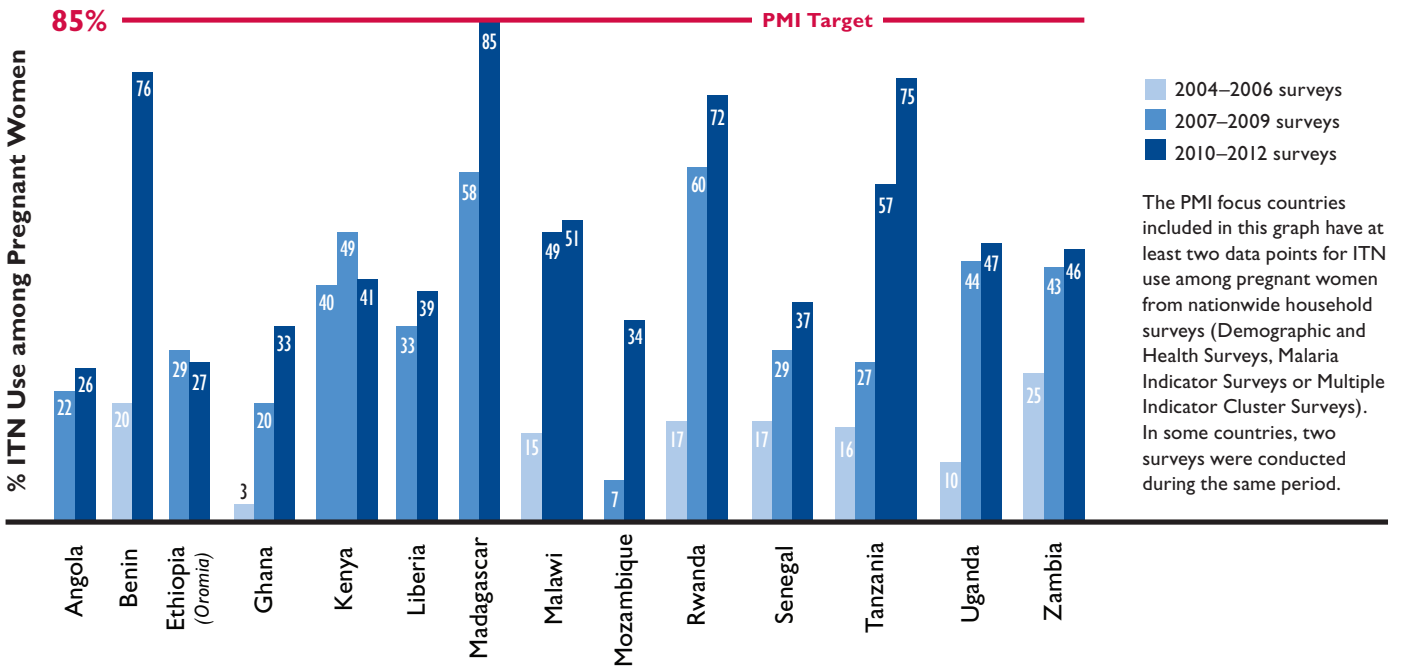
1 Eisele, T. P., D. A. Larsen, et al. (2012). Malaria prevention in pregnancy, birth weight, and neonatal mortality: a meta-analysis of 32 national cross-sectional datasets in Africa. *The Lancet Infectious Diseases.*

2 It is important to note that coverage of ITNs and IPTp is tracked through nationally representative surveys, such as the Demographic and Health Survey and Malaria Indicator Survey. However, while a change in ITN ownership and use can be measured immediately, it may take several years following a change in practice or policy to observe a change in IPTp uptake as, in these surveys, women of reproductive age are asked about IPTp use in pregnancies over the previous two years.

* defined as the median of the percent coverage

FIGURE 4

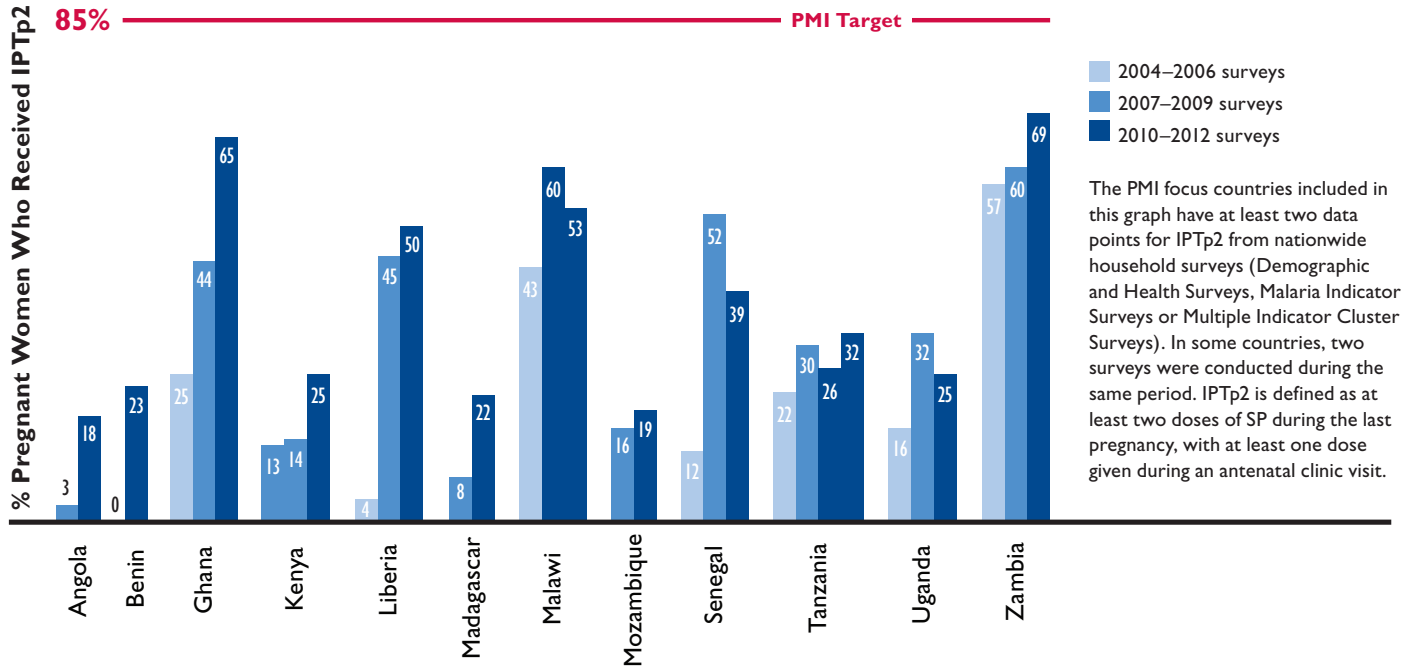
Increasing ITN Use among Pregnant Women



The PMI focus countries included in this graph have at least two data points for ITN use among pregnant women from nationwide household surveys (Demographic and Health Surveys, Malaria Indicator Surveys or Multiple Indicator Cluster Surveys). In some countries, two surveys were conducted during the same period.

FIGURE 5

Increasing IPTp2 Rates



The PMI focus countries included in this graph have at least two data points for IPTp2 from nationwide household surveys (Demographic and Health Surveys, Malaria Indicator Surveys or Multiple Indicator Cluster Surveys). In some countries, two surveys were conducted during the same period. IPTp2 is defined as at least two doses of SP during the last pregnancy, with at least one dose given during an antenatal clinic visit.

Response to the PMI External Evaluation Report (February 2012)

Following the observation of the external evaluators that coverage rates achieved for IPTp have been low, PMI established an interagency malaria in pregnancy working group to address operational and behavioral constraints to improving IPTp rates and other malaria in pregnancy interventions. The working group has:

- Updated guidance to the field to encourage renewed focus on improving malaria in pregnancy coverage at the country level
- Prioritized addressing key implementation challenges, including:
  - Ensuring SP is consistently available in ANC
  - Improving health provider practices in administering directly observed treatment of IPTp
  - Working with WHO and other partners to simplify and disseminate WHO policy recommendations on IPTp

promotes the implementation of policies established by WHO.

During the past year, a WHO Evidence Review Group reviewed published and unpublished studies on the efficacy of IPTp with SP, some of which were funded by PMI. They included a meta-analysis of studies, which shows that three or more doses of IPTp with SP are better than two doses.[3] This led to revised policy recommendations from WHO on IPTp in October 2012. These recommendations now state that SP treatments should be given at each scheduled ANC visit starting in the second trimester. They do not place an upper limit on the number of treatments administered, as SP has been shown to be safe in pregnant women right up to delivery. PMI is working with countries to adopt this simplified guidance.

A nurse in Mozambique dispenses IPTp during this pregnant woman's routine antenatal visit.

Credit: William Brieger, Jhpiego

Increasing resistance of malaria parasites to SP has led to concerns about the long-term efficacy of IPTp with SP as an intervention. It has been shown that IPTp with SP remains efficacious even when SP is no longer useful for the treatment of malaria. However, there currently is no known threshold to define when IPTp with SP is no longer efficacious. In order to address this question, PMI participated in a multicountry study to assess at what level of resistance this intervention can no longer provide benefit to pregnant women and their infants. PMI supported three of eight sites supported by the Bill & Melinda Gates Foundation-funded Malaria in Pregnancy Consortium (i.e., **Malawi, Uganda** and **Zambia**). Results from the individual sites have been inconsistent so far, and a pooled analysis is under way to better assess the data and determine if these results have policy implications.

TRAINING HEALTH CARE WORKERS

PMI collaborates with NMCPs and reproductive, maternal and child health divisions of ministries of health and other partners to train health care workers to provide FANC and prevent, diagnose and treat malaria in pregnant women. More than 27,000 health workers were trained to provide IPTp with PMI's support during FY 2012. At the country level, capacity building activities during FY 2012 included:

- In **Zimbabwe**, PMI supported training for 2,066 facility-level and community health workers in malaria case management and 215 health workers in FANC, including IPTp.
- In **Liberia**, PMI continued to support a multipronged approach to addressing malaria in pregnancy, which includes nationwide supply and distribution of SP, pre-service training through instructor coaching and the printing and distribution of curriculum materials to all training institutions in the country, in-service training of 289 health workers and performance-based incentives.
- **Ghana** continued to make significant progress in preventing malaria in pregnancy. The proportion of pregnant women receiving at least two treatments of IPTp increased from 44 in the 2008 Demographic and Health Survey, to 65 percent, in the 2011 Multiple Indicator Cluster Survey. Since 2008, PMI has supported the Ghana Health Service to scale up various activities to improve IPTp rates. In FY 2012 alone, 2,665 health workers were trained in FANC, including IPTp, with PMI's support. In addition, quarterly supportive supervision visits in 7 of the country's 10 regions focused on helping health staff comply with malaria in pregnancy guidelines and improve provider care. To sustain gains, PMI supports midwifery and community health nursing schools to improve the knowledge, skills and practices of their students.

3 Kayentao K, et al. (2013). Intermittent preventive therapy for malaria during pregnancy using 2 vs 3 or more doses of sulfadoxine-pyrimethamine and risk of low birth weight in Africa: systematic review and meta-analysis. *JAMA* 309(6): 594-604.

INTEGRATING MALARIA AND MATERNAL HEALTH ACTIVITIES

PMI collaborates with partners and supports activities to prevent and treat malaria in pregnancy within the context of MCH services. In FY 2012, for example:

- PMI supported **Malawi's** Ministry of Health to increase uptake of IPTp through a partnership between the Reproductive Health Unit and the NMCP to train 31 trainers of trainers and advance the use of IPTp as directly observed treatment by ensuring a clean water supply and providing drinking cups at health facilities during FANC visits. Furthermore, health education messages were used to sustain demand for IPTp. ITNs were provided to pregnant women through ANC services, while BCC campaigns specifically promoted use of long-lasting ITNs during pregnancy. In addition, through community-based organizations and a small grants program, support was provided at the local level to promote and increase demand for ANC and IPTp.

SUPPORTING BEHAVIOR CHANGE COMMUNICATION, COMMUNITY OUTREACH AND MOBILIZATION

PMI supports BCC at the community level to promote early attendance at ANC clinics, acceptance of IPTp and regular use of ITNs, and to overcome community and cultural barriers that could prevent women from accessing malaria prevention and treatment services. For example:

- In **Zambia**, PMI supported community BCC activities for IPTp primarily through the expansion of Safe Motherhood Action Groups. These groups were formed and trained in 18 districts in FY 2012 to deliver BCC about staying healthy during pregnancy, including the importance of taking SP for IPTp, sleeping under an ITN and seeking immediate care for fever. These groups now exist in more than 50 districts.

- In **Guinea**, PMI supported an update to the national BCC plan to use radio and television to sensitize communities on the importance of IPTp. Support included editing a training manual for volunteers on BCC techniques related to malaria prevention and treatment and revising and pre-testing storyboards for educational talks and outreach activities. Furthermore, training on BCC techniques related to malaria prevention and case management was conducted at the community, facility and national levels for more than 230 people (community health workers, Health and Hygiene Committee members and extension agents).

Health providers deliver messages to the public during a stop near Sikekodji Health Center in Cotonou, Benin.

IPTp and ITN Promotion through Community Caravans in Benin

The 2011–2012 Benin Demographic and Health Survey found that more than 70 percent of children under five and pregnant women use ITNs, up from 25 percent in 2006. Only 23 percent of women reported receiving the recommended two IPTp treatments during their last pregnancy. To address the low uptake of IPTp, PMI is supporting a multipronged strategy to promote malaria prevention behaviors through caravans, radio and TV spots, advocacy with opinion leaders and reinforcement of interpersonal communication skills of health providers and malaria managers.

Caravans bring malaria messages (and health workers) out of health centers and into neighborhoods, engaging audiences with music, dance and theater. In FY 2012, one such caravan – aimed at increasing awareness about the importance of long-lasting ITNs and of the use of SP to prevent malaria during pregnancy – traveled to three health centers within the health zone of Cotonou. Health workers relayed key messages in local languages from a promotional truck decorated with banners displaying messages about correct ITN use and IPTp2. A local theater group performed skits, and more than 5,000 people were exposed to the messages.

Ms. Aguey Chimene attended the caravan and commented, "What I learned for the first time [was in] regards the use of SP and how this drug can destroy malaria in the placenta and reduce the risk of malaria in the fetus. These messages are important for both men and women."

Serge Scherrer, MCHIP

CHAPTER 3

Malaria Diagnosis and Treatment

Effective case management of malaria, consisting of early, accurate diagnosis and rapid treatment with a recommended antimalarial drug combination, remains a central component of malaria prevention and control activities. Although the President's Malaria Initiative (PMI) has prioritized scaling up effective case management in all 19 focus countries in sub-Saharan Africa, progress has been slower than with other malaria prevention and control interventions, such as insecticide-treated mosquito nets (ITNs) and indoor residual spraying (IRS), due to the weak health systems that exist in many African countries. For decades, most cases of malaria in sub-Saharan Africa were diagnosed clinically based on the presence of fever. After more costly artemisinin-based combination therapies (ACTs) were introduced and the relatively low-cost rapid diagnostic tests (RDTs) were developed, the World Health Organization (WHO) issued new guidance in 2010. The guidance calls for universal diagnostic testing, and it recommends that antimalarial treatment only be administered when a test is positive. Accordingly, PMI promotes this approach both in health facilities and through community health workers. In almost all countries where quality data are available, annual increases in the proportion of suspected malaria cases that are confirmed with laboratory tests have been demonstrated.

PMI'S APPROACH TO CASE MANAGEMENT

PMI works closely with ministries of health and nongovernmental partners to scale up malaria case management. PMI supports all elements of a comprehensive program to diagnose and treat patients appropriately for malaria, including:

- Development of updated diagnosis and treatment policies, guidelines, training curricula and supervision materials

HIGHLIGHTS

- To date, PMI has procured more than 189 million ACTs and 62 million RDTs to support appropriate management of malaria cases in PMI focus countries.
- In FY 2012, PMI supported training of more than 39,000 health workers in malaria case management and more than 28,000 health workers in malaria laboratory diagnosis.
- PMI supports therapeutic efficacy studies for current first-line malaria treatments in 16 of 19 PMI focus countries in Africa and in all 6 countries in the Greater Mekong Subregion. An additional two countries, Madagascar and Nigeria, implemented studies using other sources of funding, and a study is planned for DRC in FY 2013.

PMI DIAGNOSIS AND TREATMENT SUMMARY								
Indicator[1]	**Year 1 (2006)**	**Year 2 (2007)**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**	**Year 6 (FY 2011)[2]**	**Year 7 (FY 2012)**	**Cumulative[3]**
RDTs procured	1,004,875	2,082,600	2,429,000	6,254,000	13,340,910	14,572,510	28,957,905	62,539,290 procured (38,019,883 distributed)
Health workers trained in malaria diagnosis (RDTs and/or microscopy)	–	1,370	1,663	2,856	17,335	34,740	28,210	N/A[4]
ACT treatments procured	1,229,550	8,851,820	22,354,139	21,833,155	41,048,295	38,588,220	72,345,860	189,168,489 procured (136,330,819 distributed)
ACT treatments procured by other donors and distributed with PMI support	–	8,709,140	112,330	8,855,401	3,536,554	6,993,809	950,239	28,092,273
Health workers trained in treatment with ACTs	8,344	20,864	35,397	41,273	36,458	42,183	39,797	N/A[4]

1 The data reported in this table are up-to-date as of September 30, 2012, and include all 19 PMI focus countries and the Greater Mekong Subregion. For data by country, see Appendix 2.
2 For Year 6, PMI transitioned from a calendar year to a fiscal year reporting schedule.
3 The cumulative count of RDTs and ACT treatments procured and distributed takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year).
4 A cumulative count of health workers trained is not provided because some health workers were trained on more than one occasion.

- Procurement and distribution of essential commodities and equipment, including ACTs, microscopes and RDTs
- Supervision and training of health workers at all levels of the health system, including in the community
- Development and support for quality assurance systems for diagnostic testing and monitoring the efficacy of antimalarial drugs
- Development and implementation of behavior change communication (BCC), interpersonal communication and community mobilization activities to support diagnostic and treatment guidelines
- Support of operations research to evaluate and improve diagnostic and treatment interventions

PMI has led the way in introducing and developing the systems that are essential to a high-quality malaria case management program. In FY 2012, PMI focused on areas such as:

- Scaling up diagnostic testing
- Improving the management of severe malaria
- Supporting systems for monitoring for drug resistance
- Strengthening pharmaceutical and supply chain management
- Integrating community case management
- Expanding access to malaria diagnosis and treatment through the private sector

SCALING UP DIAGNOSTIC TESTING

Even prior to WHO's updated guidance recommending universal diagnostic testing for malaria, PMI had been providing leadership at both the global and country levels in supporting the scale-up of high-quality diagnostic testing for malaria with microscopy and RDTs. In addition to procuring essential commodities (including RDTs, microscopes and laboratory supplies), PMI's support to countries has included the revision and dissemination of national malaria diagnostic policies and tools; the strengthening of quality assurance programs and the training and supervision of laboratory technicians and clinicians. PMI also has provided technical and financial support to WHO's RDT product quality testing program housed at the U.S. Centers for Disease Control and Prevention, development of global guidance and tools to assist countries in the selection of appropriate RDTs and the quantification of RDT needs, as well as guidance on the components of a comprehensive diagnostic testing program for malaria. PMI's experience with scaling up diagnostic testing in countries has informed the development of these tools.

Examples of PMI's work related to malaria diagnosis in FY 2012 include:

- In **Kenya**, PMI purchased 1.7 million RDTs and supported training on malaria laboratory diagnosis for more than 400 health workers. This support will contribute to the national scale-up of Kenya's policy of universal diagnostic testing before treatment for all suspected malaria cases (see the story in this chapter).
- In **Malawi**, PMI supported implementation of the national malaria quality assurance/quality control (QA/QC) plan, with a focus on microscopy through training and supportive supervision for laboratory and clinical health workers. Malaria diagnostic supervision is being integrated with the U.S. President's Emergency Plan for AIDS Relief's supervision and laboratory strengthening efforts for tuberculosis, and HIV and AIDS. To date, a core group of laboratory and clinical supervisors at the national and district levels has been established and QA/QC and supportive supervision have been rolled out to all health districts, reaching 107 out of

During training in Kenya, health workers learn how to use malaria RDTs and interpret RDT results properly.

In Kenya, the Use of RDTs Ensures Effective and Rapid Case Management

Kenya has adopted the policy of universal diagnosis before treatment for all fever cases suspected to be malaria. During FY 2012, PMI contributed to the implementation of this policy by purchasing 1.7 million RDTs and supporting training on malaria laboratory diagnosis for more than 400 health workers nationwide. USAID's five regional integrated service delivery projects are also assisting with the roll-out of RDTs.

The effects of this policy change can be seen at facilities such as the Mbale Rural Health Training Center in Western Province. It receives about 120 patients a day. One such patient is Victor, a one-year-old brought in by his mother with high fever and poor appetite. Upon the nurses' recommendation, Victor received a malaria RDT. Within 30 minutes, Victor was diagnosed with malaria and immediately treated.

This might have been a different story three months earlier. Victor and his mother could have waited hours for a diagnosis by microscopy in the laboratory before receiving treatment. Dr. Jacob Odipo, the director of the health center, explained, "Previously, we used to rely solely on microscopy for malaria testing and with the limited number of laboratory technicians, patients would have to wait hours for their results. Some left before receiving test results because of the long distances they had to travel back home. An unknown number were also self-medicating to avoid the long lines. Malaria RDTs have helped ease congestion in the laboratory and helped patients receive treatment faster, with only those who test positive for malaria receiving medication."

the 164 facilities that offer microscopy. The national malaria control program (NMCP) also completed the roll-out of nearly 3 million RDTs in all 630 health facilities in the country and provided training and supervision of laboratory technicians and clinicians.

- In **Ghana**, PMI supported local institutions to create a high-quality malaria slide bank for use in training and proficiency testing. A national archive of malaria reference slides was launched in April 2010 in collaboration with the Kintampo Health Research, a Malaria Center of Diagnostic Excellence in Ghana, as a critical resource for quality assurance and training. It is anticipated that this archive will be a resource for other countries in West Africa. PMI also supports supervisory field visits and on-the-job training to further strengthen and extend the reach of the quality assurance program.

IMPROVING MANAGEMENT OF SEVERE MALARIA

When malaria patients delay seeking care, they risk the progression of an uncomplicated case of malaria to a severe illness. Severe malaria is characterized by fever plus one or more serious signs or symptoms, such as liver or kidney failure, respiratory distress, severe anemia, convulsions or coma. Untreated, mortality in patients diagnosed with severe malaria is very high. Even with rapid appropriate treatment, mortality rates may rise above 30 percent.

Intravenous quinine has been the standard treatment for severe malaria for decades. Based on evidence from two recent large multicenter, randomized trials, WHO modified its treatment guidelines for severe malaria in 2011 to recommend injectable artesunate as the first-line treatment in children and adults, with injectable quinine or artemether as alternatives. In facilities that are not equipped to provide injectable antimalarials, such as peripheral health clinics or at the community level, pre-referral treatment with rectal administration of artesunate suppositories and rapid referral to a higher-level health facility is recommended.

In response to the updated WHO guidelines, PMI has been working with ministries of health to update their national policies. By the end of 2012, new policies supporting the preferential use of intravenous artesunate and the addition of rectal artesunate for pre-referral treatment have been adopted or were soon to be adopted in 17 and 16 PMI-supported countries, respectively. Specific country examples of PMI's work related to the management of severe malaria in FY 2012 include:

- In **Malawi**, the Ministry of Health and NMCP updated their national treatment guidelines in 2011 to be consistent with WHO recommendations. Accordingly, PMI worked with the NMCP in 2012 to update its training materials and plan for procurement, distribution and implementation of intravenous artesunate in hospitals and higher-level health centers nationwide during the first half of 2013.

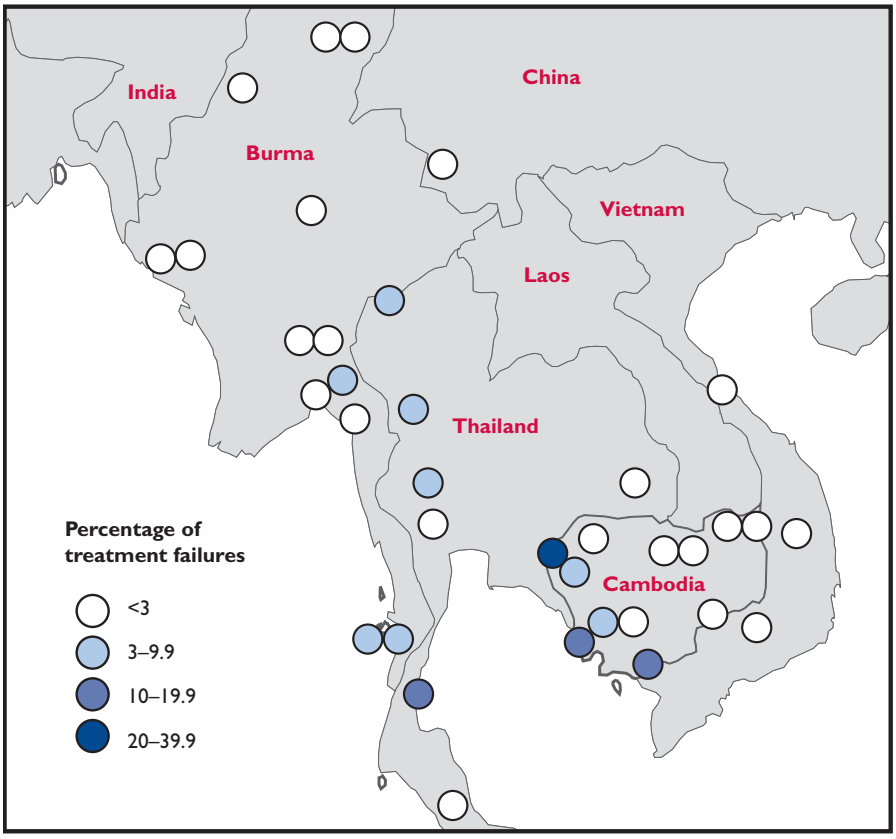
- In the **Democratic Republic of the Congo (DRC)**, the Ministry of Health and NMCP updated their national treatment guidelines to include the use of injectable artesunate for the treatment of severe malaria cases as well as the use of rectal artesunate for pre-referral treatment in both primary health facilities and the integrated community case management (iCCM) program. In collaboration with the NMCP and other partners, PMI assisted in the development, revision and editing of the new guidelines, health worker training manuals and implementation planning. PMI and the NMCP are finalizing a study protocol on the feasibility of scaling up the use of rectal artesunate at the community level.

MAKING STRIDES AGAINST DRUG RESISTANCE

Because artemisinin resistance has been reported in Southeast Asia – and would represent a severe setback to malaria control efforts in sub-Saharan Africa, should it appear there as well – routine monitoring of the efficacy of antimalarial drugs remains a high priority. PMI is supporting therapeutic efficacy studies for current first-line malaria treatments in 16 of the 19 PMI focus countries in Africa and all 6 countries in the **Greater Mekong Subregion**. An additional two countries, Madagascar and Nigeria, implemented studies using other sources of funding, and a study is planned for DRC in FY 2013. Studies of first-line drugs and potential alternatives, as appropriate, are carried out every two years in line with WHO

FIGURE 1

Treatment Failures in the Greater Mekong Subregion (WHO, 2011)



guidelines. Data are being reviewed regularly in each country to inform national malaria treatment guidelines.

In the Greater Mekong Subregion, PMI supports a regional network of therapeutic efficacy studies at 36 sites. Studies conducted by this network first heralded the emergence of ACT failures and triggered further research to characterize and confirm the artemisinin resistance and help develop a containment response (see Figure 1). Historically, the widespread availability of antimalarial drugs, often of poor quality, in the private sector has been a significant contributing factor to the development of drug resistance in this region. Furthermore, the extensive population movement among gem miners, soldiers, refugees and plantation workers in and around the forested areas of these countries has contributed to the spread of resistance.

The regional network continues to provide early warning information on the extent of resistance in the region. Between 2006 and 2011, early warning signs of emerging drug resistance were noted: delayed parasite clearance times and an increasing proportion of patients with positive blood slides on day three of treatment. This raised concerns of artemisinin resistance along **Cambodia-Thailand** and **Burma-Thailand** border areas, as well as **southern Vietnam**.

If artemisinin resistance should spread to Africa, it would have a catastrophic impact on malaria control in the region and threaten global progress against the disease. In addition to monitoring the therapeutic efficacy of antimalarial drugs, PMI supports a multipronged approach to dealing with drug resistance in border areas of the Greater Mekong Subregion by:

- Funding malaria prevention and case management activities to reduce transmission and ultimately eliminate *P. falciparum* malaria
- Improving diagnostics
- Improving patient adherence to treatments through behavior change communication (BCC) activities
- Monitoring for substandard and counterfeit drugs in markets

PHARMACEUTICAL AND SUPPLY CHAIN MANAGEMENT

Malaria control measures cannot be implemented without predictable supplies of diagnostic tests and essential drugs, as well as ITNs, insecticides and other supplies for IRS. Therefore, PMI helps strengthen supply chain management systems to ensure products are available when and where they are needed and to protect their quality and safety. To date, PMI has procured more than 189 million ACTs and 62 million RDTs to support appropriate management of malaria cases. During FY 2012, PMI provided supply chain management assistance in PMI focus countries, including:

- In **Zambia**, PMI invested in the roll-out of the Essential Medicine Logistics Improvement Program (EMLIP) to improve distribution of malaria commodities. EMLIP provides information on product availability and also ensures central-level visibility into the stock situation at service delivery points. At the end of FY 2012, the program was rolled out in 26 of the 89 districts country-wide, covering 476 sites. In these 26 districts, the facility reporting rate was 93 percent over the last six months of FY 2012, according to the Logistics Management Unit of Zambia's central medical stores.

- In **Zimbabwe**, since 2009, PMI has supported the Ministry of Health and Child Welfare to implement the Zimbabwe Informed Push system. It automates data collection on malaria and tuberculosis commodities at health facilities and improves data accuracy and timeliness. The previous process relied on manual data entry, often resulting in errors and delays in data analyses and reports to stakeholders. With PMI's support for automated data collection, timely and high-quality essential logistics data are now available to inform decisions on the quantities of commodities to deliver, the redistribution of supplies, and the quantification of future requirements for the NMCP. Report turnaround time decreased from between four and six weeks in 2011 to just two weeks in 2012. In addition, the system has significantly improved the accuracy of consumption

A clinician explains appropriate treatment with ACTs in Angola.

Credit: William Brieger, Jhpiego

forecasts for all four ACT treatment presentations.

Furthermore, in the Greater Mekong Subregion, PMI supports the establishment of national systems to monitor the quality of antimalarial drugs and build country capacity to prevent the availability of substandard or counterfeit drugs. In focus countries in Africa, PMI supports technical assistance to strengthen the QA/QC of antimalarials. This assistance focuses on strengthening medicine regulatory authorities and national laboratories to conduct better quality control of medicines in the supply chain. In FY 2012, PMI supported activities in eight African focus countries – **Benin, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Mali** and **Senegal**. Additionally, in Latin America, PMI helps promote medicines quality as one component of the collaborative Amazon Malaria Initiative.

INTEGRATED COMMUNITY CASE MANAGEMENT

Most PMI countries have adopted strategies to provide treatment for malaria, pneumonia, and diarrhea at the community level through iCCM. This is an approach that extends the reach of public health services beyond health facilities by using trained community health workers who are equipped with standardized treatment algorithms. PMI's iCCM efforts, as well as its malaria in pregnancy activities, are integrated with the U.S. Agency for International Development's maternal and child health and reproductive health programs. Examples of progress in this area in FY 2012 include:

- In **DRC**, the NMCP and PMI implementing partners provided refresher training for 1,525 health workers (from health facilities and community care sites) in malaria case management and BCC to support the use of ACTs. They also coordinated with the iCCM program to introduce, for the first time in the country, RDTs for improving malaria diagnosis at more than 100 iCCM sites in South Kivu and West Kasai Provinces. With PMI's support, more than 13,000 uncomplicated malaria cases were treated with ACTs at the community level during FY 2012.

- To overcome barriers to access to health services, **Mali's** Ministry of Health adopted an iCCM package in February 2010 that includes treatment for malaria, diarrhea, pneumonia and malnutrition; essential newborn care and family planning. Free treatment for children under five is provided by trained community health workers and has included malaria diagnosis with RDTs and treatment with ACTs. With support from PMI and other partners, 37,817 malaria cases, 21,967 diarrhea cases, 33,076 pneumonia cases and 8,410 malnutrition cases were treated at the community level during FY 2012.

- In **Senegal**, PMI supported an expansion of services provided by home-based malaria workers to include management of acute respiratory infections and diarrheal disease. This expansion was introduced in five health districts, where 88 malaria workers were trained and equipped with medical supplies. Initial community feedback has been positive, and the pilot will be formally evaluated in 2013.

MALARIA CASE MANAGEMENT IN THE PRIVATE SECTOR

PMI supports case management through multiple channels: public and private health facilities, community health workers and pilot projects in private pharmacies and drug shops. Since a large proportion of patients with malaria are treated within the private sector, improving the quality of malaria treatment through private pharmacies is critical. PMI recognizes that the private sector encompasses different types of outlets, such as private facilities and pharmacies, drug shops (licensed and unlicensed) and nongovernmental organizations. Each presents its own challenges and opportunities. Thus, PMI's approach to working with them takes their variations into account. PMI is committed to working with The Global Fund to Fight AIDS, Tuberculosis and Malaria, WHO, the Roll Back Malaria Partnership and other partners to support evidence-based strategies to improve malaria diagnostics, treatment and referral support for suspected malaria in children in the private sector, when endorsed by ministries of health.

To strengthen case management of malaria in the private sector, PMI:

- Works to ensure that malaria case management in the private sector is carried out in partnership with the public sector, including malaria diagnostic testing, appropriate treatment, referral for severe cases and treatment for non-malaria febrile illnesses, such as pneumonia

- Strives to make sure that the specific country context is taken into account in the design and implementation of private sector initiatives for case management

- Promotes further country pilots to determine the best models of subsidy delivery, health worker incentives for diagnosis and treatment, and referral for suspected severe malaria or non-malarial illnesses in the private sector

PMI is supporting a project in **Angola's** Huambo Province to provide subsidized ACTs and RDTs in private pharmacies. In 2012, 198 private pharmacies (90 percent of all pharmacies present in the province) were enrolled and agreements were reached on standard pricing ($0.78 per treatment) and monitoring. Repackaged artemether-lumefantrine was supplied to 179 pharmacies, and, to date, sales indicate satisfactory adherence and uptake by the pharmacists and the local population. Within a six-month period, more than 53,000 subsidized treatments were sold. The project also plans to introduce RDTs in private pharmacies to offer reliable malaria diagnosis to the local population seeking care in the private sector.

CHAPTER 4

Global and U.S. Government Partnerships

Partnerships at the national and international levels are key to the success of the President's Malaria Initiative's (PMI's) malaria control efforts. PMI's investments are strategically targeted to support each focus country's malaria control strategy and plan while coordinating with and leveraging the support of other partners, including:

- Multilateral and bilateral organizations
- Other U.S. Government agencies and initiatives
- Private sector partners
- Community-based organizations

HIGHLIGHTS

- PMI supported the Roll Back Malaria Harmonization Working Group to help six African countries prepare their malaria proposals for The Global Fund Transitional Funding Mechanism – all of which were successfully funded.
- During FY 2012, DFID channeled funds through PMI for the procurement of antimalarial commodities in Zambia. In addition, PMI and DFID initiated discussions to develop partnerships in an additional four PMI focus countries.
- Peace Corps volunteers in 14 PMI focus countries assisted with malaria control activities.
- To date, PMI has supported malaria activities through more than 200 nonprofit organizations, approximately one-third of which are faith based.

MULTILATERAL AND BILATERAL COLLABORATION

The Global Fund to Fight AIDS, Tuberculosis and Malaria (The Global Fund): PMI and The Global Fund are committed to coordinating their investments for malaria control to maximize their impact on malaria burden in each focus country. All PMI focus countries receive substantial malaria financing from The Global Fund. The U.S. Government is The Global Fund's largest single contributor and has a seat on The Global Fund Board. The U.S. Global Malaria Coordinator and Deputy Coordinator are members of the U.S. delegation at Global Fund Board meetings. The Deputy Coordinator is a member of the Technical Evaluation Reference Group. This engagement helps inform and shape policy issues at the highest levels of The Global Fund's governance mechanisms. Because The Global Fund has no in-country presence, PMI in-country advisors play an important

PMI provides funding to strengthen regional antimalarial drug surveillance networks in the Greater Mekong Subregion through the WHO Mekong Malaria Programme. This Karen boy, living near the Thai-Burmese border, is one of the many children benefiting from malaria control, prevention, and surveillance activities in the region.

Credit: Denise Allen, CDC

role in coordinating and planning malaria activities in each country and sharing information with Global Fund Secretariat staff on grant implementation issues. Since 2010, The Global Fund has undergone substantial organizational changes, some of which have resulted in even closer coordination and collaboration between PMI and The Global Fund on resolving country-specific problems and joint planning of resources. One PMI staff member participates on the Technical Review Panel for Global Fund proposals and another on the grant renewals panel.

Roll Back Malaria (RBM): PMI is an active member of the RBM Partnership, a global alliance of governments, multilateral organizations, private sector companies, foundations, academic institutions and other nongovernmental organizations (NGOs) working to coordinate the international response to malaria. PMI provides financial support for numerous RBM activities, serves on the partnership's Board of Directors and participates in many of its working groups, including the Harmonization Working Group, the Case Management Working Group, the Vector Control Working Group, the Procurement and Supply Chain Management Working Group and the Monitoring and Evaluation Reference Group. During fiscal year (FY) 2012, PMI provided support to the Harmonization Working Group to:

- Assist six eligible African countries (**Benin, Burkina Faso, Chad, Ethiopia, Niger** and **Zambia**) to prepare their malaria proposals for The Global Fund's Transitional Funding Mechanism – all of which were successfully funded
- Assist countries to develop "gap analyses" for their national strategic plans. These analyses are used by The Global Fund and other donors for planning and coordination
- Provide, through its Alliance for Malaria Prevention Work Stream, technical and operational guidance to countries and their partners on the scale-up of long-lasting insecticide-treated mosquito net (ITN) ownership and use via mass campaigns and continuous distribution

To maximize the impact of U.S. Government investments in The Global Fund, PMI works with the Office of The Global AIDS Coordinator at the U.S. Department of State to manage a grant to RBM to provide technical assistance to countries experiencing implementation problems with Global Fund-financed malaria programs. Activities supported through this grant during FY 2012 included:

- Eleven countries were supported to develop procurement and supply management plans, monitoring and evaluation plans, and work plans and budgets required by The Global Fund.
- Twenty-eight implementation bottlenecks were resolved and 10 of the highest-burden countries have received additional support to track and respond to those bottlenecks.
- Twelve countries received support to develop successful Global Fund phase 2 funding requests.

U.K. Department for International Development (DFID): PMI and DFID collaborate at both the global and country levels. During FY 2012, PMI and DFID continued to collaborate closely in **Zambia**, where DFID has channeled funds through PMI for the procurement of commodities. Also, PMI and DFID initiated discussions to develop partnerships in an additional four PMI focus countries (**Kenya, Malawi, Rwanda,** and **Uganda**), with collaboration expected to begin in FY 2013. Examples of PMI's collaboration with DFID during FY 2012 are described below.

- In **Zambia**, DFID previously provided $11 million in funding for the procurement of antimalarial drugs for the period of 2010–2012. DFID also committed $23 million in funding for the procurement of antimalarial drugs and essential medicines for other conditions for the period of 2011–2015 through PMI. In FY 2012, PMI procured more than 4.6 million artemisinin-based combination therapies (ACTs) and a variety of essential medicines with DFID funding. In July of 2012, the country faced an impending nationwide central stock-out of ACTs. With an additional commitment of $2 million in funding from DFID (increasing the commitment to a total of $25 million), PMI was able to provide ACTs from the PMI warehouse and avert the stock-out. At the same time, PMI procured an additional 2.7 million ACTs and nearly 1 million rapid diagnostic tests (RDTs). The ongoing, strong collaboration with DFID, which channels funds through PMI, will make it possible to fill commodity gaps and improve access to commodities through 2015.

United Nations Children's Fund (UNICEF): PMI works closely with UNICEF on integrated community case management (iCCM) activities. In FY 2012, the partnership was primarily at a global level, but it also included collaborations with countries, such as **Mali** and **Senegal**. At a global

level, PMI and UNICEF worked together alongside the World Health Organization (WHO) and Save the Children on the iCCM Global Task Force Steering Committee, an association of multilateral and bilateral agencies and NGOs working to promote integrated community-level management of childhood illness. This includes, but is not limited to, helping to advocate for iCCM in countries, creating and disseminating iCCM indicators and benchmarks and distributing community case management training and planning guidelines.

World Bank: The World Bank is a major funder of malaria activities in several PMI focus countries, such as **DRC, Mozambique** and **Nigeria**. PMI and the World Bank work closely together to help overcome bottlenecks in donor funding and malaria control activities in those countries. PMI collaborates with the World Bank on the RBM Board Executive Committee and working groups, and PMI continues to engage in discussions with the World Bank on its efforts to provide new funding for strengthening health systems.

World Health Organization (WHO): PMI provides financing to the WHO Global Malaria Programme to support activities related to antimalarial drug resistance surveillance, vector control and monitoring and evaluation. In FY 2012, PMI:

- Supported the salaries of 16 WHO national and international program officers in PMI focus countries, including 4 at the WHO Africa Regional Office and 2 at the WHO Mekong Malaria Programme
- Provided support for a U.S. Centers for Disease Control and Prevention epidemiologist seconded to the Global Malaria Programme at WHO headquarters
- Provided funding to strengthen a regional antimalarial drug surveillance network in the **Greater Mekong subregion** through the WHO Mekong Malaria Programme, which coordinates and enhances collaboration between WHO's Southeast Asia and Western Pacific Regional Offices

In addition, the U.S. Agency for International Development (USAID) continued to support malaria control efforts in seven countries in the Amazon Region of South America (**Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru** and **Suriname**) through the Pan American Health Organization

OTHER U.S. GOVERNMENT-SUPPORTED HEALTH PROGRAMS

PMI integrates its activities with other U.S. Government-funded global health programs to maximize health sector investments and reduce duplication.

Peace Corps: In 2011, PMI and the Peace Corps launched a partnership to recruit experienced Peace Corps volunteers to support NMCPs in PMI focus countries. Since then, Peace Corps volunteers in 14 PMI focus countries (**Benin, Ethiopia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Tanzania, Uganda** and **Zambia**) have begun working on joint activities with NMCPs and PMI in-country teams. PMI staff, both at headquarters and in-country, have provided technical guidance, training, monitoring and mentoring of Peace Corps volunteers. These are some examples of in-country collaboration during FY 2012:

- Peace Corps collaborated with PMI and the University of **Ghana** to conduct research on the effectiveness of indoor residual spraying (IRS) operations in a remote rural district of the country. Six Peace Corps volunteers served as field supervisors during three household surveys that measured malaria and anemia prevalence. When the research team identified outdoor sleeping as a factor that was possibly undermining the effectiveness of IRS, 1 Peace Corps volunteer took the lead in implementing a rapid survey of 58 Peace Corps volunteers in Ghana to document their observations of typical nighttime activity patterns in the communities where they lived. The survey's findings on frequent outdoor sleeping behavior have prompted a formal investigation of the topic by PMI and local partners.
- In **Senegal**, a Peace Corps volunteer was placed with a PMI implementing partner to help coordinate the participation of volunteers in mass ITN distribution activities in two regions. In addition, both PMI Resident Advisors and several staff from the NMCP and PMI implementing partners participated in the Stomp Out Malaria boot camps, which are organized several times a year. While attending the boot camps, these malaria specialists share their expertise with Peace Corps volunteers who will work on malaria-specific activities across Africa.
- In **Zambia**, Peace Corps volunteers are assisting with a PMI-supported operational research study to assess the longevity of ITNs under field conditions. The study involved 38 Peace Corps volunteers and their local counterparts who conducted a survey on the durability and insecticide persistence of two types of ITNs. The results will help the Zambian NMCP better forecast when future ITN distributions will be needed.

U.S. President's Emergency Plan for AIDS Relief (PEPFAR): In FY 2012, PMI and PEPFAR continued to work to strengthen and expand collaboration in the 13 countries where both programs are present. In two countries, **Nigeria** and **Zambia**, the interagency teams identified additional opportunities where PEPFAR resources will

Mass ITN distribution campaigns to achieve universal coverage require partnership and coordination and often bring together partners, such as NMCPs, The Global Fund, DFID, Peace Corps and PMI. These Ghanaian children hold up brochures explaining proper use and care of ITNs, received during an ITN distribution campaign.

Credit: Lisa Kramer, PMI

be requested to increase the reach of malaria prevention and control interventions to populations at risk for both diseases. Examples of PMI-PEPFAR collaboration during FY 2012 include:

- Joint support to **Tanzania's** Medical Stores Department to install new software in July 2012, which enables them to manage all components of their business operations in real time. The system has significantly enhanced the capacity of the medical stores to manage inventories for all health commodities at both the regional and national levels. PMI also partnered with PEPFAR and the Tanzanian Government on the 2011–2012 Tanzania HIV/AIDS and Malaria Indicator Survey (THMIS). PMI cofunded the survey, which showed a 47 percent reduction in malaria prevalence when compared with the 2007–2008 THMIS.

- Financial contributions by PMI, PEPFAR, and other partners to support the national health management information system (HMIS) in **Rwanda**. Using HMIS data, the Rwandan malaria program documented significant reductions in the burden of malaria, including a 70 percent reduction in outpatient malaria cases at health centers, a 50 percent reduction in reported malaria deaths and a 40 percent reduction in the blood smear positivity rate.

U.S. Department of Defense (DOD): PMI accesses technical expertise from the DOD through Navy entomologists, who provide technical assistance in vector control and insecticide resistance management at both the country level and at PMI headquarters, and through secondment of an Army scientist who serves as an advisor on the PMI Mekong Team based in Bangkok, **Thailand**. PMI collaborates with the DOD on a variety of activities; for example, in FY 2012:

- In **Ethiopia**, PMI collaborated with a behavior change communication (BCC) implementing partner and the DOD's Combined Joint Task Force Horn of Africa Civil Affairs teams to hang 121,100 nets in five districts. At Abaya District in Oromia Regional State in early 2012, these partners assisted local officials with an urgent mass distribution and hang-up of 16,500 long-lasting ITNs in response to a malaria outbreak in 2011 that resulted in 65 malaria hospitalizations and 1 death. In 2012, the district reported a much lower number of malaria illnesses and no hospitalizations or deaths due to malaria.

- In **Kenya**, with PMI support, the U.S. Army Medical Research Unit – Kenya, which is part of the Walter Reed Army Institute of Research (WRAIR), worked with the NMCP to provide training to build the capacity of laboratory quality assurance officers from the Central, Eastern, and Rift Valley Provinces. In addition, the U.S. Army Medical Research Unit supported the NMCP to procure laboratory equipment and supplies to strengthen the national diagnostics program.

- In **Tanzania**, WRAIR completed a pilot project on approaches to improve the quality of malaria RDT testing in Tanzania. Based on this pilot, WRAIR has drafted a proposed national malaria RDT quality management scale-up strategy, which PMI is now discussing in collaboration with WRAIR and the NMCP.

PRIVATE SECTOR PARTNERSHIPS

PMI works with private sector partners to help leverage their capabilities and resources and ensure that their efforts are well coordinated with government strategies and plans. To date, this has primarily included partnering with companies from the mining and sugar cane industries to implement IRS activities in **Ghana, Liberia, Malawi** and **Zambia**. In Zanzibar, PMI has also partnered with a telecommunications company for malaria case reporting via text messaging. Examples of PMI collaboration with the private sector in FY 2012 are below.

- The ExxonMobil Foundation provided $500,000 to support PMI objectives in **Angola**, bringing its total contributions to PMI to $4.5 million for the period of 2006–2012. The foundation's support is specifically for the scale-up of ACTs and intermittent preventive treatment for pregnant women (IPTp) through subgrants to NGOs and faith-based organizations in eight provinces (Benguela, Huambo, Huila, Kwanza Norte, Kwanza Sul, Malange, Uige and Zaire) where government health infrastructure is weak. During FY 2012, more than 2,600 health workers were trained in pharmaceutical management, laboratory diagnosis, rational use of ACTs, malaria in pregnancy and IPTp with this funding.

- In **Liberia**, PMI implemented IRS activities in partnership with the steel company Arcelor Mittal, which protected more than 5,900 residents in two areas where the company has operations (Grand Bassa and Nimba Counties). PMI provided training together with insecticides and spray tanks, while Arcelor Mittal covered the costs of spray personnel and operational expenses for the campaign.

Children in the Machinga District of Malawi.

Credit: Jacklyn Wong, CDC

COMMUNITY-BASED ORGANIZATIONS

NGOs and faith-based organizations usually have strong bases of operations in underserved, rural areas where malaria is a major public health problem and formal health services may be limited. Through support to these groups, and in close coordination with NMCPs and local health authorities, PMI is improving community-level access to critical malaria prevention and treatment services while also building local capacity and ensuring program sustainability. To date, PMI has supported malaria activities through more than 200 nonprofit organizations, approximately one-third of which are faith based. For example, during FY 2012:

- In **Liberia**, PMI procured and distributed 300,000 long-lasting ITNs to complement Global Fund ITN contributions for a nationwide universal coverage campaign led by the NMCP. PMI's support was channeled through a government-to-government agreement with Liberia's Ministry of Health and Social Welfare. Using this agreement, the NMCP contracted with seven NGOs to distribute ITNs and mobilize communities to use them. After the NMCP completed the postcampaign evaluation, PMI reimbursed the government. This effort was complemented by a PMI-funded BCC campaign to promote ITN use through community radio.

- In **Senegal**, the USAID/Senegal Community Health Project expanded into rural and suburban areas of Dakar Region, which are flood prone and have become hotspots for malaria transmission. The project has brought two local NGOs (Enda Graf Sahel and Enda Santé) into an existing consortium. Thus, it has benefited from their more than 10 years of experience working in these zones. PMI's support to the two NGOs enabled 37 community health huts to provide an integrated basic package of services for a population of 1.6 million people. During FY 2012, more than 2,000 people were treated for malaria at these locations.

- In **Mozambique**, PMI continued to support a social BCC program through the *Programa Inter-religioso Contra a Malaria* (PIRCOM), a consortium of religious groups, which is working in Inhambane, Nampula, Sofala and Zambézia Provinces. PIRCOM supported the NMCP to achieve its objective of ensuring that 95 percent of the population receives key messages related to malaria prevention, diagnosis and treatment. During the past year, PIRCOM trained more than 6,000 religious leaders on key malaria messages. These religious leaders in turn have reached approximately 100,000 people in 35 districts.

Maggie Hallahan Photography

CHAPTER 5

Malaria Research and Innovation

U.S. GOVERNMENT SUPPORT FOR RESEARCH AND INNOVATION

Research to support malaria control efforts and reduce the burden of malaria has been a high priority of the U.S. Government for many years. The U.S. Government malaria research effort involves the U.S. Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH) of the Department of Health and Human Services (HHS), the Naval Medical Research Center (NMRC) and the Walter Reed Army Institute of Research (WRAIR) of the U.S. Department of Defense (DOD) and the U.S. Agency for International Development (USAID). Each of these agencies has its own direct funding for malaria research. The President's Malaria Initiative (PMI) funds operational research in addition to these other research efforts.

These U.S. Government agencies collaborate with a wide variety of partners in the United States and globally, including national malaria control programs (NMCPs), universities, research institutes, private companies and nongovernmental organizations (NGOs). Such partnerships help strengthen local capacity and contribute to the sustainability of national malaria control efforts. U.S. Government-supported malaria research has made contributions in the following areas:

- Defining basic malaria biology and pathogenesis to design new malaria prevention and treatment interventions
- Developing candidate vaccines and carrying out field trials
- Developing new drugs to address antimalarial drug resistance

HIGHLIGHTS

- Research to support malaria control efforts and reduce the burden of malaria is a high priority of the U.S. Government and is implemented by several U.S. Government agencies, including CDC, NIH, DOD and USAID.
- USAID support of drug development has led to the approval and use of new treatments for malaria.
- PMI support of malaria operational research focuses on topics, such as mosquito net durability; the effectiveness of combining interventions such as IRS and ITNs; and looking forward, the impact of insecticide resistance on mosquito net effectiveness, better use of diagnostics to guide malaria treatment and new vector control technologies.

- Evaluating and setting standards for malaria diagnostic tests
- Improving treatment strategies for severe malaria
- Improving malaria control program implementation and impact

Research activities supported by the U.S. Government provide direction and support for reducing the global burden of malaria by ensuring that basic research and product development are effectively translated into field-applicable interventions.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

U.S. Centers for Disease Control and Prevention (CDC): In addition to operational research as part of PMI, CDC investigators are engaged in a wide range of strategic and applied research activities, including:

- **Diagnostics:** Evaluating and developing new tools for field-based malaria diagnosis, including methods that employ simple, portable equipment to perform rapid molecular tests in the field; and evaluating rapid tests for G6PD deficiency to guide radical treatment of nonfalciparum malaria.
- **Treatment:** Evaluating the potential efficacy of new antimalarial drug compounds in nonhuman primates; developing tests to assess malaria drug quality and identify counterfeit drugs; evaluating effectiveness of new strategies to increase prompt, appropriate treatment for malaria in sub-Saharan Africa; identifying strategies to improve health care worker performance in case management of malaria; monitoring client adherence to recommended antimalarial drug regimens and exploring interventions to improve adherence; documenting the impact of subsidized artemisinin-based combination therapies on malaria treatment market factors, health systems and care-seeking practices; tracking the evolution and spread of drug-resistant malaria parasites and investigating the optimal dose of primaquine for eliminating infectious *Plasmodium falciparum* gametocytes.
- **Prevention:** Assessing the impact of insecticide resistance on the effectiveness of insecticide-treated mosquito nets (ITNs); evaluating vaccine candidate antigens in nonhuman primates and field trials; evaluating determinants of net durability and determining the impact of size and location of holes on the likelihood of malaria transmission; testing new combinations of strategies to reduce malaria transmission; evaluating new tools to reduce vectorial capacity for malaria transmission; establishing new ways to measure malaria transmission; identifying the optimal mix of malaria control interventions in different malaria transmission settings; determining the effect of specific interventions on malaria transmission in different settings; and evaluating strategies to deploy diagnostic tools and malaria treatment to reduce malaria transmission by asymptomatic persons in endemic communities.
- **Malaria in pregnancy:** Evaluating new strategies to reduce the burden of malaria in pregnancy; monitoring the continued effectiveness of intermittent preventive treatment for pregnant women (IPTp) with sulfadoxine-pyrimethamine; testing new drugs for IPTp; testing and evaluating ways to improve IPTp coverage and evaluating intermittent screening and treatment for malaria in pregnancy as an alternative to IPTp.
- **Clinical:** Evaluating how the new World Health Organization (WHO) recommendation to provide antimalarial treatment only to children with a parasitologically-confirmed malaria infection is affecting the case management of children without malaria; and exploring the nonmalarial causes of febrile illness.
- **Entomologic:** Developing assays to detect insecticide resistance and surveillance systems to monitor and manage insecticide resistance; testing new combination ITNs to manage insecticide resistance; understanding resistance mechanisms in anopheline mosquitoes and documenting the emergence, spread and public health impact of insecticide resistance.

National Institutes of Health (NIH): NIH-supported investigators carry out research in a broad range of areas, including:

- **Basic research:** Studying the biology of malaria parasites and mosquito vectors as well as disease immunology, and characterizing the pathogenesis and mechanisms by which malaria parasites infect and survive in humans and by which infections result in disease. Understanding these mechanisms should yield new approaches to malaria prevention and treatment.
- **Genomics:** Supplying scientists with the complete genetic sequences of the mosquito vector *Anopheles gambiae* and the parasites *P. falciparum* and *P. vivax* to help identify new targets for effective disease interventions, such as vaccines or drugs.
- **Vaccine development:** Identifying novel vaccine candidates, which ultimately could confer protection from infection or

A microscopist examines blood smears for malaria parasites in Zanzibar.

Credit: Maggie Hallahan Photography

Enriching Communication: The Malaria Research Network of Ethiopia

Malaria is a major public health problem in Ethiopia, with 75 percent of the over 80 million inhabitants at risk for malaria epidemics. Although significant progress has been observed in scaling-up malaria control interventions over the past few years, limited efforts have been invested in using research results to inform national malaria policy and the implementation of malaria control activities. Currently, considerable malaria research is being conducted by in-country stakeholders, including the Government of Ethiopia (e.g., the Ethiopian Health and Nutrition Research Institute), NGOs (e.g., the Carter Center) and academic institutions. Unfortunately, research is sometimes poorly coordinated among stakeholders, as well as with the Federal Ministry of Health, and results are often not widely disseminated.

To address this problem, Addis Ababa University, in collaboration with PMI, conducted a malaria research workshop in 2010 that led to the establishment of the Malaria Research network of Ethiopia. The purpose of the network is to improve connections between researchers, health practitioners, policymakers, and organizations that implement malaria control activities.

The third meeting of the network, conducted at Jimma University, brought together 70 participants from universities, health institutions and NGOs, as well as the media, for a full day of discussions on malaria research topics such as evaluating perceptions of malaria caregivers, assessing different malaria diagnostic tests and analyzing the effectiveness of mosquito repellants. The goal of the meeting was to share malaria research results to inform control and prevention activities in the country, and for researchers to understand and address the country's operational research needs. Thanks to the ongoing efforts of the network, Ethiopia is better able to apply research findings to inform and improve malaria prevention and control.

disease, by characterizing protective immunological responses to malaria parasites from various life cycle stages. Alternative strategies seek to identify vaccine candidates intended to interrupt transmission of malaria parasites from humans to mosquitoes or from mosquitoes to humans.

- **Drug development:** Developing new methods and improving existing ones for the treatment of malaria, including the identification and characterization of unique parasite biochemical pathways that may serve as targets for drugs; determining the mode of action of existing and potential drugs and analyzing the mechanisms of drug resistance.

- **Diagnostics:** Developing easy-to-use tests for the diagnosis of malaria infections and identifying parasite drug resistance profiles.

- **Clinical and field research:** Strengthening field site capacity for research and clinical trials on drugs, vaccines and diagnostics, and supporting multiple clinical trials in the United States and in malaria-endemic countries.

NIH invests heavily in developing and strengthening sustainable local research capacity in disease-endemic countries with the Fogarty International Center. Through the National Institute of Allergy and Infectious Diseases, NIH supports 10 International Centers of Excellence for Malaria Research in Africa, Asia and Latin America, which generate an evidence base for strategies to support malaria prevention and treatment.

The Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) supports a program on malaria and HIV in pregnant women and children, and will be supporting a study on central nervous system malaria in children. NICHD has also supported studies that are looking at various aspects of the malaria parasite life cycle, particularly as they pertain to the safety and effectiveness of interventions to prevent and treat iron deficiency. NICHD also continues to support clinical trials in **Burkina Faso, Ghana, Kenya, Tanzania** and **Thailand** to assess these relationships in women (before, during and postpregnancy) and children.

U.S. DEPARTMENT OF DEFENSE

The Military Infectious Disease Research Program's efforts are focused on antimalarial drugs and vaccines. The antimalarial drug development program at DOD is an Army-led effort at WRAIR, which has been instrumental in developing antimalarial drugs for global use since World War II. The U.S. Military Malaria Vaccine Program is a combined Army-Navy research and development initiative that represents more than 20 years of research, with a focus on creating vaccines to prevent malaria in military personnel. Both the drug and vaccine programs take advantage of DOD's laboratories outside the contiguous 48 states of the United States.

- **Navy Malaria Program:** The Navy Malaria Program, based at NMRC, focuses on vaccine development and other preventive measures to protect military personnel deploying to malaria-endemic areas. The program includes malaria research efforts based out of Naval Medical Research Units in **Cambodia, Egypt, Ghana** and **Peru**, where studies of malaria epidemiology, drugs and vaccines are conducted, many of these in collaboration with U.S. Army components.

- **Army Malaria Program:** The Army Malaria Research Program focuses on supporting military personnel through the development of malaria vaccines, drugs for prevention and treatment of malaria (including severe malaria) and malaria diagnostics. The Army Malaria Research Program encompasses the Armed Forces Research Institute of Medical Sciences – **Thailand** and the U.S. Army Medical Research Unit – **Kenya**, where studies on malaria epidemiology, drugs and vaccines are conducted.

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

While USAID does not directly conduct malaria research, it invested approximately $11 million in FY 2012 to develop new antimalarial drugs and malaria vaccines.

Medicines for Malaria Venture (MMV): MMV is a public-private partnership established in 1999 to catalyze antimalarial drug development by supporting development of effective and affordable medicines for the treatment

From the PMI External Evaluation Report:

The PMI external evaluation highlighted the need for improved organizational clarity around operational research and a defined PMI operational research strategy with an expanded scope, including establishing research priorities and incorporating input from external experts. PMI has taken the following steps to address these observations:

- A PMI Operational Research Coordinator was hired to oversee and provide leadership for the PMI operational research agenda, and a CDC Operational Research Lead was designated to help coordinate the PMI operational research implemented by CDC.
- An operational research strategy was developed by an interagency USAID CDC team to help focus operational research funding on the most important questions facing PMI program implementation.
- As part of this strategy, a prioritization exercise highlighted the research topics that are most important to current PMI programming questions, which will help ensure that studies funded by PMI will yield results that inform and improve program effectiveness.

and prevention of malaria. Currently, MMV is partnering with 21 biotech companies and 38 pharmaceutical companies, enabling it to gain access to novel and proprietary compound libraries to boost the diversity of candidate drugs in discovery research. USAID has provided funding for MMV activities since 2004, contributing to MMV's achievements, which include the following:

- More than 50 unique compounds are in various stages of the research and development pipeline.
- Three new treatments – dispersible artemether-lumefantrine, dihydroartemisinin-piperaquine and pyronaridine-artesunate – have received strict regulatory authority approval. The first two are already being used for treatment of clinical malaria cases in many PMI focus countries.
- Injectable artesunate, an alternative to quinine, has received WHO prequalification and is now being recommended by WHO as preferred treatment for severe malaria. More than 3.2 million treatments have already been delivered to countries, and many other countries are adopting this as their first-line treatment for severe malaria.
- A new class of antimalarial drugs, known as synthetic peroxides, has completed Phase II trials and is currently undergoing trials to identify appropriate partner drugs. Phase III trials of successful partner combinations are scheduled to begin later in 2013.

Vaccine Research: USAID, as well as NIH, CDC and the Military Malaria Vaccine Program, all contribute to the development of safe and effective malaria vaccines. USAID's Malaria Vaccine Development Program (MVDP) strives to accelerate the development of a vaccine that can be used as part of malaria control efforts. Over the years, the program has shifted its emphasis from research into promising vaccine candidates to producing and testing investigational vaccines. The MVDP works with academia, the commercial sector and other government agencies. To date, MVDP's key accomplishments include:

- Discovery of systems for cultivating different stages of the parasite in the laboratory
- Initial discovery of a parasite molecule that is potentially useful as a vaccine constituent, and subsequent discoveries of other molecules that are candidates for vaccine development
- Numerous evaluations of investigational vaccines in humans

THE PRESIDENT'S MALARIA INITIATIVE

PMI investments in operational research play an important role in supporting the successful implementation of PMI prevention and treatment measures and in achieving PMI goals. This research focuses on program-relevant questions, complementing the more upstream vaccine and drug development work funded by NIH, DOD and USAID. PMI supports operational research studies on topics such as mosquito net durability, the effectiveness of combining interventions, such as indoor residual spraying (IRS) and ITNs; and looking forward, the effect of insecticide resistance on ITN effectiveness, better use of diagnostics for accurate malaria treatment and the effectiveness of malaria prevention treatment during pregnancy in an environment of increasing resistance. PMI uses study results to help guide its program investments, make policy recommendations to NMCPs and target interventions to increase their cost-effectiveness. As the burden of malaria falls in sub-Saharan Africa, operational research

A laboratory technician reviews malaria RDT results at the Zambia National Malaria Control Center's laboratory.

Credit: IMAD

PMI funded a study of adherence to artemether-lumefantrine therapy in Malawi, the results of which will be used by the Malawi Ministry of Health in evaluating the first-line treatment for uncomplicated malaria. A survey team reviews study data.

Credit: Kimberly Mace, CDC

will help programs adjust to the changing epidemiological landscape. The following are examples of PMI-funded operational research studies:

- Eight PMI focus countries (**Angola, Benin, Kenya, Malawi, Mozambique, Rwanda, Senegal** and **Zambia**) are conducting studies on the physical and insecticidal longevity of ITNs. Overall study results have shown that many mosquito nets do not last the expected three years due to loss of physical integrity. Thus, ITNs may need to be replaced more frequently than anticipated in order to maintain high coverage. These findings are being used to inform research on ITN care and repair behaviors, as well as to aid design changes to ITNs to improve physical durability.

- In **Nigeria**, preliminary results from a study looking at mosquito net care and repair behaviors indicate that few residents repair their mosquito nets when they are damaged. Encouraging mosquito net repair could help prolong the useful lifetime of a mosquito net and thus reduce the cost of mosquito net procurements over time.

- In **Zanzibar**, where the prevalence of malaria parasites has been less than 1 percent since 2008, the Zanzibar Ministry of Health is re-evaluating the need to continue its IPTp program. Results showed that, of 1,321 women giving birth who did not receive the preventive treatment, 4 had evidence of placental malaria. These results will help the Ministry of Health decide whether to continue its program or implement alternative methods to protect pregnant women from adverse outcomes of malaria infection.

- In **Kenya**, where mosquitoes have developed resistance to pyrethroid insecticides used in IRS campaigns, PMI supported a study to assess the effect of nine different insecticides or insecticide formulations on mosquito populations. Results were presented to the national vector control technical working group, which then made recommendations to the NMCP to use a carbamate insecticide in future IRS campaigns.

- In **Uganda**, PMI concluded a study on the effectiveness of door-to-door hang-up activities on improving ITN utilization. No difference was observed between the intervention area and the control area. Results from this study suggest that door-to-door visits to promote ITN hang-up and use may only be cost-effective and promote significant increases in mosquito net use in certain settings, such as in communities without an established ITN culture.

Appendix 1: PMI Funding FYs 2006–2012 (in USD)

	Country[1]	FY 2005 Jump-Start Funding	FY 2006	FY 2007[2]	FY 2008[3]	FY 2009	FY 2010[4]	FY 2011[5]	FY 2012[6]	Total
Round 1	Angola	1,740,000	7,500,000	18,500,000	18,846,000	18,700,000	35,500,000	30,614,000	30,750,000	**162,150,000**
	Tanzania	2,000,000	11,500,000	31,000,000	33,725,000	35,000,000	52,000,000	46,906,000	49,000,000	**261,131,000**
	Uganda	510,775	9,500,000	21,500,000	21,822,000	21,600,000	35,000,000	34,930,000	33,000,000	**177,862,775**
Round 2	Malawi		2,045,000	18,500,000	17,854,000	17,700,000	27,000,000	26,447,000	24,600,000	**134,146,000**
	Mozambique		6,259,000	18,000,000	19,838,000	19,700,000	38,000,000	29,241,000	30,000,000	**161,038,000**
	Rwanda		1,479,000	20,000,000	16,862,000	16,300,000	18,000,000	18,962,000	18,100,000	**109,703,000**
	Senegal		2,168,000	16,700,000	15,870,000	15,700,000	27,000,000	24,451,000	24,500,000	**126,389,000**
Round 3	Benin		1,774,000	3,600,000	13,887,000	13,800,000	21,000,000	18,313,000	18,500,000	**90,874,000**
	Ethiopia		2,563,000	6,700,000	19,838,000	19,700,000	31,000,000	40,918,000	43,000,000	**163,719,000**
	Ghana		1,478,000	5,000,000	16,862,000	17,300,000	34,000,000	29,840,000	32,000,000	**136,480,000**
	Kenya		5,470,000	6,050,000	19,838,000	19,700,000	40,000,000	36,427,000	36,450,000	**163,935,000**
	Liberia			2,500,000	12,399,000	11,800,000	18,000,000	13,273,000	12,000,000	**69,972,000**
	Madagascar		2,169,000	5,000,000	16,862,000	16,700,000	33,900,000	28,742,000	27,000,000	**130,373,000**
	Mali		2,490,000	4,500,000	14,879,000	15,400,000	28,000,000	26,946,000	27,000,000	**119,215,000**
	Zambia		7,659,000	9,470,000	14,879,000	14,700,000	25,600,000	23,952,000	25,700,000	**121,960,000**
Round 4	DRC						18,000,000	34,930,000	38,000,000	**90,930,000**
	Nigeria						18,000,000	43,588,000	60,100,000	**121,688,000**
	Guinea							9,980,000	10,000,000	**19,980,000**
	Zimbabwe							11,977,000	14,000,000	**25,977,000**
	Mekong							11,976,000	14,000,000	**25,976,000**
	Headquarters		1,500,000	10,000,000	21,596,500	26,100,000	36,000,000	36,000,000	36,000,000	**167,196,500**
	PMI Total		**30,000,000**	**154,200,000**	**295,857,500**	**299,900,000**	**500,000,000**	**578,413,000**	**603,700,000**	**2,462,070,500**
	Jump-Start Total	**4,250,775**	**35,554,000**	**42,820,000**	**0**	**0**	**36,000,000**	**0**	**0**	**118,624,775**
	Total Overall	**4,250,775**	**65,554,000**	**197,020,000**	**295,857,500**	**299,900,000**	**536,000,000**	**578,413,000**	**603,700,000**	**2,580,695,275**

(1) This table does not include other U.S. Government funding for malaria activities from USAID, CDC, NIH or DOD. (2) $25 million plus-up funds include $22 million allocated to 15 PMI focus countries ($19.2 million for Round 2 countries and $2.8 million for jump-starts in Round 3 countries). (3) Levels after USAID 0.81-percent rescission. (4) In FY 2010, USAID also provided funding for malaria activities in Burkina Faso ($6 million), Burundi ($6 million), Pakistan ($5 million), South Sudan ($4.5 million), the Amazon Malaria Initiative ($5 million) and the Mekong Malaria Programme ($6 million). (5) In FY 2011, USAID also provided funding for malaria activities in Burkina Faso ($5,988,000), Burundi ($5,988,000), South Sudan ($4,491,000) and the Amazon Malaria Initiative ($4,990,000). (6) In FY 2012, USAID also provided funding for malaria activities in Burkina Faso ($9,000,000), Burundi ($8,000,000), South Sudan ($6,300,000) and the Amazon Malaria Initiative ($4,000,000).

Appendix 2: PMI Contribution Summary

The reporting timeframe for this PMI annual report is the 2012 fiscal year (October 1, 2011 to September 30, 2012). PMI counts commodities (ITNs, SP tablets, ACT treatments and RDTs) as "procured" once a purchase order or invoice for these commodities has been issued by the procurement service agent during the reporting fiscal year. Depending on the country, commodities are reported as "distributed" once they have reached the central medical stores or once they have transitioned beyond the central medical stores to regional warehouses, health facilities, or other distribution points.

1. INDOOR RESIDUAL SPRAYING

PEOPLE PROTECTED BY PMI-SUPPORTED INDOOR RESIDUAL SPRAYING (IRS)[1]

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6[2] (FY 2011)	Year 7[3] (FY 2012)
Round 1	Angola	590,398	612,776	992,856	485,974	650,782	650,782	689,668
	Tanzania	1,018,156	1,279,960	1,569,071	2,087,062	4,861,179	4,502,814	7,107,010
	Uganda	488,502	1,865,956	2,211,388	2,262,578	2,794,839	2,839,173	2,543,983
Round 2	Malawi	_	126,126	106,450	299,744	364,349	364,349	321,919
	Mozambique	_	2,593,949	1,457,142	2,263,409	2,945,721	2,945,721	2,825,648
	Rwanda	_	720,764	885,957	1,329,340	1,365,949	1,571,625	1,025,181
	Senegal	_	678,971	645,346	661,814	959,727	887,315	1,095,093
Round 3	Benin	_	_	521,738	512,491	636,448	426,232	652,777
	Ethiopia	_	3,890,000	5,921,906	6,484,297	2,064,389	2,920,469	1,506,273
	Ghana	_	_	601,973	708,103	849,620	926,699	941,240
	Kenya	_	3,459,207	3,061,967	1,435,272	1,892,725	1,832,090	2,435,836
	Liberia	_	_	_	163,149	420,532	827,404	876,974
	Madagascar	_	_	2,561,034	1,274,809	2,895,058	2,895,058	2,585,672
	Mali	_	_	420,580	497,122	440,815	697,512	762,146
	Zambia	_	3,600,000	4,200,000	6,500,000	4,056,930	4,056,930	4,581,465
Round 4	Nigeria	_	_	_	_	_	_	346,115
	TOTAL	**2,097,056**	**18,827,709**	**25,157,408**	**26,965,164**	**27,199,063**	**28,344,173**	**30,297,000**

(1) A cumulative count of the number of people protected is not provided because many areas were sprayed on more than one occasion. (2) Angola, Madagascar, Malawi, Mozambique and Zambia implemented spray rounds during the first quarter of FY 2011; these activities are therefore also reported in the Year 5 (2010) column. (3) During FY 2012, USAID also provided support for an IRS campaign in Burkina Faso, which protected 115,538 people.

HOUSES SPRAYED WITH PMI SUPPORT[1]

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6[2] (FY 2011)	Year 7[3] (FY 2012)
Round 1	Angola	107,373	110,826	189,259	102,731	135,856	135,856	145,264
	Tanzania	203,754	247,712	308,058	422,749	889,981	833,269	1,338,953
	Uganda	103,329	446,117	575,903	567,035	878,875	908,627	823,169
Round 2	Malawi	_	26,950	24,764	74,772	97,329	97,329	77,647
	Mozambique	_	586,568	412,923	571,194	618,290	618,290	660,064
	Rwanda	_	159,063	189,756	295,174	303,659	358,804	236,610
	Senegal	_	169,743	153,942	176,279	254,559	240,770	306,916
Round 3	Benin	_	_	142,814	156,223	166,910	145,247	210,380
	Ethiopia	_	778,000	1,793,248	1,935,402	646,870	858,657	547,421
	Ghana	_	_	254,305	284,856	342,876	354,207	355,278
	Kenya	_	1,171,073	764,050	517,051	503,707	485,043	643,292
	Liberia	_	_	_	20,400	48,375	87,325	99,286
	Madagascar	_	_	422,132	216,060	576,320	576,320	502,697
	Mali	_	_	107,638	126,922	127,273	202,821	205,066
	Zambia	_	657,695	762,479	1,189,676	1,102,338	1,102,338	916,293
Round 4	Nigeria	_	_	_	_	_	_	58,704
	TOTAL	**414,456**	**4,353,747**	**6,101,271**	**6,656,524**	**6,693,218**	**7,004,903**	**7,127,040**

(1) A cumulative count of the number of houses sprayed is not provided because many areas were sprayed on more than one occasion. (2) Angola, Madagascar, Malawi, Mozambique and Zambia implemented spray rounds during the first quarter of FY 2011; these activities are therefore also reported in the Year 5 (2010) column. (3) During FY 2012, USAID also provided support for an IRS campaign in Burkina Faso, which sprayed 36,870 houses.

SPRAY PERSONNEL TRAINED WITH PMI SUPPORT[1]

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6[2] (FY 2011)	Year 7[3] (FY 2012)
Round 1	Angola	350	582	2,104	585	834	834	0
	Tanzania	536	734	688	2,806	5,890	4,397	10,756
	Uganda	450	4,062	4,945	4,412	5,171	1,771	541
Round 2	Malawi	_	300	309	462	929	929	885
	Mozambique	_	1,190	1,282	1,343	1,996	1,996	1,121
	Rwanda	_	655	2,091	2,276	2,088	2,357	1,986
	Senegal	_	275	706	570	1,024	911	1,097
Round 3	Benin	_	_	335	347	459	617	825
	Ethiopia	_	_	1,198	3,017	4,049	3,855	2,260
	Ghana	_	_	468	577	572	636	992
	Kenya	_	4,697	1,452	1,719	2,496	2,118	5,921
	Liberia	_	_	_	340	480	793	802
	Madagascar	_	_	1,673	851	1,612	1,612	4,634
	Mali	_	_	413	424	549	816	872
	Zambia	_	1,300	1,413	1,935	2,396	2,396	929
Round 4	Nigeria	_	_	_	_	_	_	351
	Zimbabwe	_	_	_	_	_	_	158
	TOTAL	**1,336**	**13,795**	**19,077**	**21,664**	**30,545**	**26,038**	**34,130**

(1) A cumulative count of the number of people trained is not provided because many areas were sprayed on more than one occasion. Spray personnel are defined as spray operators, supervisors, and ancillary personnel. This definition does not include many people trained to conduct information and community mobilization programs surrounding IRS campaigns. (2) Angola, Madagascar, Malawi, Mozambique and Zambia implemented spray rounds during the first quarter of FY 2011; these activities are therefore also reported in the Year 5 (2010) column. (3) During FY 2012, USAID also provided support for an IRS campaign in Burkina Faso, which trained 332 people.

2. INSECTICIDE-TREATED MOSQUITO NETS

INSECTICIDE-TREATED MOSQUITO NETS (ITNS) PROCURED AND DISTRIBUTED WITH PMI SUPPORT

		ITNs Procured / ITNs Distributed							
	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7[1] (FY 2012)	Cumulative[2]
Round 1	Angola	540,949	294,200	734,198	395,748	1,353,298	1,011,800	727,700	4,046,093
		540,949	0	339,440	446,348	294,169	630,000	207,000	2,457,906
	Tanzania	130,000	0	143,560	1,468,966	623,441	0	697,201	3,063,168
		130,000	0	113,560	1,498,966	623,441	0	697,201	3,063,168
	Uganda	376,444	1,132,532	480,000	765,940	1,009,000	709,000	1,200,000	4,963,916
		305,305	683,777	999,894	651,203	294,139	221,325	225,890	3,378,356
Round 2	Malawi	_	1,039,400	849,578	1,791,506	850,000	1,659,700	1,261,285	7,451,469
		_	211,995	849,578	851,436	457,822	1,142,938	1,768,951	5,114,450
	Mozambique	_	786,000	720,000	1,450,000	500,000	1,200,000	1,200,000	5,856,000
		_	565,000	842,802	930,000	500,000	1,494,277	850,000	5,074,916
	Rwanda	_	0	550,000	912,400	100,000	310,000	1,000,500	2,872,900
		_	0	0	500,000	962,400	0	806,100	2,268,500
	Senegal	_	200,000	790,000	408,000	1,025,000	2,880,000	500,000	5,803,000
		_	196,872	792,951	380,000	28,000	1,546,617	1,614,563	4,559,003
Round 3	Benin	_	221,000	385,697	875,000	634,000	905,000	510,000	3,530,697
		_	215,627	45,840	879,415	315,799	699,300	360,000	2,515,981
	Ethiopia	_	102,145	22,284	1,559,500	1,845,200	1,845,200	2,540,000	6,069,129
		_	102,145	22,284	559,500	1,000,000	1,845,200	2,510,746	6,039,875
	Ghana	_	60,023	350,000	955,000	2,304,000	1,994,000	1,600,000	5,789,023
		_	60,023	0	350,000	955,000	2,313,546	1,616,400	4,932,869
	Kenya	_	_	60,000	1,240,000	455,000	2,212,500	1,299,195	5,266,695
		_	_	60,000	550,000	690,000	2,589,180	35,090	3,603,470
	Liberia	_	197,000	0	430,000	830,000	650,000	0	1,757,000
		_	0	184,000	430,000	480,000	350,000	300,000	1,744,000
	Madagascar	_	_	351,900	1,875,007	1,715,000	0	2,112,000	6,053,907
		_	_	351,900	1,005,007	2,579,720	2,217,074	0	3,936,627
	Mali	_	369,800	858,060	600,000	2,110,000	3,037,150	600,000	6,035,010
		_	369,800	258,060	600,000	0	2,040,964	1,510,000	4,778,824
	Zambia	_	808,332	186,550	433,235	1,800,000	1,760,146[3]	833,000	4,421,263
		_	550,017	444,865	433,235	400,000	1,760,146	833,000	4,421,263
Round 4	DRC	_	_	_	_	824,100	2,000,000	455,000	3,279,100
		_	_	_	_	589,553	314,111	2,113,864	2,968,563
	Mekong	_	_	_	_	_	_	298,573	298,573
		_	_	_	_	_	_	0	0
	Nigeria	_	_	_	_	614,000	1,000,000	3,315,675	4,929,675
		_	_	_	_	0	614,000	204,635	818,635
	Guinea	_	_	_	_	_	_	800,000	800,000
		_	_	_	_	_	_	0	0
	Zimbabwe	_	_	_	_	_	_	457,000	457,000
		_	_	_	_	_	_	457,000	457,000
	TOTAL	**1,047,393**	**5,210,432**	**6,481,827**	**15,160,302**	**18,592,039**	**23,174,496**	**21,407,129**	**82,743,618**
		976,254	**2,955,256**	**5,305,174**	**10,065,110**	**10,170,043**	**19,778,678**	**16,110,440**	**62,133,406**

(1) During FY 2012, USAID also provided support for ITN activities in Burundi; 530,000 ITNs were procured. (2) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year). (3) In addition to these ITNs procured with USAID funds, 1 million ITNs were procured in FY 2011 for Zambia with a donation from DFID.

ITNS PROCURED BY OTHER DONORS AND DISTRIBUTED WITH PMI SUPPORT

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7[1] (FY 2012)	Cumulative[2]
Round 1	Angola	_	0	109,624	17,089	540,851	0	0	667,564
	Tanzania	_	0	350,000	117,400	871,680	615,010	1,077,840	3,031,930
	Uganda	_	369,900	0	0	2,431,815	125,017	0	2,810,732
Round 2	Malawi	_	_	0	10,700	9,600	20,000	0	40,300
	Mozambique	_	_	78,000	179,730	0	0	0	257,730
	Senegal	_	_	0	1,875,456	621,481	385,427	0	2,882,364
Round 3	Ethiopia	_	_	_	475,000	0	0	0	475,000
	Ghana	_	_	750,000	0	82,600	0	6,788,328	7,620,928
	Madagascar	_	_	_	290,636	3,204,647	2,772,824	0	3,495,283
	Mali	_	_	_	_	_	_	258,000	258,000
Round 4	DRC	_	_	_	_	3,966,000	0	0	3,966,000
	Mekong	_	_	_	_	_	_	951,019	951,019
	Nigeria	_	_	_	_	0	15,389,478	1,852,604	16,377,973
	TOTAL	_	**369,900**	**1,287,624**	**2,966,011**	**11,728,674**	**19,307,756**	**10,927,791**	**42,834,823**

(1) During FY 2012, USAID also provided support for distribution of 327,000 Global Fund-procured ITNs in South Sudan. (2) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year).

3. MALARIA IN PREGNANCY

SULFADOXINE-PYRIMETHAMINE (SP) TREATMENTS PROCURED AND DISTRIBUTED WITH PMI SUPPORT[1]

		SP Treatments Procured / SP Treatments Distributed							
	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7[2] (FY 2012)	Cumulative[3]
Round 1	Uganda	0	0	18,333	72,666	39,367	26,666	26,667	171,033
		0	0	2,556	45,780	40,063	26,666	0	107,270
Round 2	Mozambique	_	_	0	0	3,645,052[4]	0	2,000,000	5,645,052
		_	_	0	0	0	3,645,052	0	3,645,052
	Rwanda	_	583,333	0	0	0	0	0	583,333
		_	583,333	0	0	0	0	0	583,333
Round 3	Benin	_	0	766,666	0	0	405,863	227,550	1,400,079
		_	0	0	307,121	150,000	309,546	227,550	894,217
	Ghana	_	_	0	0	25,000	0	0	25,000
		_	_	0	0	0	25,000	0	25,000
	Kenya	_	_	0	840,000	0	0	0	840,000
		_	_	0	840,000	0	0	0	840,000
	Liberia	_	_	0	78,666	85,333	85,333	79,667	243,666
		_	_	0	78,666	0	71,333	7,667	157,666
	Mali	_	_	1,000,000	0	0	0	531,000	1,531,000
		_	_	0	1,000,000	0	0	531,000	1,531,000
	Zambia	_	_	0	666,666	0	3,083,300[5]	0	3,749,966
		_	_	0	0	666,666	3,083,300	0	3,749,966
Round 4	DRC	_	_	_	_	2,470,000[6]	1,100,000	300,000	2,770,000
		_	_	_	_	1,370,000	0	223,683	1,593,683
	Nigeria	_	_	_	_	_	_	1,000,000	1,000,000
		_	_	_	_	_	_	0	0
	Guinea	_	_	_	_	_	_	108,333	108,333
		_	_	_	_	_	_	108,057	108,057
	Zimbabwe	_	_	_	_	_	_	220,000	220,000
		_	_	_	_	_	_	220,000	220,000
	TOTAL	_	**583,333**	**1,784,999**	**1,657,998**	**6,264,752**	**4,701,162**	**4,493,217**	**18,287,462**
		_	**583,333**	**2,556**	**2,271,567**	**2,226,729**	**7,160,897**	**1,317,957**	**13,455,244**

(1) Please note that one treatment consists of three tablets. (2) In FY 2012, 826,667 SP treatments were procured for Tanzania with funds from the Royal Embassy of the Kingdom of Netherlands. (3) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year). (4) All treatments were procured with nonmalaria U.S. Government funds. (5) In addition to the SP treatments procured with U.S. Government funds, 2,250,000 SP treatments were procured in FY 2011 for Zambia with a donation from DFID. (6) Of this total, 1,370,000 treatments were procured with nonmalaria U.S. Government funds.

	HEALTH WORKERS TRAINED IN IPTp WITH PMI SUPPORT[1]							
	Country	**Year 1 (2006)**	**Year 2 (2007)**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**	**Year 6 (FY 2011)**	**Year 7 (FY 2012)[2]**
Round 1	Angola	1,450	290	1,481	2,554	2,695	1,488	1,308
	Tanzania	376	1,158	2,532	2,288	2,157	4,634	1,210
	Uganda	168	807	649	724	870	5,341	5,651
Round 2	Malawi	_	_	2,747	348	181	0	31
	Mozambique	_	_	_	_	_	_	776
	Rwanda[3]	_	250	436	0	964	225	0
	Senegal	_	43	2,422	865	1,025	1,563	672
Round 3	Benin	_	605	1,267	146	80	0	0
	Ghana	_	_	464	1,170	2,797	7,577	2,665
	Kenya	_	_	0	5,107	93	1,844	4,950
	Liberia	_	_	417	750	535	404	289
	Madagascar	_	_	0	0	1,576	3,370	3,808
	Mali	_	_	142	0	1,173	1,983	270
	Zambia	_	_	_	63	0	0	387
Round 4	DRC	_	_	_	_	0	443	1,347
	Nigeria	_	_	_	_	0	0	3,456
	Guinea	_	_	_	_	_	_	313
	Zimbabwe	_	_	_	_	_	_	215
	TOTAL	**1,994**	**3,153**	**12,557**	**14,015**	**14,146**	**28,872**	**27,348**

(1) A cumulative count of individual health workers trained is not provided because some health workers were trained on more than one occasion. (2) During FY 2012, USAID also provided support for malaria in pregnancy activities in Burkina Faso and South Sudan; 2,077 health workers were trained in IPTp. (3) Health workers in Rwanda were trained in focused antenatal care because IPTp is not national policy.

4. CASE MANAGEMENT

RAPID DIAGNOSTIC TESTS (RDTS) PROCURED AND DISTRIBUTED WITH PMI SUPPORT

		RDTs Procured / RDTs Distributed							
	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7[1] (FY 2012)	Cumulative[2]
Round 1	Angola	129,875	375,000	375,000	600,000	832,000	1,637,000	862,150	4,361,025
		0	101,000	380,875	975,000	282,000	1,518,250	862,150	4,119,275
	Tanzania	875,000	550,200	1,075,000	950,000	292,000	117,000	212,500	4,071,700
		250,000	1,025,200	425,000	989,500	661,900	194,574	212,500	3,694,174
	Uganda	0	0	0	0	1,309,000	1,346,650	2,061,000	3,391,650
		0	0	0	0	34,000	296,985	0	295,055
Round 2	Malawi	_	0	0	0	0	0	2,966,675	2,966,675
		_	0	0	0	0	0	2,966,675	2,966,675
	Mozambique	_	0	0	0	0	5,000,000	1,000,000	6,000,000
		_	0	0	0	0	3,452,550	1,000,000	4,452,550
	Rwanda	_	0	0	0	200,010	200,010	500,010[3]	700,020
		_	0	0	0	0	109,991	90,019	200,010
	Senegal	_	0	0	0	0	0	700,000	700,000
		_	0	0	0	0	0	700,000[4]	700,000
Round 3	Benin	_	178,400	0	0	600,000	600,000	980,000	1,758,400
		_	73,815	104,585	0	0	600,000	490,000	1,268,400
	Ethiopia	_	_	0	1,680,000	1,560,000	0	0	3,240,000
		_	_	0	820,000	2,420,000	0	0	3,240,000
	Ghana	_	_	0	74,000	725,600	725,600	3,048,000	3,847,600
		_	_	0	0	0	725,600	1,000,000	1,725,600
	Kenya	_	_	0	0	547,800	547,800	1,745,120	2,292,920
		_	_	0	0	0	292,040	667,960	960,000
	Liberia	_	_	0	850,000	1,200,000	0	1,900,000	3,950,000
		_	_	0	850,000	1,116,275	83,725	0	2,050,000
	Madagascar	_	_	0	0	270,000	1,500,000	778,000	2,548,000
		_	_	0	0	202,031	248,329	1,491,589	1,832,469
	Mali	_	_	0	30,000	500,000	500,000	1,000,000	2,030,000
		_	_	0	0	530,000	500,000	600,000	1,630,000
	Zambia	_	979,000	1,639,000	2,070,000	4,804,500	2,337,450[5]	3,056,250	12,632,100
		_	0	979,000	1,250,000	2,550,400	2,337,450	999,975	5,862,725
Round 4	DRC	_	_	_	_	500,000	0	3,500,000	4,000,000
		_	_	_	_	0	400,425	428,175	828,600
	Mekong	_	_	_	_	_	61,000	248,500	309,500
		_	_	_	_	_	61,000	5,250	66,250
	Nigeria	_	_	_	_	_	0	2,700,000	2,700,000
		_	_	_	_	_	0	428,400	428,400
	Guinea	_	_	_	_	_	_	100,000	100,000
		_	_	_	_	_	_	100,000	100,000
	Zimbabwe	_	_	_	_	_	_	1,599,700	1,599,700
			_	_	_	_	_	1,599,700	1,599,700
	TOTAL	**1,004,875**	**2,082,600**	**2,429,000**	**6,254,000**	**13,340,910**	**14,572,510**	**28,957,905**	**62,539,290**
		250,000	**1,200,015**	**1,889,460**	**4,884,500**	**7,796,606**	**10,820,919**	**13,642,393**	**38,019,883**

(1) During FY 2012, USAID also provided support for case management activities in Burkina Faso, Burundi and South Sudan; 1,600,000 RDTs were procured and 900,000 were distributed. (2) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year). (3) Of the 500,010 RDTs Rwanda procured in FY 2012, 260,000 were relocated to Tanzania to avoid expiry. (4) In FY 2012, an additional 250,000 RDTs procured by other donors were distributed with U.S. Government support in Senegal. (5) In addition to the RDTs procured with U.S. Government funds, 1,350,000 RDTs were procured in FY 2011 for Zambia with a donation from DFID.

	HEALTH WORKERS TRAINED IN MALARIA DIAGNOSIS WITH PMI SUPPORT[1]							
	Country	**Year 1 (2006)**	**Year 2 (2007)**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**	**Year 6 (FY 2011)**	**Year 7 (FY 2012)[2]**
Round 1	Angola	_	374	1,356	691	1,022	1,028	225
	Tanzania	_	0	0	247	388	338	83
	Uganda	_	0	100	1,115	941	1,651	427
Round 2	Malawi	_	_	0	0	307	549	1,039
	Mozambique	_	391	0	136	0	0	0
	Rwanda	_	_	0	0	29	0	172
	Senegal	_	_	90	19	4,158	2,920	1,239
Round 3	Benin	_	605	0	24	583	232	884
	Ethiopia	_	_	0	0	0	7,666	9,068
	Ghana	_	_	0	46	4,511	8,680	2,540
	Kenya	_	_	77	0	485	210	408
	Liberia	_	_	0	22	906	39	0
	Madagascar	_	_	0	108	2,701	8,932	535
	Mali	_	_	40	412	1,276	1,957	1,292
	Zambia	_	_	0	36	0	37	2,017
Round 4	DRC	_	_	_	_	28	499	1,762
	Mekong	_	_	_	_	0	0	63
	Nigeria	_	_	_	_	0	2	3,555
	Guinea	_	_	_	_	_	_	835
	Zimbabwe	_	_	_	_	_	_	2,066
	TOTAL	_	**1,370**	**1,663**	**2,856**	**17,335**	**34,740**	**28,210**

(1) A cumulative count of individual health workers trained is not provided because some health workers were trained on more than one occasion. (2) During FY 2012, USAID also provided support for case management activities in Burkina Faso and Burundi; 1,789 health workers were trained in malaria diagnostics.

ARTEMISININ-BASED COMBINATION THERAPY (ACT) TREATMENTS PROCURED AND DISTRIBUTED WITH PMI SUPPORT

ACTs Procured

ACTs Distributed

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7 [1,2] (FY 2012)	Cumulative[3]
Round 1	Angola	587,520	2,033,200	3,035,520	5,572,860	3,767,040	3,770,010	7,429,800	22,425,940
		0	1,689,321	3,109,089	1,947,188	3,567,360	3,770,070	7,429,800	21,512,828
	Tanzania	380,160	694,050	146,730	4,001,760	8,751,150	7,608,900	8,201,910	26,213,100
		380,160	494,050	346,730	544,017	4,873,207	8,819,640	8,663,280	21,813,694
	Uganda	261,870	0	1,140,480	0	2,085,120	2,085,120	1,169,820	4,657,290
		227,827	0	0	1,140,480	0	545,310	52,501	1,966,118
Round 2	Malawi	_	4,695,450	8,449,920	1,169,280	1,634,520	214,500	7,691,970	23,641,140
		_	4,694,013	3,579,278	3,693,510	2,198,460	215,100	6,536,307	20,701,568
	Mozambique	_	218,880	4,988,160	0	5,331,840	7,064,040	8,731,950	23,529,750
		_	218,880	1,440,000	2,210,320	1,553,430	4,920,990	2,830,380	12,195,580
	Rwanda	_	714,240	0	0	0	0	0	714,240
		_	0	714,240	0	0	0	0	714,240
	Senegal	_	0	0	443,520	670,080	659,790	355,000	2,070,310
		_	0	0	0	443,520	455,756	468,776	1,368,052
Round 3	Benin	_	_	1,073,490	215,040	1,002,240	509,100	1,841,190	4,641,060
		_	_	326,544	812,232	1,002,600	470,749	1,181,091	3,786,170
	Ethiopia	_	_	600,000	1,081,000	2,268,000	0	1,365,000	5,314,000
		_	_	0	1,681,000	648,000	1,620,000	1,365,000	5,314,000
	Ghana	_	_	1,142,759	0	0	0	2,090,130	3,232,889
		_	_	0	1,028,000	114,759	0	2,090,130	3,232,889
	Kenya	_	_	1,281,720	7,804,800	6,997,080	6,960,390	9,578,970	29,992,560
		_	_	1,281,720	6,015,360	7,667,310	3,268,260	2,410,810	20,175,980
	Liberia	_	496,000	0	1,303,175	1,631,625	4,444,875	2,375,525	9,679,600
		_	0	496,000	1,303,175	1,631,625	1,623,781	2,375,525	7,430,106
	Madagascar	_	_	0	0	0	100,025	400,000	500,025
		_	_	0	0	0	0	84,948	84,948
	Mali	_	_	0	241,720	739,200	1,289,190	2,400,030	3,930,940
		_	_	0	241,720	0	1,289,190	900,000	2,430,910
	Zambia	_	_	495,360	0	2,390,400[4]	1,688,160[5]	2,721,060[6]	6,658,020
		_	_	80,640	173,160	2,257,920	1,688,160	2,721,060	6,283,980
Round 4	DRC	_	_	_	_	3,780,000	0	7,000,000	10,780,000
		_	_	_	_	639,075	855,948	1,007,387	2,406,271
	Mekong	_	_	_	_	0	0	68,070	68,070
		_	_	_	_	0	0	0	0
	Nigeria	_	_	_	_	0	0	7,201,535	7,201,535
		_	_	_	_	1,043,352[7]	0	1,241,363	2,284,715
	Guinea	_	_	_	_	_	1,450,000	754,750	2,204,750
		_	_	_	_	_	0	915,500	915,500
	Zimbabwe	_	_	_	_	_	744,120	969,150	1,713,270
			_	_	_	_	520,884	1,192,386	1,713,270
	TOTAL	**1,229,550**	**8,851,820**	**22,354,139**	**21,833,155**	**41,048,295**	**38,588,220**	**72,345,860**	**189,168,489**
		607,987	**7,096,264**	**11,374,241**	**20,790,162**	**27,640,618**	**30,063,838**	**43,466,244**	**136,330,819**

(1) During FY 2012, USAID also provided support for case management activities in Burkina Faso, Burundi and South Sudan; 4,991,250 ACTs were procured and 2,367,675 were distributed. (2) During FY 2012, PMI also procured 786,305 ACT treatments for emergency stockpile purposes. These will be counted in next year's annual report once they have been allocated to specific countries. (3) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year). (4) In addition to the ACTs procured with U.S. Government funds, 1,599,360 ACTs were procured in 2010 for Zambia with a donation from DFID. (5) In addition to the ACTs procured with U.S. Government funds, 3,805,560 ACTs were procured in FY 2011 for Zambia with a donation from DFID. (6) In addition to the ACTs procured with U.S. Government funds, 4,686,750 ACTs were procured in FY 2012 for Zambia with a donation from DFID. (7) These ACTs were distributed in 2010 with U.S. Government funds but were procured before Nigeria became a PMI focus country.

ACT TREATMENTS PROCURED BY OTHER DONORS AND DISTRIBUTED WITH PMI SUPPORT

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7 (FY 2012)	Cumulative[1]
Round 1	Uganda	_	8,709,140	112,330	4,459,918	0	0	0	13,281,388
Round 2	Malawi	_	_	0	2,056,170	0	5,015,490	0	6,779,580
	Mozambique	_	_	0	1,423,350	2,857,590	1,428,630	0	4,951,070
	Rwanda	_	_	_	396,625	282,494	114,471	966	794,556
	Senegal	_	_	_	0	0	0	275,000	275,000
Round 3	Madagascar	_	_	_	519,338	396,470	124,118	674,273	1,699,579
Round 4	Nigeria	_	_	_	_	_	311,100	0	311,100
	TOTAL	_	**8,709,140**	**112,330**	**8,855,401**	**3,536,554**	**6,993,809**	**950,239**	**28,092,273**

(1) The cumulative column takes into account the three-month overlap between Year 5 (covering the 2010 calendar year) and Year 6 (covering the 2011 fiscal year).

HEALTH WORKERS TRAINED IN TREATMENT WITH ACTS WITH PMI SUPPORT[1]

	Country	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)	Year 6 (FY 2011)	Year 7 (FY 2012)[2]
Round 1	Angola	1,283	290	1,357	2,784	2,868	238	1,489
	Tanzania	4,217	1,011	1,767	1,018	1,162	1,520	2,218
	Uganda	2,844	12,637	9,159	1,356	0	485	5,651
Round 2	Malawi	_	0	5,315	809	1,813	378	204
	Mozambique	_	174	422	16,768	219	0	2,383
	Rwanda	_	5,127	8,565	7,672	7,180	8,911	3,098
	Senegal	_	1,020	4,776	1,162	4,158	2,375	1,196
Round 3	Benin	_	605	_	762	1,178	1,207	678
	Ethiopia	_	_	2,786	0	1,740	7,666	8,694
	Ghana	_	_	368	1,144	2,952	7,954	1,318
	Kenya	_	_	_	4,747	390	0	0
	Liberia	_	_	595	746	1,008	498	289
	Madagascar	_	_	_	1,696	4,575	8,039	580
	Mali	_	_	101	412	1,283	1,957	1,260
	Zambia	_	_	186	197	0	493	542
Round 4	DRC	_	_	_	_	874	462	1,525
	Mekong	_	_	_	_	0	0	291
	Nigeria	_	_	_	_	5,058	0	5,608
	Guinea	_	_	_	_	_	_	707
	Zimbabwe	_	_	_	_	_	_	2,066
	TOTAL	**8,344**	**20,864**	**35,397**	**41,273**	**36,458**	**42,183**	**39,797**

(1) A cumulative count of individual health workers trained is not provided because some health workers were trained on more than one occasion. (2) During FY 2012, USAID also provided support for case management activities in Burkina Faso and Burundi; 1,727 health workers were trained in ACT use.

Appendix 3: PMI Country-Level Targets

The President's Malaria Initiative's (PMI's) goal to reduce the burden of malaria will be achieved by reaching and sustaining 85 percent coverage of the most vulnerable groups – children under five years of age and pregnant women – with proven preventive and therapeutic interventions, including insecticide-treated mosquito nets (ITNs), indoor residual spraying (IRS), intermittent preventive treatment for pregnant women (IPTp) and artemisinin-based combination therapies (ACTs). PMI has a single set of country-level targets for these four major control measures:

ITNs

- More than 90 percent of households with a pregnant woman and/or children under five will own at least one ITN.
- 85 percent of children under five will have slept under an ITN the previous night.
- 85 percent of pregnant women will have slept under an ITN the previous night.

IRS

- 85 percent of houses in geographic areas targeted for IRS will have been sprayed.
- 85 percent of pregnant women and children under five will have slept under an ITN the previous night or in a house that has been protected by IRS.

IPTp

- 85 percent of women who have completed a pregnancy in the last two years will have received two or more doses of IPTp during that pregnancy.

ACTs

- 85 percent of government health facilities will have ACTs available for the treatment of uncomplicated malaria.*

* PMI is working with the Roll Back Malaria Monitoring and Evaluation Reference Group to develop a new indicator to measure effective case management of malaria. Until a new indicator is approved, this one will be used in place of the standard, but now less relevant, case management indicator (treatment with an ACT within 24 hours of onset of fever). As the burden of malaria has been reduced and the proportion of fever illnesses not caused by malaria has increased, administering ACTs based solely on the presence of fever is no longer an acceptable practice.

Abbreviations and Acronyms

ACT	Artemisinin-based combination therapy
ANC	Antenatal care
BCC	Behavior change communication
CBO	Community-based organization
CDC	U.S. Centers for Disease Control and Prevention
DFID	U.K. Department for International Development
DOD	U.S. Department of Defense
DRC	Democratic Republic of the Congo
EMLIP	Essential Medicine Logistics Improvement Program
FANC	Focused antenatal care
FY	Fiscal year
Global Fund	The Global Fund to Fight AIDS, Tuberculosis and Malaria
HIV and AIDS	Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome
HHS	Department of Health and Human Services
HMIS	Health management information system
iCCM	Integrated community case management
IPTp	Intermittent preventive treatment for pregnant women
IRS	Indoor residual spraying
ITN	Insecticide-treated mosquito net
M&E	Monitoring and evaluation
MCH	Maternal and child health
MMV	Medicines for Malaria Venture
MVDP	Malaria Vaccine Development Program
NGO	Nongovernmental organization
NICHD	The Eunice Kennedy Shriver National Institute of Child Health and Human Development
NIH	National Institutes of Health
NMCP	National malaria control program
NMRC	Naval Medical Research Center
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
PIRCOM	*Programa Inter-religioso Contra a Malaria*
PMI	U.S. President's Malaria Initiative
QA/QC	Quality assurance/quality control
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
SP	Sulfadoxine-pyrimethamine
THMIS	Tanzania HIV/AIDS and Malaria Indicator Survey
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WHO	World Health Organization
WRAIR	Walter Reed Army Institute of Research

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and all U.S. Government staff who have contributed to the achievements described in these pages.

COVER PHOTO CREDIT

Clockwise from top:
A mother and her daughter are protected by a long-lasting insecticide-treated mosquito net in Senegal.
Credit: Maggie Hallahan Photography

In Zanzibar, a health worker tests a young child for malaria using a rapid diagnostic test.
Credit: Maggie Hallahan Photography

A girl in Ethiopia prepares her home prior to indoor residual spraying.
Credit: Brant Stewart, RTI

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