Technical Brief

Data Drives Decisions in Vector Control

Strong Entomological Monitoring Leads to Evidence-Based Decision Making

The U.S. President's Malaria Initiative (PMI) delivers vector control interventions and protects millions of people from contracting malaria through its PMI VectorLink Project. An integral part of the project is robust entomological monitoring to help enable entomologists to identify which mosquitoes carry the malaria parasite, the relative geographical and temporal distribution of the mosquitoes transmitting malaria, and the feeding and resting habits of the vector. PMI VectorLink monitors the quality of indoor residual spraying (IRS) and the durability and bio-efficacy of insecticide-treated nets (ITNs). Monitoring also helps to determine which insecticides are effective against the target mosquito population and to assess the impact of IRS and ITNs on mosquito densities, behavior, and infection rates. Insecticide resistance (IR) data is also routinely collected and is made public through the IR Mapper, an online data platform, which consolidates reports of insecticide resistance in malaria vectors onto filterable maps to inform vector control strategies.

What Data Are Collected?

Vector Abundance and Behavior

Knowing and understanding the malaria vector density, longevity, and resting and feeding behavior is essential for effective vector control planning. PMI VectorLink entomologists work with local government entities, research institutes and universities to collect such information from both intervention and control villages. The data are mainly used to assess the impact of vector control interventions on vector species composition, density, behavior, longevity and infectivity.

Insecticide Resistance

Data on the susceptibility of vectors to potential insecticides is routinely collected, analyzed, and presented to local government and in-country partners to inform selection of insecticide for IRS and procurement of ITNs. PMI VectorLink also uses World Health Organization (WHO) tube tests and Centers for Disease Control and Prevention bottle bioassays to determine the intensity of resistance to pyrethroid insecticides, by exposing mosquitoes to 5x or 10x the discriminating concentration, the results of which may indicate or predict operational failure depending on the strength of resistance detected. Synergist bioassays are conducted to determine whether next generation ITNs with piperonyl butoxide (PBO) synergist would provide better levels of control in areas of intense pyrethroid resistance.

Spray Quality Assurance

Using WHO cone bioassay tests, PMI VectorLink conducts testing in the first week of spraying to assess the quality of IRS and subsequently monitor residual bio-efficacy. Any cases with less than 98% mortality of

susceptible mosquitoes within one week of spray is investigated and corrective measures implemented immediately. This could be in the form of adjusting faulty equipment or retraining of spray operators.

Monitoring the Residual Life of Insecticides

Each month following the spray, cone bioassay data continues to be collected to determine whether the insecticide has remained effective on sprayed surfaces. The project also monitors the insecticidal activity of ITNs at six- to 12-month intervals to determine the bio-efficacy of the insecticides used to treat the nets. This is critical for quality assurance of ITNs and informs time for re-application of IRS and replacements of nets.

Net Durability Monitoring

PMI VectorLink is supporting net durability monitoring activities in a number of project countries. Specifically, PMI VectorLink is undertaking the bio-efficacy test of nets at 6, 12, 24- and 36-months post-distribution of ITNs in several countries. Most of the net monitoring activities currently involves new products designed to kill vectors resistant to pyrethroid insecticides. Tests on such nets depend on the availability of a pyrethroid-resistance colony of malaria vectors. For example, a container setup for rearing and maintaining a resistance colony to be used for these bio-efficacy tests has been completed in Ghana.

How Are the Data Managed and Shared?

PMI VectorLink prioritizes the generation and use of high-quality entomological data. This is promoted through the use of standardized data collection methodologies, robust analyses, and the recent roll-out of a comprehensive database to manage and analyze diverse streams of data described above.

Entomological data collected by the PMI VectorLink Project is regularly shared with stakeholders and partners through different dissemination forums. These include directly sharing annual reports with NMCPs, presenting findings at local and international vector control working group meetings, international conferences, such as the American Society of Tropical Medicine and Hygiene and Pan African Mosquito Control Association, and publications at peer reviewed journals. Annual reports are also posted at www.pmi.org. Insecticide resistance data is shared with WHO on annual basis and contributes significantly to data presented in the Malaria Threat Map and world malaria reports.

VectorLink Collect, DHIS2 for Entomology

PMI has developed DHIS2-based instances to manage important entomological data and indicators: insecticide resistance, cone bioassay, and vector bionomics. This system, VectorLink Collect, uses web-based cloud capacities to allow for easy real-time sharing of information within the country and with the home office, which can be used for further analysis, evaluation, and feedback. Using a platform, DHIS2, which is already supported in the countries where we work, aligns with a focus on supporting national priorities and systems, and supports PMI's priority of improved and sustained capacity to use data for decision making.

The database also allows for integrated, detailed and comparable analysis of the entomology data from multiple countries and enables PMI to contribute to the global and/or regional entomological evidence base. Further, VectorLink Collect provides a unique opportunity for PMI-funded IRS and entomological data to be managed in a single platform to drive complex integrated vector control decisions.

Building Capacity

Trained and well-experienced entomologists in malaria control programs are key to establishing a strong entomological monitoring system. Where possible, VectorLink hires trained entomologists to coordinate and lead entomological activities in the project countries. In countries lacking trained entomologists, such as Mozambique, high school graduates interested in entomology are recruited locally. Extensive training is provided on basic entomological monitoring, with a focus on practical demonstrations and field exercises. Recruits are supplied with the necessary equipment and deployed to conduct field work under the direct supervision of experienced entomologists before being allowed to work independently. Continuous assessment, technical support, and on-the-job training are provided.

Regional molecular entomology training courses were conducted in Tanzania and Benin by the project with assistance from the CDC and the University of Notre Dame, with participants from 17 countries. This training strengthened data quality for determining the proportion of *Anopheles* mosquitoes infected with malaria sporozoites and for conducting molecular mosquito species identification.

In Angola, Liberia, Mali, and DRC insectaries (infrastructure for rearing and keeping mosquitoes) were lacking. PMI took innovative measures to overcome this challenge, converting 40-foot shipping containers into insectaries (Insectary-in-a-Box). These insectaries provided an optimal environment for rearing and keeping of mosquitoes; testing; and identification, dissection and preserving mosquitoes for further analysis.

PMI VectorLink has a specific focus on building capacity of NMCPs to make evidence-based malaria control decisions. We have made considerable progress in ensuring that NCMP stakeholders have access to VectorLink Collect. We are demonstrating to stakeholders that the use of digital solutions is critical to support timely malaria control decisions, and achievable at scale.

Moving Forward

PMI VectorLink provides the information governments and stakeholders need to ensure IRS, ITNs and other vector control strategies are effective and efficient. Strong data combined with increased capacity of local governments to implement vector control is helping to reduce the incidence of malaria.

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