



PRESIDENT'S MALARIA INITIATIVE



# PMI | Africa IRS (AIRS) Project

## Indoor Residual Spraying (IRS 2) Task Order Six

# THE PMI AIRS PROJECT SEMI-ANNUAL REPORT APRIL 1, 2015 – SEPTEMBER 30, 2015

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**THE PMI AIRS PROJECT  
SEMI-ANNUAL REPORT**

**APRIL 1, 2015 – SEPTEMBER 30, 2015**

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# ACRONYMS

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<b>AIRS</b>	Africa Indoor Residual Spraying Project
<b>CDC</b>	Centers for Disease Control and Prevention
<b>COP</b>	Chief of Party
<b>COR</b>	Contracting Officer's Representative
<b>CRC</b>	Centre de Recherche en Entomologie de Cotonou
<b>DDT</b>	Dichlorodiphenyltrichloroethane
<b>EC</b>	Environmental Compliance
<b>ECO</b>	Environmental Compliance Officer
<b>EOSR</b>	End of Spray Report
<b>HLC</b>	Human Landing Catch
<b>IEC</b>	Information, Education, and Communication
<b>IRS</b>	Indoor Residual Spraying
<b>kdr</b>	Knockdown resistance
<b>LLIN</b>	Long-lasting insecticide-treated nets
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MSP</b>	Mobile Soak Pit
<b>NMCP</b>	National Malaria Control Program
<b>PMI</b>	President's Malaria Initiative
<b>PPE</b>	Personal Protective Equipment
<b>PSC</b>	Pyrethrum Spray Catch
<b>PSECA</b>	Pre-Spray Environmental Compliance Assessment
<b>SEA</b>	Supplemental Environmental Assessment
<b>SMS</b>	Short Message Service
<b>SOP</b>	Spray Operator
<b>UCAD</b>	Université Cheikh Anta Diop de Dakar
<b>USAID</b>	United States Agency for International Development
<b>USG</b>	United States Government
<b>WHO</b>	World Health Organization
<b>WHOPES</b>	World Health Organization Pesticide Evaluation Scheme



# EXECUTIVE SUMMARY

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During this reporting period (April 1, 2015, through September 30, 2015), the President's Malaria Initiative (PMI) Africa Indoor Residual Spraying (AIRS) Project, funded by the United States Agency for International Development, continued implementation under Task Order 6. The Project implemented indoor residual spraying (IRS) campaigns in Benin, Ethiopia, Ghana, Madagascar, Mali, Rwanda, and Senegal. The Project covered an average of 96.6% of targeted structures, and protected more than 6.5 million people from malaria. Details regarding all monitoring and evaluation (M&E) outcomes by country are reported in Annex B.

## TOP-LINE RESULTS FROM IRS CAMPAIGNS, APRIL – SEPT 2015

- 2,018,316 structures sprayed
- 96.6 percent average spray coverage
- 6,454,765 people protected from malaria including:
  - 147,474 pregnant women
  - 1,017,718 children under 5 years of age
- 13,079 people trained with United States Government funds to deliver IRS

During the reporting period, the Project also:

- Obtained required approvals and selected an incineration facility for DDT disposal in Ethiopia;
- Carried out health facility data quality audits in one district in Mali to assess the quality of epidemiological data found in the HMIS system. Further investigations into the HMIS data are planned to be done in two more districts before the end of the year;
- Worked with EnCompass on rolling out two pilots of the capacity building trainings in Zambia and Rwanda in July 2015;
- Collected baseline data for the Operational Research study sites selection in Zambia;
- Continued and expanded the use of smartphones for collecting operations and environmental compliance data in Benin, Ethiopia, Ghana, Madagascar, Mali, Rwanda, and Senegal;
- Implemented gender studies in Ethiopia, Madagascar, and Rwanda to measure changes in gender norms from before and after the spray campaigns. In addition, AIRS Ethiopia conducted a qualitative study to better understand income use and perception of income earned by women on the project;
- Wrote and disseminated five success stories and two e-letters (in June and September) to more than 3,700 global health professionals; and
- Submitted five journal article manuscripts to PMI. One manuscript previously approved was published by the *Malaria Journal*.

# I. COUNTRY HIGHLIGHTS

## I.1 ANGOLA

### PROGRAM HIGHLIGHTS

- Prepared and implemented an inventory disposition plan from TO4 to TO6. This plan was approved by PMI/Washington and PMI/Angola.
- Held a workshop in coordination with PMI/Angola and the National Malaria Control Program (NMCP) to engage Provincial Departments of Health (DPS) in leading IRS implementation as a malaria intervention in their respective provinces using their own funding. A few private sector partners were also present to explore opportunities for partnerships.
- Completed all planned preparatory activities for entomological data collection, including selection of sentinel sites and locations with the assistance of respective DPS staff in the selected provinces, in order to commence monthly monitoring activities in October 2015.
- Submitted report in May 2015 on first national vector susceptibility study in nine provinces across the country. The study was carried out February – March 2015.
- In July 2015, 3,629 *Anopheles* mosquitoes – all collected from the national susceptibility study – were shipped to CDC Atlanta for molecular and biochemical analysis.

## I.2 BENIN

**TABLE I: AIRS BENIN AT A GLANCE**

Number of communes covered by the PMI-supported IRS campaign	<b>9 communes: Boukoumbé, Cobly, Kérou, Kouandé, Matéri, Natitingou, Péhunco, Tanguiéta, and Toucountouna</b>
Insecticide	Organophosphate (Pirimiphos-methyl CS)
Number of structures found by SOPs	270,141
Number of structures sprayed by PMI-supported IRS	252,706
2015 PMI-supported IRS campaign spray coverage	93.5%
Population protected by 2015 IRS campaign	Total population – 802,597 Pregnant women – 30,454 Children under 5 years – 156,863
Dates of PMI-supported IRS campaign	April 30 – May 22, 2015
Length of campaign	20 days
Number of people trained with US Government funds to deliver IRS*	1,500

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## PROGRAM HIGHLIGHTS

AIRS Benin's 2015 IRS campaign took place April 30-May 22, 2015. Working in close collaboration with PMI/Benin and several Beninese government partners, the 2015 spray campaign covered 93.55% of eligible structures (252,706 sprayed) in Atacora Department in Northwest Benin, protecting 802,597 residents from malaria. The 2015 campaign emphasized enhancing the quality of spray, promoting gender equality across operations, and expanding the use of mobile technology. To improve quality of spray and ensure a constant application rate, AIRS Benin introduced the use of control flow valves (CFVs) on all spray pumps to steady the flow of insecticide, and ensure an even distribution of insecticide onto treated walls. Following the IRS campaign, AIRS Benin coordinated logistics for a national level strategy workshop where NMCP, PMI, and other stakeholders discussed the country's IRS strategy for the next five years. The workshop took place October 1-2.

To promote gender equality across operations AIRS Benin sought to hire more female SOPs, team leaders, and supervisors. AIRS Benin included gender awareness and sexual harassment in the Training of Trainers (ToT) training curricula and posted project policies against sexual harassment at all operational sites. During the campaign AIRS Benin enhanced and expanded the use of mobile health (mHealth) technology for IRS using short message service (SMS) and the data platform, TextIt, to collect daily IRS data from the field to the nine communes of Atacora. In turn, the management team overseeing IRS operations used this mobile data to make daily decisions and adjustments during the spray campaign. AIRS Benin reinforced the NMCP staff capacity to manage and lead the IRS campaign by extending and expanding their responsibilities in three communes. Finally, AIRS Benin used smartphones to perform all environmental inspections as well as the pre-spray environmental compliance assessment (PSECA), pre-contract vehicle inspection, and mid- and post-spray inspections.

## ENTOMOLOGY

Contracted directly by PMI/Benin, the Centre de Recherche en Entomologie de Cotonou (CREC) collected entomological data to evaluate the spray quality of the 2015 IRS campaign. CREC noted that the quality of the IRS was good at the baseline test performed May 6-7, 2015, with 100% mortality rates for mosquitoes coming into contact with treated walls.

## EPIDEMIOLOGY

AIRS Benin collaborated with a World Bank-funded health systems strengthening (HSS) project that collects and improves health facility data across eight health zones in Benin and disaggregates malaria incidence data by pregnant women and children under five. AIRS Benin and the project shared the HSS project's malaria incidence data from four districts in northern Benin, including three IRS spray districts (i.e. Kérou, Kouandé, and Péhunco in Atacora).

## 1.3 BURUNDI

### PROGRAM HIGHLIGHTS

- The entomological surveillance in Burundi was conducted in eight sentinel sites representing the major malaria epidemiological settings (facies) in the country: Cankuzo & Gihofi (areas of perennial malaria), Kiremba (plateaus area), Vumbi (wooded savannah), Mabayi (edge of a rain forest), Mpanda (greater marsh with irrigated agriculture), Nyanza–Lac (the coastal area), and Matana (the Congo Nile crest).
- Mosquito collections using pyrethrum spray catch (PSC), CDC-light trap and human landing catch (HLC) methods caught eight morphologically identified *Anopheles* species: *An. gambiae* s.l., *An. brohieri*, *An. funestus* s.l., *An. maculipalpis*, *An. marshalli*, *An. pharoensis*, *An. squamosus*, and *An. ziemanni*.

*Anopheles gambiae* s.l. and *Anopheles funestus* s.l. remain the main vectors and represent 77% and 17% of the *Anopheles* collected, respectively. The CDC-light trap method collected the most species. *An. gambiae* s.s. and *An. funestus* s.s. were predominant in the *An. gambiae* complex and *An. funestus* groups.

- The indoor resting density for *Anopheles gambiae* s.l. was highest in the sites of Vumbi, Kiremba, and Gihofi. For *Anopheles funestus* s.l., the density was highest in Cankuzo and Mpanda sentinel sites.
- Regarding the biting behavior, the main malaria vectors were biting more or less equally indoors and outdoors, 54% and 53%, respectively, for *An. gambiae* s.l. and *An. funestus* s.l.

### CHALLENGES AND LESSONS LEARNED

- The political unrest this year led to a displacement of populations and a situation of insecurity, limiting the proper implementation of activities, especially field work in sentinel sites.
- Health centers that host the sentinel sites are still underserved in human resources. As a result, technicians assigned to these sites often spend time on other health centers activities. Moreover, the basic skills in entomological surveillance of new technicians assigned in sentinel sites still need to be reinforced, especially in the identification of species and dissection of mosquitoes.

## 1.4 DEMOCRATIC REPUBLIC OF THE CONGO

### PROGRAM HIGHLIGHTS

- AIRS Democratic Republic of the Congo (DRC), through the National Institute of Biomedical Research (NIBR), implemented entomological monitoring activities in seven sentinel sites. Entomological monitoring activities include PSC and HLC collections and insecticide susceptibility testing.
- HLCs and PSCs were carried out in all the seven sentinel sites: Lodja, Kabondo, Kalemie, Kapolowe, Katana, Kingasani, and Mikalayi. Twelve species of *Anopheles* were caught and morphologically identified in the seven sentinel sites. Out of these species, four are recognized as malaria vectors in DRC: *An. gambiae* s.l., *An. funestus*, *An. paludis*, and *An. nili*. The eight other species of *Anopheles*, which are not recognized as malaria vectors in DRC are: *An. implexus*, *An. rufipes*, *An. christyi*, *An. salbaii*, *An. ziemanni*, *An. tenebrosus*, *An. caliginosus*, and *An. swahilicus*. *An. gambiae* s.l. and *An. funestus* were present in all the sentinel sites. *An. paludis* was identified in Kapolowe, Katana, and Lodja sites.
- *An. gambiae* s.l. is generally susceptible to pirimiphos-methyl and bendiocarb insecticides in all sentinel sites. It is also susceptible to deltamethrin in most sites, except in two sites where resistance and possible resistance were reported. The vector is resistant to permethrin in most of the sites, except in two sites where possible resistance was documented. *An. gambiae* s.l. was resistant to DDT in all sites.
- Other activities, such as the susceptibility tests using CDC bottle assays, the surveillance of *Anopheles paludis* in Lodja, and molecular identification of sibling species of the *An. gambiae* s.l. complex and knockdown resistance (*kdr*) genes are still in progress.

## 1.5 ETHIOPIA

**TABLE 2: AIRS ETHIOPIA AT A GLANCE**

Number of districts covered by PMI-supported IRS	36 districts in the Oromia region
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Number of structures found by SOPs	708,258
Number of structures sprayed by PMI-supported IRS	704,945
2015 spray coverage	99.5%
Population protected by PMI-supported IRS	Total population – 1,655,997 Pregnant women – 23,084 Children under 5 years – 230,366
Dates of PMI-supported IRS campaign	July 21 – Aug 15, 2015 (organophosphates) Aug 11–Sep 15, 2015 (carbamates)
Length of campaign (total days)	31 days
Number of people trained with U.S. Government funds to deliver IRS*	2,845

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## PROGRAM HIGHLIGHTS

In collaboration with the Federal Ministry of Health (FMOH), AIRS Ethiopia conducted IRS in 36 districts targeting 708,258 structures. The spray campaign was completed in 31 days and achieved a coverage rate of 99.5%, spraying 704,949 structures. A combination of community-based IRS and district-based IRS methods were used, as well as two different insecticides, organophosphates (OPs) and carbamates.

In addition to spraying, AIRS Ethiopia worked closely with the NMCP and the Oromia Regional Health Bureau to conduct a number of capacity building activities for FMOH staff during the reporting period. National-level capacity building workshops were conducted on IRS implementation, entomological monitoring, and environmental compliance (EC). The project developed a Supplemental Environmental Assessment (SEA) amendment in 2015 which authorizes technical assistance and IRS in all zones in the country and is valid for a period of five years (2015 – 2020).

In collaboration with Jimma and Addis Ababa Universities, AIRS Ethiopia is conducting studies to determine the decay rate of different insecticides in experimental huts in two sites. Insecticide resistance, wall bioassays, vector density and behavioral studies were also conducted. Due to issues with spray quality, AIRS Ethiopia is currently re-conducting the decay rate study to ensure that IRS is performed with high quality.

The project contracted Mabbett & Associates Inc. and Veolia ES Field Services to support training and the exportation of obsolete DDT, respectively. Focal points for Ethiopia at the FMOH and Ministry of Environment & Forests were appointed, and documents required for prior informed consent and transboundary movement of hazardous wastes were submitted to Polish and intermediate country authorities. Finally, the Ethiopia team worked with the AIRS Gender Specialist to implement two surveys on gender, one on gender norms and the other on income use.

## ENTOMOLOGY

- Wall bioassay tests conducted three to six days after spraying on sprayed structures with Actellic CS indicated 100% mortality for both wild and susceptible mosquitoes for all wall surfaces tested. No difference was recorded between community-based (CB) and district-based (DB) IRS. Mortality at one month post spraying ranged from 93 – 100%.
- Mortality of wild and susceptible mosquitoes was 100% for dung, plastered and painted houses for bendiocarb sprayed structures and ranged from 90 to 96% for mud wall surfaces. At one month after spraying, mortality ranged from 92 – 100% on all wall surfaces except one site where 53.3% mortality was recorded on mud surfaces.
- Susceptibility of *An. gambiae* s.l. was tested against 11 WHOPES-approved insecticides for IRS using

the WHO tube assay in four of eight sites. The vector showed susceptibility to propoxur, fenitrothion, and pirimiphos-methyl in all sites, and susceptibility to bendiocarb in three of four sites, and possible resistance in one site. The vector is susceptible in two sites and resistant in another two sites to malathion. The vector is resistant to DDT and all pyrethroids tested in all four sites.

### CHALLENGES AND LESSONS LEARNED

- Some SOPs did not pay critical attention to spray protocol thus leading to poor spray quality. Recruitment of experienced SOPs and enhanced training and supervision will be the main focus next year to ensure that the quality of IRS operations is consistently high across all districts.
- Supervision gaps created due to competing government priorities impacted SOP training, supervision and spray quality. Careful planning of FMOH activities at regional and district levels is needed to ensure that IRS is the main focus during the campaign.
- Storage space at district and health posts was limited, especially for Actellic bottles, leading to use of available space that did not necessarily meet the required IRS commodity storage standards.
- Network connectivity was intermittent in several districts leading to delays in data reporting as data clerks had to travel long distances to towns with coverage. This also impacted mHealth activities.
- A lack of adequate door-to-door mobilization led to household unpreparedness for spraying.
- As a result of poor spray quality in the experimental huts, the study will be re-conducted in mid-November.

## 1.6 GHANA

**TABLE 3: AIRS GHANA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	5 districts: Bunkpurugu Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, West Mamprusi
Insecticide	Organophosphate (Actellic 300 CS)
Number of structures found by PMI-supported IRS	224,592
Number of structures sprayed by PMI-supported IRS	205,935
Spray coverage	91.7%
Population protected by PMI-supported IRS	Total population: 553,954 Pregnant women: 11,676 Children under five: 98,525
Dates of PMI-supported IRS campaign in 2015	April 14 to May 23, 2015
Length of campaign	35 days
Number of people trained with USG funds to deliver IRS*	698

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### PROGRAM HIGHLIGHTS

In 2015, AIRS Ghana continued to implement IRS in five districts. The 2015 IRS campaign took place April 14- May 23, 2015. Stakeholder, partner planning, and community sensitization meetings were held to create the necessary awareness and effective involvement of all stakeholders for successful spray operations. To improve effectiveness of IEC, the project recruited 16 IEC assistants, one for each site, up from five the previous year. Logistics and environmental compliance assessments were carried out to ensure that the standard operating procedures and Best Management Practices (BMPs) were followed.

To improve gender integration, AIRS Ghana set up clearly marked separate shower and changing rooms and toilet facilities for women and men. The program displayed the project-wide anti-sexual harassment policy at each operational site. The number of women hired in supervisory roles increased by 59%.

To improve supervision and rapid reporting, the project successfully introduced two mHealth initiatives. The Performance Management Tracker (PMT), a daily SMS reporting with mobile phones, was used to report spray data daily to reach out quickly to underperforming teams. The other initiative was a smartphone application for supervision of environmental compliance, spray quality, IEC, and mobilization components of the IRS campaign used by supervisors from the AIRS team and the government to observe the performance and report it to the project leadership for immediate adjustments. The government supervisors and the team completed 1,950 inspection forms using the application.

During the 2015 IRS campaign, AIRS Ghana undertook a biomonitoring program to evaluate the level of OP exposure for seasonal workers from regular IRS operations and, in so doing, confirm the effectiveness of prescribed PPE for spray operations. AIRS Ghana produced a separate report that includes methodology, analysis, cost implications, and the feasibility of conducting the biomonitoring program in Ghana.

## **ENTOMOLOGY**

- Entomological monitoring continued across five sentinel districts: Bunkpurugu-Yunyoo and Kumbungu (sprayed with Actellic 300CS), Savelugu-Nanton and Tolon (where IRS has been withdrawn) and in Tamale metropolis (an unsprayed district). Results from the entomological monitoring conducted during this reporting period by AIRS Ghana and the Noguchi Memorial Institute of Medical Research (NMIMR) showed a reduction in vector density, biting rate and parity in the IRS districts.
- Results from the WHO bioassays indicated high-quality spraying and strong performance of the insecticide, with 100% mortalities for the different types of wall surfaces— wood, cement, and mud within two weeks of spraying. Monthly cone bioassay tests continued through September 2015 to monitor the decay rate of the insecticide. Monthly insecticide decay rate bioassays conducted so far show sprayed insecticides remained efficacious in killing local vectors through the end of the reporting period.
- NMIMR is conducting analysis for PCR species identification and infection rate. The results will be included in the annual entomological summary report. PMI through AIRS Ghana has been supporting the National Insecticide Resistance Monitoring Partnership which brings together researchers and partners to generate and monitor IR data in the country. In 2015 PMI through AIRS Ghana provided funds to collect IR data from 10 sentinel sites. NMIMR, contracted out for this work, has collected data from five sentinel sites, and lab work and analysis of data is underway.

## **CHALLENGES AND LESSONS LEARNED**

- Though the project surpassed the 85% (PMI) and 90% (NCMP) targets, spray coverage in relatively urban areas in West and East Mamprusi districts required considerable effort in working with health offices and community leaders. To maintain improvement in spray coverage, the project will place more emphasis on strengthening collaboration with community level leaders.
- Within the first two weeks of operations, there was frequent malfunctioning of spray pumps, especially with the Goizper brand. The project replaced problematic Goizper pumps with Hudson pumps. The project has a large number of 10L and 8L Hudson pumps to be repaired for use before the 2016 campaign. With the introduction of CFVs for Hudson pumps, all functioning 8L pumps that have been in stock will be deployed during the next spray campaign as well.
- Piloting the biomonitoring program resulted in an increased workload for AIRS Ghana and for some

SOPs not working full time. This put pressure on fewer SOPs and reduced daily outputs. As a result, the campaign was extended by five days in four of the biomonitoring pilot sites.

- The ethnic conflict in Bunkpurugu at the beginning of the campaign resulted in a two-week delay of spraying and increased pressure on spray operators to work within strict curfew hours.

## 1.7 LIBERIA

### PROGRAM HIGHLIGHTS

- In collaboration with Liberia NMCP staff, entomological monitoring activities were conducted in two sentinel sites from May to September 2015. Insecticide resistance tests were conducted in three counties to assess the susceptibility of *An. gambiae* s.l. to five insecticides (pirimiphos-methyl, bendiocarb, DDT, deltamethrin and alphacypermethrin).
- Indoor resting density of *An. gambiae* s.l. was higher in Frank Town than Tomato camp sentinel site.
- Data collected using CDC light traps and HLCs from Tomato camp showed that *An. gambiae* s.l. bite almost equally indoors and outdoors. However, in Frank Town, the trend was not consistent for both collection methods, probably due to the low number of mosquitoes collected via CDC light trap. In Frank Town, 86 and 136 *An. gambiae* s.l. were collected indoor and outdoor, respectively, by HLC collections, while 31 were caught indoors and 13 caught outdoors using CDC traps.

Regarding insecticide resistance tests conducted from June to August 2015:

- In Zewedru, Grand Gedeh County, the results showed that *An. gambiae* mosquitoes were susceptible to bendiocarb and resistant to DDT, deltamethrin, and alphacypermethrin.
- In Nimba County, *An. gambiae* s.l. is fully susceptible to pirimiphos-methyl. However, a probable resistance to bendiocarb was observed. In this site, the resistance level was very high for DDT and alphacypermethrin.
- In Jorquellie, Bong County, *An. gambiae* s.l. mosquitoes were susceptible to pirimiphos-methyl. Tested mosquitoes were possibly resistant to bendiocarb and resistant to DDT, alphacypermethrin, and deltamethrin.

## 1.8 MADAGASCAR

**TABLE 4: AIRS MADAGASCAR AT A GLANCE**

	South East of Madagascar (Blanket)	East Coast of Madagascar (Blanket)	Total
Number of districts sprayed by PMI-supported IRS in 2015	1 (Farafangana)	3 (Brickaville, Tamatave II and Fenerive Est)	4
Insecticide	Organophosphates (Actellic 300 CS)	Organophosphates (Actellic 300 CS)	
Number of structures found by SOPs	81,941	186,888	268,829
Number of structures sprayed by PMI-supported IRS	75,782	172,120	247,902
Spray coverage	92.5%	91.9%	92.2%
Total population protected by PMI-supported IRS	361,980	654,861	1,016,841

	South East of Madagascar (Blanket)	East Coast of Madagascar (Blanket)	Total
Pregnant women protected	14,832	21,409	36,241
Children under 5 protected	65,737	81,945	147,682
Dates of PMI-supported IRS campaign	August 3- August 27, 2015	August 31- September 26, 2015	
Length of Campaign	23	24	47
Number of people trained with USG funds to deliver IRS*	521	798	1,319

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## PROGRAM HIGHLIGHTS

AIRS Madagascar conducted IRS in two areas: one district in the South East and three districts in the East, from August 3- 27 and August 31- September 26, 2015, respectively. This was the first time that the South East received IRS. A total of 230,126 structures were targeted by spray operators and they found and sprayed, more than their target. AIRS Madagascar conducted all pre-season activities, such as site refurbishments, and built mobile soak pits, before the campaign was launched. In both areas, the team encountered some challenges so they added a few extra days on the campaign (three days in the SE and one in the East) to increase coverage. The team worked closely with NMCP and local health staff to reiterate IEC messages and supervise the campaign. During IRS implementation, an mHealth pilot was conducted in the East. The mHealth tool, called mSpray, replaced the paper-based M&E system with a digital version, which allowed for real time spray progress and coverage to be reported.

## ENTOMOLOGY

- Cone bioassay tests conducted during the first week of the IRS campaign revealed that the quality of spraying was good (100% test mortality after 24h) in all the IRS areas and that the insecticide used during the IRS campaign was effectively killing mosquitoes.
- Distribution of vector species varied considerably between sentinel sites: a higher number of anopheline species were found in sentinel sites in the East compared to the South East.
- During this investigation period (July to September 2015), *An. gambiae* s.l., *An. funestus*, and *An. mascariensis*, the three vectors of malaria in Madagascar, were found in Toamasina II (Vohitrambato), in Vavatenina (control site of the East) and Farafangana. The vector density was highest in Vohitrambato (Toamasina II). *An. funestus* was absent in two sites of the East: Ambodifaho, Brickaville and Mahambo, Fenerive. *An. mascariensis* was absent in one site of the East: Ambodifaho, Brickaville, and in one site of the South East: Lopary, Vangaindrano.

Vector human biting rates were low, except in Vohitrambato and Ambodifaho, before spraying. In the East, the vector biting rates inside houses have decreased post spraying in comparison with the baseline. In the South East, the decrease was lower due to low overall vector density.

- Susceptibility testing is ongoing and will be completed by the end November 2015.

## CHALLENGES AND LESSONS LEARNED

- Refusals were still the principal challenge faced by the program both in the South East and East Coast; total refusals were 40.0% in 2015 compared to 32.3% in 2014. To improve spray coverage IEC messaging was reinforced, increased supervision was targeted in areas with the lowest coverage. AIRS worked closely with the NMCP to address the causes of refusals.
- Some reported reasons for refusals were the insecticide smell and that people do not feel

comfortable packing out their household objects.

- Distance and access to remote areas require spray operators to walk long distances within the commune to find structures and spray them.
- Some CVFs were obstructed because of dried insecticide. It is recommended that they are cleaned daily to avoid this problem.
- Communalization as an operational approach works and helps to improve spray coverage faster than working from the district but some practical aspects need adjustment for better achievement. With this approach AIRS Madagascar sprayed more structures than the fixed targets (14,114 more in the East Coast and 3,662 more in the South East).
- mHealth tools were helpful to monitor spray progress and spray supervision. They allowed the management team to make quick decisions and respond to problems in a timely manner.
- mSpray was a useful tool but required a lot of special attention and effort to employ it.
- Collaboration with NMCP and district medical staff was very strong this year and their support was helpful to supervise the campaign. AIRS will continue to work closely with NMCP to improve national capacity building.
- Advocacy meetings with stakeholders to address identified issues and problems during the operations are a key to improving coverage rates.
- Involvement of the chief Fokontany as IEC mobilizer and having IES mobilizers and SOPs from the commune were very helpful to increase spray coverage.
- Local authorities and health personnel should be part of the spray operations supervision team.

## 1.9 MALI

**TABLE 5: AIRS MALI AT A GLANCE**

Number of districts covered by PMI-supported IRS in 2015	2 districts: Baroueli and Koulikoro
Insecticide	Organophosphates (Actellic 300 CS)
Number of structures found by spray operators	135,971
Number of structures sprayed by PMI-supported IRS	133,527
2015 spray coverage	98.2%
Population protected by PMI-supported IRS in 2015	Total population: 494,205 Pregnant women: 13,219 Children under five: 87,861
Dates of PMI-supported IRS campaign	July 1–August 9, 2015
Length of campaign (operational days)	37 days
Number of people trained with U.S. Government funds to deliver IRS*	582

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## **PROGRAM HIGHLIGHTS**

The IRS campaign took place in July and August. The project worked closely with government counterparts at both district and national levels involving them in planning, scheduling of the IRS roll-out, and sensitization of communities. Involvement of local administrative authorities is important to increase the success of sensitization activities, in particular, to help manage and minimize refusal cases.

Use of the mobile soak pit and a modified motorbike called a taxini, both of which were introduced in the 2014 IRS campaign, was successfully expanded in 2015. The team successfully switched to using mobile payments instead of cash payments to the seasonal workers in one of the two districts. In 2016, AIRS Mali will transition to using mobile payments across both districts.

The mobilization strategy was revised to reduce the number of mobilizers, however, it should be further modified to ensure that mobilizers work with the village residents not only on the day of spraying but also before spray teams arrive during the 2016 IRS campaign.

AIRS Mali organized a workshop in May with representatives from the NMCP, MOH, Ministry of Environment, and National Directorate for Sanitation and Pollution Control (DNACPN) to continue building skills and knowledge among central-level personnel in the different IRS components (planning, environmental compliance, training, and implementation).

A data quality audit took place in Koulikoro in September to determine if health facility data can be used for assessing relations between reported positive malaria cases and IRS in selected districts. The audit demonstrated that the data is often incomplete and cannot produce accurate results. AIRS Mali presented the findings to PMI for further guidance and next steps.

## **ENTOMOLOGY**

In June, the project conducted baseline data collection. The monitoring of vector density, parity and behavior was conducted, along with collecting insecticide resistance data, in August and September. *An. gambiae* s.l was the prevalent vector and the density decreased after IRS. The intensity of resistance was heterogeneous among study areas and between the two insecticides tested, deltamethrin and permethrin.

Quality assurance tests conducted in two IRS-targeted districts showed that the quality of spraying was good and homogeneous, with mortality of 100%. One month after spraying, test mortality was 97.58% in Koulikoro and 98.36% in Baroueli, indicating a promising residual life of Actellic 300 CS at this period.

AIRS Mali continued working on the Combination LLIN Study, evaluating LLINs that incorporate piperonyl butoxide (PBO). The project completed bimonthly entomological and net fabric integrity data collection in April, June, and August. In August, AIRS Mali hired a new and well-qualified study lead.

## **CHALLENGES AND LESSONS LEARNED**

- During the 2015 IRS campaign, the project encountered several challenges in introducing mHealth initiatives, specifically daily reporting of data by SMS. The reasons included poor quality of phones procured at a local market, confusion of tasks and responsibilities during team leader and supervisor training, confusion regarding delivery receipt message, and incomplete confirmation of team leaders' phone numbers in the database. The team also experienced difficulties with maintaining sufficient phone credit. The project used one telecom provider, which had limited coverage of the geographical area, and as a result, seasonal workers subscribed to alternative providers were not able to receive the messages. In 2016, arrangements will be made to purchase and configure phones earlier in the preparation stage and ensure comprehensive training, including significant practical exercises for involved seasonal workers before the beginning of the IRS campaign.
- During this period, three senior AIRS Mali employees resigned: The M&E Manager, the Environmental Compliance Officer and the Accountant. The team recruited a new M&E Manager

and will recruit for a new ECO. With regard to the Accountant, AIRS Mali is conducting an internal reassignment of tasks and will not rehire for this position. This approach will contribute to the reduction of the budget in 2016.

- The company that has recycled OP bottles last year refused to do so this year. The team identified another company that meets the technical requirements for this job.

## **I.10 MOZAMBIQUE**

### **PROGRAM HIGHLIGHTS**

AIRS Mozambique went through a Chief of Party (COP) transition whereby Lourdes Loch assumed the program leadership from Cathy Clearance (on/about April 20, 2015). In May 2015, the MOH and PMI selected OPs for three PMI districts: Mocuba, Morrumbala, and Derre, which showed resistance to pyrethroids. The remaining districts for the 2015 spray campaign, including Milange, Molumbo, and Quelimane, would continue to spray with pyrethroids. Note that Milange and Morrumbala were each split into two districts in late 2014 by the Government of Mozambique. Derre was part of Morrumbala District and Molumbo was part of Milange District.

The realignment of activities due to budget constraints, because of the switch to OPs, reduced the scope of the enhanced surveillance activities from an original 24 health facilities to seven. The seven selected health facilities were chosen based on the history of IRS use in their districts and their pairing with the entomological monitoring sentinel sites in Milange, Mopeia (where CDC light traps will continue), Morrumbala, Molumbo, Maganja da Costa, and Quelimane. Quelimane was further prioritized to see if the additional support would positively impact the poor data quality across all HFs in that district.

Working in collaboration with the DPS and the NMCP, AIRS Mozambique focused on planning the 2015 spray campaign, ranging from micro-planning meetings at the provincial level to international and local procurements. AIRS Mozambique trained nearly 1,700 people, including spray operators, team leaders, mobilizer/helpers, supervisors, data entry clerks, database coordinators, M&A assistants, health technicians, spray pump technicians, washers, storekeepers, and guards.

### **ENTOMOLOGY**

- During this reporting period, the entomology team continued to conduct cone wall bioassays to assess the decay rate of insecticide sprayed on the walls during the 2014 campaign. This activity was conducted until June when mortality rates fell below 80 percent in all villages of each of the intervention districts of Mocuba, Milange, Morrumbala, and Mopeia. The residual effect of the insecticide remained active for about three months for deltamethrin from Tagros, and six to seven months for deltamethrin from Bayer.
- AIRS Mozambique continued PSC, CDC-light trap and HLC collections to assess mosquito density and biting rates and potential impact of IRS on vector density in four intervention sites. The density and biting rate of malaria vectors were also monitored in one control site.
- Susceptibility testing was carried out April-June by the NMCP through financial and material support from the PMI AIRS Project to monitor insecticide resistance in sentinel sites outside of Zambezia. The NMCP teams have also monitored insecticide decay rates and conducted PSCs to assess species composition and density. AIRS Mozambique is supporting the salary of two insectary technicians at the Maputo insectary, as well as three lab technicians at the Institute of Public Health in Maputo.

## 1.11 NIGERIA

### PROGRAM HIGHLIGHTS

The National Malaria Elimination Programme (NMEP) in collaboration with PMI held a National Entomology Review Meeting in Keffi, Nasarawa State with Principal Investigators from the six sentinel sites, to assess the state of malaria vector surveillance at the different sentinel sites in Nigeria.

Thirty participants attended the meeting, including entomology experts from the CDC, the PMI AIRS Project, NMEP and other partners, including the Malaria Consortium, National Arbovirus and Research Institute (NARI), the University of Keffi, and the Nigerian Institute of Medical Research. Six key recommendations were made to the Vector Control Working Group of the Federal MOH through the National Coordinator of NMEP for immediate implementation. These include:

- Establishment of a forum where major stakeholders (Federal Ministries of Agriculture, Environment, Water Resources and Housing, NAFDAC, Standard Organization of Nigeria (SON) and relevant research institutions) would discuss issues related to insecticide resistance;
- Development of an Insecticide Resistance Management (IRM) Plan based on data collected from the sentinel sites and other sources, for malaria vector control in Nigeria;
- Establishment of a centralized database for malaria vectors in Nigeria;
- Provision of standard entomology laboratories and strengthening human capacity for entomological surveillance in the sentinel sites; and
- Stratification of the country into eco-epidemiological zones to prioritize areas for better malaria vector control interventions.

### ENTOMOLOGY

- Between April and September 2015, the study teams used baited CDC light traps and PSC sampling methods to collect 10,599 *Anopheles* mosquitoes. Of this number, 5,800 (54.72%) were caught using the PSC method; 4,799 (45.28%) mosquitoes were caught using CDC light traps, with 2,899 (60.41%) caught indoors and 1,900 (39.59%) caught outdoors.
- This study has established the predominance of *An. gambiae* s.l. (in all sentinel sites compared to other *Anopheles* groups over a six-month period), which is in agreement with previous findings in similar locations. Important minor species such as *An. nili* and *An. moucheti* were observed. *An. nili* was more prevalent in Sokoto and Enugu, while *An. moucheti* was observed in the forest areas of Enugu State.
- The indoor resting density of the *Anopheles* mosquitoes was highest in Plateau State in the Guinea Savannah and Enugu State in the rainforest. The peak biting hours of the main malaria vector, *An. gambiae* s.l., varied with time across all the sentinel sites.

## 1.12 RWANDA

**TABLE 6: AIRS RWANDA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	4 districts (Gisagara, Nyagatare, Bugesera and Kirehe)
Insecticide	Carbamates
Number of structures targeted by PMI-supported IRS	220,114
Number of structures sprayed by PMI-supported IRS	215,981

Spray coverage	98.1%
Total population protected by PMI-supported IRS	Total: 889,326 Pregnant women: 14,375 Children under five: 132,568
Dates of PMI-supported IRS campaign	September 14 - October 10, 2015
Length of campaign	24 days
Number of people trained with USG funds to deliver IRS*	2,005

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## PROGRAM HIGHLIGHTS

AIRS Rwanda provided IRS technical and material support to the MOH's Malaria and Other Parasitic Diseases Division as they conducted IRS in four districts (Bugesera, Gisagara, Nyagatare, and Kirehe) in September 2015.

## ENTOMOLOGY

- Monthly WHO cone bioassay tests continued into April through July following the February 2015 IRS campaign. Average percentage mortalities dropped below 80% (77.5% and 70.5) four months post-spray in Gisagara and Nyagatare.
- During the September 2015 IRS campaign cone bioassays were conducted within the first week of spraying for quality assurance. Mortality rates of 100% for susceptible *An. gambiae* s.l. were recorded in all the test sites in the four sprayed districts.
- Vector density was generally higher in Kirehe District (control site) than the intervention sites (IRS districts). A new control site was established at Ngoma District (a non-IRS district), since Kirehe District was sprayed in the September IRS campaign.

## CHALLENGES AND LESSONS LEARNED

- SOPs did not record/mark all unsprayed structures mainly during the first week of spraying.
- There was inconsistent filing of checklists on mobile phones by supervisors. Not all of them filled the checklists out every day as expected.
- Absence of some households during the time of spraying because of farming, market days, work days, funerals and some refusals meant some structures could not be covered, even after mop-up.
- Some structures/rooms in structures were used for storage of harvested food and this limited their availability for spraying.
- Engagement of community health workers' supervisors at operational site level for IEC coordination in the sectors enhanced coordination of IRS activities at the community level.
- Building the capacity of local leaders (boot camp) by training them on all components of IRS operations enhanced their interest and ownership of the project activities.
- Engaging all relevant stakeholders in the recruitment of SOPs and other seasonal workers ensured that all SOPs were community health workers, and the stakeholders displayed more responsibility in their supervision.

Enhanced supervision by the AIRS staff, MOPDD, district and sector staff and regular feedback meetings were instrumental to the smooth implementation and high spray coverage recorded.

## I.13 SENEGAL

**TABLE 7: AIRS SENEGAL AT A GLANCE**

Number of districts covered by the PMI-supported IRS campaign	Four districts: Koumpentoum, Kounghoul, Malem Hoddar, and Nioro
Insecticide used	Organophosphates: 32,925 bottles Carbamates: 6,279 sachets
Number of structures found by spray operators	133,252
Number of structures sprayed by PMI-supported IRS	130,170
2015 IRS campaign spray coverage	97.7%
Population protected by 2015 IRS campaign	Total: 514,833 Pregnant women: 9,936 Children under five: 89,574
Number of people trained to deliver IRS with US Government funds*	893

Note: \*This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### PROGRAM HIGHLIGHTS

AIRS Senegal’s 2015 IRS campaign took place in two phases: the first phase sprayed OPs over 20 days between May 22 and June 14, 2015, and the second phase sprayed carbamates over 10 days September 5-14, 2015. Working in close collaboration with PMI/Senegal and several Senegalese government partners, the 2015 spray campaign covered a total of 97.7% of eligible structures in four districts (Koumpentoum, Kounghoul, Malem Hoddar, and Nioro) and protected 514,833 residents from malaria. The 2015 IRS campaign employed a revised technical strategy that sprayed structures only in “hot spot” health zones within the targeted districts (i.e. health posts with caseloads in excess of 15 cases per 1,000 residents) in order to concentrate the IRS intervention to residents living in those health posts identified as most at risk of malaria while conserving overall costs.

During the 2015 IRS campaign, AIRS Senegal enhanced quality of spray by introducing CFVs on all spray pumps to steady the flow of insecticide. To promote gender equity, AIRS Senegal involved women’s associations (“Badjénou gokh”) in all district meetings concerning IRS activities. AIRS Senegal expanded use of mobile technology through the continued use of the Dimagi-based SMS platform to collect and disseminate spray campaign data on a daily basis to PMI and local stakeholders. While ongoing epidemiological evaluations will help evaluate the efficacy of the revised “hot spot” technical strategy, AIRS Senegal improved the operational and cost efficiency of IRS operations through these and other new initiatives.

### ENTOMOLOGY

In Senegal, PMI through AIRS Senegal worked with Université Cheikh Anta Diop de Dakar (UCAD) to conduct entomological monitoring in the IRS target districts. The specific purpose of this reporting period’s entomological monitoring activities was to ensure sentinel sites are relevant to the focal IRS technical approach being implemented in Senegal. UCAD conducted cone bioassays tests two months after spraying using susceptible *An. gambiae* Kisumu strain in the four IRS districts (Koumpentoum, Malem Hoddar, Kounghoul, and Nioro). Results from Koumpentoum, Kounghoul, and Nioro showed good efficacy up to four months. Data collected five months post spraying from Koumpentoum, Kounghoul, and Malem Hoddar showed 84.4-89.4% test mortality rate, above the WHO 80% threshold.

## **I.14 TANZANIA**

### **PROGRAM HIGHLIGHTS**

AIRS Tanzania transitioned smoothly from the previous implementing contractor to Abt Associates. Home Office start-up trips were conducted in May and June 2015. Recruitment of staff commenced in May 2015 and remained on-going, with only a few key positions still outstanding by September. The F&A Manager and COP were fielded to post in July and August, respectively. Project offices and warehouses were established in Mwanza (central office), Bukoba, Musoma and Unguja, and all inventories were appropriately transferred to Abt.

In collaboration with the NMCP, the Zanzibar Malaria Elimination Program and PMI Tanzania, the 2016 spray regions were selected as Kagera, Mara, Mwanza and Geita on the mainland (Lake Zone) and high burden shehias in Unguja and Pemba for Zanzibar. The Public Private Partnership with Geita Gold Mine remains an integral part of the 2016 spray campaign in the mine catchment areas, targeting about 20,000 structures. The 2016 spray campaign has been determined as a mix of community-based (pilot) and district-based IRS approaches, targeting about 30,000 structures in Zanzibar and approximately 420,000 structures in the Lake Zone.

### **CHALLENGES**

- The hiring process during the start-up phase took longer than expected because the Tanzanian labor law required all staff to give one month notice before transitioning from their employers to the PMI AIRS Project.
- The government's introduction of a new VAT exemption policy in July 2015 resulted in some delay in clearing the first shipment of imported goods for project use.

## **I.15 ZAMBIA**

### **PROGRAM HIGHLIGHTS**

During the lead up to the spray campaign which began September 28th, the AIRS Zambia team conducted extensive pre-season activities and finalized all staffing. Twenty district coordinators (DCs) were recruited and hired to improve the quality of AIRS supervision of the 2015 spray campaign. To ensure DCs had the knowledge and skills needed, they attended a week-long orientation in Lusaka before they were assigned to their districts. Evelyne Alyko, AIRS Benin's Technical Manager and Entomologist, relocated to Zambia to serve as lead entomologist.

The AIRS team coordinated closely with Zambia government staff to create the spray schedule, pre-season assessments, and to emphasize the need to improve the quality of IRS implementation in 2015. Geographical reconnaissance and district level planning were conducted. All operational sites were assessed and improvements were made, if needed, including ensuring that soak pits were ready to use before the campaign began. The ODK smartphone platform was used to conduct the pre-season assessments, and will also be used during the campaign to assess the quality of environmental and operational performance during the campaign.

AIRS finalized subcontracts with partners Akros, Dimagi, and Encompass. Zambia was selected to receive the Encompass training in 2015 since they have extensive government involvement in the implementation of IRS. The training occurred from June 29 - July 6. Eighty-nine participants attended, including 40 IRS Managers, 10 Master Trainers, 18 AIRS DCs, 10 AIRS staff from the Lusaka office, six NMCP staff and five Provincial Environmental Health Officers.

With input from AIRS and district teams, Akros updated their IRS maps in the seven districts to make them more operationally friendly. In 2015, mSpray will be implemented in the same seven districts. Finally, Dimagi prepared for the roll out of their performance management tool, which sends out daily spray performance data to key supervisors to help them manage the progress of the campaign.

## **ENTOMOLOGY**

- Entomological surveys were conducted in six districts in Zambia in April, May, June and August.
- Treatment and control sites were compared on a monthly basis. The average vector densities in the treatment sites were lower compared to the control sites, except in Milenge and Mwense districts where the average density was high in both treatment and control sites.
- WHO cone bioassay tests were conducted in April, May, and July 2015 to estimate the residual efficacy of sprayed insecticide, Actellic 300 CS. The average percentage mortality (24 hrs) five months after spraying was still over the 80% threshold in all districts except in Milenge District, where the mortality was below 80% for both mud and cement walls, and in Serenje and Mwense districts, where the mortality was less than 80% for the mud treated walls. Eight months after the spraying, the mortality was over 80% for mud treated walls in Katete District.

## **CHALLENGES AND LESSONS LEARNED**

- Since Zambia is such a large spray program, the team conducted pre-season activities well in advance, improving the team's quality of preparations. This is recommended for subsequent years.
- The coordination and setup of new mHealth activities requires more time than planned, and preparations should start earlier next year.
- Although insecticide was ordered on time, the replacement batch of insecticide was delivered during the spray campaign. Fortunately, AIRS Zambia had adequate insecticide to begin the campaign.
- AIRS Zambia worked with the Zambia Environmental Management Agency (ZEMA) to investigate the company that recycled empty Actellic bottles in 2014. ZEMA received proof that the work was completed. AIRS Zambia will work with a new company in 2015 to ensure that the bottles are recycled with a company that is registered by the South African Environmental Agency and the work is completed on time and in scope.

## **1.16 ZIMBABWE**

### **PROGRAM HIGHLIGHTS**

AIRS Zimbabwe completed timely logistics preparations, procurement and training for the 2015 campaign, which was scheduled to start on October 11, 2015. Pre-IRS Environmental Assessments were carried out at 23 IRS camp sites proposed for use in the 2015 IRS season. The team repaired defects identified during assessments. Lorries hired for spray operations were pre-inspected and certified for use well before the campaign start. The team obtained a timely PMI approval for the Letter Report to ensure environmental compliance and readiness for the campaign.

Special efforts were made to work with the local leaders in wards that had high refusal/locked rates during the 2014 campaign. This included increased and focused community meetings being organized with/through the ward leaders, and asking village chiefs to assign volunteers to walk spray operators from house to house.

AIRS Zimbabwe continued to collaborate with NMCP and other PMI partners such as Population Services International regarding IRS campaign messages, materials, and malaria prevention

communication activities. It included evaluation of “roadshow” messages for the two drama groups that worked in the four districts before the start of the campaign.

During the reporting period, AIRS Zimbabwe produced a report on a Beneficiary Satisfaction Assessment carried out in February 2015. The project also obtained access to the DHIS 2 data to conduct an assessment of the association between use of OPs for IRS and confirmed malaria cases at health facilities in four districts in Manicaland Province. A report with preliminary results was submitted to PMI for feedback and review. The team together with the PMI AIRS gender specialist developed a Gender Norms Study protocol that was approved by the Medical Research Council of Zimbabwe in time for implementation at the beginning of the 2015 IRS campaign.

## **ENTOMOLOGY**

- During the reporting period, AIRS Zimbabwe continued monthly entomological monitoring using PSC and CDC light trap collections in three sites in Manicaland, with exception of July. Two of the sites (Burma Valley and Chakohwa) are supported by PMI IRS programming and sprayed with pirimiphos-methyl while the third site is in an unsprayed control site.
- The team completed bioassay tests in May and June at Burma Valley and Chakohwa, respectively. The insecticide demonstrated residual effectiveness at four months in Burma Valley and at five months in Chakohwa before it fell below 80 percent for two consecutive months.
- AIRS also collected data on vector densities and behavior at four sentinel sites outside Manicaland, namely, Kamhororo (Gokwe South District), Chilonga (Chiredzi District), Old Mazowe Bridge (Rushinga District) and Manjolo (Binga District) in August and September.
- Refresher training of Mosquito Collectors was completed at Kamhororo in August. The susceptibility to pirimiphos-methyl of *An. gambiae* s.l. from Masakadza was established in August. These mosquitoes will be used to perform cone bioassay tests to assess insecticide decay rate at Burma Valley and Chakohwa once IRS starts in October 2015.
- The project is working to expand entomological work in response to requests from the NMCP and PMI to increase entomological data collection on a larger geographic scale to enable the NMCP to make evidence-based decisions for malaria vector control in different ecological regions. Recruitment of the Entomological Data Base Officer, as well the National Entomological Officer to be seconded to NMCP, was initiated.

## **CHALLENGES AND LESSONS LEARNED**

- The project continues to face challenges with getting mosquito specimens analyzed in a timely manner by the National Institute of Health Research. As a result, AIRS Zimbabwe is exploring options to have specimens sent to Africa University, laboratories in South Africa, or elsewhere.
- The Ministry of Health and Child Care continues to be highly sensitive about releasing health data. This resulted in delays in obtaining DHIS2 data for the OP assessment exercise, which was meant to be completed during this reporting period.
- AIRS Zimbabwe has experienced challenges in finding a suitable local candidate for the position of the Entomological Officer who is to be seconded to the NMCP to further strengthen national entomological surveillance.
- Several inconclusive consultations were held among NMCP, Environmental Management Authority and Ministry of Agriculture to explore options for disposal of the 12,000 bottles of OPs leftover from the 2014 campaign. The team continues looking for options.

## 2. CORE SECTION

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### 2.1 CAPACITY BUILDING

AIRS is working with EnCompass to develop a comprehensive training curriculum for IRS. In July 2015, pilots were conducted in Zambia and Rwanda at the national and district levels, and Facilitative Skills Training Modules of the draft curriculum were also conducted. Participants included AIRS staff, national level stakeholders, and district level officials. In Zambia, the training was attended by nine and 74 participants from the national and district levels, respectively. Forty participants attended the Facilitation Skills Training in Zambia. In Rwanda, the training was attended by 15 and 38 participants from the national and district levels, respectively, and there were 18 participants in the Facilitation Skills training. Overall, participants responded well to the trainings. Initial participant feedback indicates the trainees gained knowledge and skills. Detailed curriculum revisions are being made based on feedback from the participants, and on post-training reviews. The AIRS Operations Director Allan Were and Ms. Ann Miceli from EnCompass facilitated the trainings. Detailed activity reports of the trainings were submitted to the COR team.

### 2.2 VECTOR CONTROL WORKING GROUP

As an active member and co-chair of the Capacity Building for IRS Work Stream of the Vector Control Working Group, the PMI AIRS Project is working with Konstantina Boutsika on the re-development of their webpage on IRS. AIRS re-organized and created new content for the webpage, received feedback from the other co-chair, and will work with Konstantina to upload the information.

### 2.3 OPERATIONAL RESEARCH

Up to now program decisions on vector control strategies have been made on the basis of insecticide resistance as measured by frequency of mortality at diagnostic doses of insecticides, and pyrethroid resistance based on this definition is now widespread. However, control failure, the practical expression of resistance significance, may depend far more upon resistance intensity. AIRS Zambia is supporting the implementation of an operational research study which will examine the effect of resistance intensity on control failure. Baseline data collection for the OR study sites selection was performed in September. Two transects were assessed, one for *Anopheles funestus* s.l. in Milenge District and another one for *Anopheles gambiae* s.l. in Mwense. *Anopheles funestus* s.l. was resistant to deltamethrin at all selected sites in Milenge (except Nsomfwa) and Mwense districts. A difference was also observed between the sites in the intensity of insecticide resistance. Despite the different level of intensity for deltamethrin resistance observed in Mwema-Musongo and Libwete in Milenge District, *Anopheles funestus* s.l. collected from these sites was fully susceptible to permethrin. The resistance within pyrethroid class may be selected independently. *Anopheles funestus* s.l. was also susceptible to bendiocarb in the area. Only two *Anopheles gambiae* s.l. were collected from Mwense. Additional collections will be performed during the rainy season for the *Anopheles gambiae* transect.

### 2.4 WEST AFRICA RESIDUAL LIFE ASSESSMENT

In order to understand why there is a variation in the residual life of insecticides in AIRS countries in West Africa, AIRS is collecting background information on factors that could influence the residual life. This information is currently being collected in Ghana, Senegal, and Mali. Collection has already been

completed for Benin. Soil samples will also be analyzed from each country. Once the collection is completed in each country, all of the data will be analyzed to see if there are any trends.

## 2.5 EPIDEMIOLOGICAL SURVEILLANCE

During this reporting period, the project carried out the epidemiological surveillance work described in the country work plans. Below is a summary of the epidemiological work completed per country.

- Benin: AIRS continued its collaboration with the World Bank's Performance-Based Financing project which collects health facility level data from clinics and hospitals in Kerou, Pehunco, and Kouande (spray areas) and Banikoara (located in Alibori, a bordering comparison district) in north Benin. The team received the first set of data and has begun analysis.
- Madagascar: In the East, AIRS Madagascar worked with the PASSOBA HSS Project to collect data from our three IRS districts and two comparison districts: Soanierana-Ivongo and Vavatenina. A final version of the analysis of malaria data for September 2014 through February 2015 was submitted in June. It is hard to draw conclusions with the data since there was a region-wide RDT stock out and the reported malaria incidence was higher than the supposed actual malaria incidence.
- Mali: In August 2015, AIRS Mali carried out a health facility data quality assessment in Koulikoro district. The objectives of the data quality assessment were to rank the health facilities based on perceived data quality for use in possible epidemiological analyses and determine which, if any, facilities capture data that is of high enough quality to use for IRS-related epidemiological analysis. The final report was submitted in September 2015. Unfortunately, the audit concluded that the data were not of high enough quality to allow for an impact assessment. Going forward, data quality assessments will not be carried out in the other districts. Instead, AIRS Mali will support epidemiological trend analysis of malaria incidence in children under five in Bla, Baraoueli, and Koulikoro for 2013 through 2015.
- Mozambique: The epidemiological surveillance work that began under TO4 was continued under TO6. AIRS Mozambique submitted their Enhanced Surveillance Semi-Annual Report. The final version of this report presented malaria data from 2013 through May 2015. The results showed the same trend as in previous years.
- Senegal: Collection of health facility data began via the HMIS system. The plan is to now use that data to conduct an analysis about the efficacy of "hot-spot" spraying versus blanket spraying.
- Zimbabwe: In September, AIRS submitted a preliminary epidemiological analysis of the IRS insecticide change, in select districts, from pyrethroids (or DDT) to OPs in 2015. The analysis showed a statistically significant decrease in malaria incidence in all spray districts between 2014 and 2015 with the largest drop in the PMI IRS districts that made the switch from PYs to OPs.

## 2.6 ENVIRONMENTAL COMPLIANCE

During this reporting period, PMI AIRS Project environmental personnel prepared and completed SEAs for Ethiopia, Senegal, and Zambia. To increase in-country capacity, the Ethiopian and Zambia SEAs were the first SEAs of which the first draft was prepared by the in-country Environmental Compliance Officers (ECO). The Environmental Compliance Coordinator traveled to Zambia to assist with the development of that SEA. Letter Reports for Benin, Madagascar, Mali, Rwanda, and Zimbabwe were prepared and submitted on time.

The Director of Environmental Compliance and Safety traveled to Tanzania for the preparation of an updated SEA, and made arrangements for the preparation of Environmental Impact Assessments for the Tanzanian and Zanzibar governments. The 1st, 2nd, and 3rd drafts of the SEA were submitted during

that time period. In addition, EC personnel continued working on and submitted a final draft for the Mozambique SEA, and continued to develop templates for standardization of SEA sections.

Also in this time period, AIRS executed a biomonitoring pilot program in Ghana and submitted 1st and 2nd drafts of the report. The project worked with country ECOs to integrate Environmental Mitigation and Monitoring Reports (EMMR) into country EOSRs, and reviewed, edited and submitted EOSR sections for Benin, Ghana, Mali, and Senegal, which incorporated the EMMR.

The project worked with Dimagi to integrate supervisory reports into the Commcare system and to produce user-friendly reports. Between April and September 2015, 5,466 mid-spray inspection reports were conducted with smartphones and submitted to the Commcare server from five countries.

Work continued on extending the use of mobile soak pits (MSP) in Madagascar, Mali, and Senegal. Meanwhile, performance testing of the MSP using Actellic CS was completed, and testing with bendiocarb began. It was necessary to terminate testing at Abt's Cambridge facility, so the work was contracted out to the Massachusetts Pesticide Analysis Laboratory, the same organization that had been analyzing the samples prepared by Abt personnel.

Finally, the project advanced the Ethiopia DDT re-packaging and collection project. AIRS signed contracts with Veolia Field Services (for transportation and destruction) and Mabbett and Associates (for training). AIRS and Veolia worked with the Ethiopian Ministries of Health and Environment to initiate the export notification process, and established a schedule for performance of the project. AIRS developed the training curriculum and materials, purchased generators, vacuum cleaners, PPE, and the needed supplies for execution of the activity.

## 2.7 COST EFFICIENCY

AIRS implemented a series of cost efficiency initiatives in several countries. The impact of these initiatives was observed mostly on an operational level. Actions taken by individual countries included:

- Downsizing staffing by combining two positions into one (e.g., employee handling both the procurement and logistics functions);
- Transitioning ownership of mobilization from the project to the local government;
- Decreasing the number of mobilizers;
- Staggering spray starts each day to reduce vehicle rental;
- Reducing training days and spray campaign days;
- Negotiating lower costs with local suppliers;
- Sharing offices when feasible with other Abt projects in-country;
- Using government help with incineration and recycling;
- Increasing the number of structures per SOP and paying a fixed price per SOP versus paying per structure sprayed. If the target number is not reached, the SOP will not be paid in full;
- Reproducing in-house most of the items that were outsourced last year to printing companies;
- Reducing the number of printed manuals & IEC tools by using the previous year's documents.

Emphasis has now been placed on cost reduction initiatives to reduce the overall (net) budget.

## 2.8 M&E TRAINING (JUNE 2015)

Each country employs an M&E manager and a database manager (where applicable) who are responsible for tracking campaign preparation and implementation. The PMI AIRS Project's home office M&E team held a three-day training in Ghana for these staff to discuss project-wide competencies, responsibilities, and goals for M&E teams before, during, and after IRS campaigns. Three AIRS M&E Specialists (Jennifer Burnett, Keith Mangam, Ashley Thomas), AIRS Project Assistant, Pamela Dasher, and Senior Software Support Specialist/Trainer, Jeanne Goodman, led the AIRS M&E Training in Accra, Ghana, June 10-12<sup>th</sup>. A total of 19 participants representing nine IRS countries attended the training. Training topics included roles and responsibilities of M&E staff, M&E systems and tools, and successful innovations implemented during campaigns, among others. Presentations were led by the Home Office team and country representatives, and discussions among participants were robust and fruitful. At the conclusion of the training, participants reported a greater understanding of the overall goal of M&E, the importance of data quality assurance, and lessons learned from implementation of IRS campaigns in other countries.

## 2.9 ENTOMOLOGY TRAINING

In year one of TO6 implementation 36 participants from 17 countries were successfully trained on essential aspects of malaria entomology. The training was conducted in two locations, Ghana and Ethiopia. The first training in Adama, Ethiopia, took place July 6-10, 2015. The second was conducted July 13-17 in Ghana. Forty participants were trained.

Topics covered during this training included:

- the role of entomological monitoring in malaria vector control
- purpose and methods of mosquito sampling
- morphological identification of malaria vectors
- insecticide resistance monitoring and approaches to resistance management
- insecticide resistance intensity
- use of CDC bottle bioassay with synergists to assess the involvement of metabolic resistance mechanism
- WHO cone bioassay testing
- preserving and shipping mosquito samples
- PMI entomological indicators and
- AIRS entomology data collection formats, analysis and interpretation of entomological data.

The training involved presentations by Dr. William G. Brogdon, Dr. Aklilu Seyoum, Dr. Laura Norris, Dr. Christen Fornadel, and Mr. Dereje Dengela, and were followed by practical exercise.

To assess the impact of this training, pre- and post-tests were given to the participants of the Ethiopia training (Table 8). The pre- and post-test results clearly indicated that participants gained knowledge from the training. The mean test result increased from 78.2% pre-test to 92.1% post-test. The standard deviation was higher during the pre-test compared to post-test. The post-test result was significantly higher than the pre-test ( $p < 0.001$ ).

The participants also acquired hands-on experience in entomological monitoring in efforts to further improve the quality of entomological data collected and strengthen working relationships between the project and NMCP entomologists.

**TABLE 8: PRE AND POST-TEST RESULTS.**

Variable	No of participants that took the test	Mean	Min	Max	Std. Dev.	Std. Err.	95% CI	P-value
Pre-test	14	78.21	60	95	10.69	2.86	72.04-83.38	<0.001
Post- test	14	92.07	76	99	6.55	1.75	88.29-95.85	

## 2.10 FILTER PAPER STUDY

A study was conducted to assess variations in the quantity of insecticides absorbed by filter papers in experimental huts through a sub-contract to the Nigerian Institute of Medical Research. The study was conducted in experimental huts located at the field site of Kanji, New Bussa, Nigeria. Filter papers were taped to the walls, pinned flush against the wall, and pinned without touching the wall. The insecticides sprayed were alpha-cypermethrin, bendiocarb, deltamethrin and chlorfenapyr. The filter papers sprayed with insecticides were sent to CRA-W, BASF and CDC laboratories for processing.

## 2.11 SEQUENCING OF MOSQUITO SAMPLES

Mosquito samples were sent from Liberia, DRC and Ghana to the University of Notre Dame, USA for advanced molecular analysis (sequencing). Out of a total of 150 samples of *An. gambiae* s.l. from Liberia, 145 were identified as *An. gambiae* s.s. and the remaining as *An. coluzzii*. All the 36 samples of *An. paludis* were identified as three unknown species in the *An. coustani* group (*An. paludis* also belongs to the *An. coustani* group). The three unknown species are temporarily designated as unknown 1 (27 samples), unknown 2 (6 samples) and unknown 3 (3 samples). The sequence of *An. paludis* is not available in the database (GenBank). It is possible that one of the species designated as unknown could be *An. paludis*. *Anopheles paludis* could also be a member of a cryptic species complex.

## 2.12 GENDER

During the past six months, the PMI AIRS Project gathered data on how the project is changing gender norms in three of the four study countries: Ethiopia, Madagascar, and Rwanda. These country teams randomly selected operational sites where all the seasonal workers took a survey that measured gender norms both before the spray campaign and at the end of the campaign to capture any change in gender norms. In Ethiopia, no change in gender norms was found. In Madagascar and Rwanda there was a small, but statistically significant, increase in gender equality as measured by the gender norms scale.

AIRS Ethiopia conducted a qualitative study to better understand income use and perception of income earned by women on the project. In-depth interviews with a sub-set of women, and their spouses or heads of households, were also conducted to better understand the intra-household decision making. Data was collected once during the spray campaign to provide an understanding of how women accessed and used their income and how it varied by age, marriage status, education level, or IRS program specific factors.

The AIRS Gender Technical Working Group continued to support countries implementing these new project objectives and presented the approach to USAID's Global Health Division on May 14th.

## 2.13 MHEALTH

During the reporting period, the PMI AIRS Project rolled out three mobile technology-based tools to seven country programs, with the exception of the Job Aid tool in Mali. Two of the tools transitioned from pilots to project-wide implementation: the Performance Management Tracker (PMT) and the SMS-based Job Aids for Spray Operations. The third technological upgrade was using a smartphone-based supervisory application to upload data to a new cloud-based platform that can be used for storing and reporting and creating a user-friendly template for summary reports. These summary reports provided the results of the supervisory inspections conducted by both government supervisors and project staff to inform real-time decision-making. Dimagi, a small technology firm based in Cambridge, Massachusetts, and a partner on the PMI AIRS Project, led the on-the-ground introduction of the tools. Dimagi also worked on modifications and improvements identified during roll-outs in the first group of countries (Senegal and Mali) that sprayed earlier in the year.

In Ghana, Benin and Mozambique, the project relied on Abt's Center for Technology Communications instead of Dimagi to implement these tools. In the case of Benin and Ghana, which spray early in the year, Dimagi required additional time to finish the design stage of the tools and do the tests. For Mozambique, the decision to continue with Abt internal technology support was driven by the country program budget limitations.

During the reporting period, technology partner Akros began implementing an mSpray system in Madagascar and Zambia. It is a cloud-based data recording and management system that allows spray personnel to electronically collect spray data and GPS coordinates by mobile phone or tablet. Additional information is included in Section 1.15 in Zambia Highlights.

Four countries continued using mobile money as a payment mechanism and two more countries introduced this form of payment during the reporting period.

## 2.14 NEW EMPLOYEES

Ashley Thomas, Monitoring and Evaluation Specialist, provides support to the AIRS M&E teams in Ethiopia, Mozambique, and Zimbabwe. She supports the mHealth Technical Working Group with managing the subcontractor, Dimagi, and provides guidance on the implementation of mobile pilots in several countries.

Senior Finance and Contract Analyst Marina Nado supports country programs in Burundi, DRC and Zambia. Junior Finance and Contract Analyst James Rawls III provides support to the AIRS Finance and Contract Management teams in Ethiopia, Kenya, and Tanzania.

## 2.15 CONFERENCES

The PMI AIRS Project held its annual COP retreat in Baltimore, June 5-7. Nearly 38 project staff, including 12 COPs, and the PMI COR team, attended the retreat, which addressed cross-cutting issues, such as public-private partnerships, gender integration, and cost-efficiency. Prior to the Project retreat, COPs attended Abt's Annual COP Conference, June 1-4. A key theme of the conference was turning evidence to action to impact. Eleven COPs also attended a full-day High Impact Presentation training.

## 2.16 COMMUNICATIONS

The PMI AIRS Project website ([www.africaairs.net](http://www.africaairs.net)) received 65,242 website visits from April 1-September 30, 2015, maintaining approximately the same rate of site visits as the previous six months.

During this period, five success stories were written, posted on the project and PMI websites, shared on Abt Associates' Facebook page and the AIRS Twitter feed, and distributed via the AIRS quarterly e-letter. AIRS distributed two e-letters (in June and September) to more than 3,700 global health professionals. One infographic was developed for use on social media and was produced as a bookmark that has been distributed to field offices and at conferences.

Two PMI AIRS Project Malaria Fighter profiles were developed and shared widely through social media, and PMI, AIRS, and Abt websites.

The video *Saving Lives in Madagascar* was approved and released widely on the Abt website, the project website, via social media and an e-alert, and with USAID missions. Bi-monthly Tech Talks continued with the COPs to encourage peer-to-peer exchange across the project. Topics included: mHealth lessons learned, UNITAID, and household preparations and quality of spray.

As a part of World Malaria Day (WMD) 2015, the PMI AIRS Project commemorated the day with US Embassies, USAID Missions, NMCPs, and other malaria prevention partners. In Nigeria, the project exhibited at the US Embassy's World Malaria Day Commemoration and in Zimbabwe, the project hosted a commemorative event at USAID Zimbabwe. The project was featured on the Abt Associates website, and participated in the #DefeatMalaria Twitter campaign.

## 2.17 JOURNAL PUBLICATIONS

Five manuscripts were submitted to and/or approved by PMI during this reporting period. One previously approved manuscript was published by the *Malaria Journal*. Manuscripts include:

- Mobile Water Treatment Device Improves Spray Team Productivity and Environmental Compliance of Malaria Control Program – will be submitted November/early December;
- Feasibility and Efficacy of mHealth: A Case Study of Mobile Messaging in Mali – approved;
- Multi-Country Assessment of Residual Bio-efficacy of Insecticides Used for Indoor Residual Spraying in Malaria Control on Different Surface Types: Results from Program Monitoring in 15 PMI/USAID supported IRS Countries –approved/submitted to *Malaria Journal*;
- mHealth Matters: People, Money & Performance: Case Studies from Africa – white paper submitted
- Cost of malaria control in Ethiopia: Comparing community-based indoor residual spraying to district-based indoor residual spraying – submitted;
- The effect of different wall surfaces and spray water pH on the decay rate of carbamates – expected resubmission to *Parasites and Vectors*;
- Characterizing *Anopheles gambiae* s.l. insecticide resistance in Mali – published in *Malaria Journal* in August 2015.

# ANNEX A: INSECTICIDE AND EQUIPMENT PROCUREMENT

Commodity	Country	Description	Total Cost	Order/PO Date	Delivery Date
Insecticides	Madagascar	Organophosphates	\$945,969.96	5/20/2015	Sept, 2015
Insecticides	Rwanda	Carbamates	\$1,670,508.86	6/30/2015	Sept, 2015
Insecticides	Mozambique	Organophosphates	\$4,557,833.28	5/20/2015	Oct, 2015
Insecticides	Tanzania	Organophosphates	\$3,570,048.00	8/11/2015	*Pending*
Insecticides	Tanzania	Organophosphates	\$1,319,194.58	9/28/2015	*Pending*
Insecticides	Tanzania	Organophosphates	\$91,675.00	*Pending*	*Pending*
Insecticides	Zimbabwe	Organophosphates	\$1,520,050.51	5/20/2015	Sept, 2015
Goizper Sprayers	Zimbabwe	Spare Parts kit	\$1,046.28	8/11/2015	Sept, 2015
Goizper Sprayers	Senegal	Spare Parts	\$792.55	4/28/2015	May, 2015
Micron	Rwanda	CFV's & Nozzles	\$10,125.00	7/16/2015	Sept, 2015
Micron	Madagascar	CFV's & Nozzles	\$2,085.55	7/9/2015	Aug, 2015
Micron	Zambia	CFV's & Nozzles	\$14,752.28	7/8/2015	Sept, 2015
Micron	Zimbabwe	CFV's & Nozzles	\$3,759.25	7/8/2015	Sept, 2015
Micron	Mozambique	CFV's & Nozzles	\$20,762.40	7/8/2015	Aug, 2015
Micron	Ghana	CFV's & Nozzles	\$2,020.45	5/17/2015	June, 2015
Hudson Sprayers & Parts	Rwanda	Sprayers & Spare Parts	\$69,118.80	5/7/2015	June, 2015
Hudson Sprayers & Parts	Mozambique	Sprayers & Spare Parts	\$18,992.82	6/1/2015	June, 2015
Hudson Sprayers & Parts	Zambia	Sprayers & Spare Parts	\$120,452.80	6/1/2015	June, 2015
Hudson Sprayers & Parts	Zimbabwe	Sprayers & Spare Parts	\$26,406.96	7/8/2015	July, 2015
Personal Protective Equipment	Ethiopia	DDT Removal Supplies	\$10,451.96	9/8/2015	Sept, 2015
Personal Protective Equipment	Senegal	PPE Supplies	\$2,444.99	4/29/2015	May, 2015
Personal Protective Equipment	Rwanda	PPE Supplies	\$67,846.80	4/30/2015	May, 2015
Personal Protective Equipment	Mozambique	PPE Supplies	\$31,530.80	5/11/2015	May – June, 2015
Personal Protective Equipment	Zambia	PPE Supplies	\$25,722.40	5/28/2015	June, 2015
Personal Protective Equipment	Benin	PPE Supplies	\$5,634.80	6/23/2015	June, 2015
Personal Protective Equipment	Mali	PPE Supplies	\$11,186.40	6/23/2015	June, 2015
Personal Protective Equipment	Madagascar	PPE Supplies	\$14,590.00	6/23/2015	June, 2015

<b>Commodity</b>	<b>Country</b>	<b>Description</b>	<b>Total Cost</b>	<b>Order/PO Date</b>	<b>Delivery Date</b>
Equipment					
Personal Protective Equipment	Zimbabwe	PPE Supplies	\$11,788.20	6/23/2015	June, 2015
Entomology Supplies	Burundi	Entomology Monitoring Supplies	\$12,593.85	May, 2015	June, 2015
Entomology Supplies	Burundi	Impregnated Papers	\$3,676.00	May, 2015	June, 2015
Entomology Supplies	DRC	Entomology Monitoring Lab Supplies	\$4,053.42	April, 2015	May, 2015
Entomology Supplies	Ethiopia	Entomology Monitoring Lab Supplies	\$6,039.71	May, 2015	June, 2015
Entomology Supplies	Ghana	Entomology Monitoring Supplies	\$11,880.00	May, 2015	May, 2015
Entomology Supplies	Ghana	Entomology Monitoring Lab Supplies	\$5,263.11	May, 2015	June, 2015
Entomology Supplies	Liberia	Entomology Monitoring Supplies	\$3,591.84	April, 2015	April, 2015
Entomology Supplies	Liberia	Entomology Monitoring Supplies	\$2,014.73	Sept, 2015	Oct, 2015
Entomology Supplies	Liberia	Impregnated Papers	\$1,350.00	April, 2015	June, 2015
Entomology Supplies	Mali	Entomology Monitoring Lab Supplies	\$514.99	April, 2015	April, 2015
Entomology Supplies	Mozambique	Entomology Monitoring Supplies	\$1,249.20	August, 2015	Sept, 2015
Entomology Supplies	Mozambique	Entomology Monitoring Supplies	\$1,442.41	August, 2015	Sept, 2015
Entomology Supplies	Mozambique	Impregnated Papers	\$4,095.00	August, 2015	Oct, 2015
Entomology Supplies	Rwanda	Entomology Monitoring Supplies	\$844.95	Sept, 2015	Sept, 2015
Entomology Supplies	Senegal	Entomology Monitoring Supplies	\$873.31	Sept, 2015	Sept, 2015
Entomology Supplies	Zambia	Entomology Monitoring Supplies	\$8,450.00	Aug, 2015	Sept, 2015
Entomology Supplies	Zambia	Entomology Monitoring Supplies	\$8,949.00	Aug, 2015	Sept, 2015
Entomology Supplies	Zambia	Impregnated Papers	\$1,832.00	Aug, 2015	Sept, 2015
Entomology Supplies	Zambia	Entomology Monitoring Supplies	\$4,093.70	Sept, 2015	Sept, 2015
Entomology Supplies	Zimbabwe	Entomology Monitoring Lab Supplies	\$8,778.92	June, 2015	Oct, 2015
Entomology Supplies	Zimbabwe	Entomology Monitoring Supplies	\$31,850.88	June, 2015	June, 2015
Entomology Supplies	Zimbabwe	Impregnated Papers	\$1,717.20	May, 2015	June, 2015



# ANNEX B:

## IRS RESULTS SUMMARY

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**TABLE 9: IRS RESULTS APRIL 2015 – SEPTEMBER 2015**

Country	# Structures Sprayed	Spray Coverage	Total Population Protected	Children Under Five Protected	Pregnant Women Protected	# People Trained*
Benin	252,706	93.5%	802,597	156,863	30,454	1,500
Ethiopia**	704,945	99.5%	1,655,997	230,366	23,084	2,845
Ghana	205,935	91.7%	553,954	98,525	11,676	698
Madagascar**	247,902	92.2%	1,016,841	147,682	36,241	1,319
Mali**	133,527	98.2%	494,205	87,861	13,219	582
Rwanda, Sept**	215,981	98.1%	889,326	132,568	14,375	2,005
Senegal**	130,170	97.7%	514,833	89,574	9,936	893
<b>AIRS TOTAL</b>	<b>1,891,166</b>	<b>96.4%</b>	<b>5,927,753</b>	<b>943,439</b>	<b>138,985</b>	<b>9,842</b>

\*Includes spray staff (e.g., spray operators, team leaders, supervisors, clinicians) only. Excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

\*\*Data validated and final, but EOSR not yet approved.