



U.S. PRESIDENT'S MALARIA INITIATIVE



# THE PMI VECTORLINK PROJECT ANNUAL REPORT

OCTOBER 1, 2018 – SEPTEMBER 30, 2019

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# ACRONYMS

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<b>AGAMal</b>	AngloGold Ashanti Malaria Control Limited
<b>AIRS</b>	Africa Indoor Residual Spraying
<b>BAO</b>	BAO Systems
<b>CDC</b>	U.S. Centers for Disease Control and Prevention
<b>COP</b>	Chief of Party
<b>CS</b>	Capsule Suspension
<b>DDT</b>	Dichlorodiphenyltrichloroethane
<b>DFID</b>	Department for International Development UK
<b>DHIS2</b>	District Health Information Software 2
<b>ELISA</b>	Enzyme-linked immunosorbent assay
<b>IEC</b>	Information, Education, and Communication
<b>IRS</b>	Indoor Residual Spraying
<b>INRB</b>	National Institute of Biomedical Research
<b>IRM</b>	Insecticide Resistance Management
<b>ITN</b>	Insecticide-treated Nets
<b>MAC</b>	Malaria Alert Centre
<b>MOH</b>	Ministry of Health
<b>MOPDD</b>	Malaria and Other Parasitic Diseases Division
<b>M&amp;E</b>	Monitoring and Evaluation
<b>NgenIRS</b>	Next Generation Indoor Residual Spray
<b>NMCP</b>	National Malaria Control Program
<b>NMEP</b>	National Malaria Elimination Program
<b>PAMCA</b>	Pan African Mosquito Control Association
<b>PBO</b>	Piperonyl-butoxide
<b>PMI</b>	President's Malaria Initiative
<b>PSI</b>	Population Services International
<b>SEA</b>	Supplemental Environmental Assessment
<b>SOP</b>	Spray Operator
<b>STTA</b>	Short-Term Technical Assistance
<b>USG</b>	U.S Government
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization
<b>VL</b>	VectorLink
<b>VLX</b>	Vector Learning <i>Xchange</i>
<b>ZAMEP</b>	Zanzibar Malaria Elimination Program

# EXECUTIVE SUMMARY

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The U.S. President's Malaria Initiative (PMI) VectorLink (VL) Project is funded by the United States Agency for International Development (USAID), through PMI, and was awarded to Abt Associates on September 30, 2017. The PMI VL Project builds on the indoor residual spraying (IRS) campaigns and entomological monitoring activities implemented under the predecessor PMI Africa Indoor Residual Spraying (AIRS) Project. New scopes of work under PMI VL include a variety of activities to support insecticide-treated nets (ITNs) in many countries in addition to IRS under a broader vector control mandate. In addition, new data analytics and data visualization are being used to support vector control decisions and measure their impact. These activities are being supported by Abt's core subcontract partners Population Services International (PSI) and PATH. Other technical sub-contractors include BAO Systems (supporting VectorLink Collect, a new VL monitoring and evaluation (M&E) platform based on District Health Information Software 2 (DHIS2), Dimagi Inc. (supporting IRS supervision and reporting tools), and the Malaria Consortium (supporting National Malaria Control Programs (NMCPs) to develop Insecticide Resistance Management Plans and an integrated VC strategic framework).

During this reporting period (Oct. 1, 2018 – Sept. 30, 2019), PMI VL conducted successful IRS campaigns in 14 countries (Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe). The Malawi IRS campaign was the first implemented through PMI since 2011.

## TOP-LINE RESULTS FROM IRS CAMPAIGNS, OCT 2018-SEPT 2019

- **5,442,141** structures were sprayed
- **21,866,894** people were protected from malaria
  - **3,611,686** children under-five years of age protected from malaria
  - **687,686** pregnant women protected from malaria
- **29,767** people were trained to deliver IRS with U.S. Government funds

## HIGHLIGHTS FROM THIS REPORTING PERIOD

- Two countries (Burkina Faso and Rwanda) sprayed the newly World Health Organization (WHO)-recommended insecticide, Fludora Fusion, a dual-acting formulation (clothianidin and deltamethrin). Nine countries sprayed SumiShield, a clothianidin insecticide recommended by WHO in 2017. Of the 14 IRS country programs, eight countries used two different insecticides, and Burkina Faso used Fludora Fusion, SumiShield and Actellic.
- VL purchased all insecticide orders for Actellic and SumiShield for \$15 per bottle/sachet through the Next Generation Indoor Residual Spray (NgenIRS) co-payment agreement. Fludora Fusion orders did not receive a co-payment as the manufacturer's price is already below the \$15 co-payment threshold.
- VectorLink Collect was rolled out successfully in eight IRS countries (Burkina Faso, Kenya, Malawi, Mali, Rwanda, Tanzania, Uganda and Zambia). A mobile spray data collection pilot was conducted in Burkina Faso with promising results for expanding to other countries.
- Expanded work in three additional countries, including restarting operations in Angola after a four-year absence; signing an agreement with the Cambodian Ministry of Health (MOH)/NMCP to support entomological monitoring; and conducting a needs assessment trip to support the Colombia NMCP in entomological monitoring and vector control.
- Supported ITN activities in six countries. This included conducting net durability monitoring activities in Ghana, Madagascar, Niger and Rwanda; developing operational guidelines for continuous ITN distribution to support the Niger NMCP; and supporting Cameroon's NMCP to

distribute 1.3 million ITNs in 14 districts across the Far North. In Tanzania, VL supported the Zanzibar Malaria Elimination Program (ZAMEP) to distribute 288,000 PBO nets. In Senegal, VL conducted an assessment and provided recommendations to the NMCP on their continuous distribution system.

- Developed interactive vector control dashboards and visualizations to support IRS and ITN planning and evaluation in several countries. In Zambia, the dashboard includes more than 2.5 million data points that integrate VC coverage, case incidence and entomological monitoring data, and was used to support PMI/Zambia's Malaria Operational Plan discussions. In Nigeria, VL assessed malaria case data and population estimates to inform the ITN monitoring plan. In Mali, VL is supporting the NMCP to develop VC dashboards to prioritize, target and evaluate the impact of IRS and ITNs. In Ethiopia, VL reviewed case data from previous years to assess the suitability of using this data to evaluate IRS impact.
- Rolled out the 'new and improved' Mobile Soak Pit (MSP) II in Ghana, Ethiopia and Uganda, and provided short-term technical assistance (STTA) to the National Malaria Elimination Programs (NMEPs) in Zambia and Zimbabwe on using the MSP II for safe DDT waste-water disposal in provinces they spray with their own resources.
- Developed an Integrated Vector Control Strategic Framework to support NMCPs that is available on the Vector Learning*Xchange* website.
- Published a multi-country study in the *Malaria Journal* using data from 16 countries on resistance to clothianidin.
- Produced two new videos set in Malawi showcasing the impact of IRS on reducing malaria from a beneficiary perspective.

# I. COUNTRY HIGHLIGHTS

## I.1 ANGOLA

### PROGRAM HIGHLIGHTS

- Received approval of the Year 1 work plan in May 2019. The main objectives are to select and re-establish three entomological monitoring sites and conduct one month of routine vector surveillance data at each site during the peak transmission period (January to March).
- Completed a scoping SITTA in September 2019 and, together with a CDC entomologist, met with key stakeholders at the *Instituto Nacional de Saúde Pública* and its research arm, *Instituto Nacional de Investigação em Saúde*. All stakeholders agreed upon the location of the three sites and the plan for data collection. The team hired an entomology program coordinator to support preparations before collections are launched in January 2020.
- VL engaged the University of Witwatersrand to assess the bioefficacy of a small sample of nets received in Angola for the mass campaign by conducting cone bioassays. Mortality rates at 24 hours were 100% for all nets (two batches represented).

## I.2 BENIN

**TABLE I: VL BENIN IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	Six districts in two departments: Donga (Djougou, Copargo, Ouaké), and Alibori (Kandi, Gogonou, Segbana)
Insecticide	Actellic 300 CS
Number of structures sprayed	335,207
Number of structures found	387,711
Spray coverage	86.5%
Population protected by PMI-supported IRS	1,077,411 (51,872 pregnant women; 243,648 children under 5 years old)
Dates of PMI-supported IRS campaign	May 6 – 29, 2019
Length of campaign	21 operational days
Number of people trained with U.S. Government funds to deliver IRS*	1,623

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

### PROGRAM HIGHLIGHTS

- The project completely withdrew IRS from the two districts of Atacora Department (Kérou and Péhunco) in accordance with the National Insecticide Resistance Management Plan, which recommends the withdrawal of IRS in areas where the same insecticide is used for more than three successive campaigns.
- The 2019 spray campaign was conducted over 21 operational days in six districts. The project used 53,504 bottles of Actellic to spray 335,207 structures in six IRS districts, with a utilization ratio of approximately 6.3 structures sprayed per bottle of insecticide.
- As the primary partner, the NMCP was involved in all of the main IRS activities and had more responsibilities in directly supervising implementation of IRS activities in four districts.



- The project hosted a USAID/PMI IRS supervisory field visit as part of the implementation of the 2019 IRS campaign.
- The Entomological Research Center of Cotonou conducted wall bioassays to assess the quality of spraying in the target districts; test mortality was 100% within two weeks of spraying, indicating quality of spraying was satisfactory.
- The project incinerated all insecticide-contaminated wastes, including used nose masks at Hopital de l'Ordre de Malte, a hospital serving Djougou, Copargo and Ouaké districts. The hospital also handled damaged gloves and worn-out boots. Other non-contaminated solid wastes were recycled at Cise Recycle Plant, while paper cartons were recycled at GHES Inter S.A.R.L.
- Participated in the workshop that reviewed the contribution of IRS in reducing malaria-related morbidity in Benin, convened by the PMI mission from September 18 to 20, 2019.

### I.3 BURKINA FASO

**TABLE 2: VL BURKINA FASO IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	Three districts (Kampti, Kongoussi and Solenzo)
Insecticide	Actellic CS300 (Kongoussi), SumiShield WG (Kongoussi and Solenzo) and Fludora Fusion (Kampti).
Number of structures sprayed	201,901
Number of structures found	220,482
Spray coverage	91.6%
Population protected by PMI-supported IRS	587,248 (11,959 pregnant women; 92,809 children under 5 years old)
Dates of PMI-supported IRS campaign	June 6 – July 10, 2019
Length of campaign	30 operational days
Number of people trained with U.S. Government funds to deliver IRS*	2,045

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

#### PROGRAM HIGHLIGHTS

- VectorLink re-started spray activities in Burkina Faso in 2018 after it last sprayed in 2012. In 2019, VL conducted IRS in three districts, targeting 221,255 structures from June 6 to July 11, 2019. A total of 201,901 structures were sprayed out of 220,482 structures found by SOPs in the targeted districts, accounting for a coverage rate of 91.6%.
- The selection of IRS districts in 2018 was based on epidemiological data from the Health Management Information System and the entomological monitoring activities conducted in the South West, North West and Center. Based on the entomological monitoring results and susceptibility of the existing vector (*An. gambiae* s.l.) to pirimiphos-methyl in IRS districts at the time, and the fact that testing of a new insecticide had not yet produced conclusive results, the Burkina National Vector Control Steering Committee decided to use long-lasting organophosphate Actellic®300CS in the two districts of Kongoussi and Kampti, and Sumishield in the district of Solenzo in 2018. The NMCP team shared the latest population data in order to estimate the number of structures in the target areas.
- The spray target in 2019 was initially based on a total of 266,765 structures with a goal of protecting 774,378 people; however, this target was reduced to 221,255 structures due to the exclusion of five sites (Bourzanga, Nassere, Rollo, Zimtenga and Nafo) out of 13 sites in Kongoussi District because of security issues/concerns that the team faced in-country. The team conducted a daily check-in with the local security forces (gendarmerie, police) in all three districts in order to assess whether or not it was safe enough for the spray teams to be deployed to the field.

- VL conducted IRS over 30 operational days in three districts and protected a total of 587,248 people.
- The project used 33,885 sachets of SumiShield, 15,358 bottles of Actellic and 5,326 sachets of Fludora Fusion to spray 201,901 structures in three districts, with a utilization ratio of approximately 3.7 structures sprayed per insecticide bottle/sachet. During the first four months (June, July, August and September), the efficacy of each treatment in terms of mortality rate was 98-100% for the susceptible Kisumu and wild *An. gambiae* s.l. mosquitoes.
- To improve data quality and availability in a timely manner for rapid decision-making purposes, VL Burkina Faso implemented mobile data collection. SOPs used tablets at the household level for the 2019 IRS campaign in the three IRS targeted districts. The team developed a data collection form on the ODK Collect application, associating images to the different variables on the form for easy use of the form by SOPs. All spray data from the tablets was synchronized at the end of the day and available the same day in the VectorLink Collect database with all relevant details, such as reasons for not spraying, which represented valuable information during the daily debriefing meeting and planning for the next day.

## 1.4 BURUNDI

### PROGRAM HIGHLIGHTS

- Conducted entomological monitoring in nine sentinel sites (Cankuzo, Gihofi, Kiremba, Mabayi, Matana, Mutaho, Mpanda, Nyanza-Lac and Vumbi). A total of 33,414 *Anopheles* mosquitoes were collected. *Anopheles gambiae* s.l. represented 75% of the total collected.
- The susceptibility of *An. gambiae* s.l. to insecticides was determined at eight sites, with the vector susceptible to chlorfenapyr, pirimiphos-methyl and bendiocarb at Cankuzo, Gihofi, Kiremba, Mabayi, Mpanda, Nyanza-Lac, and Vumbi (99-100%). *An. gambiae* s.l. was also susceptible to deltamethrin in all eight sites (100%). Resistance and possible resistance to permethrin and alpha-cypermethrin was observed at eight sentinel sites with mortalities ranging from 73-92%.
- In April 2019, VL provided technical assistance to the NMCP to complete the first round of the 2019 IRS campaign in Ngozi and Muyinga provinces. VL supported implementation of a successful IRS operation in accordance with international standards, monitored the insecticide decay on sprayed walls after IRS, and conducted entomological monitoring before and after the spray campaigns to assess the impact of the intervention. VL supported the IRS campaign to ensure best practices are implemented at all stages of the spray operation.
- The monitoring of the insecticide decay on the wall surfaces after IRS with the cone bioassay indicated around four months of residual life of bendiocarb in Muyinga and Kirmeba districts.
- Continued supporting the development of an IRS implementation work plan as well as the operational plan of the NMCP.

## 1.5 CAMBODIA

### PROGRAM HIGHLIGHTS

- Concluded critical Memorandum of Understanding (MOU) negotiations with the National Center for Parasitology and Malaria Control (CNM). The MoU is a pre-requisite before field activities can begin.
- Collaborated with CNM in the development of a work plan for 2019/2020 field activities and associated budget. This includes: 1) a 10-day training in the field for CNM team and provincial and operational district staff from two endemic provinces; 2) a 10-day training attended by provincial staff and project entomology technicians in Phnom Penh.
- Conducted training for VL entomology technician, a Cambodian national, in mosquito identification and taxonomy, WHO insecticide resistance assays and field trapping methods in collaboration with NAMRU-2 in three provinces.
- Drafted a set of pictorial keys to be used as aids for identifying *Anopheles* mosquito activity.

## 1.6 CAMEROON

### PROGRAM HIGHLIGHTS

- Conducted longitudinal entomological vector surveillance in five sentinel sites across the country including monthly mosquito collections in Gounougou and Simatou in the North for a total of 11 surveys and bimonthly in Nyabessang (6 surveys), Mangoum (6 surveys), and Bonabéri (5 surveys) in the South. Conducted CDC bottle assay and WHO susceptibility tests, intensity and synergist assays of *An. gambiae* s.l. to insecticides used in vector control (pyrethroids, carbamate, organophosphates, neonicotinoids, and pyrroles) in four sentinel sites (Gounougou, Simatou, Nyabessang, and Mangoum) in 2018 and in all five sites in 2019. Resistance to all three pyrethroids tested (deltamethrin, permethrin, and alpha-cypermethrin) was observed in all sites; PBO partially restored the susceptibility at all sites. Susceptibility to pirimiphos-methyl was observed in one site while clothianidin resistance was found in two of the four sites monitored.
- Organized in-country entomological trainings in October 2018 and July 2019 to reinforce the capacity of the field data collectors. Thirty-eight representatives from NMCP and the three research institutes supporting the country data collection were trained on PMI entomological data collection procedures. Susceptibility test protocols and adult mosquito collection methods and data collection forms were harmonized.
- Provided logistical support to the planning and coordination of the mass ITN distribution campaign in the Far North including household registration and microplanning efforts to advise the NMCP on quantification, timing, and advocacy efforts, and secured the support of influential stakeholders such as the Governor of the Far North. Phase 1 was completed in September 2019, providing an estimated 1.3 million ITNs and protecting approximately 2.3 million people across 709 sites in 14 districts in the Far North. In close collaboration with the NMCP at the central and regional levels as well as the GHSC-PSM project. VectorLink provided technical and operational assistance for campaign microplanning, household registration, and ITN distribution activities. VectorLink also supported town criers, billboards, and a variety of media that informed the public about how to access and receive the nets.
- Prepared for Phase 2 of the mass ITN campaign targeting the Far North's remaining 16 districts by holding strategy and planning meetings with health area and district health officials.

## 1.7 CÔTE D'IVOIRE

### PROGRAM HIGHLIGHTS

- Conducted longitudinal entomological vector surveillance in four sites selected by NMCP as potential IRS sites (Gagnoa, Bocanda, Jacquville, Sakassou) in 2018 and (Beoumi, Dabakala, Nassian, Sakassou) in 2019 for selection of the districts, insecticide, and timing for planned IRS implementation in 2020.
- Conducted insecticide resistance monitoring including CDC bottle assay and WHO susceptibility testing, intensity and synergist assays of *Anopheles gambiae* s.l. in 15 sites across the country to inform the selection and stratification of ITNs for future mass campaigns. This included Abengourou, Aboisso, Adzope, Beoumi, Bettie, Bouake, Bouna, Dabakala, Daloa, Gagnoa, Nassian, Odienne, Sakassou, San Pedro, and Yamoussoukro.
- In 2020, Cote d'Ivoire will conduct its first large-scale IRS campaign. In preparation, VL facilitated a workshop with NMCP, PMI and stakeholders to support IRS district selection and ITN stratification across the country with the introduction of new types of nets.
- VL conducted a rapid geographical reconnaissance exercise in April 2019 in Bettie, Nassian, and Sakassou, selected by NMCP and PMI during the March workshop, to determine their suitability for IRS. During this exercise, Nassian and Sakassou were selected as the districts to receive IRS in 2020. Subsequently, VL conducted full-scale geographic reconnaissance and enumerated all eligible structures in these two districts to estimate the target number of structures and quantify the insecticide and IRS equipment needs.
- Organized a workshop in May 2019 with NMCP, PMI and stakeholders to validate the selection of IRS districts, control districts and insecticides to be sprayed. Clothianidin-based products were

selected for IRS because the vectors were susceptible in both districts. Based on the geographical contiguity and similarity of the environmental and epidemiological characteristics of the control sites and the IRS sites, the districts of Beoumi and Dabakala were proposed as control sites for entomological surveillance.

- Organized a refresher training for entomology technicians and students from four local research institutes involved in entomological data collections and NMCP focal points to harmonize field protocols and improve on lessons learned from 2018. In total, 20 participants were trained, including four women.
- Conducted a capacity needs assessment of the three national entomological research institutes to undertake entomological activities at the standard set by WHO and the Government of Cote d’Ivoire. The main objective was to identify priority areas for capacity to be built and enable them to advocate for the resources needed to conduct routine entomological activities to support the country’s vector control strategies.

## 1.8 DEMOCRATIC REPUBLIC OF THE CONGO

### PROGRAM HIGHLIGHTS

- Through the National Institute of Biomedical Research (INRB), entomological monitoring activities were conducted in eight provinces: Kinshasa, Haut-Uele, Bas-Uele, Kongo Central, Kasai Central, Sankuru, Tanganyika, and Tshopo.
- Longitudinal entomological activities, including pyrethrum spray catch and human landing catch collections, were conducted monthly in three provinces: Kalemie (Tanganyika), Sankuru (Lodja) and Kabondo (Tshopo).
- Insecticide susceptibility testing with permethrin, deltamethrin, alpha-cypermethrin and chlorfenapyr was conducted in five provinces at two sentinel sites per province for a total of 10 sites, including Kingasani, Binza Meteo, Muanda, Kimpese, Nebobongo, Pawa, Mikalayi, Tshikaji, Aketi and Buta.
- Pyrethroid resistance intensity and PBO synergist assays were conducted in all 10 sites to aid decision-making regarding type of nets to purchase for future ITN distribution campaigns.
- Facilitated quality testing of 84 DawaPlus 2.0 ITNs.
- Supported NMCP to establish the Vector Control Working Group, to facilitate review of country data and inform vector control decision-making.
- Supported 10 local entomologists to attend Malaria Scientific Day, coordinated by the NMCP.
- Equipped the molecular laboratory at INRB entomology section with a PCR machine for laboratory analysis of mosquito samples.

## 1.9 ETHIOPIA

**TABLE 3: VL ETHIOPIA IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	44 in three regions (Benishangul-Gumuz, Gambela, Oromia)
Insecticide used	Actellic 300 CS
Number of structures sprayed	487,746
Number of structures found	510,449
Spray coverage	95.5%
Population protected by PMI-supported IRS	Total population: 1,334,868 (33,245 pregnant women and 228,262 children under 5)
Dates of PMI-supported IRS campaign	May 20–July 22, 2019
Length of campaign	64
Number of people trained with U.S Government funds to deliver IRS*	2,297

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

## PROGRAM HIGHLIGHTS

- In 2019, VL Ethiopia conducted IRS in the same 44 target districts in three regions that were sprayed in 2018: Benishangul-Gumuz (20 districts), Gambela (14 districts) and Oromia (10).
- VL targeted 542,148 structures across 44 districts using Actellic 300CS; the target was later revised to 509,594 structures as a result of security issues prohibiting teams from reaching certain areas. The spray campaign took place from May 20 to June 15 in Gambela Region, and from June 3 to July 22 in Oromia and Benishangul-Gumuz regions.
- According to data from the Gambela Regional Health Bureau, malaria cases in Gambela Region in September 2018 were 39% lower than those recorded during the same month in 2017. Annual deaths attributed to malaria also fell from 13 in 2017 to 3 in 2018. In 2018, the region recorded a cumulative 57,882 cases of malaria compared to 94,257 in 2017 and 92,465 in 2016.
- Prior to the IRS campaign, Ethiopia conducted a satellite enumeration and ground-truthing activity in Gambela Region. All structures were mapped through VL and turned into “points” against which data could be entered. By using this map, VL visited almost 240,000 structure points to determine whether structures were eligible for spray. The IRS target for this region was changed to reflect the team’s findings.
- Sprayed 487,746 structures out of 510,449 structures found by spray operators, resulting in 95.5% spray coverage. In total, 1,334,868 residents were protected, including 228,262 children under 5 years old (17.1% of residents protected) and 33,245 pregnant women (2.5%).
- Trained 2,297 individuals to deliver IRS. Of these, 292 were supervisors, 1,361 were spray operators, and 644 were squad leaders. Women accounted for 26.9% of all staff trained, and 10.5% of supervisory positions.
- A total of 121,768 bottles of insecticide were used to spray 487,746 structures, with an average utilization ratio of approximately 4.0 structures sprayed per bottle.
- Selected one district, Ilu in Oromia, in which SOPs collected IRS data in addition to spraying, contrary to the legacy data collection model in Ethiopia where data is collected by Squad Leaders. There was no difference in quality between the data collected by SOPs and the ones collected by Squad Leaders. As a result, the project will transfer data collection responsibilities to SOPs in subsequent campaigns.
- Piloted 15 Goizper pumps in Waliso District. SOPs reported that the pumps were lightweight, had increased visibility, and had a pressure gauge and backpack straps that made them much easier to use than Hudson pumps.
- Conducted wall bioassays within 24-48 hours of spraying and recorded 100% mortality of susceptible *Anopheles arabiensis* in two out of three sites and 99% mortality in one site.
- The 2019 IRS campaign saw a marked reduction in the number and magnitude of challenges as compared with the 2018 campaign. One of the major challenges faced during the campaign was civil unrest in some areas targeted for IRS. The campaign in Benishangul-Gumuz extended beyond the original end date as a result of security concerns, which pushed back the start date in 11 districts of the region and caused interruptions in several others. The other major challenge was payment related. Even though the mobile payment system which was introduced in 2019 was simple and secure, there were challenges related to cash-out as most districts did not have banks or agents to pay the seasonal workers. The challenges were compounded by severe interruptions of the mobile phone system during the campaign. These affected supervision as most VL supervisors spent more time resolving payment issues.

## 1.10 GHANA

**TABLE 4: VL GHANA IRS AT A GLANCE**

Number of districts covered by IRS	8 districts: Bunkpurugu-Nakpanduri (BND), East Mamprusi (EMD), Gushegu (GUD), Karaga (KAD), Kumbungu (KUD), Mamprugu Moaduri (MMD), West Mamprusi (WMD), and Yunyoo-Nasuan (YND),
Insecticide used	Actellic® 300CS (5 districts) and SumiShield® 50WG (3 districts)
Number of structures sprayed	298,385
Number of structures found	316,285
Spray coverage	94.3%
Population protected by PMI-supported IRS	875,481 (including 19,844 pregnant women and 157,398 children under 5 years)
Dates of PMI-supported IRS campaign	April 2–May 9, 2019; May 16-26, 2019
Length of campaign	30 operational days (original spray campaign) 6 operational days (partial spray pilot)
Number of people trained with US Government funds to deliver IRS*	864 (676 men, 188 women)

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

### PROGRAM HIGHLIGHTS

- For the first time, engaged 46 Community Health Nurses to integrate IRS messaging in daily routine work and enhance mobilization during the campaign. In 398 IRS communities, where integration occurred, average spray coverage reached 99.9% compared to 93.2% in 2018 and 95% in 2017.
- Completed partial spraying of 1,458 structures in three communities as part of a small-scale field pilot study to partial spray with pirimiphos-methyl in households. This operational research study is aimed at exploring the feasibility and cost of a partial IRS campaign and its impact on vector population under natural field conditions as a measure of making IRS more sustainable.
- Recycled 33,788 bottles of Actellic 300CS; 1,129 kg of other plastic waste (broken Goizper pump parts, face shields, etc.) and 2,510 kg of cardboard boxes.
- Successfully tested SOPs use of a miner’s-type headlamp instead of flashlights, which require frequent repair and battery change during spraying. SOPs found a headlamp brighter and easier to use than a flashlight and appreciated the ability to re-charge the lamp. VL Ghana is considering scaling up use of the headlamps to more districts.
- In October 2018, USAID Administrator Mark Green visited the VL Ghana office in Tamale, where he met with the VL team and invited district partners, and observed mosquito identification dissections in the project’s entomological laboratory. His visit greatly increased the morale of the team ahead of the intense pre-spray preparation period.
- In October 2018, VL held an eight-day IRS boot camp for 30 government officials, VL Ghana staff, the AngloGold Ashanti Malaria Control Limited (AGAMal) and other IRS implementers.
- Trained two staff from the six community radio stations of PMI-supported districts in IRS implementation. This enabled the radio stations to effectively communicate about the spray campaign schedules and resolve misconceptions about IRS to improve community acceptance.
- Upon request from the NMCP, VL Regional Entomological Advisor served as key facilitator and reviewer during the revision of the national Integrated Malaria Vector Management policy.
- Spray quality test results demonstrated 100% mosquito mortality at 1-3 days after spraying across all districts for both insecticides used during 2019 IRS (Actellic 300CS and SumiShield).

- Data collection from an operational research study on the effect of IRS on *Anopheles* vector behaviors and their impact on malaria transmission was completed successfully in April 2019.
- Protracted ethnic conflict forced VL to cancel 2019 IRS operations in Chereponi, a new district prepared for IRS expansion. Violence erupted after the project had completed almost all preparations including insecticide procurement, door-to-door mobilization, worker recruitment, infrastructure set-up, and materials' dispatch. For 2020, VL will conduct a thorough geo-political analysis, as well as the usual epidemiological one, to identify another potential district for IRS expansion.
- Mitigation measures including a guarantor signatory for all seasonal workers and serialization of each insecticide container helped to drastically reduce insecticide pilferage cases to only one in 2019.
- Homeowner preparation continues to be a challenge mainly in peri-urban communities due to packing burden. The project will continue to hire packers and station some spray teams in the communities for the entirety of the campaign. This was done in eight towns this year.
- Successfully transitioned leadership for durability monitoring research from the outgoing PMI VectorWorks team to VL. Data collection for the 12-month durability monitoring round in Nanumba South and Zabzugu was completed. VL co-facilitated training and provided quality assurance oversight to data collection during first days of fieldwork.
- Worked with the NMCP Vector Control and Monitoring and Evaluation teams to select indicators from an existing ITN monitoring checklist for inclusion in the EDS-based Outreach Training and Supportive Supervision (OTSS) checklist.

## I.II KENYA

**TABLE 5: VL KENYA IRS AT A GLANCE**

Number of sub-counties sprayed by PMI-supported IRS	14 sub-counties: 6 in Migori county (Awendo, Nyatike, Rongo, Suna east, SunaWest and Uriri) and 8 in Homa Bay County (Homa Bay Township, Ndhiwa, Rachuonyo East, Rachuonyo North, Rachuonyo South, Rangwe, Suba North and Suba South)
Insecticide	Actellic 300CS (14 sub-counties) and SumiShield 50WG (at one operation site in Rachuonyo North Sub County)
Number of structures sprayed	507,777
Number of structures found	551,689
Spray coverage	92.0%
Population protected by PMI-supported IRS	2,011,860 (including 44,999 pregnant women and 249,275 children under 5 years)
Dates of PMI-supported IRS campaign	<ul style="list-style-type: none"> <li>• January 28, 2019 to February 23, 2019 (Migori County)</li> <li>• February 11, 2019 to March 16, 2019 (Homa Bay County)</li> </ul>
Length of campaign	24 days (Migori County); 30 days (Homa Bay County)
Number of people trained with U.S Government funds to deliver IRS*	2,974 people (1,794 men, 1,180 women)

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

### PROGRAM HIGHLIGHTS

- Conducted IRS for a third year using Actellic in Migori County and a second year in Homa Bay County. Introduced SumiShield for the first time in Kenya at a single operations site in Homa Bay County.
- Of the 551,689 structures found by the spray operators, a total of 507,777 structures were sprayed (286,233 sprayed in Homa Bay County and 221,544 sprayed in Migori County) resulting in an overall spray coverage rate of 92.0%.

- Rolled out the VectorLink Collect mobile spray data collection initiative during the 2019 IRS campaign at the Dede operations site in Awendo Sub-County, which involved 30 SOPs, five SOP team leads, one site coordinator, one storekeeper, and two site supervisors.
- For the first time, VL Kenya used bicycles in the 2019 IRS campaign by SOPs at Rariw Dispensary, Rangwe Sub County, Homa Bay County as a cost-saving measure. It would have cost \$4,200 to hire SOP vehicle transportation. The project spent \$2,620 for the SOP and site coordinator bike allowance, supervisor motorcycle hire, and pump holders. Consequently, VL saved \$1,580, a 38% savings.
- Ten data falsification incidences were reported to PMI during the 2019 spray campaign, the majority of which were small-scale incidents involving one to two SOPs. Among the 10 is a larger-scale incident involving 10 SOPs from two spray teams at the Magunga operations site. Following the large-scale data falsification incident, VL Kenya conducted a mini post-spray data quality audit, which estimated a spray coverage of 48.85% at Magunga, significantly lower than the coverage reported during the campaign. Communities in the affected area were re-visited to ensure as many unsprayed eligible structures as possible were covered. The re-spray took place for a period of 12 days (May 20 to June 1, 2019), resulting in an overall Magunga operations site spray coverage of 86.3%.
- Supporting and participating in the development of key national IRS documents: IRS Implementation Strategy, Mosquito Surveillance Guidelines, Integrated Vector Control Strategy and Insecticide Resistance Management Plan. Document completion is underway.
- Spearheaded malaria epidemiological data quality discussions with other implementing partners in both Migori and Homa Bay counties to facilitate decision making and support the IRS exit strategy.
- Community-based entomological monitoring through community health volunteers was established in two sites in each of Kakamega and Vihiga counties in western Kenya from April 2019. Each volunteer conducted trapping using CDC light traps in 20 houses per week for longitudinal monitoring of vector populations.

## 1.12 LATIN AMERICA (LAC)

- VL developed a study protocol for the evaluation of the efficacy of IRS and ITN distribution using and strengthening the entomological monitoring systems already in place in Colombia. These studies will support the development and application of evidence-based approaches on how and where to best apply the vector control tools.
- Nelson Grisales, VL Entomologist, met in person with Colombia MOH and National Institute of Health counterparts to identify the region for the study and scope, based on already planned government activities. Final negotiations with MOH are ongoing, but a work plan and budget are being drafted along with an MOU in order to coordinate agreed upon work with the MOH.

## 1.13 LIBERIA

### PROGRAM HIGHLIGHTS

- VectorLink Liberia and the NMCP completed all vector surveillance activities in the four sentinel sites: Madina, Fissebu, Koryah and Saint John, located in Grand Cape Mount, Lofa, Bong and Grand Bassa counties, respectively, to assess vector composition, behavior and density using CDC light traps, human landing catch and pyrethrum spray catch collection.
- Insecticide resistance tests were done in Zolowee (Nimba), Sinje (Grand Cape Mount), Zwedru (Grand Gedeh), Barclayville (Grand Kru), Greenville (Sinoe), Bopolu (Gbarpolu) and Zorzor (Lofa). Synergist assay using PBO was performed for deltamethrin and permethrin. The different tests showed that *An. gambiae* s.l. was resistant to pyrethroids and PBO did not restore full susceptibility of *An. gambiae* s.l. to the pyrethroids tested. All tests were performed using the CDC bottle assay protocol.



- CDC bottle assays were used to test vector susceptibility to chlorfenapyr in one site in each of the following five counties: Nimba, Grand Cape Mount, Bong, Grand Gedeh and Margibi. Full susceptibility was observed in all sites three days post-exposure.
- VL participated in select ITN durability monitoring activities as part of the transition of durability monitoring from VectorWorks to VectorLink.
- VL participated and supported several different events held by NMCP including World Malaria Day, the mid-term review, the integrated vector management plan review and the annual review.
- The project established a partnership with National Public Health Institute of Liberia (NPHIL) via sub-contract for the laboratory processing of mosquito samples. Given that the old enzyme-linked immunosorbent assay circumsporozoite protein (ELISA) machine was not functioning, VL purchased a new ELISA machine and desktop for use in sample processing by NPHIL.
- VectorLink participated in several stakeholder meetings, led by the MOH/NMCP, on planning for school-based ITN distribution, currently planned to occur for the first time in Liberia in early 2020.

## 1.14 MADAGASCAR

**TABLE 6: VL MADAGASCAR IRS AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	9 districts
Insecticide	Actellic 300CS and SumiShield 50WG
Number of structures sprayed	548,789
Number of structures found	586,768
Spray coverage	93.5%
Population protected by PMI-supported IRS	2,232,097 (including 85,821 pregnant women and 328,092 children under 5 years)
Dates of PMI-supported IRS campaign	July 23 to August 20, 2018 in four districts in the South East (Farafangana, Vohipeno, Manakara and Mananjary); September 3 to September 29, 2018 in three districts in the East Coast (Brickaville, Fénériver Est, and Tamatave II); September 17, 2018 to October 17, 2018 in two districts in the South West (Sakaraha and Tulear II)
Length of campaign	24 operational days
Number of people trained with U.S Government funds to deliver IRS*	7,085

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

### PROGRAM HIGHLIGHTS

- VL Madagascar conducted IRS over 24 operational days in nine districts, protecting 2,232,097 people. VL used 18,807 sachets of SumiShield and 69,250 bottles of Actellic to spray 548,789 structures in nine districts.
- Conducted pre-spray activities for the 2019 spray campaign and transferred 32,142 unused bottles of Actellic from NMCP to be used during the campaign in Ihosy, Ampanihy and Betsioky districts.
- Participated in environmental compliance training organized by USAID Madagascar.
- Implemented the “Exit Plan” developed by the VL team in close coordination with NMCP and PMI in Tomasina II, Brickaville, Feneriver East, Mananjary, Manakara, Farafangana and Vohipeno, which were previously sprayed by PMI. The Exit Plan’s main objective was to monitor malaria incidence and to ensure that other vector control strategies were in place after the withdrawal of IRS in those seven districts.
- Conducted entomological data collection, recording *Anopheles gambiae* s.l., *Anopheles funestus*, and *Anopheles mascarensis* as malaria vectors, and one potential vector, *An. coustani*, in various sentinel sites. *Anopheles gambiae* s.l. was the main vector in the East Coast, the South East and South West region.

- Conducted insecticide resistance monitoring across the country with results indicating susceptibility of *Anopheles gambiae* s.l. to pirimiphos-methyl, clothianidin, bendiocarb, and chlorfenapyr in all sprayed areas. Resistance to pyrethroids observed in five (four in the East and one in the South West) out of 13 sites where tests were performed.
- Conducted monthly WHO wall cone bioassay for residual efficacy tests of sprayed insecticides. The recorded residual efficacy of Actellic 300 CS was seven months after spraying in five sites of the East and the South West, with more than 80% mortality, and six months in two sites of the South East. The residual efficacy of SumiShield 50 WG was seven months in the sprayed districts.
- Conducted ITN durability monitoring activities of DawaPlus 2.0 nets distributed during the August 2018 mass campaign in three districts: Farafangana (Atsimo Atsinanana region); Maintirano (Melaky region); and Bekily (Androy region). Baseline data collection was conducted from September 7-October 13, 2018, one month after the mass distribution campaign in each district. A separate sample of DawaPlus 2.0 nets from the 2018 campaign were taken from the field to test for insecticidal effectiveness. This work was completed by the Institut Pasteur de Madagascar in February 2019.

## 1.15 MALAWI

**TABLE 7: VL MALAWI IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	1 district: Nkhotakota
Insecticide used	Organophosphate (Actellic 300CS)
Number of structures sprayed	112,264
Number of structures found	118,355
Spray coverage	94.9%
Population protected by PMI-supported IRS	501,324 (including 11,066 pregnant women and 90,953 children under 5 years)
Dates of PMI-supported IRS campaign	October 2, 2018 – November 7, 2018
Length of campaign	32 operational days
Number of people trained with U.S. Government funds to deliver IRS*	575 people (357 men, 218 women)***

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

### PROGRAM HIGHLIGHTS

- In 2018, Malawi was added to the VectorLink portfolio of countries. IRS was last carried out in Malawi in 2012. With PMI funding, the 2018 IRS program in Nkhotakota District was the first IRS program conducted in the country in six years.
- Within a six month period between April and October 2018 staffed and trained a highly capable local team who were responsible for planning and carrying out IRS. In addition, completed training of a cadre of over 1,000 seasonal personnel to help implement the program.
- The 2018 IRS program contributed to a 54.8% reduction of malaria incidence in Nkhotakota, based on HMIS data obtained six months following spray.<sup>1</sup>
- Completed spray of 112,264 structures, achieving 94.9% of the targeted 118,000 structures and protecting 501,524 persons.
- Evaluated the internal capacity of the NMCP and stakeholders to carry out the technical, operational, monitoring, and management functions for implementing an IRS program. Overall, Malawi's aptitude

<sup>1</sup> Data retrieved from National Health Management Information System (HMIS) data, Malawi Ministry of Health on June 7, 2019.

for executing IRS operations independent of donor support is quite high. The technical component rated highest was entomology followed by IEC/BCC. The technical components rated lowest were environmental compliance and logistics and warehouse management, followed by procurement.

- Malaria Consortium, a VL subcontractor, supported the development of a country IRM plan which was completed in the second quarter of 2019. The plan was developed with the assistance of in-country consultants and shared with stakeholders through Vector Control Working Group meetings.
- Through a local partner, Malaria Alert Centre (MAC), VectorLink conducted longitudinal entomological monitoring and molecular analysis to assess the vector bionomics and susceptibility of *An. funestus* and *An. gambiae*, the predominant vectors in Nkhotakota District.
- MAC also completed a three-year study of the attrition and durability of Yorkool and Royal Sentry nets distributed in Mangochi and Kasungu districts during a national campaign in 2016.
- Assessed the cause of low residual efficacy of Actellic 300 CS in houses sampled 0 to 3 months after spray in Nkhotakota. Sample size, spray quality, sprayer discharge rate, and bioassay test quality were analyzed and ruled out as contributing factors to the low residual efficacy. Additional tests of insecticide microencapsulation release rate were done by an independent laboratory, and an eight-week bio-evaluation was conducted by Syngenta on the three separate batches of insecticide sprayed in Malawi in 2018. Insecticide was determined to perform as expected and not a contributing factor.
- Through a series of STTA visits and dedicated team advisories on spray techniques, spray operations, environmental compliance, and monitoring and evaluation, the VectorLink team developed local capacity of the Mangochi District government to carry out IRS in the last quarter of 2019.

## 1.16 MALI

**TABLE 8: VL MALI IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS in 2019	35 health areas in 3 districts (Bandiagara, Djenné, and Mopti)
Insecticide used	Actellic 300CS in Mopti and Bandiagara SumiShield 50WG in Djenné
Number of structures sprayed	148,198
Number of structures found	153,191
Spray coverage	96.7%
Population protected by PMI-supported IRS	690,793 total (including 35,484 pregnant women and 98,217 children under 5)
Dates of PMI-supported IRS campaign	July 1, 2019 – August 4, 2019
Length of campaign	30 operational days
Number of people trained with U.S. Government funds to deliver IRS*	616 people (541 men, 75 women)

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

### PROGRAM HIGHLIGHTS

- In 2019 VL Mali implemented IRS in 35 health areas across three districts in the Mopti region: Bandiagara, Djenné, and Mopti, protecting a total of 690,793 people.
- In January 2019, a new COP was appointed and a new lead entomologist joined the project in June 2019. The COP also traveled to Ghana in April to observe PMI best management practices during IRS operations.
- Major pre-season achievements included the installation of a new incinerator unit at Noumoubougou and the training of operators. In addition, a new central warehouse was set up in Bandiagara to replace the one that was previously located in Bankass. Also, to minimize excessive wastewater and transportation costs, mobile soak pits were established alongside permanent soak pits in four health

areas. The team also hosted an independent Environmental Compliance Field Evaluation from June 7-16, 2019.

- VL used 51,347 bottles of Actellic and 10,270 sachets of SumiShield and sprayed 148,198 structures in three districts, with a utilization ratio of approximately 2.4 structures sprayed per bottle/sachet.
- Leading up to the 2019 campaign, a number of violent incidents were recorded throughout the Mopti region in current or former IRS areas. Local authorities advised VL not to travel to five villages and two hamlets in Bandiagara District due to conflict-related population displacement.
- Hosted the USAID/PMI Mission supervisory visit to IRS sites in Mopti District from July 15-18 (including meetings with administrative authorities, the Regional Directorate of Health, and the Mopti District directorate of health), and to the VL data center and central warehouse in Mopti.
- 2019 post-IRS Review Meetings were held September 11–16, 2019, at district and regional levels, and attended by 205 participants from MOH, including NMCP, regional and district officials, Ministries of Environment and Women, local authorities, community leaders, NGOs, associations and radios.
- IRS quality assurance and monthly insecticide decay rate monitoring was conducted in the three IRS districts. Quality assurance cone bioassays performed 24-48 hours after spraying showed 100% mortality regardless of the type of wall for both Actellic and SumiShield. At three months after spraying, the mortality rate of *An. coluzzii* exposed to sprayed surfaces was around 80% on surfaces sprayed with Actellic CS in Bandiagara and Mopti and as high as 98% on surfaces sprayed with SumiShield in Djenne. Monthly entomological surveillance was carried out in 2019 in four sites, including the three 2019 IRS target districts (Bandiagara, Djenné, Mopti) and one control site (Tominian). Surveillance was stopped at two other control sites due to security concerns.
- Fourteen sites were surveyed for the nationwide insecticide resistance study. WHO susceptibility tube tests showed resistance to pyrethroids in all sites.
- Synergist assays with PBO increased the mortality rate at all sites, demonstrating the role of metabolic resistance. However, pre-exposure to PBO only resulted in 100% mortality in Kati for deltamethrin and in Sikasso and Koulikoro for permethrin.
- Worked with PMI and NMCP to compile, analyze, and visualize existing data to guide malaria vector control decisions and strategies at the national level. This activity is ongoing with the development of draft visualizations, including malaria case incidence, IRS, ITN mass campaign and ITN routine data.

## I.17 MOZAMBIQUE

**TABLE 9: VL MOZAMBIQUE AT A GLANCE**

Number of districts covered by PMI-supported IRS	Six districts in Zambézia Province: Derre, Milange, Molumbo, Mopeia, Morrumbala and Maganja da Costa
Insecticide class	Organophosphate (Actellic® 300CS) and the neonicotinoid clothianidin (SumiShield 50WG).
Number of structures sprayed	387,413
Number of structures found	409,908
Spray coverage	94.5%
Population protected by PMI-supported IRS in 2018	1,663,078 (including 90,089 pregnant women and 237,944 children under 5)
Dates of PMI-supported IRS campaign	October 16–November 28, 2018
Length of campaign	35 days
Number of people trained with U.S. Government funds to deliver IRS*	1,577

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

## PROGRAM HIGHLIGHTS

- PMI VL implemented IRS in six districts and entomology activities in Zambezia Province and provided technical support in entomology and IRS to the NMCP in Nampula Province during the reporting period.
- SumiShield was sprayed for the first time in Mopeia and Morrumbala in Zambezia Province.
- Participated in technical working groups (Entomology and IRS); played a key role in reviewing and updating the national IRS tools (supervision, IRS training curriculum and structure definition).
- Supported NMCP preparations for IRS campaign in Nampula Province, including provincial training of trainers to support IRS implementation from September 12-16, 2019, and a Pre-spray Environmental Compliance Assessment of the eight operation sites for the eight IRS districts in July 2019.
- Supported NMCP and Sofala Provincial Health Directorate in response to the cyclone Idai emergency with entomological monitoring, including logistical support and materials for three months of vector density monitoring, identification and susceptibility to 0.25% pirimiphos-methyl and 0.1% bendiocarb; Provided IRS technical assistance through planning, Training of Trainers, SOPs training and environmental compliance.
- Conducted entomological monitoring in three intervention districts in Zambezia Milange, Maganja da Costa and Mopeia, which is the operational research study district, and in the control district, Lugela. In Nampula, the Provincial Health Directorate conducted IRS using pirimiphos-methyl (Actellic® 300CS) in eight districts. VL performed monthly entomological monitoring in two intervention districts, Nampula City and Monapo, and in Erati, the control district.
- Quality of IRS assessed by cone wall bioassays showed that spray teams were able to achieve optimal insecticide application in all districts, demonstrating appreciable skills in consistent uniform application of insecticides across districts. Bioassay results on Actellic sprayed areas showed high mortalities ranging from 99% to 100% of *An. arabiensis* at the 24 hours holding period, whereas 100% mortality was recorded at 72 hours holding period for Sumishield sprayed areas.
- The insecticide decay rate assessment show that Actellic® 300CS had variable decay periods, from four to six months. SumiShield® 50WG was found to last up to 10 months.
- Results of insecticide susceptibility tests show that local vectors are fully susceptible to pirimiphos-methyl, chlorfenapyr, clothianidin, bendiocarb, and DDT. Assays for pyrethroids once again revealed occurrence of widespread vector resistance to pyrethroids. Further assays to assess the strength of resistance in *An. gambiae* s.l. show presence of moderate to high intensity resistance to pyrethroids. Synergist assays with piperonyl butoxide (PBO) demonstrated recovery of mortality, indicating involvement of oxidase-mediated resistance mechanisms.

## 1.18 NIGER

### PROGRAM HIGHLIGHTS

- Conducted longitudinal entomological vector surveillance in six sentinel sites (Agadez, Gaya, Ingall, Niamey V, Tessaoua and Zindarou) from October 2018 to March 2019 and 10 sentinel sites (Agadez, Balleyara, Fararrat, Gaya, Guidimouni, Ingall, Niamey V, Say, Tessaoua and Zindarou) from April to September 2019.
- Conducted insecticide resistance monitoring, including the WHO susceptibility test, intensity and synergist assays of *An. gambiae* s.l. to insecticides used in public health in nine sites across the country.
- *An. gambiae* s.l. were found to be resistant to all three pyrethroids tested (deltamethrin, permethrin and alpha-cypermethrin) in all sites in both 2018 and 2019 data collections. Pre-exposure to PBO could not restore full susceptibility in all sites, except with permethrin and alpha-cypermethrin in Zinder.

- The Technical Program Manager traveled to Niger in June 2019 to provide general program oversight and management support, strengthen partner relations, and observe facilities.
- Data collection for the 12-month round of durability monitoring of Olyset nets in Gazaoua (Maradi Region) and Madaoua (Tahoua Region) was completed in July 2019 and the nets collected for chemical testing were shipped to Swiss Center for Scientific Research in Cote d'Ivoire. The NMCP participated in the training and fieldwork. The Research Manager traveled to Niamey to co-facilitate the training and to provide quality assurance oversight during first days of fieldwork.
- An operational guide for ITN continuous distribution was developed with the NMCP and PMI Niger teams. The guide was validated by the PMI COR team in September 2019.
- A sample of 28 TANA-brand ITNs were tested for bioefficacy and found to induce expected mosquito mortality levels.
- Hosted a six-day training for 18 entomological technicians from NMCP and CERMES from August 6-11. The training covered morphological identification of *Anopheles* mosquitoes, ovary dissection and reporting, WHO and CDC susceptibility tests. The Regional Technical Advisor traveled to Niger to facilitate the training, observe field collections, and support the establishment of CERMES insectary.
- VL Niger F&A Manager attended a U.S. Embassy training on USAID administrative and financial procedures and common challenges faced by partners. He also participated in a US Embassy briefing on tax exemption for implementing partners.
- VL participated in a “High Burden to High Impact” Information and Planning Forum in September 2019.
- A MOU between VL Niger and CERMES, outlining each party’s responsibility in generating entomological monitoring data, was signed in July 2019.
- A Data Sharing Agreement was developed to document the terms of use of data generated by PMI VectorLink, to be signed by NMCP, VL Niger, CERMES, and PMI Niger.

## 1.19 NIGERIA

### PROGRAM HIGHLIGHTS

- Conducted monthly routine surveillance activities across seven sites and expanded insecticide resistance activities from nine to 11 sentinel sites. VL technical staff based in Abuja provide routine supervision to the new and existing sites; staff from other VL-supported sites (VL-supported insectary in Keffi and Sokoto) also provided state-to-state support to the new sites. VL also supported Global Fund-supported sentinel sites in the procurement and distribution of entomology materials for surveillance and insecticide resistance activities.
- Assessed malaria case data and population estimates to inform the monitoring plan to assess the entomological and entomological impact of deployment of PBO ITNs in Ebonyi. The project is using interrupted time series approach and will develop a data analytics dashboard which will summarize trends in ITN coverage and key entomological and epidemiological indicators. Confirmed malaria case incidence will be measured before and after distribution to assess the epidemiological impact of the ITN campaign.
- External challenges to program implementation include banditry and kidnappings in Zamfara and clashes between farmers and herders in Plateau and Benue.
- Permethrin resistance was predominant in *An. gambiae* s.l. mosquitoes across all sentinel sites. Similarly, an increase in deltamethrin resistance was observed. In Ebonyi and Plateau, where *An. gambiae* s.l. mosquitoes were resistant to deltamethrin in all selected Local Government Areas, susceptibility to deltamethrin was observed at all sampling sites in Kebbi and Benue states. Pre-exposure of resistant mosquitoes to PBO restored deltamethrin susceptibility in *An. gambiae* s.l. from Akwa, Ibom, Cross River, Ebonyi, Oyo, Sokoto, and Zamfara. Alpha-cypermethrin resistance observed in *An. gambiae* s.l. in Akwa Ibom, Oyo, Nasarawa, Plateau, Sokoto, and Zamfara states; susceptibility was restored when pre-exposed to PBO.

- Trained 72 entomology technicians and mosquito collectors, as well as 33 ITN data collectors to assess ITN ownership and use among households in five sampled Local Government Areas (LGAs) in Ebonyi prior to distribution of PBO nets across the state. Data collected will feed into the program monitoring dashboard described above.
- Worked with NMEP to conduct a National Entomological Review meeting in Lagos.

## I.20 RWANDA

**TABLE 10: VL RWANDA IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	Two districts (Kirehe and Nyagatare)
Insecticide	Fludora Fusion
Number of structures sprayed	221,712
Number of structures found	226,169
Spray coverage	98%
Population protected by PMI-supported IRS	915,047 (13,222 pregnant women; 130,647 children under 5 years old)
Dates of PMI-supported IRS campaign	September 2-24, 2019
Length of campaign	20 days
Number of people trained with U.S. Government funds to deliver IRS*	2,128**

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

\*\*In Rwanda Sector IEC's are also included in this calculation because they have supervision responsibilities separate from mobilization.

### PROGRAM HIGHLIGHTS

- Conducted IRS in two districts, spraying 221,712 structures of the 226,169 found by SOPs. 915,047 people were protected with a 98% spray coverage. A third district, Ngoma, including 89,000 structures, will receive IRS in January/February 2020.
- Implemented IRS using a combination of walk-to-work and vehicle transportation in all 34 operational sites. This strategy reduces cost and the project's carbon footprint, promotes health benefits through physical activity and mitigates risks associated with motor vehicles accidents.
- With the support of District Leadership, VL implemented a new strategy for community mobilization in both Kirehe and Nyagatare districts. The strategy engaged diverse groups and clubs, such as cell and village leaders, Isibo leaders, policing, youth volunteers, and community health workers, at no cost to the project, to conduct door-to-door community mobilization, reducing costs by approximately \$27,000. The strategy was successful and will be implemented in the new district in 2020.
- Constructed concrete soak pits with sloped wash areas that pipe effluent to a separate soak pit, and rolled out the construction of the soak pits in 32 operational sites in both districts. If well-maintained, the new soak pits are expected to last more than five years.
- For the second year, VL Rwanda adopted electronic banking and mobile money payment systems. All transport allowances for meetings and trainings were paid using mobile money. Salaries for team leaders, spray operators, washers and guards were paid through mobile money.
- Rolled out VectorLink Collect for the 2018 IRS Campaign. Rwanda's Malaria and Other Parasitic Diseases Division (MOPDD) is also using VectorLink to house their IRS data. In both instances, data collection, entry, and storage were managed by VL Rwanda.

- Provided technical support to MOPDD to support Global Fund-funded IRS districts, namely Huye, Gisagara Bugesera, Gatsibo, Ngoma, Kayonza and Rwamagana in the area of M&E, focusing on data collection, data cleaning and reporting during the implementation of the spray operations.
- Assessment of quality of spraying in both districts following September 2019 spray campaign showed 100% mortality of susceptible *An. gambiae* s.s.. Conducted WHO susceptibility tests of the main vector *An. gambiae* s.l. to carbamates, organophosphates, organochlorines, pyrethroids and neonicotinoids. Vector was resistant to pyrethroids and DDT. No resistance was observed to organophosphates, carbamates, or neonicotinoids.
- Given Actellic CS has been used for several years in Rwanda, VL shifted to spraying a new insecticide (Fludora Fusion WP 56.25) in 2019 in line with the national insecticide management strategy.

## 1.21 SENEGAL

### PROGRAM HIGHLIGHTS

- During the first two years of the project, entomological surveillance was the main activity conducted in Senegal. Under the oversight of VL and NMCP, implementation of field and laboratory activities was completed through the Vector and Parasite Ecology Laboratory of University Cheikh Anta Diop in collaboration with the Research Institute for Development and Institut Pasteur de Dakar. In 2019, additional activities outside routine surveillance were included which include the assessment of ITN distribution, a malaria urban landscape analysis and preparation for spraying to resume in 2020.
- Monitored the dynamics of malaria vectors. Distribution of malaria vectors, resting and biting behavior, anthropophilic rate as well as contribution in malaria transmission were determined according the different climatic areas in the country.
- Monitored the resistance of vectors to insecticides used in public health: The mapping of vector resistance to different insecticides showed *An. gambiae* s.l. resistance to pyrethroid and susceptibility to pirimiphos-methyl, chlorfenapyr and clothianidin.
- Monitored the ecological and determinants of malaria transmission in urban areas of Diourbel, Touba and Kaolack: This assessment included identification of permanent and temporary breeding sites for malaria vectors, monitoring of malaria vector composition and behavior, insecticide resistance testing, and a household survey to understand vector control practices.
- VectorLink in collaboration with NMCP carried out a survey with national partners and peripheral structures on the various stages of the routine ITN distribution system. The preliminary report including recommendations was sent to PMI for the preparation of the FY20 Malaria Operational Plan.
- Worked with the NMCP to begin planning for the 2020 PMI-funded IRS campaign which included the selection of spray districts (Koumpentoum, Koungheul, Maka Coulibanta and Kedougou) and the selection of insecticides (Fludora Fusion and SumiShield).
- Began recruiting vendors to refurbish entomological lab spaces and establish a new insectary on-site.

## 1.22 SIERRA LEONE

### PROGRAM HIGHLIGHTS

- VectorLink Sierra Leone conducted monthly entomological monitoring in eight sentinel sites in four districts representing the four regions in Sierra Leone: Lagon and Gerihoun in Bo (Southern Region), Kamaranka and Masongbo in Bombali (Northern Region), Teikor and Sori Town in Kono (Eastern Region) and Sand Sand Water and Tombo in Western Rural (Western Region). Synergist assays with PBO using the WHO procedures were conducted with permethrin 0.75% and deltamethrin 0.05% in Gbanti Kamaranka in Bombali, Jaima Bongor in Bo, Nimyama in Kono and in Koya in Western Rural Area. *An. gambiae* s.l., the predominant vector in all sentinel sites, is highly resistant to permethrin. The timely completion of the PBO testing facilitated the procurement of PBO nets for the 2019 mass campaign.



- Cameroon-based partner Centre for Research in Infectious Diseases analyzed subsamples of malaria vectors collected for species identification, detection of Plasmodium infection and mechanism of resistance determination.
- Supported the NMCP in review of the Insecticide Resistance Monitoring and Management Plan.
- Trained 17 environment health officers from the sentinel districts (Bo, Bombali, Kono and Western Rural Area) and two NMCP/MOH staff on entomological monitoring, including morphological identification of Anopheles, susceptibility tests and cone bioassays in Makeni.
- Supported the NMCP's bioefficacy testing of the ITNs distributed in 2017 by providing *An. gambiae* Kisumu strain for the cone bioassay.
- Supported the NMCP in the review of the Integrated Vector Management policy and strategic plan.

## 1.23 TANZANIA

**TABLE 11: VL TANZANIA IRS AT A GLANCE**

	Tanzania Mainland	Zanzibar	Total
Number of districts sprayed by PMI-supported IRS	7 (Bukoba Rural, Missenyi, Ngara, Chato, Nyang'hwale, Buchosa, Kakonko)	10 (Central, Chakechake, Micheweni, Mkoani, North A, North B, South, West A, West B, Wete)	17
Insecticide	Clothianidin (SumiShield 50WG)	Pirimiphos-methyl (Actellic®300 CS)	
Number of structures sprayed	501,584	94,339	595,923
Number of structures found	525,222	99,126	624,348
Spray coverage	95.5%	95.2%	95.4%
Population protected by PMI-supported IRS:	1,926,767	477,243	2,404,010
Children under five	353,983	82,717	436,700
Pregnant women	65,311	12,892	78,203
Dates of PMI-supported IRS campaign	Oct. 24–Nov. 20, 2018	Feb. 23–Mar. 17, 2019	
Length of the campaign	27 days	20 days	47 days
Number of people trained with U.S. Government funds to deliver IRS*	2,340	559	2,899

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

### PROGRAM HIGHLIGHTS

- VL Tanzania sprayed 595,923 structures out of 624,348 structures found by spray operators (SOPs) in the targeted districts, a coverage rate of 95.4 percent. The project protected 2,404,010 residents, including 436,700 children under the age of five and 78,203 pregnant women.
- Trained 2,899 individuals to deliver IRS in the 17 targeted districts. Of these, 2,442 were SOPs (949 females and 1,493 males), 69 were supervisors (19 females and 50 males), and 388 were team leaders (168 females and 220 males). Females accounted for 38.9 percent of the SOPs trained. Of all individuals trained for the October 2018–March 2019 IRS campaigns, 35.3% (1,360) were female.
- VL used 154,744 sachets of SumiShield in Mainland and 27,193 bottles of Actellic in Zanzibar.
- Recruited an M&E Officer and a Regional Coordinator.
- Introduced culturally-appropriate PPE skirts for women in Pemba, Zanzibar. The skirts were well-received and will be expanded to all of Zanzibar for the next IRS campaign. The project employed a

pregnant SOP applicant to cross-check data, an employment opportunity without risk of insecticide exposure.

- Conducted half-day workshops on the VectorLink Collect database targeting the NMCP and ZAMEP staff to build local capacity.
- Distributed 288,000 PBO bed nets and 148,550 ITN coupons to 179 health facilities in Zanzibar.
- Received 1,200,000 PBO ITNs for distribution through the School Nets Programme in October in the regions of Geita, Kagera, Mwanza and Kigoma.

## 1.24 UGANDA

**TABLE 12: VL UGANDA IRS AT A GLANCE**

Funding		DFID		PMI	
		Actellic	SumiShield	Actellic	SumiShield
Insecticide used		Actellic	SumiShield	Actellic	SumiShield
Number of districts covered by PMI/DFID-supported IRS		4	1	9	1
Number of structures found by PMI/DFID-supported IRS SOPs		295,941	80,472	844,591	172,558
Number of structures sprayed PMI/DFID-supported IRS		281,838	75,219	789,621	144,891
Spray coverage		95.2	93.5	93.5	84.0
Population protected with PMI/DFID support	Total Pop:	790,044	198,440	3,044,358	446,315
	Children < 5:	143,615	32,889	619,909	66,123
	Pregnant Women:	15,648	3,807	88,950	10,672
Dates of campaign		May 27 - June 27, 2019		March 18 - April 15 and May 27 - June 27, 2019	
Length of campaign		24 days	24 days	24 days	24 days
Number of people trained with US/DFID government funds to support IRS		2,365		6,216	

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

### PROGRAM HIGHLIGHTS

- VL Uganda successfully conducted a two-phase IRS campaign in 15 districts. The project used Actellic in 13 districts and piloted the use of SumiShield in two districts (Dokolo and Lira). USAID/PMI funds supported spraying for 10 of the districts, while the United Kingdom's Department for International Development (DFID) funded spraying in the other five (Alebtong, Amolatar, Dokolo, Kaberamaido, and Otuke). VL sprayed the eight Phase I districts (Budaka, Bugiri, Butaleja, Butebo, Kibuku, Namutumba, Pallisa, and Tororo) from March 18–April 15, 2019, and the seven Phase II districts (Alebtong, Amolatar, Dokolo, Kaberamaido, Lira, Otuke, and Serere) from May 27–June 27, 2019. VL conducted spray campaign supervision in collaboration with district and MOH staff.
- Sprayed 1,291,569 of the 1,393,562 structures found in the 15 IRS target districts, for a coverage rate of 92.7%. A total of 4,479,157 people protected, including 862,536 (19.3%) children under five years and 119,077 (2.7%) pregnant women.

- The project used 449,604 bottles of Actellic 300CS and 91,553 sachets of SumiShield 50WG with a consumption rate of 2.4 houses per bottle or sachet of insecticide.
- Conducted a pilot of the mobile soak pit II in Serere, Lira, and Alebtong districts during May – June 2019 to reduce the need for SOPs to travel long distances back to operations sites. The MSP II is larger and more durable than the original MSP, and services up to three spray teams. Trained VectorLink staff, district NMCP health officers, and seasonal spray teams on construction, installation, and use of the MSP II.
- IRS insecticide-contaminated wastes were incinerated at Green Label Ltd. Other solid wastes, including empty bottles and assorted plastics, were recycled at Gentex Enterprise Ltd, while paper cartons will be recycled at Pulp and Paper Mills Ltd.
- Wall bioassays conducted within one week of spraying to assess the quality of spraying in eight of the 15 target districts recorded 100% mortalities for susceptible *Anopheles gambiae* s.s. The average mortality at one and two months post spray was 100%, indicating satisfactory spray quality.

## I.25 ZAMBIA

**TABLE 13: VL ZAMBIA IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	Twenty-Six districts across Four Provinces (Luapula, Muchinga, Northern, and Eastern)
Insecticide	Actellic 300CS (Northern, Luapula, Muchinga) and SumiShield (Eastern)
Number of structures sprayed	579,490
Number of structures found	644,677
Spray coverage	89.9%
Population protected by PMI-supported IRS	2,818,176 (411,416 children under the age of five, and 89,959 pregnant women)
Dates of PMI-supported IRS campaign	October 15- December 15, 2018
Length of campaign	34 operational days
Number of people trained with U.S. Government funds to deliver IRS*	2,089

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

### PROGRAM HIGHLIGHTS

- In 2018, VL supported IRS in 26 districts across Luapula, Northern, and Muchinga Provinces under the main program, and in three districts in Eastern Province (Katete, Sinda, and Chadiza) under the pre-elimination program. A total of 630,000 eligible structures were targeted; 450,000 structures in the three provinces to be sprayed with Actellic 300CS, and 90,000 structures in the three pre-elimination districts of Eastern Province to be sprayed with SumiShield.
- The 2018 spray campaign lasted for 30 operational days on average and achieved a spray coverage of 90%. 579,490 eligible structures were sprayed out of 644,677 structures found by SOPs in the targeted districts. The campaign protected a total of 2,818,176 residents including 411,416 (14.6%) children under the age of five, and 89,959 (3.2%) pregnant women.
- Based on entomological surveillance following the 2018 IRS campaign, the residual efficacy of SumiShield was seven months, and three to five months for Actellic 300CS.
- In 2019, the NMEP requested VL to support IRS in 20 districts (all 10 districts of Copperbelt Province, all nine districts in Eastern Province, and Nchelenge District in Luapula Province). VL procured 53,877 sachets of Fludora Fusion for Copperbelt Province and Nchelenge District and 116,188 sachets of SumiShield for the Eastern Province. Required spray equipment and materials

were also procured.

- Based on the shift in geographical scope of the 2019 IRS campaign, VL established new entomological sentinel sites in Mambwe, Lufwanyama, Chililabombwe and Nchelenge and continued supported in the three existing sites (Kasama, Serenje and Milenge). The team also hosted a national entomology training for Environmental Health Technicians in 2019.
- VL worked closely with the NMEP and other provincial and district stakeholders to plan for the campaign and harmonize spray tools.
- Conducted pre-season environmental compliance assessments in all 20 PMI-supported IRS districts, and supported the necessary repairs and rehabilitations with the deficiencies found. A total of 31 new operation sites were established across the three provinces.
- The 2015-2020 Supplemental Environmental Assessment (SEA) amendment was approved by PMI, and allowed for the provision of technical assistance to NMEP on the use of DDT for IRS. It also authorized the use of Fludora Fusion.
- Provided technical assistance to the NMEP to successfully transition to DDT. The project supported one NMEP staff to travel to Zimbabwe on a study tour of DDT use for IRS. In addition, VectorLink trained 60 GRZ officials on the use of Mobile Soak Pits (MSPs) to treat DDT effluent, and also donated 61 MSPs to the NMEP for use in the DDT districts.
- Since March 2019, VL has participated in ITN Task Team Coordination meetings and is represented on the Monitoring and Evaluation and Technical & Implementation ITN sub-committees officially established by the NMEP in July 2019.
- Continued work to support vector control program planning and evaluation. Developed interactive dashboards on product choice, IRS and ITN coverage, and IRS timing and presented them during a data review workshop in February 2019. Based on feedback from the workshop, the team revised existing and developed new visualizations to support IRS microplanning and Zambia's Malaria Operational Plan. The results of this work will be documented in a data use case study later this year.
- Rains and inadequate community mobilization led to less than a minimum 85% coverage in three districts, while migration of the communities to camps for caterpillar harvesting affected 15 of the 29 districts. To address these challenges, the project overhauled the mobilization strategy by engaging chiefs and headmen (in rural communities) and section leaders (in urban areas) instead of community health workers. For the 2019 spray campaign, the project planned to use the newly WHO-approved insecticides that have a longer residual efficacy and to spray by early October before the onset of rains and caterpillar season.

## 1.26 ZIMBABWE

**TABLE 14: VL ZIMBABWE IRS AT A GLANCE**

Number of districts covered by PMI-supported IRS	2 districts: Mudzi, Mutoko
Insecticide	Pirimiphos-methyl (Actellic 300CS)
Number of structures sprayed	112,805
Number of structures found	125,249
Spray coverage	90.1%
Number of eligible structures found by Geo-mapping	149,645
Population protected by PMI-supported IRS	276,343 (including 3,846 pregnant women and 43,789 children under 5 years old)
Dates of PMI-supported IRS campaign	November 5 to December 18, 2018
Length of campaign	37 days
Number of people trained with U.S. Government funds to deliver IRS*	295 (232 men, 63 women)

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

## PROGRAM HIGHLIGHTS

- VectorLink Zimbabwe continued to implement a full package of IRS support in two districts (Mudzi, Mutoko) in Mashonaland East Province and provided technical and limited material support for transitioning out of the four districts in Manicaland Province (Nyanga, Mutasa, Mutare, and Chimanimani), previously under PMI support.
- The project worked with national, provincial, and district government stakeholders to conduct micro-planning and post-IRS conference meetings to most effectively review and plan for spray operations.
- The launch of the 2018 IRS campaign in Mudzi and Mutoko was postponed by a week to allow sufficient time to stockpile fuel, and secure lorries and trucks for the campaign.
- In collaboration with provincial and district health staff, VL funded and provided technical assistance for district and community mobilization meetings with stakeholders, influential leaders, and IRS beneficiaries.
- Mitigated fuel shortages during the 2018 campaign through the early procurement and storage of fuel to ensure there was enough to last the campaign. Shortages of cash and fuel coupled with a three-tier pricing system in a USD-denominated cash economy posed huge challenges, sometimes resulting in delayed implementation of planned activities. Limitations in transacting and accessing cash from the banks also resulted in delayed payments to SOPs and vendors, though all were by mid-March 2019 through a project-established cash-in-transit system or through electronic banking.
- Successfully piloted the rollout of the Mobile Soak Pit for managing DDT liquid waste in the four PMI-supported districts in Manicaland.
- Following the 2019 campaign, IRS waste was disposed of by February 2019 through incineration in Hwange or recycled through a local company, David Tebogo Investments.
- Collaborated with the NMCP and Mashonaland East provincial health officials and Allied Systems to conduct geo-mapping in Mudzi and Mutoko districts, which included using satellite and machine imagery provided by Digital Globe to guide identification of eligible structures as part of a ground-truthing exercise. Results from the geo-mapping exercise were used to set spray targets and develop spray calendars for the 2019 IRS campaign.
- Hired a full-time M&E manager to directly support data collection and reporting, mHealth supervisory checklists, and SMS job aids in the field as well as monitor the geo-mapping exercise. Hired a full-time Logistics and Procurement officer to support procurement, warehousing and logistics of malaria commodities.
- Procured reagents for mosquito analysis at Africa University and established a formal partnership through Africa University to conduct laboratory processing of mosquito samples.
- Engaged a consultant to support the completion of the insectary at Africa University.
- The project began preparations for the 2019 spray campaign. This included support of micro-planning meetings, mobilization efforts at the district and community level, initiating refurbishment of eight traditional campsites in Mudzi and Mutoko Districts in Mashonaland East Province and completion of the SEA in August 2019.
- Conducted post-spray environmental compliance inspections in February 2019 which involved the official closing of all IRS campsites that were used during the 2018 season.

## 2. CORE

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### 2.1 OPERATIONS RESEARCH

#### **Small-scale Field Pilot of Partial IRS with pirimiphos-methyl in Households in Northern Ghana for Malaria Vector Control**

VL is conducting a small-scale pilot study of partial IRS with pirimiphos-methyl at the community level in Northern Ghana. The current assessment is a prospective observational study to determine the feasibility and impact on cost of a partial IRS campaign and impact on vector population under natural field conditions. This study has been conducted in a total of eight communities, two per each of three IRS districts and one district that has not been previously sprayed (control), in the Northern Region of Ghana. The IRS communities are: Gbullung and Gupanarigu (Kumbungu District); Kpemale and Bunbuna (Bunkpurugu Nakpanduri District); and Banda-ya and Tum-Tu Zie (Gushegu District). Kulaa and Tugu are communities in the Tamale metropolis and serving as control communities. In each of the three IRS districts, one community received partial spraying and the other received full IRS with Actellic 300CS®. The communities were sprayed in May 2019 after the baseline data collections in April. Post-intervention data collection started in June 2019 in all study communities and will be completed in December 2019.

### 2.2 MONITORING AND EVALUATION

**VectorLink Collect Implementation and Rollout:** As the central, global database for the project, VectorLink Collect was developed on the DHIS 2 platform and will house all IRS and entomological data across the 25 PMI VectorLink focal countries by the end of Year 3. As of September 30, 2019, VectorLink Collect had been rolled out for IRS campaign data management and analysis in eight countries, including Burkina Faso, Kenya, Malawi, Mali, Rwanda, Tanzania, Uganda and Zambia. System development and preparatory work was also completed in Madagascar, Mozambique and Zimbabwe for system rollout in October/November 2019 spray campaigns. With VectorLink Collect, IRS data are available in almost real-time for program monitoring, quality assurance, and analysis through a variety of core DHIS2 visualization functionalities. The M&E team and BAO continued to develop data analytics and user-friendly dashboards to support overall accessibility, interpretation, and use of program data.

The VL M&E team, VectorLink Collect system administrator, and BAO Systems continued to make system refinements and stress-test the VectorLink Collect online data entry portal, offline desktop application, data quality assurance tools, and other associated tools. The project supported country-specific mobile data pilots for IRS data collection in Burkina Faso and Kenya, and ensured that collected data were integrated into VectorLink Collect. VL supported continued use of the Access-based spray databases and cleaning/reporting tools for Benin, Ethiopia and Ghana to ensure continued access to spray data and to support ongoing, day-to-day monitoring of progress during spray campaigns. These countries will roll out VectorLink Collect in 2020.

**VectorLink Collect Entomology Modules:** In collaboration with PMI VL initiated an intensive review and mapping of entomology related data flows and data collection processes, began updating and refining VL entomology data collection forms and advanced the development of core entomology programs within VectorLink Collect. The team developed five VectorLink Collect entomology programs to manage vector bionomics (longitudinal monitoring), insecticide resistance and insecticide residual life data. Five entomologists were also trained on these initial programs during the April 2019 Regional M&E training in Kigali, Rwanda.

**Expedited Roll out of VectorLink Collect:** The U.S. Global Malaria Coordinator requested that VL expedite the rollout of VectorLink Collect entomology programs and to fast track the importation of legacy IRS and entomology data into VectorLink Collect. These activities and timelines were outlined in a July 2019 VectorLink ‘Acceleration Plan’, approved by PMI. PMI approved a template for legacy IRS data in early September 2019, and VectorLink initiated the data compilation process.

**Collaboration with WHO DHIS2 Development:** VL has collaborated with relevant global partners to ensure alignment with other global DHIS2 initiatives. During the reporting period, this includes:

- Collaboration with WHO to ensure that the VectorLink Collect IRS and Entomology programs will be well aligned with the WHO DHIS 2 modules, to facilitate data transfer in the most efficient, seamless way possible and to share VectorLink experiences to inform WHO modules still in design. WHO and VectorLink agreed to develop a mapped data dictionary to demonstrate alignment between VectorLink Collect and WHO DHIS2 modules, and relate metadata between the two systems.
- Collaboration with CHAI through the Digital Solutions for Malaria Elimination (DSME) initiative, to discuss complementary investments in malaria information system design and development. This included the exploration of different data transfer options or integration for consideration and piloting in Mozambique. The PMI Mozambique team has participated in the discussions between VectorLink, WHO, and CHAI, and has been championing the need for system alignment and integration in the interest of longer term sustainability.

**PMP Indicator Review:** VL and the PMI COR team jointly conducted a comprehensive review of the VectorLink Performance Management Plan to ensure relevance and appropriateness of indicators. This review was conducted from May to July 2019, and resulted in several refinements of results and indicator language, removal/addition of indicators, as well as updates to respective performance indicator reference sheets for standardized operationalization.

**Regional VectorLink Collect Training** was conducted during this reporting period to provide a comprehensive orientation and training for selected staff on DHIS2 and the VectorLink Collect system. VL home office M&E specialists, system administrators, and BAO project staff designed and carried out this four-day comprehensive training, held in April 2019 in Kigali, Rwanda, for 17 staff from six VL countries: Rwanda, Zimbabwe, Mozambique, Madagascar, Burkina Faso and Mali. In addition to building necessary technical skills and system competencies, this training helped the associated roles and responsibilities around data collection, data entry, data management, and system management. Post training evaluations helped to guide more targeted, customized follow-up technical support to specific country teams where competency or knowledge gaps were identified. VL updated M&E related modules of the overall PMI IRS Training Curriculum, in collaboration with the VectorLink Operations team.

## 2.3 GENDER

Across the project, innovative approaches led by field-based staff advanced the project's gender mainstreaming and female empowerment goals, and the project continues to disseminate results to inform the global dialogue. Following a successful pilot in Ghana and Kenya where the freedom from harassment policy was printed on the reverse of seasonal worker contracts, the project rolled this out as a new standard for all programs with seasonal labor. The project piloted new PPE for women in Pemba, Zanzibar. The new PPE include a long skirt, which aligns with typical dress for women in Pemba. The skirts were well-received, with some feedback from users on sizing and fabric color.

Following a presentation on gender integration in IRS at a boot camp in Ghana, the AGAMal began integrating women in its field operations for the first time since its inception in 2006. AGAMal is the only other organization in Ghana implementing IRS; it is financed by the Global Fund.

VL presented at the South Africa Malaria Research Conference in July. The Zambia team shared results of an assessment of the effect of increased women's participation on IRS operations in Zambia. Additionally, VL welcomed a new gender focal point in Zambia and started a WhatsApp group to facilitate communication among the project's gender focal points.

## 2.4 ENVIRONMENTAL COMPLIANCE AND SAFETY

VL produced one SEA (for Madagascar), four SEA Amendments (for Benin, Kenya, Uganda and Zambia), and nine Letter Reports as needed, where the SEAs were current.

VL Home Office environmental compliance staff traveled to Madagascar, Malawi, Uganda, Ethiopia and Zambia to provide technical assistance for the country programs. In Madagascar, ECD met with officials and

gathered information and produced an update to that country's 2019 SEA. In Uganda, two STTAs were conducted, the first was geared towards supporting a pilot of the MSP II, and to train and assist the new Environmental Compliance Assistant, due to the loss of the Environmental Compliance Officer just prior to the campaign, while the second was for field trips to support the preparation of the new nationwide SEA for 2020 to 2024. In Zambia, technical assistance from the Home Office was provided to the NMEP to support the transition to spraying with DDT, using the MSP II in place of evaporation tanks, and to provide training on environmental compliance elements. In Malawi, VL ECD provided a six-day boot camp to the Malawi NMCP for environmental compliance training.

## 2.5 CONFERENCES

The project had 14 abstracts accepted to the 2018 **PAMCA conference**, four of which were oral presentations, one was a booster talk and nine were poster presentations. Links to the presentations can be found here: <https://pmivectorlink.org/2019/09/23/pmi-and-pamca/>. VL presented five posters at the **American Society of Tropical Medicine and Hygiene 2018 Conference**. In 2019, VL submitted 10 abstracts to the conference. Two were accepted as oral presentations and eight were accepted as poster presentations.

In January 2019, VL participated in the **Alliance for Malaria Prevention and Roll Back Malaria Annual Vector Control Working Group** meeting. VL presented on the use of the DHIS2-based VectorLink Collect system, highlighted how it has supported VL's efforts to standardize data collection and reporting, and showcased sample IRS dashboards used to inform decision-making.

VL attended the **DHIS2 Symposium** in April. Two team members gave a presentation on integrating vector control data at global scale. The session focused on: why VectorLink chose DHIS2; how IRS and entomology data will be integrated for decision making; a review of the custom offline applications and cleaning tools that were developed for our program context; and a review of lessons learned and future plans. In June 2019, two VectorLink M&E Specialists participated in the DHIS2 Annual Conference, formerly known as the DHIS2 Experts Academy. This conference/training brought together over 216 stakeholders and DHIS2 practitioners from 61 countries to share experiences and best practices around system configuration and implementation. VL presented on the first day of the conference during a 3-hour session on "Malaria Surveillance", one of few presentations representing the use of DHIS2 in high-burden malaria-control settings.

Project staff presented a poster at the **South African Malaria Research Conference** assessing the effect of women's participation on IRS operations in Zambia and the project's gender advisor participated in the 2019 **Women Deliver** conference in Vancouver, Canada.

## 2.6 COMMUNICATIONS

During this reporting period, 10 success stories, one photo story and two videos were produced and posted on the project and PMI websites, and distributed via the PMI VectorLink quarterly e-letter (see Annex B). In addition, the VL manuscript "Susceptibility testing of *Anopheles* malaria vectors with the neonicotinoid insecticide clothianidin; results from 16 African countries, in preparation for indoor residual spraying with new insecticide formulations" was published in the *Malaria Journal* on August 1, 2019.

For World Malaria Day, VL rebranded and shortened an AIRS video to promote VL. Resources, tool kits, trainings, and videos were added to the Vector Learning~~exchange~~ (VLX), and two ITN webinars were hosted on the VLX (in both French and English). VL distributed four e-letters (January, April, June, and August) and five e-alerts (April for World Malaria Day, August for World Mosquito Day, May for the ITN VLX Webinar, September for Gift Wants to Be A Police Officer video, and October 2018 for ASTMH) to nearly 4,000 global health professionals.

In May 2019, the project introduced a new weekly series, called Fist Bump Fridays, to recognize teams and individuals in the field who are creating impact through innovation and hard work. The Fist Bumps are meant to motivate and build team morale as well as share new ideas. Eighteen Fist Bumps were sent out during this reporting period and can be found here: <https://pmivectorlink.org/field-notes/>.

Nine Tech Talks (EC, Comms, Gender, PIP Process, Operations/Finance, Understanding the Pipeline, Procurement, Budget Tracking, VC Steering Committees) were held with all COPs.



The project website was updated to reflect the project’s integrated vector approach, including our work in data analytics and ITNs with an added page on each. Two technical briefs on the new technical areas were produced and shared widely. Four infographics were created showing project impact, including the number of structures, number of people trained, number of people protected and our IRS, ITN and entomological monitoring activities by country. Links to graphics can be found in Annex B.

## 2.7 GLOBAL WORKSHOP

The PMI VectorLink Project held a Global Workshop in Kigali, Rwanda, from March 23-25, 2019. The workshop participants included all members of the PMI Contracting Officer’s Representative (COR) Team, the home office-based PMI VectorLink team, Chiefs of Party, Technical Manager, and Operations Managers from each VectorLink country office, representatives from Abt’s core partners (PSI and PATH), and two NGenIRS staff. Participants shared lessons learned and best practices in the key program/technical areas of IRS, entomological monitoring, data analytics, ITNs and environmental compliance and safety. The workshop also focused on improving vector control management and supervision by country leadership team and looked at ways to implement new IRS models/approaches that are potentially more sustainable and cost-effective, while maintaining spray quality.

## 2.8 NGENIRS

In 2019, VL Director of Project Operations and Procurement and Logistics Manager liaised with NGenIRS on all activities. This included participation in stakeholder meetings with other relevant PMI VL colleagues, monthly coordination meetings, and regular communication on insecticide forecasting and orders. All PMI spray programs implemented through VL participated in the NgenIRS project in 2019.

Actellic and SumiShield procurements were co-paid to a net price of \$15 per Actellic bottle and SumiShield sachet. SumiShield co-payments included: Burkina Faso, Ghana, Kenya, Mali, Madagascar, Malawi, Tanzania Uganda and Zambia. Actellic co-payments included: Benin, Ethiopia, Ghana, Kenya, Mali, Malawi, Tanzania and Uganda. Six countries used Fludora Fusion in 2019 but Fludora Fusion was not co-paid under the NGenIRS Project as the manufacturer’s price is already below \$15.

NGenIRS carried out three regional insecticide forecasting workshops for VL staff, NMCP and other malaria stakeholders. PMI VectorLink Headquarters was represented in both the Mozambique and Benin workshops. See Table 15 for details. Workshop achievements included allocation of funds for each country validated; estimated insecticide volumes for 2020 spray campaigns determined with NMCPs and linked to funding sources; shared country experiences with VC steering committees; IRM plans and lessons learned; and information gathered, which informed minimum volume guarantee negotiations between NGenIRS and suppliers.

**TABLE 15: REGIONAL WORKSHOPS FOR INSECTICIDE FORECASTING**

Venue	Dates	Countries in attendance	No. of Participants
Maputo, Mozambique	7/24/19-7/25/2019	Rwanda, Zimbabwe, Zambia, Mozambique, Kenya, Malawi	35
Cotonou, Benin	8/20-8/21	Madagascar, Mali, Burkina, Senegal, Ivory Coast, Benin	26
Addis Abbaba, Ethiopia	9/4-9/5	Ghana, Ethiopia, Uganda, Tanzania/Zanzibar, Sierra Leone	33

## 2.9 FINANCE

This year the project focused on capacity building for Finance and Procurement site office staff. VL held monthly online trainings hosted by Abt’s home office Finance and Procurement team, which culminated in a three-day Finance and Procurement Workshop in August 2019 in Zambia. The workshop brought together a total of 35 site office finance and procurement staff and 12 home office finance, procurement and operations staff from 22 VectorLink countries. Topics included in-depth interactive discussions on VL procurement best practices and the procurement life cycle, reviews on USAID rules and regulations, as well as overviews of budget and procurement tracking tools, the development of accurate projections and expectations of F&A Managers and Procurement Officers in VL site offices.

# ANNEX A:

## M&E RESULTS SUMMARY

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Country	# Structures Sprayed	# Structures found	Spray Coverage	Total Population Protected	Children Under Five Protected	Pregnant Women Protected	# People Trained to deliver IRS
Benin	335,207	387,711	86.5%	1,077,411	243,648	51,872	1,623
Burkina Faso	201,901	220,482	91.6%	587,248	92,809	11,959	2,045
Ethiopia	487,746	510,449	95.5%	1,334,868	228,262	33,245	2,297
Ghana	298,385	316,285	94.3%	875,481	157,398	19,844	864
Kenya	507,777	551,689	92.0%	2,011,860	249,275	44,999	2,974
Madagascar	548,789	586,768	93.5%	2,232,098	328,092	85,821	2,511
Malawi	112,264	118,355	94.9%	501,324	90,953	11,066	575
Mali	148,198	153,191	96.7%	690,793	98,217	34,484	616
Mozambique	387,413	409,908	94.5%	1,663,078	237,944	90,089	1,577
Rwanda	221,712	226,169	98.0%	915,047	130,647	13,222	2,128
Tanzania	595,923	624,348	95.4%	2,404,010	436,700	78,203	2,899
Uganda	1,291,569	1,393,562	92.7%	4,479,157	862,536	119,077	7,274
Zambia	579,490	644,677	89.9%	2,818,176	411,416	89,959	2,089
Zimbabwe	112,805	125,249	90.1%	276,343	43,789	3,846	295
TOTAL	5,442,153	5,859,345	92.90%	21,866,894	3,611,686	687,686	29,767

# ANNEX B: COMMUNICATIONS

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## SUCCESS STORIES

<https://pmivectorlink.org/2019/09/30/closing-the-entomology-gap-in-zambia/>  
<https://pmivectorlink.org/2019/09/03/johns-hopkins-university-visits-pmi-vectorlink-zambia/>  
<https://pmivectorlink.org/2019/08/22/ghanas-community-health-nurses-help-spread-the-word-about-irs/>  
<https://pmivectorlink.org/2019/07/12/mobile-data-collection-for-rapid-decision-making/>  
<https://pmivectorlink.org/2019/07/12/gender-success-in-ghana/>  
<https://pmivectorlink.org/2019/05/29/reducing-costs-and-expanding-coverage/>  
<https://pmivectorlink.org/2019/05/16/mobilizing-the-masses-against-malaria/>  
<https://pmivectorlink.org/2019/05/14/fighting-malaria-and-poverty/>  
<https://pmivectorlink.org/2019/05/07/it-takes-a-village-to-fight-malaria/>  
<https://pmivectorlink.org/2019/04/15/why-we-fight-world-malaria-day-2019/>

## PHOTO STORY

<https://pmivectorlink.org/2019/05/14/photo-story/>

## VIDEOS

<https://pmivectorlink.org/2019/09/23/pmi-vectorlink-protects-the-most-vulnerable-from-malaria/>  
<https://pmivectorlink.org/2019/09/23/gift-wants-to-be-a-police-officer/>  
<https://pmivectorlink.org/2019/09/10/the-importance-of-ento-monitoring/>

## INFOGRAPHICS

<https://pmivectorlink.org/2019/09/04/2018-results-and-project-outcomes/>  
<https://pmivectorlink.org/2019/09/04/pmi-vectorlink-integrated-vector-control-coverage/>

## TECHNICAL BRIEFS

<https://pmivectorlink.org/wp-content/uploads/2019/06/PMI-VectorLink-Integrated-Analytics-Brief-2019-Abt-May-9-2019.pdf>  
[https://pmivectorlink.org/wp-content/uploads/2019/10/PMI-VectorLink-ITN-Tech-Brief\\_Oct-18.2019.docx.pdf](https://pmivectorlink.org/wp-content/uploads/2019/10/PMI-VectorLink-ITN-Tech-Brief_Oct-18.2019.docx.pdf)