



U.S. PRESIDENT'S MALARIA INITIATIVE



THE PMI VECTORLINK  
PROJECT  
ANNUAL REPORT  
OCTOBER 1, 2021–  
SEPTEMBER 30, 2022

**Recommended Citation:** The PMI VectorLink Project. November 2022. *The PMI VectorLink Project Annual Report: October 1, 2021–September 30, 2022*. Rockville, Maryland: The PMI VectorLink Project, Abt Associates.

**Contract:** AID-OAA-I-17-00008

**Task Order:** AID-OAA-TO-17-00027

**Submitted to:** United States Agency for International Development/PMI

**Submitted:** November 14, 2022

**Approved:** December 15, 2022



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# ACRONYMS

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<b>AI</b>	Active ingredient
<b>ANC</b>	Antenatal care
<b>ASTMH</b>	American Society of Tropical Medicine and Hygiene
<b>ATSB</b>	Attractive Targeted Sugar Baits
<b>Bti</b>	<i>Bacillus thuringiensis israelensis</i>
<b>CDC</b>	U.S. Centers for Disease Control and Prevention
<b>CERMES</b>	<i>Centre de Recherche Médical et Sanitaire</i> (Medical and Health Research Center)
<b>CNM</b>	National Center for Parasitology, Entomology and Malaria Control (Cambodia)
<b>CS</b>	Circumsporozoite
<b>DHIS2</b>	District Health Information Software 2
<b>ELISA</b>	Enzyme-linked immunosorbent assay
<b>EPI</b>	Expanded Programme on Immunization
<b>GESI</b>	Gender equality and social inclusion
<b>G2G</b>	Government-to-government
<b>HBO</b>	Human behavior observation
<b>HLC</b>	Human landing catch
<b>IG2</b>	Interceptor G2 [Net]
<b>IRS</b>	Indoor residual spraying
<b>ITN</b>	Insecticide-treated nets
<b>LSM</b>	Larval source management
<b>M&amp;E</b>	Monitoring and evaluation
<b>MOPDD</b>	Malaria and Other Parasitic Diseases Division
<b>NMCP</b>	National Malaria Control Program
<b>NMEP</b>	National Malaria Elimination Program
<b>P.</b>	<i>Plasmodium</i>
<b>PBO</b>	Piperonyl butoxide
<b>PCR</b>	Polymerase chain reaction
<b>PMI</b>	(U.S.) President's Malaria Initiative
<b>PSC</b>	Pyrethrum spray catch
<b>PSI</b>	Population Services International
<b>SBD</b>	School-based distribution
<b>SDM</b>	Streamlined durability monitoring
<b>TOT</b>	Training of trainers
<b>UCAD</b>	University of Cheikh Anta Diop (Senegal)
<b>UCSF</b>	University of California San Francisco

<b>UMP</b>	Uzumba Maramba Pfungwe
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization
<b>ZAMEP</b>	Zanzibar Malaria Elimination Programme



# EXECUTIVE SUMMARY

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The U.S. President's Malaria Initiative (PMI) VectorLink Project is funded by the United States Agency for International Development (USAID), through PMI, and was awarded to Abt Associates on September 30, 2017. PMI VectorLink builds on the indoor residual spraying (IRS) campaigns and entomological monitoring activities implemented under the predecessor PMI Africa Indoor Residual Spraying (AIRS) Project, with an expanded focus that includes support for insecticide-treated nets (ITNs) in addition to IRS under a broader vector control mandate. PMI VectorLink also focuses on data analytics and data visualization to support vector control decisions and measure their impact. During this reporting period, the project actively worked across 23 countries in sub-Saharan Africa as well as in Cambodia and Colombia. The project's activities are supported by Abt's core subcontract partners, Population Services International (PSI) and PATH. In Year 5, technical subcontractors included:

- Dimagi Inc., supporting mobile-based IRS supervision and reporting tools.
- BAO Systems, supporting the District Health Information Software 2 (DHIS2)-based VectorLink Collect system for IRS and entomological data management with hosting services and technical support for custom applications where needed.
- The University of California San Francisco (UCSF), a new partner in Year 5, tasked with leading a training for national malaria control programs (NMCPs) on the use of the Entomological Surveillance Planning Tool during a VectorLink regional training in Senegal.

During this reporting period (October 1, 2021–September 30, 2022), PMI VectorLink conducted successful IRS campaigns in 13 countries: Côte d'Ivoire, Ethiopia, Ghana, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Sierra Leone, Tanzania, Uganda, and Zambia. PMI VectorLink continued conducting routine entomological monitoring in 24 countries, and operations research studies in Colombia, Côte d'Ivoire, and Ethiopia. PMI VectorLink directly managed distribution of ITNs in Senegal and supported local government ITN planning and implementation efforts in Ghana, Senegal, and Zambia. PMI VectorLink carried out net durability monitoring work in 15 countries.

## TOP-LINE RESULTS FROM VECTOR CONTROL ACTIVITIES, OCTOBER 2021–SEPTEMBER 2022

- 4,853,342 structures were sprayed, protecting 17,620,239 people from malaria, including:
  - **2,843,712** children under 5 years of age
  - **562,274** pregnant women
- **25,949** people were trained to deliver IRS with U.S. Government funds.
- PMI VectorLink directly distributed **7,324** ITNs in Senegal, protecting approximately **14,648** people from malaria.

## HIGHLIGHTS FROM THIS REPORTING PERIOD

While COVID-19 restrictions began easing in this period, PMI VectorLink continued to successfully address operational and technical challenges in the context of the pandemic as they arose. Project offices were cautiously reopened, some international travel resumed, and in-country travel returned to nearly pre-pandemic levels. Pandemic-induced procurement and supply chain issues persisted throughout the reporting period, but the procurement and logistics team persevered to ensure that country teams received international procurements of insecticide, personal protective equipment, entomological supplies, and spray equipment so they were able to start spray campaigns on time. Throughout these changes and challenges, PMI VectorLink adapted and updated prevention and response measures as needed to keep staff, partners, and members of the communities where we work safe.

In October 2021, VectorLink supported the National Malaria Elimination Programme (NMEP) in Zambia to distribute piperonyl butoxide (PBO) nets procured by PMI in 469 primary schools in four

Eastern Province districts, facilitating provincial- and district-level training of trainers for Ministry of Health and Ministry of Education staff before distribution, and participating in supervision and monitoring during the campaign. In addition, the team worked with the NMEP to develop a system for school-based distribution (SBD) electronic data entry into DHIS2—the first time that SBD data had been captured electronically in the country.

In February 2022, PMI VectorLink Madagascar began larval source management (LSM) activities via drone, spraying 7,760 hectares of rice fields twice a month through July 17, 2022, in Morombe and Ankazobe districts. The team also conducted larviciding entomological monitoring in 24 sites within those districts, entering data in VectorLink Collect entomology modules. Early results showed a decrease in larval density and human biting rate of adults, and effectiveness of *Bacillus thuringiensis israelensis* (Bti) on the reduction of larval density until at least seven days after spraying.

PMI VectorLink launched LSM in Ethiopia in August 2022 in six towns, conducting biweekly visits and applying Bti or source reduction and entomological monitoring to nearly 50,000 containers in areas where the invasive *An. stephensi* species has been detected. A launch ceremony took place in Dire Dawa and was attended by PMI/USAID and Ethiopian government officials.

In June 2022, PMI VectorLink conducted two important regional trainings on VectorLink Collect Entomology for entomology technical managers and entomology database managers (one for Anglophone countries, one for Francophone), the first in-person regional trainings since the start of the COVID-19 pandemic. These trainings, which took place in Cameroon, focused on refining data quality approaches and fostering critical skills in the use of VectorLink Collect for analysis and interpretation. These were critical steps to strengthening data use processes within our teams and preparing PMI VectorLink country teams to cascade skills building to NMCP counterparts in their respective countries.

In August, PMI VectorLink hosted another in-person entomological training course for Anglophone, Francophone, and Lusophone country participants. The goal of this training, held in Senegal, was to provide more advanced entomological surveillance training to NMCP representatives, with a primary focus on data interpretation and supporting the use of entomological data for vector control decision making. The NMCP participants were those actively working on entomological surveillance or likely to be assigned to such duties in the near future; additional attendees came from partner institutes that directly support NMCP entomological surveillance activities such as the Nigeria Institute of Medical Research and Africa University (Zimbabwe). PMI VectorLink entomology staff who had not previously attended any regional entomology trainings conducted by the project also participated.

PMI VectorLink prioritized efforts to support DHIS2-based solutions for vector control and data management in the countries where we work, and in this reporting period supported government organizations in Cambodia, Malawi, Tanzania, Zambia, and Zanzibar to strengthen their vector control and entomological data management practices and systems.

The project continued to use mobile data collection, with five countries implementing full mobile data collection for IRS campaigns (Côte d'Ivoire, Ghana, Mali, Senegal, and Tanzania) and two countries implementing a hybrid data collection approach using a blend of paper-based and mobile solutions (Madagascar and Uganda) this year. The project also completed a successful pilot for mobile data collection for entomological data capture during this period, and launched efforts to introduce mobile data collection for entomology in nine countries (Côte d'Ivoire, Cameroon, Ethiopia, Ghana, Mali, Nigeria, Senegal, Sierra Leone, and Uganda).

PMI VectorLink revised the **Vector Control Integrated Data Analytics and Visualization Best Practices Guide**, work begun in Year 4, which was completed in this reporting period. The guide was translated into French and is available on the PMI and VectorLink websites.

Finally, to better support the 2021–2026 PMI Strategy launched at the beginning of the reporting period, which includes a strategic focus area on “reaching the unreached,” PMI VectorLink strategically expanded its gender work to focus more broadly on equity integration across all project activities to include hard-to-reach population groups such as refugees, migrants, or people with disabilities.

The following pages outline PMI VectorLink activities and accomplishments for Year 5, beginning with country highlights, followed by core activities, and two annexes.

# 1. COUNTRY HIGHLIGHTS

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## 1.1 ANGOLA

### 1.1.1 PROGRAM HIGHLIGHTS

- Conducted refresher trainings for 21 mosquito brigade staff across seven provinces on how to collect mosquito larvae and adults using standard methods, identify samples to genus level, collect geolocation data, and preserve and store samples for lab analyses. Brigade members also reviewed and observed susceptibility testing protocols.
- Conducted insecticide susceptibility tests and PBO synergist assays in six provinces (Cuanza-Norte, Huambo, Lunda-Sul, Malanje, Uíge, and Zaire) to inform future ITN procurement decisions made by the NMCP, PMI, and other partners. *An. gambiae* s.l. from Cuanza-Norte, Lunda-Sul, Malanje, Uíge, and Zaire were resistant to two or more of the pyrethroid insecticides tested (deltamethrin, alpha-cypermethrin, and permethrin). In Huambo Province, there was either full susceptibility or probable resistance to the pyrethroids tested. Pre-exposure to the synergist PBO either fully or partially restored susceptibility to pyrethroid resistant vectors. Susceptibility tests in Luanda and Lunda-Norte were not conducted during the reporting period due to the limited number of malaria vectors of interest collected.
- Continued monthly community-based entomological surveillance using indoor CDC light traps in Huambo and Luanda provinces to assess species composition and malaria transmission intensity. The team also piloted community-based entomological surveillance in Lunda-Norte province from December 2021-April 2022.
- Continued to strengthen in-country capacity for entomological data analysis and use by sponsoring the participation of one VectorLink Angola technician in two project-wide trainings (one on data interpretation and use through VectorLink Collect and one on entomology best practices in Dakar, Senegal). VectorLink Angola also sponsored an NMCP staff at the latter.
- Continued to strengthen the capacity of *Instituto Nacional de Investigação em Saúde* (National Institute of Health Research), collaboratively maintaining inventory, establishing a workflow for molecular analysis of VectorLink field samples, and setting up database management processes. Received hands-on support on the polymerase chain reaction (PCR) protocol from the CDC molecular entomologist in March 2022. Conducted a hybrid (virtual and in-person) training on CS ELISA in September 2022 for three NMCP staff and two INIS technicians. PMI and CDC HQ provided remote support during interactive Q&A sessions held each afternoon throughout the training. Developed summary reports on key activities, preliminary data, and capacity-strengthening efforts by province, that were translated into Portuguese and disseminated them to national and local officials.
- Following challenges with establishing a susceptible colony in Huambo using *An. coluzzii* SUA strain from The University of the Witwatersrand in South Africa, PMI VectorLink Angola shifted efforts to the Luanda insectary located at the National Institute of Health Research. Temperature and humidity were measured daily, and the optimal mosquito rearing conditions were achieved. A cohort of *An. gambiae* s.s. Kisumu eggs received from CDC Atlanta were imported in March 2022 and reached the F1 generation but did not survive due to fumigation activities proximate to the insectary facility. Lack of coordination with the NMCP on scheduled fumigation activities led to this unfortunate incident and highlighted the need for good communication and clarity of roles. A new collaboration is in progress with the *Instituto de Instituto de Combate e Controlo das Tripanossomiase* (Institute to Fight and Control Trypanosomiasis), which has a campus and human resources in Luanda that would serve as a better insectary location.

- Helped the NMCP to convene four Vector Control Working Group meetings and participated in strategic discussions to: finalize the revised National Malaria Strategic Plan 2021–2025; finalize a list of Angola’s core entomological indicators for integration into World Health Organization (WHO) Entomology Modules (which will ultimately be incorporated into the country’s DHIS2); and review country-level entomological data from all partners, discussing challenges and coordinating next steps.
- Continued to collaborate with the Global Fund/MENTOR team conducting entomological activities in Benguela and Cuanza-Sul to discuss progress, results, and challenges and coordinate solutions and next steps as appropriate. Harmonization of entomology methods and data collection tools continued throughout the reporting period.

## 1.2 BENIN

### 1.2.1 PROGRAM HIGHLIGHTS

- Hosted an end-of-project ceremony at the VectorLink office in Cotonou, attended by in-country stakeholders including the NMCP and the USAID Mission staff, who delivered speeches highlighting the project’s successes.
- Ended the PMI VectorLink Project in Benin on December 31, 2021.

## 1.3 BURKINA FASO

### 1.3.1 PROGRAM HIGHLIGHTS

- Continued monitoring the residual efficacy of the sprayed insecticides from the 2021 IRS campaign, in partnership with the Health Sciences Research Institute/*Institut de Recherches en Sciences de la Santé* (IRSS), from May 2021 to March 2022 which showed mosquito mortality at 98–100% through March 2022.
- Conducted monthly entomological monitoring in seven sites from June 2022 to September 2022: three former IRS sites (Kampti, Solenzo, and Bena), two paired unsprayed control sites (Nouna and Gaoua), and two PBO sites (Soumouso and Karangasso-Vigué).
- Completed an evaluation of the 2018 IRS campaign, which found that confirmed malaria case rates in IRS districts of Solenzo and Kampti were significantly lower (31.7% and 36.1% lower, respectively) than in unsprayed control districts following the campaign.
- Completed an evaluation of the 2020 IRS campaign, which found that confirmed malaria case rates in IRS district Kampti were significantly lower (36.2%) than in the control district after the IRS campaign. In Solenzo, malaria case rates were 16.9% lower than in the control district, though this difference was not significant at the 5% level ( $p=0.057$ ). Although reported IRS coverage was higher in Solenzo than in Kampti, the failure to detect an impact of the 2020 IRS campaign on malaria incidence in Solenzo may be due to the multiple malaria prevention activities implemented during the evaluation period. Seasonal malaria chemoprevention campaigns were implemented annually in Solenzo starting during the pre-IRS baseline period, while in Kampti, the campaigns began in 2018, the same year as IRS. The Burkina Faso Demographic and Health Survey, published in 2021, found that Solenzo also had higher reported ITN use than Kampti following the 2019 campaign. The combination of seasonal malaria chemoprevention and high ITN use may be masking the impact of IRS in Solenzo. IRS may also have differential impact across the different climate zones and malaria transmission settings. Kampti, located in a tropical climate, had somewhat higher and more variable malaria case incidence rates when compared with the Sudano-Sahelien district of Solenzo. These factors may be associated with the increased impact of IRS.
- Results of the 2018 and 2020 IRS evaluations were compiled in a report and draft manuscript for publication.
- Completed remote training-of-trainers (TOT), in-person fieldworker training, and data collection for all three study sites for the 36-month durability monitoring round of 2019 mass ITN distribution nets. The TOT was held on June 21–22 and in-person fieldworker training took place on June 28–

July 1. Data collection was conducted on July 3–18 in Orodara, and on August 4–20 in Gaoua and Banfora.

- Completed bioassay testing of Interceptor standard pyrethroid, PermaNet 3.0 PBO synergist, and Interceptor G2 (IG2) dual active ingredient (AI) field ITNs collected during the 24-month durability monitoring round. Completed chemical testing of 24-month ITN samples and revised the 24-month report accordingly.
- Provided technical support to the NMCP in planning and conducting the mini-IRS campaign in the district of Dangouana with VectorLink’s leftover Actellic 300CS insecticide. The campaign took place in Dangouana from August 12-16, 2022, and the NMCP sprayed a total of 1,721 structures in Dangouana with 403 bottles of Actellic 300CS, protecting 4,756 persons.

## 1.4 BURUNDI

### 1.4.1 PROGRAM HIGHLIGHTS

- Conducted the 24-month ITN durability monitoring between February 28 and March 11, 2022, in two sites: Vumbi (PBO ITN) and Gashoho (standard deltamethrin ITN). Three NMCP technicians received training and conducted ITN bio-efficacy tests under the supervision of PMI VectorLink. Following the 12-month round, study implementers made a collective decision that the 24-month round would be the final follow-up in Burundi, in contrast to other PMI-supported durability monitoring studies, which conclude after 36 months. The main reason was the low levels of cohort ITN survival recorded after the 12-month round, and the schedule of the next ITN mass campaign that was planned for June 2022, six months before the 36-month round of durability monitoring.
- Provided technical assistance for wall cone bioassays to monitor insecticide decay after the government-implemented IRS campaign in September 2021 in Ngozi and Muyinga provinces. The mortality of susceptible *An. gambiae* Kisumu strain in the wall cone bioassays was above 80% threshold 11 months after IRS, indicating long residual life of Fludora Fusion WP-SB in the two provinces.
- Conducted monthly longitudinal entomological surveys in nine sentinel sites, using human landing catch (HLC), pyrethrum spray catch (PSC), and CDC light trap collections. The results indicated that *An. gambiae* s.l. represented 67% of the total mosquito collections, followed by *An. funestus* s.l. (19%). *An. funestus* s.l. is the second predominant malaria vector in Burundi. Vector indoor biting activity was high in Mpanda from October to June with a mean human biting rate varying between 11 and 46 bites per person per night. The human biting rate was relatively low in Matana, Mabayi, Cankuzo, and Kiremba (IRS site) in comparison to the other sites, across all collection months. At all sites where the tests were conducted, the vector was susceptible (100% mortality) to all tested insecticides: pirimiphos-methyl (0.25%), deltamethrin (0.05%), permethrin (0.75%), alpha-cypermethrin (0.05%), bendiocarb (0.1%), clothianidin (4µg per bottle), and chlorfenapyr (100µg per bottle).

## 1.5 CAMBODIA

### 1.5.1 PROGRAM HIGHLIGHTS

- Conducted monthly entomological monitoring in four sentinel sites in Mondulkiri (annex village of Pu Till and nearby forest site) and in Stung Treng (annex village of Ou Chay village and nearby forest site) from October to December 2021 and switched to bi-monthly entomological monitoring from January to September 2022. Monthly and bi-monthly collections provided on-the-job capacity skills building of provincial health and operational district staff.
- Performed longitudinal monitoring using different collection methods: human double net, cow bait double net, Furvela tent trap, and CDC light trap for village sites, and human double net and Furvela tent trap at forest sites. During the collection period in October to December 2021 and February, April, June, and August 2022, *Anopheles* abundance and species richness was higher in Mondulkiri (total collected=12,630, species=27) than in Stung Treng (total collected=10,839, species=30). The primary vectors, *An. dirus* s.l., *An. minimus* s.l., and *An. maculatus* s.l., were found in both provinces:

*An. dirus* s.l. was the predominant vector (Mondulkiri n=1,517; Stung Treng n=1,395). However, *An. minimus* s.l. and *An. maculatus* s.l. also occurred in high numbers in Mondulkiri but not Stung Treng. Results confirm that the highest risk of being bitten by a primary malaria vector species is outdoors, particularly in the forest fringe, reinforcing the need for additional protection from outdoor biting.

- Conducted insecticide susceptibility testing for *An. dirus* s.l., *An. maculatus* s.l., and *An. minimus* s.l. in both provinces against deltamethrin, permethrin, and alpha-cypermethrin. All species are susceptible to the pyrethroids, indicating that pyrethroid ITNs are still effective.
- Carried out bi-monthly complementary entomological monitoring to support National Center for Parasitology, Entomology and Malaria Control (CNM)-led foci investigation using human double net traps, cow double net traps, and indoor CDC light trap for three consecutive nights. To date, project has responded to one local case (L1) in Stung Treng and four L1 in Mondulkiri. Primary vectors *An. dirus* s.l., *An. maculatus* s.l., and *An. minimus* s.l. were collected. This confirmed receptivity of the foci to onward malaria transmission.
- Performed circumsporozoite (CS) enzyme-linked immunosorbent assay (ELISA) from July–September 2022 on *Plasmodium* (*P.*) *vivax* 210, Pv247, and *P. falciparum* for 815 *Anopheles* mosquito samples (*An. dirus* s.l., *An. minimus* s.l., and *An. maculatus* s.l. collected from May through December 2021. As result, one *An. maculatus* s.l. was confirmed positive for Pv210.
- Held a Vector Control Working Group meeting on August 26, 2022, in collaboration with CNM, after a several years’ hiatus. The meeting was attended by PMI/USAID, WHO, University of California, the San Francisco Bite Interruption Toward Elimination project, National Institutes of Health, Clinton Health Access Initiative, Malaria Consortium, Catholic Relief Services, and URC-CHS Cambodia Malaria Elimination Project 2. The theme was the role of entomology data in Malaria Elimination: Surveillance and Foci Management. One objective of this meeting was to discuss and agree on the terms of reference for the working group, reactivate and update partner memberships and build consensus and commitment for the working group going forward as a platform for the malaria control community.
- Rolled out a customized entomology module using the PMI VectorLink Collect DHIS2-based data management system to replace the MS Excel database for all entomological data and trained the VectorLink Cambodia team on its use. This new PMI VectorLink Collect module provides a robust and flexible data management system with analytical capabilities and addresses the increased scope of VectorLink Cambodia.
- Began providing technical support to CNM to customize its current malaria information system to include entomology modules to receive mosquito collection and insecticide resistance testing data. This also includes the addition of an entomological data dashboard to provide automatic summaries and visualizations of mosquito collection and insecticide resistance data.
- Fully engaged with CNM to provide technical input and support in the mid-term review of Cambodia malaria elimination action framework toward *P. falciparum* elimination by 2023 and all forms of malaria cases by 2025.
- Carried out the internal CS ELISA training for the two VectorLink entomology technicians and technical manager on June 16–21, 2022, led by a VectorLink Cambodia laboratory technician.
- Trained the VectorLink Cambodia laboratory technician on PCR for species identification of *An. dirus* s.l., *An. maculatus* s.l., and *An. minimus* s.l. in August 2022.
- Completed negotiations of extension of the memorandum of understanding between CNM and VectorLink, culminating with signature on October 6, 2022.

## 1.6 CAMEROON

### 1.6.1 PROGRAM HIGHLIGHTS

- Conducted longitudinal entomological vector surveillance in five sentinel sites (Gounougou in the North, Simatou in the Far North, Bonabéri in the Littoral Region, Mangoum in the West, and Nyabessang in the South) every other month from October 2021 to September 2022. Activities

included adult mosquito collection using indoor and outdoor HLCs, indoor PSCs, indoor and outdoor CDC light traps, and outdoor Prokopack aspirations. Key findings, which highlight the need for the NMCP to consider additional vector control interventions beyond ITNs (e.g., IRS), were presented orally at the 2022 Pan African Mosquito Control Association (PAMCA) Conference in Kigali, Rwanda in September 2022.

- Conducted insecticide susceptibility testing in August and September 2022 in 10 sites (Gazawa, Garoua, Mada, Mogode, Bertoua, Ndelele, Touboro, Njombe, Ngaoundere, and Kousseri) to inform future ITN procurement and deployment decisions by the NMCP. VectorLink assessed the susceptibility of *An. gambiae* s.l. to pyrethroids (alpha-cypermethrin, deltamethrin, and permethrin) with and without PBO, organophosphates (pirimiphos-methyl) and carbamates (bendiocarb) using WHO test kits, and neonicotinoids (clothianidin) and pyrrole (chlorfenapyr) insecticides using CDC bottle assays. Resistance intensity was also determined when pyrethroid resistance was observed.
- Conducted the first of three larval collection surveys to assess the presence of *An. stephensi* near the Douala port in July 2022. PCR species identification was conducted, and nine samples did not amplify as either *An. funestus* s.l. or *An. gambiae* s.l. The Centre for Research in Infectious Diseases (CRID) is currently sequencing these samples to determine if they are *An. stephensi* or another species.
- Supported the NMCP to organize two Vector Control Committee meetings in March and September 2022.
- Supported the development of a draft streamlined durability monitoring (SDM) study protocol to monitor the physical and chemical durability of PBO synergist and dual active ingredient IG2 ITNs in Northern Region over three years, following the 2022 mass ITN distribution campaign.

## 1.7 CÔTE D’IVOIRE

**TABLE I: PMI VECTORLINK CÔTE D’IVOIRE VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	May 16–June 10, 2022 20 operational days		
	Number of districts covered by PMI-supported IRS	2 (Sakassou, Nassian)		
	Insecticide(s) and units	SumiShield 50WG (8,681 units) and Fludora Fusion WP-SB (16,137 units)		
	IRS results	Structures Sprayed: 70,392	Structures Found: 71,474	Spray Coverage: 98.5%
	Population protected by PMI-supported IRS	Total: 228,432	Pregnant Women: 7,119	Children < 5: 38,795
	Number of people trained with U.S. govt funds to deliver IRS*	349 (43 female, 306 male)		

\* Throughout this report, the indicator “Number of people trained with U.S. govt. funds” to deliver IRS is based on the PMI indicator definition, and includes only spray staff such as spray operators, team leaders, and supervisors. It excludes clinicians; data entry clerks; information, education, and communication mobilizers; drivers; washers; porters; pump technicians; and security guards.

### 1.7.1 PROGRAM HIGHLIGHTS

- Conducted the third IRS campaign in the same two districts as in 2020 and 2021 (Sakassou and Nassian). In 2022, VectorLink Côte d’Ivoire introduced ‘self-mobilization,’ which transfers accountability to community leaders to ensure community acceptance of IRS. This strategy resulted in higher coverage (98.5%) than in prior years (96.7% in 2021 and 91.9% in 2020).
- Trained 2,017 people to perform all roles required to implement IRS, which include supervisors, spray operators, site managers, data cleaners, storekeepers, drivers, technicians, and community mobilizers. The trainings included 304 women (15%), including NMCP personnel, the National Vector Control Steering Committee, national and regional environmental agents, and community IRS actors. Two health district staff were selected as supervisors and served in each district as co-trainers,

which contributed to the development of human resources capacity strengthening for future IRS efforts in the country.

- Collaborated with the NMCP and the Regional Environment Directorate to inspect 23 premises used for IRS activities in line with PMI's Best Management Practices.
- Trained 24 entomology field technicians (including five women) in four local institutes to conduct mobile data collection for live data entry in the VectorLink Collect database. VectorLink Côte d'Ivoire implemented first-time entomological mobile data collection across all districts, including longitudinal bionomic monitoring, insecticide resistance monitoring, and IRS insecticide residual efficacy monitoring.
- Conducted monthly longitudinal entomological vector surveillance in four sites: Nassian and Sakassou (IRS districts), and Béoumi, and Dabakala (control) to assess the IRS impact.
- Completed vector susceptibility tests in 17 sites, which included 14 new sites (Agboville, Bouaflé, Bondoukou, Bongouanou, Divo, Dimbokro, Ferkessédougou, Guiglo, M'Bahiakro, Sassandra, Séguéla, Soubré, Tingréla, and Touba) selected by the Vector Control Steering Committee through subcontractor *Centre Suisse de Recherches Scientifiques* (Swiss Center for Scientific Research) and in collaboration with the three national research institutes. Susceptibility and intensity assays against pyrethroids (alpha-cypermethrin, deltamethrin, and permethrin), organophosphates (pirimiphos-methyl) and carbamates (bendiocarb) were conducted using WHO tube test kits, while neonicotinoids (clothianidin) and pyrrole (chlorfenapyr) were assessed using CDC bottle assays. PBO synergism was conducted for pyrethroid insecticides.
- Conducted residual efficacy assessment of the August 2021 IRS campaign through May 2022 and of the May 2022 IRS campaign since June 2022.
- Carried out the Continuous Distribution Assessment in October, which determined that one major issue was the lack of Continuous Distribution Guidelines. Subsequently, the guidelines were developed through a series of consultations, including a two-day partners workshop. The final, approved document is being formatted for printing by PMI VectorLink and will then be shared for distribution.
- Completed remote TOT, in-person fieldworker training, and data collection across Abengourou and Aboisso for the 12-month durability monitoring study round of 2021 mass ITN distribution nets. The TOT was conducted on March 21–23, 2022 and the in-person training on March 22–25, 2022. Data collection took place in both sites on April 4–14, 2022.
- Conducted ITN cone bioassays and chemical content analysis for PermaNet 3.0, a PBO ITN, and IG2, a dual AI ITN collected from the field during the baseline durability monitoring round. Submitted the baseline report, which was approved. Bioassays for the 12-month round are in progress.
- Celebrated the opening of the newly rehabilitated insectary at the *Institut National d'Hygiène Publique* (National Institute of Public Health) on July 29, at an event presided over by U.S. Ambassador Richard Bell, Côte d'Ivoire's Public Health Director Professor Mamadou Samba, and Institute Director Professor Joseph Benie Bi Vroh.
- The U.S. Ambassador recognized the VectorLink Côte d'Ivoire team's outstanding support of the NMCP, and on August 1, awarded the team with a certificate of recognition that highlighted their three consecutive, successful PMI-funded IRS campaigns in 2020, 2021, and 2022.
- Updated interactive dashboards summarizing malaria case incidence, 2021 IRS campaign coverage, entomological indicators, climate data, health management information system data quality, and the impact of COVID-19 on routine data sources to support the IRS impact evaluation.
- Finalized and presented to the NMCP an IRS impact evaluation plan, including analysis protocols for epidemiological impact, descriptive entomological analysis, field data collection of epidemiological data, and covariates including climate factors and stockout of rapid diagnostic tests.
- Developed a mobile data collection tool and dashboards to monitor progress and collection quality in real-time and carried out field data collection directly from health facility consultation registers in 96



health facilities in the four districts (Sakassou, Nassian, Béoumi, and Dabakala) that will be included in the IRS impact evaluation.

## 1.8 DEMOCRATIC REPUBLIC OF THE CONGO

### 1.8.1 PROGRAM HIGHLIGHTS

- Conducted entomological activities through the National Institute of Biomedical Research in 11 provinces (Kwango, Sankuru, Nord Ubangi, Haut Lomami, Bas Uele, Haut Uele, Kinshasa, Tshopo, Haut Katanga, Kasai Central, and Tanganyika) and the Public Health School of Kinshasa in three provinces (Ituri, Kasai, and Nord Kivu).
- Conducted monthly vector bionomics monitoring in three sites: Kenge (Kwango), Karawa (Nord Ubangi), and Sankuru (Lodja).
- Conducted insecticide susceptibility testing with permethrin, deltamethrin, and alpha-cypermethrin in 14 provinces at one sentinel site per province. Pyrethroid resistance intensity, PBO synergist assays, and susceptibility tests with chlorfenapyr were conducted in all sites to aid decision making regarding the types of nets to purchase for future ITN campaigns.
- Conducted the 24-month survey for the comparative evaluation of standard (PermaNet 2.0) and dual-treated (PermaNet 3.0) ITN efficacy in Sud Ubangi, which included entomological and ITN bio-efficacy monitoring.
- Conducted 12-month durability monitoring of Veeralin (PBO ITN) and SafeNet (Standard ITN) ITNs distributed in Tanganyika Province.
- Conducted pre-distribution testing of IG2 (dual AI net) distributed in Nord Ubangi Province.
- Conducted bi-annual monitoring (dry and rainy season) of reported and observed household net use in Tanganyika Province.
- Piloted entomological monitoring by water hygiene and sanitation supervisors in Ituri, Kasai, and Nord Kivu provinces, which included training supervisors on entomological monitoring methods.
- Supported the National Institute of Biomedical Research and the Public Health School of University of Kinshasa in managing the insectary, including maintenance of the susceptible reference colony of *An. coluzzii* in Ngousso and *An. gambiae* (Kisumu), ensuring that all activities in the insectary follow standard protocols.
- Conducted laboratory analyses of a subsample of malaria vectors from all sites where insecticide resistance and vector bionomics monitoring is conducted. Tests include mosquito species identification, detection of sporozoites, and presence of molecular markers of insecticide resistance.
- Supported the NMCP's biannual Vector Control Working Group workshop, to facilitate review of country data and inform vector control decision making.
- Organized three entomology dissemination meetings with the NMCP to share quarterly activity trackers, report and discuss entomology data for use in NMCP decision making. Participating organizations included the NMCP, the University of Kinshasa, the National Institute of Biomedical Research, and VectorLink.

## 1.9 ETHIOPIA

**TABLE 2: PMI VECTORLINK ETHIOPIA VECTOR CONTROL AT A GLANCE**

<b>IRS</b>	<p><b>Dates and length of PMI-supported IRS campaign</b></p> <p><b>Benishangul-Gumuz Region:</b> June 8–July 4, 2022 (up to 25 operational days per district)</p> <p><b>Gambela Region:</b> May 12–31, 2022 (17 operational days)</p> <p><b>Oromia Region:</b> May 12–June 30, 2022 (up to 20 operational days per district)</p> <p><b>Amhara Region:</b> June 8–July 1, 2022 (up to 21 operational days per district)</p>
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LSM	Number of districts covered by PMI-supported IRS	42 (Benishangul-Gumuz (15), Gambela (14), Oromia (7), and Amhara (6))		
	Insecticide(s) and units	Actellic 300CS (71,883 units), SumiShield 50WG (65,562 units), and Fludora Fusion WP-SB (41,081 units)		
	IRS results	Structures Sprayed: 684,490	Structures Found: 702,358	Spray Coverage: 97.5%
	Population protected by PMI-supported IRS	Total: 1,792,145	Pregnant Women: 58,065	Children < 5: 245,803
	Number of people trained with U.S. govt funds to deliver IRS	3,992 (966 female, 3,026 male)		
	Dates and length of PMI-supported LSM implementation	Six towns Ongoing since August 22, 2022*		
	Number of towns included in LSM implementation	6 (Afar (1), Dire Dawa (1), Oromia (2), and Somali (2))		
	Number of properties visited	Total for four implementation rounds: 73,094		
	Number of people trained and hired to implement and monitor LSM	Number trained 374	Number hired 348	
	Number of people residing in properties with LSM interventions	Total 514,451	Pregnant Women 12,261	Children < 5 74,760

\* This activity is ongoing beyond the reporting period; results are for August 22 – September 30, 2022.

### 1.9.1 PROGRAM HIGHLIGHTS

- Conducted the 2022 IRS campaign under difficult security conditions, forcing the project to exclude Kamash Zone and Mao-Komo Special Zone in Benishangul-Gumuz Region and some *kebeles* in Oromia and Benishangul-Gumuz regions. The security situation created enormous logistical challenges—particularly with vehicles, which the project overcame by hiring vehicles locally within the IRS areas—and required collaboration with local authorities to keep spray teams, communities, and USAID assets safe.
- Expanded IRS support to three refugee camps in Benishangul-Gumuz, resulting in an additional 19,312 structures sprayed and protecting 54,120 previously unserved individuals against malaria.
- Expanded community-based IRS, transitioning three additional districts from Benishangul-Gumuz regional state from district- to community-based IRS. To ensure environmental compliance, 30 new operations sites were established in these districts and provided with the necessary equipment and commodities for the community to implement IRS with minimal transportation and supervision.
- Evaluated the quality of IRS and decay rates of Actellic 300CS in Dera, Fogera, Jawi, Lare, Metema, and Quara districts; Fludora Fusion WP-SB in Abaya district; and SumiShield 50WG in Bambasi and Pawi districts. In the first week after spraying, all three insecticides killed 100% of insectary *An. arabiensis* in all districts. Mortality of *An. arabiensis* continues to exceed 80% three months post-IRS in all the sites.
- Developed LSM guideline, mobile data collection tools, and DHIS2-based database to help facilitate LSM implementation for *An. stephensi* control.
- Conducted sensitization and microplanning for the implementation of *An. stephensi* LSM in Batu/Zeway, Degehabur, Godey, Dire Dawa, Meki, and Semera-Logia towns.
- Conducted property enumeration and two to four weeks of entomological baseline data collections in Batu/Zeway, Degehabur, Godey, Meki, Semera-Logia and Dire Dawa towns prior to implementing LSM.
- Launched the implementation of LSM in Dire Dawa on August 22, 2022, in the presence of the U.S. Ambassador to Ethiopia, the State Minister of Health’s advisor, Regional Health Bureau

representatives, and the Mayor of Dire Dawa. Subsequently, VL Ethiopia and the NMEP began conducting biweekly visits and applying Bti or source reduction to nearly 50,000 containers in six towns, in areas where the invasive *An. stephensi* species has been detected.

- Conducted longitudinal entomological monitoring in Bambasi, Lare, and Pawi and found *An. arabiensis* in all the sites, constituting 25% of all collections. *An. pharoensis* was present in the collections from Lare and Bambasi but not from Pawi. The indoor resting density of *An. arabiensis*, *An. funestus* s.l., and *An. pharoensis* was generally low, with less than 1.0 per house per day in Bambasi, Lare, and Pawi.
- Conducted entomological monitoring in the five districts in Amhara (Dera, Fogera, Jawi, Metema, and Quara) where the impact of PBO nets as compared to IRS plus standard nets is being assessed.
- Assessed the residual efficacy of 60 PBO and standard nets collected from communities in Dera, Fogera, Jawi, Metema, and Quara after 12 months of use. The roof of PBO nets in cone bioassay tests induced 34.5% mortality of wild *An. arabiensis* raised from larval collections from Sodere.
- Conducted pirimiphos-methyl resistance monitoring in three districts of Amhara (Fogera, Metema, and West Armachiho), finding *An. arabiensis* populations to be susceptible to the insecticide (mortality >100%).
- Assessed the susceptibility status of *An. arabiensis* from Abaya to chlorfenapyr and clothianidin. Susceptibility to the two insecticides was ascertained from mortality of 99–100%.
- Conducted entomological capacity-building training including *An. stephensi* surveillance for 15 people: 11 from Ethiopia, two from Sudan, one from Kenya, and one from Benin.
- Investigated the presence of *An. stephensi* through larval surveillance in 16 new sites in Amhara and Somali regional states; 50% of these sites were positive. The presence of *An. stephensi* was confirmed for the first time in Metema Yohannes Town in Amhara, and Chereti, Dhanga, Dollo Ado, Elkere, Fik, Hamero, Hardhaga, and Hargele in Somali Region, bringing the total number of *An. stephensi* positive sites in Ethiopia to 45.
- Developed interactive dashboards and a corresponding baseline report summarizing trends in malaria case incidence, IRS and ITN campaign coverage, and climate metrics covering the two years before the 2021 IRS and ITN campaigns in the evaluation kebeles.
- Updated interactive dashboards summarizing case incidence, vector control coverage, and descriptive analyses of the impact of IRS for the 2015 to 2019 campaigns in Benishangul-Gumuz and Gambela.

## 1.10 GHANA

**TABLE 3: PMI VECTORLINK GHANA VECTOR CONTROL AT A GLANCE**

IRS	<b>Dates and length of PMI-supported IRS campaign</b>	March 2–April 12, 2022 30 operational days		
	<b>Number of districts covered by PMI-supported IRS</b>	9 (Bunkpurugu-Nakpanduri, East Mamprusi, Gushegu, Karaga, Kumbungu, Mamprugu Moaduri, West Mamprusi, Tatale-Sanguli, Yunyoo-Nasuan)		
	<b>Insecticide(s) and units</b>	Fludora Fusion WP-SB (37,982 units) and SumiShield 50WG (41,295 units)		
	<b>IRS results</b>	Structures Sprayed: 355,940	Structures Found: 381,442	Spray Coverage: 93.3%
	<b>Population protected by PMI-supported IRS</b>	Total: 961,413	Pregnant Women: 20,581	Children < 5: 159,546
	<b>Number of people trained with U.S. gov't funds to deliver IRS</b>	951 (276 female, 675 male)		
ITN	<b>ITN distribution channel(s) and dates of distribution</b>	School-Based Distribution: July 4–29, 2022 Mass Campaign: October 2021–March 2022*		
	<b>Number of districts included in distribution</b>	School-Based Distribution: 15 regions, 235 districts Mass Campaign: 2 regions (Ashanti and Greater Accra)		
	<b>Number of ITNs distributed</b>	Distributed by VectorLink: N/A	Distributed by partners with VectorLink support:	

		School-Based Distribution: 1,442,511 Mass Campaign: 5,168,068*
<b>Type and brand of ITNs distributed</b>	ITN <u>Types</u> Distributed: Pyrethroid only, PBO, Dual AI	ITN <u>Brands</u> Distributed: SBD: PermaNet 3.0, Interceptor G2 MC: PermaNet 3.0, Interceptor G2, MagNet, Olyset Plus

\* The ITN mass campaign commenced prior to this reporting period. The data in this table represents only those ITNs distributed during the reporting period and is not reflective of the full results of the mass campaign. PMI VectorLink Ghana provided technical support to the NMCP for the campaign but did not distribute ITNs.

### 1.10.1 PROGRAM HIGHLIGHTS

- Provided technical assistance to the NMCP with the 2021/2022 mass ITN distribution campaign. PMI VectorLink supported national level planning, TOT, supervision of household registration, and monitoring of the distribution in the Greater Accra and Ashanti regions. The Global Health Supply Chain-Procurement and Supply Management Project procured, and transported PMI funded ITNs and monitored the campaign. The NMCP led overall planning, implementation, Global Fund-funded ITN procurement, transportation, training, and supervision. In total, the NMCP and partners distributed 16,139,502 nets which covered most of the population of Ghana per WHO guidance of one net per two persons. The last 5,168,068 ITNs were distributed in Eastern and Greater Accra regions in October 2021–March 2022.
- Rolled out a new IRS tracking tool, the Community Spray Tracker, to track daily results per community to enable accurate and targeted planning for next day spraying.
- Facilitated vaccination of 151 seasonal workers to support Ghana’s COVID-19 prevention efforts. Including those already vaccinated before IRS campaign, workers had vaccination rates of 98% among seasonal staff and 100% among VectorLink staff.
- Recycled 860 kg of packaging card boxes and 2,255 kg of plastic waste and incinerated 3,101 kg of various contaminated plastic waste generated during the 2022 spray campaign.
- Established productive pyrethroid-resistant mosquito colony of *An. gambiae* Tiassale strain at the project insectary. The colony is used to conduct residual efficacy tests in place of the wild mosquitoes in the areas where pyrethroid combination insecticides, such as Fludora Fusion, are sprayed.
- Successfully piloted a mosquito labeling system using QR coding to improve mosquito sample management and enable the integration of molecular datasets into VectorLink Collect. The pilot enabled bulk upload of molecular data into the global DHIS2-based system. The project plans to expand the approach to other countries to improve integrated data analysis.
- Conducted monthly entomological monitoring activities in eight PMI VectorLink Project districts and continued data collection in four additional entomological surveillance sites as part of the Ghana NMCP-led national entomological surveillance.
- Conducted spray quality tests, which showed 100% mortality of exposed mosquitoes at 1–3 days after spraying of SumiShield 50WG and Fludora Fusion WP-SB, indicating high spray quality in 2022. Monthly cone assays continue for residual efficacy monitoring.
- Initiated insecticide susceptibility bioassays across the project districts. Vectors are susceptible to clothianidin, the active ingredient of SumiShield 50WG and Fludora Fusion WP-SB, in all sites except a site in Kumbungu district (80%). Testing is continuing for other insecticides.
- Trained and transferred mosquito collection responsibility for four sites to the Navrongo Health Research Center research assistants as part of the NMCP-led national entomological surveillance program.
- Donated equipment and supplies to the entomology unit of the Biomedical Science Department of the Navrongo Health Research Center in northern Ghana to enhance mosquito collection, rearing, and testing capacities.

- Received acceptance of an abstract for the 2022 annual Social Behavior Change Communication Summit in Morocco, scheduled for December 5–9. The abstract highlights maximizing participation to improve IRS acceptance and sustain gains in malaria control in northern Ghana.
- Completed post-spray data quality audit, which showed that VectorLink Ghana obtained high spray coverage and protected much of the population in the 2022 IRS campaign (90.6% audit results vs. 93.3% reported post IRS), but certain districts should improve data collection and accuracy.
- Provided in-person molecular training in June 2022 for both VectorLink and AgaMal laboratory technicians on new and revised PCR protocols for easy and immediate implementation.
- Trained 3,047 health and education staff from the Ghanaian government to plan SBD of 1,442,411 ITNs to pupils in primary classes 2 and 6. Monitored the distribution, which was successfully completed in July 2022.
- Expanded ITN use and care activity to 10 districts in Eastern region through a local social and behavior change communication partner, Total Family Health Organization, which has trained 317 health facility workers as ITN champions in six districts to date.
- Supported integration of ITNs for routine distribution into the Ministry of Health national supply chain system known as the Last Mile Distribution in Eastern, Oti, and Volta regions.
- Conducted monthly analysis of DHIS2 ITN data on distribution of nets through antenatal and child welfare clinics to share as part of feedback interactions with the district health teams.
- Presented the 36-month durability monitoring study to the national stakeholders on March 7, 2022. Publicly accessible report and datasets are available on [www.pmi.gov](http://www.pmi.gov) and [www.durabilitymonitoring.org](http://www.durabilitymonitoring.org).

## 1.11 GUINEA

### 1.11.1 PROGRAM HIGHLIGHTS

- Began start-up activities in December 2021, including registering the Abt office in Guinea and engaging in discussions with the PMI team to establish work plan priorities for 2022. The chief of party and the regional finance director traveled to Guinea early in the year to finalize the recruitment of local staff, set up the office, help set up the insectary, conduct site and laboratory assessments, and take stock of the inventory of equipment available for the project’s activities in-country. The chief of party was fielded to the office on April 4, 2022.
- Conducted training in malaria entomology for 13 technicians from the prefectures of Forecariah, Boffa, Labe, Kankan, Kissidougou, Faranah, and Dabola, and the NMCP.
- Conducted monthly malaria vector bionomics monitoring in four sentinel sites in Forecariah prefecture since July 2022, using HLC, PSC, and CDC light trap collections. The results indicated that *An. gambiae* s.l. represented 99.8% of the total *Anopheles* collected. *An. zizemanni*, *An. squamosus*, and *An. costani* were the other *Anopheles* collected.
- Conducted insecticide susceptibility tests, PBO synergism, and resistance intensity of pyrethroids (alpha-cypermethrin, deltamethrin, and permethrin) in Forecariah, Boffa, Dabola, Faranah, Kissidougou, and Kankan using WHO tube test kits. The data showed high resistance to the three pyrethroids at all sites tested.
- Continued ongoing insecticide susceptibility testing of chlorfenapyr and clothianidin in the same sites, using CDC bottle assays.

## 1.12 LATIN AMERICA (COLOMBIA)

### 1.12.1 PROGRAM HIGHLIGHTS

- Carried out nine months of entomological data collection during the reporting period, with a total of 108,021 anophelines collected. Eighty-seven percent of *Anopheles* caught were *An. neivai*, 12.6% were *An. albimanus*, and 0.4% were *An. apicimacula*.
- Investigated biting behavior during the reporting period by comparing (using the Mann-Whitney test) the geometric means of the human biting rates per month for each mosquito species for a period of 10 months. *An. albimanus* was active throughout the night, while *An. neivai* had a peak of activity between 18:00–19:00 hours. *An. albimanus* presented a preference for the outdoors ( $p=0.02$ ), reflecting exophagic behavior; however, *An. neivai* did not show a preference ( $p=0.63$ ).
- Processed a total of 28,777 female *Anopheles* by ELISA to detect the presence of *Plasmodium* parasites in salivary glands. Five specimens were found positive for *P. falciparum*, four *An. albimanus*, and one *An. neivai*. One *An. neivai* was found positive for *P. vivax*.
- Carried out susceptibility tests using CDC bottle bioassays for deltamethrin (12.5 µg/ml), alpha-cypermethrin (12.5 µg/ml), and permethrin (21.5 µg/ml) on *An. albimanus* and *An. neivai* mosquitoes in March 2022, after the third round of spraying. Vector populations of *An. albimanus* from Guapi, and *An. neivai* from Guapi and Timbiquí, were susceptible to all insecticides tested. Populations of *An. albimanus* from Coteje, in the municipality of Timbiquí, were 100% susceptible to alpha-cypermethrin and deltamethrin but have shown variability in susceptibility to permethrin, and resistance was detected (78% mortality) in the most recent bioassay.
- Evaluated net bio-efficacy and physical integrity at 6 and 12 months after distribution in 40 ITNs randomly selected from across the 20 ITN clusters. Bio-efficacy was very low at six months post-intervention, with a mean knock-down and mortality of 3% and 5% respectively. This was compared against new ITNs for which knock-down was 100% and mortality 40%, suggesting that the nets were underdosed during manufacturing. Physical integrity data indicate that after 6 months of use, 67% of the nets exhibit at least one hole and this increased to 90% at 12 months. A year after distribution, 40% of the nets were torn.
- Carried out quality assurance of IRS during the third round of spraying in July 2022. Seven days post-spraying, WHO cone bioassays were carried out in two households in each of the 20 IRS clusters showing a mean knock-down of 80% and mortality of 73%.
- Organized an event on June 10 to share the project's preliminary results and to recognize and strengthen the cooperation between all stakeholders. Representatives from the Ministry of Health, the National Institute of Health, and the Cauca Department Health Secretariat, as well as leaders from community councils and representatives from the health areas of Guapi and Timbiquí municipalities attended the event, with a total of 114 people participating in the day's activities.

## 1.13 LIBERIA

### 1.13.1 PROGRAM HIGHLIGHTS

- Conducted monthly vector surveillance activities in eight sentinel sites across seven counties, assessing vector composition, behavior, biting rate, and density at each site. *An. gambiae* s.l. was the predominant vector in six sites and *An. funestus* s.l. in two.
- Conducted CDC bottle assays in 10 sites across nine counties to assess the susceptibility status of *An. gambiae* s.l. to alpha-cypermethrin with and without the synergist PBO. *An. gambiae* s.l. populations were resistant to alpha-cypermethrin. Mortality of mosquitoes increased after pre-exposure to PBO, but full susceptibility was not restored in all the sites. Further molecular analysis will assess the other mechanisms of resistance which may be involved.
- Conducted susceptibility tests that showed *An. gambiae* s.l. to be susceptible to chlorfenapyr in all the sites monitored.

- Conducted a remote PCR training, in coordination with the CDC, for the Liberia Institute of Biomedical Research, establishing both DNA extraction and PCR protocols to further in-country molecular analysis.
- Continued processing of mosquito samples using ELISA at the Liberia Institute of Biomedical Research to determine the sporozoite rate on field samples.
- Resumed molecular analysis of mosquito samples for species identification. This activity has been followed virtually, and an in-person training on insecticide resistance mutation diagnostics is being planned.
- Completed 36-month time point of standard durability monitoring of DuraNet ITNs in Lofa and Grand Gedeh counties; manuscript drafted and under review. The team also developed and submitted a late breaker abstract for poster presentation to the 2022 American Society of Tropical Medicine and Hygiene (ASTMH) conference.
- Performed bioassays as part of SDM pre-distribution of IG2 ITNs, using susceptible *An. coluzzii* lab colony at the VectorLink insectary and resistant VKPER strain in tunnel tests at PAMVERC, Benin. Chemical content analysis was performed at CDC.
- Completed training and data collection for the 12-month time point of SDM of IG2 ITNs in Bong and Bomi counties. Remote training of trainers was conducted on June 1, followed by in-person fieldworker training on June 8–9. Data collection was conducted on June 15–21 in Bomi and July 6–13 in Bong. Net sample processing for chemical content analysis and bio-efficacy tests are ongoing.

## 1.14 MADAGASCAR

**TABLE 4: PMI VECTORLINK MADAGASCAR VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	November 2–December 3, 2021 24 operational days		
	Number of districts covered by PMI-supported IRS	5 (Tuléar II, Sakaraha, Betioky, Ihosy, Iakora)		
	Insecticide(s) and units	Actellic 300CS (2,304 units), SumiShield 50WG (12,540 units), and Fludora Fusion WP-SB (25,450 units)		
	IRS results	Structures Sprayed: 213,922	Structures Found: 217,289	Spray Coverage: 98.5%
	Population protected by PMI-supported IRS	Total: 885,814	Pregnant Women: 32,041	Children < 5: 147,119
	Number of people trained with U.S. govt. funds to deliver IRS	894 (164 female, 730 male)		
LSM	Dates and length of PMI-supported LSM implementation	February 2, 2022–July 14, 2022 (119 operational days)		
	Number of districts	2 (Morombe, Ankazobe)		
	Breeding site surface sprayed with Bti	7760 hectares		
	Number of drone flights conducted	6,842		

### 1.14.1 PROGRAM HIGHLIGHTS

- Conducted monthly entomological data collection, which showed the presence of *An. gambiae* s.l. (main vector in Atsimo Andrefana, Ihorombe, Menabe, and Diana regions) and *An. funestus* s.l., as malaria vectors, and *An. coustani*, a potential vector in various sentinel sites.
- Conducted insecticide susceptibility tests in nine selected sites, including the IRS sites. Results indicated susceptibility of *An. gambiae* s.l. to pirimiphos-methyl, clothianidin, and chlorfenapyr in all sprayed and non-sprayed sites. In two of the sites, resistance to either deltamethrin or permethrin was observed. Synergist assays by pre-exposing of mosquitoes to PBO restored full susceptibility to both pyrethroids.

- Conducted monthly WHO wall cone bioassays, which showed at least five months of residual efficacy for Actellic 300CS, and at least six months for SumiShield 50WG and Fludora Fusion WP-SB.
- Conducted larviciding of 7,760 hectares of rice fields twice a month via drones from February 2 to July 17, 2022, in Morombe and Ankazobe districts with 5,103 bottles of water-soluble Bti Vectobac® strain AM65-5 (manufactured by Valent BioSciences Corporation), as operational research.
- Conducted larviciding entomological monitoring in 24 sites in Ankazobe and Morombe, and managed data in VectorLink Collect entomology programs, which showed a decrease in larval density and human biting rate of adults, and good effectiveness of Bti on the reduction of larval density until at least seven days after spraying.
- Completed an evaluation of the 2017–2020 IRS campaigns in Madagascar, which found that 245,471 (122,969–374,000) malaria cases were averted by IRS from July 2016 to June 2021 overall. The analysis also found that two consecutive years of IRS implementation yielded the greatest impact and that achieving high spray coverage (>85%) conferred additional malaria case reduction benefits. Authored and submitted a manuscript of this evaluation study to a peer-review journal.
- Completed analysis and submitted a report for the 36-month round of durability monitoring started in Year 4 during the reporting period; the report also was approved during the period. Uploaded a publicly accessible study report to [www.pmi.gov](http://www.pmi.gov) and [www.durabilitymonitoring.org](http://www.durabilitymonitoring.org), and the publicly accessible anonymous study datasets to [www.durabilitymonitoring.org](http://www.durabilitymonitoring.org).
- Completed training and data collection for the 12-month round of SDM of PermaNet 3.0 PBO synergist nets in Tamatave II, SafeNet standard pyrethroid nets in Vagaindrano and Yahe, and standard pyrethroid nets in Mananjary. In-person TOT was conducted on August 8, followed by a fieldworker training from August 9–11, 2022. Data collection was conducted from August 14–31, 2022 across all study sites. Household questionnaire and bioassay analysis are underway.

## 1.15 MALAWI

**TABLE 5: PMI VECTORLINK MALAWI VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	October 4–November 12, 2021 30 operational days		
	Number of districts covered by PMI-supported IRS	1 (Nkhotakota)		
	Insecticide(s) and units	Fludora Fusion (43, 100 sachets) and SumiShield 50WG (23,465 sachets)		
	IRS results	Structures Sprayed: 120,097	Structures Found: 129,410	Spray Coverage: 92.80%
	Population protected by PMI-supported IRS	Total: 481,075	Pregnant Women: 10,795	Children < 5: 81,810
	Number of people trained with U.S. govt. funds to deliver IRS	677 (300 female, 377 male)		

### 1.15.1 PROGRAM HIGHLIGHTS

- Trained 2,654 (1,245 female, 46.9%) temporary workers, using PMI funds, to support IRS activities in Nkhotakota as well as in the three districts (Mangochi, Balaka, and Nkhata Bay) where IRS is supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria and their secondary recipient partner World Vision.
- Provided two technical advisors who worked full-time to support the NMCP, World Vision International, and the Mangochi, Balaka, and Nkhata Bay district health offices with the planning, training, supervision, and close-out of IRS operations in Mangochi, Balaka, and Nkhata Bay.



- Hired 751 people as seasonal staff to support IRS; 46% (n=345) of them were women. Of the 197 people hired for leadership positions, 36.0% (n=71) were women.
- Worked with the NMCP, district health offices, and the Environmental Affairs Department to ensure environmental compliance through inspections before, during, and after spraying in Nkhotakota District.
- Strengthened national and district levels through trainings on IRS planning, supervision, implementation, monitoring and evaluation (M&E), and advocacy, to ensure high-quality spray.
- Piloted the use of the VectorLink Collect mobile app to track near real-time progress on community mobilization meetings, which enabled mid-course corrections based on operations site performance.
- Conducted comprehensive longitudinal entomological monitoring activities through local partner Malaria Alert Center in 17 sentinel sites in eight districts across Malawi.
- Performed molecular lab analysis for species identification and detection of malaria parasite infection in vector mosquitoes. *An. Gambiae* s.l. (46.8%) and *An. Funestus* s.l. (49.8%) were the dominant species identified.
- Conducted insecticide resistance monitoring tests in selected sites. *An. Funestus* s.l. and *An. Gambiae* s.l. are fully susceptible to pirimiphos-methyl, chlorfenapyr, and clothianidin, and are highly resistant to deltamethrin, permethrin, and alpha-cypermethrin. Pre-exposure of *An. Funestus* s.l. and *An. Gambiae* s.l. to 4% PBO restored their susceptibility to pyrethroids. Ace-1 resistant allele was absent in *An. Arabiensis* and *An. Gambiae* s.s.
- Conducted spray quality check and residual efficacy tests in selected IRS sites. Overall, spray quality was satisfactory in the three IRS districts of Nkhotakota (PMI supported) and Nkhata Bay and Mangochi (Global Fund supported). Fludora Fusion is still highly effective (100% mosquito mortality) in Nkhotakota District, 10 months after spraying, and in Balaka and Mangochi districts, nine months after spraying. Similarly, SumiShield is still effective (>80% threshold) after 10 months in Nkhotakota and nine months in both Balaka and Mangochi.
- Began the impact evaluation for the 2021 IRS and ITN mass campaigns by engaging stakeholders, producing a baseline report that included an HMIS data quality assessment, and producing an ITN and IRS impact evaluation plan
- Supported quarterly meetings of the national Vector Control Technical Working Group and provided technical support to the NMCP during the ITN mass distribution campaign.

## 1.16 MALI

**TABLE 6: PMI VECTORLINK MALI VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	May 30–July 6, 2022 27 operational days		
	Number of districts covered by PMI-supported IRS	3 (Bandiagara, Djenné, Mopti)		
	Insecticide(s) and units	Actellic 300CS (11,042 units) in Bandiagara, Fludora Fusion WP-SB (10,162 units) in Djenné, and SumiShield 50 WG (4,965 units) and Fludora Fusion WP-SB (676 units) in Mopti.		
	IRS results	Structures Sprayed: 72,106	Structures Found: 73,586	Spray Coverage: 98%
	Population protected by PMI-supported IRS	Total: 273,831	Pregnant Women: 20,728	Children < 5: 49,996
	Number of people trained with U.S. govt funds to deliver IRS	238 (27 female, 211 male)		

### 1.16.1 PROGRAM HIGHLIGHTS

- Implemented measures to mitigate risks due to security and COVID-19 challenges, managed real risks of fuel supply shortage during the IRS campaign, and applied appropriate approaches to consume the entire stock of insecticide. All target health areas completed spraying within 27 operational days despite the concerns encountered, particularly the two serious security incidents, one of which resulted in the tragic death of a spray maintenance technician on June 3, 2022, and a three-day pause of the spray activities (June 4–6). The project team successfully completed spray operations and ensured that no insecticide remained from the final year of PMI-supported IRS in Mali.
- Expanded the electronic scanning of insecticide barcodes to the 16 health areas beyond the three pilot areas that served for the trial conducted in 2021. As a result, in all 19 health areas, collection of complete, quality logistics data made the daily tracking of insecticide stock and movement easier and significantly more efficient and allowed real-time resolution of any issues found using ODK and Google Sheets.
- Hosted the NMCP director’s two-day supervision visit in the Mopti District on June 14–15, which included a visit to the VectorLink Data Center and central warehouse in Sévaré, a series of meetings with the local government and community leaders, and direct observation of key stages of daily spray campaign activities.
- Conducted IRS quality assurance and monthly insecticide decay rate monitoring in 10 houses in each of the three IRS districts (Mopti, Djenné, and Bandiagara). All three insecticides (Actellic 300CS, Fludora Fusion WP-SB, and Fludora Fusion WP-SB) yielded greater than 80% mortality from the week after spraying and every subsequent month in this reporting period on all wall types. Residual efficacy will continue to be monitored monthly until the mortality drops below 80% for two consecutive months.
- Conducted monthly entomological monitoring through community-based surveillance using CDC-LT and PSC in six sites in Mopti Region. In each IRS district, two sentinel sites (one sprayed and one unsprayed) were monitored.
- Conducted monthly entomological monitoring from July through September 2022 in two ITN sites in Sikasso Region: Bougouni (Yorkool net) and Selingue (IG2 net).
- Trained 10 entomological technicians on the use of mobile collection of entomological data, May 10–13, 2022. As a result, the technicians used the DHIS2 mobile digital platform in the field to record data from cone tests and HLC activities directly with smartphones from June through September.
- Organized a refresher training for the six community-based mosquito collectors on mosquito collection, morphological identification and larval collection, and reared mosquitoes.
- Tested six of eight scheduled sites for insecticide resistance using WHO susceptibility tube tests and CDC bottles assays. Resistance to pyrethroids was observed in six sites with implication of mixed function oxidases. Susceptibility to pirimiphos-methyl 0.25%, clothianidin 4µg (MERO), and chlorfenapyr 100µg was recorded in all six sites.
- Continued engaging the *Laboratoire de Biologie Moléculaire Appliquée* (LBMA) for the molecular analysis of entomological samples.
- Prepared an interim report with key data describing trends in malaria case incidence and entomological monitoring indicators one year after the 2020 IG2 and standard pyrethroid ITNs campaigns in Sikasso Region. This report was finalized and approved in advance of progressing statistical analyses evaluating how trends in malaria case incidence differ between districts receiving IG2 and standard pyrethroid ITNs.
- Held a one-week data analysis and visualization capacity-building workshop with NMCP and VectorLink staff in Bamako. During the workshop, participants strengthened skills in Tableau Desktop and knowledge of data visualization and dashboard design principles. At the end of the workshop, participants had created and presented their own data dashboards.
- Continued ongoing environmental compliance audit of the PMI VectorLink Mali project, which has to be conducted in its final year of IRS, in accordance with country regulations.

## 1.17 MOZAMBIQUE

**TABLE 7: PMI VECTORLINK MOZAMBIQUE VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	November 8–December 23, 2021 30 operational days		
	Number of districts covered by PMI-supported IRS	4 (Milange, Molumbo, Mopeia, Morrumbala)		
	Insecticide(s) and units	Actellic 300 CS (120,773) and Ficam (15,544)		
	IRS results	Structures Sprayed: 309,547	Structures Found: 319,732	Spray Coverage: 96.8%
	Population protected by PMI-supported IRS	Total: 1,408,179	Pregnant Women: 79,410	Children < 5: 189,408
	Number of people trained with U.S. govt funds to deliver IRS	1,487 (353 female, 1,134 male)		

### 1.17.1 PROGRAM HIGHLIGHTS

- Conducted a successful 2021 spray campaign despite a delayed start due to the late delivery of insecticide procured through the Global Fund Pooled Procurement Mechanism. Originally, the campaign was planned to start on October 18 and end on November 20 with Actellic 300CS (an organophosphate) and Ficam (a carbamate). Immediately upon receipt of Actellic 300CS, the project began spraying in Milange, Molumbo, and Morrumbala districts on November 8 and ended on December 11, except for the Liciro and Milange sede sites in Milange, where spraying ended on December 13 and 14, respectively. On delivery of the Ficam insecticide, the project began spraying in Mopeia on November 22 and ended on December 23, 2022.
- Conducted 2021 spray campaign with 100% vaccination among project staff and seasonal workers. The province of Zambezia considered PMI VectorLink staff as essential workers and, together with other cadres, the government of Mozambique designated them as such; consequently, the project staff were able to be vaccinated ahead of the public.
- Performed monthly entomological monitoring in three IRS districts in Zambezia Province (Molumbo, Milange, and Mopeia) and one control district (Lugela), which did not receive IRS. The project also supported entomological activities in two IRS districts (Nampula City and Erati) and one control district (Mogovolas) in Nampula Province. Activities included Prokopack, CDC light trap, and pit shelter collections. Susceptibility tests were performed in Erati, Nampula City, and Mogovolas districts in Nampula Province. Nampula Provincial Health Directorate staff conducted the activities with technical assistance from the PMI VectorLink entomology coordinator seconded to the province.
- Conducted insecticide resistance monitoring in six districts (Maganja da Costa, Milange, Molumbo, Mopeia, Morrumbala, and Lugela) in Zambezia and in three districts (Nampula City, Erati, and Mogovolas) in Nampula.
- In addition to the entomology activities in Nampula and Zambezia provinces, financially supported for NMCP led entomological monitoring activities in Cabo Delgado, Manica, Niassa, Sofala and Tete provinces and procured laboratory supplies and reagents for molecular analysis conducted by *Instituto Nacional de Saúde* (National Institute of Public Health).
- Conducted spray quality cone wall bioassays in Nampula and Zambezia provinces, which showed 100% mortality for Actellic 300CS, Ficam, and Fludora Fusion WP-SB. However, follow-up wall bioassays showed that Ficam lasted for less than four months in Zambezia and up to five months in Nampula. Actellic 300CS lasted up to two months in Milange District and up to five months in Molumbo District. In Nampula Province, Fludora Fusion WP-SB lasted up to 11 months in Nampula City and up to 10 months in Erati.
- Provided financial and logistical support to 37 participants (30 males, 7 females) to attend the training of trainers held in Nampula City on September 20–22, 2022, in support of the NMCP-led IRS

campaign; participants were drawn from the eight IRS target districts and the province and included the district medical chief, representatives of the departments of community health and health education, and malaria focal points. Training and training materials were based on harmonized training materials which VectorLink had contributed to developing in previous years.

- Provided technical assistance to the Zambezia Provincial Health Directorate to prepare for IRS activities under government-to-government (G2G) agreement, which PMI had planned to enter in 2021/22. Though the G2G agreement was not signed in time for the 2022 IRS campaign, it was signed in August 2022 for 2023 IRS implementation.
- Began preparation for 2022 spray campaign, despite the later than usual approval of the 2022 work plan due to G2G negotiations.
- Halted entomological activities in Erati district due to reported terrorist-related attacks in September 2022.
- Completed the construction of new insectary in Zambezia, which replaces the insectary that burned down in February 2017. A contract was signed in late 2019 with construction to begin in February–March 2020; the COVID-19 pandemic delayed progress for a year and half before construction restarted in September 2021.
- Supported the travel for the Nampula Province seconded entomology coordinator and two NMCP entomology staff to attend the VectorLink Regional Entomology Training in Dakar, Senegal, on August 22–27, 2022.

## 1.18 NIGER

### 1.18.1 PROGRAM HIGHLIGHTS

- Completed entomological monitoring in 15 sentinel sites selected by the NMCP between June and December 2021 and 4 sites between June and September 2022. The NMCP used the 2021 entomological data to update vector control tools with the introduction of IG2 and PBO nets in 2022 mass campaign and routine distribution.
- Conducted longitudinal vector surveillance in six sites (Agadez, Keita, Balleyara, Guidimouni, Gaya, and Niamey V) using HLC, PSC, and CDC light traps. *An. Gambiae* s.l. remains the main malaria vector in all sites except in Guidimouni, where *An. Funestus* s.l. was predominant.
- Conducted insecticide susceptibility tests, intensity assay, and PBO synergism in 4 (Guidimouni, Say, Tassiou, and Tillabery) of 15 sites planned in Year 5 against pyrethroids (alpha-cypermethrin, deltamethrin, and permethrin) using WHO tube test kits, susceptibility to organophosphates (pirimiphos-methyl) using WHO test kits, and susceptibility to neonicotinoids (clothianidin) and pyrroles (chlorfenapyr) using CDC bottle assays.
- Continued to support the *Centre de Recherches Médicale et Sanitaire* (Medical and Health Research Center, CERMES) to maintain laboratory colonies and ensure that all activities in the insectary follow standard protocols, thereby supporting the NMCP to make evidence-based vector control decisions.
- Supported the training of two local technicians in Balleyara and Keita, in addition to the local technician in Gaya, on basic entomological methods as part of an effort to strengthen district-level capacity to conduct entomological monitoring activities.
- Promoted the use of the DHIS2-based VectorLink Collect database for improved entomological data monitoring, reporting, and decision making by relevant stakeholders. In June 2022, the CERMES database manager received training in Cameroon that increased the country's capacity to autonomously generate, manage/maintain, and analyze national entomology data in a universal platform.
- Conducted in-person training for field technicians involved in the PMI VectorLink-supported entomological data collection from CERMES and NMCP on entomological methods.
- Received approval of the 36-month round of durability monitoring, submitted in Year 4, in this reporting period. A publicly accessible study report was uploaded to [www.pmi.gov](http://www.pmi.gov) and

www.durabilitymonitoring.org. Publicly accessible anonymous study datasets were uploaded to www.durabilitymonitoring.org.

- Conducted a hybrid in-person/virtual meeting to formally disseminate final durability monitoring results to key stakeholders on July 26, 2022.
- Carried out a feasibility assessment review of the OTSS+ tool Health Network Quality Improvement System (HNQIS), which found strong alignment between supervision activities in the PMI-supported regions in Niger, supporting the idea of integrating the ITN supervision checklist into the tool.
- Provided technical assistance to the NMCP and CERMES entomological technicians for the review and interpretation of entomological data to inform strategic and cost-efficient deployments of vector control interventions and to improve integrated vector control decision making.

## 1.19 NIGERIA

### 1.19.1 PROGRAM HIGHLIGHTS

- Conducted monthly vector surveillance and insecticide resistance monitoring in six sites (Akwa Ibom, Ebonyi, Kebbi, Oyo, Plateau, and Sokoto) and insecticide resistance monitoring only in 10 additional sites (Bauchi, Bayelsa, Benue, Bonny Island, Cross River, Enugu, Federal Capital Territory, Kaduna, Nasarawa, and Zamfara) with supervision from VectorLink and the Nigeria Institute of Medical Research.
- Provided training and technical assistance to Nigeria Liquefied Natural Gas for entomological surveillance, insecticide resistance monitoring, and laboratory activities in Bonny Island, thus helping to enable the company to carry out these activities independently in the future.
- Procured molecular equipment to be installed at the Department of Biological Sciences, Nasarawa State University Keffi, as part of efforts to expand malaria laboratory analysis capacity. Staff will be trained in Y6. VectorLink also assisted Global Fund-supported sentinel sites in the procurement and distribution of entomology materials for surveillance and insecticide resistance monitoring activities.
- Completed the final evaluation report assessing the epidemiological and entomological impacts of the 2019 PBO ITN campaign in Ebonyi State, finding that PBO ITNs were associated with a reduction in malaria case incidence of between 32.6% and 51.7%, translating to between 350,372 and 774,277 cases averted. This impact was significantly greater than the impact of pyrethroid-only ITNs in Cross River. PBO ITNs were also associated with a 69% lower human biting rate and a 74% lower indoor resting density in the high transmission season after the ITN campaign compared to the same time period the year before.
- Completed a baseline assessment presentation describing the trends in malaria case incidence and climate metrics in the three years before, and entomological monitoring indicators in the one year before the IG2 and PBO ITN campaigns (November 2022) in Kebbi and Sokoto, respectively.
- Successfully transitioned from a Microsoft Access-based data collection system to the DHIS2-based VectorLink Collect database in six sentinel sites where longitudinal surveillance activities were being carried out, in October 2021. In March 2022, the team rolled out mobile data collection for longitudinal surveillance via Android devices in four of the six sites (Akwa Ibom, Ebonyi, Oyo, and Plateau). All 16 sites conducting insecticide resistance monitoring starting in June 2022 were also trained and used VectorLink Collect to capture data.
- Supported the development of a draft national vector surveillance and insecticide resistance implementation guide containing practical guidance as well as harmonized protocols and procedures for implementation of entomological activities by the NMEP and its partners. The guide was reviewed, validated by key stakeholders, and approved by the technical working group in February 2022.
- In collaboration with the Nigeria Institute of Medical Research, conducted bio-efficacy tests on pre-distribution nets as a part of SDM of IG2 ITNs with distribution in November 2022 in Kebbi State. The team also updated the SDM study protocol, which aims to monitor the physical and chemical durability of the nets over three years post-distribution.

- Facilitated supplemental molecular analysis and sequencing by the University of Witwatersrand on samples collected by VectorLink in Akwa Ibom that were morphologically identified as *An. Hargreavesi*. Results confirmed that about 84% of the samples belonged to the *An. Marshalli* complex (16% were *An. Hargreavesi*).
- Collaborated with local GIS firm OEA Consultants to carry out a LSM feasibility survey to identify and map *Anopheles* larval breeding sites within Argungu, Bunza, and Kalgo local government areas of Kebbi State, to determine if this intervention is suitable in Nigeria. A final report is under development.

## 1.20 RWANDA

**TABLE 8: PMI VECTORLINK RWANDA VECTOR CONTROL AT A GLANCE**

IRS	<b>Dates and length of PMI-supported IRS campaign</b>	August 22–September 16, 2022 20 operational days		
	<b>Number of districts covered by PMI-supported IRS</b>	3 (Nyagatare, Ngoma, Kirehe)		
	<b>Insecticide(s) and units</b>	Actellic 300CS (232,452 units)		
	<b>IRS results</b>	Structures Sprayed: 354,669	Structures Found: 356,254	Spray Coverage: 99.6%
	<b>Population protected by PMI-supported IRS</b>	Total: 1,358,152	Pregnant Women: 18,435	Children < 5: 181,561
	<b>Number of people trained with U.S. govt funds to deliver IRS</b>	3,201 (1,643 female, 1,558 male)		

### 1.20.1 PROGRAM HIGHLIGHTS

- Conducted IRS in Nyagatare, Ngoma, and Kirehe districts and one refugee camp, protecting 1,358,152 people from malaria. The campaign exceeded its targeted number of structures. The campaign observed current COVID-19 mitigation measures.
- Intensified IRS messages and strengthened supervision on inadequate reporting of non-sprayed structures and distribution of structure cards following reports of concerns on these matters.
- Rehabilitated an entomology laboratory and insectary and equipped it with modern equipment that includes DNA automated extractor/RADI Extractor 32, and Binocular Microscopes. A Real Time PCR Detection System has been purchased but not yet delivered to Rwanda.
- Conducted entomological monitoring in three IRS districts (Kirehe, Ngoma, and Nyagatare) in collaboration with the Malaria and Other Parasitic Diseases Division (MOPDD) division. PMI VectorLink Rwanda also performed ELISA tests to assess parasite infection rate and blood meal source in a sample of mosquitoes, and PCR for identification of *An. Gambiae* s.l. to the species level.
- Conducted wall cone bioassays in collaboration with the MOPDD division, to monitor until July 2022 the residual efficacy of Actellic 300CS sprayed in 2021 in three IRS districts (Kirehe, Ngoma, and Nyagatare). In August 2022, VectorLink Rwanda began monitoring residual efficacy of Actellic 300CS for the 2022 spray campaign. Tests confirmed that the residual efficacy of Actellic 300CS was more than 11 months.
- Completed training, data collection, household survey, and data analysis for the 24-month durability monitoring. The activity monitors PermaNet 3.0 ITNs in Kicukiro, Yahe ITNs in Ruhango, IG2 ITNs in Karongi, and Olyset ITNs in Burera. For the 24-month round, remote TOT was conducted on February 23–25, 2022, followed by in-person fieldworker training on February 28–March 4, and data collection for three sites (Ruhango, Burera, and Kicukiro) on March 7–April 9, and one site (Karongi) on June 13–July 16. Laboratory analysis and final reporting are in progress.
- Provided capacity building of entomology technicians, accountants, and heads of health centers from 12 sentinel sites of the MOPDD on entomological monitoring techniques, data management, and proper reporting of technical and financial components.

## 1.21 SENEGAL

**TABLE 9: PMI VECTORLINK SENEGAL VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	May 30–June 24, 2022 20 operational days		
	Number of districts covered by PMI-supported IRS	4 (Kédougou, Makacolibantang, Koumpentoum, Kounghoul)		
	Insecticide(s) and units	Actellic 300CS in Makacolibantang (7,488 units) Fludora Fusion 50WP in two districts: Koumpentoum and Kounghoul: (29,740 units) SumiShield 50WG in three districts: Kédougou and partially in Koumpentoum and Kounghoul (10,859 units)		
	IRS results	Structures Sprayed: 138,752	Structures Found: 142,347	Spray Coverage: 97.5%
	Population protected by PMI-supported IRS	Total: 570,283	Pregnant Women: 14,169	Children < 5: 116,844
	Number of people trained with U.S. govt funds to deliver IRS	914 (266 female, 648 male)		
	ITN distribution channel(s) and dates of distribution	Public sector through health facilities, and community through community-based organizations October 1, 2021–September 30, 2022		
ITN	Number of districts included in distribution	14 (Dakar, Kaffrine, Kaolack, Fatick, Ziguinchor, Sedhiou, Diourbel, Thies, Kolda, Tambacounda, Kedougou, Saint Louis, Matam, Louga)		
	Number of ITNs distributed	Distributed by VectorLink: 7,324 ITNs	Distributed by partners with VectorLink support: 1,275,550 ITNs	
	Type and Brand of ITNs Distributed	ITN <u>Types</u> Distributed: Pyrethroid-only (1,235,274) PBO (47,600)	ITN <u>Brands</u> Distributed: Olyset Olyset Plus (PBO)	

### 1.21.1 PROGRAM HIGHLIGHTS

- Organized National IRS Planning Workshop on March 3, 2022 and completed advocacy visits from March 21 through March 25, 2022.
- Completed the procurement of IRS commodities, including but not limited to SumiShield, Fludora Fusion, and Actellic insecticides.
- Hired 988 seasonal workers in preparation for the campaign and conducted 14 trainings for seasonal workers and supervisors. Communication activities were primarily carried out by the NMCP.
- Implemented an M&E system based on two mobile phone applications, VectorLink Collect for spray performance data and CommCare for supervision-related data, allowing real-time data review and increasing data quality.
- Completed procurement of equipment for the University of Cheikh Anta Diop (UCAD) laboratories and insectary.
- Conducted cone bioassays to assess the quality of IRS in two sprayed villages in each IRS district within two to five days of receiving IRS. The results of bioassays indicated that the structures were adequately sprayed in both districts, with 100% mortality recorded between one and five days on both wall types.
- Conducted entomological monitoring in 34 sites across 19 districts of the country through PSCs, HLCs, and insecticide susceptibility testing. Eight Anopheles species were collected during the monitoring; *An. Gambiae* s.l. was the predominant vector collected in all sites except in Ndoffane, where the prevalent species was *An. Funestus* s.l.
- Conducted insecticide susceptibility tests, intensity assays, and PBO synergism assays against pyrethroids insecticides (alpha-cypermethrin, deltamethrin, and permethrin) in seven districts using WHO tube test kits and tested organophosphates (pirimiphos-methyl) and carbamates (bendiocarb) using WHO tube test kits while susceptibility to neonicotinoids (clothianidin) and pyrrole (chlorfenapyr) was assessed using CDC bottle assays.

- Trained six UCAD entomologists on DHIS2 Capture application to collect monthly field entomology data on tablets, which led to the successful pilot in nine sentinel sites across five districts starting in August 2022.
- Supported the NMCP’s nationwide continuous distribution of ITNs through technical assistance and distribution to 14 regions and selected districts.
- Organized joint supervision with the NMCP visit to monitor the routine ITN distribution program; visited 11 regions, 53 district health offices, and 243 health facilities.
- Implemented the social inclusion pilot project reaching children attending Koranic schools (*daaras*). The pilot project distributed 7,324 ITNs to these children (known as *talibé* children) and other *daaras* residents.
- Conducted ITN durability monitoring in the districts of Koumpentoum (Olyset plus) and Kounghoul (Olyset). Activities completed to date include approval of the study protocol by the Senegal Institutional Review Board and collection of samples of both ITN brands, which were sent to CDC Atlanta for chemical and bio-efficacy analysis.

## 1.22 SIERRA LEONE

**TABLE 10: PMI VECTORLINK SIERRA LEONE VECTOR CONTROL AT A GLANCE**

IRS	Dates and length of PMI-supported IRS campaign	May 9–June 9, 2022 24 operational days		
	Number of districts covered by PMI-supported IRS	2 (Bo, Bombali)		
	Insecticide(s) and units	SumiShield 50WG (52,173 units)		
	IRS results	Structures Sprayed: 143,509	Structures Found: 148,772	Spray Coverage: 96.5%
	Population protected by PMI-supported IRS	Total: 652,232	Pregnant women: 19,528	Children < 5: 97,675
	Number of people trained with U.S. govt. funds to deliver IRS	1,206 (545 female, 661 male)		

### 1.22.1 PROGRAM HIGHLIGHTS

- Conducted an IRS capacity-building workshop in March 2022 for 30 participants at the national and district levels.
- Supported an independent environmental compliance field evaluation of PMI VectorLink IRS activities in Sierra Leone.
- Conducted a Post-Spray Data Quality Audit in August 2022 to assess the spray coverage.
- Conducted vector bionomic monitoring at 10 routine sentinel sites in five districts. *An. Gambiae* s.l. is the predominant vector species across all sites followed by *An. Funestus* s.l. This finding is similar to observations made in previous years.
- Continued insecticide resistance monitoring in 10 sentinel sites representing all ecological features in Sierra Leone. *An. Gambiae* s.l. are resistant to permethrin, deltamethrin, and alpha-cypermethrin but pre-exposure to PBO was able to restore partial susceptibility. Resistance to pirimiphos-methyl was reported in all districts, but *An. Gambiae* s.l. were fully susceptible to chlorfenapyr and clothianidin.
- Conducted a spray quality assessment in selected sites in the Bo and Bombali districts that had been sprayed with SumiShield 50WG in May 2022. Results showed that mortality of *An. Gambiae* s.s. Kisumu strain in cone bioassays on walls was 100% within the standard five-day post-exposure holding time.
- Continued monitoring the residual efficacy of SumiShield 50WG monthly; results show that mortality of exposed mosquitoes is above the 80% threshold for four months. Monitoring continues.
- Continued to evaluate the co-deployment of IRS and PBO ITNs on confirmed malaria case burden.
- Completed training for all VectorLink technicians and select supervisors on mobile data collection for entomology using the DHIS2 android capture application and the VectorLink Collect system.



- Trained 43 district health management staff and local entomologists on malaria vector surveillance.
- Facilitated the signing of the memorandum of understanding between the Sierra Leone NMCP and Njala University to process mosquito samples at Bo Campus laboratory.
- Completed a baseline report describing trends in malaria case incidence, entomological monitoring indicators, campaign coverage, and climate metrics in advance of the 2021 IRS campaign in Bo and Bombali districts. Report described data collected through April 2021, including one year of data after the nationwide PBO ITN campaign (2020).
- Progressed on the development of an interim report containing interim, descriptive analyses of trends in malaria case incidence, and final statistical analyses of entomological monitoring indicators before and after co-deployment of IRS (2021) and PBO ITNs (2020) in Bo and Bombali districts.
- Completed remote TOT, in-person fieldworker training, and data collection in two study sites for the 24-month durability monitoring round of 2020 mass ITN distribution nets. The TOT was conducted on April 4–5 and in-person fieldworker training took place on April 11–14, 2022. Data collection was conducted on April 20–June 7 in Bo and Moyamba districts.
- Continued bioassay and chemical testing of PermaNet 3.0 and Olyset Plus PBO synergist field ITNs collected during the 24-month durability monitoring round.

## 1.23 TANZANIA

**TABLE I I: PMI VECTORLINK TANZANIA VECTOR CONTROL AT A GLANCE**

IRS	<b>Dates and length of PMI-supported IRS campaign</b>	October 5–December 22, 2021 55 operational days		
	<b>Number of districts covered by PMI-supported IRS</b>	6 Mainland Tanzania (Kakonko, Kasulu, Kibondo, Biharamulo, Bukombe, Ukerewe)		
	<b>Insecticide(s) and units</b>	Fludora Fusion (112,250 units) and SumiShield 50WG (55,198 units)		
	<b>IRS results</b>	Structures Sprayed: 568,484	Structures Found: 611,112	Spray Coverage: 93.0%
	<b>Population protected by PMI-supported IRS</b>	Total: 2,081,886	Pregnant Women: 76,358	Children < 5: 394,668
	<b>Number of people trained with U.S. govt funds to deliver IRS</b>	3,069 (1,626 female, 1,443 male)		

### 1.23.1 PROGRAM HIGHLIGHTS

- Collaborated with UN High Commissioner for Refugees office and the Tanzania Ministry of Home Affairs to conduct IRS in the three refugee camps of Mtendeli, Nduta, and Nyarugusu in Kigoma Region.
- Piloted IRS campaign activities during spraying in the refugee camps in collaboration with the district health teams and NMCP, with the overall objective of building the ownership capacity of these key stakeholders to implement IRS sustainably in the future.
- Used 55,198 sachets of SumiShield 50WG in Bukombe and Biharamulo districts, and 112,250 sachets of Fludora Fusion in Ukerewe and Kigoma.
- Used mobile data collection for all 2,463 spray operators in the Lake Zone, which resulted in real-time data for better reporting, data accuracy, and decision making during the campaigns.
- Provided technical support to the Zanzibar Malaria Elimination Programme (ZAMEP) to conduct focal IRS in seven selected shehias of Unguja (Kizimkazi Mkunguni) and Pemba (Ukunjwi, Finya, Konde, Kwale, Kivugo, and Wingwi), including developing a reactive rapid response operational manual. The project also completed the installation of the incinerator at Kivunge Hospital and ensured that it was operational.

- Supported information system strengthening activities with ZAMEP and the Mainland NMCP to discuss and complete the transfer of IRS data from VectorLink Collect to NMCP and ZAMEP databases, as well as support the design of the ZAMEP database to capture and support rapid response IRS results.
- Rolled out electronic registration and time filing for temporary community service participants. During the contract signing period, the mobile system was used to register all cadres, which helped reduce the workload for the administration team.
- Implemented IRS in line with PMI and global best practices to mitigate the risk of COVID-19. The project completed all planned spray campaigns successfully while facing the additional logistical challenge of carrying out large-scale operations during the COVID-19 pandemic, diligently following each step in the mitigation measures in accordance with the Ministry of Health and PMI VectorLink global guidelines, ensuring continuity of protection from malaria despite a global pandemic.
- Established a new role of site-based M&E assistants, who oversaw the mobile roll-out in each operations site, helping to streamline mobile data collection by resolving the challenges encountered by spray operators.
- Encouraged qualified women to apply for spray operator positions, aiming for a 1:2 male-to-female ratio of applicants during recruitment, to overcome the challenges of low participation of women in prior years. With women overrepresented among initial applicants in this way, the project nearly achieved a gender-balanced workforce—47.1% of its seasonal workforce was female. The percentage of women hired to work at supervisory levels such as external supervisors, site supervisors, team leaders, storekeepers, and M&E assistants accounted for 48.3% (289/598) of all staff employed in supervisory positions, which is a 7.2% increase from the 2020/2021 spray campaign.

## 1.24 UGANDA

**TABLE 12: PMI VECTORLINK UGANDA VECTOR CONTROL AT A GLANCE**

<b>IRS</b>	<b>Dates and length of PMI-supported IRS campaign</b>	February 28–March 26, 2022 24 operational days		
	<b>Number of districts covered by PMI-supported IRS</b>	10 (Budaka, Bugiri, Butaleja, Butebo, Kibuku, Namutumba, Pallisa, Lira, Serere, Tororo)		
	<b>Insecticide(s) and units</b>	Fludora Fusion WP-SB (302,823 units) and SumiShield 50WG (140,876 units)		
	<b>IRS results</b>	Structures Sprayed: 1,104,083	Structures Found: 1,187,864	Spray Coverage: 92.9%
	<b>Population protected by PMI-supported IRS</b>	Total: 3,894,239	Pregnant Women: 110,534	Children < 5: 724,448
	<b>Number of people trained with U.S. govt funds to deliver IRS</b>	6,125 (1,706 female, 4,419 male)		

### 1.24.1 PROGRAM HIGHLIGHTS

- Conducted a single-phased IRS campaign using Fludora Fusion WP-SB in eight districts and SumiShield WG50 in two districts, working in collaboration with the Ministry of Health, district local government, subcounty leaders, and other stakeholders while strictly observing COVID-19 mitigation measures.
- Strengthened supervision during the campaign and deployed additional district and local leaders to supervise IRS activities and mitigate misplacement of insecticide by the spray team members.
- Implemented mobile data collection for a second year in five operation sites in Bugiri District during the 2022 spray campaign as a step toward achieving real-time spray data collection on the project.
- Piloted mobile data collection for entomological data using the DHIS2 android capture application and VectorLink Collect to conduct insecticide resistance testing in Bugiri with plans to expand to additional sites and data collection activities.
- Implemented electronic insecticide serialization in 10 operation sites to enhance insecticide tracking and minimize insecticide losses.

- Under the stewardship of local partner, Communication for Development Foundation Uganda (CDFU), conducted social behavior change activities in consultation with the district health management teams to sensitize communities on IRS and COVID-19 through use of mobile vans, mass media, and community dialogues to promote intervention acceptance.
- Conducted wall bioassays in six districts (Bugiri, Butaleja, Kibuku, Lira, Serere, and Tororo) within one week of IRS to assess the spray quality. The project recorded 100% mortality for susceptible *An. Gambiae* s.s., implying that the quality of spraying was satisfactory. Residual efficacy monitoring on surfaces sprayed with Fludora Fusion WP-SB and SumiShield WG50 is ongoing in five districts (Bugiri, Kibuku, Lira, Serere, and Tororo).
- Conducted monthly vector surveillance to assess the composition, density, and behavior of malaria vectors in six sentinel sites (Apac, Bugiri, Lira, Serere, Soroti, and Tororo).
- Conducted assays to determine the susceptibility status of *An. Gambiae* s.l. and *An. Funestus* s.l. to clothianidin, pirimiphos-methyl, deltamethrin, permethrin, alpha-cypermethrin, and chlorfenapyr in nine districts (Bugiri, Gulu, Hoima, Kamwenge, Katakwi, Kitgum, Lira, Soroti, and Tororo). Also conducted synergist assays with PBO for deltamethrin and intensity assays for permethrin and deltamethrin.
- Strengthened capacity of Ministry of Health and district staff in West Nile Region to manage IRS operations including planning, spraying, resource management, and M&E in preparation for the Global Fund-funded IRS campaign to be implemented in the West Nile in 2022.
- Strengthened entomological capabilities through training and the establishment of a mosquito insectary at Muni University in West Nile Region. The insectary will raise malaria vectors including *An. Gambiae* s.s. (Kisumu strain) to serve in monitoring insecticide residual efficacy and other malaria vector studies for the West Nile Region.
- Completed the 12-month assessment of ITN durability monitoring for cohorts of Royal Guard® (alpha-cypermethrin and pyriproxyfen) and PermaNet 3.0 (deltamethrin and PBO) distributed in the 2020–2021 mass campaign in Apac and Mubende.

## 1.25 ZAMBIA

**TABLE 13: PMI VECTORLINK ZAMBIA VECTOR CONTROL AT A GLANCE**

IRS	<b>Dates and length of PMI-supported IRS campaign</b>	September 28–November 10, 2021 30 operational days April 4-9, 2022* 6 operational days		
	<b>Number of districts covered by PMI-supported IRS</b>	21 (14 Eastern Province, 3 in Luapula Province, 4 in Copperbelt Province) 1: Luapula Province*		
	<b>Insecticide(s) and units</b>	SumiShield 50WG (51,547 units) and Fludora Fusion WP-SB (151,673 units) SumiShield 50WG (754 units)*		
	<b>IRS results</b>	Structures Sprayed: 717,351 2,430*	Structures Found: 738,659 2,461*	Spray Coverage: 97.0% 98.7*
	<b>Population protected by PMI-supported IRS</b>	Total: 3,032,558 14,096*	Pregnant Women: 94,511 535*	Children < 5: 416,039 1,906*
	<b>Number of people trained with U.S. gov't funds to deliver IRS</b>	2,846 (1,068 female, 1,778 male) 41 (17 female, 24 male)*		
	<b>ITN distribution channel(s) and dates of distribution</b>	SBD October 4–8, 2021		
ITN	<b>Number of districts included in distribution</b>	4 in Eastern Province (Chadiza, Chipangali, Katete, Petauke)		
	<b>Number of ITNs distributed</b>	Distributed by VectorLink: 0	Distributed by partners with VectorLink support: 51,434	

Type and Brand of ITNs Distributed	ITN <u>Types</u> Distributed: PBO	ITN <u>Brands</u> Distributed: Olyset Plus
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\*A six-day mini-IRS campaign took place in Nchelenge District in April 2022; Nchelenge was also sprayed as part of the main IRS campaign that took place September–November 2021. The Nchelenge IRS results are only counted once for country-level reporting.

## 1.25.1 PROGRAM HIGHLIGHTS

- Conducted a successful IRS campaign as a result of (1) maintaining strong working relationships between the project and key stakeholders; (2) reducing spray operator targets from 13 structures to 12 structures per day in the four rural Copperbelt districts given the far distances between structures in some communities; (3) maintaining two embedded mobilizers from Neighborhood Health Committees per spray team to assist with community sensitization and household preparation; and (4) maintaining a five-day work week to allow the spray teams two days of rest per week. The project adhered to global, project and PMI COVID-19 mitigation guidelines and did not record any COVID-19-related incidents during the campaign.
- Achieved 45% female inclusion in the main IRS campaign, an increase from 42% in 2020, due in part to an updated protocol disseminated to community leaders to encourage more women to apply for IRS positions.
- Conducted fieldwork for the ITN Misuse Assessment in Luapula, Muchinga, and Northern provinces in September/October 2021, followed by data preparation, analysis, and development of an assessment report, which was approved in July 2022. Preliminary results were presented to the Vector Control Technical Working Group in May 2022.
- Supported the NMEP to distribute PBO nets procured by PMI in 469 primary schools in four Eastern Province districts in October 2021. VectorLink facilitated provincial- and district-level TOT for Ministry of Health and Ministry of Education staff before distribution and participated in supervision and monitoring during the campaign. In addition, the team worked with the NMEP to develop a system for SBD electronic data entry into DHIS2. This was the first time that SBD data had been captured electronically in the country.
- Completed remote TOT, in-person fieldworker training, and data collection in February/March 2022 in Nyimba for the 12-month durability monitoring round of Olyset Plus PBO synergist ITNs distributed during the 2020/21 mass campaign. (The 12-month round was restricted to Nyimba given the short time that had elapsed between the conclusion of the baseline survey in Serenje and the planned 12-month round.) Bioassays ITNs collected during the 12-month durability monitoring round were also completed during the reporting period, while chemical analysis is ongoing.
- Worked with the National Malaria Elimination Centre to conduct a Continuous Distribution ITN Assessment in five provinces (Luapula, Copperbelt, Northern, Eastern, and Western), 16 districts, and 39 health facilities in early 2022. The exercise identified opportunities and recommendations for strengthening existing continuous distribution systems and processes, and informed revisions to the national guidelines on the distribution and utilization of ITNs for malaria prevention. With the support of VectorLink, the NMEP revised the guidelines (last updated in 2017) at a five-day workshop in May 2022. During the workshop, VectorLink presented the NetCalc tool (used to evaluate continuous distribution channels) to the NMEP, generating preliminary recommendations for future consideration. Following the workshop, VectorLink supported the finalization of the guidelines and will fund the printing of 5,000 copies. The team also helped the NMEP develop a job aid based on the updated guidelines, for use by health facility staff responsible for issuing ITNs during visits for antenatal care (ANC) and Expanded Programme on Immunization (EPI).
- Provided ongoing support to the NMEP to plan and prepare for the 2023 ITN mass campaign in four key areas: (1) Development of the 2023 mass campaign strategy, i.e., phased approach involving household registration followed by a pause for data validation and then door-to-door ITN distribution; (2) Quantification of ITN needs, and identification and quantification of associated non-net requirements related to procurement and supply chain, data digitization and collection, social and behavior change, training, reporting, and supervision and monitoring; (3) Development of draft macro budgets based on various scenarios, determination of funding gaps with respect to commodity

procurement as well as non-net costs, and unbundling of the budgets based on available funding and spending guidelines provided by donors; and (4) Participation in mass campaign planning meetings.

- Conducted entomological monitoring following the 2021 IRS campaign; wall bioassays conducted within 24–48 hours of spraying recorded 100% mortality of susceptible *An. Gambiae* (Kisumu strain) after 24 hours on all wall surface types sprayed with both SumiShield 50WG and Fludora Fusion, signifying a high-quality spray. As of August 2022, based on residual efficacy data, the effective duration of the two insecticides is at least 10 months. *An. Funestus* s.l. and *An. Gambiae* s.l. were fully susceptible to clothianidin, chlorfenapyr, and pirimiphos-methyl in all three provinces tested.
- Conducted entomological surveillance, including HLC, PSC, residual efficacy monitoring, and insecticide resistance studies in five districts.
- Provided central-level technical assistance to the NMEP through joint IRS planning meetings and sharing of IRS best practice tools. Incorporated updated structure and population estimates at the health facility level (provided by GRID3) into maps for all 116 districts, as well as health facility catchment area boundaries for select districts. Maps were used to support microplanning for the 2020–21 IRS and ITN campaigns.
- Supported Global Fund- and Government of the Republic of Zambia-funded 2021 IRS operational areas through procurement of IRS equipment and commodities to ensure timely commencement of IRS; environmental compliance technical assistance in the districts spraying DDT; support to engage provincial commanders to monitor the spray campaign and ensure timely entry of spray data; public-private partnerships in Copperbelt, particularly with Mopani and Konkola Copper Mines; and automated IRS monitoring dashboards that enabled national, provincial, and district stakeholders to track spray coverage and progress in real-time at the health facility catchment area level. Indicators such as data entry timeliness and structures sprayed per spray operator also helped provincial and district managers assess the quality of IRS implementation.
- Summarized vector control datasets and developed visualizations for NMEP program guidance documents, reports, meetings, PMI Malaria Operational Plans, and other ad hoc requests. In addition to documenting IRS and ITN program coverage, these visualizations summarized IRS and ITN products used, program funders and implementers, entomological surveillance sites and activities, insecticide resistance profiles, and vector species composition by location.
- Developed a national IRS Indicator Guide that details the specific IRS indicators used to plan and monitor IRS campaigns in Zambia and how they are calculated and used for decision making.
- Coordinated the adaptation and integration of the PMI VectorLink Collect entomological program into a national DHIS2-based entomology database, in collaboration with the NMEP-led Entomological Data Management Committee, which will allow the NMEP and its partners to store, analyze, and visualize all entomological data collected in Zambia in one place. VectorLink trained national, provincial, and district stakeholders and partner organization staff on the new online system in September 2022. The NMEP then led a follow-up training for the remaining districts, with technical support from VectorLink. The system is designed for future integration with national data systems.
- Provided administrative support to the NMEP for virtual meetings, including quarterly Vector Control Technical Working Group meetings and the annual Insecticide Resistance Monitoring and Management/Technical Advisory Committee meeting.

## 1.26 ZIMBABWE

### 1.26.1 PROGRAM HIGHLIGHTS

- The official opening of the Malaria Research and Reference Insectary at Africa University was held on October 22, 2021, by US Embassy Chargé d’Affairs, Mr. Thomas Hastings and Africa University Acting Vice Chancellor, Professor Peter Mageto.

- Provided technical assistance to five districts in Mashonaland East Province (Mudzi, Mutoko, Uzumba Maramba Pfungwe (UMP), Murehwa, and Goromonzi) during the IRS campaign conducted between October 13, 2021, and January 8, 2022, which was fully implemented by the Government of Zimbabwe. Technical assistance included providing technical and logistical support on proper management of liquid and solid waste, environmental compliance monitoring, operational supervision, and printing of the IRS/environmental compliance checklist.
- During the 2021 IRS campaign, helped with the shortage of face masks, supplying 5,872 N95 face masks to the teams.
- Provided technical support to Ministry of Health and Child Care officials in conducting investigations on the incidence of COVID-19 among spray operators during the 2021 IRS campaign.
- During the first and second week of February 2022, supported Ministry of Health and Child Care officials in conducting post-IRS environmental compliance close-out activities in 18 sites in the five IRS districts.
- Provided operational technical assistance to the NMCP in preparation for the 2022 IRS campaign, which is being fully implemented by the Government of Zimbabwe. Key areas of technical assistance before the start of the campaign included support in review and planning for spray operations, input in seasonal staff selection, environmental compliance and participating in select trainings.
- In May 2022, conducted a pre-IRS environmental assessment in five districts of Mashonaland East Province that guided the Refurbishment Plan.
- Implemented a refurbishment plan in preparation of the 2022 IRS campaign that included 11 campsites in three districts (three in Mudzi, three in UMP, and five in Mutoko). The plan included improving water systems, soak pits and wash slabs, and IRS storerooms, latrines, and bathing rooms.
- Submitted a new Supplemental Environmental Assessment in September 2022 that USAID is currently reviewing.
- Supported three districts (UMP, Mudzi, and Mutoko) in Mashonaland East Province with personal protective equipment (15,600 respirators, 500 face shields, and 500 brackets) and hiring of two lorries in preparation of the 2022 IRS campaign.
- Supported the NMCP in developing the “Standard Operating Procedures for Indoor Residual Spraying (IRS) Data Management in Zimbabwe” in June 2022.
- Continued routine entomological surveillance in three sentinel sites in Mashonaland East Province (Dendera in Mudzi, Kawere in Mutoko, and Makarara in Wedza District, the latter a control site).
- Conducted cone bioassay tests at Kawere and Dendera up to 10 and 11 months after spraying. The residual efficacy of Fludora Fusion sprayed on all wall surfaces remained above the 80% threshold up to 10 months after spraying in Dendera, and up to 9 months after spraying DDT in Kawere, except for brick wall surfaces (66.7% at T9).
- Conducted insecticide resistance testing in three sentinel sites (Dendera in Mudzi District, Kawere in Mutoko, and Burma Valley in Mutare). Insufficient larvae were caught and reared from the fourth site (Makarara), probably due to a drought in that area during the recent rainy season.
- Collected *An. Funestus* from Chiadzwa (Mutare District) to start susceptible colony at the Malaria Research and Reference Insectary at Africa University
- Implemented capacity building for Africa University staff on morphological identification of mosquitoes, insecticide resistance (WHO and CDC bottle bioassays protocols) and on the PMI VectorLink Collect database. Supported entomological training for 30 ZENTO<sup>1</sup>/Ministry of Health and Child Care staff at Honde Valley (Mutasa District).

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1 ZENTO is the Zimbabwe Entomological Support Program in Malaria funded by USAID and implemented by Africa University

- Led by VectorLink's entomology manager, supported the NMCP with entomological training for E8<sup>2</sup> initiative that reached 23 participants from Bulawayo City and three provinces: Matabeleland North, Matabeleland South, and Midlands.

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<sup>2</sup> E8 initiative is the Malaria Elimination 8 Southern Africa Development Community initiative that includes the following eight countries: Botswana, Namibia, South Africa, Eswatini, Angola, Mozambique, Zambia, and Zimbabwe.





# 2. CORE

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## 2.1 COVID-19 TRANSMISSION MITIGATION EFFORTS

PMI VectorLink continued to adapt project operations to prevent the spread of COVID-19 from the VectorLink team to partners and community members where the project works, and to protect project staff. Project offices were cautiously re-opened worldwide, although remote work continued when office attendance was not essential. International travel resumed, but was still markedly reduced from pre-pandemic levels, while in-country travel resumed to near-normal levels, maintaining standards for vehicle occupancy, mask use, and ventilation of cabins. As the great majority of project staff were vaccinated, COVID-19 testing prior to domestic travel was discontinued. Non-VectorLink personnel were still required to attest to their vaccination status prior to travel in VectorLink vehicles.

In field settings, PMI VectorLink adopted the majority of CDC and global guidance for COVID-19 prevention, although mandatory use of N95 or KN95 masks was maintained for most meetings and trainings, depending on the venue. The director of environmental compliance and safety evaluated each proposed training or operations venue to ensure sufficient space and ventilation, considering the number of participants and duration of activities. The project continued to require mask use and at least 2m (6ft) physical distancing and encouraged vaccination for anyone participating in project activities. Upon receipt of any positive COVID-19 test results, PMI VectorLink continued to implement strict protocols for contact tracing, testing requirements, and quarantine and isolation mandates within the project's sphere of influence. All of PMI VectorLink's COVID-19 adaptations were included in the project's Operating Standards to Reduce the Risk of Transmission of COVID-19 and supplementary material for COVID-19 vaccination and testing guidance.

VectorLink held two project-wide in-person regional entomology trainings during this period, one in Cameroon and the other in Senegal. During the first week of the Cameroon training, there was a small outbreak of COVID-19, with five attendees eventually testing positive. The training was completed, however, and for the following week—and for the subsequent Senegal training—additional prevention protocols were adopted, including daily testing by rapid diagnostic test, increased ventilation of training spaces, dedicated use of microphones and electronics, and reinforced use of N95 masks by all participants as well as hotel staff. With these measures in place, VectorLink was able to complete the second week of training in Cameroon and the entire Senegal training without any positive instances of COVID-19.

Personal protective equipment and commodity supply chain issues posed by the COVID-19 pandemic eased during the reporting year, especially concerning the availability of N95 and KN95 masks. The project's procurement and logistics team continued to work with country teams to ensure adherence to stricter and longer lead times for all orders. PMI VectorLink also continued to foster good working relationships with vendors of insecticide, personal protective equipment, and lab supplies to ensure timely delivery of supplies and prompt notices of longer lead times or logistics challenges.

## 2.2 VECTOR CONTROL OPERATIONS

### Mesto Sprayer Pilot

The vector control team supported the planning and implementation of a pilot field test of the Mesto 7.5-liter sprayer. The Mesto sprayer received WHO Pesticide Evaluation Scheme recommendation, and International Pesticide Application Research Center certification, in 2018. The test, which was conducted in Uganda between February 28 and March 29, 2022, was a follow-on to the initial pilot conducted by VectorLink Madagascar in 2019. Overall, the equipment demonstrated improvements over the original version. However, a problem of persistent leakage was observed, and will be addressed by the manufacturer.

## Electronic Timesheet Pilot

PMI VectorLink further expanded the use of electronic timesheets by IRS seasonal day laborers to five countries, Côte d'Ivoire, Ethiopia, Ghana, Malawi, and Tanzania, and used electronic timesheets for a second year in Mali, Rwanda, and Senegal. Implementing electronic timesheets during IRS reduces travel time to collect paper timesheets and the reconciliation time required for mobile money payments of thousands of seasonal workers. The electronic timesheets were implemented in each country using the existing phones or tablets already purchased for mHealth applications at each site.

## 2.3 OPERATIONS RESEARCH

### Experimental Hut Trial and Clustered Randomized Controlled Trial on the Impact of Partial Versus Full IRS on the Malaria Burden

PMI VectorLink completed experimental hut studies and a small-scale pilot study of partial IRS with pirimiphos-methyl at the community level in Northern Ghana in Years 2 and 3, and subsequently an experimental hut study in Côte d'Ivoire. In the Côte d'Ivoire study, it was demonstrated that the spraying of the lower half of walls (up to 1m from the floor) plus the ceiling was non-inferior to full spray treatments for Actellic 300CS, Fludora Fusion 56.25WP-SB, and SumiShield 50WG, reflecting the preferred resting location (on the lower wall surface) of local vectors. The upper half and ceiling partial IRS treatment with Fludora Fusion was also non-inferior to the full spraying, but this was not the case for the other two insecticides. The manuscript from this research underwent multiple drafts to ensure sound statistical comparisons and has been submitted to *Scientific Reports* for publication.

The data collected from these trials supports the need for a robust randomized control trial to determine the non-inferiority of partial IRS compared to full IRS in terms of epidemiological and entomological impact. Mozambique has been proposed as a location for this trial but would require a baseline and/or cross-over design to reach the power required for the non-inferiority design. To inform the study for Mozambique, a structural survey and resting site study were conducted in Mopeia in July–August 2022, following sensitization and training sessions in June in each operations site. These studies were designed to determine: (1) the frequency of ceilings and metal roofs in sprayable structures in Mopeia; (2) in metal roof houses without ceilings, what proportion of the total mosquitoes in the house are resting on the roof and not on the walls? and (3) of mosquitoes that rest indoors on walls, are they resting on the upper or lower half?

The surveys were conducted by village mobilizers supported by the IEC assistants (four in total, one in each operations site) and supervised by the VectorLink M&E specialist and the district coordinator. The structural survey was completed in 5,173 eligible structures (14% of structures in the spray calendar lists) within 31 IRS villages (representing 13% of all IRS villages in the four IRS operations sites in Mopeia) and seven unsprayed villages (538 structures). Mud block (49%) and plastered mud (32%) were the most common wall types; brick (14%), straw (4%), and cement (1%) were atypical. Grass thatch (82%) was the most common roof material, then metal sheets (13%). Only 1.4% of structures had ceilings; of these, 81% were plastic tarpaulin and 19% were plywood.

Four villages were selected for the resting site study, within which a total of 73 metal roof houses and 55 thatch roof houses were included. In these houses, two separate Prokopack collections were performed from lower walls, upper walls, and roofs. One collection was done between 22:00 and midnight and the other between 05:00 and 07:00. The morning collection was followed by PSC. A total of 1,711 *Anopheles* spp were caught from 128 structures in four villages (32 in each village)—366 from two sprayed villages, Josina Machel and Eduardo Mondlane, and 1,157 from two unsprayed villages, Cocorico and Ntada. In the metal roof houses, mosquitoes were evenly split between resting locations, and these did not change depending on the timing of the collection. In the evening collection, 37% were found resting on roofs, 34% on upper wall surfaces, and 32% on lower wall surfaces. In the morning, these values were 37%, 31%, and 39% respectively. The 37% of mosquitoes not resting on sprayable surfaces are not reached by either full or partial IRS. Of the population resting on the walls, 53% are resting on the lower wall surface. A partial IRS approach that only sprayed the lower wall in these houses with metal roofs would only target 34% of the mosquito indoor resting population in Mopeia. In thatch roof houses the trend was similar, but a higher percentage were found resting on the thatch roof (47% in the evening collection and

49% in the morning collection). These mosquitoes resting on the thatch would still be targeted by full and partial IRS.

### **Experimental Hut Trial on Indoor Use of Attractive Targeted Sugar Baits for Malaria Vector Control**

The use of Attractive Targeted Sugar Baits (ATSBs) has potential as an alternative way to introduce new active ingredients at scale, in combination with nets. ATSBs present an opportunity to control mosquitoes during sugar feeding, and therefore to use non-pyrethroid insecticides that can be taken up by ingestion rather than contact insecticides that are taken up through the mosquito tarsi. When ATSBs are used indoors in combination with ITNs, it is hypothesized that mosquitoes denied a blood meal and repelled by the personal protection of the nets will seek out a sugar meal and thereafter be killed by the ATSB.

This trial is subcontracted to the Swiss Center for Scientific Research in Côte d'Ivoire and coordinated by the VectorLink regional entomologist. A baseline assessment of densities, June 28–July 17 (20 nights), was conducted to look for differences between huts and check the appropriateness of the power calculations. A total of 1,868 mosquitoes were caught from the 10 huts, with the mean density of 9.3/hut/night. The non-inferiority calculation for the main study included a mean of 5.5/hut/night, so the baseline densities were acceptable, and the trial proceeded to a first preliminary study. This was run August 1–30 (20 nights of collection) to determine the optimum number of bait stations to be used in each hut (comparing the entomological impact of one ATSB station per hut to two or four ATSB stations). The preliminary trial caught 1,842 *An. gambiae* s.l. (likely all *An. coluzzii*), a mean of 9.2 *Anopheles*/hut/night. Densities were similar between huts with little to no deterrence or repellency in any arm compared to control, but sugar feeding rates and mortality were low in all arms. The two ATSB station trial arms recorded the highest 24h mortality of all arms (22%), but there were no significant differences in odds ratios between any ATSB treatment versus nets alone, and mortality in the ATSB treatment arms was not 10% or greater (absolute difference) than in the nets alone arm. Only nine mosquitoes in total were found sugar-fed—this was confirmed by uranine determination of the sugar meals from the ATSB stations. It was clear that unfed mosquitoes were exiting the hut rather than sugar feeding.

A forced exposure/forced containment laboratory study to determine the percentage of sugar feeding over time (up to 48h) is underway. Additionally, a second preliminary study is planned in November 2022 in which the opportunity to blood feed is minimized and the opportunity for sugar feeding from the ATSB stations is maximized, by deploying intact ITNs and preventing exiting of mosquitoes that enter the huts for an additional 24 hours. Ten huts will be used for the study: two control huts with untreated nets, four with ITNs only, and four huts with four ATSB stations + ITNs. For each arm (control/ITN only/ATSB+ITN) a new intact net will be used in half of the huts and a holed net in the other half. If this second preliminary study demonstrates for mosquitoes that entered the ATSB+ITN huts, (1) at least 20% sugar fed; (2) mortality greater than 50%; and (3) at least 10% absolute higher mortality than the ITN-only trial arm, this will partly determine whether to proceed to a main study in Year 6.

## **2.4 PMI VECTORLINK CORE ITN ACTIVITIES**

### **Multi-country Review of Health Facility Checklist Use, Lessons Learned, and Refinements**

In Year 4, PMI VectorLink developed a supervision checklist for continuous distribution of ITNs at health facilities based on Ghana's ITN checklist, which assesses service data management, logistics data management, and ANC EPI observation. In Year 5, PMI VectorLink solicited feedback from countries using the checklist on its strengths and areas for improvement, and the tool was refined to respond to some minor feedback from these countries. It will be reposted on the relevant websites.

### **Review of Routine Distribution Data: How Are We Doing After Over a Decade?**

The PMI VectorLink team undertook a review of the routine ITN issuing data from seven countries. Issuing rates varied across countries at ANC (31–91%) and EPI (39–92%) and across months for both channels. An abstract, “Multi-country review of ITN routine distribution data: Are ANC and EPI channels reaching their potential?” was submitted to ASTMH, which accepted it for oral presentation at the 71<sup>st</sup> annual meeting in October/November 2022. A manuscript for publication is currently being finalized with the *Malaria Journal*.

## **Adding to the Knowledge on the Cost of School-Based and Community-based Distribution**

The costing activity of two school-based and two community-based distribution programs was carried out by PMI VectorLink and Tropical Health. It was found that the cost estimates for the four continuous distribution programs showed that community-based and school-based continuous distribution systems can deliver substantial numbers of nets for costs which are comparable to other programs. The results will be disseminated through several platforms, including a joint Continuous Distribution Working Group and PMI VectorLink webinar planned for the last quarter in Year 5.

## **Facilitators and Barriers to Scale-Up of Continuous Distribution**

This activity was renamed Policy, People, Resources: Why Some Countries Have Scaled Up with School Based Distribution, Why Others Have Not, and Next Steps.

Key informant interviews with 30 decision-makers, policymakers, and implementers were carried out in three different types of countries: countries that have adopted continuous distribution at scale, countries that have conducted continuous distribution pilots but not implemented continuous distribution at scale, and countries that have not conducted continuous distribution pilots but are interested in implementing continuous distribution at scale.

The activity concluded that for a country to scale up continuous distribution activities, policy needs to be in place, as well as a “critical mass” of the right people and resources coming together at the right time. Recommendations and next steps have been presented to PMI in a report currently in the approval process, and PMI VectorLink will make the outputs, presentations, and a learning brief available in English and French by the end of 2022.

## **Continuous Distribution Working Group**

In Year 5, the VectorLink ITN Senior TA co-chair of the Continuous Distribution Working Group has been carrying out various activities such as assisting with the review of the multi-country data, carrying out a survey of waste management practices in continuous distribution channels, and preparing a continuous distribution presentation for the four RBM Sub Regional Network Meetings in 2022, as well as attending Alliance for Malaria Prevention (AMP) Working Group meetings. A webinar, on modeling access to ITN through different channels of distribution and associated cost, co-organized with PMI VectorLink and the Continuous Distribution Working Group, will be carried out in the last quarter in Year 5.

## **Continuousdistribution.org Website**

In Year 5, PMI VectorLink has continued to promote and monitor the site, updating it with new tools and carrying out quarterly reviews of the site’s Google analytics, which will be summarized into an annual report in Q1 2023.

## **2.5 PMI VECTORLINK CORE ENTOMOLOGY ACTIVITIES**

### **Regional Entomology Surveillance Training**

PMI VectorLink, with support from UCSF, developed a single six-day training course for Anglophone, Francophone, and Lusophone country participants August 22–27, 2022, in Dakar, Senegal. The goal of this training was to provide more advanced entomological surveillance training to NMCP representatives, with a primary focus on data interpretation and supporting the use of entomological data for vector control decision making.

The course was conducted in English with simultaneous French and Portuguese translation and supported by translated training materials. The training utilized a mix of approaches: presentations, group work, field trips, Q&A sessions, microscopy, and laboratory assays. A total of 25 participants from 16 countries and 9 facilitators from 5 countries attended the training: The NMCP trainees were those actively working on entomological surveillance or likely to be assigned to such duties in the near future. Additional attendees came from partner institutes that directly support NMCP entomological surveillance activities such as Nigeria Institute of Medical Research and Africa University (Zimbabwe). The final cadre of attendees were PMI VectorLink entomology staff (technical managers or entomology field

coordinators) who had not previously attended any regional entomology trainings conducted by the project.

The participants were highly engaged and provided daily feedback, and their comments were addressed during the daily recap sessions. The agenda allowed for flexibility and space for participants to request content to be repeated and ultimately led to more effective knowledge retention and communication. This approach also uncovered knowledge gaps among the participants, namely familiarity with the latest WHO guidelines for insecticide testing, and the latest approaches for SDM. A key training objective was to convey the value of entomological surveillance to NMCP staff of different cadres and to strengthen their ability to design surveillance programs to meet their needs, and to interpret the data generated by it. The priority questions that the participant groups developed and presented on the final day were a good example of their application of knowledge gained during the week. It was apparent that each country NMCP has different levels of entomological and DHIS2 management expertise available within the national health systems. The PMI VectorLink facilitators reiterated our commitment to support the development of these data management systems, and to sharing data and creating dashboards that can highlight key interpretations and takeaways from these data, to facilitate the decision-making process. Moving forward, we will continue to support country-level efforts to improve data access and facilitate interpretation of routine entomological surveillance data. A WhatsApp group was established to enable continued collaboration post-training, not just between facilitators and participants, but also for south-south learning.

### Human Behavior Observations

A standard operating procedure and data collection form have been developed for the collection of direct observation data. Analysis worksheets were developed and shared for baseline minimum essential human behavior observation (HBO) data (i.e., not considering personal protection interventions outside ITNs). Additionally, a decision tree has been developed by the HBO Working Group, in collaboration with UCSF, to reflect decision points and to allow the tailoring of HBO implementation to each VectorLink country. All HBO tools are pending final approval in December 2022 before implementation. HBO data collection will be linked to hourly human-baited mosquito collections conducted as part of VectorLink routine entomological surveillance using HLC or hourly CDC light trap (HLC proxy).

## 2.6 MONITORING AND EVALUATION

The generation and use of high-quality data remains a critical priority for PMI VectorLink. In Year 5, the project focused on M&E approaches that offer additional improvements in data quality and efficiency, including continued expansion of mobile data collection solutions for entomological data capture, and efforts to expand data use within the project and with stakeholders.

### Robust Data Management and Analysis Using VectorLink Collect

The DHIS2-based VectorLink Collect system serves as the central, global database for PMI VectorLink. The system is in use in all spray countries for IRS data management and in 20 countries for entomological data management. During this reporting period, 24 PMI VectorLink countries used VectorLink Collect programs to manage IRS and/or entomological data (see Table 14).

**TABLE 14: USE OF VECTORLINK COLLECT AND MODE OF DATA CAPTURE FOR VECTOR CONTROL AND ENTOMOLOGICAL DATA MANAGEMENT  
PROJECT INCEPTION THROUGH SEPTEMBER 30, 2022**

	IRS and/or LSM	Entomology
Angola	--	●
Benin	●◎	--
Burkina Faso	●◎	●
Cambodia	--	●
Cameroon	--	●
Colombia	--	●
Côte d'Ivoire	●◎	●◎
Democratic Republic of the Congo	--	●
Ethiopia	●◎	●

Ghana	●◎	●◎
Liberia	--	●
Madagascar	●◎	●
Malawi	●+	◇
Mali	●◎	●◎
Mozambique	●	◇
Niger	--	●
Nigeria	--	●◎
Rwanda	●+	●
Senegal	●◎	●◎
Sierra Leone	●	●
Tanzania	●◎	--
Uganda	●◎	●◎
Zambia	●◎	●
Zimbabwe	●	●

● VectorLink Collect in use ◎ Mobile data capture in use (Red shows active use during this reporting period; Gray shows previous use for countries that did not implement IRS during this reporting period)

-- PMI VectorLink does not conduct related activities in this country.

+ VectorLink Collect is also used for government-led IRS campaigns in Malawi and Rwanda.

◇ VectorLink Collect was not implemented for entomological data management in these countries due to considerations related to existing databases/systems and data management processes in each respective country.

During Year 5, PMI VectorLink prioritized several activities to continue to enhance data generation and to better enable the use of data for programmatic decision making.

- Collaboration with WHO:** In Year 5, PMI VectorLink continued to work closely with PMI and the WHO Global Malaria Program to ensure system alignment between VectorLink Collect and the WHO DHIS2 entomological and vector control modules and to expand interoperability opportunities. This included informing continued testing and improvements to the WHO MetaData Sync Tool to optimize future interoperability efforts and continued testing and piloting of the WHO Bulk Load tool. PMI VectorLink also successfully used the MetaData Sync Tool and methods to export and exchange all 2021 insecticide resistance data from VectorLink Collect with WHO for the Malaria Threats Map and World Malaria Report.
- Continued enhancements and improvements to existing VectorLink Collect:** In Year 5, PMI VectorLink continued to improve the existing VectorLink Collect programs to accommodate changes in the scope of work across the project. This includes the addition of new IRS insecticides (Klypson 500WG and 2GARD) to support 2022 IRS campaign needs and the creation of new time periods (T0–T11) for enhanced analyses and visualizations of residual efficacy data. In addition, two new *Anopheles* resistant strains (*An. gambiae* (Bungoma) and *An. gambiae* (Tissale)) were added to support evolving residual efficacy and insecticide resistance data needs across countries. In Year 5, select VectorLink IRS country programs also began reporting additional IRS-related data streams into VectorLink Collect, including community mobilization in Malawi and Tanzania and data collection verification data in Malawi.
- VectorLink Collect Program for Entomology Molecular Data:** During Year 5, PMI VectorLink collaborated with WHO to adapt and pilot the WHO DHIS2 Tracker module for mosquito-level molecular data. This work was complemented by the finalization of a standardized and customizable scannable labeling protocol for mosquito samples. In 2022, PMI VectorLink completed a field pilot of the labeling protocol and new Tracker program in Ghana, which incorporated the WHO Bulk Load tool for importing data into VectorLink Collect. This pilot served as an important proof-of-concept for integrating molecular datasets into VectorLink Collect for integrated analyses. The new protocol will be scaled up in Ghana and expanded to at least one additional country in Year 6.
- VectorLink Collect Programs for LSM:** The PMI VectorLink monitoring, evaluation, and learning team designed new data management programs to support new needs related to LSM activities.

- *PMI VectorLink's LSM activities for An. stephensi in Ethiopia:* With technical support from BAO Systems, a new Tracker program is being used successfully to manage complex granular data needs for vector control and entomological surveillance for this activity.
- *PMI VectorLink LSM in Madagascar:* PMI VectorLink Madagascar used existing VectorLink Collect programs to manage vector bionomics and insecticide resistance monitoring data across 24 larvicide-treated and untreated sentinel sites in Madagascar.
- **VectorLink Collect Program for Foci Investigations:** The PMI VectorLink monitoring, evaluation, and learning team developed a new entomology program to collect foci investigation data to support PMI VectorLink Cambodia data needs. The project continues to develop meaningful new dashboard visualizations to present key entomological indicators for foci investigation results.
- **PMI VectorLink Collect Dashboard and Visualization Enhancements:** PMI VectorLink designed and published several new dashboards in Year 5. A new global residual efficacy dashboard synthesizes results across all IRS countries and replaced routine monthly data summaries that were previously compiled and distributed in Excel. Using VectorLink Collect has automated this data sharing with PMI stakeholders at USAID and CDC and enables real-time access to monthly results. PMI VectorLink has also completed a new dashboard for cumulative IRS results across the life of the project, which will be deployed in October 2022.
- **DHIS2 maintenance:** VectorLink Collect was successfully updated with several DHIS2 software patches during the reporting period to ensure appropriate ecosystem functionality and data security.

### Regional VectorLink Collect Trainings for Entomology

In Year 5, PMI VectorLink conducted two important regional trainings for VectorLink Collect Entomology for entomology technical managers and entomology database managers, with a focus on refining data quality approaches and fostering critical skills in the use of VectorLink Collect for analysis and interpretation (see Table 15). These trainings, held in Yaoundé, Cameroon, were the first in-person regional trainings in the COVID-19 context, and served as a critical step for strengthening more-efficient data use processes within our teams, and preparing PMI VectorLink country teams to cascade skills building to NMCP counterparts in their respective countries.

Following these regional trainings, PMI VectorLink country teams are now prepared for advanced use of VectorLink Collect for project analyses and reporting needs, and actively planning to cascade critical capacity strengthening to relevant country-level stakeholders in the use of VectorLink Collect, as well as in interpretation of entomological data, to reinforce the importance of data-driven decisions. Four entomology partners participated in the training, expanding the reach of country-level capacity strengthening.<sup>3</sup>

**TABLE 15: REGIONAL VECTORLINK COLLECT ENTOMOLOGY TRAININGS**

Training Focus	Regional VectorLink Collect Entomology Training (Anglophone)	Regional VectorLink Collect Entomology Training (Francophone)
<b>Timing and location</b>	June 6–9, 2022 Yaoundé, Cameroon	June 13–16, 2022 Yaoundé, Cameroon
<b>Participants</b>	18 country-level trainees, including: entomology technical managers and entomology database managers 4 trainers: M&E/entomology specialists, entomology advisor, VectorLink Collect system administrator	17 country-level trainees, including: entomology technical managers and entomology database managers (including representatives from 4 entomology partners) 4 trainers: M&E/entomology specialists, entomology advisor
<b>Countries</b>	Angola, Ghana, Ethiopia, Liberia, Nigeria, Rwanda, Sierra Leone, Uganda, Zambia, Zimbabwe	Burkina Faso, Cameroon, Côte d'Ivoire, Democratic Republic of Congo, Madagascar, Mali, Niger, Senegal

<sup>3</sup> University of Cheikh Anta Diop in Senegal; Institute of Research on Health Sciences in Burkina Faso, National Institute of Biomedical Research in Democratic Republic of Congo; and Center of Medical and Health Research in Niger.

## 2.6.1 INTEROPERABILITY AND SYSTEMS STRENGTHENING SUPPORT

To optimize the achievements in improved data generation and management using DHIS2-based solutions, PMI VectorLink continued to prioritize several efforts to support country-level adoption of DHIS2-based solutions for vector control data management. The project supported efforts in several countries related to national stakeholder adoption of improved vector control and entomological data management practices and systems. As noted in Section 1, PMI VectorLink is supporting:

- **Cambodia National Center for Parasitology, Entomology and Malaria Control**, to design and integrate data collection modules for foci investigation, longitudinal monitoring, and insecticide resistance data into the existing national Malaria Information System.
- **Malawi NMCP**, to develop custom IRS modules to be incorporated into the national Malawi DHIS2 database for government-led IRS campaigns. Modules currently are being piloted in VectorLink Collect during the 2022 Global Fund-supported IRS campaign efforts, prior to import to the national DHIS2 in early 2023.
- **Tanzania NMCP**, to further develop an IRS module in the newly developed National Malaria Composite DHIS2 database, advise on key indicators and IRS-specific data dashboards, and provide complete IRS datasets from VectorLink Collect for successful import into the national database.
- **Zambia National Malaria Elimination Centre**, to integrate and deploy VectorLink Collect entomology programs into a new entomology-specific government-owned DHIS2 instance.
- **Zanzibar Malaria Elimination Program**, to strengthen information systems and build ZAMEP capacity to collect, manage, and use rapid-response IRS data, including roll-out of full-scale mobile data collection to support ZAMEP-led rapid-response IRS campaign efforts.

## 2.6.2 EXPAND USE OF DIGITAL TOOLS AND MOBILE DATA COLLECTION

### Expanded Use of Digital Tools and Mobile Data Collection

PMI VectorLink continues to build on the important opportunities the VectorLink Collect system offers for expanding the use of mobile data collection across all data collection efforts.

In Year 5, five countries successfully implemented full mobile data collection for IRS campaigns (Côte d'Ivoire, Ghana, Mali, Senegal, and Tanzania) and two countries implemented a hybrid data collection approach using a blend of paper-based and mobile solutions (Madagascar and Uganda). Madagascar's 2021 pilot of mobile data collection for IRS covered one district. Given the pilot's success, the country team is expanding mobile to three districts during the 2022 IRS campaign. The VectorLink Malawi and Tanzania teams also expanded mobile data collection activities to capture mobilization data in VectorLink Collect, and Malawi also used mobile approaches to capture and analyze data collection verification data in VectorLink Collect.

PMI VectorLink also used mobile data collection approaches to support LSM activities implemented this year in Ethiopia and Madagascar. The VectorLink Ethiopia team implemented full-scale mobile data collection across entomological monitoring and LSM intervention field-based activities using the newly designed DHIS2 Tracker program and the DHIS2 Android Capture application. VectorLink Madagascar designed a mobile data collection tool to support monitoring of operational, entomological, and epidemiological indicators during the operational research study.

During this reporting period, PMI VectorLink finalized its pilot of mobile data collection for entomology in Ghana (initiated during Year 4). This multi-stage pilot included comprehensive development sprints to inform the development of mobile data collection tools for all entomology programs (completed during Year 4), and a phased field pilot during which mobile programs were tested, deployed, and refined based on user feedback (initiated during Year 4 and completed during Year 5). The pilot was considered a success and the VectorLink Ghana team has continued and expanded mobile efforts throughout this reporting period. Following the success of this pilot, PMI VectorLink rapidly expanded mobile data collection for entomology to several additional countries (see Table 16). For each country deployment, the M&E team conducted extensive workflow mapping of entomology data streams to define country-



and context-specific implications in the shift from paper to mobile and supported comprehensive training for all users.

**TABLE 16: STATUS OF MOBILE DATA COLLECTION FOR ENTOMOLOGY IN YEAR 5: PROGRESS TO DATE**

Country	Status as of September 2022	Current Scope	Current Scale
<b>Côte d'Ivoire</b>	Active (full scale)	Vector bionomics Insecticide resistance Residual efficacy	18 sentinel sites: 3 sites: vector bionomics + insecticide resistance 1 site: vector bionomics 13 sites: insecticide resistance 2 sites: comprehensive
<b>Cameroon</b>	Planning and configuration in process	Vector bionomics Insecticide resistance	Plan to launch for vector bionomics in 5 sites in November 2022 and insecticide resistance in 10 additional sites in 2023.
<b>Ethiopia</b>	Active, with plans to expand	Entomological surveillance within LSM activity	All LSM sites
<b>Ghana</b>	Active (full scale)	Vector bionomics Insecticide resistance Residual efficacy	All sentinel sites
<b>Mali</b>	Active (full scale)	Vector bionomics Insecticide resistance Residual efficacy	All sentinel sites
<b>Nigeria</b>	Active	Vector bionomics Insecticide resistance	14 sentinel sites: 4 sites: vector bionomics 10 sites: insecticide resistance
<b>Senegal</b>	Active, with plans to expand to full scale	Vector bionomics Insecticide resistance Residual efficacy	9 sentinel sites: 4 sites: comprehensive 5 sites: vector bionomics + insecticide resistance Plan to scale to all 25 sites in October 2022
<b>Sierra Leone</b>	Planning and configuration in process	Vector bionomics	Plan to launch for vector bionomics in 1 site in October 2022
<b>Uganda</b>	Active, with plans to expand	Insecticide resistance	1 sentinel site: insecticide resistance Plans to scale to all sites for all entomology data in December 2022

### Supporting Data Generation and Use for Vector Control Decision Making

With efforts coordinated by PATH, PMI VectorLink updated the **Vector Control Integrated Data Analytics and Visualization Best Practices Guide**. The guide is designed to support national decision-makers and partners and was developed based on PMI VectorLink’s experiences in using existing data sources for the planning, implementation, and evaluation of malaria vector control interventions. The guide was translated into French and posted on [pmi.gov](http://pmi.gov) and [pmivectorlink.org](http://pmivectorlink.org).

PATH also led the development of a new manuscript, “Process and methodological considerations for observational analyses of vector control interventions in sub-Saharan Africa using routine malaria data.” This is designed to be a guide to support national programs and partners in implementing vector control evaluations using routine data. The manuscript is currently undergoing final reviews with PMI prior to journal submission.

## 2.7 GENDER AND SOCIAL INCLUSION

In Year 5, PMI VectorLink continued to mainstream gender and promote female empowerment across its country programs through female recruitment, implementation of respectful and equitable workplace policies, and inclusive community mobilization strategies. In addition, PMI VectorLink strategically expanded its gender work to focus more broadly on equity integration across project activities to promote

the inclusion of women as well as other population groups such as refugees, migrants, or people with disabilities. As such, all gender focal points were rebranded as equity focal points. The project's U.S.-based gender equality and social inclusion (GESI) advisor held a training with all equity focal points to review their expanded role as well as equity promotion concepts, approaches, and strategies relevant for PMI VectorLink country programs. Under this strategy, key GESI accomplishments in Year 5 include:

- Under the leadership of the equity focal points, all IRS country teams are conducting a landscape analysis on reaching the unreached. The objective of the landscape analysis is to identify population groups unreached by vector control interventions, better understand why these groups are not reached, and recommend tailored strategies to reach these groups in the future. The scope for the activity was co-developed by select country staff, the GESI advisor, and VectorLink leadership. This data-driven exercise will be completed in Year 6.
- PMI VectorLink Senegal developed and implemented a social inclusion pilot to distribute ITNs to *Talibé* children—a marginalized, low-income group that lives in traditional Koranic schools called *daaras*. The team collaborated with the Ministry of Health and Social Action and the Ministry of Education and successfully distributed 7,324 ITNs to children in 200 *daaras* in Tivaouane District.
- The GESI advisor held an informational session with all chiefs of party to review the new PMI 2021–2026 strategy, its implications on equity, and the project's efforts to expand beyond gender to encompass GESI, including a focus on reaching unreached populations.
- The PMI VectorLink Zambia operations manager participated in a panel at the Women Leaders in Global Health 2021 conference in November 2021. The PMI VectorLink Zimbabwe chief of party participated on a panel in the Women in Global Development Leadership Forum 2022.
- The project planned and hosted a webinar on May 12, 2022, on “Promoting Equity I Vector Control: Success and Challenges in Reaching the Unreached,” highlighting work in Senegal, Ghana, and Rwanda. Panelists were government representatives from each of the three countries and included one female, plus a female moderator. A story was also disseminated sharing highlights from the webinar.
- The project disseminated a story on “The Women in Charge: Leading the Fight to End Malaria” for World Malaria Day 2022, featuring five field-based female PMI VectorLink employees who hold different leadership positions.
- The project also developed and disseminated several GESI success stories featuring (1) the Tanzania team's work in refugee camps and the transition of IRS in refugee camps to district government teams; (2) examples of engaging disadvantaged population groups in Ghana, Côte d'Ivoire, and Rwanda; and (3) employing women in entomology work in Colombia.
- Sheila Ogoma Barasa, PMI VectorLink's regional technical advisor, received the Pan-African Mosquito Control Association's Women in Vector Control Excellence Award in the Mid-Career category for her leadership in entomological monitoring and capacity building.
- A manuscript on female recruitment practices in Rwanda, Madagascar, and Zambia was prepared for submission to *Global Health Science and Practice*. It includes authors from each of the three featured countries and is undergoing revision based on PMI comments; it will be submitted next quarter.

## 2.8 ENVIRONMENTAL COMPLIANCE AND SAFETY

In Year 5, PMI VectorLink's environmental compliance and safety team submitted an updated Supplemental Environmental Assessment for Rwanda, which was approved in January 2022. Timely Pre-Spray Letter Reports were prepared for Côte d'Ivoire, Ethiopia, Ghana, Madagascar, Malawi, Mali, Mozambique, Senegal, Sierra Leone, Tanzania, Uganda, and Zambia. Along with other members of the PMI VectorLink Team, the Environmental Compliance and Safety Team revised the standards to mitigate COVID-19 transmission during all phases of IRS implementation.

The environmental compliance and safety team provided technical support for the project's LSM activities. This included the submission and approval of Supplemental Initial Environmental Examinations (SIEEs) for Madagascar and Ethiopia, and a Pesticide Evaluation Report and Safer Use

Action Plan (PERSUAP) for all USAID Global Health larviciding activities. For specific country LSM programs, electronic supervision forms were developed for pre-season environmental compliance assessments of larvicide storerooms, entomological surveillance, and LSM, to monitor compliance with project protocols. New Microsoft Excel tools were created to assess red flags and monitor the frequency of supervision daily. Job aids were created to assist field teams with the selection of larvicide application and calculation of larvicide dosage.

Other environmental compliance accomplishments in Year 5 included:

- Rolled out barcode insecticide serialization to all sites in Tanzania. Expanded the use of the system to 15 additional sites in Uganda and all sites in Côte d’Ivoire.
- Provided virtual support to all campaigns for the execution of IRS.
- Provided in-country support to Ethiopia, Ghana, Madagascar, Sierra Leone, and Uganda IRS and larviciding implementation.
- Promoted Tahina Masihelison from VectorLink Madagascar environmental compliance officer to regional environmental compliance manager to support all French-speaking VectorLink countries.

## 2.9 CONFERENCES

The **American Society of Tropical Medicine and Hygiene 2021 Annual Meeting** was held virtually on November 17–21, 2021. Thirteen abstracts were accepted, resulting in one symposium, two oral presentations, and 10 poster presentations. Twenty-seven PMI VectorLink staff participated and 17 staff from the field.

In 2022, country- and core-funded abstract submissions for this year’s ASTMH conference resulted in acceptances for one symposium, two oral presentations, and 15 poster presentations. The conference will take place next quarter.

Jillian Berkowitz of the PMI VectorLink M&E Team presented on the topic of mobile data collection for malaria control during the virtual **Global Digital Health Forum** on December 6–8, 2021.

PMI VectorLink Project staff participated in the **RBM Vector Control Working Group’s** meeting, held virtually in April and May 2022. Allan Were, in his capacity as working group co-chair, co-hosted the work stream 1 (Enhancing Impact of Core Interventions) sessions. PMI VectorLink supported the program manager of the NMCP in Madagascar to prepare and deliver a presentation on the aerial application of larvicide for LSM. This presentation was made during the work stream 2 (Expanding the Vector Control Toolbox) session. Sheila Ogoma, the co-chair for work stream 2 (Expanding the Vector Control Toolbox) joined Abt and the VectorLink project in June, shortly following the annual meeting, increasing the project’s representation on the working group’s leadership team.

PMI VectorLink participated in the **DHIS2 Annual Conference**, held in person on June 20–23, 2022. M&E Specialist Marianne Parrish presented a session entitled “Let’s Go Mobile! Scaling the DHIS2 Android Capture application for mobile collection of entomological data in four African countries.”

## 2.10 COMMUNICATIONS

During this reporting period, PMI VectorLink produced nine success stories, two photo stories, and five malaria fighter profiles. These communications products were posted on the project website, promoted through the project Twitter account, and distributed via the PMI VectorLink quarterly e-letter. Some stories were further shared on the PMI website.

Project team authors published two peer-reviewed journal articles during the reporting period, both on the topic of *An. stephensi*.

PMI VectorLink organized and hosted four webinars during this reporting period: Data Drives Decision-Making in Vector Control, in October 2021, attended by 179 people; Community-Based Entomological Surveillance for Vector Control, in December 2021, attended by 160 people; Sustainability in IRS Operations, in February 2022, attended by 152 people; and Promoting Equity in Vector Control: Successes and Challenges in Reaching the Unreached, in May 2022, attended by 109 people. All webinars

can be accessed on the Vector LearningXChange here:  
<https://www.vectorlearningexchange.com/webinars/>

The project distributed three e-letters this reporting period in February, May, and August 2022, and seven e-alerts (in October and November 2021 for the first two webinars; in January 2022 to share the project's calendar year highlights; in February 2022 for that month's webinar; in April 2022 for World Malaria Day; and two in May 2022 for the equity webinar). The communications team sent 48 Fist Bump Friday internal emails to PMI and project staff, highlighting project successes and innovations.

PMI VectorLink Ghana prepared a video on "Reaching the Unreached" in the country's Northern Sector, which the comms team posted on the global website in September 2022. In addition, the communications team began production on two videos, one showcasing the project's collaboration with research institutes in Côte d'Ivoire, which was filmed in September and is currently in post-production; and a second, which will be filmed in Zambia in October 2022.

# ANNEX A: M&E RESULTS SUMMARY

**TABLE A.1: PMI VECTORLINK SUMMARY VECTOR CONTROL RESULTS AND POPULATION PROTECTED**

Country	IRS Structures Sprayed	IRS Structures Found	IRS Spray Coverage	Population Protected by IRS	Population Protected by IRS: Pregnant Women	Population Protected by IRS: Children <5	ITNs Distributed by VectorLink	Population Protected by ITNs (Estimate**)
Côte d'Ivoire	70,392	71,474	98.5%	228,432	7,119	38,795	n/a	n/a
Ethiopia	684,490	702,358	97.5%	1,792,145	58,065	245,803	n/a	n/a
Ghana	355,940	381,442	93.3%	961,413	20,581	159,546	n/a	n/a
Madagascar	213,922	217,289	98.5%	885,814	32,041	147,119	n/a	n/a
Malawi	120,097	129,410	92.8%	481,075	10,795	81,810	n/a	n/a
Mali	72,106	73,586	98%	273,831	20,728	49,996	n/a	n/a
Mozambique	309,547	319,732	96.8%	1,408,179	79,410	189,408	n/a	n/a
Rwanda*	354,669	356,254	99.6%	1,358,152	18,435	181,561	n/a	n/a
Senegal	138,752	142,347	97.5%	570,283	14,169	116,844	7,324	14,648
Sierra Leone	143,509	148,772	96.5%	652,232	19,528	97,675	n/a	n/a
Tanzania	568,484	611,112	93.0%	2,081,886	76,358	394,668	n/a	n/a
Uganda	1,104,083	1,187,864	92.9%	3,894,239	110,534	724,448	n/a	n/a
Zambia	717,351	738,659	97.0%	3,032,558	94,511	416,039	n/a	n/a
Total	4,853,342	5,080,299	96.3%	17,620,239	562,274	2,843,712	7,324	14,648

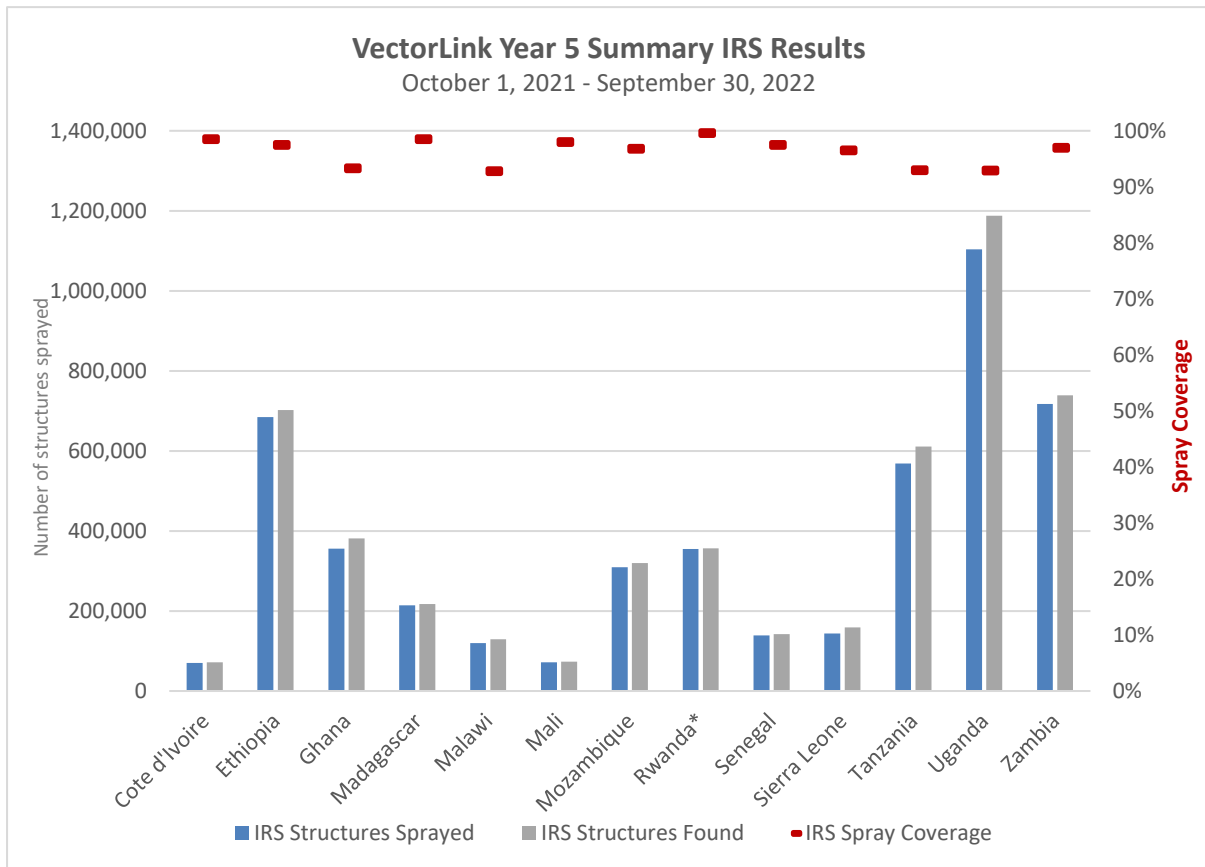
\* In this table and the figures below, an asterisk indicates that final IRS results are still under review by PMI and the End of Spray Report is not yet final.

\*\* Note: This table only estimates population protected by ITNs for ITNs distributed by PMI VectorLink using a factor of 2.0 per ITN distributed. A summary of ITNs distributed by partners with PMI VectorLink support is provided in Table A.2 below.

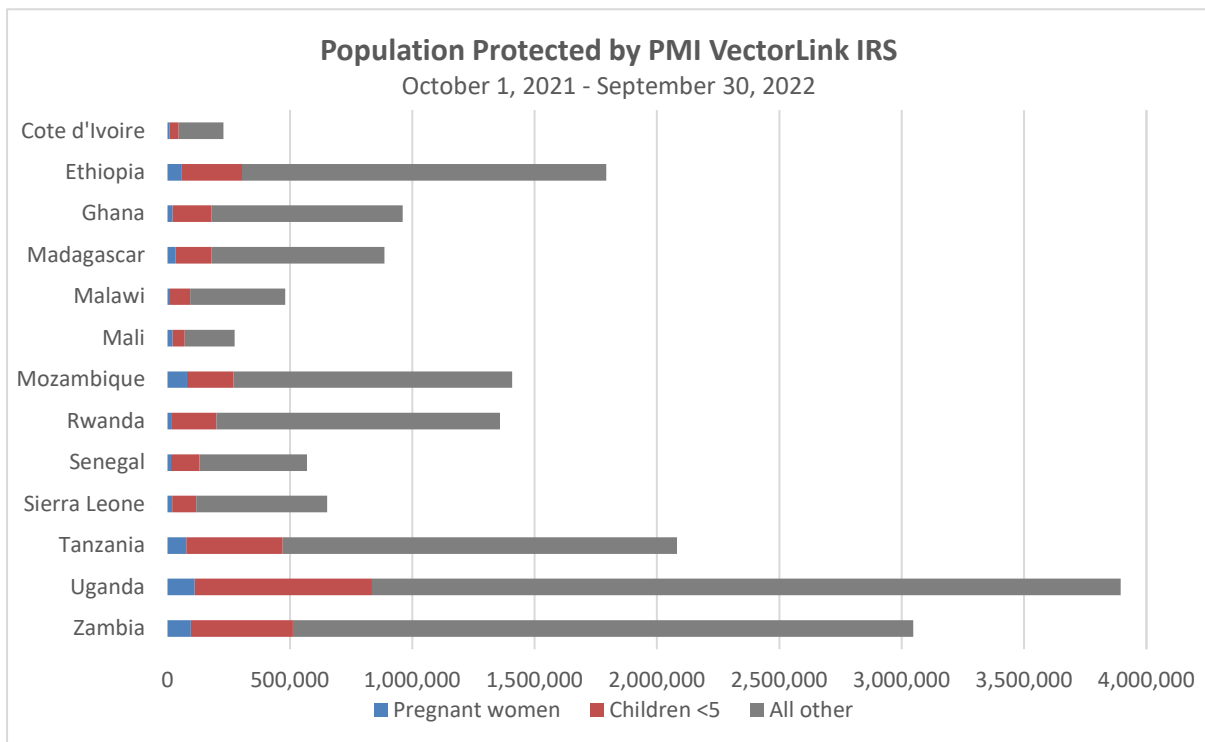
**TABLE A.2: PMI VECTORLINK VECTOR CONTROL DETAILS**

VectorLink Country	IRS			ITN		Type of ITNs Distributed
	IRS Structures Sprayed	IRS Personnel Trained with PMI Funds	IRS Insecticide Used	ITNs Distributed by PMI VectorLink	ITNs Distributed by Partners with VectorLink Support	
Côte d'Ivoire	70,392	349	Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Ethiopia	684,490	3,992	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Ghana	355,940	951	Fludora Fusion WP-SB, SumiShield 50WG	n/a	6,610,579	Standard pyrethroid only: Magnet PBO: Olyset Plus, PermaNet 3.0 Dual active ingredient: IG2
Madagascar	213,922	894	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Malawi	120,097	677	Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Mali	72,106	238	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Mozambique	309,547	1,487	Actellic 300CS, Ficam	n/a	n/a	n/a
Rwanda*	354,669	3,201	Actellic 300CS	n/a	n/a	n/a
Senegal	138,752	914	Actellic, Fludora Fusion WP-SB, SumiShield 50WG	7,324	1,275,550	Standard pyrethroid-only: Olyset PBO: Olyset Plus
Sierra Leone	143,509	1,206	SumiShield 50WG	n/a	n/a	n/a
Tanzania	568,484	3,069	Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Uganda	1,104,083	6,125	Fludora Fusion WP-SB, SumiShield 50WG	n/a	n/a	n/a
Zambia	717,351	2,846	Fludora Fusion WP-SB, SumiShield 50WG	n/a	51,434	PBO: Olyset Plus
Total	4,853,342	25,949	--	7,324	7,937,563	--

**FIGURE A.1:**



**FIGURE A.2:**







# ANNEX B: COMMUNICATIONS

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## SUCCESS STORIES

- [Transitioning Malaria Services to the Zanzibar Malaria Elimination Programme – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [New Insectary in Côte d’Ivoire Boosts Country’s Capacity in the Fight Against Malaria – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [Strengthening Entomological Capacity for Malaria Elimination in Zimbabwe – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [Promoting Equity in Vector Control: Examples from Ghana, Rwanda, and Senegal – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [At Tanzania’s Refugee Camps, Local Health Teams Take the Lead – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [Solar Powered Systems: Reliable Electricity for Cooling Systems and Data Collection – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [Adapting Malaria Services to Crises – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [Equity in Vector Control: Engaging Hard-to-Reach Populations with Indoor Residual Spraying \(IRS\) – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [From the Lab to the Field, PMI Equips Local Partners to Fight Malaria – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)

## PHOTO STORIES

- [World Malaria Day 2022 – The U.S. President’s Malaria Initiative VectorLink Project \(pmivectorlink.org\)](#)
- [The PMI VectorLink Project: 2021 Highlights – The U.S. President’s Malaria Initiative VectorLink Project](#)

## MALARIA FIGHTERS

- [PMI VectorLink Malaria Fighter: Sana Diop Dieng – The U.S. President’s Malaria Initiative VectorLink Project](#)
- [PMI VectorLink Malaria Fighter: Therese Dembele – The U.S. President’s Malaria Initiative VectorLink Project](#)
- [PMI VectorLink Malaria Fighter: Mohamed Bayoh – The U.S. President’s Malaria Initiative VectorLink Project](#)
- [PMI VectorLink Malaria Fighter: Sokhna Tall – The U.S. President’s Malaria Initiative VectorLink Project](#)
- [PMI VectorLink Malaria Fighter: Duartina Francisco – The U.S. President’s Malaria Initiative VectorLink Project](#)

## TECH BRIEFS

- [IRS-Models-Technical-Brief\\_Final.pdf \(pmivectorlink.org\)](#)

## GUIDES

- [PMI VectorLink Integrated Data Analytics and Visualization Best Practices Guide](#)

## WEBINARS

- [Promoting Equity in Vector Control: Successes and Challenges in Reaching the Unreached](#)
- [Sustainability in Indoor Residual Spraying Operations](#)
- [Community-Based Entomological Surveillance for Vector Control](#)
- [Data Drives Decision-Making in Vector Control](#)

## PEER-REVIEWED JOURNAL ARTICLES & PUBLICATIONS

- [The potential impact of \*Anopheles stephensi\* establishment on the transmission of Plasmodium falciparum in Ethiopia and prospective control measures](#), *BMC Medicine*, April 2022
- [Genetic diversity of \*Anopheles stephensi\* in Ethiopia provides insight into patterns of spread](#), *Parasites & Vectors*, December 2021