Report of the 20th Annual RBM Vector Control Working Group (VCWG) Meeting

3-5 March 2025
Golden Tulip Hotel, Cotonou, Benin

Empowering local leadership for optimal malaria vector control impact

The annual meeting offers a platform for the malaria vector control community to share the latest best practices and research relevant to current and future malaria vector control operations. The activities of the dedicated Work Streams, which focus on their work plans, are complemented by plenary sessions and panel discussions. During the meeting, the Work Stream Co-Leads and the Co-Chairs of the Working Group ratify the main projects and present the next steps and way forward.



Co-Chairs: Corine Ngufor & El Hadji Amadou Niang
Coordinator: Johanna Stenstrom
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Executive Summary

20th Annual RBM Vector Control Working Group (VCWG) Meeting
3–5 March 2025 | Cotonou, Benin

The 20th VCWG annual meeting brought together over 200 participants from 40 countries to reflect on two decades of progress and to chart a practical path forward for malaria vector control. Under the theme "Empowering Local Leadership for Optimal Vector Control Impact," the meeting focused on sharing new research, reviewing country experiences, and identifying solutions to current challenges including insecticide resistance and reduced funding for global health, including domestic mobilization.

Key Themes and Discussions:

- **Improving Existing Tools (ITNs and IRS)**

Countries reported continued challenges with the durability and effectiveness of insecticide-treated nets (ITNs). New dual-active ingredient nets, especially those containing chlorfenapyr, are being widely adopted but come at higher cost. With Indoor Residual Spraying (IRS) declining due to budget constraints, discussions focused on ensuring resistance monitoring keeps pace. Progress was shared on setting proper test concentrations for new insecticides like broflanilide, and on tools such as the Resistance to Damage (RD) score to assess net quality.

- **New Tools and Technologies**

Promising innovations include solar-powered mosquito traps, gene drive mosquitoes, and AI-assisted mosquito identification tools. Presenters stressed the need for clear regulatory guidance, evidence from field trials, and stakeholder engagement to integrate these tools effectively into national programs.

- **Integrated Approaches and Country Examples**

Countries like Nigeria and Ethiopia shared experiences linking agriculture, urban planning, and health systems to strengthen malaria control. The rise of *An. stephensi* in urban areas and malaria in humanitarian settings (e.g., Refugees and/or Displaced people camps in South Sudan and northern Nigeria) highlighted the importance of local adaptation and preparedness of malaria control interventions under humanitarian emergencies contexts.

- **Focus on Local Leadership and Sustainability**

A dedicated roundtable examined how to strengthen in-country leadership, improve local manufacturing of vector control products, and mobilize domestic resources. Benin's progress and future strategy were featured as a national example of combining evidence-based interventions with strong coordination and local accountability.

- **Way Forward**

The VCWG affirmed its commitment to supporting countries with the tools and evidence needed to make effective, locally led decisions. Priorities include improving data use for planning, scaling innovations responsibly, strengthening resistance management, and promoting more sustainable financing models. Continued collaboration across sectors and countries will be essential to protect the gains made and move closer to malaria elimination.

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Abbreviations

AI	Active Ingredient
ARMPC	Advocacy, Resource Mobilisation, and Communication Partner Committee
Bti	Bacillus thuringiensis israelensi
CAB	Community Advisory Board
CDF	Community Development Fund
CFP	ChlorFenaPyr
CHWs	Community Health Workers
CPS	Chemoprevention of Seasonal Malaria
CREC	Centre de Recherche Entomologique de Cotonou
CRSPC	Country and Regional Support Partner Committee
CSO	Civil Society Organisations
DC	Discriminating Concentration
DD	Discriminating Doses
ERP	Expert Review Panel
GC7	Grant Cycle 7
GC8	Grant Cycle 8
GDG	Guidelines Development Group
GMP	Global Malaria Program
GVCR	Global Vector Control Response
HCD	Human-Centred Design
HPLC	High-performance liquid chromatography
I-ACT	Ifakara Ambient Chamber Tests
IPTp	Intermittent Preventive Treatment in Pregnancy
IRS	Indoor Residual Sprays
ITN	Insecticide Treated Net
IVCC	Innovative Vector Control Consortium
IVM	Integrated Vector Management
IVM	Integrated Vector Management
JMPS	Joint Meeting on Pesticide Specifications
KPIs	Key Performance Indicators
LSM	Larval Source Management
MBS	Malaria Behaviour Survey
MEAL	Monitoring, Evaluation, And Learning
MoH	Ministry of Health
MSWG	Multi-Sectoral Action Working Group
NMCP	National Malaria Control Program
NMEP	National Malaria Eradication Program
PacMOSSI	Pacific MOSquito Surveillance Strengthening
PAHO	Pan American Health Organization's
PBO	Piperonyl ButOxide
PCR	Polymerase Chain Reaction
PDC	Preliminary Discriminating Concentration
PQT	PreQualification Unit
PY	PYrethroid
QC	Quality Control
RCT	Randomized Controlled Trial
RD	Resistance to Damage
RDC	Residence District Commisioner
SBC	Social and Behaviour Change
SMC	Seasonal Malaria Chemoprevention
SR	Spatial Repellents
SSA	Sub-Saharan Africa
TAG-VCPR	Technical Advisory Group for Vector Control Products
TT	Task Teams
USAID	U.S. Agency for Internal Development
USM	University Sains Malaysia
VC	Vector Control
VCAG	Vector Control Advisory Group
VCNAs	Vector Control Needs Assessments
VCP	Vector Control Product
VCRI	Vector Control and Insecticide Resistance
VCWG	Vector Control Working Group
WGs	Working Groups
WHO	World Health Organization
WHOPAR	WHO Public Assessment Report

Session 1: Introductions, Objectives and Key Updates

Welcome

Corine Ngufor, RBM VCWG co-chair and El Hadji Amadou Niang, RBM VCWG co-chair

Corine Ngufor opened the 20th annual Vector Control Working Group (VCWG) meeting by welcoming participants and acknowledging the significance of this milestone. She noted that this was the first time the meeting was held in Cotonou and expressed optimism for a productive gathering despite ongoing financial challenges in the global health landscape. Corine highlighted that many members funded by U.S. Agency for Internal Development (USAID) were unable to attend due to funding constraints.

Reflecting on the past two decades, Corine Ngufor celebrated not only the progress in malaria vector control but also the dedication, resilience, and passion of those involved in the programme. She underscored this year's theme: ***Empowering Local Leadership for Optimal Vector Control***.

Corine Ngufor also referenced the previous year's meeting, which brought together 200 participants from 33 malaria-affected countries, with the report available on the VCWG website. https://endmalaria.org/our-work-working-groups/vector-control. She announced a change in VCWG's coordination. After 20 years of dedicated leadership, Konstantina Boutsika has stepped down as coordinator and moved on to a new role with RBM Secretariat as Working Group Specialist, with Johanna Stenstrom taking over the VCWG's coordination role.

Recap of key achievements in 2024:

1. Restructuring of the VCWG – reduced number of Task Teams from 4 to 3 and created cross-cutting themes
2. Established a 5-year workplan for the VCWG
3. Participated in RBM board meetings, virtual in June 2024 and in person in Colombia in December 2024
4. Participated in Country and Regional Support Partner Committee (CRSPC) meetings in Zambia and Ghana
5. Organised multiple workshops, webinars etc on key themes e.g. private sector engagement, Vector Control (VC) in humanitarian emergencies, Insecticide Treated Net (ITN) quality etc
6. Contributed in the RBM strategy – Geneva in October 2024

Objectives and Structures

Purpose:

- To align RBM partners on best practices to reach and maintain universal coverage with effective vector control interventions.
- To support the implementation of Vector Control Guidance generated by World Health Organization (WHO) and to galvanise efforts towards achieving specific country and global malaria elimination targets.
- To convene, coordinate and facilitate communication between the diverse members of the Working Group including national programmes, product manufacturers, academia, implementers, policy makers, multi-laterals and Civil Society Organisations (CSO).

Updated VCWG structure with cross-cutting themes identified (Figure 1 and 2).

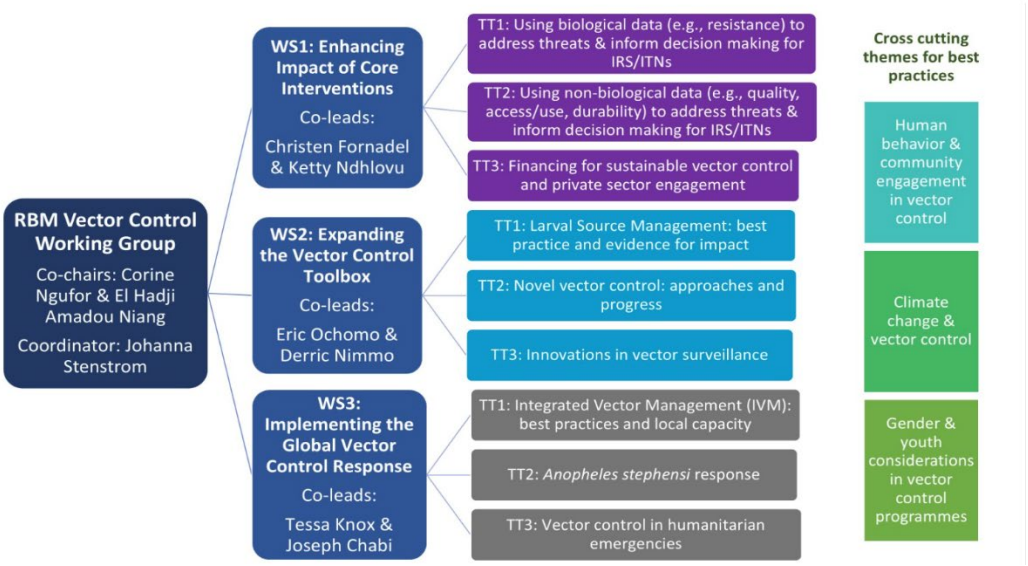


Figure 1: Structure of VCWG work streams

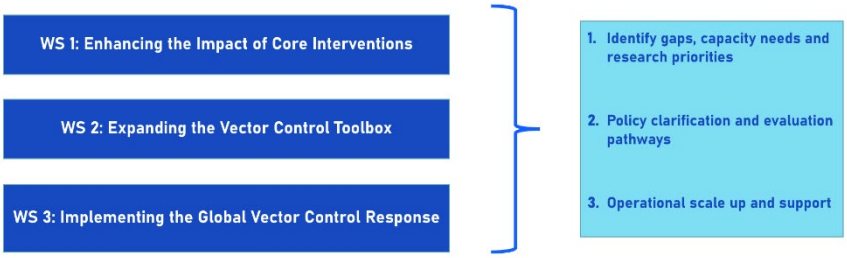
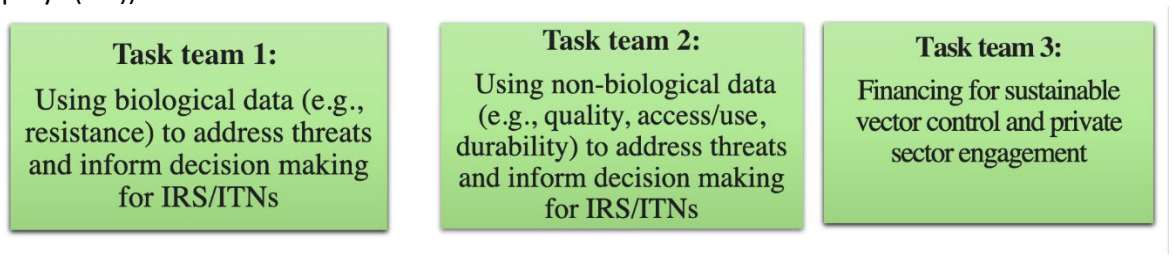
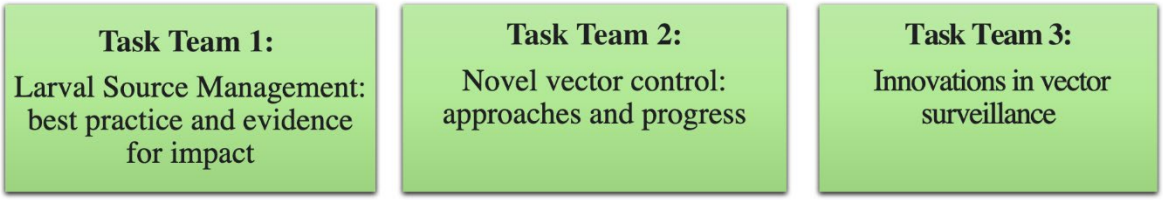


Figure 2: Objectives of VCWG work streams

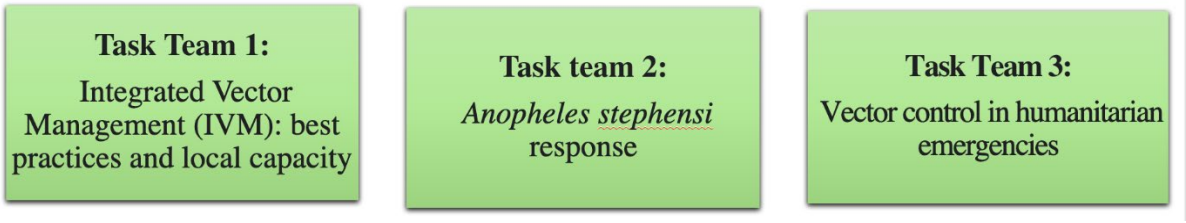
Work Stream 1: Workstream 1: Enhancing the Impact of core interventions (ITNs and Indoor residual sprays (IRS)):



Work stream 2: Expanding the vector control toolbox:



Work stream 3: Implementing the Global Vector Control Response:



Overview of Agenda and Objectives for VCWG-20

Corine Ngufor, VCWG co-chair

Corine Ngufor began with a brief overview of the meeting structure and key highlights. A total of 208 participants from 40 countries registered for the event, indicating a strong turnout. The agenda was outlined, covering activities from Monday to Wednesday, with further details available on the Attendee app.

Housekeeping instructions were provided, including information on newsletters and app access for scheduling and updates throughout the meeting. Additionally, participants were informed about a joint 20th-anniversary celebration for RBM/VCWG and Innovative Vector Control Consortium (IVCC), recognising two decades of impactful vector control efforts towards malaria elimination. This celebration was scheduled to take place following the conclusion of the Day 1 agenda.

Corine Ngufor began by expressing gratitude to the sponsors of the VCWG meeting, acknowledging their crucial support in enabling the event's success. She highlighted the generous funding from the Swiss Agency for Development and Cooperation through the GlobMal Phase 4 project at Swiss TPH, which facilitated the participation of selected malaria-affected country representatives. Additionally, she recognised the valuable contributions of organisations participating in the Exhibition Fair. Corine Ngufor encouraged attendees to engage actively in the exhibitor pitches and explore the showcased innovations and solutions.

Opening Remarks

HE Prof Imorou Batt Chabi Ali, Secretary General, Minister of Health, Benin

The session began with a warm welcome to all participants, including representatives from IVCC, Gates, Unitaid, and the National Malaria Control Programs. The speaker emphasised the need to optimise the impact of vector control efforts and drive significant change by integrating vector control programmes effectively. The importance of introducing new tools to enhance malaria prevention was also highlighted. The speaker concluded with a heartfelt welcome from the people of Benin and a message of unity and hope: "Long live Africa."

Dr. Michael Charles, CEO, RBM Partnership to End Malaria

Dr. Charles expressed regret for being unable to attend due to ongoing constraints. He highlighted this year's theme: ***Empowering Local Leadership for Malaria Impact***, recognising 20 years of malaria progress driven by steadfast support for vector control implementation guided by WHO.
He acknowledged the collective achievement of preventing 80% of malaria cases and deaths through interventions like ITNs and IRS. Despite this success, he stressed that global targets for 2030 remain off track, citing key challenges such as vector control issues, conflicts, climate change, and insecticide resistance, the emergence of *Anopheles stephensi,* which is altering mosquito dynamics and behaviour, and most importantly the current funding constraints.

Dr. Charles called for unified efforts to optimise resources and strengthen partnerships to ensure coordinated action and collaboration. He emphasised the urgent need to enhance localisation, fundraising, and local leadership, particularly through local manufacturing, to sustain progress and drive malaria elimination efforts.

He stressed the importance of continuing to innovate, brainstorm, and collaborate to achieve these goals. Special thanks were extended to co-chairs Corine Ngufor and El Hadji Amadou Niang, along with coordinator Johanna Stenstrom, for their dedication and impact. Dr Charles concluded by expressing gratitude to all participants and anticipation for the positive outcomes of their discussions.

Progress Towards Malaria Elimination in Benin

Dr. Codjo Dandonougbo, NMCP Benin

Malaria remains a significant public health concern in Benin, ranking 15th for malaria cases and 18th for malaria-related deaths globally. It is the leading cause of consultations and hospitalizations, with over 2 million cases reported in 2023. Malaria is particularly severe among children under five, representing 38.2% of consultations and 21% of deaths of all age groups. In 2024, Benin reported 1.75 million total cases, with a rate of 135 cases per 1,000 inhabitants. Malaria's impact extends beyond health, affecting life expectancy, education, and family productivity and health. It remains a significant barrier to social and economic development in the country.

Benin's PSNIE 2024-2030 strategy outlines key interventions to enhance malaria control. The strategy focuses on robust interventions, increased funding, and efficient resource-sharing mechanisms. It is built around three core areas: prevention, case management, and governance strengthening.

Benin's prevention strategies include the implementation of Seasonal Malaria Chemoprevention (SMC), targeting 5 districts with 5 intervention cycles, aiming to achieve 85% supervision coverage and reach 41% of the population. For pregnant women, Intermittent Preventive Treatment in Pregnancy (IPTp) will ensure they receive at least 4 supervised SP doses starting from the 16th week of pregnancy until delivery to reduce the risk of malaria for both mother and baby. The RTS,S malaria vaccine pilot began in April 2024 in three health zones, with plans to expand coverage to 8 out of 12 districts by February 2025, targeting 111,913 children under 11 months annually. Environmental strategies are also being introduced, including road asphalting, waste management, and sanitation improvements in urban areas. Vector control measures will focus on distributing Long-lasting Insecticidal Nets (LLINs) and implementing larval source management (LSM) in northern communes.

Between 2022 and 2024, Benin achieved notable improvements in malaria control. Malaria incidence in health facilities decreased from 21.5% to 13.5%, while malaria cases in children under five dropped from 49.7% to 25.7%. The quality of case management improved significantly, with 99.3% of suspected malaria cases being tested and 98.3% of confirmed cases receiving appropriate treatment. Stock management for essential malaria supplies maintained an average availability of 92-94%, ensuring continuity in care. Additionally, the percentage of pregnant women receiving 3+ IPTp doses increased from 49% to 55% during this period.

Despite progress, several challenges remain. Low healthcare utilisation continues to hinder intervention success. Resistance to insecticides and antimalarial drugs poses a growing concern, while environmental risks, security issues, and climate change present further obstacles. Resource mobilisation and data quality issues also threaten the effective delivery of malaria control measures. These challenges highlight the need for sustained investment and improved strategies.

To address these challenges, Benin plans to advocate for increased domestic funding to support malaria interventions. SMC will be expanded to cover regions that were previously not. The country aims to strengthen community engagement, multisectoral collaboration, and integrated vector control efforts to improve intervention reach and efficiency. Ensuring the availability and quality of healthcare services, enhancing vaccination efforts, and improving epidemiological surveillance and data quality are also key priorities. Efforts will also focus on ensuring gender and vulnerable group inclusion and effectively implementing the new community health policy to improve local health systems.

Benin has made substantial progress in reducing malaria incidence and improving treatment outcomes. The PSNIE 2024-2030 strategy aims to build on these achievements and accelerate malaria elimination by 2030. Achieving this goal will require strong political will, improved governance, and dedicated resource mobilisation to ensure all planned interventions are successfully implemented.

Update from RBM Partnership to End Malaria

Dr. Daddi Wayessa, RBM Partnership to End Malaria

The RBM Partnership continues to play a critical role in coordinating global efforts to combat malaria. Its mission focuses on strengthening partnerships, advocacy, and technical support to accelerate progress in malaria control and elimination.

Core function of RBM:

- **Coordination:** Aligns global, regional, and national malaria efforts to promote accountability and collective action.
- **Advocacy & Resource Mobilisation (RM):** Ensures malaria remains a high priority on global agendas and secures funding for malaria initiatives.
- **Technical Support:** Provides guidance and expertise to assist countries in developing effective malaria control programs.

The RBM Partnership to End Malaria is governed by the RBM Board, which provides strategic oversight and guidance. Supporting the Board is the RBM Secretariat, based in Geneva, which manages the partnership's coordination and operations.

The RBM Partnership is structured into two major pillars:

1. **Country and Regional Support Partner Committee (CRSPC):** This pillar provides a unique platform to engage malaria partners at national and global levels to coordinate support to countries and regions as they execute their malaria control and elimination programmes.
2. **Advocacy, Resource Mobilisation, and Communication Partner Committee (ARMPC):** This serves as a pivotal platform within the RBM Partnership to End Malaria for advancing malaria elimination efforts through strategic advocacy, resource mobilisation, and coordinated communications.

In addition to these pillars, RBM also operates through **six working groups**, which focus on specific technical and operational areas (Figure 3).

The RBM Partnership operates under a five-year strategic plan, with the current plan set to conclude at the end of this year (Figure 4). This year, RBM has incorporated elements reflecting current priorities, particularly around the Big Push initiative, to further shape and enhance the annual plans.

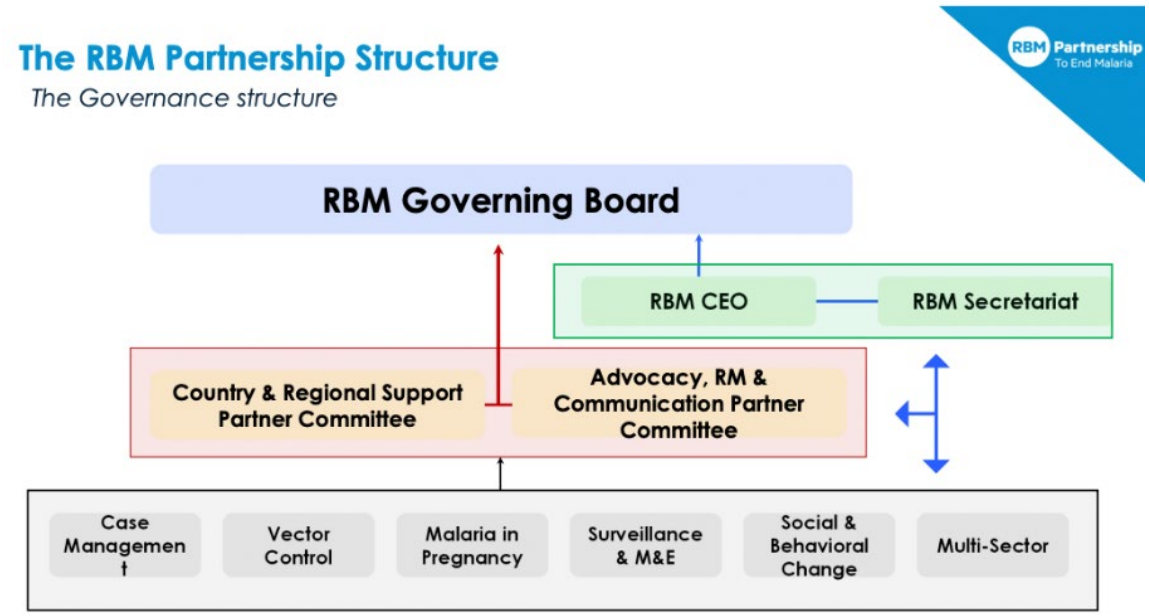


Figure 3: RBM Working Groups

Vision	**A world free from the burden of malaria**		
Mission	To convene and coordinate an inclusive, multisectoral response to prevent, control and eliminate malaria		
Principle	Ending malaria is central to achieving UHC, global health security, poverty reduction and reducing inequalities		
Strategic Objectives and Strategic Actions	**SO1. Optimize the quality and effectiveness of country and regional programming** 1.1 Support countries in the design of quality, prioritized programmes 1.2 Support countries in the use of real-time sub-national data in planning, implementation and monitoring 1.3 Facilitate timely access to implementation support to address bottlenecks and gaps 1.4 Support building local management and technical capacity 1.5 Support countries to strengthen multi-stakeholder partnership coordination at the national and sub-national level 1.6 Leverage regional alliances and initiatives to ensure cross-border and cross-sectoral coordination and coherence	**SO2. Maximize levels of financing**	2.1 Advocate for optimizing global resource envelopes from existing donors and new channels of financing 2.2 Support countries with mobilizing and prioritizing domestic and other resources for malaria and health
		SO3. Facilitate the deployment and scale-up of new products, techniques or implementation strategies	3.1 Promote and support the inclusion of new interventions in the design and delivery of programmes 3.2 Foster peer learning and knowledge exchange to facilitate deployment and scale-up of new products, techniques or implementation strategies
Cross-cutting Strategic Enablers			
Data Sharing and Use	**SE1:** Open and timely sharing of quality data to drive decision-making, build transparency and foster accountability.		
Effective Partnership	**SE2:** Meaningful engagement of partners at the global, regional and national level to leverage their unique capabilities, expertise and perspectives.		
Targeted Advocacy and Communications	**SE3:** Targeted advocacy and communications to keep malaria high on global health and development agendas to drive leadership, commitment, and change.		
Focused Secretariat	**SE4:** Ensuring a Secretariat that energizes the partnership to deliver the strategy.		

Figure 4: RBM's 2021-2025 Strategy Framework

Functions of Partner Committees and Working Groups

Partner Committees and Working Groups (WGs) play a crucial role in formalising, consolidating, and enhancing RBM's core functions. Their work is coordinated by the CEO of the Secretariat, ensuring alignment with RBM's strategic goals.

Structure and Commitment

- Partner Committees and WGs consist of RBM Partners who commit their staff's time and resources to support RBM initiatives.
- The by-laws ensure that funding is allocated to support WG coordination.

Key Objectives and Actions

- **Improved Communication:** Strengthen communication between WGs, the RBM Board, CEO, and Partner Committees to enhance coordination.
- **Country Participation:** Ensure sufficient funds are available to support country representation at WG meetings, similar to the funding model for Partner Committee participation.
- **In-Country Engagement:** Strengthen National Malaria Control Program (NMCP) involvement to maximise WG impact and align activities with country priorities.
- **Visibility and Recognition:** Elevate the profile of WGs within RBM's governance structures to highlight their significant contributions to the Partnership's success.

The RBM Data Initiative was developed to address the lack of sustainable, open-source malaria data and highlight gaps and bottlenecks in control efforts. Now available on the revamped RBM website, the RBM Global Malaria Dashboard supports global and country-level planning by offering insights for partners, donors, and national programs.

Big Push Against Malaria

The Big Push is a strategic initiative designed to accelerate progress in malaria control amid stalled global efforts. It aims to enhance the implementation of existing strategies, supported by an accountability framework. The initiative emphasises the need for improved efficiency with limited resources while shifting the narrative to drive additional funding. The Big Push was launched to respond to Yaoundé and Lusaka to overcome stalled progress. 80%-90% of their priorities were advanced by priority actions in the Big Push.

By engaging multiple sectors and stakeholders, the Big Push outlines key **priority actions** for the next five years (Figure 5):

1. Improve coordination between global, regional, and country partners
2. Uphold national leadership and accountability and advance a whole of-society approach
3. Strengthen data systems and enable data driven decision making
4. Increase accessibility, acceptability & quality for existing interventions
5. Develop and prepare for rapid introduction of new fit-for purpose tools
6. Increase funding for malaria, building on a new narrative

The six priority actions for the Big Push to address required ecosystem shifts are organised along six pillars including both transformative and supporting actions collectively recognised by key malaria stakeholders

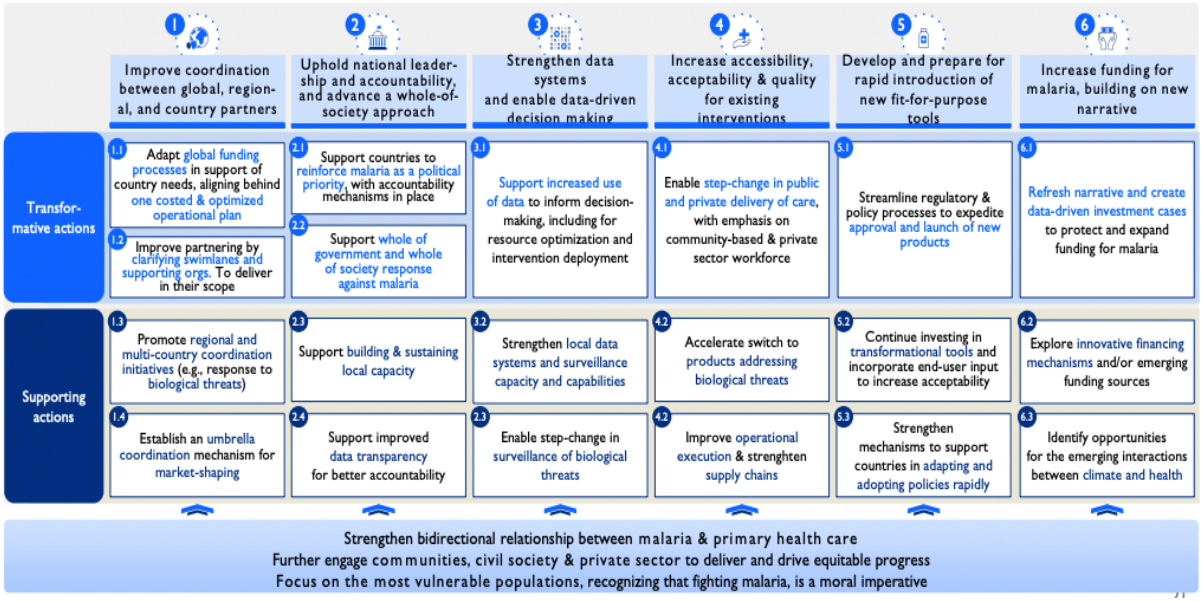


Figure 5: Six Pillars of Big Push Against Malaria

Big Push Custodian Roles and Target State

Daddi Wayessa finished the segment by outlining RBM's role as a custodian for implementing the Big Push strategy, along with the expected outcomes (target state) for these efforts.

1. Providing Visibility on Progress
    a. **Role:** RBM will ensure progress is reported transparently by tracking and sharing key performance indicators (KPIs).
    b. **Target State:** Regular reporting on KPIs through platforms such as the Big Push annual report.

2. Convening Stakeholders for Follow-Up
    a. **Role:** RBM will facilitate stakeholder meetings and maintain "living documents" that are updated as commitments evolve.
    b. **Target State:** Regular meetings among partners and updates translated into evolving commitments.

3. Supporting Country Engagement
    a. **Role:** RBM will engage with countries via CRSPC and the Secretariat to enable country-led implementation.
    b. **Target Countries:** Strengthened engagement with countries to ensure effective on-the-ground malaria control efforts.

Q&A/Discussions

Comment: The "Big Push," as referenced by Daddi Wayessa, is more of an advocacy-driven concept. It focuses on promoting key priorities and driving momentum for action in malaria control efforts.

Update from WHO Vector Control Unit

Dr. Emmanuel Chanda, WHO GMP

The WHO Vector Control and Insecticide Resistance (VCRI) Unit primary focus is to ensure efficient resource use, facilitate data generation and reporting, and provide evidence-based guidance for vector surveillance and control. It plays a crucial role in disseminating guidance and offering technical support to aid implementation efforts.

In 2024, VCRI has intensified its focus on insecticide resistance monitoring. The unit coordinated the procurement of WHO test kits to support these activities and enhance efforts against resistance. Progress has been made in improving testing protocols, including a simplified method for demonstrating susceptibility to chlorfenapyr with a single bioassay, requiring ≥98% mortality. This change removes the need for three separate tests traditionally required to confirm resistance. Adjuvants may also increase insecticide uptake, further and further investigation into adjuvants is necessary and it is also important to consider the aim of the assay when choosing the sample size. Furthermore, VCRI is developing a protocol to guide manufacturers and laboratories in establishing discriminating doses (DD) early, ensuring resistance monitoring can begin as soon as new insecticides are deployed.

Surveillance and control efforts for *An. stephensi* were highlighted through insights from various countries. In India, urban legislation has been recognised as an effective means to prevent *An. stephensi* proliferation. In Iran, improved water and electricity services have been shown to influence mosquito control. Meanwhile, in Sri Lanka, routine entomological surveillance, closing unused wells, or introducing fish are recommended strategies. Integrating *An. stephensi* surveillance with other VBD control efforts has shown promising results in improving intervention efficacy. Efforts to manage costs and improve test kit performance have also been a priority. With institutional support from University Sains Malaysia (USM), operations have been sustained successfully, and alternative sources for reducing costs while enhancing performance have been identified.

The VCRI unit has made significant progress in developing new guidance and guidelines. The Vector Control Advisory Group (VCAG) convened for its 20th and 21st meetings, addressing interventions

such as topical repellents, eave tubes, spatial repellents, Wolbachia-induced pathogen reduction, and genetically modified mosquitoes. A key policy change in late 2024 removed the requirement for non-inferiority testing for product inclusion under WHO recommendations. Moving forward, inclusion decisions will be managed by the Pre-Submission Coordination Committee, with consultation from the Guidelines Development Group (GDG) if necessary.

In terms of new guidance, recommendations have been updated for dual active ingredient (AI) ITNs (Figure 6). The IRS operational manual has been expanded to include IRS guidance for other VBDs and enhanced discussions on new technologies for LSM. The revised IRS manual is set to be published later this year.



Figure 6: Recommendations for Dual AI ITNS

Looking ahead, VCRI plans to conduct a multi-centre study to define the DD for broflanilide and isocycloseram. The current quarterly calls for *An. stephensi* updates will be expanded to include discussions on emerging threats. Additionally, VCRI is working with USM to improve bottle bioassay procurement and is developing an elimination strategy for *An. stephensi* in Africa.

To further strengthen guidance, VCRI will continue hosting VCAG meetings with an open call for new members. They also plan to update norms, standards, and processes that support the development of WHO recommendations on vector control. Lastly, the MINT tool will be expanded to improve monitoring and evaluation of vector control interventions.

Through these activities, the VCRI unit continues to advance malaria vector control efforts, ensuring that new strategies, resources, and technical guidance are effectively implemented to support countries in achieving their malaria elimination goals.

Q&A/Discussions

Jessica Rockwood: Could you elaborate further on the technical consultation regarding ITN durability and how it relates to procurement?

Seth Irish: We are still in the planning stages for the technical consultation on ITN durability. The standard expectation of 3 years of ITN durability is likely unrealistic. Our aim is to bring stakeholders together to explore this issue, including identifying better ways to measure durability and assess the contributing factors that may influence it.
Micheal MacDonald: How do we navigate this significant funding challenge? Speaking for my government, we are actively considering alternative strategies, including strengthening public-private partnerships and exploring alternative funding sources. I would appreciate insights on how we can collaborate to manage this crisis effectively.
Seth Irish: The key challenge now is finding creative solutions to sustain malaria control efforts amid funding challenges. We must focus on being cost-effective while ensuring we maintain essential services and prevention tools. Advocacy is crucial — engaging RBM, governments, organisations, and private companies to highlight the risks of halting these interventions. Now is the time to innovate and find ways to maintain or even enhance our progress in malaria control.
Corine Ngufor: Addressing the current funding challenge is a significant concern. There will be discussions on this during the upcoming roundtable and the joint workshop, including exploring private sector funding opportunities. All ideas are welcome as we look for ways to manage this challenge.
Jo Lines: Around 2007-2008, when the strategy shifted from targeting specific vulnerable groups to aiming for universal coverage, there was discussion about the potential reduction in immunity across large populations in Africa. This shift was based on short-term data demonstrating the powerful impact of LLINs as a child survival intervention. At the time, LLINs were seen to be as cost-effective as measles vaccination in improving child survival. I recall these discussions clearly, but was this ever formally documented or just part of an informal conversation?

Update from WHO-PQT/VCP

Dominic Schuler and Geraldine Foster, WHO Prequalification Unit (PQT)/ Vector Control Product (VCP)

Current work / updates

Dominic Schuler provided comprehensive updates on their team, assessment, and communication efforts. Staffing developments include the introduction of a Case Manager role and a Rotational Fellowship program. Upcoming Assessor's Session for Vector Control Products (ASVCP) meetings are scheduled and the ASVCP roster is also expanding, and initiatives such as the "Advice to Manufacturer" series, Wednesday Webinars, and CRO Webinars continue to operate.

WHO-PQT emphasises its commitment to continued collaboration with countries and partners. They are introducing regional rotation engagement days, which provide opportunities to share organisational updates, address procurement challenges, and understand government funding constraints. Through PQ's efforts and the initial pool of consultants engaged, WHO-PQT has achieved nearly 50% female participation and over 60% representation from the Global South in meetings with intention of expanding the representation further.

Dominic Schuler provided updates on the new structure of the WHO Public Assessment Report (WHOPAR (public assessment report), designed to enhance clarity and transparency regarding PQ decisions that includes detailed assessment reports, conclusions, and interpretations. Additionally, WHO-PQT highlighted the advisory groups relevant to vector control product prequalification, including VCAG, the newly formed Technical Advisory Group for Vector Control Products (TAG-VCPR (Technical Advisory Group for Vector Control Products), and Joint Meeting on Pesticide

Specifications (JMPS) (Figure 7). (Joint Meeting on Pesticide Specifications). TAG-VCPR specifically focuses on providing regulatory advice on WHO's assessment procedures for vector control products and active ingredients, ensuring improved guidance on policy and regulatory functions

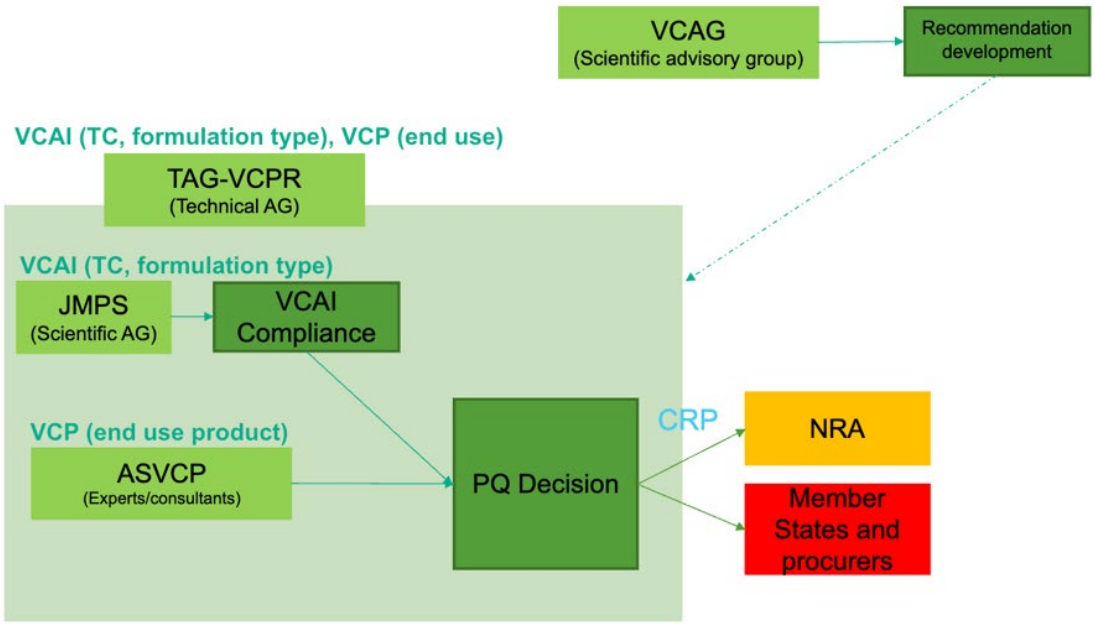


Figure 7: Advisory and assessment groups related to PQT/VCP

Submission Statistics and KPIs

Dominic Schuler shared that WHO-PQT has observed an increase in decisions and a reduction in assessment timelines. For the submission cohort, three products were prequalified in 2023/2024 with an average review time of 209 days. For the decision cohort, four products were prequalified in 2023 (average 443 days), while six were prequalified in 2024 (average 359 days). Regarding Study Protocol submissions, 93% of the 2024 decision cohort met the WHO target timeline of 90 days, with an average review time of 43 days.

There was a significant 1,133% increase in applications, largely driven by the ITN guideline implementation plan, which outlines dossier requirements and includes 46 supporting guidance documents to help manufacturers compile their data. Despite the surge in applications — rising from six in 2023 to 74 in 2024 — WHO-PQT maintained efficient processing, achieving a 90-day target for protocol reviews in 93% of cases.

Prioritisation of guideline development

Geraldine Foster introduced the WHO Guidelines for the Prequalification Assessment of Insecticide-Treated Nets, published in December 2023. She provided updates on the revised community studies protocol, designed to guide manufacturers and CROs in conducting Phase III studies previously managed by WHOPES. The updated protocol offers detailed guidance for study design rather than a general overview. The final version is currently in preparation.

Key changes and additions include:

- Sample size calculations now focus on attrition as the primary endpoint.
- Semi-field studies have been introduced to estimate entomological efficacy.
- Sampling time points have been reduced.

- WRI/Surface AI estimation has been added as part of quality testing.

She also introduced the WHO Guideline for the Prequalification Assessment of Indoor Residual Spraying Products, noting that preliminary data assessment is complete, and a formal product review is underway, expected to conclude by mid-2025. This review will provide WHO with recommendations for updating the guideline, followed by the identification of relevant experts to form a working group. The updated guideline is expected by December 2026.

Additionally, she mentioned the upcoming WHO Guideline for the Prequalification Assessment of Larvicide Products, also anticipated by December 2026. A preliminary data assessment is ongoing.

The process will mirror the approach used for ITN and IRS guidelines, involving expert recommendations, followed by forming a dedicated working group to support the guideline update.

Next Steps 2025

Geraldine Foster outlined the 2025 workplan, emphasising key priorities which include: prioritising PQ applications, establishing the TAG-VCPR, developing new guidelines, expanding the CRP, and maintaining ongoing communication and advocacy efforts. She also mentioned that guidelines on spatial repellents (SR) are currently under consideration. Discussions with the GMP are ongoing to determine how best to incorporate SR into the existing guidelines.

Q&A/Discussions

Question 1: You mentioned meetings- will they online and available for remote participation, or are they planned as in-person events?
Dominic Schuler: Apologies, the meetings are mostly closed sessions, but the schedule was shared to keep everyone informed. However, we are always available if requires further information.

Question 2: What are the requirements for semi-field studies in the PQ dossier?
Geraldine Foster: In terms of the generalised requirement for semi-field study on ITNs, two of the studies must be an open system study. The third study can have an option to be a closed system study as we recognised that you can't have experimental huts in all locations.

Question 3: Can we submit a publication of the data during the PQ assessment stage?
Geraldine Foster: Publication and dissemination of data is entirely up to the researchers and manufacturers they are working with. But public dissemination of data is always good and useful, but it is not up to pre-qualification to decide whether specific trials can or should be published.

Question 4: Can the publication itself be submitted to pre-qualification for assessment?
Geraldine Foster: No, you can submit the publication only as a supporting document. However, we require the original study report and all the raw data for the pre-qualification dossier to conduct our assessment.

Question 5: What circumstances would warrant the inclusion of partially sprayed houses in the guidelines?
Dominic Schuler: The guidelines themselves aren't designed to specify requirements for every possible scenario. Instead, they focus on what we need to know about the product's quality, safety, and efficacy. From there, it's up to manufacturers to present that information in the most appropriate way for their product.

Update from the Global Fund (Prioritisation and Budgeting)

Kate Kolaczinski, The Global Fund

The current Grant Cycle 7 (GC7) runs from 2024 to 2026, with preparatory work for Grant Cycle 8 (GC8), covering 2027 to 2029, already underway. Key funding request materials and guidance are set to be published in July 2025 to support the GC8 application process. The Global Fund Replenishment Conference, co-hosted by the UK and Africa, will be held in the UK to determine the funding available for GC8. Following this, allocation letters will be sent to national governments, outlining their available resources. Applicants will develop funding requests throughout 2026, leading into a grant-making process for implementation in 2027.

While malaria financing has increased steadily across recent grant cycles, the rising population means that per capita funding has seen a decline. In GC7, over $3 billion was committed to core malaria programming; however, significant financial gaps persist. These gaps are particularly evident in funding for ITN campaigns, Seasonal Malaria Chemoprevention (SMC) scale-up, and public health facility support.

Despite the substantial investment, the available funding remains insufficient to fully meet the needs of key interventions. Although 63 out of 65 eligible malaria-endemic countries have signed their GC7 grants, budget constraints continue to limit the scope of implementation. A significant portion of malaria funding is also directed towards health system strengthening and national program costs, further contributing to these challenges.

Vector Control Financing and Transition to Chlorfenapyr (CFP) Dual AI Nets

Within the vector control budget, ITN mass campaigns continue to dominate spending due to their cost-effectiveness and ability to reach a larger population. Funding for IRS has declined as some countries shift towards chlorfenapyr-based ITNs to manage costs. This transition has been prioritised in several programs where budget limitations make ITNs a more feasible option.

Approximately 63% of Global Fund-financed ITNs in GC7 are CFP dual AI nets. A special contracting mechanism known as the Revolving Facility was introduced to stabilise costs and secure pricing comparable to piperonyl butoxide (PBO) nets. However, initial demand surges created supply challenges, reinforcing the importance of coordinated efforts and early preparation.

Future Funding and Market Investments

As the planning for GC8 progresses, efforts will focus on ensuring affordable product supply through mechanisms such as the Revolving Facility and Access Fund, designed to secure quality, innovative products at affordable prices. Emphasis will also be placed on promoting regional manufacturing ecosystems and supporting environmentally sustainable supply chains.

A range of new malaria products is expected to enter the market during GC8. However, given the number of emerging products, strategic prioritisation will be required to identify those with the greatest potential for impact.

Vector Control Procurement and Quality Assurance

The forthcoming New Vector Control Product Quality Assurance Policy will introduce expanded recommendations and requirements, including:

- Traceability mechanisms to track product use and distribution.
- Enhanced insecticide resistance monitoring to improve surveillance and response.
- Expanded post-market surveillance to assess product performance.
- Strengthened waste management protocols to address environmental concerns.

The WHO PQ Programme will continue to provide the primary assurance mechanism, though the introduction of the Expert Review Panel (ERP) will allow for urgent procurement of products still undergoing WHO PQ processes, ensuring program needs are met without delays.

ITN Resistance to Damage Score, Packaging and Waste Management

Efforts to improve ITN Resistance to Damage Scores are ongoing, with collaboration to refine evaluation methods in line with WHO guidance. Additionally, steps are being taken to introduce bulk packaging for CFP dual AI ITNs to reduce waste and improve cost efficiency.

Strategic Programming Decisions

The design of GC7 grants was shaped by financial constraints, prompting countries to adjust their programs within available Global Fund resources. This resulted in compromises on ideal intervention strategies, requiring careful decisions on balancing prevention and case management investments and distributing resources across public, private, and community sectors.

Vector control strategies faced further challenges, with some countries prioritising broader ITN coverage, while others transitioned to improved tools like CFP dual AI ITNs despite budget limitations.

With per capita funding expected to decrease, future strategies will require careful prioritisation. This may include sub-national tailoring of interventions, increased use of tools like IRS and LSM, and improved resistance management. Strong partnerships will be essential to ensure these strategies deliver maximum impact with limited resources.

Q&A/Discussions

Jo Lines: The current approach to assessing net durability through resistance-to-damage scores has proven unreliable. Evidence since the early 2000s suggests these scores don't really work, likely because different factors contribute to net wear in different regions. A simple yet effective solution would be to include QR codes or barcodes on nets to indicate their age. This would enable national programs to gather real-time data on net durability through routine household visits. Why has this still not been done yet?
Pascal Day: While the Global Fund is supportive of IRS, its allocation in GC7 accounted for just 6.7% of the total malaria budget. He questions the sustainability of this approach and whether relying heavily on bed nets is sufficient, particularly for managing insecticide resistance. He suggests that IRS may require greater emphasis in future strategies to ensure effective malaria control.
Frank Mechan: He clarifies concerns regarding the Resistance to Damage Score, noting that recent improvements have specifically addressed the issues raised. They acknowledge previous concerns about the score not accounting for risk factors and the challenges of abrasion testing but these have

now been addressed in their most recent work, strengthening the RT score. The speaker invites attendees to hear more details about these updates in their presentation scheduled for the afternoon.

Samuel Asiedu: Over the years, we've seen a decline in IRS programmes globally. But if we look at the evidence, where IRS has been consistently used, we've seen reductions in malaria prevalence. So we can't say that IRS hasn't worked. So, do we have alternative methods? And if not, shouldn't we be investing more in IRS to make it more efficient and cost-effective?

Corine Ngufor: Yes, the support from the private sector is welcomed. Your current work in Ghana so far is a good example, and we are hoping to find more ways in which we can get additional support in funding for IRS.

Medard Rukaari: From my experience in Uganda, my advice is that both interventions are equally important. We must be sure to support them without bias, recognising each of their value.

Kentzo Mumba: From my perspective, the presentation from the Global Fund seems to imply a somewhat prescriptive approach, suggesting that one intervention is being positioned as more important than the other. I believe this isn't fair, and they should be clear about their stance. We've experienced pressure from the Global Fund to scale back on certain interventions, but in Zambia, we've put out foot down and are committed to continuing IRS as extensively as possible, as long as funding is available — not just from the Global Fund, but also from other partners, local government, and alternative sources.

Christian Atta-Obeng: The challenge we face is very real. Human compliance plays a significant role in making sure ITNs actually work. I'm not suggesting that ITNs don't work — they do — but ensuring consistent usage continues to be a struggle, especially in urban areas. This is an opportunity for us to consider allocating some ITN funds toward alternative interventions like LSM, not as a replacement but as a complementary strategy. What scenarios could shift the landscape, and what potential benefits could we gain by investing in diversified strategies?

Session 2: Work Stream Meetings

Work stream I: Enhancing the Impact of Core Interventions

Co-leads: Christen Fornadel, IVCC & Ketty Ndhlovu, Zambia National Malaria Elimination Centre

Meeting Overview

Christen Fornadel outlined several key priority issues and strategic directions within the vector control work stream. She highlighted the significant shift in the ITN market, with pyrethroid-only nets being replaced by chlorfenapyr-pyrethroid nets, which is expected to increase resistance pressures.

Consequently, Task Team 1 will focus on advancing resistance testing for new molecules to ensure proactive measures are taken with the introduction of new active ingredients (Figure 8).

This market shift is occurring alongside a notable decline in IRS implementation, largely due to the high costs associated with IRS programs. This decline will be further explored in the upcoming Task Team 3 session (Figure 8).

She also emphasized the importance of addressing ITN access and durability challenges, with Task Team 2 set to explore strategies for measuring the physical and chemical longevity of newer nets to maximise their field impact (Figure 8).
She acknowledged the financial constraints in Grant Cycle 7 (2024-2026), which will require countries and donors to prioritise achieving coverage targets over malaria prevalence reduction. Funding remains a critical concern, with 2023 malaria investments reaching only US$4 billion — less than half the US$8.3 billion required to meet GTS targets. While domestic funding has increased from 33% in 2021 to 37% in 2023, greater efforts will be needed to offset the impact of reduced US government aid.

Session	Title	Facilitators	Speakers
Session 1	Task Team 1: Insecticide resistance monitoring, with an emphasis on appropriate methods	Janneke Snetselaar Hervé Raoul Tazokong	Neil Hobbs Yuki Ando Seth Irish Gil Padonou
Session 2	Task Team 2: ITN durability guidance and monitoring - using data to inform decision making	Anna Trett Chrispin Williams	Eleanore Sternberg Emma Fairbanks Thomas Syme Frank Mechan Anna Trett Dominique Bomba Amougou
Afternoon break, selection of teas, fruit juices, snacks			
Session 3	Task Team 3: Engagement and mapping of private sector partners to support implementation	Jess Rockwood Andrew Saibu Samuel Asiedu	Louisa Messenger Pascal Day Nigeria – Dr Godwin Zambia - Kentzo Mumba Ghana - Otubea Ansah

Figure 8 : Structure of Work stream I discussion sessions

Task Team I: Insecticide Resistance Monitoring, with an Emphasis on Appropriate Methods

Simulating Insecticide Resistance Management and Transmission Control using a Mathematical Model

Neil Hobbs, University of Liverpool

The presentation highlighted the importance of managing resistance to ensure sustained effectiveness of malaria vector control interventions. As new insecticides become available, deploying them strategically is essential to maximise their impact on mosquito populations while minimising the development of resistance.

To explore this, a coupled population dynamic and population genetic model was developed. This model considers the entire mosquito life cycle and crucially includes male mosquitoes, which play a significant role in resistance evolution as they contribute 50% of the genetic material to future generations.

The study aimed to understand how ITN deployment affects resistance and malaria transmission dynamics. Three scenarios were explored: a worst-case scenario with no intervention, a best-case scenario assuming pyrethroid ITNs remain effective without resistance, and a scenario where pyrethroid ITNs are used with resistance initially present at a low frequency. The model ran 100,000 permutations, considering mosquito behaviour, ITN coverage, and resistance phenotypes.

The findings showed that resistance evolution can significantly undermine the effectiveness of ITNs, reducing their ability to control malaria transmission over time. Without careful deployment strategies, resistance could spread rapidly, compromising vector control efforts.

The study emphasised that combining population dynamic and genetic modelling provides valuable insights into resistance management. By incorporating resistance evolution into intervention planning, malaria control programmes can develop sustainable strategies that both reduce malaria transmission and delay the emergence of resistance.

Q&A/Discussions

Question 1: Have you taken changes in the vector capacity and external incubation period into consideration due to climate change effects? The models may not work if these parameters are not considered.
Neil Hobbs: We did. We can include different parasite incubation periods in the model as it changes the maximum or minimum vectorial capacity you achieve in a month in the simulation. So yes, it is one of our considerations.

Question 2: Was the resistance level fixed throughout the time-lapse, or did you change those as your interventions were longer in the field?
Neil Hobbs: Intensity does not change over time. In the monogenic model the resistant allele frequency changes over time and the intensity of any particular gene does not change over time. This is just a simple monogenic model and not a polygenic model that we can change intensity over time for an individual.

Question 3: Just out of interest, did you ever run it with two non-pyrethroid AIs?
Neil Hobbs: Yes, results showed it just lasts for longer as well essentially.

Determining the Preliminary Discriminating Concentration of Broflanilide against *Anopheles gambiae* through a Multi-center Study

Yuki Ando, Mitsui Chemicals Crop & Life Solutions, INC.

The presentation focused on determining the preliminary discriminating concentration (PDC) of Tenebenal™ (active ingredient in Vectron® T500) against *Anopheles gambiae* through a multi-centre study. Vectron® T500 is a newly developed IRS product listed by WHO PQ in March 2023 and introduced in December 2023. Tenebenal™ has demonstrated long-lasting insecticidal efficacy with no evidence of cross-resistance among pyrethroid-resistant strains of *An. gambiae*. However, an official WHO-validated discriminating concentration (DC) has yet to be established.

To address this, the study aimed to propose a PDC using susceptibility data from country registration trials. Nine datasets were analysed through WHO bottle bioassays conducted with the *An. gambiae* Kisumu strain (Figure 9). The tested doses ranged from 0.01 to 50 µg/bottle, with at least six dose points set for each test. All assays included 800 ppm MERO adjuvant, recommended by WHO SOP for bottle bioassay, which had previously been shown to stabilise Tenebenal™ efficacy.

The analysis followed WHO's 2022 guidelines for data validation and DC calculation. Of the nine datasets, only two (from Burkina Faso and Tanzania's NIMR) met the criteria for valid dose points and acceptable goodness of fit. The remaining seven datasets showed insufficient data points or poor model fit.

Based on the valid datasets, the highest estimated DC value was 16.84 µg/bottle. MCCLS subsequently proposed a PDC of 18 µg/bottle + 800 ppm MERO for operational use. The study's findings are intended to serve as a reference for WHO's ongoing determination of the official discriminating concentration for Tenebenal™, supporting its effective deployment in insecticide resistance management (IRM) strategies across malaria-endemic regions.

No.`0. lq[.	country	No. of valid dosepoints*	LC99±95%CI (µg/bottle)	Goodness of fit	Lowest LC100 (µg/bottle)	Corresponding DC (µg/bottle)
❶	Burkina Faso	3	8.42 [4.73-12.10]	0.3243	6.25	16.84 [9.46-24.20]
❷	Tanzania (NIMR)	5	0.57 [0.31-0.82]	0.4268	1	1.14 [0.62-1.64]
❸	Tanzania (KCMUCo)	7	27.84 [17.75-37.90]	<0.0001	2.15	4.3
❹	Benin	4	1.02 [0.85-1.18]	0.0001	1	2
❺	UK	6	13.44 [9.76-16.96]	0.0136	NA	NA
❻	DRC	2	NA	NA	0.781	1.562
❼	Ghana	2	NA	NA	0.781	1.562
❽	Zambia	0	NA	NA	0.781	1.562
❾	Uganda	0	NA	NA	1.563	3.126

Figure 9: Discriminating concentration (DC) of Tenebenal™ (active ingredient in Vectron® T500) against Anopheles gambiae through a multi-centre study

Q&A/Discussions

Question 1: I noticed you analyzed numerous data sets but only used a limited selection for setting the diagnostic concentration. If you were to repeat the study, would you consider adjusting the protocol to incorporate all the data sets?
Yuki Ando: Ideally, the concentration range should be assessed and adjusted between 0 and approximately LC100 to improve the quality of the raw data. I would recommend further testing to determine the diagnostic concentration.

Question 2: Could you clarify your reasoning behind the proposed DC value? By setting such a high threshold, it seems you'd need to be highly confident that they are extremely resistant before detecting resistance at all. In my view, opting for a lower DC might be a better approach.
Yuki Ando: This value was selected based on validated results and aligned with WHO guidelines. It has been designated as a preliminary value.

Question 3: I've seen studies where the proposed DC is lower, around 11 or 12, whereas your study suggests a higher value. I'm wondering if WHO has established, or is planning to establish, standardized guidance that consolidates these studies. Has a standard value been established, or is that something currently in progress?
Yuki Ando: The determination of the DC value by WHO is currently in progress, and our proposed value is provisional. While we've suggested one value for now, it may be adjusted based on the outcomes of the WHO project.

Question 4: Are you continuing to gather new data to reinforce and support the proposed DC value of 18? As I mentioned, some studies have used significantly lower values, around half of this. I'm wondering why a standardized dose hasn't been established yet. Are you actively testing or encouraging further testing in different countries to help WHO confirm the proposed dose?

Yuki Ando: The effort to establish the diagnostic concentration is currently ongoing, and I believe a team from LSTM is leading that work. The proposed DC is a preliminary value intended to bridge the gap between the implementation of interventions and the final DC determination.

Jo Lines: It's important to consider the purpose of a discriminating dose. While this isn't my area of expertise anymore, my understanding is that it was developed as a tool in the 1950s or 60s. The idea is that if something survives the dose, it signals a potential issue that requires investigation. It's not meant to reflect an average of observed values but rather a top end of those values that you observe in the in the field.

Determining Discriminating Concentrations of Novel Active Ingredients

Seth Irish, WHO

The presentation addressed the ongoing challenge of insecticide resistance, highlighting its significant threat to the efficacy of malaria primary control interventions. Given the reliance on these insecticides, effective monitoring and management strategies are critical to maintaining their effectiveness.

Two primary methods for monitoring resistance were discussed: calculating the resistance ratio and determining a DC (a threshold value that identifies resistance). Seth stressed that genetic methods would play an increasingly important role, particularly for measuring resistance to newer insecticide compounds.

Traditionally, establishing DC values has relied on extensive multi-centre studies. While these are effective, they are costly and time-consuming, often resulting in delayed outcomes. For instance, Interceptor® G2, prequalified in 2018, only received a published DC in 2022. Similarly, Vectron® T500, prequalified in 2023, is still awaiting its diagnostic concentration, although an ongoing multi-centre study is expected to provide this by summer.

Seth Irish also addressed the need to expedite this process to ensure DC values are ready before insecticides are widely deployed. A recent technical consultation in September concluded that WHO should now consider data generated during the insecticide development phase — provided certain criteria are met. These criteria include adherence to good laboratory practices, standardized protocols, accurate insecticide preparation, and the use of well-characterized mosquito strains.

The speaker acknowledged concerns about relying on LC99 values due to their inherent variability. To address this, a new protocol is being developed to guide DC determination during product development. This process will involve:

1. Testing a wide range of doses to establish a mortality curve (0–100% mortality).
2. Identifying a smaller number of doses to determine the LC99 value and establish a preliminary DC.
3. Testing this DC to confirm it achieves 100% mortality in susceptible mosquito colonies and ideally in field strains. Chemical testing will ensure the administered dose matches the intended concentration.

Seth Irish concluded by noting that the protocol is still under development but is expected to be published later this year, providing clear guidelines to streamline DC determination and enable earlier resistance monitoring.

Q&A/Discussions

Question 1: How does WHO assess incoming resistance data given the absence of a standardised approach, especially when countries are currently acting based on their own best practices?
Seth Irish: This is one thing that is challenging without an established diagnostic dose. We aim to avoid presenting data based on varying doses in resources, hence establishing a standardised dose as soon as possible is crucial. As previously mentioned, we are hoping to have that in August/September and we will share it as soon as it's finalised.

Question 2: You mentioned that data from studies conducted without WHO support can still be considered. However, there's a lot of non-standard data available, and while we don't yet have a defined dose, the product is already in use. How do you assess or weigh its validity and relevance?
Seth Irish: That is not ideal as we want to have those doses before the product goes out. The published doses are within a similar range, so using one or the other can still provide an indication of resistance. Hopefully, we will have the finalized data later this year.

Question 3: What is WHO's position when you have at least two different studies that shows very different DC? Building on Ole's earlier comment, if the goal is to detect incipient resistance, we would want to be as conservative as possible and go for the lowest discriminating dose, instead of the highest. Do you have a response to that?
Seth Irish: I haven't reviewed the data from previous work on determining the DC, but I suspect some variation between centres is not unusual and will need to be considered. This is where the conservative versus less conservative approach becomes relevant. Often, WHO's discriminating dose is set quite low to detect resistance at its earliest stages. While the dose that would negate vector control may be much higher, the purpose of these assays is to identify the beginning of resistance. Therefore, I believe it's preferable to take a more conservative threshold approach for early detection of resistance. This is why, in some cases, different diagnostic doses are set for different species. Hence, the challenge lies in determining an appropriate dose but with threshold-based approach, there's always some margin for variation.

Question 4: I believe most of us still rely on paper and tubes. How do you obtain these bottles?
Seth Irish: We are expanding the use of the WHO bottle bioassay, recognizing that not all insecticides can be effectively tested using paper assays. That's why we're working closely with USM to further develop the bottle bioassay. This will allow us to test insecticides that are suitable for paper assays, which tend to be simpler, as well as those that require bottle assays where dosing must be done manually. Note that some products cannot be easily or reliably tested using paper methods.

Resistance Monitoring in Benin

Gil Padonou, Centre de Recherche Entomologique de Cotonou (CREC)

The speaker outlines the key criteria for selecting resistance monitoring sites in Benin, which include agro-ecological zones, vector control operational areas, bioclimatic zones, malaria transmission patterns, and historical sites.

In terms of data management and reporting, finalised data is accessible to the public through the CREC platform. Within this framework, emerging resistance to carbamates was identified across all districts. Resistance emergence was first observed in 2019, with mortality rates below 90%,

confirming resistance in all locations for the three insecticides evaluated. The WHO tube test assessed the susceptibility of *Anopheles gambiae s.l.* to clothianidin, while the WHO bottle bioassay evaluated susceptibility to chlorfenapyr.
Gil Padonou highlighted overexpression of three enzymes in *Anopheles gambiae* populations, coupled with a target-site resistance mechanism (Kdr). While these mosquitoes were once susceptible to pyrethroids in 1999, their resistance has steadily increased, now reaching concerning levels in 2024. Notably, resistance to permethrin has also grown significantly over the past two years, emphasizing the urgent need for alternative molecules in vector control.

Encouragingly, combinations such as pyrethroid + PBO, ACP + CFP, and ACP + PPF have shown effectiveness in managing resistance. Recommendations stress the importance of expanding resistance monitoring efforts, particularly in high-risk areas, and strengthening biochemical and molecular resistance testing capacity. Integrated resistance management strategies must be prioritised to sustain vector control efficacy. Furthermore, developing new insecticides, exploring genetically modified mosquitoes, and leveraging novel biocontrol agents are seen as essential steps for sustainable malaria control in the future.

Q&A/Discussions

Question: You mentioned that PBO + PYR nets remain highly effective. How will this influence your ITN distribution strategy?
Gil Padonou: While resistance to certain insecticides has been observed in Benin, the levels of resistance vary depending on available resources and national program funding capacity. To address this, newer ITNs are prioritised for regions with higher resistance levels. A policy is already in place to guide this targeted distribution strategy, ensuring that interventions are aligned with the resistance landscape.

Task team II: ITN Durability Guidance and Monitoring – Using Non-biological Data to Address Threats and Inform Decision Making for IRS/ITNs

Introduction

Anna Trett introduced the session by highlighting the importance of using non-biological data to assess threats and inform decisions. She emphasized that several key pieces of information are crucial for driving the effectiveness of core strategies, including quality data, ITN use and coverage, durability, and monitoring acceptability. By integrating these factors into decision-making, we can better identify emerging trends, address potential threats, and make tailored, data-driven decisions. She began the session with a Q&A featuring VCWG Task Team co-lead Chrispin Williams from NMCP Liberia, focusing on experiences in vector control decision-making in Liberia. This was followed by a panel discussion exploring the various types of data and data components that inform such decisions.

Q&A Session

Chrispin Williams, NMCP Liberia and Task Team co-lead

Question 1: Can you tell us about how you make decisions relating to ITN distribution in Liberia? What data has so far been used to make decisions around ITN procurement or distribution?
Chrispin Williams: Prior to 2021, we were able to conduct insecticide resistance testing documenting widespread pyrethroid resistance in Liberia and transition to dual AI nets. In 2022, the dual AI nets were introduced to the school-based distribution.

Question 2: Can you tell us about the decision to introduce school-based channels for the first time in 2022, using ITN use data from the MIS?
Chrispin Williams: In 2016, the Liberia Malaria Indicator Survey assessed ITN ownership, access, and utilization. Collaboration with the School Health Division of the Ministry of Education, supported by PMI, revealed low coverage, access, and ownership rates. To improve and optimize ITN use, a school-based distribution program was introduced in early 2022. By the end of 2022, a follow-up Liberia Malaria Indicator Survey reported positive results: access increased from 42% to 52%, ownership rose from 55% to 72%, and utilization improved from 36% to 44%. Notably, malaria prevalence among children decreased significantly, dropping from 45% in 2016 to 17.7% in 2022.

Question 3: Has any durability monitoring been conducted in Liberia? If so, how was the data used?
Chrispin Williams: In 2018, we conducted durability monitoring of pyrethroid nets compared to dual AI nets; however, that data was not utilised. Instead, when deciding on the rollout in 2021, we relied on data from our documented pyrethroid resistance monitoring collected over the years.

Question 4: Finally, can you tell us what other available methods of data collection might make it easier to make informed decisions on ITN distribution?
Chrispin Williams: We aim to utilise more MIS data and other survey findings to support our decision-making process. Additionally, we are exploring small-scale studies that can be applied to guide the wider distribution of nets.

Panel Discussion: What Data/Methods can we use to Assess the Performance of Core Interventions and How can these be Used to Improve the Effectiveness of Interventions in the Field

Eleanore Sternberg, Tropical Health, UK

Question 1: How can existing durability monitoring data be used to address current issues pertaining to ITN durability?
Eleanore Sternberg: There's actually a rich database from the durability monitoring studies that's been collected in a standardized way making it very valuable for secondary data analysis. When we look across the different survey sites, we see quite a range in net survival. The median is about 2.7 years, but in some places, nets last over 4.5 years, while in others, they don't even reach 2 years. In trying to understand these variations, we can explore household factors collected during these studies, along with chemical content and bioefficacy data to better understand ITN durability.

Question 2: What are the data sources that can be useful in assisting country programmes in making procurement or distribution decisions?
Eleanore Sternberg: Durability monitoring data is incredibly useful because it's longitudinal. You go out, tag the nets, and follow them for about three years, allowing you to measure the full lifespan of the net. But beyond that, household surveys can provide valuable insights as well. By asking households whether they have nets, how they use them, or why they might not be using them, you can gather important context around net utilization. Additionally, DHS and MIS data can be really helpful for exploring questions about net use and access.

Question 3: What are the cautions around interpreting and over-extrapolating data trends between ITN brands, regions and countries?
Eleanore Sternberg: While these surveys can't really establish causal relationships, it's still incredibly valuable for identifying broader patterns and understanding how the data fits into the bigger picture within a country. It provides useful insights, even if it doesn't pinpoint exactly what's happening on the ground.

Emma Fairbanks, University of Warwick

Question 1: How can the implications of your findings complement the main methods of generating evidence for ITN effectiveness?
Emma Fairbanks: Small-scale experiments allow us to optimize products before committing to RCTs. For new products within the same class as existing ones, we may not always need another full trial if data shows they're at least as effective.
Mathematical models also play a crucial role — they let us explore "what-if" scenarios, comparing different settings on factors like climate, coverage, and durability. Durability is vital for maintaining coverage, but user behaviour is just as important. We've seen that ITN use can drop during hot, humid periods when sleeping under a net feels uncomfortable, which is especially relevant in low transmission or elimination settings where maximizing usage is critical.

Question 2: Based on your research, do you think countries can use semi-field studies to compare LLIN products and choose the most effective one? How?
Emma Fairbanks: The real advantage is the ability to rapidly evaluate tools while assessing multiple vector species and their resistance levels. Small-scale experiments using local populations allow cost-effective testing of interventions. It's important to consider gaps in protection, such as transmission driven by outdoor or daytime biting. In such cases, models can help predict the impact of these factors on transmission and highlight the limitations of LLINs against outdoor biting.

Thomas Syme, London School of Hygiene & Tropical Medicine

Question 1: What are the implications of your work into understanding the accuracy of the 20 washes as replicating three years of field life?
Thomas Syme: Our study aimed to test how well the 20-wash method predicts the end-of-life performance of different net types. As part of the New Nets Project, we withdrew nets from households in Benin after three years of use and tested them in experimental huts against nets that had been washed 20 times. We tested pyrethroid, PBO, pyriproxyfen, and chlorfenapyr nets.

For pyrethroid, PBO, and pyriproxyfen nets, the wash method aligned well with real-life performance. However, for Interceptor G2 and chlorfenapyr nets, washed nets outperformed field-aged nets, suggesting the wash method may overestimate their effectiveness. This inconsistency is problematic given the widespread distribution of these nets across Africa. Since net care and usage may vary by region, similar studies in other regions would help determine if these findings are consistent.

Question 2: What role can experimental hut trials play in generating an improved understanding/estimate of ITN durability?
Thomas Syme: Hut trials can play a crucial role in improving our understanding of net durability. While lab bioassays assess insecticide potency and bioavailability on the net's surface, they don't reflect real-world performance under operational conditions. Hut trials, or similar semi-field methods, simulate the natural interaction between mosquitoes, nets, and hosts inside households, providing a better indication of how nets perform in practice. Expanding the use of these trials in durability monitoring would offer a more holistic understanding of how durable these new nets truly are.

Frank Mechan, i2i, Liverpool School of Tropical Medicine

Question 1: What is the resistance to damage (RD) score and how can it be used to anticipate the durability of LLINs?
Frank Mechan: The RD score is an aggregated value that combines four key physical tests for ITNs: snag strength, burst strength, hole enlargement, and abrasion resistance. Developed by researchers at NIRI, this score estimates a net's overall durability by comparing its performance to an ideal standard. By combining these metrics, the score provides a useful tool to predict how well LLINs will withstand wear and tear in real-life conditions.

Question 2: How reliable is it?
Frank Mechan: The RD score has proven to be a reliable predictor of net durability. Earlier research showed that nets with above-average RD scores lasted about 7 months longer than those with below-average scores. Recent work expanded this data, confirming that nets with the highest RD scores are expected to last about 13.65 months longer than those with the lowest scores. Even a small increase of 10 points above the median score can add around 4 extra months of net life. So even in small differences in RD score, we're seeing quite meaningful differences in net life.

Anna Trett, Clinton Health Access Initiative

Question: How could the resistance to damage score help countries and other agencies in selecting LLIN products?
Anna Trett: The RD score could significantly improve selection of LLIN products by providing a reliable estimate of net durability. While price currently plays a major role in procurement decisions, ITN lifespan is not yet factored in. Since the RD score can be applied to both existing and new nets using non-woven materials, it offers a valuable tool to predict how long a net will last in real-world conditions.

Research at CHAI demonstrated that increasing average net retention by just 8 months — based on insights from RD score data — could result in 25% more malaria cases averted compared to current retention rates. They are actively discussing with procurers and manufacturers how the RD score could be integrated into decision-making to help make the most of every dollar invested in bed nets.

Dominique Bomba, Head of Prevention Department, NMCP Cameroon

Question: Could you tell us about the analysis you conducted in Cameroon and how such analysis could help other countries maximize impact within the available resource envelopes?
Dominique Bomba: Cameroon, a high malaria burden country, adapted its net distribution strategy in response to COVID-19. During the 2025-26 campaign, four strategies were assessed: the standard method, fixed post distribution, a door-to-door strategy where counting and distribution occurred simultaneously, and a "hit and run" approach for crisis and isolated areas where community-selected projects were delivered the next day.

The cost analysis revealed that the standard strategy was the least expensive, followed by the door-to-door approach, which also proved easier for monitoring and evaluation. The "hit and run" strategy was the most costly due to logistical challenges in reaching dispersed populations. Consequently, Cameroon has chosen the door-to-door strategy as the most efficient approach, ensuring optimal resource allocation and improved planning in the face of declining funding.

Q&A/Discussions

Question 1: Excellent work being done with the durability monitoring database and the introduction of the RD score; there's clearly a lot of potential moving forward. My question, mostly to Eleanor but also to others, is about the other non-biological threat — the elephant in the room. For context, this was PMI data. So, where do we go from here and continue this work? Can we rely on industry again, or are there other strategies we should consider?
Eleanore Sternberg: With the loss of PMI funding, it's important to maximize the value of secondary data analysis. Extracting insights from existing data is crucial. While I can’t say who will fund this moving forward, we should explore less costly methods for data collection. With new net types emerging, this is the ideal time to focus on gathering essential data to detect issues early and ensure nets are effective.
Anna Trett: We're also working with i2i on a post-market monitoring data framework designed to optimize resources. The aim is to identify sampling strategies that require less data while still identifying whether areas meet an acceptable threshold or fall below it. This approach allows for targeted action without the need for requiring funding for a full-scale durability monitoring study. We hope to showcase this framework later this year.

Question 2: Did you track how many times the nets collected from households had been washed over the three years? I'm curious if there's any correlation between the actual number of washes in households and the standard 20-wash protocol.
Thomas Syme: Yes, data was collected through demographic surveys as part of the New Nets Project. On average, people reported washing their nets about twice a year, which equates to six washes over three years — significantly less than the standard 20-wash protocol. However, since this is self-reported data, it should be taken with caution. This suggests that washing may not be the primary driver of insecticide loss in Benin, and other factors may be contributing instead.

Question 3: The work on the RD index looks promising, and I'm really looking forward to seeing it implemented. Since it's predictive, when do you expect it to be ready for implementation?
Frank Mechan: As Seth mentioned, the upcoming technical consultation later this year will be crucial in deciding the path forward. The RD score serves two key purposes: identifying net specifications that predict the best performance now and providing a future target for improving net design. This isn't about an abrupt shift to new bed nets but rather a gradual, strategic approach to defining what we want nets to achieve in the future.
Anna Trett: The timeline really depends on how the RD score is integrated into procurement decisions. It could take longer to influence the market to develop more durable products. In terms of understanding what's required for responsible implementation, that work has already begun. It could take at least a year to fully outline the QA processes and ensure they're in place.

Question 4: impact of RD score on the cost of nets
Frank Mechan: I want to address this misconception that a higher RD score automatically means higher cost, but that's not the case. Our preliminary analysis shows that the RD score is unrelated to cost. Some nets with higher RD scores are actually cheaper than others. Factors like weave patterns can significantly influence durability, but one weave isn't necessarily more expensive than another — it's about how the materials are constructed. That said, while the RD score doesn't directly correlate with cost, it can justify higher pricing if a net demonstrates substantially better durability and performance.

Question 5: Have you been in discussions with WHO-PQ about presenting this method? What has the approach been like? Do you see this as something that could be incorporated, and do you believe it would be useful in that context?
Frank Mechan: Regarding WHO-PQ, they currently request data on snag strength, burst strength, and hole enlargement, but the challenge is determining how to effectively use that information. One key point we're making to WHO-PQ is about abrasion testing — it's costly, difficult to measure, and highly variable.
Our data shows that abrasion isn't crucial for predicting net durability, and removing it from the metrics wouldn't compromise the accuracy of the RD score. This change could save suppliers significant time and costs. We're currently in discussions with Global Malaria Program (GMP) to present this case, and then, we may go to WHO-PQ to propose removing abrasion as a required metric.

Question 6: We tested one product in four different labs, and each returned a different RD score. Some labs seem to be more conservative than others in their scoring. How will this variation be addressed? Has standardisation been considered?
Frank Mechan: Understanding the extent of variability between labs is important, and we should have a clear sense of that in quantitative terms. I agree that we need to get a better handle on this — whether it involves establishing clear variability guidelines or requiring multiple lab tests to confirm a reliable final score. Standardizing this process will be key.

Jo Lines: The focus should be on using local national data on net durability and observed lifespans to inform procurement practices and influence market share. While the RD score was intended to address this, the issue remains unresolved. I don't believe the RD score is the solution for improving durability through WHO PQ.

Durability will only improve if we prioritize purchasing more durable nets over less durable ones, and that's not currently reflected in this work. I'm disappointed because what we really need is for observed durability data to feed directly into market decisions. Once that happens, everything else will follow.

Task Team III: Engagement and Mapping of Private Sector Partners to Support Implementation

Introduction

Jessicca Rockwood introduced the session by emphasizing the key goals: creating investment, saving IRS, and engaging the private sector to help achieve malaria control targets.

Malaria Vector Control in Sub-Saharan Africa: Complex Trade-offs to Combat the Growing Threat of Insecticide Resistance

Louisa Messenger, UNLV

Louisa Messenger emphasised the growing threat of insecticide resistance to vector control programs in sub-Saharan Africa (SSA), where 50% of the population sleeps under ITNs and only 2% are protected by IRS. From 2004-2022, 2.13 billion pyrethroid (PY) ITNs were delivered across SSA, yet PY resistance is now widespread. Despite this, mass distribution of PY-ITNs and PBO-ITNs continues to intensify resistance.

PBO-ITNs and CFP-ITNs are now the new standard, with 404 million PBO-ITNs delivered between 2018-2023. In 2023, 58% of ITNs delivered were PBO-ITNs, while PY-ITNs declined to 22%. However, PBO-ITNs and CFP-ITNs are 30-37% more expensive than PY-ITNs, creating a financial strain; requiring an estimated $132-159 million annually in SSA to fund this shift. To manage costs, some countries have scaled back IRS programs to fund PBO-ITNs/CFP-ITNs (Figure 10). For example, PMI-funded IRS coverage peaked in 2010 with 7.6 million structures sprayed, but this dropped by 30.2% between 2021-2023. Countries like Benin, Malawi, and Mali have withdrawn IRS to manage the financial burden. A Benin case study showed that switching to PBO-ITNs/CFP-ITNs required an additional $6.1-7.4 million, whereas IRS alone cost $3.9-4.1 million for a single transmission season.

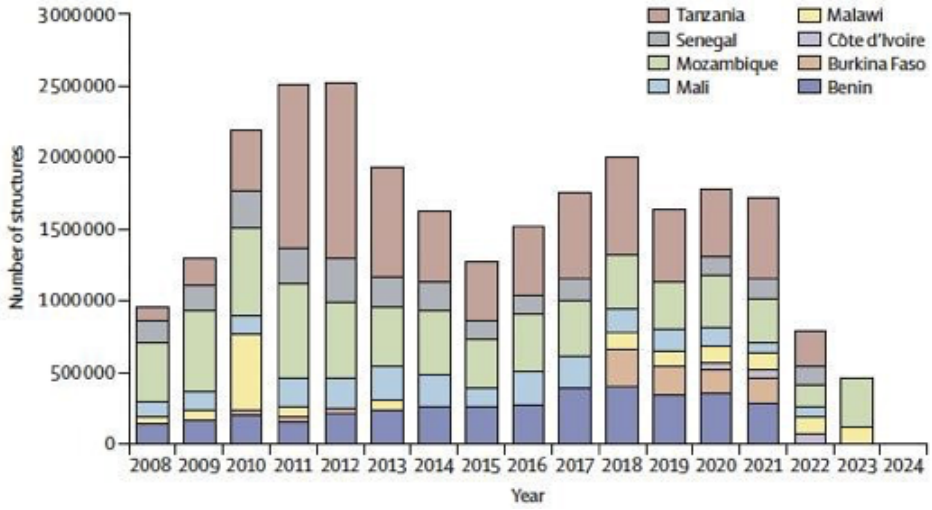


Figure 10: Graph showing countries with long-standing IRS history (Benin, Malawi, Mali, Mozambique, Senegal and Tanzania) and high burden countries with relatively new IRS programs (Burkina Faso and Côte d'Ivoire) withdrawing from IRS to fund PBO-ITNs /CFP-ITNs.

Given how expensive IRS is, there is uncertain rationale for co-deploying IRS with PBO/CFP-ITNs due to the high costs of IRS and limited evidence of added benefit plus the possibility antagonistic effects between insecticides. The potential of IRS as a resistance management tool is hindered by its high costs. The unweighted mean cost per structure sprayed by PMI increased from $19.62 in 2008 to $28.90 in 2022. For larger programs covering over 200,000 structures, costs rose from $13.13 to $15.50 during the same period. The primary driver of IRS costs is manpower and infrastructure, with insecticide accounting for only 20% of the total cost.

Critically, PBO-ITNs are not suitable for resistance management as they may accelerate resistance development. Over-reliance on CFP-ITNs as a sole intervention is also risky, posing long-term consequences for insecticide resistance management.

With the recent withdrawal of USAID funding, Louisa stressed the urgent need for resource mobilization to sustain malaria control efforts and protect past gains. She also encouraged exploring whether VC programs can be co-financed to address funding challenges effectively.

Conclusion

- IRS scaled back by donors to fund more expensive but effective PBO-ITNs /CFP/ITNs
- Limited biological rationale for the deployment of IRS with PBO-ITNs /CFP/ITNs, but that needs to be re-examined in the context of proactive resistance management.
- Over-reliance on PBO-ITNs / CFP-ITNs has significant implications for long-term insecticide resistance management
- Resource mobilisation urgently needed to sustain control gains

Review of Ghana and Zambia TT3 sessions

Andrew Saibu and Samuel Asiedu provided a recap on private sector involvement in achieving sustainable vector control.

The vision: enhanced NMP partnerships with the African private sector for expanded and sustainable vector control towards malaria elimination.
The objective: To support VCWG members in their efforts to foster sustainable ITN and IRS interventions through the capacity strengthening of NMCPs, local partners, and the private sector.
Following the recap of the Lusaka and Accra meeting objectives, key takeaways, and proposed next steps, the speaker invited Otubea Akrofi from Ghana and Kentzo Mumba from Zambia to share insights on their respective countries' perspectives and ongoing efforts to address the vector control gap.

Kentzo Mumba, Zambia

Question: The slide showed a significant decline in malaria cases after vector control tools were introduced at the Zambia sugar estate to its employees. Could you share what Zambia is doing to address current gaps, and what lessons other countries can learn from their experience?
Kentzo Mumba: Businesses, like Zambia Sugar, have learned the hard way that neglecting malaria control leads to lost man-hours and reduced productivity. Since their sugarcane fields create ideal mosquito habitats, they've had no choice but to take responsibility for protecting their workers. However, their efforts cover only a small population, around 500 households, while the government manages malaria control for the rest of the district.
With the recent decentralisation of primary healthcare to local government, we now have an opportunity to access funding through the Community Development Fund (CDF), which is allocated to every constituency. This offers a new way to support malaria control efforts.
We've also transitioned from community health workers to polyvariant workers, who are now salaried employees. This removes the cost of hiring separate spray operators, saving us resources.
In addition, the End Malaria Council, chaired by the Head of State, plays a vital role in mobilizing resources. With support from CEOs, finance officials, and other leaders, we've secured political will and funding to sustain malaria control activities.
Despite past challenges, we now have a clear path forward. The Ministry of Finance has agreed to fund IRS in all 12 districts previously covered by PMI/USAID. We've already procured insecticides, with more on the way. We're determined to push forward; Zambia first.

Otubea Akrofi, Ghana

Question: Where are you heading next in your malaria control efforts? Could you explain how the National Malaria Eradication Program (NMEP) managed to secure funding from the National Health Insurance to support the two districts in Ghana?
Otubea Akrofi: Following our visit to Rwanda, efforts were made to engage the private sector in Ghana's malaria control efforts. A roundtable discussion was held with various sectors, including mining, agriculture, telecoms, media, and airlines. As a positive outcome, a Ghanaian media icon who also serves as a malaria ambassador committed to promoting companies that support malaria control efforts.

Private sector partners like AGAMal and EcoBank have provided resources such as ITNs and tablets to fill gaps in mass campaigns. Discussions with manufacturers are ongoing to secure customized ITNs for workplace programs and vulnerable groups like orphanages.

On the IRS front, Kill Pest is being funded by Ghana's National Health Insurance to spray in two high-burden districts. This was achieved through collaboration with the Ministry of Health, leveraging political connections to secure funding. We're hoping this initiative will expand IRS to districts previously covered by PMI, especially since Ghana already has insecticides in stock. Malaria parasitaemia rates have shown a decline from 2010 to 2022 in the targeted districts following the IRS intervention, demonstrating its positive impact.

The government has played a key role in bridging the funding gap, supporting interventions like IRS and Larval Source Management (LSM) to sustain malaria control efforts. While challenges remain, the Ministry of Health continues to explore IRS expansion as a cost-effective solution.
Efforts are also underway to promote IRS in elite communities, encouraging residents to fund spraying in their homes through community organized groups. The goal is to develop a sustainable, standardised funding model to ensure long-term IRS implementation.
Andrew Saibu: It's equally important to understand the political landscape. Whether we like it or not, politicians will continue to shape decisions, so learning to communicate in a language they understand is crucial.
I believe domestic resource mobilization can help fill the funding gap. It won't be easy, but nothing worthwhile ever is. This is also a time for Africa to take ownership of its challenges and focus on homegrown solutions to drive progress.

Mentimeter Session

This session aimed to bring the focus to developing a work plan for 2025. Using Mentimeter, audience participation was encouraged, and responses were generated via a real-time feedback system in an engaging and interactive manner.

1) Do you collect data on preference of net usage based on fabric?
2) Vector control tools (IRS, LLINs) continue to play a major role in reducing the impact of malaria. Please describe the current challenges you face.
3) How can those challenges be addressed through modifications to their design and deployment?
4) What data points will you consider in the adoption and scale-up of new tools?
5) IRS is part of SNT in all countries, yet few countries have funding for it. How can the trend be reversed?
6) How do you prioritize vector, control versus other interventions (case management, diagnostics, vaccines, etc), given the current budget constraints?
7) Do you specify your net fabric preference in procurement? If yes, why? And if no. Why?

Work Stream II: Expanding the Vector Control Toolbox

Co-leads: Derric Nimmo & Eric Ochomo

Meeting Overview

Derric Nimmo highlighted the significant changes that have taken place over the past year within the working stream. Eric outlined the current structure of the task teams (TT), noting that TT2 and TT3 have been recently restructured. He emphasised that human behaviour remains a key cross-cutting element across the working stream.

Looking ahead to the next five years, the vision for each task team is as follows:

- **TT1:** Focused on LSM, with this year's primary goal being to establish a comprehensive malaria landscape analysis.
- **TT2:** Dedicated to developing novel vector control approaches, with the key objective of advancing new tools. Eric mentioned that TT2 is currently seeking additional volunteers, as there is only one active member at present.
- **TT3:** Focused on innovation in vector surveillance, with the goal of improving surveillance strategies. Similar to TT2, TT3 is also in need of new volunteers, with only one current member actively contributing.

Task Team I: Larval Source Management

Analysis of Larviciding Landscape in Sub-Saharan Africa

Steven Gowelo, UCSF

The presentation outlines a landscape analysis of larviciding programs in SSA, highlighting key challenges and opportunities. Steve reports that while there is considerable demand for larviciding among national malaria control programs, its implementation remains limited. This is primarily due to two key issues: insufficient evidence on its effectiveness and limited guidance on best practices. The assessment was conducted through literature reviews, online surveys, and in-depth interviews with key stakeholders. The main output is a comprehensive landscape document that collates best practices, highlights opportunities, and identifies priority areas for further action.

The analysis reveals that larviciding programs are primarily locally funded, with minimal support from global donors. The most commonly used products are bacterial larvicides, with the most prevalent brands being VectoBac, VectoLex, FourStar, and VectoMax. Key barriers to expanding larviciding efforts include limited access to technologies, insufficient funding, and WHO's current position, which discourages major donors from investing in larviciding initiatives. Additional challenges include funding constraints, limited knowledge of local vector populations, and a lack of structured implementation plans.

Despite these obstacles, manufacturers have shown growing interest in the African market, recognising its potential. Furthermore, there are promising opportunities for sharing best practices among countries already implementing larviciding programs, which could help improve future efforts.

Q&A/Discussions

Question: You mentioned a lack of access to technologies — is this solely related to lack of funding, or are there also regulatory challenges contributing to the issue?
Steven Gowelo: The issue with access to technologies is linked to both cost and regulatory challenges. The technologies themselves can be expensive, and obtaining the necessary licences is both costly and difficult.
Susanta Ghosh: Two key points to highlight. First, in India failing to follow LSM guidelines for *Aedes* and *An. stephensi* control is now can result in penalties— a legal measure that has strengthened compliance. Second, civic bylaws and construction regulations have been implemented and proven highly effective — I've seen this firsthand. We developed and enforced these bylaws in various cities, and they worked remarkably well. Strict communication and engagement efforts play a key role, and when people see the results, they are more likely to support these initiatives.
Jo Lines: The perception that larviciding is hard work is true, yet few people openly acknowledge this. However, I don't see that understanding reflected in practice — instead, more money is simply being spent on it. With gaps in net coverage still prevalent, we should avoid investing heavily in costly methods like larviciding. It's important that people don't contribute to the problem by diverting resources away from more effective solutions.

Urban Larval Mosquito Surveillance in Madagascar: Spatiotemporal Heterogeneity and Associated Vector Dynamics

Dr. Tovo Andrianjafy, University of Antananarivo Madagascar

This study aimed to assess the diversity and abundance of urban mosquito larvae and to understand the spatiotemporal variation in their breeding sites and associated mosquito species.
Mosquitoes were collected in Antananarivo, a highly urbanised area, between 2022-2023. Key parameters recorded included the source of breeding sites (natural or artificial), habitat type, presence or absence of larvae, proximity to human dwellings, and GPS coordinates. Both morphological and molecular identification techniques were used for species identification. A total of eight mosquito species were identified: five *Culex*, two *Anopheles*, and one *Aedes* species. Among the 21 observed breeding sites, *Culex quinquefasciatus* was found in all sites, while *Aedes albopictus* was present in about half of the sites, showing a preference for artificial habitats. Conversely, *Anopheles arabiensis* preferred natural sites such as fresh fields and aquatic agriculture.

The study highlighted the heterogeneity of mosquito larval breeding sites in urban ecosystems, revealing a rich culicidian diversity. The presence of key vector species emphasizes the need for improved vector surveillance and targeted control strategies in urban areas.

An Assessment of the Efficacy of Different Mosquito Larvicides used in America Vs used in Africa

Carol Tasiano, Mzuzu University

This study aimed to assess the efficacy of mosquito larvicides used in America and Africa, focusing on their mortality rates and residual effectiveness. The study compared the performance of Natular formulations — DT, XRT, and T30 — that contain Spinosad, a soil-derived bacterial active ingredient, with *Bacillus thuringiensis israelensis* (Bti), a bacterial-derived larvicide widely used in Africa.

The experiment was conducted in two 14-day replications, with five treatments in each replication. Results showed that both the American-based Natular DT and the African-based BTI achieved 100%

mortality within one week during both replications. Conversely, the American-based Natular XRT and T30 formulations had lower mortality rates (15-65%) over the two-week period.
While both Bti and Natular DT effectively controlled Anopheles gambiae mosquito larvae, Natular DT demonstrated a significant advantage by remaining active for up to 60 days, continuously killing mosquito larvae. In contrast, Bti is effective for only 7-10 days, requiring frequent reapplication. The findings suggest that combining both African and American products could enhance mosquito control efforts. However, further research is recommended to evaluate the long-term efficacy of these formulations and assess the risk of resistance development.

Panel Discussion: Perspectives on the Future of LSM in Africa

Christian Atta Obeng, Ghana NMEP; Silas Majambere, Valent Biosciences LLC; Dave Malone, Gates foundation

Question: Considering funding constraints, particularly with the halt in USAID funding and competing public health priorities, how can African governments and international partners prioritize and sustain investment in LSM as a key strategy, rather than just a supplementary intervention alongside core measures like bed nets and IRS?
Silas Majambere: Steven Gowelo highlighted that LSM funding is largely local, which is encouraging. However, from my understanding, much of LSM has historically been supported by PMI and USAID, so the withdrawal of this funding will undoubtedly have an impact. This is ultimately a bigger political discussion that needs to take place within countries. We've seen countries like Nigeria and Ghana increasing their local funding to help bridge the gap, and hopefully, other countries will follow suit. This situation should serve as a wake-up call for countries to reconsider their priorities — not just for LSM and malaria, but for broader public health efforts. While the situation isn't ideal, it's not entirely bleak. There's potential to explore local solutions through partnerships with the private sector and local governments. We need to rethink our approach.
Christian Atta Obeng: In Ghana, our approach has shifted from implementing interventions based on available funding to instead prioritising what works best. This has been key in moving from malaria control to elimination. We are now focused on using evidence-driven interventions. Through a detailed stratification process, we've developed a clear elimination plan outlining where specific interventions should be implemented over the next 4 to 5 years. This plan is informed by data on health system structures, resistance profiles, and other key factors. While we value donor commitments, we are increasingly committed on generating local funding to sustain our efforts. We have companies approaching us wanting to support malaria control, we guide them by aligning their contributions with our existing strategic plan. Instead of donors proposing their own ideas, we provide clear guidance on where their support is most needed.
Dave Malone: We're currently in a period of rapid change, particularly over the past 30 days. It may take around six months to fully understand how things will unfold and what the funding landscape will look like. While there's a chance that other donors may step in to fill the gap, I believe the shift towards local funding for vector control is likely to become a growing trend — and there's an opportunity within that shift.

Silas Majambere, Valent Biosciences LLC

Question: Steve's presentation highlighted that in countries implementing LSM, the products used are mostly limited to short-acting BTI, despite the availability of more innovative products on the market. What are some practical, actionable steps we can take to improve access to larvicide products in sub-Saharan Africa?

Silas Majambere: While I work for a company that produces Bti VectoBac, I'm answering this based on my 20 years of experience in LSM. In my view, the main challenge with larviciding in Africa isn't a lack of access to products — it's that it's not widely implemented in the first place. While some programs are ongoing, many haven't been sustained, largely due to limited funding and a lack of demand for these products. Historically, programs that began 15 years ago in places like Dar es Salaam used the products available at the time, typically those that had WHO PQ approval and were backed by funders. The products are not being used now because there's no demand, not because they are inaccessible. There's also a misconception that these products don't last long enough which is inaccurate. Products designed to persist longer in the environment are often banned in Europe and the US due to environmental concerns. Interestingly, while some criticize larvicides for being too short-acting, others see this as an advantage because they don't persist in the habitat, reducing environmental risks. Ultimately, larviciding is still a relatively new intervention in Africa, and confusion surrounding its effectiveness often stems from limited knowledge, education, and practice. Over time, as awareness grows and more programs are implemented, I believe these perceptions will improve.

David Malone, Gates Foundation

Question: Currently only recommends larviciding in areas where mosquito breeding sites are few, fixed and findable. However, the landscaping analysis has shown that emerging technological innovations are becoming more accessible and could help address these criteria. How can technologies such as drones, remote sensing, AI, and mobile applications be integrated into LSM strategies to improve the identification and treatment of larval habitats, especially in hard-to-reach rural areas, while also helping to reduce implementation costs?
David Malone: Building on what Silas said, larviciding operations are inherently more challenging and complex than interventions like ITNs, as success relies heavily on targeting the right place at the right time. When working with immature mosquitoes, it becomes clear that different settings require different larvicide formulations to be effective.
While technologies like remote sensing and machine learning aren't new — they've been widely used in agriculture for years — their application in larviciding can significantly improve precision targeting. By integrating these technologies, we can make operations far more effective and efficient. There are plenty of technical opportunities that can enhance the operational success of larviciding programs.

Christian Atta Obeng, Ghana NMEP

Question: Ghana has been one of the leading countries in implementing LSM. PMI's guidelines outline specific use cases for larviciding, such as urban *An. stephensi* control, rice aggregation sites, and areas nearing elimination. From Ghana's perspective:

1. How are you targeting your larviciding program to focus on areas where it's likely to have the most impact? Where do you believe LSM will be effective, and where do you think it may not be suitable?
2. In implementing this strategy, how have you leveraged partnerships with private sector partners and government ministries to maximise impact and enhance your program's success?

Christian Atta Obeng: In Ghana, our LSM program is fully financed by the government. From the start, we identified target areas where LSM would have the greatest impact. Urban areas have been a key focus since malaria burden is already declining there, and we're looking for interventions that can rapidly reduce residual transmission. Urban settings pose challenges for core interventions like

IRS (due to the nature of the area) and ITN use (which tends to be low). Our strategy has evolved to ensure we're being targeted, especially in identifying areas where we can effectively target *An. stephensi.* More recently, we've started thinking beyond malaria, recognising that LSM offers a broader advantage by targeting multiple mosquito species. Despite these evolving priorities, LSM continues to stand out as a recommended and effective strategy in our vector control efforts. Stakeholder engagement has been key to our LSM efforts in Ghana. We've learned that successful implementation requires bringing together the right stakeholders, from community leaders and regulators to private sector partners, to ensure ownership and accountability.

We spent nearly a year conducting nationwide stakeholder engagements to build awareness and secure support. While the government provides leadership and funding, we emphasise that community ownership is essential and actively encourage households to take responsibility for managing their own breeding sites.

On the partnership front, we've worked with various private sector groups, particularly in mining, agriculture, and infrastructure as these industries often contribute to mosquito breeding sites. By engaging these sectors, we are encouraging them to improve their practices and take responsibility for treating breeding sites. We've also established a platform that brings together key players to foster collaboration to ensure that LSM is both effective and sustainable in Ghana.

Task team II: Innovations in Vector Control

Mossie-GO: Solar Powered Malaria Control

Freddie Lyle, Africa Power Ltd.

Freddie Lyle introduced Mossie Go, a palm-sized device designed to effectively disrupt mosquitoes, preventing them from biting. The device is solar-powered device with a rechargeable battery via USB and operates using a fan to disperse transfluthrin repellent.

Clinical trials conducted in a laboratory free-flight room demonstrated a 90% reduction in mosquito bites. The ongoing Mossie Go trial in Uganda is a RCT involving 56 clusters across two districts. The trial began in June 2024 and is expected to conclude in June 2025. Village Health Teams (VHTs) are replacing the device's repellent coils monthly, with control and intervention clusters split 50/50. The devices are being used alongside existing malaria control interventions in these areas. The trial aims to evaluate the protective efficacy of the spatial repellent in reducing malaria prevalence in Uganda.

Challenges Identified: Intervention coverage due to user uptake and device maintenance, high variation in malaria prevalence between clusters, sample size adjustments following budget constraints, adapting to different environmental conditions and user needs, and ensuring long-term adoption beyond the trial phase

Next Steps: Data analysis and result dissemination after the trial concludes in June 2025, seeking support to expand trials to different regions, testing Mossie Go's effectiveness against other vector-borne diseases, further R&D refinement based on user feedback and exploring partnerships for large-scale deployment of the device

Chlorfenapyr can have a Potent Transmission-Blocking Impact

Victoria Ingham, Heidelberg University

This study explores the potential for insecticides to exert an unseen impact on malaria transmission. The *Plasmodium* parasite has a prolonged development period where it undergoes a significant bottleneck within mosquitoes to become infectious. Therefore, mosquitoes are likely to experience multiple exposures to insecticides during activities such as oviposition (egg-laying) and blood feeding. This raises two key questions:

1. Can insecticides have an antiparasitic effect?
2. Can insecticide exposure alter mosquito biology in ways that affect transmission?

Contact with insecticides has been shown to induce biological changes in mosquitoes.
Their research focused on tralopyril (active form of CFP) as a proof-of-principle to determine whether an insecticide can directly impact the parasite within mosquitoes. Tralopyril mode of action is targeting the mosquito's mitochondria, disrupting the production of ATP which ultimately leads to mosquito mortality. The rationale behind the experiment was to assess the impact of tralopyril on the parasite within mosquitoes. Tralopyril was topically applied 48 hours before a blood meal and following the blood meal, mosquitoes were quantified. This aligns with the critical period when the parasite develops from the oocyst to the sporozoite stage.

The results demonstrated that exposure to tralopyril had minimal impact on oocyst formation initially but significantly affected oocyst development on days 9 and 12 (Figure 11). Using a fluorescent line, researchers observed that tralopyril had a clear and significant impact on sporozoite formation in both the midgut and salivary glands. Through expansion microscopy, tralopyril exposure was shown to result in the complete arrest of oocyst development when compared to the control group, indicated by the absence of sporozoite markers. Further analysis using electron microscopy revealed structural changes to the mitochondria, supporting the proposed mode of action.

In conclusion, the findings suggest that early exposure to tralopyril during the parasite's development phase can completely block sporozoite formation by directly targeting and disrupting the parasite's mitochondria.

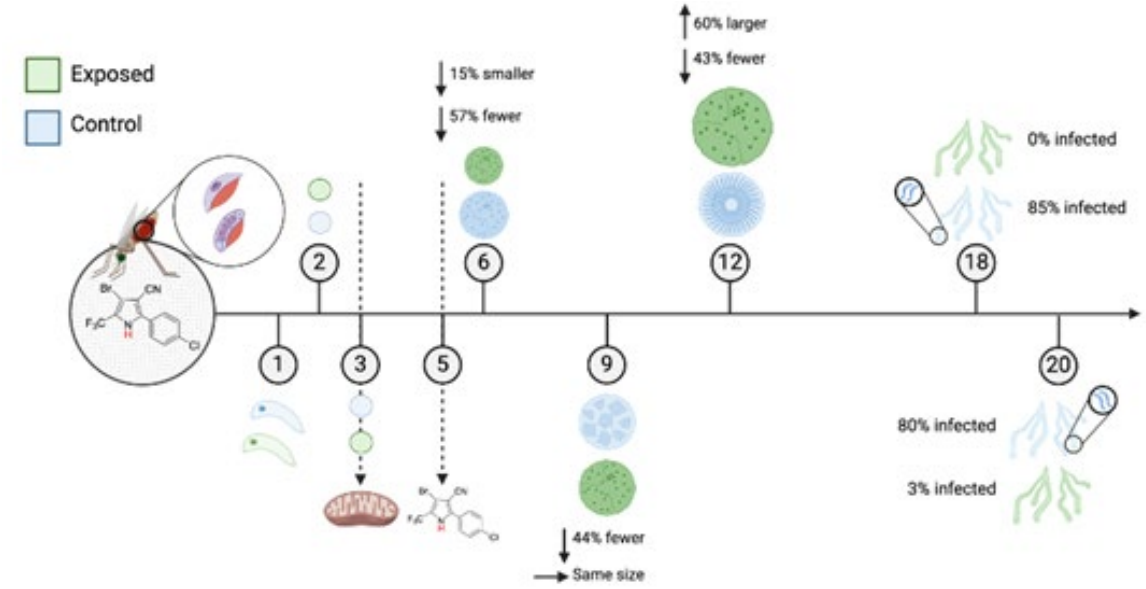


Figure 11: The impact of Tralopyril on the Plasmodium parasite within mosquitoes

Sylando: The Next-Generation Indoor Residual Spray

Patrick Frettinger, BASF

Sylando® 240 SC a newly introduced IRS containing chlorfenapyr, represents a new mode of action in the IRS toolbox and has recently achieved WHO PQ. BASF is now pursuing registration for use in several African countries to target Anopheles mosquitoes.

Sylando® 240 SC underwent rigorous testing:

- Hut trials conducted in Cove, Benin showed the highest mortality rates in resistant mosquitoes at 72 hours post-evaluation.
- In Ifakara Ambient Chamber Tests (I-ACT) conducted in Tanzania, Sylando® 240 SC demonstrated high efficacy on various substrates, including wood, mud, and concrete, with *An. arabiensis* mortality exceeding 60% over a 12-month period.
- The product also showed promising results against *Aedes aegypti*, achieving over 80% mortality and providing a residual effect lasting at least 5 months. This suggests Sylando® 240 SC could offer an additional benefit in dengue control and serve as a valuable tool in resistance management strategies.

Chlorfenapyr's bio-activation from its parent compound to its active metabolite (tralopyril) achieves 20-25% conversion of targeted doses in ITN trials, regardless of exposure duration (1 hour or 8 hours). The longer resting times associated with IRS treatments are expected to further improve its efficacy against mosquitoes and exert a robust impact on parasites inside infected mosquitoes. Early in vivo studies on tralopyril exposure indicate that exposure prior to infection indicated an observed effect on oocyst phenotype. Importantly, tralopyril appears to effectively block sporozoite production, and parasites do not seem to recover after exposure. This suggests that the observed effect is not transitory. The presentation concludes that Sylando® 240 SC, a chlorfenapyr-based IRS solution, offers 12 months of residual control on various surfaces, serving as an effective tool for resistance management while also impacting Plasmodium transmission.

Developing Gene Drive Effector Mosquitoes to Inhibit Malaria Transmission in Tanzania

Dickson Wilson Lwetoijera, Ifakara Health Institute, Tanzania

This presentation outlines Transmission Zero's genetic engineering efforts for malaria elimination through population suppression or modification using minimal genetic changes to endogenous mosquito genes, creating non-autonomous gene drives.

Previous research identified two antimicrobial peptides, magainin 2 and melittin, as effective blockers of *P. falciparum* transmission when introduced into mosquito blood meals. These peptides inhibit parasite development during the ookinete-to-oocyst formation stage. To enhance the spread of the MM-CP effector gene, researchers utilised the zpg-CC Cas9 helper strain, achieving high rates of non-autonomous homing, ensuring the MM-CP gene is efficiently inherited within mosquito populations. In 2023, the MM-CP effector strain was tested against patient-derived parasites, demonstrating promising results in blocking diverse parasite strains.

The project follows a phased development plan and the chosen field site in Ukerewe, Tanzania, was selected for its island setting, manageable scale, and strong community ties, providing an ideal research environment. They recognise the importance of community involvement and emphasises

that engagement with local communities is crucial for successful integration and acceptance of this strategy. The first phase, planned for 2027, will involve releasing the effector strain to assess its ability to block parasite development. Subsequent phases will integrate the Cas9 source to expand genetic coverage, eventually combining both effector and drive strains for enhanced malaria control.

Panel Discussion: Drivers of Stakeholder Acceptability to Novel Control Strategies - How to Integrate Novel Interventions into Current Vector Control Programs.

Frederic Schmitt, ENVU

Question: Based on your experience in developing and field-testing novel vector control tools, what are the key scientific or operational challenges that impact stakeholder acceptance, particularly at the regulatory and community level?
Frederic Schmitt: With regards to the scientific/operational challenges, regulatory hurdles are significant, particularly for new classes of interventions that require lengthy and intensive clinical studies. For interventions that involve known chemical or biological ingredients with established dossiers, conducting risk assessments and managing the tool's implementation is more straightforward. However, developing new tools or technologies without such data poses greater challenges, as building those dossiers is both time-consuming and costly. Beyond this, community acceptance poses another major challenge. While familiar interventions like IRS are generally accepted, newer solutions may face resistance from factors like appearance, colour, or perceived inconvenience. It is crucial to have open communication with the local communities to ensure they are comfortable.

Neil Lobo, University of Notre Dame

Question: What evidence do policymakers prioritise when deciding on malaria vector control interventions?
Neil Lobo: From our work at MEI, we have identified several factors that influence decision-making around shifting VC tools. First threshold for tools shifts is important. If a country's decision processes are built into their National Strategic Plan, particularly through stratification of malaria prevalence, this can really shape procurement decisions. On top of that, decisions often come down to what funders are willing to support. In terms of systems that influence decisions, registration processes can be lengthy, which can slow down tool adoption. Another critical factor is the country's monitoring and evaluation systems. We have identified seven main keys drivers of tool selection: demonstrated impact, cost, epidemiological trends, subnational tailoring, local manufacturing, politics and influence.

Tom Mclean, IVCC

Question 1: From your experience working with manufacturers, funders, and national programs, what are the biggest challenges in ensuring that novel vector control tools move from development to widespread adoption in disease-endemic countries?
Tom Mclean: Agreeing with panel, there is an overarching challenge. As small as a challenge seem, they are interlinking and interdependent. A cycle of interdependent issue arises. We need to find ways that the small individuals problems can be solved. The only way to do it is, the partners need to come together and solve them together. Don't try to do it alone, do it with partnership.
Question 2: How can we ensure that novel vector control tools remain both affordable and accessible while maintaining the commercial viability needed for sustained production and innovation?

Lucy Baker, Johns Hopkins University

Question: From your experience in public health education and community-based research, what are the most effective strategies for building trust and ensuring meaningful engagement when introducing novel vector control tools?
Lucy Baker: In my experience, establishing open and honest communication with the community you're working with is crucial. Through my work with the indigenous tribe in the US, one key aspect that communities often require — and something that's incredibly helpful in both conducting research and sharing results — is the establishment of a Community Advisory Board (CAB). This board acts as a bridge between researchers and the community, ensuring that the research process is transparent, respectful, and aligned with local values. The CAB plays a crucial role in disseminating results, fostering trust, and ensuring that the community remains informed and engaged throughout the research journey.
I also found that perceptions of efficacy can differ between researchers and communities. While researchers focus on specific outcome measures, communities may assess success in entirely different ways. It's that repeated contact that really matters: being present in the community, engaging with people regularly. When they see you, they know you, and over time, they trust you. Building that familiarity is key to establishing meaningful connections and ensuring the community feels involved and valued in the research process.

Edith N. Ramaita, NMCP Kenya

Question: What key factors influence the NMCP's decision to adopt or reject a novel malaria control strategy and how does the NMCP balance innovation with existing, proven interventions?
Edith Ramaita: In our country, we have a Malaria Policy and a recently updated Malaria Strategic Plan that will guide our efforts for the next five years. These documents outline our approach to malaria control and provide a framework for decision-making. Historically, we've been slow to adopt novel malaria control interventions, but to address this, we've incorporated a specific strategy within our updated plan to actively support the adoption of new tools, in response to emerging malaria control challenges in the country. For example, the adoption of spatial repellents was guided by this process. Dr. Eric, who led this effort, worked alongside these committees to introduce spatial repellents in high-endemic areas based on local research findings.
To stay informed and ensure evidence-based decision-making, we rely on our Vector Control Committee of Experts and Operational Research Committee, both of which meet quarterly. This regular engagement ensures we're aware of the latest data on intervention efficacy and impact, allowing us to make informed decisions. We also maintain a platform for consolidating operational research, allowing us to track studies, review data, and stay updated on findings. Ultimately, our strategic documents and guidelines serve as the foundation for balancing existing interventions with the introduction of new malaria control tools.

Q&A/Discussions

Tessa Knox: That was an excellent and insightful panel discussion. I believe it would be highly beneficial to include case studies in the discussions, making the information more impactful for a broader audience.

Task Team III: Innovations in Vector Surveillance

Genomic Surveillance for Detection and Monitoring of Insecticide Resistance Mechanisms

Christopher Clarkson, Wellcome Sanger Institute

The presentation introduced the Malaria Vector Genome Observatory, a surveillance network containing over 25,000 whole genome sequences of mosquitoes collected from 32 countries. The observatory has two primary components: *An. gambiae* complex and *Anopheles funestus* subgroup. A key focus has been promoting equitable data analysis over the past decade. Genomic data from all studies are harmonised and stored in Google Cloud, protected by a 24-month embargo to safeguard partners' data while ensuring availability for public health purposes. To simplify and accelerate data analysis, a new software tool called malariagen data was co-developed with the community. This tool enables data analysis using free cloud computing platforms like Google Colab, making it accessible to users from their own devices.

To support this, an online genomic surveillance training course offers hands-on, practical, and interactive lessons using real data, covering key topics like detecting new insecticide resistance forms. All course materials are open access. He discusses upcoming developments with the vector observatory which include an advanced-level genomic surveillance training course, an executive-level genomic surveillance course and new data resources for *An. stephensi* and *Anopheles darlingi*. The presentation further explained how genomic surveillance can help detect IR using whole genome sequencing (WGS). WGS is the only way to easily detect novel signals of selection and is now commercially available with improved turnaround times, and costs are expected to decrease further with emerging technologies like Illumina X and Ultima.

Christopher Clarkson emphasized that WGS should be complemented with amplicon sequencing which is faster, cheaper, and accessible method for validating insecticide resistance loci identified through WGS, with costs expected to decrease further with emerging technologies. In conclusion, the speaker highlighted how genomic surveillance can play a vital role in guiding public health decisions by improving the detection and monitoring of insecticide resistance.

VectorCam: A novel AI Powered Digital Tool for Automated Morphological Identification of Mosquito Species, Sex, and Abdominal Status by Village Health Teams in Uganda: A Randomized Controlled Trial (RCT)

Sunny Patel and Soumyadipta Acharya, Johns Hopkins University

Sunny Patel introduced VectorCam, a low-cost field tool powered by AI for rapid morphological identification of mosquitoes. This smartphone-operated device enables users to identify mosquito species, sex, and abdomen status simply by taking a picture.

A parallel clustered RCT was conducted in Uganda across two environmentally diverse districts, Adjumani and Mayuge, involving 240 households and 48 community health workers (CHWs). The CHWs were split into two groups: one group used VectorCam for mosquito identification and reporting, while the other collected mosquitoes for identification by entomologists. The study evaluated VectorCam's accuracy, completeness, timeliness, throughput, and usability.

The CHWs successfully collected over 73,000 mosquito images. Post-hoc analysis revealed some mislabelling and imaging issues in VectorCam outputs, while the control arm identified a degree of

human error among entomologists. After refining the data by excluding mislabelled and incomplete specimens, VectorCam's sensitivity and specificity aligned with initial predictions. A separate controlled test confirmed VectorCam's superior data completeness and timeliness, with 100% of data uploaded within a week compared to 50% in the control arm over two weeks. VHTs provided positive feedback but emphasized the need for improved training materials. An unexpected finding showed changes in Anopheles populations following IRS in Adjumani, underscoring the potential for VectorCam to track shifts in secondary vectors and species trends.

Looking ahead, VectorCam aims to expand to more districts in Uganda, address diverse mosquito species and geographies, and enhance local manufacturing. Future efforts will integrate AI-powered data for malaria control decisions and promote local ownership of surveillance efforts to improve accuracy, efficiency, and sustainability in vector monitoring.

Can a Simpler Sampling Method Offer Sufficient Information on the Biting Behaviours of Anopheles Mosquitoes

Nilani Chandradeva, Imperial College London

The presentation discusses a new method for measuring mosquito-biting behaviour to assess bed net effectiveness. Nilani Chandradeva explained that instead of hourly mosquito sampling, which is labour-intensive and poses various challenges regarding ethics, logistics and safety. A simplified segmented sampling approach can be used to measure the proportion of bites that occur when people are in bed.

The validation study shows that this segmented method produces results statistically equivalent to hourly sampling, even when there are delays between mosquito biting and human sleeping patterns. The transmission modelling predicts more variability in ITN impact within each sampling method than in between methods, suggesting that using the segmented approach does not affect epidemiological interpretation.

The new method could make data collection less invasive, more cost-effective, and more feasible in hard-to-reach locations and increase data collection opportunities. Though some limitations exist at lower bite rates and in capturing detailed human behaviour patterns. Some future work she discusses includes testing this method across diverse sites, expanding sampling capacity, and exploring alternative ways to record human behaviour.

Streamlining Insecticide Testing: Miniaturized HPLC Method for Rapid and Sustainable Quality Control of Malaria Nets

Amy Guy, LSTM

The presentation highlighted a miniaturized high-performance liquid chromatography (HPLC) method designed to improve the quality control (QC) process for malaria nets in a more efficient and sustainable manner. Unlike the conventional CIPAC method, which is resource-intensive and requires large sample sizes and lengthy processing times, the miniaturized HPLC method offers several advantages. It enables faster sample preparation using smaller volumes of non-hazardous solvents, supports high-throughput analysis, and allows for simultaneous and precise quantification of pyrethroid and pyriproxyfen insecticides.

A comparative study between the two methods demonstrated no significant difference in their ability to detect insecticide content on incorporated nets. Additionally, a preliminary study on coated nets showed that the miniaturized HPLC method successfully detected insecticide levels within the target range. Moving forward, the research team plans to test this method in a GLP-compliant environment to confirm its reliability for QC of both pyrethroid-only and dual AI nets. This innovative approach is expected to streamline the QC process for ITNs, reducing resource requirements, processing time, and hazardous waste. By enhancing the efficiency and sustainability of QC practices, this method has the potential to accelerate the approval and deployment of new ITNs, ultimately improving malaria prevention efforts in endemic regions.

Panel Discussion: How is Insecticide Resistance Data Used in the Real World? What Innovations can Better Support Countries in this Area?

Sunny Patel, Johns Hopkins University; Christopher Clarkson, Wellcome Sanger Institute

Question 1: What are the biggest gaps in the current surveillance system for genetically modified mosquitoes' population?
Christopher Clarkson: I think the biggest challenge in implementing genomic surveillance is funding, beyond that, genomic surveillance is still a relatively new approach, and to make it effective, we first need baseline data collection followed by consistent longitudinal sampling. The key challenge now is integrating genomic surveillance effectively alongside mosquito release programs.

Question 2: How can data on insecticide resistance be better integrated into national malaria control programs?
Christopher Clarkson: I believe one of the biggest challenges we face is integrating genomic surveillance into national malaria control programs. Over the past decade, we've made significant progress in detecting insecticide resistance evolution, and we can now turn around results within weeks, well within proper surveillance timelines. However, the challenge lies in ensuring public health teams understand the potential of genomic surveillance — how affordable, accessible, and powerful it is. To bridge this gap, we're developing an executive training course aimed at informing NMCPs, public health officials, and policymakers about the power of genomic surveillance. The goal is to ensure they are informed know this tool is available to be used.

Question 3: What emerging etch show the most promise in improving insecticide resistance monitoring?
Sunny Patel: I wanted to highlight some exciting developments in insecticide resistance monitoring tools. The WHO has introduced several software platforms, including the resistance vector monitoring dashboard that was presented yesterday, which I found fascinating. I also wanted to give a shout-out to Bcube, a new portable PCR device designed for field use at a low cost. It's portable, meaning mosquitoes no longer need to be transported to centralized labs for testing. The idea is to bring PCR testing directly to the field, making the process faster and more accessible. Something I'm particularly excited about is the potential to integrate these rapid results with predictive analytics. We've heard from several MoH about the lag in mosquito data reporting, and I believe combining real-time data collection with predictive insights could help us better track and anticipate insecticide resistance trends.

Exhibitor Pitch

BASF

Achim Reddig, Director of BASF shared that he has kept the first commercially produced dual insecticide net, Interceptor® G2 as a reminder of the need for continuous innovation. Marking the distribution of 100 million nets, he credited Tom McLean for his guidance and support. As a gesture of gratitude, he presented the net to Tom McLean, recognising his pivotal role in the success of the dual insecticide net initiative.

Goizper

Working closely with IVCC and IRS implementation partners, the Goizper Group has developed the IK Smart Light. The tool was designed to simplify training and enhance IRS delivery by improving application consistency. By reducing over- and under-dosing, the device aims to lower costs and extend the effectiveness of IRS campaigns. Preliminary prototypes have already undergone small-scale testing in several African countries. They aim to launch this new product to the market by the second half of the year.

MESTO

Wolfram Wagner from Mesto that specialises in sprayers and maintenance solutions presented their new battery-operated sprayer system, Mesto Eflow. It now includes an automatic flow control system, replacing manual hand pumping and is equipped with a measurement device at the nozzle, enabling precise dosing and improved coverage accuracy. The system also features a Smart Spray data collection system, which captures real-time data to monitor spray consistency.

Mitsui

Toshiki Ohashi from Mitsui introduced VECTRON T500, an innovative IRS product featuring Tenebenal as its active ingredient. VECTRON T500 is designed with strong efficacy against resistant Anopheles, long residual activity on various wall surfaces, and an odourless, stainless formula. The product is currently registered for use in 22 countries and is under development in five additional countries as part of ongoing registration efforts across Africa.

SORA Technology

Yosuke Kaneko from SORA Technology presented its innovative approach to malaria control, leveraging drones and AI to deliver cost-effective solutions. Emphasizing the value of public-private collaboration, SORA Technology highlighted its successful operational research project in Ghana conducting cost-effectiveness analysis with the drones compared with conventional LSM operation. Results have shown notable improvements in efficiency and cost savings.

Syngenta

Rosemary Peter from Syngenta acknowledged the contributions of those present in achieving recent successes in malaria control. She emphasises Syngenta's commitment to continued collaboration, particularly with the upcoming launch of its new IRS rotation partner, Sovrenta, as part of their ongoing innovative research in integrated solutions for modern IRS programs.

Vestergaard

Patrick Sieyes from Vestergaard highlighted key initiatives aimed at enhancing localisation efforts. These include establishing a bed net manufacturing facility in Nigeria to shift production to the African continent, continuing end-of-life bed net collection initiatives, and exploring sustainable materials for next-generation nets. Vestergaard also plans to strengthen advocacy efforts in the UK, US, and EU to support Global Fund replenishment and promote Africa-centric research.

Work Stream III: Implementing the Global Vector Control Response

Co-Leads: Tessa Knox & Eleanore Sternberg & Joseph Chabi

Meeting overview

The session began with welcome remarks from the three co-leads of Work Stream III. The co-leads emphasised the opportunity to highlight the progress made so far, noting that the resolution supporting this work is available on the WHO website. They stressed that it is the first VC-specific strategy developed for implementing the Global Vector Control Response (GVCR), which serves as a response framework rather than a detailed strategy. An initial progress review of GVCR has indicated some positive developments but also highlighted persistent challenges.

Work Stream III's role is to support ongoing progress by exploring future directions in vector control. While the work stream does not aim to address all aspects of GVCR, it plays a key role in advancing its implementation. Despite funding constraints, GVCR remains a crucial opportunity and serves as a unifying call for action. The three task teams presented their work as part of the day's session (Figure 12).

Task Team 1: Integrated Vector Management (IVM): best practices and local capacity	**Multisectoral engagement and localization** • Rice irrigation and malaria in Nigeria: re-examining the relationship and impact to malaria elimination • The PacMOSSI consortium in the Pacific: regional collaboration for strengthened vector surveillance and control • Panel discussion: Strengthening local capacity for vector control	**Eleanore Sternberg** Mohammad Bala Masu Tessa Knox Kentzo Mumba Martin Akogbeto Mwinyi Khamis Otubea Akrofi
Task Team 2: *Anopheles stephensi* response	***Anopheles stephensi* surveillance and control** • Spatiotemporal distribution and bionomics of *Anopheles stephensi* in different eco-epidemiological settings in Ethiopia • Urban malaria in Ethiopia: The role of *Anopheles stephensi* and urbanization • Optimisation de l'Impact des interventions de lutte antilarvaire pour une gestion durable des vecteurs • *Anopheles stephensi* situational report - Kenya and the AnoSTEP Afrika Project • Overview of knowledge on *Anopheles stephensi* from India	**Susanta Ghosh** Temesgen Ashine Hailu Merga Mohamed Ibrahim Eric Ochomo Chaitali Ghosh
Task Team 3: Vector control in humanitarian emergencies	**Vector control in emergency settings** • Malaria control in humanitarian emergencies handbook • The feasibility and impact of indoor residual spraying and larvicide for malaria control in refugee camps – a 10 year observational study in South Sudan • The effectiveness of long-lasting spatial repellent against malaria in humanitarian crisis settings: results from a two-arm cluster-randomized controlled trial in Northern Nigeria • Questions and discussion	**Michael MacDonald** Joseph Lewinski Sergio Lopes Sergio Lopes
Work Stream 3	WorkStream Priorities and Workplan	Joseph Chabi & Tessa Knox

Figure 12: Agenda for Work Stream III

Task Team I: Integrated Vector Management (IVM) - Best Practices and Local Capacity

Introduction

A call for volunteers was made for Task Team 1, which currently has only one member, highlighting the need for additional support. It was also mentioned that the panel discussion was originally planned to focus on the President's Malaria Initiative (PMI) related activities; however, due to unforeseen circumstances, alternative panellists stepped in at short notice. Their contribution and flexibility were acknowledged with gratitude.

Rice Irrigation and Malaria in Nigeria: Re-examining the Relationship and Impact to Malaria Elimination

Mohammad Bala Masu, NMEP Nigeria

The presentation discussed a collaboration between Nigeria's health and agricultural sectors to address malaria transmission in rice farming areas. The Minister of Health of Nigeria initiated a "rethinking malaria" effort, leading to the identification of several challenges. The Federal Ministry of Agriculture acknowledged mosquito breeding in rice fields as a problem and is now working with health authorities to develop a win-win strategy that maintains rice production while reducing mosquito populations. Potential solutions being explored include biological control methods like rice-fish farming and co-formulation of fertilizer with Bacillus thuringiensis israelensis (Bti).

The key issues highlighted, and actions recommended are:

- Net Use: Address net gaps using targeted campaigns based on evidence. Invest in behavioural research to improve net use and explore demand-driven ITN delivery models.
- Insecticide Resistance: Invest in innovative resistance management strategies. Expand monitoring sites and use data to guide ITN procurement and deployment.
- Weak Multisectoral Collaboration: Map malaria stakeholders, rank their influence, and engage them through technical working group (TWG) & steering committee (SC) meetings at national and state levels.
- Rice Farming and Irrigation: Collaborate with agriculture sectors to assess the malaria impact of rice farming, map rice fields, and engage stakeholders for malaria control efforts.
- Capacity Gaps: Institutionalise capacity building, involve communities in vector control, define clear roles at all levels, appoint focal points for vector control, and develop training curricula for environmental health officers.

Q&A/Discussions

Question: Are there any long-lasting residual effect with Bti formulations? How do they work?
Silas Majambere: From my experience, there have been several attempts to combine larvicides with fertilisers, but these efforts haven't been very successful. The main issue is that fertilisers are typically applied only once during the crop cycle, and few larvicides can survive the flooding process long enough to remain effective. In China, a strategy of alternating flooding and drying has shown promising results in controlling mosquitoes without the need for insecticides, Bti, or other larvicides. While it's possible to mix larvicides with fertilisers, it may only work effectively for one mosquito generation — the long-term impact is uncertain. However, there are other solutions available that activate with flooding, effectively targeting larvae during floods and remaining active through multiple future flooding events.

Susanta Ghosh: Careful planning is essential when it comes to growing rice, especially in managing water accumulation. After ~21 days, stagnant water starts to become an issue, and that's when proper regulation is crucial. This is where the Irrigation Department has a significant role to play in ensuring the water system is well managed to help prevent mosquito breeding.

The PacMOSSI Consortium in the Pacific: Regional Collaboration for Strengthened Vector Surveillance and Control

Tessa Knox, James Cook University

Tessa presented on the Pacific Mosquito Surveillance Strengthening (PacMOSSI), a regional partnership involving 21 Pacific Island Countries and seven international institutions working to improve mosquito surveillance and control. She highlights key regional challenges, including diverse mosquito species, remote populations, limited entomological data, and worsening climate impacts. Workforce capacity is strained, with some countries relying on a single environmental health officer, and many depend heavily on development partners for support.
PacMOSSI's experience highlights that shifting vector control practices takes time but can effectively prevent dengue outbreaks if swift priority actions are taken. Pre-positioning equipment ensures rapid response, and practical, achievable strategic plans improve implementation success. Combining online training with practical sessions enhances learning, while mentorship fosters sustainable collaborations. Effective data collection and presentation are crucial for informing change, and partnerships with research institutions support operational research. Networking and sharing experiences strengthen efforts, while building local capacity remains vital for long-term success.

Looking ahead, PacMOSSI's upcoming activities from April 2024 to June 2028 include follow-up Vector Control Needs Assessments (VCNAs), strategic planning for equality and inclusion, expanded online courses and practical training for trainers, increased baseline surveillance, extended operational research, and a citizen science grant program. A new mentoring program will further enhance South-to-South collaboration and expand in-country technical assistance. Tessa concludes by praising the resilience and dedication of Pacific colleagues.

Q&A/Discussions

Question: Could you explain why malaria appears to be increasing in the Pacific, as some data has suggested?
Tessa Knox: I think the increase in malaria cases is really a multifaceted issue, and it's not as simple as saying it's all down to vector control. We've had a lot of extreme weather events, which have made things even more complicated. On top of that, during the COVID-19 outbreak, we saw weakened health systems in places like Solomon Islands, Vanuatu, and Papua New Guinea — and when you're working with such a limited workforce, that really takes a toll. There's also been some discussion about whether there's an issue with the bed nets, though that doesn't seem to be linked to insecticide resistance. Honestly, I think it's a combination of all these factors coming together.

Panel Discussion: Strengthening Local Capacity for Vector Control

Mwinyi Khamis, NMEP Zanzibar

Question: How does your programme build skills for VS and control and how do you ensure the sustainability of these efforts?
Mwinyi Khamis: Our vector control officers are highly trained, with many having completed long-term training both locally and internationally. Some have enrolled in two-year programs, while others have pursued advanced studies, such as a master's program in Sudan and South Africa. We've collaborated with partners like the Ifakara Institute, Swiss TPH, Global Fund, and PMI to provide technical support. Additionally, our team actively participates in conferences on malaria. In terms of sustainability, this remains a challenge as most of our implementations are donor-dependent. However, we've introduced community health workers into our malaria control strategy who are now involved at district and grassroots levels, with the first cohort graduating last year. They have been trained to implement community-based malaria elimination, including vector control and surveillance. Their training covers LSM, identifying and treating potential breeding sites, mosquito identification, and larval counting. At the program level, we have an advanced system in place, though we welcome additional support from interested institutions. Despite the challenges, I believe we are making good progress.

Otubea Akrofi, NMEP Ghana

Question: What challenges do you face in building and maintaining capacity for vector surveillance and control?
Otubea Akrofi: Collaboration is key to achieving success in vector surveillance and control. With the support of PMI, capacity building has been significantly strengthened. For example, during the government-funded IRS projects, PMI experts provided training across various IRS implementation areas.
Community health workers have been trained not only to collect mosquitoes but also to perform basic identification and data entry. However, maintaining quality data remains a challenge, and efforts are underway to establish a quality assurance system. Another challenge is staff retention. Trained individuals often leave for educational opportunities or better job prospects, requiring constant retraining of new recruits. Additionally, many participants, particularly women, show limited understanding or interest in the purpose of surveillance and control efforts. Lastly, funding remains a major constraint. While effective plans have been developed, the resources to implement them, even simple initiatives like community training on mosquito identification, are currently lacking.

Martin Akogbeto, CREC/MoH

Question: Are there challenges you see specifically with bringing new tools or technology to improve malaria vector control?
Martin Akogbeto: Current malaria control efforts are facing stagnation, with data showing limited progress under the existing protocols. The numbers are not encouraging, and a key challenge lies in the lack of community engagement and compliance. Low adherence to recommended interventions hampers success, and monitoring these efforts remains complex. As a result, the initial intervention often becomes the most critical step, stressing the need for improved strategies to foster community cooperation.

Kentzo Mumba, NMEP Zambia

Question: Does your programme integrate capacity strengthening efforts with other departments, ministries, or partners to tackle other vector-borne diseases? If so, how and what benefits or challenges have you encountered?
Kentzo Mumba: Zambia has learned valuable lessons from its partners, particularly the importance of collaborating with institutions to train individuals. Harmonising policies across institutions has been challenging, but efforts to align practices are ongoing. To address inconsistencies in community worker payments, an agreement has been reached to place them on contract terms, ensuring uniformity and stability. Negotiations are also underway to enable the country to purchase its own insecticides, equipment, and other essential resources to reduce reliance on external funding. Sustainability efforts have been further supported by innovative fundraising methods, such as donation boxes at airports that contribute to funding community bicycles for surveillance activities. Additionally, the program receives approximately $35,000 USD per month to sustain these initiatives.

Task team II: *Anopheles stephensi* Response

Introduction

The session outlined the development of a five-year prioritised *An. stephensi* research agenda. The initiative aims to identify key knowledge gaps and prioritise research questions to guide future efforts and inform decision-making.
The process involved convening leading researchers and program managers through virtual discussions. Five key topic areas were identified: surveillance (entomological and epidemiological), control, genomics, modelling (mathematical and geospatial), and human behaviour. Each working group comprised 12-15 participants with two leads, holding 2-3 meetings to discuss and prioritise research needs.
The outcome included a ranked prioritisation of research gaps, a consensus summary document, and a survey sent to endemic country representatives for feedback. This prioritisation aims to support funders and researchers by providing clear guidance, accelerating action, and creating collaboration opportunities.

Spatiotemporal Distribution and Bionomics of *Anopheles stephensi* in Different Eco-epidemiological Settings in Ethiopia

Temesgen Ashine, AHRI

The presentation highlights the expanding distribution of *An. stephensi* in Ethiopia, particularly following a malaria outbreak in Dire Dawa in 2022. Investigations linked the outbreak to overlapping spatial patterns between *An. stephensi* and Plasmodium infections, suggesting *An. stephensi* played a role in the outbreak. This prompted further research into its distribution, bionomics, and household exposure risks.

Entomological surveys revealed that despite being recently introduced to Ethiopia, *An. stephensi* was the second most abundant species in study urban centres. Notably, its presence was detected for the first time in Assosa, western Ethiopia. Out of 26 surveyed sites, 8 were positive for *An. stephensi* (immature or adult stages), with 4 of these sites recording its presence in every collection round. Household exposure varied across locations: 30% in Danan (eastern), 26% in Awash Sebat Kilo (central), and 18% in Metehara (central). The risk was highest near the initial detection site in Danan, where adults were collected early in the study. A significant proportion of *An. stephensi* were found

to have fed on humans, reinforcing its potential to transmit malaria. A 2024 study exploring breeding habitats identified *An. stephensi* as the dominant species across all collection months in Metehara. While it commonly bred in containers, it was also found in groundwater sources.

The findings confirm *An. stephensi* as a well-adapted and dominant vector in eastern Ethiopia, with ongoing expansion westward. Urgent action is required to implement strategies that limit its spread and contain its establishment. Further studies are needed to better understand its behaviour and susceptibility to interventions.

Urban Malaria in Ethiopia: The Role of *Anopheles stephensi* and Urbanization

Hailu Merga, Jimma University

The presentation explored the factors contributing to urban malaria in Eastern Ethiopia, focusing on the impact of unplanned urbanisation and the increasing presence of *An. stephensi*. This study was conducted in 2023 in Dire Dawa using a case-control design. The sample population included 132 malaria-positive cases, who either had a fever (≥37.5 °C) or a recent history of fever (≤48 hours) and confirmed infection through microscopy/PCR. Additionally, 264 control participants, from the same age and sex group but negative for infection, were also included in the study. To investigate the presence of mosquito vectors, CDC light traps and Prokopack traps were used to collect mosquitoes from the selected households of both cases and controls.
A total of 33 adult Anopheles mosquitoes were collected, with 14 identified as *An. stephensi* and the remaining identified as *An. gambiae* s.l. Several key factors were identified as determinants of malaria infection in urban settings. These included the presence of eaves and other holes in household walls, a history of malaria diagnosis, and recent travel. Additional factors such as livestock ownership, stagnant water near households, inconsistent bed net use, and limited community knowledge were also found to contribute to malaria risk.
The study concluded that for effective urban malaria control, it is essential to strengthen vector control measures, improve housing conditions, promote consistent bed net use, and enhance community awareness. The presence of *An. stephensi* in urban areas underscores the need for integrated control strategies. As a next step, the study recommends linking household data with urbanisation variables using PCA to further understand transmission patterns. Expanding mosquito collection efforts across additional households is also suggested to improve insights into the distribution and behaviour of *An. stephensi*.

Anopheles stephensi Situational Report (Kenya Anostep): AFRIKA Project

Eric Ochomo, Kenya Medical Research Institute

The presentation began by addressing the current *An. stephensi* situation in Kenya. The species was first detected in Marsabit and Turkana in 2022 through larval sampling across various habitats such as watering troughs, waste sites, containers, and car tyres. Unlike Ethiopia and Djibouti, where *An. stephensi* was predominantly captured using Prokopack and BG Sentinel traps, the most effective trapping methods in Kenya were CDC and UV light traps. As of August 2024, *An. stephensi* has spread to seven counties, primarily in northern Kenya. Interestingly, there has been a noticeable increase in *P. vivax* malaria cases in these regions.

Eric highlighted challenges faced in Marsabit's longitudinal surveillance, which was inconsistent due to funding constraints. Results from this surveillance revealed irregular mosquito findings, particularly in October 2023, when heavy rainfall was recorded in Marsabit, yet no mosquitoes were

found. This unexpected finding underscores the need for further research to better understand *An. stephensi* behaviour, especially regarding seasonal variations and environmental conditions.

Genomic analysis of Kenyan *An. stephensi* populations revealed a similar genetic structure to populations in Hawassa, southern Ethiopia. Observations indicate that *An. stephensi* shows a strong affinity for specific temperatures, seasonality, and precipitation patterns, predominantly in northern Kenya. Modelling predicts a wider distribution of *An. stephensi* beyond the currently known positive sites, with potential overlaps in neighbouring counties.

The presentation introduced the AnoSTEP AFRIKA Project, funded by the Wellcome Trust, which aims to provide a multi-country, multi-disciplinary investigation of *An. stephensi* across diverse ecological settings in Africa through five key work packages:

- **WP1:** Utilising spatial ecological adaptive sampling models to improve *An. stephensi* sampling strategies.
- **WP2:** Assessing the bionomics and the vector's relative contribution to malaria transmission.
- **WP3:** Employing genomic approaches to confirm species identification, infection status, population structure, and spread.
- **WP4:** Investigating the influence of environmental and human-related factors on *An. stephensi* distribution.
- **WP5:** Exploring the vector's productivity and fitness across various larval habitats.

This comprehensive approach aims to improve understanding of *An. stephensi* and guide targeted control strategies across Africa.

Overview of Knowledge on *Anopheles stephensi* from India

Chaitali Ghosh, Tata Institute for Genetics and Society

The presentation explored the biology, distribution, and control of *An. stephensi*, a significant invasive malaria vector found in the Indian subcontinent, the Middle East, and increasingly in Africa. Chaitali highlights the three biological variants of *An. Stephensi:* type, intermediate, and mysorensis, each differing in egg morphology and vectorial competence.

The presentation detailed research conducted at the Tata Institute, presenting the first detailed report on the establishment of two isofemale lines of the type and intermediate biological forms. These homogeneous mosquito lines, developed using isofemale techniques, were used to assess insecticide susceptibility and vector competence with *P. berghei* and *P. falciparum*. Key life table parameters such as fecundity, egg hatchability, larval and pupal counts, sex ratio, female lifespan, and feeding frequency were recorded.

Results indicated that initial inbreeding depression was overcome, with no significant differences in wing and egg size between parental and isofemale lines in later generations. IndCh and IndInt strains showed varying resistance to insecticides from all four major classes. The study also revealed a notable shift in vectorial competence, with the type-form demonstrating higher competence than the intermediate-form.

The establishment of these isofemale lines provides a valuable resource for investigating genetic and phenotypic traits, improving insights into susceptibility, resistance, and vector competence. These lines also enable studies on host-parasite interactions and the identification of factors contributing to altered susceptibility and increased vector competence in *An. stephensi.* The presentation

concludes with updates on recent discoveries, including a wing mutant and ongoing reference genome sequencing efforts.

Task Team III: Vector Control in Humanitarian Emergencies

Introduction by Michael Macdonald

Current Situation and Challenges

In 2024, over 120 million people are displaced worldwide, with nearly two-thirds residing in malaria-endemic regions. Malaria remains the second leading cause of illness among refugees in these areas. Rising displacement and conflict have intensified malaria transmission, driven by disrupted healthcare systems, overcrowded conditions, and poor sanitation, which create ideal environments for mosquito breeding. Efforts to control malaria are further challenged by limited funding, fragmented coordination, and restrictive regulations, leading to insufficient resources for vital vector control tools such as ITNs and IRS.

Climate Change Impact

Climate change is expected to further alter malaria transmission patterns, posing additional challenges for control efforts. Combined with increased population movement, these environmental shifts may intensify the spread and impact of malaria.

Vector Control in Emergency Settings

A new approach is essential to improve vector control in emergency settings, focusing on proactive and pre-emptive measures to enhance access and utilisation of VC tools, despite the associated costs. The emphasis is on integrating VC strategies into emergency response frameworks, adopting new tools and approaches, and promoting multisectoral collaboration. The task team's efforts aim to develop these strategies within their work streams.

- Priority 1: Expanding the vector control toolbox in humanitarian settings
- Priority 2: Strengthening operational research in emergency settings
- Priority 3: Documenting and sharing best practices

Updates on the Malaria and Emergencies Handbook

The revised version of the 2013 handbook is near completion. It incorporates new WHO guidance in all areas including VC and aims to be more actionable for emergency responders. The handbook will include comprehensive information on various vector control strategies such as ITNs, IRS, and LSM. Additionally, the expansion of the vector control toolbox includes innovative tools like passive emanators, ATSBs, and insecticide-treated textiles.

A look to the future, priorities and opportunities

For 2025-2026, the priorities include advocacy through engaging with key stakeholders, coordination, expanding the vector control toolbox through finalising Malaria and Emergency Handbook, and resource mobilisation to help coordinate funding.

The Feasibility and Impact of Indoor Residual Spraying and Larvicide for Malaria Control in Refugee Camps – a 10-year Observational Study in South Sudan

Sergio Lopes, The MENTOR Initiative

The presentation focused on a 10-year observational study examining the feasibility and impact of IRS and larvicide interventions for malaria control in refugee camps in South Sudan. In 2023, over 360 million people were affected by humanitarian crises, with displacement increasing exposure to vector-borne diseases such as malaria. Since 2004, the Mentor Initiative has been actively responding to such emergencies, focusing on vector-borne disease prevention and control through integrated vector management (IVM), which includes IRS, ITNs, and LSM. However, these interventions are frequently constrained by limited funding.

The case study detailed malaria control efforts in Maban, South Sudan, following the arrival of 100,000 refugees in 2012. Severe flooding that year exacerbated malaria cases, and while LLIN distribution in 2013 offered some relief, it proved insufficient to control the outbreak. In 2023, renewed conflict triggered another influx of displaced populations, placing additional strain on existing malaria control efforts. In response, IVM strategies were adapted to meet the unique demands of this emergency context.

IRS campaigns in these settings included rotating active ingredients to mitigate insecticide resistance, while larvicide campaigns targeted mosquito breeding sites. The success of these interventions relied heavily on the ability to adapt strategies quickly in response to changing conditions. Monitoring, evaluation, and learning (MEAL) systems were integrated to assess coverage, track entomological patterns, and evaluate epidemiological indicators to guide decision-making.
Key findings revealed that in 2016, delays in IRS implementation caused by access issues and flooding resulted in a significant spike in malaria cases, highlighting the importance of timely intervention. Results from 2022-2023 indicated evidence of pyrethroid resistance, reinforcing the need to rotate insecticides to maintain effectiveness. Despite these challenges, the study demonstrated that IVM strategies, particularly IRS and larvicide campaigns, are both feasible and effective in humanitarian settings.
Several factors contributed to the success of these interventions. On-site training, supervision, and logistical support played a crucial role, while entomological monitoring ensured that decisions were guided by accurate data. Insecticide rotation was key in delaying resistance development, while the inclusion of larvicides significantly enhanced malaria control outcomes when combined with IRS.
In conclusion, IRS has proven to be a practical and effective tool in humanitarian settings, particularly suited to the shelter types found in refugee camps. Successful campaigns in Mozambique and Nigeria further demonstrated the potential for this approach when well-planned and coordinated. Despite its importance, entomological surveillance is often the first element to be cut from budgets, even though it remains vital for monitoring intervention success and guiding future strategies.

The Effectiveness of Long-lasting Spatial Repellent against Malaria in Humanitarian Crisis Settings: Results from a Two-arm Cluster-Randomized Controlled Trial in Northern Nigeria

Sergio Lopes, The MENTOR Initiative

The presentation highlighted the ongoing search for innovative and effective tools suited to humanitarian contexts, emphasising the importance of using the right tool in the right setting. Recent collaboration with SCJ has led to the development of the Guardian mosquito shield SR, an

updated version of the original Mosquito Shield. The Guardian SR is designed for ease of use, lasting up to 12 months after opening, making it ideal for rapid response situations and remote, hard-to-reach areas.

Results from a two-arm cluster RCT in Northern Nigeria demonstrated a lower mean indoor density of blood-fed *Anopheles* and *Culex* mosquitoes in the intervention arm compared to the control arm, though this difference was not statistically significant. However, observed trends suggest potential benefits, with further analysis planned to better understand these findings. Epidemiological outcomes mirrored the entomological trends, where clinical malaria cases were significantly lower in the intervention arm than in the control arm. Modelling analysis suggested that the intervention's effect diminished between the fourth and fifth month, prompting further investigation into this decline and its implications for deployment strategies. Surveys conducted alongside the study revealed high retention rates, positive user feedback, and a strong perception of the tool's effectiveness. No reported side effects and a high willingness to continue using the product further supported its acceptability.

Key points emphasised included the suitability of SRs for humanitarian emergencies due to their lightweight design, high portability, and ease of implementation requiring minimal expertise. SRs are stable for long-term stockpiling, require little behavioural change, and are unlikely to be repurposed for other uses. Their ability to overcome logistical challenges makes SRs particularly valuable in unstable, remote, and highly mobile populations, where movement occurs with little warning.

Q&A/Discussions

Question 1: Has there been any contact with UN emergency clusters, such as the Shelter Cluster or the WASH Cluster?
Michael MacDonald: If you check our website, we actually have a section dedicated to vector control in humanitarian emergencies. There's a record of a meeting we held just before COVID at the UNHCR office in Geneva in March 2020, where we brought together the Shelter and WASH clusters to discuss their vector control needs. So, yes, we've been engaged with them in the past.
That said, one of the ongoing challenges is ensuring better collaboration across sectors. You've got the Shelter teams, the WASH teams, the Health teams, and often the WASH teams are putting in boreholes without proper drainage, which then become mosquito breeding sites. So, improving coordination between these clusters is crucial. I'd really encourage you to visit the website and check out some of the previous discussions on this.

Question 2: Given the urgency in humanitarian crises, especially in refugee camps, would donors consider pre-funding strategic contingency stock to ensure timely delivery, particularly in regions with complex logistics like Port Sudan and White Nile?
Michael MacDonald: You have raised a valid point about logistical challenges in emergency situations. Pakistan's severe flooding led to population displacement serves as a strong example, where efforts to deploy IRS to the population were hindered. In such cases, SR like Guardian offer a practical solution, as 2,000 units (weighing 12 kg) can fit into one box and be easily transported, even by motorcycle, highlighting their portability advantage.

Question 3: I think one of the key steps in mobilising more people to get involved in the task team is identifying the right organizations. I'm not particularly familiar with all the organisations that are active in this space. I believe having a comprehensive list of these groups would be a great starting point — that way, we can begin reaching out and engaging with them directly.
Michael MacDonald: In response to the question about mobilizing organizations for the task team, I'd recommend visiting reliefweb.org, which provides comprehensive information about agencies

working in the humanitarian sphere. Groups such as CRS, Save the Children, and IRC are actively involved in emergency relief efforts. One of the major barriers to IRS implementation in such contexts is the requirement for environmental compliance studies, particularly for organizations receiving US funding. Mentor Initiative had the expertise to navigate this process, enabling them to conduct IRS effectively. To address this challenge, efforts have been made to build the capacity of agencies like Catholic Relief Services, International Rescue Committee, American Refugee Committee, and Oxfam to engage more actively in vector control efforts. Often, organizations unfamiliar with mosquito control may hesitate to get involved, assuming it's best left to specialists. However, by providing guidance and support, we can encourage more NGOs, faith-based groups, and humanitarian agencies to adopt these life-saving interventions.

Question 4: I think we need to think of strategies to bring them into the VCWG.
Michael MacDonald: Yes certainly, we need to be advocating for that.

Work Stream Priorities and Workplan

Co-leads: Tessa Knox, Joseph Chabi & Eleanore Sternberg

A Mentimeter session was conducted to gather insights on the direction of the WS and identify key priorities moving forward. Participants were encouraged to provide input. The results of the mentimeter is available on the RBM VCWG website.
Question 1: What stakeholder group do you represent?
Question 2: What is your perspective on Global Vector Control response?
Question 3: TT1 activities – rank the importance of these proposed activities

- Compile vector control needs assessment
- Define prioritised research agenda to support GVCR implementation
- Map research institution capacity to support molecular and other testing
- Maintain and share list of training with VCWG

Question 4: Case studies - rate the importance of documenting examples of on a scale from not important to very important:

- Functional IVM programs
- Functional inter-ministerial taskforces for IVM
- Urban legislation to support vector surveillance and control
- Productive collaboration between NMCPs and research institute
- Effective integration of disease, vector and intervention data

Question 5: TT2- rank the importance of these proposed activities from 1-4:

- Conduct more country cases studies on *An. stephensi* surveillance /control with focus on invasions in Africa
- Collate country action plans on *An. stephensi*
- Collate protocols for *An. stephensi* surveillance and control
- Produce periodic reviews of new evidence on *An. stephensi* especially spread

Question 6: TT3- rank the importance of these proposed activities from 1-5:

- Compile implementation guidance on vector control in emergencies
- Generate summary of best practices for vector control in emergencies
- Devise position statement on evidence required for vector control in emergencies
- Document case studies on use of emerging technologies in emergencies

- Establish knowledge sharing platform of vector control in emergencies

Question 7: WS3 online webinars - indicate your level of interest in these topics on a scale from not interested to very interested:

- Integrated urban malaria vector control
- Integrated information systems for data on disease, vectors and interventions
- Mechanism of *An. stephensi* spread
- Country experience with *An. stephensi* surveillance and control
- Implementing vector control in emergencies

Question 8: Suggest other priority WS3 activities to support GVCR implementation

LSM Task Team 5-year Plan and Larviciding Evaluation Framework

Edward Thomsen, MEI, USCF

The LSM task team presented their work plan priorities grouped into three categories: identifying gaps, generating guidance/evidence, and improving implementation (Figure 13).

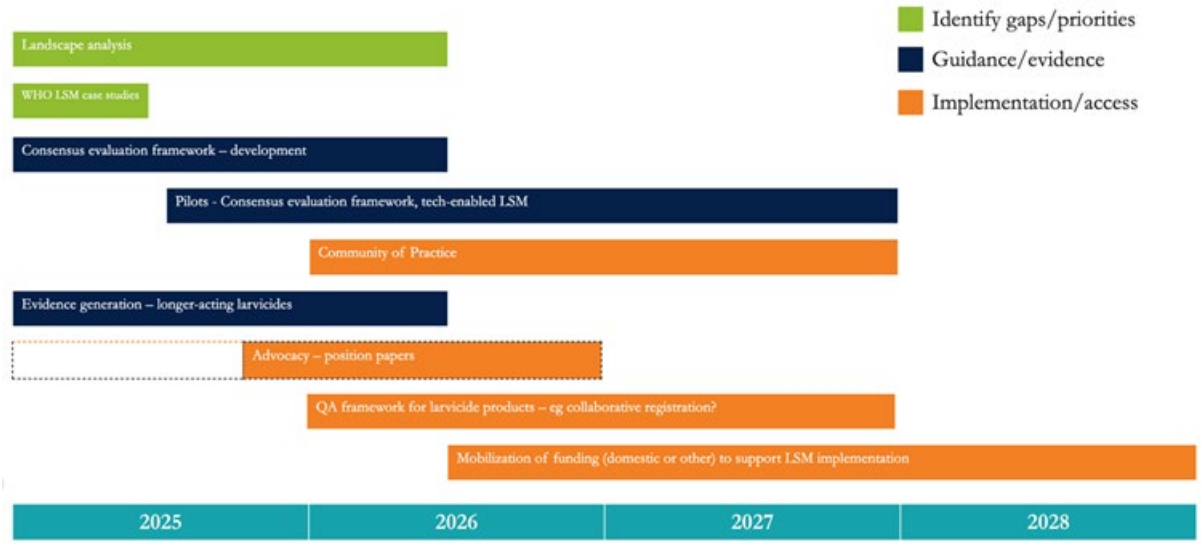


Figure 13: LSM task team work plan priorities

Consensus Building: Larviciding evaluation framework

The presentation outlines a plan to develop a standardized evaluation framework for larviciding programs in Africa, with pilot implementations planned for Uganda and Ghana. The objective is to address the evidence gap in larviciding implementation, particularly given the WHO's classification of larviciding impact evidence as low certainty.

Recognizing the limitations of RCTs, which are often costly and impractical for larviciding interventions, the proposed framework will use quasi-experimental designs as a viable alternative. These designs can provide credible evidence if conducted effectively.

The framework will emphasize both process and impact evaluation (Figure 14). Process evaluation will assess product quality, coverage, team performance, and community acceptance, while impact evaluation will focus on adult mosquito data, human behaviour observations, and malaria case data.

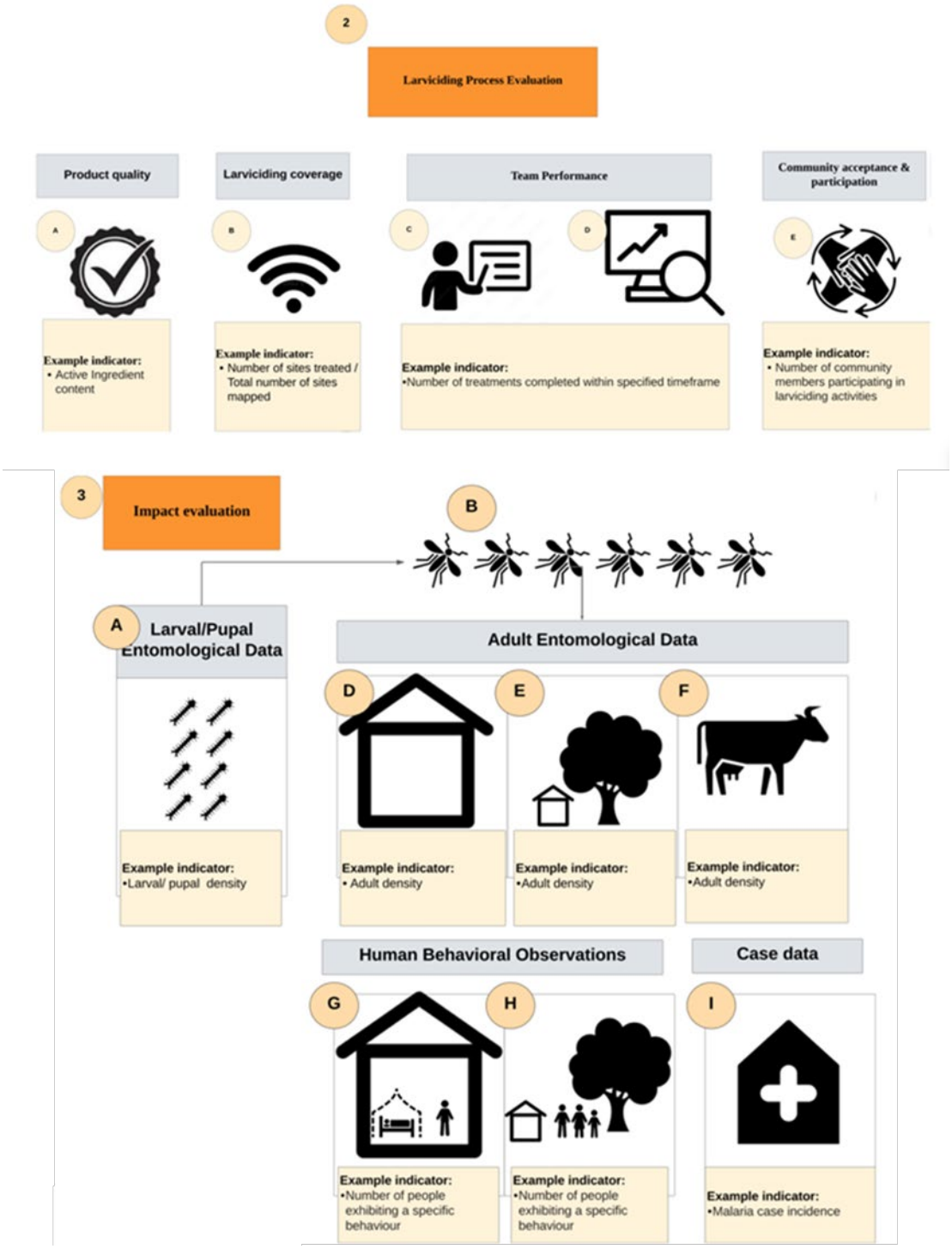


Figure 14: Larviciding evaluation framework

To refine the proposed framework, the presenter invited participants with field experience to provide their insights through group discussions. The participants were divided into teams to review and expand the proposed indicators. Their discussions centred around key questions designed to improve the framework's effectiveness and applicability.

Round 1

- Group 1: What would be the key process indicators and data elements for evaluating the implementation of larviciding program?
- Group 2: What would be the key impact indicators and data elements for evaluating the implementation of a larviciding program?

Round 2

- Group 1
  - Step 1: Review the list of impact indicators and data elements developed by Group 2. Add new indicators and data elements as necessary and remove any that are no longer relevant.
  - Step 2: Prioritize the refined list of indicators by ranking them in order of priority.
- Group 2
  - Step 1: Review the list of process indicators and data elements developed by Group 1. Add new indicators and data elements as necessary, and remove any that are no longer relevant
  - Step 2: Prioritize the refined list of indicators by ranking them in order of priority.

Session 3: Roundtable on Localization, Local Manufacturing, Local Leadership and Local Funding: where are we and where do we need to be?

Moderators: Corine Ngufor & El Hadji Amadou Niang

Roundtable: David Malone (Gates Foundation), Patrick Sieyes (Vestergaard), Rock Aikpon (NMCP Benin), Otubea Akrofi (NMEP Ghana), Justin Mcbeath (IVCC), Dominic Schuler (WHO), Faith Mangwanya (Unitaid)

Part 1: Introduction

While effective vector control is crucial in combating malaria, sustainability is heavily reliant on local leadership and support systems. Corine Ngufor pointed out the impact of reduced U.S. funding, underscoring the urgent need for countries to develop self-sustaining strategies and emphasises the importance of local manufacturing, leadership, and funding, posing a key question: What actions can countries take, and how can the global community support efforts to ensure these interventions are sustainable and country-driven? This focus on localisation is central to the discussion.

Part 2: Localisation of Vector Control Strategies, Research and Innovation

Dominic Schuler, WHO

Localising malaria vector control means adapting strategies to the specific environmental, social, and economic conditions of a community. This ensures that interventions are sustainable, effective, and culturally acceptable.
Question: What are some of the key strategies that ensure localisation of malaria vector control? What best practices exist for localising malaria vector control?
Dominic Schuler: From a PQ perspective, our focus is really on expanding access to safe, high-quality, and effective vector control products. The whole purpose of the program is to create opportunities to expand the toolbox of vector control solutions. Without a diverse toolbox, it's difficult to even begin conversations about how best to implement tailored, locally driven interventions. While PQ doesn't guide specific implementation strategies, what we do aim to provide is detailed information through our public assessment reports. These reports present all the data we've evaluated, giving implementers and product selectors the evidence they need to tailor their approaches to fit local contexts effectively.

David Malone, Gates Foundation

The Gates foundation supports a lot of locally driven research and innovation initiatives in malaria vector control in Africa.
Question: Can you tell us more about this? What are the benefits of supporting locally driven research and innovation in malaria control compared to externally led?
David Malone: From the Gates Foundation perspective, we recognise that malaria challenges are fundamentally local, and the people best positioned to address them are local researchers. That's why we've always prioritised building capacity and supporting research at the local level. We've seen many research groups in Africa producing excellent work and demonstrating leadership within their communities. Yesterday's presentations highlighted some excellent examples of localised innovations. The VectorCam tool and the field-deployable polymerase chain reaction (PCR) machine both demonstrate how data analysis can happen closer to the field.

Corrine Ngufor: That's a great point you've made. I believe that supporting local researchers is key to progressing in research and innovation.

Justin McBeath, IVCC

IVCC has been at the forefront working with industry partners to develop novel malaria vector control products. We have seen new highly effective vector control products come to market thanks to this product development partnership.

Question: What is IVCC's approach towards local leadership in vector control product development. How do you ensure that the communities that you serve are part of your mission?
Justin McBeath: I believe that all malaria programmes should have the freedom to choose products that best suit their needs — in terms of quality, cost, and overall suitability. At IVCC, we ensure that product development always starts with the customer because it's about understanding what the customer needs. One of the complexities in the vector control space is that our "customers" are not just the end-users — they're also the decision-makers, the funders, and those implementing the interventions. So when we talk about serving the community, we need to factor in all of these stakeholders to ensure sustainability and that the product is truly fit for purpose.
From IVCC's perspective, while we work closely with industry partners, the products we support are ultimately their products. Decisions around aspects like local manufacturing are led by industry, but we do provide insights and guidance where we can, to ensure products are suitable and meet the needs of the communities they're designed for. In terms of product development, we have a dedicated market access team that spends a lot of time gathering insights to align with customer needs. We also have core-funded sites in sub-Saharan Africa where much of the development and assessment work takes place.
Once a product is ready for introduction, we engage directly with country partners to ensure access, affordability, and suitability are addressed. On top of that, we have our Advisory Committee, which includes country-led input to help guide product development, ensuring that local perspectives are built into the process.

Part 3: Local Leadership in Malaria Vector Control

Rock Aikpon, NMEP Benin and Otubea Akrofi, NMEP Ghana

The concept of localisation requires that we have the right local leadership and appropriate national policies and regulations in place that encourage locally driven interventions, decision making and country ownership.
Question: What national policies, regulations and community-level leadership initiatives are in place in Benin/Ghana that ensure country leadership in malaria vector control?
Rock Aikpon: Currently in Benin, there is a clear political commitment and establishment of a clear vision. This vision is shared with our stakeholders and the national strategic plan. We all have different stakeholders who have different activities and a co-financing agreement in place. The government has committed to taking care of all malaria inputs, whether they are drug inputs or mosquitos nets. Mosquito nets for the most vulnerable groups, pregnant women and children, are provided by the national budget. The Ministry of Health (MoH) has strengthened its technical platform and built capacity in research. There is also a thematic working work who is working to implement programs better.
Otubea Akrofi: In Ghana, the NMEP is mandated by the MoH to oversee all malaria control activities, including vector control interventions. All malaria-related initiatives must align with the NMEP's directives. Currently, Ghana follows the Elimination Strategic Plan 2024-2028, which outlines the

country's malaria interventions and activities. Just recently, we have developed Vector Control Policy and Guidelines, which provide detailed instructions for implementing specific interventions.
To ensure proper oversight, Ghana has established the Malaria Vector Control Oversight Committee, which includes representatives from academia, research institutions, regulators, implementers, funders, and even manufacturers. This committee reviews all proposed vector control interventions to ensure they align with national guidelines before implementation. Political commitment has also played a vital role in Ghana's goal toward malaria elimination. For instance, new leadership in the Greater Accra Region has introduced a community-wide environmental management initiative. The Regional Minister has dedicated the first Saturday of each month for households and public spaces like markets to undergo clean-up activities to reduce mosquito breeding sites.
Before implementing any intervention, NMEP holds stakeholder meetings with key community leaders to inform and engage them in the process. This community ownership approach ensures that local leaders take the lead, allowing interventions to gain greater acceptance. The NMEP has been mandated to expand its focus beyond malaria to include other vector-borne diseases.

Part 4: Local Manufacturing for Sustainable Impact

Faith Mangwanya, UnitAid

Question: Can you tell us more about Unitaid's initiatives to improve market access to health products in endemic countries. How does Unitaid support local/regional manufacturing of malaria vector control products in endemic countries?
Faith Mangwanya: There are currently limited number of LLIN manufacturers in Africa, with East Africa emerging as a key hub for both African-founded and international manufacturers, particularly in Uganda, Tanzania, and Rwanda. There is a substantial gap between domestic supply chains and the high demand for ITNs in sub-Saharan Africa, which is currently met through imports. Several critical barriers have been identified that hinder domestic manufacturers from entering the market. These include: barriers to technology transfer, limited access to capital, complex WHO PQ process, insufficient anchor demand and high operational costs.
To address these challenges, Unitaid is adopting a comprehensive value chain approach based on three pillars: IP and technology procurement, market shaping, and quality and regulatory systems (Figure 15). In its initial interventions, Unitaid aims to support a wide range of products, including malaria diagnostics, therapeutics, and LLIN manufacturing. The second phase of the project will focus specifically on supporting LLIN production. Currently in the project design phase, Unitaid plans to launch its investment initiative in the third quarter of this year to promote regional manufacturing and strengthen domestic supply chains.

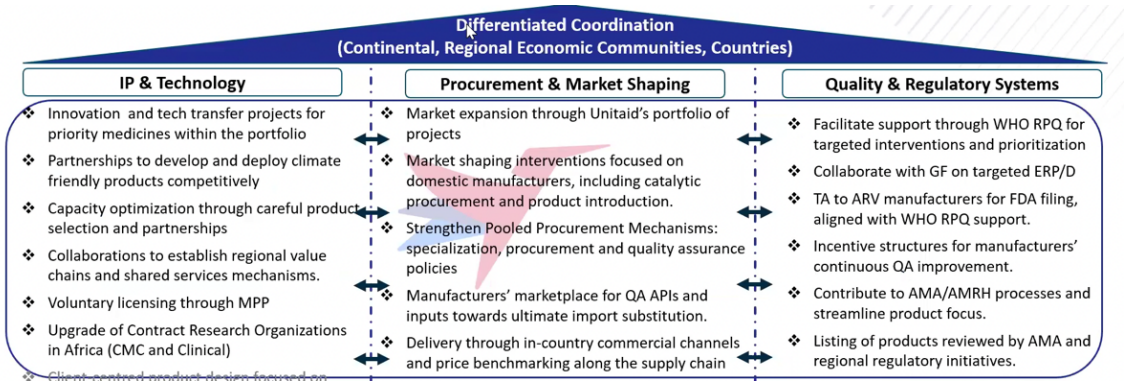


Figure 15: Unitaid provisonal framework for market-based regional manufacturing.

Dominic Schuler, WHO

Question: The WHO/PQT-VCP has a mandate to ensure access to quality vector control products. Can you tell us about what initiatives are in place to build regulatory compliance for vector control product development and how you ensure that endemic countries are involved in this process?
Dominic Schuler: I think one important point to highlight about the PQ process in vector control; there isn't always the voice of the end-user involved in the product assessment process or even have a choice in the products they end up using. That's why the standards we set through PQ are essential; they create a level playing field across all manufacturers and our role in PQ is to make sure we provide opportunities for engagement with all manufacturers.
We typically hold around 150 one-on-one meetings with manufacturers each year. These sessions focus on sharing information about requirements, guidelines, and dossier development. Our doors are always open to prospective manufacturers, and we aim to be available at various meetings to offer support. Great initiatives have emerged from the likes of Gates Foundation and CHAI who support manufacturers in different parts of the world. We're very supportive of local manufacturing and tech transfer as well. Within WHO, we have a division of Access to Medicines and Health Products that specialises in creating these kinds of opportunities for tech transfer. If anyone is looking to explore those opportunities, we're more than happy to connect people with the right teams to move those ideas forward.
Lastly, I want to stress that there's really no such thing as "partial compliance" when it comes to regulatory assessments for vector control products. Ensuring quality is non-negotiable; it's the foundation upon which safety and efficacy assessments are built, and we can't compromise on that.
Corine Ngufor: I think it would be great to see how some of those regulations could be better supported to help local manufacturers and find ways to make the process a bit easier for them.

Patrick Sieyes, Vestergaard

Question: What are some of these challenges that have prevented the establishment of multiple major ITN factories across Africa? What is Vestergaard doing as a major manufacturer of ITNs to address these challenges?
Patrick Sieyes: So, four key points to unpack here. Firstly, the initial investment in setting up these facilities is considerable. Establishing local manufacturing requires specialised machinery, significant investment in quality control systems, and importantly, the transfer of skills and technology developed over the years onto the African continent. Secondly, the supply chain presents challenges. Producing bed nets requires importing essential materials like insecticides and polymers, which are not readily available in Africa considering manufacturing has been concentrated in Asia for over two decades. Thirdly, there's the issue of tax reforms. Currently, importing finished LLINs into Africa is duty-free, yet raw materials for local production are subject to import duties. This creates a clear imbalance, and there's an opportunity to work closely with governments to introduce necessary tax concessions to support local manufacturing. Finally, balancing cost-effectiveness in local manufacturing remains challenging, particularly when competing with lower-cost imports from Asia. Many of you may have seen that we recently signed a memorandum of understanding with the Government of Nigeria. This is part of our efforts to build healthy value chains in the country. It's important to highlight that this isn't Vestergaard independently setting up a manufacturing facility; rather, it's a joint venture with a local partner. We believe this is the responsible approach; it's not about Vestergaard entering Africa, establishing production, and repatriating profits. Instead, this initiative aims to foster genuine local manufacturing and economic growth. We've identified a local partner and are now navigating the challenges I previously mentioned.

Part 5: Local Resource Mobilisation for Malaria Vector Control Intervention

Many African countries rely heavily on external donors like The Global Fund, UNITAID, WHO, and USAID for malaria control. However, to ensure long-term sustainability, countries must mobilize domestic resources and reduce dependence on foreign aid. Given the recent developments with USAID funding, this has become even more critical.

Otubea Akrofi, NMEP Ghana

Question: What strategies are in place to reduce dependence on foreign aid and mobilise local funding for malaria vector control in Ghana?
Otubea Akrofi: We recognise the government's responsibility to provide for its people. Through advocating for greater government involvement in malaria control, they have allocated funds from the National Insurance Fund to support ITNs, IRS, and LSM interventions. This is the direction we are pursuing to increase financial resources for malaria prevention. Within our programme, we have recently established a private sector desk to coordinate and collaborate with private companies, pushing for their engagement in malaria control efforts. While this initiative is still evolving, the goal is to encourage companies to either adopt a community or a district, where they can support targeted vector control interventions based on our stratification and sub-national tailoring strategies. To guide private sector involvement, our technical experts provide advice on what interventions are appropriate, where they can be implemented, and how they can be effectively delivered. While still a work in progress, companies are encouraged to invest in workplace programmes for their staff.

Rock Aikpon, NMCP Benin

Question: What strategies are in place to reduce dependence on foreign aid and mobilise local funding for malaria vector control in Benin?
Rock Aikpon: This is a cyclical problem in the current context. There is an excessive dependence on foreign aid from endemic countries which also unfortunately happen to be economically less prosperous ones. Excessive dependence can prevent the implementation of local and sustainable solutions. Reduction and suspension of aid can make you vulnerable. Endemic countries must shift the paradigm and mobilise our own resources for malaria control. Benin has taken some efforts in terms of the state contribution to the malaria. 2021 to 2025 there has been an increased effort by the government to fight malaria. In 2021, there was a contribution of 1 billion CFA and in 2025 we have about 4 billion CFA. Not enough but you have to start somewhere. There is also a Zero Malaria initiative supported by EcoBank which supported us with about 10 million CFA.

David Malone, Gates Foundation

Question: How should funding organisations support endemic countries to eliminate malaria without creating dependencies?
David Malone: I think this is a really important concern, we may not have a broad enough range of funders supporting the vector control community. Expanding the donor base is often seen as a solution, but I sometimes wonder if that simply results in more dependencies, just spread across multiple organisations. Achieving long-term sustainability is a real challenge. Strengthening health systems across various disease areas is one way to create a more stable foundation and achieve long-term sustainability. From an R&D perspective, we still face the difficulty of identifying organisations willing to take the financial risk to fund new developments. A kind of collaborative

funding model could be an effective approach moving forward, easing the burden on individual organisations and promoting greater shared responsibility.

Q&A/Discussions

Silas Majambere: I think it's important to highlight that the term *localisation* has been widely discussed over the past couple of years, but it doesn't always mean the same thing to everyone. From my perspective, localisation without local agenda-setting is ineffective , it simply doesn't make sense. In other words, if you provide funding to a country but dictate exactly how that money should be used, that's not true localisation. The reality is that countries often don't receive funding to support their own priorities; instead, they are funded to align with the strategic focus set by the donors. For instance, during PAMCA two years ago in Ethiopia, some funders presented their strategic priorities for the next five years. This illustrates that funders often determine what will be prioritised, and researchers, if they're strategic, will focus on those areas to align with available funding. So, as we continue discussing localisation, we need to reflect on whether we're genuinely talking about empowering local agenda-setting , or if we're still seeing agendas shaped externally, with local communities merely following those directives.
Justin McBeath (IVCC): I believe there's a valuable lesson to be learned from countries such as India and parts of Asia, where decisions about which tools to use are often made locally because they are funded locally, allowing for greater sovereignty in decision-making. This is something that should ideally extend to SSA as well, particularly in areas where domestic funding supports procurement outside the typical donors like the Global Fund or PMI. With increased reliance on domestic funding comes the responsibility of ensuring technical guidance and maintaining product quality, safety, and efficacy. This shift may demand more investment in local data generation to validate the effectiveness of tools in specific contexts. While this can enhance decision-making autonomy, it could also introduce additional costs and resource demands across the system. To address this, I believe it's crucial that we, as a community, support mechanisms for regional coordination in SSA. So that we can ensure that countries maintain sovereignty in decision-making without creating an overwhelming and costly data burden that could ultimately slow innovation.
Jessica Rockwood: The Task Team 3, along with Andrew, Sam, and myself, are more than willing to collaborate with you in developing advocacy and resource mobilisation strategies. When we talk about resource mobilisation, it's important to clarify that this isn't solely about engaging the private sector; private sector contributions alone won't fill significant funding gaps left by the US government. Instead, let's focus on high-level political engagement, leveraging development bank financing, and exploring regional development bank support. It's crucial to assess what will work within your country's context. For example, in Ghana, we supported the Ghana Malaria Foundation by helping them develop a resource mobilisation strategy that enabled them to request domestic financing and engage the private sector demonstrating that such opportunities exist. However, this isn't something that can be achieved overnight; it requires sustained high-level engagement, outreach, and involvement from multiple sectors. We are here to support you throughout this journey.
Anthony Bosumafi: I strongly encourage insecticide manufacturers to consider establishing production facilities in Africa. Doing so would reduce the overall cost.
Patrick Sieyes (Vestergaard): I urge governments to step up and take ownership of securing domestic funding for malaria control efforts. A strong government voice is essential, and I strongly advocate for their active involvement as a critical partner in these discussions.
Ole Skovmand: From my experience setting up four other production sites, I've found starting with cut-and-sew operations in Africa is far less costly, easy to set up, and doesn't require a huge investment in specialised equipment. Right now, imported nets from Asia face high import taxes, while Finnish-made nets are often exempt. Without some form of price protection, it's going to be a

real struggle for African manufacturers to stay competitive. Additionally, sewing efficiency in Africa tends to be lower compared to highly trained workers in places like China and Vietnam. Government support is crucial for all this to succeed. What would you do?
Patrick Sieyes (Vestergaard): This is fundamentally a cost issue. We need to create a level playing field and be realistic. Understand that establishing manufacturing on the African continent cannot achieve the same cost efficiency as production in Asia — at least not initially. It's a process that will take time and significant support from key stakeholders to succeed.
Susanta Ghosh: Given PMI's significant role in addressing the *An. stephensi* issue in Africa, are there localisation strategies in place to sustain efforts in its absence?
Corine Ngufor: Good point. Countries may need to explore alternative partnerships and strategies to sustain efforts, ensuring it does not escalate into a major issue.
Eric Ochomo: Are there plans for surveillance to be supported locally, given that surveillance was mostly funded by PMI and USaid ?
Rock Aikpon (NMEP Benin): We are making plans to have a minimum of surveillance given we don't have these partners anymore. It will not be 100% but we are making contingency plans.
Pascal Day: For IRS, the main cost concern lies in operational expenses rather than product costs. PMI's supervision significantly contributes to these higher operational costs. A suggestion I would like to make is for donors to focus solely on funding IRS products and equipment, while countries could take responsibility for financing operational aspects, including planning, monitoring, surveys, and reporting. This has the potential to reduce overall IRS costs that are largely driven by operational expenses.
David Malone (Gates Foundation): I believe it would require a slightly different product range and application method. The type of products designed for this approach should be suitable for use by less-trained individuals hence this becomes much more feasible and effective for community-based IRS.

Closing Remarks

Otubea Akrofi (NMEP, Ghana): Building on Eric's comments, I would emphasise that while securing local funding is crucial, prioritisation is equally important. Once funding is available, countries must carefully decide how best to allocate it. The key lies in being strategic in our decisions despite funding constraints and making the most of what's available.
Dominic Schuler (WHO): I believe partnerships are key — it's about respecting, understanding, and incorporating the roles of other stakeholders into our work. These discussions present an opportunity to challenge long-held assumptions and explore new possibilities.
Justin McBeath (IVCC): I believe the key lies in prioritisation. We must understand the right priorities within the appropriate context and setting, ensuring resources are allocated appropriately to address those priorities.
Rock Aikpon (NMEP, Benin): We must strengthen partnerships to drive progress and national programs have a very large role to plan given the current funding landscape
David Malone (Gates Foundation): I believe we should put emphasis on developing solutions rather than solely identifying problems.
El Hadji: Patrick, before you give your final remarks, I'd like to build on what Dominic said about thinking outside the box. With billions of nets in circulation, what could we do with those? Perhaps you could share your thoughts on this.
Patrick Sieyes (Vestergaard): I'd like to share a thought on the format of this panel session. I had hoped for more of a roundtable discussion rather than just us speaking to the audience. I believe the real value lies in having a collective conversation with the key players— that's where meaningful dialogue and progress can happen.

I believe that collaboration is essential, and we can achieve far more than by acting alone. To future-proof solutions, we need to embrace next-generation materials, bioactives, and other innovative approaches. The key wins go beyond the products; it's also about strengthening supply chains, supporting local economies, and creating job opportunities. Technology transfer will play a vital role in building local capacity and ensuring sustainable progress. Sustainability must be a core focus — not only in operations but also in environmental responsibility. Investing in energy-efficient machinery, water treatment systems, and renewable energy sources like solar power can significantly reduce environmental impact. A circular economy, where used materials are collected and repurposed, is the ideal outcome. Exploring next-generation bioplastics to replace traditional polymers will be crucial.

IRS Advocacy Group

IRS: A Proven Tool against Malaria to be Reinvented

Pascal Day, i2i and IRS Advocacy Group

A working group within i2i has been established to support IRS as an essential vector control tool. This group includes six chemical companies, two sprayer manufacturers, and three partners. To date, 18 products have received WHO PQ listing, including eight new compounds.

Current challenges

IRS usage has declined significantly, largely replaced by ITNs in Global Fund's GC7. Forecasts indicate a continued decline, with IRS volumes projected to fall by 50% between 2026 and 2032. This shift risks limiting resistance management strategies, as the focus moves away from rotational insecticide strategies. Donors are encouraged to adopt Pan American Health Organization's (PAHO) approach of rotating insecticides every three years to mitigate resistance.

Impact and Cost

IRS remains a vital tool in malaria prevention, protecting an estimated 54 million people annually based on five individuals per household. While ITNs are generally considered more cost-effective, IRS can achieve comparable or lower costs if operational expenses are managed effectively. Notably, 75% of IRS costs are operational, unlike ITNs.

Innovative IRS Approaches for Cost Reduction

New strategies are being explored to improve IRS efficiency and reduce costs:

- Partial Spraying
- Year-Round Spraying Teams
- Community-Based IRS
- Smart Technology

Way Forward in 2025

Efforts are underway to promote these innovative IRS approaches:

- Engagement with Key Stakeholders: Collaboration with NMEPs in Benin, Ghana, Mozambique, Nigeria, Rwanda, Uganda, and Zambia is in progress to test cost-reducing IRS models.
- Seeking co-financing: Efforts are ongoing to secure co-financing from organisations such as EDCTP, BGC (Nigeria Gas Company), and AU-NEPAD.

- Advocacy: Presenting IRS initiatives at the RBM VCWG conference in Cotonou aims to raise awareness and gather support.
- WHO Alignment: Efforts are ongoing to encourage WHO to adopt these improved IRS practices in their standard guidelines once new data is available.

Q&A/Discussions

Michael Macdonald: We need your support in addressing two critical areas. Firstly, we require industry's help in developing data to expand IRS application in temporary shelters. Not all IRS formulations are the same, and generating this data will be crucial for widening its effective use in emergency settings.
Secondly, we are working to introduce targeted IRS for *Ae. aegypti* control in Asia, following PAHO's recommendation. However, one major challenge in this region is the dearth of data on IR in *Aedes aegypti*. We need to collaborate with industry to expand the use in both humanitarian emergencies and targeted vector control strategies.

Question 1: Have you tested the approach you proposed at your level? Demonstrating its operational impact is crucial, as we need concrete evidence to present to investors.
Pascal Day: We reviewed ~20 scientific publications to inform this presentation, and there is substantial documentation supporting the effectiveness of targeted IRS.

Question 2: Are you suggesting that your approach involves spreading IRS coverage over several months by visiting different households during that period? Do you think this method is more effective than conducting a one-time spray for all households within the same timeframe?
IRS Advocacy Group: I believe this is more food for thought than concrete evidence at this stage. The intention is to rethink current operational approaches and establish a more stable strategy by training individuals to be professionals in IRS delivery.

Corine Ngufor: The plan moving forward is for VCWG to organise webinars to continue advocating for IRS and explore the most cost-effective deployment strategies. I must say, I admire the collaboration within the industry group, and I hope other sectors can adopt a similar approach. Thank you.

Social and Behaviour Change (SBC)

Corine Ngufor highlighted the upcoming presentation and its role as one of the cross-cutting themes in vector control. She explained that each year during their annual meetings, VCWG plans to feature one or two cross-cutting themes, with dedicated presentations on those topics. Previously, a task team within WS1 focused on human-centred design and SBC; however, recognising that these issues impact all aspects of vector control, they restructured the approach.

Human Behaviour and community engagement in vector control

Kaci McCoy, Johns Hopkins University

Kaci stresses the need for tailored approaches to address recent stalled malaria progress and emerging challenges. She highlights that the effectiveness of new and existing tools relies heavily on consistent and correct usage by the community. She emphasises that human behaviour and community engagement are relevant across all workstreams. The presentation aims to provide ideas and encourage everyone to consider how their work can incorporate these elements, especially in the absence of a central champion driving this forward.

1. Increase impact of core interventions

The presentation emphasised the crucial role of behaviour in maximising the impact of vector control tools, particularly ITNs. Effective ITN use requires multiple behavioural steps, from registering during campaigns and ensuring consistent use in varying conditions to proper care and responsible disposal. SBC strategies should adapt throughout a programme's lifecycle, addressing key behaviours at different stages — such as promoting registration, encouraging consistent use, and guiding net maintenance. Successful behaviour change extends beyond providing information; individuals must also feel confident in their abilities, understand the benefits, have social support, and access necessary resources. The Malaria Behaviour Survey (MBS) was recommended as a valuable tool for understanding community perceptions, barriers, and motivators to inform tailored SBC strategies.

2. Identify and characterise gaps in protection

The combination of behavioural insights with mosquito surveillance data, researchers can better identify where and when individuals are most at risk of mosquito exposure, even when core interventions like ITNs and IRS are in place. Kaci introduced a methods paper by April Monroe that provides a step-by-step guide for collecting and integrating such data, complete with an Excel template that generates visual outputs to illustrate risk patterns. This approach helps identify vulnerable groups, activities, and timings, allowing for better optimisation of existing tools or the introduction of new interventions.

3. Integrate social and behavioural research in evaluation of new tools

This section highlighted the importance of human-centred design (HCD) in aligning vector control tools with end-user needs. Engaging stakeholders throughout development ensures interventions fit into daily life, improving uptake and sustained use. Kaci emphasised incorporating social and behavioural research in tool evaluations. Trials like the AEGIS spatial repellents study demonstrated the value of combining epidemiological, entomological, and behavioural data, improving product placement and ensuring continued intervention use. Researchers were encouraged to collaborate with SBC experts and utilise resources such as the SBC guidance for *An. stephensi* vector control in Africa to enhance behaviour-focused malaria control strategies.

Q&A/Discussions

Jo Lines: One key takeaway for me is the importance of integrating essential public health knowledge into primary education. I believe we often overlook where people acquire much of their foundational knowledge. From what I've observed, the curriculum hasn't evolved significantly since colonial times. A major gap I see is the lack of distinction between mosquito species — *Anopheles*, *Culex*, and *Aedes*. Understanding which mosquito is biting you, when they bite, and where they come from is vital for protecting one's family's health. These three mosquito types are easy to identify, yet this basic knowledge isn't being communicated effectively. Instead, focus is often on instructing people on how to use our tools, while neglecting to equip them with simple, actionable knowledge they can apply independently at home.

Closure

The wrap-up session highlighted key points and highlights of the meeting. Despite concerns about reduced turnout due to the funding crisis, participation exceeded expectations. A major highlight of the meeting was the joint 20th anniversary celebration of VCWG & IVCC and the recognition of several awardees for their contributions.

There was acknowledgement of uncertainty surrounding malaria-funded projects, with several facing termination due to the funding crisis. Konstantina shared as of Wednesday, 26th February 2025, RBM's USAID grant was terminated. Despite this setback, RBM remains committed to its core mandate of **coordination**, **communication**, **advocacy**, and **convening**, emphasising the critical need for strengthened collaboration during this period.

RBM will continue to focus on uniting the malaria ecosystem, particularly in coordinating efforts against anti-malarial drug resistance and advancing the Big Push initiative. Additionally, RBM will take the lead in supporting countries with resource optimisation, diversification of funding, and localisation strategies to sustain malaria control efforts. The RBM Partnership calls for increased solidarity during this challenging time.

Way forward in 2025-2026

1. Open vacancies for task team leads include:
    - Workstream 1: Task Team 1
    - Workstream 2: Task Teams 2 and 3
    - Workstream 3: All task teams
2. Bi-weekly CRSPC meetings are ongoing. Meetings are open to programme implementers, and individuals are encouraged to contact the CRSPC via email to participate.
3. Plans are underway to hold webinars to strengthen resource mobilisation through Workstream 1, Task Team 3
4. 5-year VCWG work plan to undergo revisions reflecting the withdrawal of PMI, USAID support
5. Funding mobilisation webinar to be held to address funding gaps following funding cuts
6. Discussions with countries on prioritisation during funding constraints
7. Webinar on ITN quality and durability
8. Webinar on IRS advocacy

Corine Ngufor ended the 20th VCWG meeting by thanking the task team leads, presenters, participants, sponsors, and the organisers.