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**U.S. PRESIDENT'S
MALARIA INITIATIVE**

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THE PMI VECTORLINK PROJECT FINAL REPORT



U.S. PRESIDENT'S MALARIA INITIATIVE

vectorlink

INTELLIGENT > INNOVATIVE > INTEGRATED

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ANNEX  **COUNTRY RESULTS**

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ACRONYMS

AI	Active Ingredient
ATSB	Attractive Targeted Sugar Bait
BTI	<i>Bacillus thuringiensis israelensis</i>
DHIS2	District Health Information Software 2
ECO	Environmental Compliance Officer
HBO	Human Behavior Observation
IG2	Interceptor® G2
INIS	<i>Instituto Nacional de Investigação em Saúde</i>
IRS	Indoor Residual Spraying
IVC	Integrated Vector Control
ITN	Insecticide-Treated Net
LSM	Larval Source Management
NMCP	National Malaria Control Program
NMEP	National Malaria Elimination Programme
NMP	National Malaria Program
PERSUAP	Pesticide Evaluation Report and Safer Use Action Plan
PBO	Piperonyl Butoxide
PMI	U.S. President’s Malaria Initiative
PSI	Population Services International
SBD	School-based Distribution
SEA	Supplemental Environmental Assessment
SHEP	School Health Education Program
SIEE	Supplemental Initial Environmental Examination
USAID	United States Agency for International Development
VCWG	Vector Control Working Group
WHO	World Health Organization
ZAMEP	Zanzibar Malaria Elimination Programme



INTRODUCTION

The U.S. President's Malaria Initiative (PMI) VectorLink Project was a global, six-year program (from October 1, 2017 through September 30, 2023) funded by the United States Agency for International Development (USAID) through PMI. The project's goal was to support PMI in conducting entomological monitoring, the planning and implementing of indoor residual spraying (IRS) programs, the distribution of insecticide-treated nets (ITNs), and other proven, life-saving malaria vector control interventions, such as larval source management (LSM), to reduce the burden of malaria. Between 2017 and 2023, PMI VectorLink worked with national malaria programs (NMPs) and their partners in a total of 27 countries.

The project's primary objectives were to:

- **Objective 1:** Direct implementation of and/or technical assistance for implementation of IRS and other proven, life-saving vector control interventions utilizing an integrated approach to malaria vector control programming.
- **Objective 2:** Support entomological and epidemiological monitoring and provide technical support for strategic decision making and deployment of vector control interventions for malaria control.
- **Objective 3:** Procure insecticides for IRS and support the delivery and storage of IRS and other malaria vector control products.
- **Objective 4:** Support innovation in vector control interventions for malaria control, including piloting of promising novel tools or approaches that have received World Health Organization (WHO) recommendation for malaria control or promising products with a strong evidence base to be considered by WHO for recommendation.

PMI VectorLink was implemented by a consortium of expert partners that included:

- **Abt Associates:** The prime implementer, with deep expertise in vector control. Responsible for overall program management, performance, and reporting. Oversaw the technical work; monitoring, evaluation, and learning; and developed innovative approaches to support complex entomological monitoring, collect data, and procure commodities.
- **PSI:** Managed the distribution of ITNs through continuous or mass channels, implementation of durability monitoring, and social and behavior change activities.
- **PATH:** Led the data analytics and visualization component of the PMI VectorLink project, supporting countries to analyze vector control efforts through improved visualizations of malaria data to make evidence-based decisions about the deployment of specific vector control tools.
- **BAO Systems:** Supported the design, development, and initial deployment of the District Health Information Software 2 (DHIS2)-based VectorLink Collect system to support complex data management. Provided hosting services and technical support over the life of the project.
- **Dimagi:** Supported mobile-based IRS supervision and reporting tools, providing ongoing technical support, and training guidance to the countries conducting IRS activities.
- **EnCompass:** Contributed to capacity strengthening initiatives including development of an IRS training curriculum, an entomology-focused training curriculum, and materials to support users of the VectorLink Collect database system.

- **Innovative Vector Control Consortium:** Developed an Integrated Vector Control Strategic Framework to support NMPs.
- **Malaria Consortium:** Provided technical assistance for the development of effective integrated vector control (IVC) strategies and insecticide resistance management plans, including the second edition of the framework for integrated vector control strategies for malaria control.
- **Maxar Intelligence:** Produced satellite-generated images of specific areas of interest within PMI partner countries.

In addition, PMI VectorLink partnered with 55+ entomological research institutions and a further 40+ local partners in the project’s countries.

PMI VectorLink worked in 27 countries: Angola, Benin, Burkina Faso, Burundi, Cambodia, Cameroon, Colombia, Côte d’Ivoire, Democratic Republic of Congo, Ethiopia, Ghana, Guinea, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Uganda, Zambia, and Zimbabwe. See Figure I below.

FIGURE I. MAP OF PMI VECTORLINK COUNTRIES

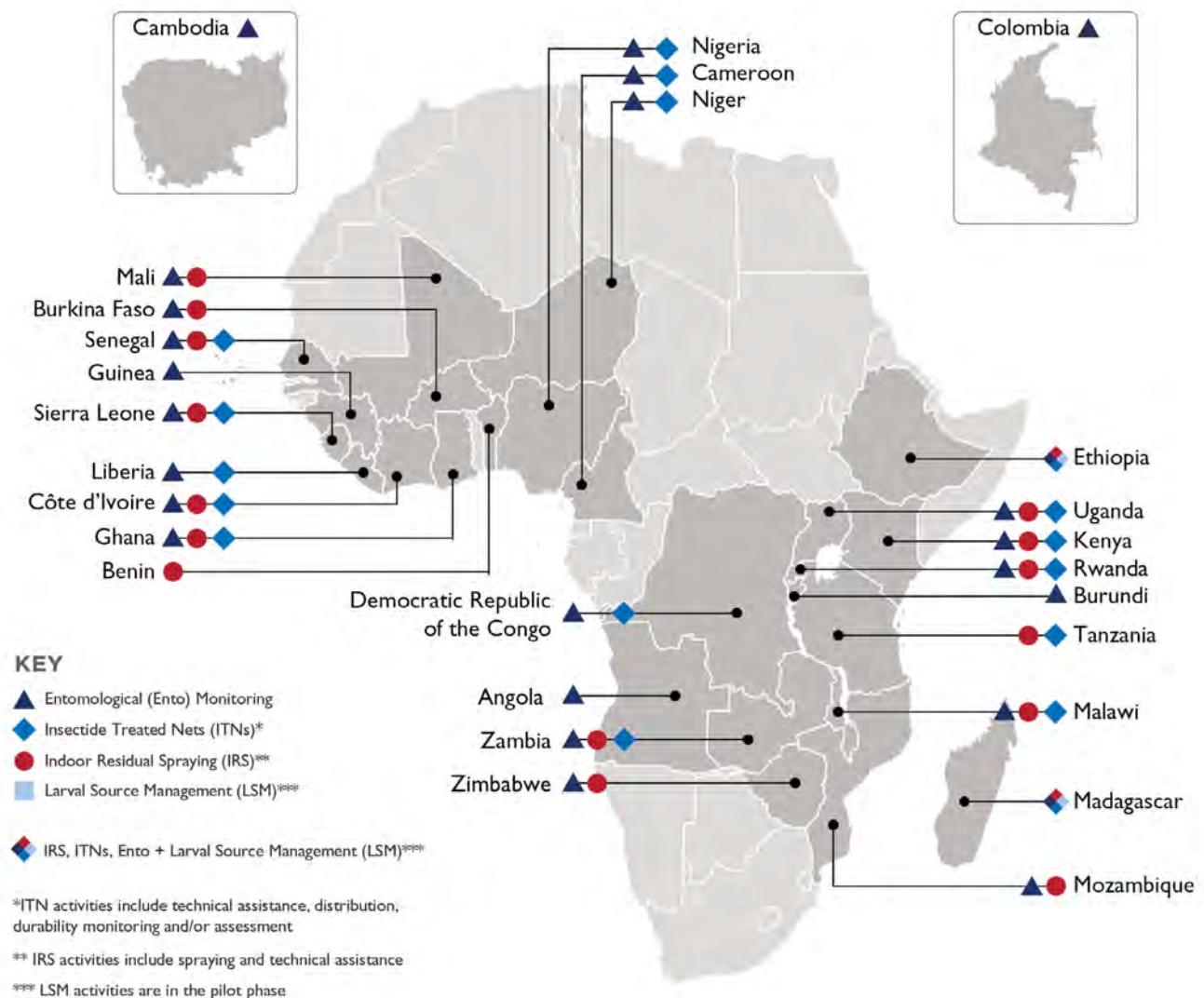



FIGURE 2. ACHIEVEMENTS AT A GLANCE


Supported national malaria programs and their partners to plan and implement safe, cost-effective, and sustainable life-saving vector control interventions with the overall goal of reducing the burden of malaria to help end malaria faster.




**PARTNERED WITH
27 COUNTRIES &
95 LOCAL ORGANIZATIONS**
to drive results and optimize impact




PEOPLE PROTECTED FROM MALARIA



BY IRS




BY ITNs




BY LSM

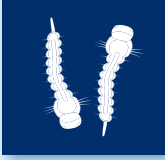
2018	12.4 M in 8 countries		
2019	21.9 M in 14 countries		
2020	21.0 M in 16 countries	11.4 M in 2 countries	
2021	21.9 M in 17 countries	13.4 M in 3 countries	
2022	17.6 M in 13 countries	14.6 M in 1 country	596 K in 2 countries
2023	12.6 M in 9 countries		637 K in 2 countries



IMPLEMENTED 77 IRS CAMPAIGNS in 17 COUNTRIES
Supported local partners to conduct IRS in 4 countries



DISTRIBUTED 12.4 M ITNs in 4 COUNTRIES
Supported local partners to conduct ITN distribution activities in 5 countries



IMPLEMENTED LSM Interventions with national malaria program partners in 2 COUNTRIES

STRENGTHENING RESILIENCE

- Uninterrupted life-saving vector control and critical entomological monitoring during COVID-19
- Rigorous surveillance and community vector control against emerging threat of *Anopheles stephensi*



PROCURED AND DELIVERED ON TIME:

8.9M UNITS OF INSECTICIDE

13.5K ENTOMOLOGICAL SUPPLIES & EQUIPMENT

2.1M PERSONAL PROTECTIVE EQUIPMENT masks



ENTOMOLOGICAL SURVEILLANCE in 27 COUNTRIES
340 sentinel sites for vector bionomics
372 sentinel sites for insecticide resistance

ITN DURABILITY MONITORING in 9 COUNTRIES

324 K PEOPLE TRAINED TO SUPPORT VECTOR CONTROL

156K trained to conduct IRS with USG funds
~**3K** trained in entomological monitoring
221K trained in gender awareness

*The same individuals may have been trained year after year.



DESIGNED & DEPLOYED DHIS2-BASED VECTORLINK COLLECT for vector control & entomological data management in 25 COUNTRIES



21 EVALUATIONS AND OPERATIONAL RESEARCH STUDIES conducted to inform vector control decisions



24 PEER-REVIEWED PUBLICATIONS to support the global evidence base



1 STRENGTHENING COUNTRY CAPACITY



Yolande Niangara, a member of the Côte d'Ivoire National Malaria Control Program's Vector Control Unit, received PMI support to strengthen her entomology skills through a six-month advanced training course in medical entomology at the Institut de Recherche en Science de la Santé (IRSS) in Burkina Faso.

Photo: Bienvenue Kassi



I. STRENGTHENING COUNTRY CAPACITY

Vector control efforts are most successful when countries take the lead at all levels. National stakeholders in malaria control and prevention efforts, such as the ministry of health and NMPs, along with the regional- and district-level health officers and malaria focal persons, scientists and colleagues in laboratories and research institutions, and people living in malaria-endemic communities are all key partners in malaria vector control. Over the years of the PMI VectorLink project, the project team partnered with these entities in a variety of ways to strengthen existing capacity across vector control activities—including conducting IRS and distribution of ITNs; increasing the generation and use of entomological data to drive vector control decisions; and empowering communities to support critical vector control and entomological activities whenever possible.

Strengthening capacity to deliver vector control interventions

Over the life of the project, PMI VectorLink conducted IRS in 17 countries (Benin, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Sierra Leone, Tanzania, Uganda, Zambia, and Zimbabwe). In support of those campaigns, PMI VectorLink and its partners trained vector control specialists, health system staff, and community members to conduct IRS. In total, PMI VectorLink trained more than 156,000 people to deliver IRS across the project.

For local government partners, capacity strengthening efforts focused on planning and implementing safe, cost-effective, and sustainable IRS campaigns—from pre-campaign activities such as community mobilization and recruiting spray operators, to collecting, managing, and using IRS data. In some cases, PMI VectorLink organized IRS boot camps for government partners when a new in-country partner became involved in vector control activities, such as when the Government of Malawi initiated IRS activities with the Global Fund. In other countries, such as Zambia, all IRS implementers adopted the VectorLink planning, supervision, and monitoring and evaluation tools across the country.

With the ultimate goal of enabling countries to lead their own vector control efforts, PMI VectorLink supported several countries to make strides toward increased ownership for sustainability. During the project, PMI VectorLink Tanzania transitioned all IRS activities in Zanzibar to the Zanzibar Malaria Elimination Programme (ZAMEP). After years of working side-by-side with PMI VectorLink, Burkina Faso's Permanent Secretariat for Malaria Elimination took the lead on the first small-scale government-led IRS campaign, supported by a private mining company.

With the spread of *Anopheles stephensi* threatening decades of gains in malaria control in Africa, the PMI VectorLink project spearheaded a surveillance program and piloted larval source management (LSM) in Ethiopia. After 12 months of LSM with very encouraging results, the project worked hand in hand with town administrators to gradually transfer human resource responsibilities to four municipalities who integrated them into existing health extension and/or sanitation programs, with continued material and technical support from the project.

Strengthening national entomological surveillance capacities and local research institutes

The collection of robust entomological surveillance data to identify which mosquito species are contributing to malaria transmission, the relative geographical and temporal distribution and abundance of these mosquitoes, their resistance to insecticides used in vector control interventions, and their feeding and resting behavior are an integral part of evidence-based malaria vector control. PMI VectorLink worked with countries to support and strengthen entomological capacities from the project's inception, beginning surveillance activities in five new PMI partner countries—Cambodia, Cameroon, Côte d'Ivoire, Niger, and Sierra Leone—in project Year 1, and training district health staff and NMP staff in entomological monitoring, including mosquito identification, that year and in subsequent years.

By Year 5, the project was organizing regional entomological surveillance training with PMI's support,

primarily for NMP representatives from 16 countries, focusing on entomological data interpretation for vector control decision-making. Additional attendees came from partner research institutions supporting NMPs in this work.

The presence of a well-functioning molecular laboratory is key to obtaining the most informative entomological data. Correctly identifying the malaria-transmitting species and understanding the molecular basis of resistance guides the selection of effective vector control interventions and helps decision-makers manage the response to emerging resistance. However, at the start of the PMI VectorLink project, only some countries had the in-country capacity to perform molecular analysis, and others still needed technical assistance to optimize their performance. In other countries this capacity was non-existent, and PMI VectorLink delivered tailored laboratory training in three countries—Burundi, Cambodia, and Sierra Leone—to establish lab capacity for the first time. Three additional countries received tailored, in-person technical assistance for advancing their lab capacity—Ghana, Malawi, and Niger. Despite the challenges of the COVID-19 pandemic, the project established molecular lab capacity in Angola and Liberia, working with the CDC to provide virtual training in these two countries.

Angola, DRC, Liberia, Niger, Senegal, and Sierra Leone lacked insectaries for rearing and keeping mosquitoes. To overcome this challenge, PMI VectorLink supported the conversion of 40-foot shipping containers—“Insectary-in-a-Box” to support insectary activities in Angola, DRC, Liberia and Senegal. In other countries, PMI VectorLink worked with local institutions to rehabilitate existing facilities to better support the countries’ entomological activities. These insectaries allowed for the rearing of mosquitoes for use in cone bioassays for durability monitoring and susceptibility tests; and provided facilities for identification, dissection, and preservation of mosquitoes for further analysis.

In response to the growing threat of *Anopheles stephensi*, PMI VectorLink also provided classroom-based, on-the-ground-based, and laboratory-based training to NMPs and local partners in several African countries to strengthen their capacity to collect, monitor and conduct morphological identification of this invasive species. Nine researchers and

STRENGTHENING ANGOLA’S IN-COUNTRY LAB CAPACITY

At the project's inception, Angola's *Instituto Nacional de Investigação em Saúde* was unable to conduct in-country molecular analysis of malaria-transmitting mosquitoes, delaying its ability to provide timely data to the NMCP.

PMI VectorLink Angola had been partnering with INIS and the NMCP since 2019 to collect and analyze samples obtained through routine entomological surveillance and insecticide resistance monitoring activities. As these activities progressed, the project team worked diligently to procure the needed equipment and materials to start laboratory analyses. Once the equipment was available in 2022, PMI VectorLink hosted a CDC entomologist who supported the INIS team as they conducted the first molecular tests to identify species of mosquitoes collected by the project. Later in the year, with intense in-person support from a PMI VectorLink laboratory technician, PMI VectorLink successfully trained two technicians from INIS and three NMCP staff in a hybrid format on how to detect infective malaria parasites within mosquito samples.

Since that training, the team has continued to consistently process mosquito samples at a rapid pace, sharing the data with the NMCP to help inform future vector control efforts.

As Julio Estobre, one of the molecular biology laboratory technicians at INIS noted after the training,

“With the right data at our fingertips, we can help better understand malaria transmission in Angola.”

entomologists from four countries (Benin, Kenya, Nigeria, and Sudan) traveled to Ethiopia for training. In Ethiopia, PMI VectorLink trained a total of 189 people—from the NMEP, regional and district health offices, universities and research institutions, and communities supporting community mosquito collectors—to support entomological and vector control activities. In Nigeria, the project worked with the NMEP to train seven principal investigators and 56 entomology technicians in PMI and Global Fund focus states to support surveillance efforts.

Developing community-based entomological surveillance

In many PMI VectorLink countries, entomological surveillance was conducted by a handful of formally trained entomologists who traveled from a central location to data collection sites. As such, the number of sites was often limited by funding and human resource constraints. Entomological data needs to be aggregated and managed at a level that is

informative for locally adaptive vector control interventions. The PMI VectorLink project introduced the community-based entomological surveillance model, where community members were trained and hired to conduct basic entomological data collection, which enabled collection of longitudinal entomological data from a greater number of sites, allowing the country to gather more granular data and protect more communities at risk of malaria with the most appropriate vector control tools. This approach was also useful in countries where conflict, insecurity, and the remoteness of some areas prohibited regular surveillance by trained entomologists. PMI VectorLink developed a training curriculum in Year 3 to train district malaria focal persons and community mosquito collectors in species collection, identification, and preservation. This approach was subsequently implemented in multiple sites across Angola, Ethiopia, Kenya, Mali, and Senegal. The community-based training curriculum can be found on the [PMI VectorLink website here](#).



*PMI VectorLink Nigeria supported training of principal investigators and entomology technicians on how to operate the Prokopac aspirator to collect adult *Anopheles stephensi* mosquitoes.*
Photo: Ifeanyi Okeke

2

ADVANCING INTEGRATED VECTOR CONTROL



In Ethiopia, where unused tires like the one seen here may provide a breeding site for Anopheles stephensi, larvicide is applied to kill the larvae.
Photo: Allan Were



2. ADVANCING INTEGRATED VECTOR CONTROL

The emergence and spread of insecticide resistance in major mosquito vector species has been of increasing concern to the global malaria community for some time. In 2012, the World Health Organization (WHO) issued a generic guideline for managing insecticide resistance in its Global Plan for Insecticide Resistance Management (GPIRM), urging endemic countries to develop strategies for preventing and managing insecticide resistance to ensure the continued effectiveness of the limited number of insecticides available for vector control at that time. Rational deployment of malaria vector control interventions requires much broader information than just factors related to insecticide resistance. In response to this issue, PMI VectorLink finalized an Integrated Vector Control (IVC) strategy framework to support the development of country specific IVC strategies, including an insecticide resistance management (IRM) plan. The framework—aligned with PMI technical guidance—comprised a multi-year plan including deployment of a rational strategy for IRS, guidance for decisions involving the use of piperonyl butoxide (PBO) nets and other new types of ITNs, as well as WHO-recommended new tools.



Indoor Residual Spraying

Year after year, PMI VectorLink's IRS campaigns protected millions of people from malaria, reaching a high of more than 21 million people every year between 2018 and 2021. Notable accomplishments in Year 1 included implementing eight IRS campaigns protecting more than 12 million individuals, and adopting a new insecticide, SumiShield, for IRS. In Year 2, PMI VectorLink expanded its impact, conducting campaigns across 14 countries, including the introduction of a second new insecticide, Fludora Fusion. In Year 3, the project expanded IRS operations to 16 countries, initiating the first-ever spray campaign in Côte d'Ivoire and reinitiating spraying in Senegal after a hiatus. The project adeptly managed the operational challenges of the COVID-19 pandemic, sustaining malaria vector control activities by implementing strict preventive and response measures. In Year 4, the project's accomplishments extended to 17 countries, launching IRS for the first time in Sierra Leone, continuing to

manage pandemic-related obstacles while prioritizing staff vaccination against COVID-19. Year 5 encompassed successful IRS campaigns across 13 countries, demonstrating adaptability in the changing COVID-19 landscape while ensuring efficient malaria control efforts. The introduction of the new insecticides, 2GARD and Klypson, served multiple crucial purposes to overcome vector resistance, sustain effectiveness, and enhance long-term impact.



Insecticide-Treated Nets

Insecticide-treated nets (ITNs) are a well-established malaria vector control intervention and PMI VectorLink's ITN distribution helped to protect more than 23 million people against malaria over the life of the project. Collaborating closely with NMPs, PMI VectorLink executed ITN operations across 18 sub-Saharan African nations. These ITN activities encompassed a wide spectrum of activities, from supporting ITN distribution via continuous channels and mass campaigns to conducting crucial activities such as monitoring the durability of ITNs. Beyond ITN distribution, PMI VectorLink extended valuable support and capacity reinforcement to NMPs, often deploying personnel within their teams. The project also engaged in initiatives targeting social and behavioral change to enhance the acceptance and use of ITNs.

PMI VectorLink actively supported the introduction of new ITN types, such as those incorporating the synergist PBO or dual active ingredient (dual-AI). In October 2021, PMI VectorLink partnered with NMEP in Zambia to distribute PBO nets to primary schools in four districts, demonstrating the project's commitment to promote effective distribution channels and new products in vector control. PBO and dual-AI nets are important tools because they address the growing challenge of insecticide resistance among malaria vectors. By combining different insecticides, new nets enhance effectiveness against resistant mosquitoes, ensuring sustained impact in regions where standard pyrethroid-only ITNs might be less effective. Introducing new ITN types along with novel IRS insecticides demonstrated PMI VectorLink's dedication to actively counter vector resistance.

Mass campaigns: PMI VectorLink played a pivotal role in ITN mass campaigns, both as a direct implementer and by assisting NMPs in their distribution efforts. Highlights over the project period include managing direct ITN distributions in Côte d'Ivoire, while providing technical support at the sub-national level with ITN distributions in Cameroon, Ghana, Senegal, and Zambia. The project's expertise in planning, coordination, and logistics proved instrumental in the success of mass campaigns, ensuring the effective distribution of life-saving nets to vulnerable populations.

Continuous distribution: PMI VectorLink's continuous distribution activities were marked by its substantial involvement in managing Senegal's nationwide health facility ITN distribution program as well as the project's support to school-based distributions across countries. In Senegal, the project played a crucial role in coordinating and implementing the continuous distribution of ITNs through health facilities during antenatal care (ANC) and the expanded program for immunizations (EPI) channels throughout the country. By working closely with Senegal's NMP and local authorities, PMI VectorLink was instrumental in ensuring the sustained availability of ITNs for pregnant women and children under age five.

Additionally, PMI VectorLink contributed significantly to ITN school-based distribution (SBD) in Ghana, Tanzania, and Zambia and piloted the approach in Sierra Leone. These efforts aimed to reach school-going children and their families with essential malaria prevention tools. By collaborating with educational and health authorities, PMI VectorLink facilitated the distribution of ITNs to students and teachers, expanding the impact of malaria control measures within school communities. This initiative demonstrated the project's commitment to exploring diverse and effective continuous distribution strategies for ensuring widespread access to ITNs and advancing malaria prevention in youth populations.

Lastly, over the project period PMI VectorLink provided technical assistance and training to various NMPs and other malaria partners to ensure that continuous ITN distribution through routine and other channels was strategically planned and implemented. Starting with comprehensive assessments of current ITN distribution channels in three countries—Burkina Faso, Cameroon, Niger—the project identified gaps and opportunities for

improvement. These findings were used to make strategic recommendations for future ITN activities, explore the expansion of continuous distribution channels to maintain ITN coverage, and to develop national guidelines.

Durability monitoring: Beginning in Year 1 with ITN durability monitoring studies in Madagascar and Niger, the project conducted studies in 17 countries: Burkina Faso, Burundi, Cameroon, Côte d'Ivoire, DRC, Ghana, Kenya, Liberia, Madagascar, Malawi, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Uganda, and Zambia. These studies provided critical insights into the effectiveness and longevity of ITNs in real-world conditions.

PMI VectorLink's ITN durability monitoring activities evolved to offer a comprehensive understanding of ITN performance, which helped to refine strategies, optimize resources, and enhance the overall impact of malaria vector control efforts including the introduction of new types of nets.



Larval Source Management

In 2022, PMI VectorLink piloted larval source management (LSM) activities in Madagascar, where rice fields are a popular breeding site for mosquitoes, increasing malaria risks for farmers engaged in rice production. After consultation with Madagascar's NMP, the Ministry of Agriculture and Livestock, and the Ministry of Environment and Sustainable Development, the project determined that LSM by drone would be the best way to implement larviciding. The project and the NMP first worked with local organizations to socialize the farming communities about this approach. Then, they deployed drones to spray 7,760 hectares (more than 19,000 acres) of rice fields twice a month over a five-month period in Morombe and Ankazobe districts. The team also conducted entomological monitoring in 24 sites within those districts, and early results showed a decrease in larval density and human biting rate of adult mosquitoes, and the biological larvicide, *Bacillus thuringiensis israelensis* (Bti) effective in reducing larval density until at least seven days after spraying.

The project also used larviciding in Ethiopia. In 2019, the WHO issued an alert about the invasion and spread of the *Anopheles stephensi* mosquito in Africa, which is projected to put millions more people at risk of malaria. The WHO urged countries to enhance

their surveillance to be able to monitor this mosquito's presence and spread. With indications that the proven vector control tools of IRS and ITNs might be less effective against this mosquito, the WHO also recommended the use of complementary approaches to help control its spread. PMI's *An. stephensi* action plan, developed in 2021, outlines its approach to mitigate the harmful effects of this invasive mosquito, and includes enhanced vector and disease surveillance, as well as coordinated intervention implementation. LSM, the targeted

management of mosquito breeding sites to reduce mosquito larvae, is one complementary approach.

Having supported a study in the project's third year to assess the potential impact of *An. stephensi* on malaria cases in Ethiopia, PMI VectorLink worked with the country's NMEP to launch LSM in eight towns. In addition to applying Bti, PMI VectorLink trained community members to work with local residents on source reduction efforts—removing and/or reducing the number of containers where mosquitoes could potentially breed.

ENSURING ENVIRONMENTAL SAFETY & COMPLIANCE IN IRS CAMPAIGNS

PMI VectorLink prioritized safety across all vector control operations in accordance with global and national standards and ensured the environmental impact of those interventions was mitigated when and where possible. Among the project's accomplishments in these areas:

Waste Management: Building on the success of the mobile soak pit piloted under the PMI Africa Indoor Residual Spraying (AIRS) project, PMI VectorLink's Environmental Compliance (EC) team rolled out this wastewater innovation to all IRS countries. The EC team also updated the PMI Best Management Practices Manual for IRS in Vector Control Interventions to incorporate new standards and practices, including updates for the progressive rinsing procedure. PMI VectorLink also supported countries to reduce, reuse, and recycle their waste, forging partnerships with private waste disposal companies to minimize the impact of equipment and supplies—plastic buckets and sheeting, worn-out helmets and face shields, water bottles, cardboard boxes, insecticide bottles and other materials.

Capacity strengthening: PMI VectorLink trained, mentored, and collaborated with local and national host-country environmental officials in environmental compliance for IRS operations through a series of virtual trainings for 80 government representatives from 16 countries. This training series, started in year 3 of the project, accelerated the generation and adoption of EC improvements, disseminated PMI best practices, and enhanced the partnerships between national stakeholders and the project.

Commodities tracking: To ensure the proper monitoring of insecticides, the team piloted and rolled out an insecticide tracking program, using serialized barcodes, for insecticide sachets and bottles in IRS countries.

Improvements in Environmental

Compliance: The PMI VectorLink project refined and standardized existing systems, resulting in improved environmental compliance and greater efficiency. Enhancements included more user-friendly supervisory inspection checklists for district coordinators and supervisors; standardized content for the EC training of trainers, supervisors, and spray operators; and revised vehicle equipment and safety guidelines and standardized training materials for all project-related drivers, including staff and drivers of rented vehicles. These improvements, among others, guided revisions to the *PMI Best Practices Manual for IRS*.

Regulatory Adherence: In accordance with USAID 22 CFR 216, the project updated the Supplemental Environmental Assessment (SEA) standard language used for all countries to approve the use and application of insecticides for IRS. With the introduction of LSM activities, the project submitted 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. These documents provided the necessary basis for any PMI approval of LSM activities as a component of integrated vector control.

3

DRIVING DECISIONS THROUGH DATA: VECTORLINK COLLECT



Pengby Ngor, lead for the Malaria Information System Unit of Cambodia's National Center for Parasitology, Entomology, and Malaria Control (CNM).
Photo courtesy of Pengby Ngor



3. DRIVING DECISIONS THROUGH DATA: VECTORLINK COLLECT

To support the demand for data to drive decision-making across PMI VectorLink countries, the project developed a global system, VectorLink Collect, to improve the way data was captured, managed, and used across the project. Created using the widely available District Health Information Software 2 (DHIS2) platform, VectorLink Collect modules and metadata packages were designed and successfully deployed for community mobilization, IRS, LSM, vector bionomics, insecticide resistance, quality of spray, residual efficacy, and molecular data management. At the project’s conclusion in 2023, a total of 25 countries had used the system to manage critical vector control and/or entomological data (see Table 1).

TABLE 1: USE OF VECTORLINK COLLECT AND MODE OF DATA CAPTURE FOR VECTOR CONTROL AND ENTOMOLOGICAL DATA MANAGEMENT

	IRS and/or LSM	Entomology
Angola	--	●
Benin	●☒	--
Burkina Faso	●☒	●
Cambodia	--	●
Cameroon	--	●☒
Colombia	--	●
Côte d’Ivoire	●☒	●☒
Democratic Republic of the Congo	--	●
Ethiopia	●☒	●☒
Ghana	●☒	●☒
Kenya	●☒	◇
Liberia	--	●
Madagascar	●☒	●
Malawi	●+	◇
Mali	●☒	●☒
Mozambique	●	◇
Niger	--	●
Nigeria	--	●☒
Rwanda	●+	●
Senegal	●☒	●☒
Sierra Leone	●	●
Tanzania	●☒	--
Uganda	●☒	●☒
Zambia	●☒	●
Zimbabwe	●	●

- VectorLink Collect used ☒ Mobile data capture deployed
- 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.

By developing VectorLink Collect using open source DHIS2—widely used by government ministries and health programs—PMI VectorLink facilitated digital collaboration with NMP partners, and increased opportunities for interoperability with both country level and global partners. Although each PMI VectorLink country was at a different point in its digital journey at the inception of VectorLink Collect, the project team focused on strengthening capacity of NMP staff members and their partners to make evidence-based malaria control decisions. PMI VectorLink ensured that over 150 NMP stakeholders had access to and used VectorLink Collect.

PMI investments in VectorLink Collect have generated important lessons on the use-case of DHIS2 for malaria vector control and contributed directly to strengthening government-owned data management systems and digital tools for vector control data. PMI VectorLink worked in close collaboration with the WHO to align vector control DHIS2 metadata packages that are available as digital public goods and serve as an accessible starting point for NMPs to integrate vector control data into national systems.

PMI VectorLink supported national stakeholder development and adoption of improved vector control and entomological data management systems in Angola, Cambodia, Ghana, Malawi, Tanzania, Uganda, Zambia, and Zanzibar.

INTEGRATING ENTOMOLOGICAL DATA INTO CAMBODIA'S MALARIA INFORMATION SYSTEM

Cambodia, striving to eliminate malaria by 2025, has been implementing an electronic data management system known as the Malaria Information System (MIS).

Led by Cambodia's National Center for Parasitology, Entomology, and Malaria Control (CNM), this system was custom-built for Cambodia and tracks country-wide data related to malaria cases but, until 2023, was missing entomological data. Leveraging PMI VectorLink's expertise in entomological data collection, management, and analytics gained in the development and use of the DHIS2-based VectorLink Collect system, CNM worked with the project to integrate this data into the MIS to complement the existing malaria case management information.

To enable seamless transfer of VectorLink Collect's entomology data into the MIS—which does not use DHIS2—the PMI VectorLink team co-designed and developed data collection tools, user interfaces, and dashboards to meet CNM's specific MIS needs. PMI VectorLink worked with CNM to train MIS staff, entomologists, and provincial-level staff on data collection tools used as the foundation for the MIS, and then introduced the entomological modules within the system.

Pengy Ngor, who leads CNM's MIS unit, said:

“The entomology module has become a complementary tool to better inform and use data from that module for decision-making.”

Today, Cambodia has a more comprehensive national system for tracking, treating, and preventing malaria, with data available when they need it, critical for moving forward on the path to elimination.



Login page for Cambodia's Malaria Information System, which was expanded to include entomological data with the support of PMI VectorLink Cambodia, as described in the story at right.

Photo: Lilly Siems

4

CONTRIBUTING TO GLOBAL RESEARCH, STANDARDS & BEST PRACTICES



*Two data collection agents in Cote d'Ivoire practice using the mobile data collection tool during a health facility data collection training in 2022.
Photo: Emily Hilton*



4. CONTRIBUTING TO GLOBAL RESEARCH, STANDARDS & BEST PRACTICES

Impact Evaluations on the Efficacy of IRS and ITN interventions

With the introduction of new vector control products in the context of mosquitoes' increasing resistance to insecticides, NMPs are increasingly looking for data at the sub-national level to generate the localized evidence needed to determine the efficacy of these new products. Between 2018 and 2021, PMI VectorLink initiated 12 vector control impact evaluations across nine countries in response to these needs. Seven of these evaluations were completed; the remaining five are still underway and will be completed under PMI Evolve, PMI's new global malaria vector control project.

A critical component for each of these evaluations was the integration and use of routine health systems data, entomological data, climate data, and vector control program data. While cluster randomized controlled trials provide the highest quality of evidence for impact, they are costly and provide limited evidence within specific country contexts regarding the impact of new vector control tools, or the combination of tools, to support national and subnational product choice and tailoring decisions. With improved availability and quality of routine malaria case data in countries' health management information systems (HMIS), as well as increased availability of entomological and vector control program data, there is a greater opportunity to use these data to help address important malaria control questions. By partnering with NMPs to conduct impact evaluations using routine data, PMI VectorLink generated the localized evidence needed to support their vector control intervention decisions.

Together, the evaluations completed by PMI VectorLink in six countries in collaboration with NMPs found a positive impact of the vector control interventions implemented in multiple countries (see Table 2).

More specifically, the [findings from the seven evaluations](#) completed under PMI VectorLink presented several key takeaways:

- Newer IRS and ITN products with non-pyrethroid insecticides were effective at reducing malaria burden and entomological indicators of malaria transmission in settings of confirmed pyrethroid resistance.
- Dual-AI and PBO ITNs had a greater epidemiological impact compared to standard pyrethroid-only ITNs.
- The impact of IRS may differ significantly by climate-related transmission setting and patterns of ITN use.
- Sustained implementation of IRS over multiple years and higher levels of IRS coverage may provide additional benefits.

TABLE 2: PMI VECTORLINK'S IMPACT EVALUATION PORTFOLIO

Country and study years	Evaluation Focus	Year Completed	Key Finding
Burkina Faso (2018-2021)	IRS: Determining impact of IRS by malaria transmission setting	2022	The implementation of IRS, in combination with seasonal malaria chemoprevention (SMC) and ITNs, may differ significantly by climate, and may have higher impact in areas with low ITN use.
Côte d'Ivoire (2020-2021)	IRS: Using clothianidin-based IRS	2022	This study, among the first to assess the impact of clothianidin-based insecticides, shows the effectiveness of these IRS products in a setting of increasing resistance to the current insecticides being used.
Ethiopia (2015-2019)	IRS: Measuring the impact of non-pyrethroid IRS on the malaria burden	2020	For every ten-percentage-point rise in the population protected by IRS, there was a decrease of 7.2% in the malaria case incidence rate, suggesting there is an additional incremental benefit of reaching more people with IRS, and programs should aim to achieve the highest level of coverage feasible.
Madagascar (2017-2020)	IRS: Evaluating the impact of IRS and sustained exposure to IRS	2021	Non-pyrethroid IRS appeared to substantially reduce malaria incidence. Sustained implementation of IRS over three years conferred additional benefits.
Mali (2017-2019)	IRS: Impact of IRS on all-age and under five malaria case incidence	2020	Analyzing three campaigns showed differential impacts: In 2017, IRS was associated with a 32% decrease in malaria case incidence; but there was no observable impact in 2018 or 2019.
Mali (2020)	ITNs: Assessing the impact of IG2 ITNs v. Standard ITNs	2022	Findings suggest a greater epidemiological impact of Interceptor® G2 (IG2) ITNs compared to standard pyrethroid ITNs in an area of moderate to high intensity pyrethroid resistance. However, additional research is needed.
Nigeria (2019)	ITNs: Evaluating the impact PBO ITNs vs. Standard ITNs	2022	PBO ITNs were associated with a 46.7% decrease in malaria case incidence in the two years after the PBO ITNs were distributed; additionally, mosquito biting rate and indoor density rate were lower after the PBO ITN distribution.

Operational Research

Studies on the Impact of Partial Versus Full IRS on Malaria Vector Control

PMI VectorLink conducted a small-scale pilot study of partial IRS with pirimiphos-methyl at the community level in Northern Ghana in Years 2 and 3 of the project. A prospective observational study to determine the feasibility and impact on cost of a partial IRS campaign and impact on vector population under natural field conditions, the study was conducted in a total of eight communities, two per each of three IRS districts and one district that has not been previously sprayed (control), in the Northern Region of Ghana. In each of the three IRS districts, one community received partial spraying and the other received full IRS with Actellic 300CS. Results, [published in *Scientific Reports*](#), indicated that partial IRS is an effective, feasible, and cost saving approach to IRS that could be adopted to sustain and expand implementation of this key malaria control intervention.

In Year 4 and 5, PMI VectorLink conducted another study assessing the efficacy of SumiShield 50WG (neonicotinoid-based insecticide), Fludora Fusion 56.25WP-SB (mixture of neonicotinoid-deltamethrin insecticides), and Actellic 300CS (pirimiphos-methyl) when partially sprayed in experimental huts, in Tiassalé, Côte d'Ivoire. The study evaluated two iterations of partial wall spraying – either the top or bottom half of the walls was sprayed along with the ceilings – compared to full spraying and unsprayed huts. Again, the intent was to determine whether partial spraying could reduce the cost of IRS without compromising efficacy. Results indicated that the spraying of the lower half of walls plus the ceiling

was non-inferior to full spray treatments for all the insecticides used. 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.

Combined, these study results underscore 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.

In Year 5, PMI VectorLink also conducted a study assessing the potential for indoor use of Attractive Targeted Sugar Baits (ATSBs) in laboratory experiments and in combination with ITNs in experimental huts in Tiassalé, Côte d'Ivoire. Following low ATSB sugar feeding rates in a preliminary hut trial, and determination that most mosquitoes did not feed on sugar within the first 12 hours of exposure to bait stations in a laboratory setting, the second hut trial set out to determine if preventing mosquito exit from huts for an additional 24h, in the absence of a host, would increase sugar feeding rates from ATSB stations and resultant mortality. Only 0.8% of mosquitoes in trial 1 fed from the ATSB station but 10% did so in trial 2. However, there was clearly a strong protective effect of bloodfeeding in both trials and the increase in mortality in the ATSB+intact ITN arm compared to an intact ITN arm only in trial 2 could not be explained by the increase in mortality following sugar feeding. It was concluded that mosquitoes are not entering the huts to seek a sugar meal, and most exit without taking a sugar meal, regardless of whether they are successful at taking a bloodmeal from a protected or unprotected human occupant.

EVALUATING PBO NETS IN NIGERIA

In Nigeria, the country with the highest malaria burden globally, ITNs are the primary vector control tool. However, pyrethroid resistance has been widely documented, threatening their effectiveness. New types of ITNs, such as pyrethroid nets treated with PBO, have been developed to address this resistance and in some countries, have been found to significantly lower malaria parasite prevalence compared to standard pyrethroid-only ITNs. Based on this evidence, the Nigeria NMEP and PMI decided to deploy 1.7 million PBO ITNs in Ebonyi State in November 2019, the first PBO campaign in the country.

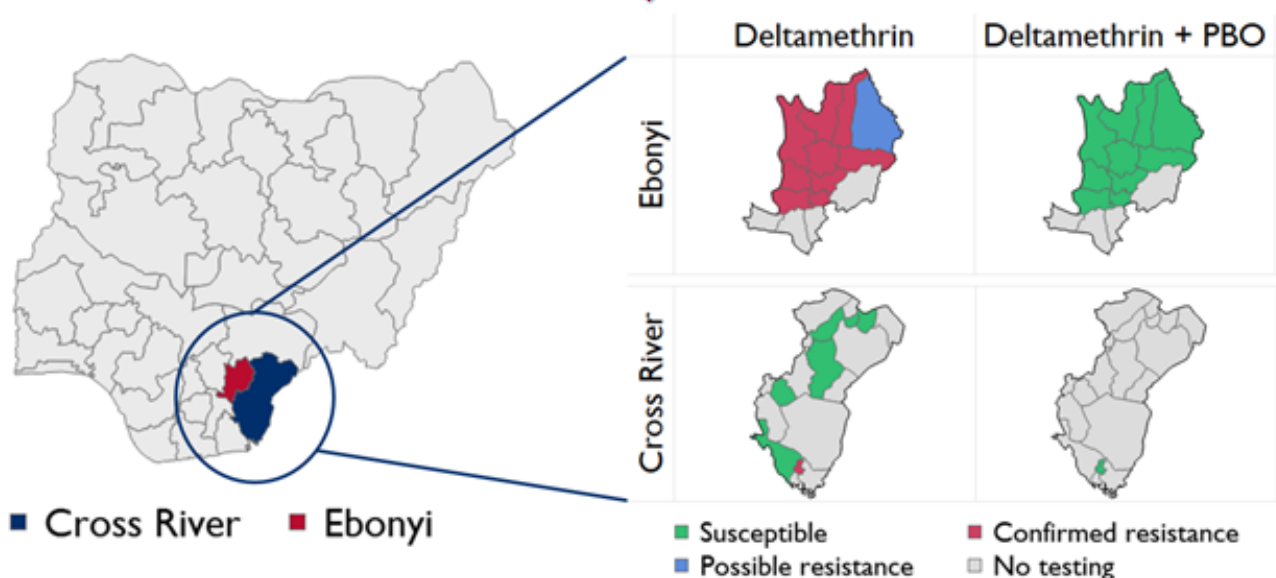
In collaboration with the NMEP, PMI VectorLink designed an evaluation to assess the epidemiological and entomological impact of the Ebonyi campaign. Using routine data from the country's HMIS, a controlled interrupted time series analysis was conducted using monthly malaria incidence data from two years before and after the PBO ITN campaign (December 2017 to November 2021). A pre/post analysis was also conducted to assess the impact of the PBO ITNs on the two entomological indicators of interest—human biting rate and indoor resting density—during the high transmission season before and after the mass campaign.

Among the findings: PBO ITNs were associated with a 46.7% decrease in malaria case incidence in the two years following their distribution compared to if no ITNs had been distributed, with a significant decrease from 269.6 predicted cases per 1,000 population to 143.6. During the high transmission season immediately following the campaign, the human biting rate was 72% lower and indoor resting density was 73% lower compared to the high transmission season before the campaign.

These results were subsequently used in the NMEP's Global Fund application to advocate for greater use of PBO ITNs in areas of documented pyrethroid resistance. Nigeria has since moved towards procuring new types of ITNs for future mass campaigns.

NMEP Deputy Director Philip Oyale noted,

“These results have reinforced the national program’s resolve to continue to leverage the evidence that is being produced from entomological surveillance activities.”



Resistance of *An. gambiae s.l.*, the major malaria vector in Nigeria, to deltamethrin with or without PBO in Ebonyi and Cross River, 2019.

5

MAKING MALARIA SERVICES RESILIENT



Environmental Compliance Officer Tahina Masihelson showcasing the solar-powered cooling and ventilations system at Tongobory operations site, Madagascar. Photo courtesy of Tahina Masihelson



5. MAKING MALARIA SERVICES RESILIENT

PMI's 2021-2026 strategy calls for adapting malaria services to support partner countries' resiliency against shocks including COVID-19, other emerging threats, and climate change, so that prevention and control efforts can continue. PMI VectorLink worked side-by-side with NMPs to confront challenges like these, successfully adapting vector control services.

COVID-19

The COVID-19 pandemic caused widespread disruptions in health services, but the WHO and malaria partners worldwide were determined that malaria and vector control activities should continue. PMI VectorLink worked with NMPs to ensure that IRS campaigns continued; distribution of ITNs and durability monitoring moved forward; entomological surveillance was continued safely when possible; and capacity strengthening efforts were transitioned from in-person to virtual, to ensure that key training was still provided. When project offices were closed, the team rapidly developed remote working capabilities, and also adopted strategies to mitigate risks put in place by the CDC and WHO—social distancing, handwashing, and use of personal protective equipment (PPE). Supply chain issues brought on by the pandemic included increased lead times for ordering select commodities and potential shipping delays. However, PMI VectorLink's procurement team was able to rely on long-standing relationships with supply chain partners globally and in PMI partner countries, to ensure adherence to stricter and longer lead times for purchasing to ensure timely implementation of activities. The project conducted a pooled procurement of KN95 masks in 2019, after noting an increased demand for this type of PPE, avoiding the stock-out problems that arose around masks early in the pandemic. As a result, PMI VectorLink-supported countries conducted IRS campaigns with little or minimal delays; some ITN distribution campaigns were delayed, but also continued. Entomological surveillance was suspended across the project for three months (April-July 2020), but as countries began to adapt to the COVID-19 context, surveillance activities resumed. Overall, while some interventions were interrupted or delayed in Year 3, PMI VectorLink continued to deliver on its programmatic interventions that year and in the year following, and programming was back to normal in Year 5.

Other Shocks

The pandemic resulted in shocks that reverberated beyond the health system. Oil prices climbed steeply at the end of 2021, resulting in fuel shortages in many countries, including Mali and Sierra Leone. In these countries, PMI VectorLink worked with fuel providers, district health management teams—which sometimes had intermittent stocks of fuel that VectorLink could leverage, and community members to ensure that campaigns continued. Country spray teams adjusted their calendars based on fuel availability, shifting spray dates for targeted communities when necessary. These strategies minimized disruptions as much as possible, and ensured that PMI VectorLink successfully met or exceeded the spray coverage minimum goals despite their resources challenge.

In Ghana, teachers in public schools embarked on a nationwide strike in 2022, demanding a cost-of-living allowance to cope with rising prices brought on by pandemic-induced financial shocks. The strike coincided with Ghana's planned school based ITN distribution, jeopardizing the delivery of 1,476,632 nets to students in primary schools. More than 3,300 regional and district offices from the Ghana Education Service (GES) had already been trained for ITN distribution, and Ghana Health Services had already been tapped to provide supervision of distribution efforts. Moving quickly, PMI VectorLink and the National Malaria Elimination Program (SHEP) to use community information centers in rural and semi-urban areas to mobilize parents and students to receive nets, since the public schools were not in session due to the strike. They were supported by the GES and school improvement support officers, who handled record-keeping and data entry to ensure proper distribution. PMI VectorLink Ghana, the NMEP, and SHEP met their distribution goals while the public schools were on strike, delivering nets to over 1.4 million children.

Emerging Threats

Insecticide resistance is a threat that a growing number of NMPs across Africa are confronting. PMI VectorLink's integrated vector control team supported NMPs to develop rotation and subnational deployment strategies for insecticides used in IRS to ensure continued efficacy

in vector control. As noted earlier, in the project's third year, the team facilitated discussions at the country-level that resulted in 14 of the 16 IRS country programs deploying multiple insecticides within their campaigns. Insecticide resistance surveillance contributed to decision making around the procurement of dual-AI ingredient nets and PBO nets, as highlighted in the previous section of this report. The project regularly shared insecticide resistance data with the WHO to incorporate into the global Malaria Threats Map.

Adapting to Climate Change

In response to the rising temperatures in some countries due to climate change, the IVC team adapted their programming. In Madagascar, PMI VectorLink piloted the use of solar panels to cool insecticide storerooms, which should be kept at a certain temperature to ensure insecticides remain effective. While storerooms have historically been kept cool by electricity, a solar-powered cooling and ventilation system proved to be effective at cooling a storeroom to below the recommended temperature level, and in addition, was less expensive and more climate-friendly than running a generator. In Tanzania, PMI VectorLink turned to solar power to provide data collection teams with a renewable source of energy to charge their mobile data devices during an IRS campaign. The rollout of this solar-powered system enhanced the quick availability of data to support timely decision-making and adjust field supervision priorities during a spray campaign. Further, the solar panels were used to support electrification of the central store once the campaign was completed, reducing the costs normally incurred when using a generator.

DELIVERING MALARIA AND CHOLERA PREVENTION EFFORTS TOGETHER

COVID-19 wasn't the only disease to impact the project. In 2022, Malawi was severely hit by a cholera outbreak that spread to all 29 districts in the country. When it reached Nkhhotakota, where PMI VectorLink implements IRS, the team sprang into action.

In advance of the annual October IRS campaign, PMI VectorLink expanded its focus from malaria control to also support the district health office in its cholera response. Their approach involved collaborating on community engagement efforts, ensuring that community mobilizers were providing information about the IRS campaign, cholera prevention, and ongoing COVID-19 prevention efforts. When the district health teams ran low on fuel to transport cholera-fighting commodities, PMI VectorLink stepped in to aid with transport.

PMI VectorLink also emphasized cholera prevention efforts to the spray teams, once the IRS campaign was fully underway. Daily mobilization efforts of the spray teams included recurring health messages and rigorous health checks. These efforts paid off: with all of the more than 500 seasonal workers engaged to deliver the intervention remaining cholera-free.

6

LESSONS & RECOMMENDATIONS



COVID-19 Compliance: In Ghana, handwashing stations like the one shown here were set up to follow COVID-19 guidance.
Photo: PMI VectorLink Ghana



6. LESSONS & RECOMMENDATIONS

Strengthening National Capacity

Over the six years of the project, PMI VectorLink prioritized support to the NMPs to advance their ownership in key areas of programming. Among the lessons learned: the most successful capacity strengthening interventions are those that were requested by local stakeholders, even more so in instances where the local partners were already entirely responsible for the ultimate delivery (e.g., IRS boot camp in government-led IRS districts, establishing a national entomology database, etc.). USAID's continued emphasis on inclusive and locally led development, and the launch of its first Local Capacity Strengthening Policy in PMI VectorLink's final year, are timely. As PMI prioritizes sustainability in vector control, NMPs and local organizations must assume an increasing leading role in defining capacity strengthening priorities, setting objectives, and developing plans for investing in, gaining, and sustaining institutional capacity over multiple years with support from PMI.

Advancing integrated vector control

The cost of conducting IRS campaigns is a constraint in many countries. The operational research studies on partial wall spraying, which indicate the potential for cost savings if fully implemented, underscore the need for a robust randomized control trial to the feasibility of this approach in terms of epidemiological and entomological impact. To further advance integrated vector control more studies are recommended for all vector control tools and approaches and their costs: community-based IRS and entomological surveillance; insecticide resistance; the epidemiological and entomological impact of new and complementary vector control tools, such as dual-AI and PBO ITNs; and the efficacy of LSM.

Driving decisions through data

The development of the VectorLink Collect database and supporting mobile data capture has enabled timely data capture and analysis, as well as visualization of high-quality data across all levels of the health system for both IRS and entomological data. Moving forward, it is critical to maintain a focus on ensuring that high-quality data is generated and used to make critical vector control decisions.

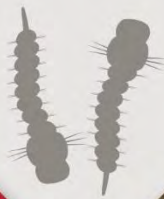
Contributing to global research, standards, and practices

The use of routine health system data can help to answer important malaria control questions related to the impact of IRS and ITNs. Evidence generated under PMI VectorLink indicates that newer IRS and ITN products with non-pyrethroid insecticides are effective at reducing malaria burden and entomological indicators of malaria transmission. Further studies can fill in gaps in evidence relating to the impact of complementary vector control tools, the combinations of tools to be deployed for maximum impact, and cost-effectiveness of these interventions.

Making malaria services resilient

During the COVID-19 pandemic, PMI VectorLink learned how to pivot, when necessary, to innovate ways of collaboration and implementation to sustain malaria vector control programs. Climate change presents a similar threat and opportunity—and while its impact on mosquito populations and vector control interventions may differ from country to country, it calls for new approaches and collaboration and a renewed commitment to protecting the populations who are most vulnerable to malaria.

ANNEX **A** COUNTRY RESULTS



PMI VectorLink Angola

Implementation Period: May 2019–April 2023


I. Programming Highlights

- In collaboration with the NMCP, PMI VectorLink mapped and characterized mosquito breeding sites across eight provinces over the life of the project.
- At the project’s inception, Angola lacked an insectary for rearing and keeping mosquitoes. PMI VectorLink Angola supported the conversion of a 40-foot shipping container, known as an “insectary-in-a-box,” in response to this need, advancing the country’s capacity to conduct entomological activities.
- The project trained national, provincial, and municipal staff on entomological monitoring and Angola technicians at *Instituto Nacional de Investigação em Saúde* (INIS) on lab techniques, allowing malaria vectors to be analyzed in-country for the first time.
- In 2023, PMI VectorLink supported the country to establish their first two susceptible mosquito colonies at the *Instituto de Combate e Controlo das Tripanossomíases* (ICCT) in Luanda.

2. Key Partners

- NMCP
- *Direção Nacional de Saúde Pública* (National Directorate of Public Health)
- *Instituto Nacional de Investigação em Saúde* (INIS, National Health Research Institute)
- *Instituto de Combate e Controlo das Tripanossomíases* (ICCT)
- *Direcção Provincial de Saúde* (Provincial Health Directorate)
- The MENTOR Initiative

TABLE I: PMI VECTORLINK ANGOLA RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of sites for vector bionomics monitoring	--	--	2	1	3	2
	Number of sites for insecticide resistance	--	--	0	7	8	4
	Number of people trained in entomological monitoring	--	--	15 13% female	50 10% female	30 0% female	--

PMI VectorLink Benin

Implementation Period: January 2018–December 2021*



1. Programming Highlights

- PMI VectorLink Benin project worked with the Ministry of Health (MOH), National Malaria Control Program (NMCP), and partners to spray targeted structures in three districts of the department of Donga (Copargo, Djougou, and Ouaké), three districts in Alibori (Gogounou, Kandi, and Segbana) and three districts in Atacora (Kerou, Pehunco, and Kouande).
- In conjunction with spray operations, the project implemented mobile data collection with smart phones to facilitate reporting and decision making.

2. Key Partners

- NMCP/Ministry of Health
- Entomological Research Center of Cotonou (CREC)
- Departmental Directorate of the Living Environment and Sustainable Development (DDCVDD)
- Department of Agriculture (DAGRI)
- Departmental Directorate of Health (DDS)

TABLE 2: PMI VECTORLINK BENIN RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	
 Population protected by PMI-supported IRS: Total	1,321,758	1,077,411	1,104,928	927,007	
	Pregnant women protected	58,086	51,872	44,046	40,470
	Children under 5 protected	269,164	243,648	199,200	107,330
	Structures Sprayed	400,997	335,207	350,349	280,237
	Spray Coverage	90.6%	86.5%	93.4%	93.5%
Insecticide(s)	Actellic 300CS	Actellic 300CS	Actellic 300CS, Fludora Fusion WP-SB	SumiShield 50 WG	
 Number of people trained to support vector control in target areas	4,230 20% female	2,607 20% female	3,547 17% female	2,997 20% female	
	Number of people trained to support IRS with USG funds	2,229 13% female	1,623 15% female	2,128 11% female	1,850 16% female
	Number of people who completed gender awareness training	2,547 15% female	2,141 19% female	3,547 17% female	2,938 19% female

* The Benin NMCP re-strategized their vector control priorities; hence the closeout of the PMI VectorLink project in 2021.

PMI VectorLink Burkina Faso

Implementation Period: January 2018–March 2023*




1. Programming Highlights

- PMI VectorLink Burkina Faso successfully implemented IRS in three districts (Solenzo, Kampti, and Kongoussi) with high malaria incidence rates, using mobile data collection at the spray operator level to collect all spray-related data to improve data quality and availability in a timely manner for rapid decision-making purposes. In addition, the project conducted monthly entomological surveillance activities to monitor vector bionomics to determine malaria vector density, species composition, biting and resting behavior, parity, and plasmodium sporozoite infection rates. The project also conducted insecticide susceptibility tests, in collaboration with the Health Sciences Research Institute (IRSS), to assess the residual efficacy of insecticides from the IRS campaigns, and durability monitoring on multiple types of ITNs from the 2019 mass ITN distribution campaign.
- After four years working side-by-side with PMI VectorLink project in the three districts named above (in Solenzo, Kampti, and Kongoussi from 2018 to 2019, and Solenzo and Kampti from 2020 and 2021), the NMCP/Permanent Secretariat for Malaria Elimination (SP/Palu), with the support of a private mining company, took the lead on a first of its kind, small-scale, government-led IRS campaign in 2022 to spray over 4,700 homes in Dangouna and Lokiéhoun, protecting close to 15,500 people, including more than 400 pregnant women and 2,435 children under five. In addition to providing the insecticide, PMI VectorLink Burkina Faso provided technical assistance and supported SP/Palu's planning activities while monitoring the campaign's progress and guiding the team when needed.
- Burkina Faso faced significant security challenges at the national level throughout the project, affecting all project operations but, in particular, the work carried out by IRSS, PMI VectorLink's main entomology partner in Burkina Faso. The IRSS team, with PMI VectorLink's support, adopted an effective community-led approach which enabled the team to complete all entomological and durability monitoring work in a timely manner and within the set deadlines, despite the severe security challenges.

2. Key Partners

- MOH, Regional Health Directorate, District Management teams
- NMCP/*Secrétariat Permanent pour l'élimination du Paludisme* (Permanent Secretariat for Malaria Elimination)
- *Centre de Santé et Promotion Sociale* (CSPS, Center for Health and Social Promotion)
- IRSS (Institute of Research on Health Sciences)
- *District Sanitaire: Service Information, Education pour la Communication et l'Assainissement* (Information, Education and Communication and Hygiene Unit)
- Community groups (local associations, women's associations, religious organizations, and traditional leadership structures)

TABLE 3: PMI VECTORLINK BURKINA FASO RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	
 Population protected by PMI-supported IRS: Total	766,374	587,248	508,107	586,249	--	
	Pregnant women protected	14,183	11,959	21,103	31,218	--
	Children under 5 protected	125,206	92,809	95,445	120,019	--
	Structures Sprayed	258,766	201,901	162,037	175,523	--
	Spray Coverage	97.0%	91.6%	94.6%	92.7%	--
	Insecticide(s)	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	--
 Number of people trained to support vector control in target areas	2,227 20% female	2,045 19% female	1,493 18% female	1,823 19% female	--	
	Number of people trained to support IRS with USG funds	1,147	928	879	1,065	--
	Number of people who completed gender awareness training	2,227 20% female	2,045 19% female	1,403 18% female	465 14% female	--
 Number of sites for vector bionomics monitoring	9	14	14	14	6	
	Number of sites for insecticide resistance	18	12	12	12	17
	Number of people trained in entomological monitoring	10 30% female	0	0	22 14% female	--

**No IRS operations were implemented beyond 2022 due to fund limitations.*

PMI VectorLink Burundi

Implementation Period: October 2017–July 2023


I. Programming Highlights

- PMI VectorLink Burundi guided evidence-based decision making for IRS implementation by recommending the appropriate campaign season through establishing the seasonality of malaria vector populations and monitoring vector’s susceptibility to insecticides.
- The project conducted ITN durability monitoring and informed the national program on the short life span of nets distributed in the 2019 mass campaign.
- The team provided technical support for the IRS program implemented by the government through monitoring the residual efficacy and sharing best practices.
- The project strengthened the capacity of the NMCP, enabling the district staff to conduct vector surveillance and morphological identifications with limited support from the project team.
- PMI VectorLink Burundi established laboratory capacity for PCR assays at INSP, allowing the institute to stop sending mosquito samples outside of the country.

2. Key Partners

- NMCP
- *Institut National de Santé Publique (INSP)*

TABLE 4: PMI VECTORLINK BURUNDI RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of sites for vector bionomics monitoring	--	8	9	9	9	9
	Number of sites for insecticide resistance	--	7	8	9	9	9
	Number of people trained in entomological monitoring	--	27 15% female	27 15% female	27 15% female	--	--

PMI VectorLink Cambodia

Implementation Period: October 2019–July 2023


1. Programming Highlights

- PMI VectorLink Cambodia provided technical assistance to the National Center for Parasitology, Entomology and Malaria Control (CNM), including conducting routine entomological surveillance in sentinel sites before shifting to case-based entomological surveillance during foci investigations.
- The project designed and developed an entomological surveillance module which was integrated with the existing CNM’s malaria case management MIS.
- PMI VectorLink Cambodia strengthened local capacity by training 71 Provincial Health Department and Operational District staff from nine provinces on morphological identification of primary vectors of malaria.

2. Key Partners

- CNM
- University of Puthisastra
- Provincial health department
- Operational district

TABLE 5: PMI VECTORLINK CAMBODIA RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of sites for vector bionomics monitoring	--	0	0	4	4	4
	Number of sites for insecticide resistance	--	0	0	4	4	4
	Number of foci investigations responded to by PMI VectorLink	--	--	--	--	4	2
	Number of people trained in entomological monitoring	--	1 0% female	11 18% female	14 14% female	174 12% female	210 13% female

PMI VectorLink Cameroon

Implementation Period: May 2018–April 2023




1. Programming Highlights

- With PMI VectorLink’s support, longitudinal surveys were conducted in five sentinel sites representing Cameroon’s three major ecological zones (Forest, Savannah, Sahelian).
- PMI VectorLink conducted annual insecticide resistance testing in 15 sentinel sites, with the data generated used by the NMCP to stratify ITN distribution during the 2022 national ITN campaign.
- Eighty-one (81) NMCP and partner organization staff were trained in basic entomology skills.

2. Key Partners

- NMCP/ Ministry of Public Health
- Cameroon National Vector Control Committee
- Centre for Research in Infectious Diseases (CRID)
- Organisation de Coordination des Endémies de l’Afrique Centrale (OCEAC)
- The Biotechnology Centre (BTC) of the University of Yaoundé

TABLE 6: PMI VECTORLINK CAMEROON RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of ITNs distributed by partners with VL support	--	--	1,329,189	--	--	--
	ITN distribution channel(s)	--	--	Mass	--	--	--
	Type of ITNs Distributed	--	--	Pyrethroid-only	--	--	--
	Number of people trained to support vector control in target areas	--	122 9% female	11,454 4% female	767 26% female	32 [⊠] %	--
	Number of sites for vector bionomics monitoring	--	5	5	5	5	5
	Number of sites for insecticide resistance	--	3	5	5	10	10

[⊠] Here and through the remainder of the annex, ⊠ indicates that the sex disaggregate details were not available.

ANNEX  **COUNTRY RESULTS**

	Number of people trained in entomological monitoring	--	20 5% female	0	51 27% female	32 40% female	
--	-------------------------------------------------------------	----	-----------------	---	------------------	------------------	--

PMI VectorLink Colombia

Implementation Period: January 2020–June 2023


1. Programming Highlights

- PMI VectorLink Colombia collected data to assess the efficacy of IRS and ITNs in the context of Latin America and Caribbean (LAC), where there is little evidence about the efficacy of these interventions.
- The project collected a lot of data on the mosquito population species composition and behaviors that was previously unknown.
- The team gained insights into the status of the knowledge, attitudes & practices (KAP) of the communities in Guapi & Timbiqui, Colombia, regarding vector control and malaria to better inform vector control efforts.

2. Key Partners

- Cauca Department Health Secretariat (SSDC)
- The Colombian National Institute of Health (INS)
- Municipalities of Guapi and Timbiqui
- Centers for Disease Control and Prevention (CDC)

TABLE 7: PMI VECTORLINK COLOMBIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Number of sites for vector bionomics monitoring	--	--	--	40	40	40
Number of sites for insecticide resistance	--	--	--	5	4	4
Number of people trained in entomological monitoring	--	--	24 71% female	44 68% female	44	0

PMI VectorLink Côte d'Ivoire

Implementation Period: November 2017–March 2023



I. Programming Highlights



- PMI VectorLink Côte d'Ivoire successfully introduced IRS at district-scale for the first time in Côte d'Ivoire in 2020.
- The project guided appropriate vector control decision-making, ensuring the good use of all the insecticide resistance monitoring data collected to support the NMCP's decisions.
- The project strengthened capacity of the NMCP and partner research institutes, including the rehabilitation of the insectary at the National Institute for Public Hygiene (INHP) and the Center for Medical and Veterinary Entomology (CEMV) laboratory animal shelter and supporting the Institute Pierre Richet (IPR) with equipment and supplies.
- PMI VectorLink Côte d'Ivoire supported the creation of a vector control unit at the NMCP to manage and coordinate all issues related to vector control and entomology at the NMCP.

2. Key Partners

- NMCP
- *Institut National d'Hygiene Publique* (INHP)
- *Centre Suisse de Recherches Scientifique* (CSRS)
- Center for Medical and Veterinary Entomology (CEMV)
- *MB & Associés* (MBA)

TABLE 8: PMI VECTORLINK CÔTE D'IVOIRE RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	
 Population protected by PMI-supported IRS: Total	--	--	193,935	201,178	228,431	
	Pregnant women protected	--	--	4,349	5,008	7,119
	Children under 5 protected	--	--	30,053	32,068	38,795
	Structures Sprayed	--	--	53,962	60,496	70,392
	Spray Coverage	--	--	91.9%	96.7%	98.5%
	Insecticide(s)	--	--	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG
 Number of ITNs distributed by VL	--	--	--	3,074,527	--	
	ITN distribution channel(s)	--	--	--	Mass	--
	Type of ITNs Distributed	--	--	--	PBO	--

	Number of people trained to support vector control in target areas	--	--	1,129 19% female	864 19% female	2,017 15% female
	Number of people trained to support IRS with USG funds	--	--	353 13% female	256 10% female	349 12.3% female
	Number of people who completed gender awareness training	--	--	1,111 16% female	851 16% female	2,030 13% female
	Number of sites for vector bionomics monitoring	4	4	4	4	4
	Number of sites for insecticide resistance	10	16	18	18	18
	Number of people trained in entomological monitoring	17 24% female	19 21% female	35 37% female	58 24% female	53 2% female

PMI VectorLink Democratic Republic of Congo (DRC)

Implementation Period: October 2018–July 2023


1. Programming Highlights

- At the project’s inception, the DRC lacked an insectary for rearing and keeping mosquitoes. PMI VectorLink supported the conversion of a 40-foot shipping container, known as an “insectary-in-a-box,” in response to this need, advancing the country’s capacity to conduct entomological activities.
- PMI VectorLink DRC supported the NMCP to select effective ITNs based on resistance data.
- The project supported the NMCP to leverage community-based entomological surveillance in the DRC.
- The project also strengthened capacity and developed infrastructure for molecular analysis at the National Institute of Biomedical Research in Kinshasa.

2. Key Partners

- NMCP/ Ministry of Health
- *Institut National de Recherche Biomédicale and Ecole de Santé Publique, Université de Kinshasa (INRB)* (National Institute of Biomedical Research)
- School of Public Health of the University of Kinshasa
- Clinton Health Access Initiative
- Against Malaria Foundation

TABLE 9: PMI VECTORLINK DRC RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of sites for vector bionomics monitoring	4	8	3	3	3	3
	Number of sites for insecticide resistance	11	10	14	14	14	10
	Number of people trained in entomological monitoring	6 0% female	0	12 0% female	6 0% female	14 14% female	0

PMI VectorLink Ethiopia

Implementation Period: January 2018–September 2023












1. Programming Highlights

- PMI VectorLink Ethiopia shifted 70 percent of IRS districts from a district-based to a community-based approach, which, in addition to enabling safe IRS operations in unstable security contexts, resulted in increased community acceptance, reduced costs, and strengthened capacity of local health teams.
- The project expanded IRS targeted communities in 2022 and 2023 to reach previously unreached populations living in 10 refugee camps in Benishangul-Gumuz and Gambella.
- PMI VectorLink Ethiopia detected the presence of *An. stephensi* in 47 sites (contributing to the 51 total in which it has been found in Ethiopia as of September 2023), assessed its insecticide/larvicide susceptibility status, and characterized its breeding and resting behavior to determine the most appropriate vector control intervention. Subsequently, designed and rolled out the first large-scale implementation of LSM in eight towns, determined its effectiveness in control *An. stephensi* larvae, and transferred sustainable LSM operations to four municipal governments with minimal continued support through larvicide procurement and technical assistance.

2. Key Partners

- NMCP
- Regional, Zonal, and District Health Bureaus; Town Administrations
- Jimma University
- ArbaMinch University
- Amhara Public Health Institute
- Armauer Hansen Research Institute
- Addis Ababa University
- Assosa University
- Bahir Dar University
- Debre Markos University
- Dilla University
- Dire Dawa University
- Gonder University
- Jigjiga University
- Mekele University
- Oromia Public Health Institute

TABLE 10: PMI VECTORLINK ETHIOPIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Population protected by PMI-supported IRS: Total	1,264,189	1,334,868	1,511,728	1,618,765	1,792,145	2,172,031
Pregnant women protected	28,944	33,245	43,747	50,137	58,065	76,959
Children under 5 protected	213,459	228,262	226,996	221,612	245,803	320,936
Structures Sprayed	472,569	487,746	527,375	604,921	684,490	776,698
Spray Coverage	97.4%	95.5%	95.6%	94.9%	97.5%	95.8%
Insecticide(s)	Actellic 300CS	Actellic 300CS	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG
 Number of people trained to support vector control in target areas	4,371 32% female	4,887 27% female	3,013 24% female	5,611 26% female	5,986 26% female	7,386 30% female
 Number of people trained to support IRS with USG funds	2,413 9% female	2,297 6% female	2,350 24% female	3,430 24% female	3,992 24% female	4,786 27% female
 Number of people who completed gender awareness training	4,401 32.3% female	4,922 26.8% female	2,966 23.4% female	5,653 26% female	6,030 26% female	7,439 29% female
 Number of people living in properties with LSM interventions	--	--	--	--	514,451	570,136
 Pregnant women	--	--	--	--	12,261	14,413
 Children under 5	--	--	--	--	74,760	86,361
 Number of properties visited by LSM teams	--	--	--	--	73,094	89,609
 Number of sites for vector bionomics monitoring	3	9	11	10	8	7
 Number of sites for insecticide resistance	4	6	15	21	8	0
 Number of people trained in entomological monitoring	4 25% female	23 13% female	0	46 7% female	12 ^o	0

PMI VectorLink Ghana

Implementation Period: January 2018–July 2023





1. Programming Highlights

- PMI VectorLink Ghana expanded IRS to nine districts up from seven districts in 2018.
- The project contributed to national entomological surveillance through PMI VectorLink-implemented insecticide resistance and longitudinal monitoring in eight PMI-supported IRS districts and four national sites, and financially supported National Insecticides Resistance Monitoring Partnership (NIRMOP) through the Noguchi Memorial Institute for Medical Research (NMIMR) to collect and report on insecticide resistance data in 30 sites throughout the country.
- PMI VectorLink Ghana strengthened the capacity of staff of the Navrongo Health Research Center (NHRC) to conduct entomological collections at four sites (Krachi East district in Oti region, Sefwi Wiawso district in Western North region, Fanteakwa North district in Eastern region and Asutifi North district in Ahafo region) and transferred the field work to the center in June 2022.
- The project completed a three-year ITN durability study of DawaPlus 2.0 ITNs distributed in Zabzugu and Olyset ITNs distributed in Nanumba South in the June 2018 mass campaign; supported routine distribution of ITNs in 16 regions, the 2021 nationwide mass ITN campaign of 15.3 million nets in 15 regions, and 2020 school based ITN distribution of 1.4 million ITNs to 23,000 schools in 15 regions. The team also implemented social behavior and communication activities between 2020-2022 to recruit and train community health workers and community leaders as ITN use and care champions in Central and Eastern region.

2. Key Partners

- National Malaria Elimination Program (NMEP)
- NIRMOP
- NMIMR
- NHCR
- Ghana Education Service - School Health Education Program (SHEP)
- Ghana Health Service
- Global Fund to Fight AIDS Tuberculosis and Malaria
- District assemblies for IRS districts
- Ghana Environmental protection agency

TABLE I I: PMI VECTORLINK GHANA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	
 Population protected by PMI-supported IRS: Total	836,376	875,481	965,467	928,692	961,418	1,021,269	
	Pregnant women protected	18,397	19,844	21,295	20,118	20,581	21,991
	Children under 5 protected	148,627	157,398	161,750	156,671	159,546	168,872
	Structures Sprayed	298,701	298,385	339,139	329,838	355,940	381,151
	Spray Coverage	92.0%	94.3%	92.6%	90.5%	93.3%	94.1%
	Insecticide(s)	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG
 Number of ITNs distributed by partners with VL support	--	--	1,606,095	1,175,249	6,610,579	--	
	ITN distribution channel(s)	--	--	Health facility, school	School	School, Mass	--
	Type of ITNs Distributed	--	--	Standard pyrethroid, PBO	Standard pyrethroid, PBO, Dual AI	Standard pyrethroid, PBO, Dual AI	--
 Number of people trained to support vector control in target areas	2,360 14% female	2,289 18% female	2,716 19% female	2,809 21% female	2,865 19% female	2,820 21% female	
	Number of people trained to support IRS with USG funds	837 19% female	864 22% female	843 29% female	920 30% female	951 29% female	968 27% female
	Number of people who completed gender awareness training	874 18% female	910 22% female	2,716 19% female	2,809 21% female	2,865 19% female	2,796 21% female
 Number of sites for vector bionomics monitoring	20	16	12	8	12	12	
	Number of sites for insecticide resistance	0	0	13	13	18	13
	Number of people trained in entomological monitoring	74 4% female	36 8% female	42 38% female	16 50% female	24 25% female	24 29% female

PMI VectorLink Guinea

Implementation Period: September 2021–March 2023


1. Programming Highlights

- PMI VectorLink Guinea trained 13 health workers from the NMCP to carry out insecticide resistance monitoring and vector bionomics monitoring.
- The project assessed the susceptibility of local vectors to pyrethroids, neonicotinoid, pyrroles, and organophosphates. This data was used to recommend the procurement of Dual-AI or PBO ITNs countrywide.
- PMI VectorLink supported the NMCP to transition the Integrated Malaria Technical Working Group to an Integrated Vector Control Technical Working Group.

2. Key Partners

- NMCP
- *Direction Préfectorale de la Sante* (DPS) of Forecariah, Boffa, Labe, Faranah, Kissidougou, Kankan, and Dabola

TABLE 12: PMI VECTORLINK GUINEA RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of sites for vector bionomics monitoring	--	--	--	--	4 (plus 6 sites for spot checks only)	4
	Number of sites for insecticide resistance	--	--	--	--	7	7

PMI VectorLink Kenya

Implementation Period: July 2018–September 2021


I. Programming Highlights



- In collaboration with Division of National Malaria Program (DNMP), Homa Bay and Migori county Ministry of Health, implemented IRS in eight sub counties in Homa Bay and six sub counties in Migori, which included spraying a neonicotinoid insecticide in Homa Bay and Migori for the first time in 2021, following several years spraying an organophosphate as part of an insecticide rotation strategy. Prior to full scale rotation, in 2019, Kenya conducted a spray pilot with a newly WHO prequalified neonicotinoid insecticide to identify any operational changes that vector control programs needed to make to support spraying new insecticides. The pilot was limited to one operation site in Homa Bay.
- PMI VectorLink Kenya conducted longitudinal monitoring and insecticide resistance in eight counties in Western Kenya in the Lake endemic zone to monitor IRS and ITN effectiveness.
- The project completed 24- and 36-month ITN durability studies of DawaPlus 2.0 ITNs distributed in Busia County and DuraNet ITNs distributed in Kwale County during the 2017 mass campaign.
- PMI VectorLink Kenya supported the development, publication, and dissemination of key national policy documents: IRS Implementation Strategy 2020-2024, Malaria Vector Surveillance Operational Guidelines 2020-2024, Integrated Vector Control Strategy 2020-2024, and Insecticide Resistance Management Plan 2020-2024.

2. Key Partners

- DNMP
- Migori Ministry of Health
- Homa Bay Ministry of Health
- Kisumu Ministry of Health
- Siaya Ministry of Health
- Bungoma Ministry of Health
- Vihiga Ministry of Health
- Busia Ministry of Health
- Kakamega Ministry of Health
- National Environmental Management Authority

TABLE 13: PMI VECTORLINK KENYA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021
 Population protected by PMI-supported IRS: Total	--	2,011,860	1,792,495	2,083,177
Pregnant women protected	--	44,999	40,727	50,494
Children under 5 protected	--	249,275	211,868	244,948

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021
Structures Sprayed	--	507,777	436,472	497,564
Spray Coverage	--	92.0%	90.4%	97.4%
Insecticide(s)	--	Actellic 300CS, SumiShield 50 WG, piloted at one operation site	Actellic 300CS	Actellic 300CS, Fludora Fusion WP-SB
 Number of people trained to support vector control in target areas	--	6,751 53% female	5,128 50% female	5,813 53% female
Number of people trained to support IRS with USG funds	--	2,974 40% female	2,309 41% female	2,462 41% female
Number of people who completed gender awareness training	--	6,358 54% female	5,039 50% female	5,713 53% female
 Number of sites for vector bionomics monitoring	--	19	14	21
Number of sites for insecticide resistance	--	12	11	8
Number of people trained in entomological monitoring	--	4 0% female	4 ⁰	4 ⁰

PMI VectorLink Liberia

Implementation Period: October 2018–July 2023


1. Programming Highlights

- At the project’s inception, Liberia lacked an insectary for rearing and keeping mosquitoes. PMI VectorLink Liberia supported the conversion of a 40-foot shipping container, known as an “insectary-in-a-box,” in response to this need, advancing the country’s capacity to conduct entomological activities such as durability monitoring.
- The project worked with the Liberia Institute of Biomedical Research (LIBR) to facilitate their capacity to conduct PCR tests to reinforce species identification from the field and expand knowledge on insecticide resistance and bloodmeal host preference of malaria-transmitting vectors.
- The team performed vector bionomics data collection across the country to understand geographical distribution, seasonal trends, and behavior of the main malaria vector in Liberia.
- The team monitored the susceptibility of the malaria vector to different insecticides used to treat ITNs.
- The project completed 36-month durability monitoring survey of Duranet ITNs, and conducted pre-distribution analysis and 12- and 24-month streamlined durability monitoring rounds for Interceptor G2 ITNs.

2. Key Partners

- NMCP
- Liberia Institute of Biomedical Research (LIBR)
- University of Liberia-Atlantic Center for Research and Evaluation Africa Center (UL-PIRE)

TABLE 14: PMI VECTORLINK LIBERIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Number of sites for vector bionomics monitoring	3	4	8	8	8	4
Number of sites for insecticide resistance	8	7	7	7	11	8
Number of people trained in entomological monitoring	8 13% female	8 13% female	8 13% female	8 13% female	8 13% female	8 13% female

PMI VectorLink Madagascar

Implementation Period: January 2018–June 2023





I. Programming Highlights

- PMI VectorLink Madagascar adapted to climate change by using solar panel-operated humidifiers at district and operations sites' warehouses to manage high temperatures for proper and compliant storage of insecticide and IRS materials.
- The project successfully implemented IRS and LSM activities in all intervention districts, through excellent collaboration with the NMP, regional, district, and local authorities during the planning and implementation process of IRS and larval source management campaigns in the intervention districts.
- The project conducted the first larviciding campaign from February 2022 to July 2022 in the Morombe and Ankazobe districts, and a second round of larviciding from November 2022 to March 2023 in Morombe. The implementation of larviciding rice fields with *Bti* using drones in Morombe was conducted with the drone operating company, Aerial Metric, with oversight from the NMP. The teams worked together to plan and supervise proper treatment of selected rice fields located within 1 km of the center of the fokontany in both districts.
- Results from collected malaria entomological indicators in 20 districts of 11 regions helped the NMP make informed decisions to guide vector control programming and identify effective insecticides based on the impact of IRS on vector density, resting and feeding behavior.
- The project conducted a 36-month durability monitoring study, which included ITNs that were distributed during the 2018 campaign in four districts spread geographically across Madagascar: Farafangana on the Southeast coast, Maintirano on the West coast, Bekily in the South, and Fort Dauphin on the Southeast coast. DawaPlus 2.0 ITNs were monitored in Farafangana, Maintirano and Bekily, and PermaNet 2.0 ITNs were monitored in Fort Dauphin. The study districts represented settings with varying climactic conditions and malaria transmission, as well as varying levels of population access to ITNs. At baseline, the study team successfully recruited a total of 1,650 ITNs to study cohorts in each district (including campaign nets reported as lost before the baseline round). For the 36-month round, the study teams visited 517 households across the four districts and recorded 308 cohort ITNs still present (127 in Farafangana, 56 in Bekily, 49 in Maintirano, and 76 in Fort Dauphin).
- The project conducted a streamlined durability monitoring for PermaNet® 3.0, Yahe®, and SafeNet® ITNs in three districts, namely, Toamasina II on East Coast, Mananjary, and Vangaindrano in Southeast. The first round (12-month survey round) of data collection took place between August 14–August 31, 2022, 12 to 13 months after distribution.

2. Key Partners

- NMP/Ministry of Health
- Ministry of Environment
- Ministry of Ministry of Agriculture and Livestock

TABLE 15: PMI VECTORLINK MADAGASCAR RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Population protected by PMI-supported IRS: Total	--	2,232,098	1,150,922	833,483	885,814	886,329
Pregnant women protected	--	85,821	53,287	32,504	32,041	25,650
Children under 5 protected	--	328,092	204,833	138,031	147,119	134,531
Structures Sprayed	--	548,789	267,874	197,787	213,922	198,311
Spray Coverage	--	93.5%	95.8%	97.4%	98.5%	108.7%
Insecticide(s)	--	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, Klypson 500WG
 Number of people trained to support vector control in target areas	--	2,511 22% female	1,663 26% female	1,114 23% female	2,748 25% female	2,448 28% female
Number of people trained to support IRS with USG funds	--	2,511 22% female	1,063 14% female	948 15% female	894 18% female	818 19% female
Number of people who completed gender awareness training	--	27 33% female	319 31% female	249 29% female	244 32% female	227 34% female
 Number of people living in areas with LSM interventions	--	--	--	--	81,237	66,441
Number of hectares treated with LSM	--	--	--	--	7,760	10,754
 Number of sites for vector bionomics monitoring	--	11	12	10	10	24
Number of sites for insecticide resistance	--	13	13	13	11	11
Number of people trained in entomological monitoring	--	--	12 50% female	29 55% female	0	0

PMI VectorLink Malawi

Implementation Period: April 2018–March 2023



I. Programming Highlights



- PMI VectorLink Malawi conducted high-coverage IRS campaigns in Nkhatakota District from 2018-2022.
- The project provided technical assistance to the NMCP on planning, implementation, and supervision of IRS in Balaka, Mangochi and Nkhata Bay Districts.
- With a local institution, provided entomological surveillance and residual efficacy assessments from 2018-2023.
- The project worked with Malaria Alert Centre (MAC) and NMCP to conduct an interim analysis of ITNs and IRS impact evaluation to support NMCP's application for its 2023 Global Fund grant application.
- PMI VectorLink Malawi conducted and completed the baseline and 12-months survey for streamlined durability monitoring of ITNs distributed in 2021.

2. Key Partners

- NMCP
- Malaria Alert Centre
- World Vision Malawi

TABLE 16: PMI VECTORLINK MALAWI RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	
 Population protected by PMI-supported IRS: Total	--	501,324	441,375	453,383	481,075	476,625	
	Pregnant women protected	--	11,066	11,182	10,524	10,795	9,752
	Children under 5 protected	--	90,953	74,173	78,171	91,810	77,473
	Structures Sprayed	--	112,264	107,565	114,196	120,097	119,400
	Spray Coverage	--	94.9%	88.8%	91.0%	92.8%	91.7%
	Insecticide(s)	--	Actellic 300CS	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG
 Population protected by ITNs distributed by VL (estimate)	--	--	8,654	--	--	--	
	Number of ITNs distributed by VL	--	--	4,808	--	--	
	ITN Distribution Channel	--	--	Targeted	--	--	
	Type of ITNs Distributed	--	--	PBO	--	--	

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	Number of people trained to support vector control in target areas	--	1,114 37% female	1,089 42% female	2,717 46% female	2,654 47% female	3,839 49% female
	Number of people trained to support IRS with USG funds	--	575 38% female	565 45% female	639 46% female	677 44% female	705 46% female
	Number of people who completed gender awareness training	--	567 38% female	1,089 42% female	693 48% female	2,635 47% female	3,858 51% female
	Number of sites for vector bionomics monitoring	--	11	15	13	13	13
	Number of sites for insecticide resistance	--	5	6	6	6	6
	Number of people trained in entomological monitoring	--	2 ⁰	0	0	0	5 ⁰

PMI VectorLink Mali

Implementation Period: January 2018–March 2023



I. Programming Highlights


- PMI VectorLink Mali introduced improved supervision and insecticide tracking tools, allowing for early detection of IRS performance gaps and greater local accountability for addressing them.
- The project fostered local ownership and high levels of IRS acceptance among households through strong community and stakeholder engagement, and created the trust, communication, and relationships required to operate safely in a highly unstable security environment.
- PMI VectorLink Mali determined that clothianidin-based IRS and Interceptor G2 nets had a statistically significant protective effect on malaria case incidence and strengthened the NMCP's capacity to analyze and visualize multiple data sources for strategic vector control decision-making.
- The project created the conditions for the appropriate, locally led re-introduction of the IRS by preparing a "transfer package" to guide the NMCP/MOH or any local partner to plan and implement IRS in accordance with the PMI Best Management Practices (BMP).

2. Key Partners

- NMCP/ Ministry of Health
- Direction Nationale de l'Assainissement du Contrôle des Pollutions et des Nuisances (DNACPN), and regional and district health authorities
- Community members (including local government representatives, community leaders, etc.)
- *Laboratoire de Biologie Moléculaire Appliquée (LBMA)*

TABLE 17: PMI VECTORLINK MALI RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Population protected by PMI-supported IRS: Total	665,581	690,793	503,043	233,663	273,831
	Pregnant women protected	20,992	34,484	34,462	17,768	20,728
	Children under 5 protected	93,968	98,217	87,606	45,249	49,996
	Structures Sprayed	160,723	148,198	129,302	61,791	72,106
	Spray Coverage	95.9%	96.7%	96.9%	96.7%	98.0%
Insecticide(s)	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	
	Number of people trained to support vector control in target areas	2,645 22% female	1,362 21% female	1,009 23% female	585 19% female	586 16% female
	Number of people trained to support IRS with USG funds	824 13% female	616 12% female	441 17% female	238 13% female	238 11% female

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Number of people who completed gender awareness training	2,689 22% female	1,017 21% female	814 21% female	631 19% female	632 15% female
	Number of sites for vector bionomics monitoring	7	4	6	8	8
	Number of sites for insecticide resistance	14	14	10	8	8
	Number of people trained in entomological monitoring	18 78% female	18 78% female	15 13% female	18 17% female	19 16% female

PMI VectorLink Mozambique

Implementation Period: March 2018–March 2023




1. Programming Highlights

- Together with Zambezia Provincial Directorate of Health (*Direção Provincial de Saúde*), Zambezia Provincial Health Services (*Serviços Provinciais de Saúde*), District Services for Health, Women and Social Welfare, Ministry of Agriculture and Rural Development (*Ministério da Agricultura e Desenvolvimento Rural*, MADER) and Ministry of Land and Environment (*Ministério da Terra e Ambiente*, MITA), PMI VectorLink Mozambique implemented IRS in six districts in 2018, five in 2020, four in 2021 and two districts in 2022, culminating in the transition of IRS implementation fully to Zambezia province in 2023.
- The project trained Zambezia and Nampula district health personnel to conduct entomological field activities in 12 sentinel sites in Zambezia (10 sites in 2020-21) and 7 sentinel sites in Nampula and supported Nampula province by seconding an entomology coordinator to province and procuring supplies and equipment for Nampula insectary and field activities.
- The project supported the construction of Zambezia province's insectary to replace the one which was destroyed by fire in February 2017.
- PMI VectorLink Mozambique financially supported 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 the National Institute of Health (*Instituto Nacional de Saúde*).
- The project actively participated in IRS Technical Working Group meetings, where a key objective was to harmonize IRS implementation amongst three implementers, NMCP, Tchou Tchou Malaria and PMI VectorLink resulting in the adoption of PMI VectorLink spray data collection form, supervisory tools, and training materials.

2. Key Partners

- NMCP
- *Direção Provincial de Saúde*
- *Serviços Provinciais de Saúde*
- District Services for Health, Women and Social Welfare
- Nampula and Zambezia Provincial Directorates of Health
- Tchou Tchou Malaria
- *Instituto Nacional de Saúde*
- MADER
- MITA

TABLE 18: PMI VECTORLINK MOZAMBIQUE RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	
 Population protected by PMI-supported IRS: Total	--	1,663,078	1,484,191	1,619,088	1,408,179	620,567	
	Pregnant women protected	--	90,089	77,084	85,856	79,410	36,707
	Children under 5 protected	--	237,944	209,747	231,509	189,408	85,649
	Structures Sprayed	--	387,413	338,330	361,820	309,547	142,463
	Spray Coverage	--	94.5%	96.6%	97.0%	96.8%	97.4%
	Insecticide(s)	--	Actellic 300CS, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Ficam	Actellic 300CS, Ficam
 Number of people trained to support vector control in target areas	--	4,093 20% female	3,362 19% female	3,221 20% female	2,911 20% female	1,451 17% female	
	Number of people trained to support IRS with USG funds	--	1,641 23% female	1,446 28% female	1,480 23% female	1,487 24% female	672 21% female
	Number of people who completed gender awareness training	--	1,641 23% female	1,446 28% female	1,516 23% female	1,519 24% female	716 21% female
 Number of sites for vector bionomics monitoring	--	7	7	7	7	6	
	Number of sites for insecticide resistance	--	7	7	7	9	9
	Number of people trained in entomological monitoring	--	1 0% female	0	0	10 30% female	1 0% female

PMI VectorLink Niger

Implementation Period: July 2018–March 2023


1. Programming Highlights

- Trained 20 technicians to do field entomological monitoring using all collection methods both for the vectors bionomics and to determine the status of vector susceptibility to insecticides.
- Strengthened the laboratory capacity of the *Centre de Recherches Médicale et Sanitaire* (CERMES) to perform molecular analyses (PCR and ELISA) of mosquito samples collected in sentinel sites.
- Enabled the country to conduct—for the first time—bio-efficacy tests (in WHO cone and tunnel) for the ITN durability study in 2022, which had previously been done for two years in an external laboratory.

2. Key Partners

- NMCP
- CERMES

TABLE 19: PMI VECTORLINK NIGER RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Number of sites for vector bionomics monitoring	--	6	10	6	6	6
Number of sites for insecticide resistance	--	9	9	15	15	15
Number of people trained in entomological monitoring	--	12 25% female	18 28% female	20 25% female	20 75% female	20 30% female

PMI VectorLink Nigeria

Implementation Period: January 2018–July 2023


1. Programming Highlights

- PMI VectorLink provided trainings and tools to Principal Investigators from 16 institutions in Nigeria to support the generation of data required for vector control decisions at the state level.
- The project supported the development of national harmonized entomology standard operating procedures to guide new and existing partners conducting vector monitoring in the country.
- Insecticide resistance data collected by PMI VectorLink led the National Malaria Elimination Program (NMEP) to deploy new types of ITNs (PBO) for the first time in the country, in Ebonyi State. The project also evaluated the impact of these new ITNs.
- PMI VectorLink provided training and technical assistance to Nigeria Liquefied Natural Gas company to carry out entomological surveillance and insecticide resistant monitoring in Bonny Island. The project also partnered with Nasarawa State University Keffi, procuring lab equipment to expand its malaria laboratory analysis capacity.
- Following the discovery of *An. stephensi* in Gombe State, PMI VectorLink worked with the NMEP to conduct surveillance in seven high-risk states to assess the spread of this invasive species. The project trained more than 50 Principal Investigators and technicians across the country in *An. stephensi* surveillance and identification.
- The team also successfully rolled out mobile data collection for longitudinal entomological surveillance in four sites and instituted a standardized data labeling system for lab samples.
- The project collaborated with local geographic information system firm to carry out an 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.

2. Key Partners

- NMEP
- State Malaria Eliminations Programs
- Nigeria Integrated Vector Management Sub-Committee
- Nigerian Institute for Medical Research
- Nigeria Liquefied Natural Gas Company
- Universities: Abubakar Tafawa Balewa University, University of Uyo, Nasarawa State University Keffi, University of Ibadan, Federal University Gusau, Ebonyi State University-Abakaliki, Usmanu Danfodiyo University, University of Jos, Federal University of Agriculture Makurdi, University of Calabar, Federal University Birin Kebbi

TABLE 20: PMI VECTORLINK NIGERIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Number of sites for vector bionomics monitoring	7	7	5	5	7	7
Number of sites for insecticide resistance	60	69	70	82	92	90
Number of people trained in entomological monitoring	23 30% female	120 25% female	159 20% female	197 6% female	22 27% female	171 26% female

PMI VectorLink Rwanda

Implementation Period: December 2017–March 2023




1. Programming Highlights


- PMI VectorLink Rwanda supported IRS in Nyagatare, Ngoma, and Kirehe Districts as well as Mahama Refugee Camp in Kirehe District.
- The project renovated the existing Malaria and Other Parasitic Diseases Division (MOPDD's) entomology laboratory and procured updated laboratory equipment.
- The project completed a 36-month ITN durability monitoring study in four sites.
- PMI VectorLink Rwanda participated and actively supported all activities of the national Vector Control Technical Working Group.

2. Key Partners

- The Ministry of Health
- Rwanda Biomedical Center
- MOPDD

TABLE 21: PMI VECTORLINK RWANDA RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Population protected by PMI-supported IRS: Total	840,773	1,229,657	1,295,420	1,340,280	1,358,152
	Pregnant women protected	12,131	16,871	17,863	19,507	18,435
	Children under 5 protected	117,878	167,492	175,504	186,521	181,561
	Structures Sprayed	208,026	307,130	327,704	346,277	354,669
	Spray Coverage	99.7%	98.0%	99.7%	99.5%	99.6%
	Insecticide(s)	Actellic 300CS	Fludora Fusion WP-SB	Fludora Fusion WP-SB	Actellic 300CS	Actellic 300CS
	Number of ITNs distributed by partners with VL support	--	--	2,529,206	88,400	--
	ITN distribution channel(s)	--	--	Mass and EPI/ANC		--
	Type of ITNs Distributed	--	--	Standard pyrethroid, PBO	PBO	--
	Number of people trained to support vector control in target areas	4,762 29% female	4,376 40% female	3,585 47% female	7,466 33% female	7,551 32% female
	Number of people trained to support IRS with USG funds	1,710 26% female	2,874 51% female	2,882 50% female	3,080 50% female	3,201 51% female
	Number of people who completed gender awareness training	4,444 29% female	2,874 51% female	2,889 50% female	3,091 51% female	3,214 51% female
	Number of sites for vector bionomics monitoring	19	9	7	7	7

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Number of sites for insecticide resistance	12	4	4	4	4
	Number of people trained in entomological monitoring	66 36% female	60 40% female	66 32% female	66 44% female	0

PMI VectorLink Senegal

Implementation Period: January 2017–March 2023



1. Programming Highlights



- PMI VectorLink Senegal distributed ITNs nationwide through routine distribution channels (health facilities and community-based organizations) from 2020 to March 2023
- The project constructed an insectary and established a modern entomology laboratory including the supply of all needed equipment at University Cheikh Anta Diop (UCAD) in Dakar.
- PMI VectorLink Senegal distributed 7,312 ITNs to 237 Daaras in region of Thiès, reaching 14,524 Daaras residents including 12,187 Talibé children and 2,337 non-Talibé residents living in the Daaras.

2. Key Partners

- *Laboratoire d'Ecologie Vectorielle et Parasitaire* (LEVP) at UCAD
- Development Research Institute (IRD)
- Pasteur Institute of Dakar (IDP)
- NMCP
- Association of Daaras
- Medical Regions and District staff

TABLE 22: PMI VECTORLINK SENEGAL RESULTS AT A GLANCE

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Population protected by PMI-supported IRS: Total	--	--	571,649	556,620	570,283
	Pregnant women protected	--	--	13,575	13,445	14,169
	Children under 5 protected	--	--	95,249	99,323	116,844
	Structures Sprayed	--	--	136,417	141,717	138,752
	Spray Coverage	--	--	98.9%	97.2%	97.5%
	Insecticide(s)	--	--	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG
	Number of people protected by ITNs distributed by VL (estimate)				20,030	14,648
	Number of ITNs distributed by VL			--	10,015	7,324
	ITN distribution channel(s)			Health facility and community	CD	CD
	Number of ITNs distributed by partners with VL support			373,900	1,483,300	1,275,550

Key Result/Indicator		2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
	Type of ITNs Distributed			Standard pyrethroid	Standard pyrethroid, PBO	Standard pyrethroid, PBO
	Number of people trained to support vector control in target areas	--	--	2,791 37.9% female	2,965 37.9% female	2,951 45% female
	Number of people trained to support IRS with USG funds	--	--	828 24% female	915 25% female	914 29% female
	Number of people who completed gender awareness training	--	--	2,811 13% female	2,965 ^o	2,951 45% female
	Number of sites for vector bionomics monitoring	55	49	28	30	24
	Number of sites for insecticide resistance	15	19	17	10	11
	Number of people trained in entomological monitoring	--	--	18 28% female	20 15% female	20 15% female

PMI VectorLink Sierra Leone

Implementation Period: January 2018–July 2023



I. Programming Highlights

- The PMI VectorLink Sierra Leone project successfully implemented IRS in the districts of Bo and Bombali from 2020-2023.
- The project supported the NMCP in the implementation of the Integrated Vector Management (IVM) strategy by creating the IVM-technical working group (IVM-TWG) comprised of various departments from ministries of health, agriculture, and environment; universities; poison and pharmacy board; and the WHO, China CDC.
- Supported NMCP’s operations research activities by evaluating the benefits of combining PBO ITNs and IRS with clothianidin, which will provide evidence not only to Sierra Leone but to other countries including PMI and WHO on the impact of co-deploying the two interventions.
- Made significant achievements in developing entomological capacity in the country since 2018, including the set-up of Sierra Leone’s first insectary in Makeni and Freetown, and the subcontracting and capacity strengthening of a local institution, Njala University, to implement in-country molecular analysis.
- Supported the NMCP to pilot a school-based distribution (SBD) of ITNs to approximately 89,000 pupils in 531 primary schools across Kono district in classes 1, 3, and 5 in March and April 2023. In June and July, approximately one to two months after the SBD, an assessment was conducted to document the extent to which the SBD was implemented according to guidelines, identify intervention strengths and weaknesses, and to determine household and population-levels of ITN access and population-level ITN use.

2. Key Partners

- NMCP/ Ministry of Health
- District Health Management Teams
- Njala University

TABLE 23: PMI VECTORLINK SIERRA LEONE RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Population protected by PMI-supported IRS: Total	--	--	--	672,696	652,232	753,214
Pregnant women protected	--	--	--	26,604	19,528	29,738
Children under 5 protected	--	--	--	111,103	97,675	110,320
Structures Sprayed	--	--	--	150,895	143,509	159,013
Spray Coverage	--	--	--	93.8%	96.5%	92.6%
Insecticide(s)	--	--	--	SumiShield 50 WG	SumiShield 50 WG	Actellic 300CS, SumiShield 50 WG
 Number of people trained to support vector control in target areas	--	--	--	1,992	2,798 28.7% female	5,281 33.9% female

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
Number of people trained to support IRS with USG funds	--	--	--	1,223 26% female	1,206 45% female	1,125 27% female
Number of people who completed gender awareness training	7 14% female	7 14% female	12 25% female	1,536 28% female	1,971 26% female	5,281 67% female
Number of sites for vector bionomics monitoring	8	8	16	16	10	10
Number of sites for insecticide resistance	4	4	10	6	10	8
Number of people trained in entomological monitoring	18 6% female	21 19% female	31 19% female	26 19% female	130 2% female	50 10% female



PMI VectorLink Tanzania

Implementation Period: June 2018–June 2023





1. Programming Highlights

- PMI VectorLink Tanzania successfully completed five rounds of spraying operations in selected districts in Mwanza, Kagera, Kigoma, and Geita Regions and protected up to 2,404,010 Tanzanians per year against malaria. The project maintained and achieved coverage and progress rates that exceeded the 85% target.
- In Kigoma Region, the project 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 2019, reaching a population often unreached by national malaria control efforts, due to access and security issues. In 2021, PMI VectorLink transitioned leadership to the District IRS Technical Teams to lead the spraying in these camps, with the project team providing support through the provision of supervisory tools and assistance with the recruitment process.
- PMI VectorLink Tanzania strengthened the capacity of the NMCP and ZAMEP staff to plan, implement, and supervise IRS in the targeted districts through supportive and increasingly autonomous supervision. Additionally, focus was put on the NMCP's and ZAMEP's capacity to develop and use dashboards to help decisions making related to vector control interventions and support program planning, targeting, and evaluation.
- The project distributed 1,545,985 ITNs through two channels:
 1. Health facility-based distribution: PMI VectorLink provided technical and direct service delivery support to ZAMEP to distribute 288,000 PBO ITNs in 179 health facilities in Zanzibar.
 2. School-based distribution: PMI VectorLink distributed 1,257,985 PBO ITNs through 3,158 schools in 30 councils across the regions of Mwanza, Gieta, Kigoma, and Kagera on mainland Tanzania. A report from the Basic Education Management Information System (BEMIS) indicated a total of 1,173,941 pupils (49.8% boys; 50.2% girls) received ITNs through School Net Program 7 (SNP7), reaching 93% of target pupils (source: BEMIS ITNs report; January 3rd, 2020).

2. Key Partners

- NMCP/Ministry of Health
- President's Office, Regional Administration and Local Government Tanzania
- National Environment Management Council
- Tropical Pesticides Research Institution
- National Institute for Medical Research
- Regional- and District-level government authorities
- Ward and Village Executive Officers

TABLE 24: PMI VECTORLINK TANZANIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	
 Population protected by PMI-supported IRS: Total	--	2,404,010	1,915,151	2,285,089	2,081,886	945,879	
	Pregnant women protected	--	78,203	56,964	82,057	76,358	39,464
	Children under 5 protected	--	436,700	373,976	433,985	394,668	183,324
	Structures Sprayed	--	595,923	471,622	598,973	568,484	241,470
	Spray Coverage	--	95.4%	93.7%	93.3%	93.0%	94.9%
	Insecticide(s)	--	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG
 Population protected by ITNs distributed by VL (estimate)	--	--	10,230,392	7,184,538	--	--	
	Number of ITNs distributed by VL	--	--	5,683,551	3,592,269	--	--
	ITN distribution channel(s)	--	--	School, health facility, community	School, health facility, community	--	--
	Type of ITNs Distributed	--	--	Standard pyrethroid, PBO	Standard pyrethroid, PBO	--	--
 Number of people trained to support vector control in target areas	--	3,849 35% female	4,164 44% female	5,103 40% female	4,264 45% female	1,714 44% female	
	Number of people trained to support IRS with USG funds	--	2,899 39% female	3,182 48% female	3,788 46% female	3,069 53% female	1,236 52% female
	Number of people who completed gender awareness training	--	3,883 35% female	4,197 44% female	5,136 40% female	4,294 45% female	1,714 44% female
 Number of sites for vector bionomics monitoring	--	-	--	--	--	3	
	Number of sites for insecticide resistance	--	--	--	--	0	
	Number of people trained in entomological monitoring	--	--	--	--	--	0

PMI VectorLink Uganda

Implementation Period: September 2017–July 2023



1. Programming Highlights


- PMI VectorLink Uganda conducted six IRS rounds and annually sprayed between 774,153-1,395,569 structures, attaining an average coverage of 94% each year.
- The project strengthened the capacity of different cadres of national and district stakeholders to plan, conduct, and monitor effective IRS campaigns and support vector control and surveillance activities.
- The project renovated the insectary at the MOH Vector Control Division and established three other insectaries at Gulu University, Tororo referral Hospital, and Muni University.

2. Key Partners

- MOH/NMCD
- Communication for Development Fund Uganda (CDFU)
- Infectious Diseases Research Collaboration (IDRC)

TABLE 25: PMI VECTORLINK UGANDA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Population protected by PMI-supported IRS: Total	4,436,156	4,479,157	4,938,643	4,466,905	3,894,239	3,235,862
Pregnant women protected	121,590	119,077	110,170	127,711	110,534	87,142
Children under 5 protected	892,390	862,536	756,617	832,250	724,448	558,168
Structures Sprayed	1,292,309	1,291,569	1,395,569	1,294,515	1,104,083	774,173
Spray Coverage	94.4%	92.7%	94.6%	93.3%	92.9%	92.2%
Insecticide(s)	Actellic 300CS	Actellic 300CS, SumiShield 50 WG	Actellic 300CS, Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB	Fludora Fusion WP-SB, SumiShield 50 WG	Actellic 300CS, Fludora Fusion
 Number of people trained to support vector control in target areas	8,463 28% female	8,580 28% female	9,232 26% female	8,636 27% female	6,569 29% female	4,639 29% female
Number of people trained to support IRS with USG funds	8,463 28% female	8,580 28% female	9,232 26% female	8,636 27% female	6,125 28% female	4,006 30% female
Number of people who completed gender awareness training	8,463 28% female	8,580 28% female	10,763 31% female	8,251 35% female	6,569 27% female	4,639 29% female

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Number of sites for vector bionomics monitoring	6	6	6	6	6	4
Number of sites for insecticide resistance	5	8	3	6	11	11

PMI VectorLink Zambia

Implementation Period: April 2018–March 2023

1. Programming Highlights

- PMI VectorLink Zambia conducted five successful IRS campaigns, maintaining strong working relationships with district and provincial stakeholders. In 2022, 45% of spray actors were female.
- PMI VectorLink assessed distribution of ITNs through routine distribution (ANC/EPI) in 16 districts and ITN repurposing and misuse in 9 fishing communities across 3 provinces, guiding the NMEP’s ITN strategy.
- The project developed and presented integrated data visualizations to the NMEP each year to inform the insecticide and nets to deploy, and helped establish a national entomology database.

2. Key Partners

- NMEP
- International Centers for Excellence in Malaria Research
- Tropical Disease Research Center
- Konkola and Mopani Copper Mines
- Zambia Environmental Management Agency
- Akros




TABLE 26: PMI VECTORLINK ZAMBIA RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023 ²
Population protected by PMI-supported IRS: Total³	--	2,818,176	2,273,188	2,776,336	3,032,558	2,484,465 14,096
Pregnant women protected	--	89,959	50,100	73,959	94,511	76,638 535
Children under 5 protected	--	411,416	318,396	391,438	416,039	332,300 1,906
Structures Sprayed	--	579,490	536,983	648,914	717,351	619,328 2,430
Spray Coverage	--	89.9%	90.0%	96.5%	97.0%	99.3% 98.7%
Insecticide(s)	--	Actellic 300CS, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG	Fludora Fusion WP-SB, SumiShield 50 WG, Klypson, 2GARD



² The Nchelenge mini-campaign results, which took place in April 2022, are included on the second row for relevant indicators. These results are not included in the overall figures since the campaigns took place at different times.

³ There were version control issues with the MEPs for the 2018/2019 and 2019/2020 years; the figures presented here are correct but may not match what is in the EOSR MEPs.

	Number of ITNs distributed by partners with VL support	--	--	--	2,101,403	51,434	--
	ITN distribution channel(s)	--	--	--	Mass		--
	Type of ITNs Distributed	--	--	--	Standard pyrethroid, PBO	PBO	--
	Number of people trained to support vector control in target areas	--	2,006 27% female	9,897 24% female	14,766 42% female	24,272 47% female	17,232 48% female
	Number of people trained to support IRS with USG funds	--	2,089 31% female	2,120 33% female	2,576 43% female	2,846 38% female	2,121 46% female
	Number of people who completed gender awareness training	--	2,370 33% female	2,360 33% female	2,896 43% female	3,188 38% female	2,414 45% female
	Number of sites for vector bionomics monitoring	--	14	14	14	14	8
	Number of sites for insecticide resistance	--	16	4	9	8	8
	Number of people trained in entomological monitoring	--	24 33% female	213 22% female	22 27% female	14 29% female	0

PMI VectorLink Zimbabwe

Implementation Period: March 2018–February 2023



I. Programming Highlights


- PMI VectorLink Zimbabwe established the Malaria Research and Insectary at Africa University in October 2020 and strengthened their staff’s entomological capacity through material and technical support in the laboratory as well as on-site entomological trainings covering molecular methods, insectary management, insecticide resistance, and mosquito species identification of malaria-transmitting mosquitoes.
- The project implemented a full package of IRS support in two districts of Mashonaland East Province (Mudzi and Mutoko) from 2018 to 2020. From 2021 to 2022, the project provided IRS technical and limited material support to five districts of Mashonaland East Province (Mudzi, Mutoko, UMP, Murehwa, and Goromonzi), with a focus on strengthening local capacity in IRS management and operations.
- The project conducted entomological surveillance to understand malaria vector behavior and trends in targeted sites throughout Zimbabwe.
- PMI VectorLink Zimbabwe developed standard operating procedures (SOPs) to strengthen the Government of Zimbabwe IRS data management.

2. Key Partners

- NMCP
- Africa University
- Provincial Health Team
- District Health Team

TABLE 27: PMI VECTORLINK ZIMBABWE RESULTS AT A GLANCE

Key Result/Indicator	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
 Population protected by PMI-supported IRS: Total	--	276,343	307,209	315,403	--	--
Pregnant women protected	--	3,846	5,010	4,620	--	--
Children under 5 protected	--	43,789	48,047	49,029	--	--
Structures Sprayed	--	112,805	131,191	133,078	--	--
Spray Coverage	--	90.1%	93.9%	97.3%	--	--
Insecticide(s)	--	Actellic 300CS	Actellic 300CS, Fludora Fusion WP-SB	Fludora Fusion WP-SB	--	--
 Number of people trained to support vector control in target areas	--	385 40% female	400 25% female	456 25% female	308 20% female	248 21% female
Number of people trained to support IRS with USG funds	--	295 21% female	430 28% female	319 25% female	240 20% female	200 23% female

	Number of people who completed gender awareness training	--	385 40% female	417 25% female	471 28% female	--	--
	Number of sites for vector bionomics monitoring	--	4	6	4	3	3
	Number of sites for insecticide resistance	--	7	4	5	3	4
	Number of people trained in entomological monitoring	--	35 17% female	41 20% female	7 43% female	29 34% female	61 26% female

ANNEX **B** KEY PERSONNEL



For questions and further information:

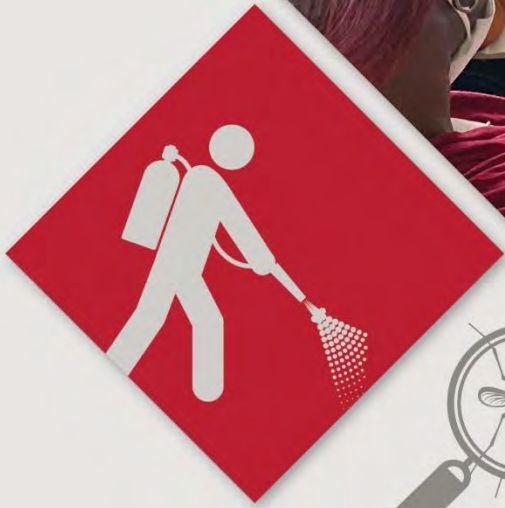
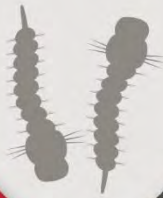
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PEER REVIEWED JOURNAL ARTICLES



- [Urban malaria vector bionomics and human sleeping behavior in three cities in Senegal](#), *Parasites & Vectors*, September 2023
- [Process and methodological considerations for observational analyses of vector control interventions in sub-Saharan Africa using routine malaria data](#), *The American Journal of Tropical Medicine and Hygiene*, August 2023
- [Measuring quality of facility-based ITN distribution in Ghana | SpringerLink](#), *Malaria Journal*, August 2023
- [Successful implementation of ITN distribution through health facilities in Ghana | SpringerLink](#), *Malaria Journal*, August 2023
- [Using routine health data to evaluate the impact of indoor residual spraying on malaria transmission in Madagascar](#), *BMJ Global Health*, July 2023
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- [Countrywide insecticide resistance monitoring and first report of the presence of the L1014 knockdown resistance in Niger, West Africa](#), *Malaria Journal*, December 2022
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- [Genetic diversity of *Anopheles stephensi* in Ethiopia provides insight into patterns of spread](#), *Parasites & Vectors*, December 2021
- [Partial indoor residual spraying with pirimiphos-methyl as an effective and cost-saving measure for the control of *Anopheles gambiae* s.l. in northern Ghana](#), *Scientific Reports*, September 2021
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- [PMI VectorLink Study Points to New Avenues for Malaria Control Strategy in Cote d’Ivoire](#), *Malaria Journal*, December 2020
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- [*Anopheles gambiae* \(s.l.\) exhibit high intensity pyrethroid resistance throughout Southern and Central Mali \(2016–2018\): PBO or next generation LLINs may provide greater control](#), *Parasites & Vectors*, May 2020

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- [Indoor residual spraying for malaria control in sub-Saharan Africa 1997 to 2017: an adjusted retrospective analysis](#), *Malaria Journal*, April 2020
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- [Susceptibility testing of *Anopheles* malaria vectors with the neonicotinoid insecticide clothianidin; results from 16 African countries, in preparation for indoor residual spraying with new insecticide formulations](#), *Malaria Journal*, Aug 2019

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