Report of the 18th Annual RBM VCWG Meeting
6-8 February 2023
Movenpick Ambassador Hotel, Accra, Ghana

Harnessing vector control innovations for optimal malaria control impact

The objective of the 18th annual RBM VCWG meeting is to provide a platform for the malaria vector control community to exchange on latest best practices and research relevant to current and future malaria vector control operations. Plenary sessions and panel discussions complement the activities of the dedicated work streams who focus on their work plans, ratify the main projects and present the next steps and way forward. The work plan activities are funded by Partners, and coordinated by the work stream Co-leads and the Co-chairs of the Working Group.

Co-Chairs: Corine Ngufor & Justin McBeath
Coordinator: Konstantina Boutsika
Technical support: Sunghea Park
Rapporteur: Jessica Dennehy

Monday 6 February 2023

Plenary

Session 1: Introductions, objectives, key updates

Welcome & introduction of participants - Justin McBeath (VCWG)

Justin McBeath, VCWG, (JM) opened the meeting welcomed participants and thanked all for their attendance at the 18th Annual RBM VCWG meeting. JM highlighted the significant achievement to host the meeting in Africa after 2 years of virtual meetings. Thanks were also made to the local Ghanaian National Malaria Elimination Program (NMEP) team for hosting the meeting and to Konstantina Boutsika, Swiss TPH, (KB) for coordinating. JM introduced himself and Corine Ngufor (CN) as VCWG Co-chairs and outlined a brief overview of meeting structure and objectives.

Purpose: To align RBM partners on best practices to reach and maintain universal coverage with effective vector control interventions.

Convene: VCWG convenes meetings, workshops, and other forums to develop consensus among stakeholders.
Co-ordinate: VCWG supports and co-ordinates dialogue between national programs, product manufacturers, academia and implementers.
Facilitate Communication: VCWG has a very diverse membership, and our annual meetings and work stream Task Teams provide unique opportunities for connection and networking around specific areas of interest.

JM discussed the fantastic representation at 17th Annual VCWG in March and May 2022, and reminded that previous meeting minutes and agenda are available on the RBM VCWG webpage. The meeting preceded with an overview of the work stream structures, including key outputs and the creation of task forces to tackle workplan elements. Specifically outlining the principles for selection of Task Force membership. Co-leads of the Task Teams were mentioned and summarized below:

Work stream 1: Enhancing the impact of core interventions (ITNs and IRS)
Leads: Allan Were and Mary Kante

Task Team 1	Task Team 2	Task Team 3	Task Team 4
• Using data to inform optimal selection of core interventions. • Leads: D. Levi Hinneh and Chrispin Williams, NMCP Liberia; Sarah Burnett, PATH	• Addressing biological threats; new insecticides for vector control (for IRS and ITNs) • Leads: Christen Fornadel, IVCC and Julia Mwesigwa, PATH	• Capacity building, localization, and private sector involvement for sustainable vector control • Leads: Samuel Asiedu, AGAMal and Jessica Rockwood, International Public Health Advisors	• Addressing non-biological threats: ITN quality, access and use, durability/replacement • Lead: El Hadji Amadou Niang, UCAD

Work stream 2: Expanding the vector control toolbox
Leads: Sheila Ogoma and Derric Nimmo

Task Team 1	Task Team 2	Task Team 3
• Larval Source Management • Leads: Jennifer Armistead, PMI and Prosper Chaki, IHI / PAMCA	• Innovations in vector control and vector surveillance • Leads: TBD	• Anthropology and human centered design (interface between vector control and human behavior) • Lead: April Monroe, JHUCCP

Work stream 3: Implementing the global vector control response
Leads: Chadwick Sikaala and Anne Wilson

Task Team 1	Task Team 2	Task Team 3	Task Team 4
• Integrated Vector Management • Leads: Jo Lines, LSHTM and Charles Mbogo, KEMRI	• Capacity and collaboration • Lead: Tanya Russell, JCU	• *Anopheles stephensi* response • Leads: Melissa Yoshimizu, USAID; Sarah Zohdy, CDC; Susanta Ghosh, Mangalore University India	• Vector Control in Humanitarian Emergencies • Leads: Dana McLaughlin, UN Foundation and Joe Lewinski, CRS

JM briefly mentioned the upcoming MOOC on 'The resistant mosquito: staying ahead of the game in the fight against malaria'. The next online course will take place on March 13th-April 1st on FutureLearn or permanently available, with free access, on University of Basel Tales platform (https://tales.nmc.unibas.ch/en/the-resistant-mosquito-43/).

Overview of agenda and objectives for VCWG 18 – Corine Ngufor (VCWG)
Corine Ngufor introduced herself as co-chair of VCWG and highlighted the structure of the meeting over the coming days. CN took all attendees through the meeting agenda, reminded them of the VCWG code and conduct and housekeeping rules. CN thanked all sponsors and partners for supporting the meeting, with a special mention of the travel sponsorships granted by the Swiss Agency for Development and Cooperation (GlobMal project at Swiss TPH).The meeting proceeded with introductions to and opening remarks from Dr Francis Chisaka Kasolo (Country Representative for WHO Ghana), Dr Corine Karema (Interim CEO RBM Partnership to End Malaria) and Dr Anthony Ofosu (Deputy Director General Ghana Health Service).

Progress towards malaria elimination in Ghana – Keziah Malm (NMEP)
The National Malaria Elimination Programme (NMEP) in Ghana has progressed from the previous National Malaria Control Programme (NMCP) and follows a key mandate, vision and mission.

Mandate: To lead all malaria control efforts in the country, coordinating activities of all agencies and partners.
Vision: Malaria Free Ghana to contribute to the improvement of economic and social development.
Mission: To ensure that the entire population of Ghana has a universal and equitable access to interventions for malaria prevention and treatment and to achieve pre-elimination in selected areas.

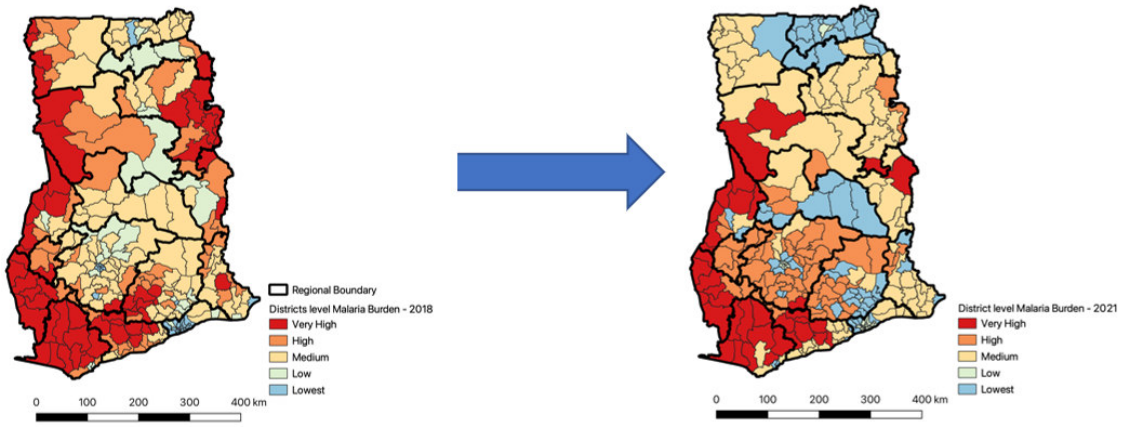
The profile of malaria in Ghana was described, including the prevalence, transmission patterns, dominant vectors and parasites. *Plasmodium falciparum* (*P. falciparum*) accounts for 96.3% of malaria cases and a reduction in parasite prevalence was observed in children under 5 from 27% in 2011 to 14% in 2019. Key events in malaria control in Ghana were shown from 2003 to 2022, including acquisition of Global Fund grants, resistance to insecticides, development of new insecticides and change from control to elimination in 2022. The heterogenic status of malaria throughout the country was emphasized.

The NMEP strategic goals include reduction in malaria mortality by 90% by 2025, reduction in malaria case incidence by 50% by 2025 and achieve malaria pre-elimination in at least 6 districts by 2025. The main malaria interventions implemented in Ghana to achieve this include distribution of long-lasting insecticide treated nets (LLINs), indoor residual spraying (IRS), larval source management (LSM), vaccines, Intermittent Preventive

Treatment (IPTp), seasonal malaria chemoprevention (SMC) and case management, diagnosis and treatment. The geographic coverage for each intervention was discussed, with nationwide coverage achieved for ITN routine distribution, IPTp and case management. It is predicted that by 2025, implementation of the National Strategic Plan under current coverage will lead to nearly 100 districts with prevalence below 10% and with high coverage is predicted to lead to 175 districts with prevalence below 10% and only 9 with prevalence >25%. The results of the plan after just two years (2021-2023) are shown, with a clear reduction in malaria prevalence in the North East part of the country.

Risk strata combining incidence, prevalence and All-cause U5 mortality rate, 2018

Risk strata combining incidence, prevalence and All-cause U5 mortality rate, 2021



2018 2021

Between 2018-2022, there was a reduction in reported malaria deaths in health facilities, however the number of admitted cases attributable to malaria has increased overall. Ensuring implementation of actions is essential to prevent this. Testing rates have increased between 2017-2022, with an ultimate aim of testing and treating 100% of suspected malaria cases. The malaria elimination agenda requires conscientizing communities, improving strategic partnerships, increasing focus on malaria at all levels and implementing malaria elimination strategies. The next steps for the programme include harmonizing all the thematic documents, Mid Term Review (MTR) of the current strategic plan in January 2023, develop National Malaria Elimination Strategic Plan (NMESP) by March 2023 and Submit to the Presidency through Ghana Health Service (GHS)/ Ministry of Health (MOH) (By April 2023).

Update from RBM Partnership to End Malaria - Philippe Batienon & Marscha Deda (RBM Partnership to End Malaria)

RBM is a global partnership with the vision of achieving a world free from the burden malaria. There are 3 key Strategic objectives 2021-2025:

1. Optimize the quality and effectiveness of country and regional programming.
2. Maximize levels of financing.
3. Facilitate the deployment and scale up of new products, techniques or implementation strategies.

The strategy framework is shown in more detail:

RBM Partnership to End Malaria 2021-2025 Strategy Framework

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.		
Adapt to evolving COVID-19 environment			

In 2022, RBM continued to engage the global community of partners through its Partner Committees: ARMPC, CRSPC and SCPC. In order to meet strategic objective 1 (optimize the quality and effectiveness of country and region planning), the following activities have been undertaken:

1) Technical strategies and implementation plans.
2) Resolve implementation bottlenecks.
3) Resource mobilization.

The major achievements in 2022 included, provision of a platform to engage the RBM community in coordinating implementation support to countries and subregional entities as they execute their malaria control and elimination programmes. At both country and regional levels, supports were provided through the three Partner Committee mechanisms. The support included technical assistance for planning and implementation bottlenecks resolution. Support for MPRs/ MTRs and NSP development and/or adjustment were also provided in collaboration and under leadership of WHO. This includes prioritization and subnational tailoring of interventions for better impact. Further examples were discussed for the support given to countries in the design of quality, prioritized programmes at country and regional levels as well as the implementation support to address bottlenecks and gaps. An analysis of the distribution of 2022 technical assistance support by focus area shows the most support for the Global Fund (GF) proposal development / programmatic gap analysis and the development of plans and implementation of ITNs campaign. The least support was provided to the review of malaria communication strategies.

Further information was provided on support for:

- The impact of technical assistance, including aligning malaria planning with the broader health and development agenda, and support to mobilize resources at country and regional levels.
- Opportunity to incorporate a mix of new tools and best practices, including strategy to ensure access to everyone.
- Enabling countries to design policies, set new targets and improve their coordination systems, including incorporation of CRG programming.

- Mainstream malaria in the agenda of the regional economic communities including at Head of State, minister and technical level.

Overall, this support has helped to mitigate against the impact of COVID-19. The Malaria Programs and Partners meeting for Central Eastern, Southern and Western Africa SRNs was also a significant achievement in 2022.

In order to meet strategic objective 2 (maximize levels of financing), the following activities have been undertaken:

- Supporting the Global Fund Replenishment Campaign by amplifying the global fund investment case, leveraging key moments to increase support for the global fund, elevating malaria and CSO voices throughout campaign and Francophone engagement.
- Support countries to fill financial gaps. Notably, 95% of highly and moderately endemic countries mobilized sufficient resources to cover their LLIN, IRS, SMC and case management gaps in 2022.

The major achievements for this objective in 2022 includes the orientation meeting on The Global Fund GC7 application process to provide detailed information on the Global Fund differentiated application processes and an overview of WHO technical recommendations for malaria; support countries to develop their application development plans and timelines; review RBM Partnership to End Malaria support tools including the programmatic and financial gap analysis template to be used to support the submission; and compile, review and plan the technical support needed through RBM/CRSPC.

Priorities were outlined for the next months, focusing on supporting countries in their Global Fund funding request in 2023. To achieve this, the CRSPC will provide a comprehensive package of support to countries, based on a tried and tested country-led approach. International consultants will provide TA to support the development of funding applications and background documents, provision of funds to countries for additional support, mock Technical Review Panel (TRP) meetings will be helped to facilitate country peer review of draft applications, remote expert review of final draft funding applications and support planned to assist countries to achieve timely grant signature.

The RBM data initiative project is one of the strategic enablers of the RBM 2021-2024 strategic framework that fills a gap existing on data central global coordination. The main gaps include, limited opportunities for countries to bring current challenges to the attention of the global stakeholder ecosystem, little visibility on near real time data on bottlenecks for the malaria community, as well as scattered information across many websites requiring advanced IT skills for accessing.

Participants encouraged to access the Global Malaria Dashboard, accessed via the RBM website. In 2022, new dashboards were published including:

Weather forecast – showing regions with increased probability of climate optimal for malaria transmission to help countries and partners to increase buffer stocks or ensure early deployment of commodities to the field of interventions. This dashboard was developed by Institute for Climate and Society (IRI) and predicts weather forecast 3-4 months in advance. More information behind the theory can be accessed through RBM website. This dashboard is still a work in progress and participants of VCWG are encouraged to share their expertise to optimise user access.

Long term malaria commodities forecasting outputs – projections of need and demand for vector control and case management commodities until 2031. Projections developed by the Global Malaria Commodities Forecasting Consortium (lead by CHAI) and published on RBM global malaria dashboard. Outputs to be updated annually until December 2025. Long-term forecast projections are modelled based on multiple data inputs including demographics, epidemiology, coverage of interventions, resistance, trends in domestic and donor funding for malaria.

Malaria data repositories – Collation of malaria data links from various websites and organisations to have 1 repository for all malaria data.

Other new features include:
New data and visuals on interventions historical trends available - 2017-2021 data from Global Fund results framework on LLIN distributed by years, households covered by IRS and pregnant women receiving IPTp. This data is filterable and downloadable from the RBM website.

Improved landing page - On global malaria dashboard to make it more user friendly and improve visibility / ease of access – left hand side dashboards available on the global malaria dashboard. Participants are encouraged to visit, collaborate and provide recommendations for improvement and data sharing opportunities.

Examples of targeted advocacy and communication were given, focusing on resource mobilisation, rallying the community, raising urgency and keeping the Partnership informed.

Update on malaria vector surveillance and control work at WHO - Seth Irish (WHO GMP)
The mission of the Vector Control Response (VCR) is to support optimal resource use for malaria vector control by WHO Member States and by their implementing partners. The three activities of the VCR and their associated activities were outlined:

1. **Support generation and reporting of data related to malaria vectors and interventions**

- District Health Information System 2 (DHIS2) standard entomology and vector control modules to support collection, collation and interpretation of vector control data. Modules rolled out at request of WHO member states in collaboration with partners.
- Vector Control Advisory Group (VCAG) to provide advice on generation of high-quality data to inform development of WHO recommendations. Full meeting reports available on VCAG webpage.
- Vector control prioritization of work achieved through pilot decision workshop to aid prioritization of resources for malaria control in Ghana (Sept 2022) and development of guidance on the prioritization of insecticide-treated nets in situations where resources are limited.

2. **Develop or revise evidence-based WHO recommendations and programmatic guidance on vector surveillance and control, including for new tools vector.**

- WHO recommendation development and dissemination. The WHO Guidelines for Malaria were released in February 2021, updated approximately every 6 months and available in French, Arabic and Spanish. The next update anticipated in March 2023 with new recommendations on two types of dual active ingredient (AI) nets: WHO Guidelines for malaria
- Other documents include companion documents (revision of IRS manual ongoing), Preferred Product Characteristics (IRS / endectocides and ectocides and interventions to combat outdoor malaria transmission), evaluation guidance (high-level video developed for vector control evaluation processes) and insecticide resistance monitoring guidance.

3. **Support timely dissemination of vector surveillance and control guidance and contribute to its implementation through technical support and capacity building activities based on identified priorities.**

- District Health Information Software development of module detailed documentation and incorporation of DHIS2 modules into the broader WHO module production scheme coordinated by the University of Oslo on behalf of WHO. Official information page, Promotional video in YouTube and translated into

Spanish and French, Map tracking use of DHIS2 for entomology and vector control.
- Malaria Threats Map user consultation finalized, new prototypes developed & validated. Improvements under implementation and videos translated into Spanish and French.

In September 2022, WHO launched the initiative to stop the spread of *Anopheles stephensi (An. Stephensi)* in Africa. Actions include vector alert update in January 2023, face-to-face convening in the Horn of Africa planned for March 2023 and maintenance of the Malaria Threat Map, with negative sites now being displayed. Quarterly *An. stephensi* calls are also conducted.
The Global Vector Control Response actions include:
- Joint Action Group (JAG) meets quarterly.
- GVCR Progress Report 2017-2020 published late 2020.
- WHO 5-year report submitted early 2022.
- Online SharePoint hub for GVCR focal points launched in 2020 to monitor implementation.

Announcing the new WHO Guideline on Prequalification Assessment of Insecticide Treated Nets and other updates from the WHO Prequalification Unit Vector Control Product Assessment Team - Marion Law, Dominique Schuler, Jude Onwujei (WHO-PQT/VCP)
This is a milestone meeting for WHO on Prequalification Assessment of Insecticide Treated Nets and other updates from the WHO Prequalification Unit Vector Control Product Assessment Team.
The mandate of WHO vector control prequalification is to increase access to safe, high quality and effective Vector Control Products (VCPs). This mandate is essential to prevent deviations and achieving goals to ensure access to the products that communities and countries need. The responsibility for evaluation of VCPs transferred from NTD (WHOPES program) to Prequalification Unit in 2017 by DG directive.

Key achievements in 2022 - submission workload summary:

*RDP = Request for determination of pathway

Prequalification Submissions/activity	No. Received	No. Assessed /Decisions taken	Currently under assessment
New Products	12	4	23
Change Submissions	38	35	17
Study protocols	9	9	1
RDP	28	28	-
Pre-sub meetings	>100	N/A	N/A
Product Review	-	9	-

Guidance documents and communication including advice for manufacturers series, guidelines for prequalification of insecticide treated nets, manual on the development and use of FAO and WHO specifications for chemical and microbial pesticides and diverse communication strategy developed including biweekly Wednesday webinars, advice to manufacturers series guidance and quarterly updates. The biweekly webinars provide a good opportunity to get to know stakeholders and understand expectations between both parties.

Assessors' session for vector control products will be held in Ghana and will include the attendance of 17 PQ/VCP assessors, which also reviewed the glossary for the ITN guideline and operational policy documents and framework for biological vector control products.

The objectives of the ITN project are to undertake a systematic review of information available to enable a robust evaluation of the performance of ITNs, including data requirements, product specifications, standards for testing,

methodology, recommended use and labelling. A summary of the before, during and after prequalification activities was shown, along with outputs, processes and other WHO/JMPS activities.

The principles of the WHO guidelines for prequalification assessment of ITNs are:

- Reflective of the mandate of the WHO PQ/VCP and appropriate to the use of the product (*commensurate to use and risk*).
  - Purpose and target audience.
  - Explanation of PQT role, mandate and processes.
  - Evidence-based operational policies supporting science and processes.
  - Detailed science requirements to demonstrate quality, safety and efficacy, and methods for consideration.
  - Format and presentation of data (dossier).
  - Assessment approaches.
  - Documentation.
- Reflective of existing products and that can evolve to meet needs of new interventions (*flexibility*).
- Use established practices and systems where still relevant (*efficiency*).
- Useful and user friendly and targeted to key stakeholders *(relevancy*).
- Collaborate and involve stakeholders and partners (*transparency*).

Specific goals of the guidelines, considerations for new guideline development approach and guideline objectives were discussed. These goals include:

- To address all aspects which support the prequalification of an ITN.
- To fill current gaps in information required to assess ITNs.
- To bring clarity to areas of confusion and misunderstanding.
- To apply consistent approaches and criteria to data requirements, data generation, methodologies, processes and policies.
- To provide more detail to minimize the need to make assumptions and to assist with the interpretation of supporting information.
- To strengthen product baseline information.
- To allow for evolution of science and methods within a robust framework.

Considerations for new guidance development approach include:

- Electronic format.
- Varying stakeholder needs.
- Data collection over the past 5 years.
- Experts who indicate their interest to contribute to the development of the guideline.
- Existing guideline content that is relevant, evidence based and peer reviewed.
- Guideline versus implementation guidance.

Guideline objectives:

- Set out all data requirements to support the comprehensive assessment of ITNs in order to establish:
- Quality – based on the assessment of the formulation, manufacturing process and supporting data, the identity and physical/chemical characteristics of the proposed product are established and the submitted data support the consistency of the manufacturing process.
- Safety – based on the Generic Risk Assessment Model for ITNs, the product, as formulated and constructed, does not pose an unacceptable risk to users.

- Efficacy – based on the assessment of the submitted data, there is a reasonable expectation that the product will perform as intended to mitigate/kill vectors of disease in operational settings.
- Align data requirements with appropriate module.
- Introduce information on the assessment approach and decision framework.
- Introduce appropriate flexibility to account for diversity of formulations, novel chemistries, variabilities in testing, use pattern, environmental use conditions.
- Allow for submission of rationales to justify / explain test results and selected methods.

Transformational elements include complete and comprehensive dossier provided to PQT/VCP for evaluation, manufacturer is responsible for generation of supporting data and compiling the completed dossier, requirement for data to be generated in GLP accredited facilities and supporting data requirements linked to appropriate product component.

The draft WHO/PQ ITN guideline was developed, a series of consultation meetings were conducted in 2022 and the draft was submitted to WHO PQT/VCP in Oct/Nov 2022. Over 205 comments were received from the stakeholder community including manufacturers, technical experts and procurers / donors. Sixty five percent of comments had to do with the writing format and terminology, with the most comments for the characteristics and product life stages, followed by prequalification submission.
A summary of common areas and themes include: classification of ITNs, formulation / manufacturing, abrasion testing, definition (LLIN rather than ITN), thresholds vs weight of evidence approach, request for additional chapters, need for classification of ITNs, equivalency, clarification (long lasting/20 wash and 3 year).

PQT/VCP priorities for 2023 were summarized:
- Submission assessments and decisions.
- Finalize and publish ITN guideline.
- Develop plan for implementation of new guideline.
- Initiate discussions on aspects raised during guideline consultations.
- Reliance on thresholds.
- Initiate discussions on post market initiatives for ITNs.
- Initiate IRS guideline development.

Participants encouraged to look at values of prequalification assessor team and hold organization accountable to follow these. These guiding principles include engagement with all stakeholders, process and decision-making and broader impact.

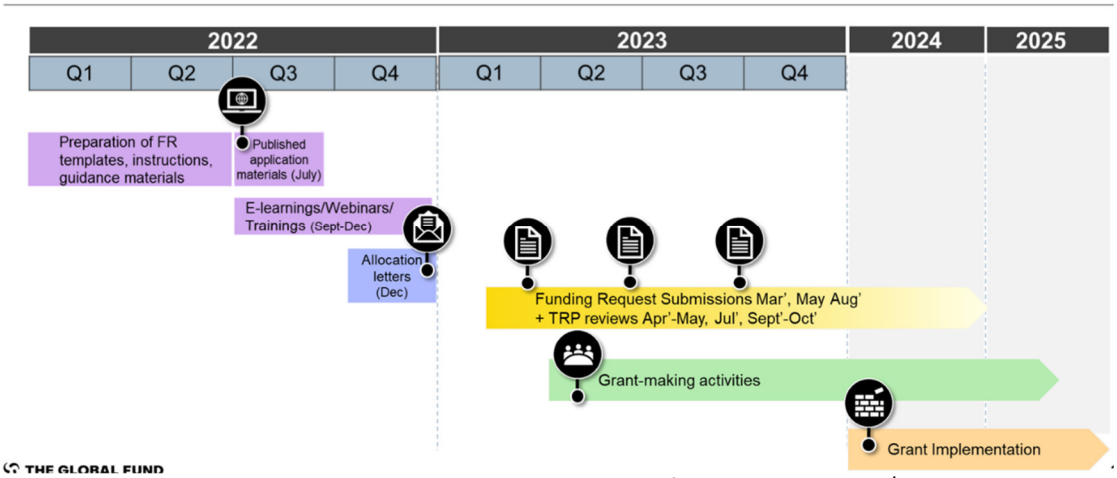
Global Fund update on vector control financing - Kate Kolaczinski (The Global Fund)
The objectives of the global fund malaria strategy 2023-2028 are to:
Implement malaria interventions, tailored to sub-national level, using granular data, and capacitating decision-making and action
Ensure optimal and effective vector control coverage.
Promote sub-national tailoring, evidence-based prioritization and entomological surveillance expansion to ensure optimal coverage and strengthened program effectiveness.

a. Address barriers hampering the rapid scale-up of new products
b. Foster and engage in partnership-wide discussions to align on partnership-wide challenges such as:
    I. Maintain effective VC coverage.
    II. Address waste management.

III. Invasive vector species.
IV. Evolving indicators to emphasize coverage and underpin subnational-tailoring (SNT).
V. Ensuring quality and performance of vector control products.

1. Optimize chemoprevention.
2. Expand equitable access to quality early diagnosis and treatment of malaria, through health facilities, at the community level and in the private sector, with accurate reporting.
3. Drive towards elimination and facilitate prevention of re-establishment of malaria.

The new grant cycle timelines are shown below:



Changes to allocations include higher resource envelope, malaria funds increase by $111.2 million compared to 2020-2022 and changes in malaria allocation to the 15 highest burden countries when comparing 23-25 and 20-22:

- 22 countries had decreases, average 13%.
- 11 countries stable (0 – 0.5%).
- 29 countries had increases, average 12%.
- No malaria specific catalytic funding (though NextGen SI).

It was noted that the global fund replenishment was successful but did not get enough money needed to drive malaria elimination (e.g. not enough to account for increases in population, number of impactful tools available (unable to optimize)) and therefore focus of allocation money going to highest burden countries.

The malaria Information Note has been developed to provide funding request guidance on vector control. The purpose of this note is to complement the normative guidance to assist with preparation of the funding requests and to cover Global Fund considerations around procurement and supply chain management etc. This vector control guidance emphasizes 1) the strong recommendation for use of (IRS or) most effective ITNs in areas of pyrethroid resistance, statement that PBO or dual ai nets should be proposed in areas that previously received these; encouragement to carefully consider sizes/accessories and locations for deployment, 2) the expectation that ITN strategy may well be sub-nationally varied (as appropriate) with consideration given to ITN types, ITN delivery approaches (timing, channels), 3) funding requests (FRs) asked to elaborate both i) the full need for optimal effective coverage, and ii) the actual asks in the FRs, which may be lower if budget was not available and finally 4) flags the importance of support for strengthened entomological surveillance and efforts to monitor and respond to *An. stephensi.*

Challenges and opportunities for achieving priorities from the 2023-2028 strategy were summarized. Global Fund must work internally and across partnerships to:

- Promote SNT, evidence-based prioritization and entomological surveillance expansion to ensure optimal coverage.
- Address barriers hampering the rapid scale-up of new products.
- Addressing waste management.
- Invasive vector control species.
- Evolving indicators to emphasis coverage and underpin SNT.
- Ensuring quality and performance of vector control products.

Sub-objectives of each strategy were discussed in further detail. This included evolution of data sources and indicators intending to enable more effective SNT, active program management and more appropriate performance tracking. Efforts to ensure entomological surveillance remains a priority, current activities are underway for An. stephensi. One of the main opportunities in the next grant cycle is to maximize impact from ITNs, considering guidance for most effective ITNs versus financing. This will also require robust market conditions: working internally and with partnership to look at mechanisms to ensure sufficient capacity and appropriate/affordable pricing for dual ai nets and improved demand forecasting as well as distribution efficiency. For newer tools, there is no catalytic funding, so continued work with partners and evaluation funding continues until 2024 with contracted work around ITNs and IRS. Plans to address waste management include organization wide efforts of Global Fund financed commodities– led by the health systems team and specific work to explore improvements in ITN area specifically – led by the supply operations team. The performance and quality of ITNs will be reviewed through engagement in Gates/Innovation to Impact (i2i) and Clinton Health Access Initiative (CHAI) led partnership work. Additionally, further consideration needed on how efficacy is understood, communicated, and used to inform procurement decisions. Further consideration needed on how efficacy is understood, communicated and used to inform procurement decisions and on-going internal work on specific quality signals and challenges. Concerns around longevity of nets and retainment will inform the actions discussed above.

The Global Fund, Net Transition Initiative has launched a Request For Proposals (RFP) titled: Entomological investigations and stakeholder perspectives to support introduction of dual active ingredient ITNs into the wider vector control space. For more details, please check: **https://www.theglobalfund.org/en/business-opportunities/**

PMI malaria vector control policy and strategy updates - Lilia Gerberg (PMI)

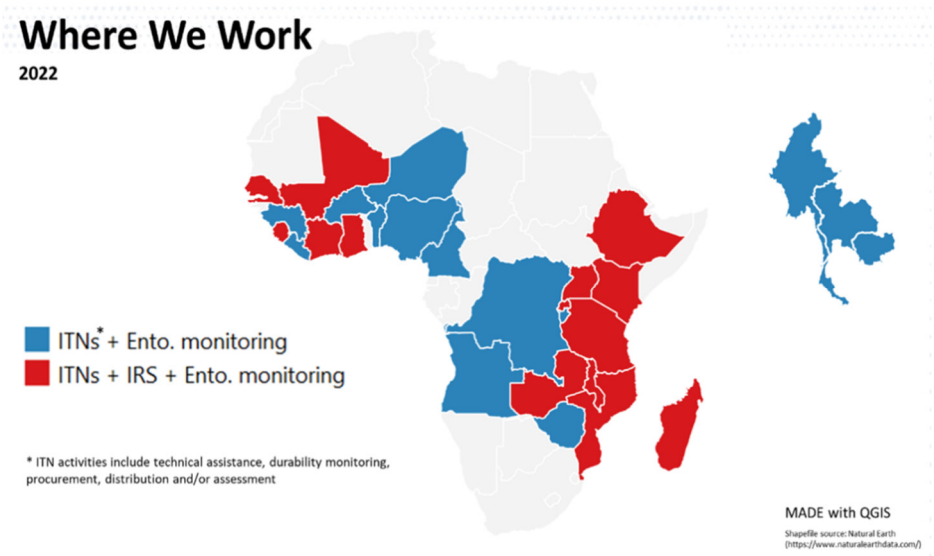
The PMI strategic framework 2021-2026 has a continued vision of world free of malaria within our generation, with the goal to prevent malaria cases, reduce malaria deaths and illness, and eliminate malaria in PMI partner countries. The three main objectives are described below, along with the 5 key focuses:

1. Reduce deaths by 33% from 2015 level.
2. Reduce illness by 40% from 2015 level.
3. Accelerate towards elimination in 10 countries and eliminate in $\geq$ 1 country.

FOCUS 1	FOCUS 2	FOCUS 3	FOCUS 4	FOCUS 5
Reach the unreached with effective interventions	**Strengthen community health systems** to defeat malaria	**Keep malaria services resilient** against shocks including COVID-19	**Invest locally** in partners and governments to lead	**Lead and innovate** to end malaria faster

The priorities of USAID are localization and climate. In order to achieve localization, by FY 2025, USAID will provide >1/4 of program funds directly to local partners and by 2030, local communities will lead 50% of programming to set priorities, codesign projects, drive implementation, or evaluate the impact of programs. To address climate, they will prioritize locally led development, equity and inclusion, private sector engagement, nature-based solutions and evidence, technology, and innovation.

PMI conduct evidence-informed deployment of traditional and new vector control tools to achieve universal coverage with at least one intervention which may entail sub-national stratification of interventions and operational research program evaluations for new tools and / or approaches.



Entomological monitoring forms the backbone of integrated vector management strategies and contributes to answer specific questions to inform programmatic decision making. This involves both insecticide resistance and mosquito behaviour monitoring. Additional entomological monitoring activities include collecting human behaviour observation data, community based mosquito collectors and collaboration with local partners (>75 local institutions).

PMI have supported implementation of IRS, specifically piloting two new clothianidin-based products (2GARD and Klypson) in 2022, supporting partial IRS study and TA assistance for countries implementing reactive IRS. Between 2005-2022 there has been an overall decline in PMI support for IRS coverage due to companies having to make challenging decisions in regards to vector control coverage in countries. PMI continues to support the distribution of ITNs and in the financial year 2022, of all the nets provided by PMI, 53% were Pyrethroid-piperonyl butoxide (PBO) and almost 10% were dual AI. PMI are continuing to support ongoing durability monitoring activities (pausing new monitoring until WHO PQT ITN Guideline and Post-Market module available) as well as conduct impact evaluations and support country efforts to incorporate use of digital tools. PMI's An. stephensi Task Force have generated general guidance on surveillance and control to build capacity in early detection. Additional larviciding activities may be conducted with appropriate environmental compliance approvals required prior to larviciding implementation. PMI also support other vector control activities such as larval source management, topical repellents for elimination settings and house screening. Current OR/PE investments support evaluation of programs involving housing modifications, IRS, ITNs and larval source management across Africa.

Main challenges include limited funding envelope leads to difficult vector control decisions, growing resistance to clothianidin and other new insecticides for IRS and ITNs and new threats to malaria control (An. stephensi, climate change, political conflict and displacement etc.). Main opportunities include localization of decision making, decentralization of approaches to entomological monitoring, refining estimates of malaria transmission risk by better defining vector-human interactions, ensuring strategic deployment of integrated vector control interventions sub-nationally, data analytics and visualization platform and harmonization with WHO DHIS2 modules and partner coordination to drive accountability, quality, innovation.

Strategic investments in vector control – A donor perspective on innovation - Matthew Black & Kelsey Barrett (Unitaid)

Unitaid is a global development agency whose vision is to provide equitable access to health innovations to ensure healthy lives and promote well-being for all. The mission of Unitaid it to expand the reach of the best health products for those who need them most. Unitaid has large investment portfolio across HIV, TB and malaria. Unitaid accelerates equitable access to innovate health products, key access areas focusing on innovation & availability, quality, affordability, supply and delivery and demand and adoption.

The 2023-2027 strategic objectives and programmatic priorities reinforces traditional core area of work: e.g., grant making, especially for HIV, TB, malaria; scale-up, formalizes work in areas that have been introduced and demonstrated, e.g., local manufacturing; engagement with affected communities and expands Unitaid's mandate to new areas e.g., making healthcare greener; responding to global health emergencies; disseminating knowledge and evidence on access.

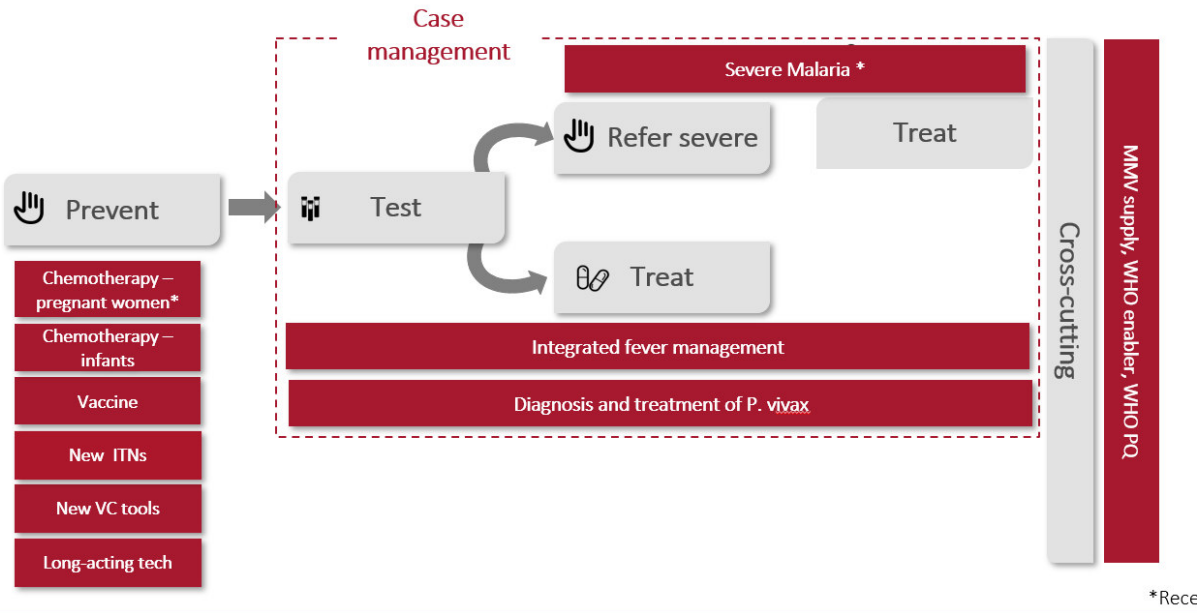
The programmatic priorities for malaria are to 1) introduce and optimize prevention tools and 2) improve access to quality case management.

Malaria priority 1: Introduce and optimize prevention tools (vector control, chemoprevention and vaccines). Unitaid has a short, mid and long-term illustrative portfolio of topics and interventions:

- Short-term (current): optimize delivery of malaria chemoprevention Intermittent Preventative Treatment during Infancy (IPTi) and ensure access to quality-assured drugs; evaluate new vector control tools (spatial repellents and ivermectin).
- Mid-term (2-3 years): optimize deployment of prevention tools e.g. through at-scale pilots, innovative delivery approaches, and generating evidence to guide policy and prioritization.
- Long-term (4-5 years): lay the groundwork for transformational new prevention tools (e.g. genetically

modified mosquitos, long-acting technologies and vaccines).

Unitaid's current malaria portfolio ($327 million) is shown:



Unitaid's grants and their associated impacts were discussed:
The New Nets Project's lead grantee is IVCC, running from 2018-2022 for a value of US$66M in Benin, Burkina Faso, Rwanda, Mali, Mozambique, Nigeria, Cote d'Ivoire, Liberia, Ghana, Democratic Republic of Congo (DRC), Malawi, Niger, Cameroon, and Burundi. The impact of the grant it to introduce new LLINs in areas of insecticide resistance.

- Advancing spatial repellents for vector borne disease control is led by the University of Notre Dame, running from 2019-2024 for a value of US$33.7M in Kenya, Mali, Sri Lanka and Uganda. The impact of the grant is to evaluate slow-release repellents that drive mosquitoes from inhabited areas. Interim results to be published soon to facilitate moving forward with trial in 2024.

- Broad One Health Endectocide-based Malaria Intervention in Africa (BOHEMIA) is led by Barcelona Institute for Global Health (ISGlobal), running from 2019-2024 for a value of US$25M in Mozambique and Kenya. The impact of the grant is to develop a new complementary new-class vector control tool, ivermectin (endectocides).

- IMPACT: long-acting injectable formulation of ivermectin as a new vector control tool to reduce malaria transmission. Currently in preclinical development (2020-2023), clinical development planned for 2023-2025 and regulatory commercialization by 2026.

- The roadmap for innovation includes 30 key products by 2030. Key malaria prevention tools include next generation LLINs, malaria vaccines, chemoprevention tools and approaches, spatial repellents and ivermectin mass drug administration (MDA).

Discussion - All

Question 1: Why does USAID aim to provide >1/4 of program funds directly to local partners by 2025 and not sooner?

- Lilia Gerberg (PMI) responded that this is a global target and elements need to be in place to enable organizations to receive funds. This timeline is set to ensure organizations are capable of executing objectives and allow for a realistic risk threshold in achieving objectives. PMI is working to ensure partnering organizations have excellent research institutions, with sufficient regional level technical capacity and expertise, such as PAMCA.

Question 2: When will vector control transition into an approach with pre-emptive resistance management strategies?

- Kate Kolaczinski (The Global Fund) responded that this is the goal and funding to underpin this strategy needs to be established. It was noted that resources such as IRS and LLINs with different active ingredients will be key for insecticide management, in combination with downstream evidence-based decision making. The medium and long-term impact of preventative management should be considered when measuring the benefit of interventions. Decisions currently focus on spreading the money around to get the most impact now without taking in the medium to long term benefits. How can decisions take into account all benefits rather than just immediate impact benefits? Ultimately there needs to be further funding to move away from solving the immediate impact problems.

Question 3: Why is universal coverage with LLINs not an aim of PMI? Spatial repellents and Ivermectin do not have the long lasting life so are niche products to be used in particular situations – in relation to how to deploy interventions in specific settings and times, who is making these recommendations? Comments were made about the durability of interventions – post marketing monitoring in the long run needed.

- Kelsey Barrett (Unitaid) responded that products should be used in context-specific situations where tools will be most effective. Further advise should be provided on the deployment of vector control tools.

Question 4: What is the status of longitudinal monitoring of fabric durability of nets? And it was commented that post marketing monitoring in the long run needed.

- Kate Kolaczinski (The Global Fund) responded that the monitoring of resistance to damage was continued at significant scale under Gate funded work and some of this research informed changes to PQ. Durability

monitoring remains important and some countries have increased frequency of campaigns.

Question 5: What is the impact of IRS and LLINs in combination specifically in India, as currently data shows no added impact?

- Lilia Gerberg (PMI) responded that financial resources and current guidance aims to ensure at least 1 type of effective vector control intervention. It will be useful to discuss further at the India level and this observation reflects unfortunate funding scenario in India and the importance of discussing India specific data.

Question 6: How can strategies discussed be scaled up in the private sector?

- Matthew Black (Unitaid) responded that it is Unitaid's role to create conditions for scale up to allow other actors to implement this. As they are not a service delivery organisation, they do not have the capacity to scale up however aim to provide the correct conditions for this e.g. global manufacturing discussions, country engagement etc.

Question 7: What are the opportunities to align access and availability of supply of vector control tools and how does this inform pilot planning?

- Marion Law (WHO-PQT/VCP) responded that further work is being done to consider access, affordability, availability and efficacy in the field. This will take more than a discussion, it will take process, engagement and accountability.

Session 2: Work stream sessions

Work Stream 1 (WS1): Enhancing the Impact of Core Interventions – Leads: Allan Were (Management Sciences for Health) & Mary Kante (Eau Claire Consulting)

During the 2023 VCWG Annual Meeting, WS1 on Enhancing the Impact of Core Interventions will facilitate presentations and in-depth discussions for Session 1: Durability testing of the bioefficacy of dual active ingredient ITNs, methods and country data, Session 2: Increase in the malaria EIR following IRS withdrawal in Benin; Beneficial ITN repurposing practices in Uganda, Session 3: School-based ITN distribution; A practical checklist for using routine data to measure vector control impact, Session 4: Vectron T500 hut and community trials; Sub-lethal exposure to chlorfenapyr kills Plasmodium parasites in surviving insecticide-resistant Anopheles mosquitoes; Estimating the malaria prevention impact of dual active ingredient ITNs: Results from the New Nets Project pilot evaluations, Session 5: Vision for vector control capacity building; Local resource mobilization to support ITN distribution in Nigeria; Experience of a malaria elimination project.

Welcome participants, meeting overview - Allan Were (Management Sciences for Health) & Mary Kante (Eau Claire Consulting)

Work stream 1 (WS1) leads, Mary Kante (MK) and Allan Were (AW), were introduced. Further introductions were made of the WS1 Task Team leads and a general overview was given of the objectives for each Task Team. Participants were reminded that there is space to join Task Teams, especially Task Team 4.

WS1 Task Team 1: Using data to inform optimal selection and deployment of core interventions.
Sarah Burnett (PATH), Chrispin Williams (Liberia NMCP) and Levi Hinneh (Liberia NMCP).

WS1 Task Team 2: Addressing biological threats - new insecticides for vector control.
Julia Mwesigwa (PATH) and Christen Fornadel (IVCC).

WS1 Task Team 3: Capacity building, localization, and private sector involvement for sustainable vector control.
Samuel Asiedu (AGAMal) and Jessica Rockwood (International Public Health Advisors).

WS1 Task Team 4: Addressing non-biological threats, including ITN/ IRS spray qualities, ITN/IRS access and

use/acceptance, and ITN durability/replacement as well as IRS residual efficacy.
El Hadji Amadou Niang (Cheikh Anta Diob University).

WORKSTREAM ONE	Focus Output 1 Identify tool gaps or capacity needs & steer research priorities	Focus Output 2 Policy clarification & evaluation pathways	Focus Output 3 Implementation/Operational scale-up support/Training and capacity building initiatives
Enhancing Impact of Core Interventions **Themes:** • **ITNs** • **IRS** **Co-Leads:** **Allan Were** **Mary Kante**	Using data to inform optimal selection and deployment of Core Interventions – Task Team 1	Using data to inform optimal selection and deployment of Core Interventions – Task Team 1 **Task Team leads:** D. Levi Hinneh and Chrispin Williams/NMCP Liberia; Sarah Burnett/PATH	Capacity building, localization, and private sector involvement for sustainable vector control – Task Team 3 **Task Team leads:** Samuel Asiedu/AGAMal and Jessica Rockwood/IPHA
		Addressing biological threats: new insecticides for vector control (for IRS and ITNs) – Task Team 2 **Task Team leads:** Christen Fornadel/IVCC and Julia Mwesigwa/PATH	Addressing non-biological threats – Task Team 4 • ITN quality • ITN access and use issues; IRS coverage • ITN durability/replacement **Task Team lead:** El Hadji Amadou Niang/UCAD

A special session was held on October 18, 2022 with the aim of engaging the private sector in vector control, led by Task Team 3. This involved presentations by and discussion with IVCC, LSHTM, PSMP, AGAMal, Tenke Fungurume, CAMA, Ghana NMCP, DRC NMCP, and Nigeria NMEP. Presentations, meeting report, and recording available at: https://endmalaria.org/special-session-engaging-private-sector-vector-control

Task Team 4: Addressing non-biological threats: ITN/IRS quality, access and use/acceptance, durability/residual efficacy. Facilitator: El Hadji Amadou Niang (Cheikh Anta Diob University, Senegal)

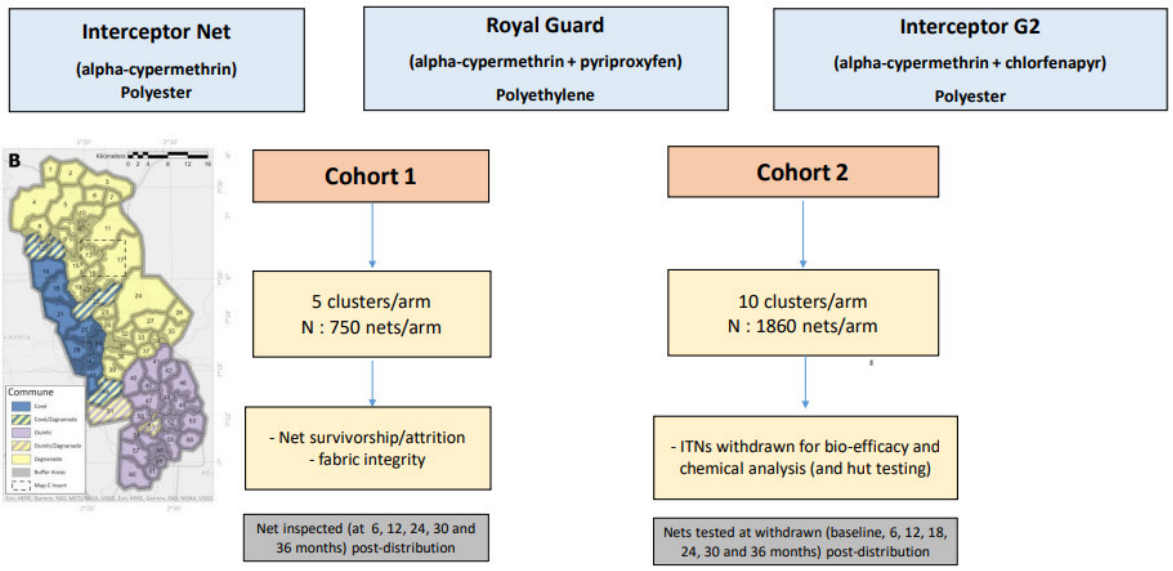
Session 1: Durability testing of the bioefficacy of dual active ingredient ITNs, methods and country data survivorship, fabric integrity, bioefficacy and chemical content of two dual-active ingredient ITNs (Interceptor G2 and Royal Guard), 24 months after distribution in communities in Benin – Corine Ngufor (CREC-LSHTM)
Presentation on the data collected for testing ITNs in Benin and Tanzania, with a focus on the methods used for testing ITNs. Two types of dual-active ingredient ITNs (Pyrethroids + new insecticide) and one Pyrethroid + piperonyl butoxide (PBO):

1. Pyrethroid-PBO ITNs: Synergist piperonyl butoxide (PBO) enhances mortality of pyrethroid resistant mosquitoes. Ex Olyset Plus, Permanet 3.0 etc.
2. Pyrethroid-pyriproxyfen ITNs: Pyriproxyfen sterilizes female mosquitoes which survive exposure to the net. Ex Royal Guard.
3. Pyrethroid + Chlorfenapyr (CFP) ITNs: Chlorfenapyr is a pyrrole insecticide that kills pyrethroid resistant mosquitoes. Ex. Interceptor G2.

Overview of 2 major trials in Tanzania and Benin, recently published, comparing nets in the two countries. Both demonstrated outstanding results for interceptor G2 (Pyrethroid-CFP), with 44% and 46% reduction in malaria incidence compared to standard pyrethroid LLIN over 2 years for Tanzania and Benin, respectively.

The study design for the durability assessments in Benin were described:

Durability assessment – study design Benin



The completed studies include survivorship/attrition/fabric integrity up to 24 months post distribution, bioefficacy (cone bioassays and tunnel tests) up to 24 months post-distribution, experimental hut testing of field collected nets at 12 and 24 months and chemical content at baseline, 12- and 24-months post-distribution.

To collect data on ITN survivorship/attrition/fabric integrity up to 24-months post distribution, ITN durability surveys were conducted at month 6 and 12 for presence or absence of ITN, reasons for loss and other information and physical integrity – assessment of holes in ITNs. Results showed the proportion of each type of net in 'good' condition has decreased over the years, the Interceptor net had the highest medium survival time (2.6 years) and the net usage was lowest for Royal Guard and highest for Interceptor G2.

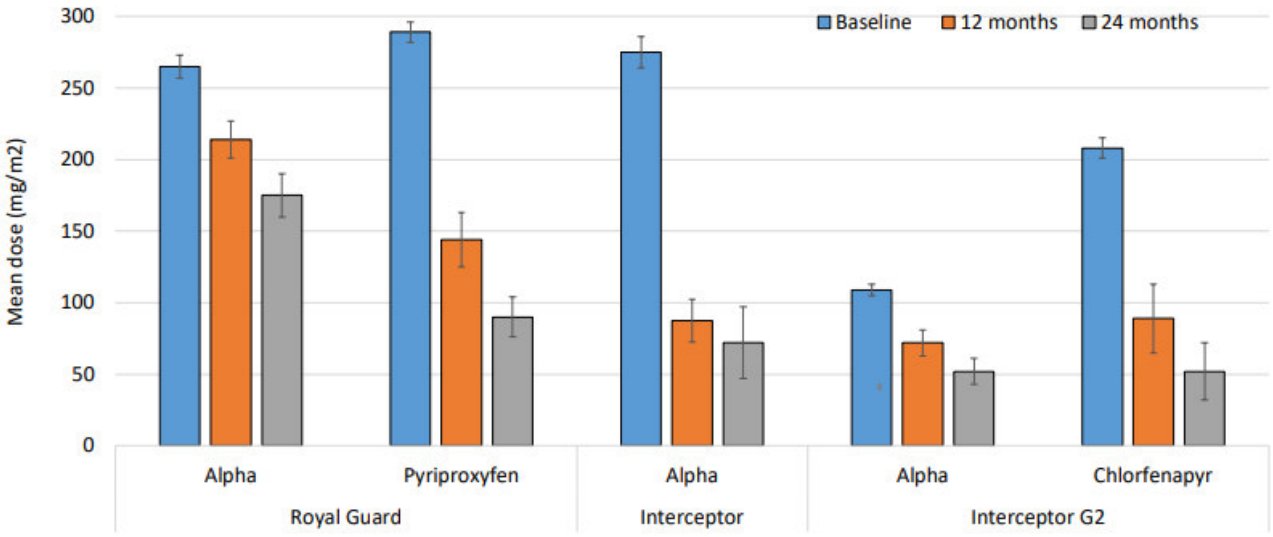
Bioefficacy testing was conducted using cone bioassays and tunnel test (baselines, 12 and 24 months), with susceptible (Kisumu) and pyrethroid resistant (Akron) *Anopheles* strains. The Bio-efficacy testing plan is shown:

LLIN type	Brand	Active ingredient	Strain	Primary Test Method	Key outcome measures	Remarks/additional tests
Pyrethroid-only	Interceptor LN	Alpha-cypermethrin	KISUMU-S	cone bioassays	Knockdown, 24h Mortality	Tunnels for failed nets
Pyrethroid-chlorfenapyr	Interceptor G2	chlorfenapyr	AKRON-R	Tunnel tests	72h Mortality BFI (alpha)	1 net piece per ITN
Pyrethroid-pyriproxyfen	Royal Guard	Alpha-cypermethrin	KISUMU-S	cone bioassays	Knockdown, Mortality	Tunnels for failed nets
		pyriproxyfen	Blood-fed AKRON-R	cone bioassays	Reduction in Fertility (dissection)	>30% fertility in control Assumed 50% cut off
Pyrethroid-PBO	Olyset Plus	Permethrin	KISUMU-S	cone bioassays	Knockdown, Mortality	Tunnels for failed nets
		PBO	AKRON-R	Tunnel tests	Mortality	1 net piece per ITN

Results for bioefficacy of alpha-cypermethrin in Interceptor LITN showed 100% of nets passed in cones and / or tunnels at baseline and 12 months, and 63% at 24 months. Percent dead was 98.4/100 and 53.7 at baseline, 12

and 24 months, respectively. Results for durability of bioefficacy of Alpha-cypermethrin in Royal Guard showed 100% of nets passed in cones bioassays with Kisumu strain at baseline, 12 and 24 months. Percentage of death were 100, 98, 5 and 93.8 at baseline, 12 and 24 months, respectively. Results for durability of bioefficacy of pyriproxyfen in Royal Guard showed 100, 43 and 37% of nets induced >50% reduction in fertility at baseline, 12 and 24 months, respectively. Percent dead was 99.5, 36.4 and 37 at baseline, 12 and 24 months respectively. Results for durability of bioefficacy Interceptor G2 showed 100, 63 and 20% of nets passing in Tunnel tests at baseline, 12 and 24 months respectively. Percent dead was 95.7, 82.1 and 51 at baseline, 12 and 24 months, respectively.

Chemical analysis results at 24 months presented in the graph below. The active ingredient content remains steady for alpha-cypermethrin in Royal Guard but declines sharply for pyriproxyfen and chlorfenapyr.



Experimental hut trials were conducted to determine efficacy at 12 and 24 months in Benin, following standard trial protocol. For mortality, results showed reduced efficacy overtime for all nets except for Interceptor. Performance of PermaNet 3.0 and Royal Guard was similar to pyrethroid-only net at 24 months. Interceptor G2 shows superior efficacy at all time points. For blood-feeding inhibition, protection from biting increased as ITNs aged. Royal Guard provided superior blood-feeding inhibition at 12 and 24 months. For reduction in fertility, Royal Guard's reproductive suppression effect was high at baseline but was lost over time.

Conclusions include:

- Median survival is 1.7 years for Royal Guard, 2.2 years for Interceptor G2 and 2.6 years for Interceptor.
- Usage (% hung) was lower with Royal Guard compared to Interceptor G2 nets and Interceptor. Householders in the Royal Guard arm tended to replace their study nets with non-study nets. Could be due to fabric type.
- Bioefficacy of alphacypermethrin in Royal Guard and Interceptor was more durable in laboratory bioassays. Chlorfenapyr and pyriproxyfen bioefficacy in G2 declined substantially in laboratory bioassays with 24 months nets.
- Chemical content of Chlorfenapyr in Interceptor G2 also declined substantially at 24-months.
- Efficacy declined in experimental huts over time with Royal Guard and Interceptor G2. However, Interceptor G2 induced superior mortality rates compared to all other ITN types at all time points.
- Blood-feeding inhibition in hut trials increased as nets aged. Could contribute to improved protection in

community trial despite reduced bioefficacy.

Bio-efficacy and durability of next generation insecticide-treated bed nets against pyrethroid resistant malaria vectors in Tanzania - Jackline Martin (KCMU, NIMR, Tanzania)

Results for a study, similar to that previously described for Benin were presented for Tanzania. 4 interventions were compared (Interceptor, Interceptor G2, Royal Guard and Olyset Plus). Results for attrition showed a similar % of net loss at 6 months and higher proportion of Olyset Plus (60%) no longer present in HH after 24M compared to standard net and other nets. Results for fabric integrity showed proportion of good and damaged decrease over time for all the nets and at each time point Olyset Plus had the largest proportion of torn nets compared to other nets. All nets had the recommended concentration of insecticide or PBO when new. Reduction of the second a.i. was 82% for chlorfenapyr, 62% for pyriproxyfen and 70% for PBO at 24 months.

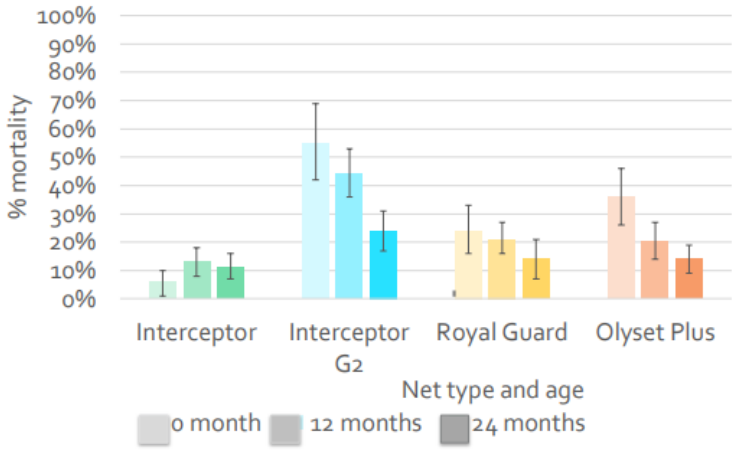
Bioefficacy testing followed WHO pyrethroid testing guidelines. For susceptible Kisumu, there was 99% mortality alpha-cypermethrin and 95% mortality permethrin. For resistant Muleba-kis, Resistance intensity was higher for permethrin (1x=29%) than alpha-cypermethrin (1x=52% mortality) ; however, none of the insecticides scored 80% mortality using diagnostic dose. For susceptible Kisumu, over 80% of the nets pass the WHO criteria at all time points either in cone or tunnel. In tunnel high BFI was the reason for the pass rate and mortality in cone decreased for all nets over time. For Interceptor G2 in resistant strain, 72 hour mortality decreased over time and mortality was constantly higher than Interceptor at their respective time points. Only two Interceptor G2 ITNs pass 72 hours mortality at zero month and one at 12 months and 72 hours mortality in resistant mosquitoes exposed to Interceptor G2 was lower than 80%.

For Royal Guard against resistant strain, at zero-month, 88% sterility was observed and reduced to 47% in cone after six months of net use vs. 0.01% in standard LLIN regardless of age and 18% sterility at 12 months and 2% at 24 months, in tunnel test and lower than 3% in cones. 88% [n=12] of new Royal Guard (RG) ITN passed sterility with cut-off point of 50% and reduced to 58.6% [n=17] after six months. No net passed 12 or 24 months. Higher mortality at 24 [43%] and 72 hours [54%] in RG compared to standard LLIN [12% & 19%] at all time points. % of blood-fed *Anopheles* still alive at 72 hours in RG was lower [57%, 1981/3468] than in the standard LLIN (83%), this suggests that PPF is also inducing mortality and the main effect of RG is through killing rather than fertility reduction or that the release rate of pyrethroid is more important in RG than Interceptor.

For Olyset Plus against resistant strain, at 12 and 24 months 24 hours mortality was 67% and 70% respectively and at each time point Olyset Plus performed better than standard net (Interceptor). 29 nets passed at zero months and 8 passed at 12 months and 10 at 24 months.

Resistance intensity was measured in wild *Anopheles* using CDC bottle assays and showed resistance intensity was high in permethrin mortality compared to alpha cypermethrin in *Anopheles gambiae*. Mortality with *An. funestus* against Alpha-cypermethrin was lower than 80% in all concentration.

The efficacy of dual AI ITNs in experimental huts is shown below. The results show that mortalities were consistently higher in each of the dual a.i. or PBO-py ITN compared to standard LLIN at each time point however the difference diminished over time with nearly similar mortality at 24 months.



Species composition 63% *An. gambiae* s.l & 37% *An. funestus* s.l.

In conclusion:

Durability:

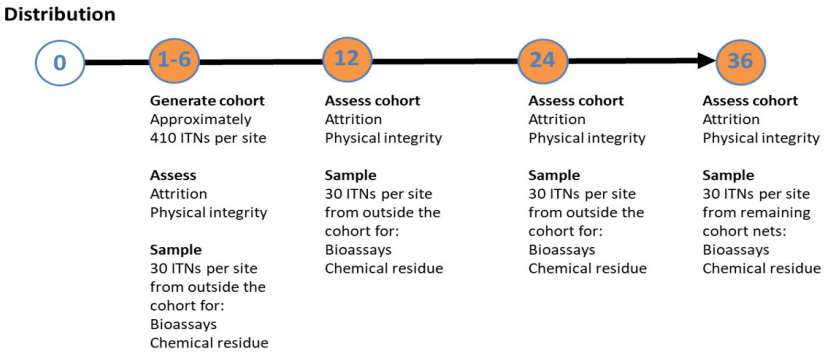
- Overall attrition and development of holes was in general higher in the dual a.i./PBO ITNs compared to standard LLIN with Olyset Plus the worst of all.

Bio-efficacy of second a.i. or PBO-Py

- Royal Guard: Sterility effect was observed at 0 and 6 months but mortality was consistently higher compared to standard LLIN except after 2 years in the huts.
- Mortality with Olyset Plus was consistently higher against resistant *Anopheles* except wild *Anopheles* in hut at 24 months.
- Mortality with Interceptor G2 was higher against resistant *Anopheles* in both lab and hut.
- For all dual a.i. or PBO ITNs the difference compared to standard LLIN diminished over time with mortality only slightly higher at 24 months.

Physical and insecticidal durability of dual active ingredient and PBO ITNs: Results from 24-month surveys - Keith Esch (VectorLink, PSI)

Presentation of the results of durability monitoring studies of new ITNs in four sub-Saharan African countries: Burkina Faso, Sierra Leone, Rwanda, and Burundi. Field work and laboratory methodology shown below:



Final study outcomes are not yet available, so preliminary study results were described for each country. Gaining

insights into drivers into the field will require additional modelling, analyzing risk factors and behavior studies. In Burkina Faso, mass distribution began in 2019 of Interceptor G2 and PermaNet. Approx 15% of nets were lost due to wear and tear at both sites within 24 months. The medium survival was 2.4 and 2.9 years for Interceptor G2 and PermaNet respectively.

In Rwanda, mass distribution began in 2020 of Interceptor G2 and PermaNet. The estimated median survival was 3.0 and 3.5 years for Interceptor G2 and PermaNet respectively. Chemical content data is still to be added when available.

In Sierra Leone, Olyset Plus and PermaNet were trialed. The estimated median survival was 2.3 and 4.8 years for OlysetPlus and PermaNet respectively.

For Burundi, only PermaNet was trialed, with an estimated median survival of 1.7 years. This study was ended due to low level ITN survival at 24 months.

Next steps include completing 36-month survey rounds and circulating the final report (Burkina Faso July 2022, Rwanda May 2023, Sierra Leone April 2023). Additionally, to support the development and operationalization of forthcoming WHO ITN pre-qualification and post-market surveillance guidance.

Discussion – All

- It was asked how much of a role does the human environment play in durability, following the report that very different durability has been observed across different countries.
    - *It was responded that this will be considered within the methodology used, as several questions were examined through household interviews looking at cooking habits, presence of rodents, net washing process and knowledge and expose to vector control campaigns. This will be very important for contextualizing the data that was found.*
- It was asked whether only measuring attrition would be sufficient data to influence market share and manufacturers decisions for ITNs?
    - *It was answered that if we look at attrition due to wear and tear, ITNs did not seem to perform differently from each other. The major difference observed was for Royal Guard, mainly due to preference of fabric type. It was observed that households replaced ITNs from previous Royal Guard campaigns because they did not like the material.*

Session 2: Increase in the malaria entomological inoculation rate following indoor residual spraying withdrawal in Atacora, Benin – Rock Aikpon (NMCP Benin)

Background given on the challenges of the cost of vector control (VC) e.g., median economic cost of protecting 1 person per year for any VC intervention ranged for $1.18-$5.70 and because of the high cost of VC interventions, the perenniality becomes a great challenge for the NMCP. In Benin, malaria control relies on ITNs (mass distribution campaigns and routine distribution for pregnant women and children of about 1), and IRS (annually in northern Benin which is a high transmission area).

From 2011-2016 IRS was implemented in Atacora and in 2017 the program was withdrawn from 2 other regions, with hope that gains would be sustained due to seasonality of malaria transmission, leading to the question - What is the vulnerability of population after withdrawal of IRS? Data was collected in three districts in the intervention area in 2016 (during the last IRS campaign) and in 2018 (2 years after the withdrawal of IRS). The entomological indicators of malaria transmission were compared between 2016 (before IRS) and 2018 (after IRS) in the implementation area).

Results showed a drastic increase (~3 times higher) of vector abundance (*Anopheles gambiae*) after the withdrawal of IRS. Additionally, a significant increase in the EIR was recorded after IRS cessation in 2018 was observed at all 3 sites. A change in biting behaviour (vectors bite more indoors) was also observed after IRS withdrawal.

In conclusion, the withdrawal of IRS confers a vulnerability of the population regarding malaria transmission. After VC withdrawal, adapted measures should be taken according to the context not only to maintain the gains capitalized with VC interventions, but also to avoid any rebound of transmission. Contingency plans must then be implemented to minimize the resurgence of malaria transmission. Robust monitoring is needed to better understand how, when, and where IRS can be safely withdrawn.

Long-lasting insecticide-treated net repurposing practices and their predictors among households in Ibanda district, western Uganda - Medard Rukaari (NMCP Uganda)

In Africa, non-beneficial net repurposing has been established as being one of the factors that reduce LLIN effectiveness in their vector control endeavors. There are two forms of net repurposing practices (non-beneficial used for other purposes than vector control) and beneficial (used for purposes of vector control).

Ibanda district (Uganda) has been consistently reporting the cases of net misuse and harmful LLIN repurposing. Examples of repurposing include constructing chicken coops, and providing fencing for gardens and nursery beds. Ibanda district still registers the highest number of malaria cases in the Ankole region. The broad objective of the study was to assess the LLINs repurposing practices and their predictors among households in Ibanda district – Western Uganda and the research question was to determine the prevalence and predictors of LLINs repurposing practices among households in Ibanda district – Western Uganda. Theoretical and conceptual frameworks were used to develop study methodology.

Study design	A community based analytical cross-sectional study
Study setting	Ibanda district
Sources of data	Primary
Study population	**Household heads** or their representatives who were recipients of LLINs
Sample size determination	Formula by **Krejcie and Morgan (1970).** $s = \frac{X2 \times P (1- P)}{d2 (N -1) + X.P (1 – P)}$ X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841). *N* = the population size = **54,604** households in both counties *P* = the population proportion (assumed to be .50 since this would provide the maximum sample size). *d* = the degree of accuracy expressed as a proportion (.05). On substitution, **s = 381 Households**
Sampling procedures	Stratification, Simple random sampling and systematic sampling were used

Results for objective 1 (To determine the prevalence of long-lasting insecticide treated net repurposing practices among households in Ibanda district – Western Uganda), show 4% of net repurposing was beneficial (nets still used for vector control) while 96% was non-beneficial (harmful or neutral).

Results for objectives 2 and 3 (Intra-household and programmatic predictors of long-lasting insecticide treated

net repurposing practices among households in Ibanda district – Western Uganda), show intra-household predictors to be the number of children below five years in household and programmatic predictors to be health education about net use at DP and net repurposing & its importance.

In conclusion, repurposing practices of old LLINs among households in Ibanda is still very low with only 1 in every 27 households repurposing its old nets beneficially and both intra-household and programmatic characteristics predict repurposing practices; where programmatic take more precedence.

The four key recommendations from this study are for the MoH mandate to intensify Social and Behavior Change Campaigns (SBCC) at DPs with key messages for LLINs beneficial repurposing should be explored. DTF should enforce SBCC during health education and sensitization related to net repurposing by net distributors before LLINs are given to households. Community mobilization and interpersonal communication channels should be done at household level to further emphasize beneficial repurposing practices by the VHTs. A qualitative study should be conducted to explore the reasons behind non-beneficial repurposing & the fact that harmful repurposing was the most wide-spread practice in Ibanda.

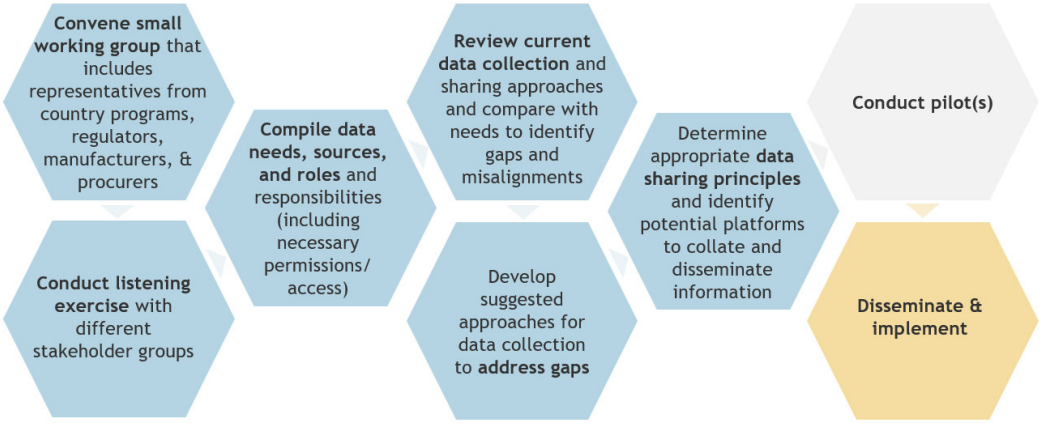
Rethinking post-market monitoring - Tara Seethaler (CHAI)

Current post-market monitoring has gaps in guidance, measurement, and implementation, affecting ability to use data for decisions. ITN post-market monitoring (PMM) is the process of conducting activities to track the performance of ITN products in the field, including measuring physical integrity, bioefficacy, and use. PMM data has utility across countries, manufacturers, regulators and procurers. Key issues include lack of guidance and piecemeal implementation affecting interpretation of the data. In response to this issue, 'Raising the Floor' for ITNs is convening a post-market monitoring working group. This includes partners from different stakeholder groups to meet monthly. Estimated completion within one year, or the decision to extend will be made in one year's time (January 2024).

The objectives of this response are to:

1. *Identify post-market data needs and decision points for major stakeholder groups (countries, procurers, manufacturers, WHO PQ & GMP).*
2. *Discuss and recommend data sources and collection approaches for ITN field monitoring and funding sources.*
3. *Identify data management and sharing tools, and discuss interpretation needs.*

The proposed approach to updating PMM will involve stakeholders identifying and piloting harmonized data collection.



CHAI would like to hear from partners, particularly country programs, on how to improve post-campaign ITN data collection and inputs will feed into improving ITN data collection, with the expectation that this will lead to:

- More relevant, fit-for-purpose ITN products.
- Better data to make decisions for sub-national tailoring.
- Easier/simpler collection methods.
- More timely data.

If you are interested in sharing your feedback, please reach out to Tara Seethaler: tseethaler@clintonhealthaccess.org, Angus Spiers: angus.spiers@innovation2impact.org or Rosemary Lees: Rosemary.Lees@innovation2impact.org

Discussion – All

- It was asked, based on the malaria data we currently have, is it still a good idea to invest in new nets?
  - *It was answered that there is a need for more analysis about cost effectiveness overtime, beyond the scope of post market monitoring.*
- It was asked whether the IRS study was multifaceted and whether contingencies were put in place when IRS was withdrawn?
  - *It was answered that the increase in entomological indices indicates that when this is withdrawn, contingencies such as fumigation must be put in place. This was not able to take place in the above study due to lack of resources and inability to link the entomological impact with the epidemiological one.*
- It was asked what benefits were seen in the households from non-beneficial net repurposing and data collected for the motivations for doing this?
  - *It was answered that in-depth qualitative analysis on influences of non-beneficial repurposing was not conducted.*

Task Team 1: Using data to inform optimal selection of core interventions Facilitators: D Levi Hinneh & Chrispin Williams (NMCP, Liberia), Sarah Burnett (PATH)
Session 3: School-based ITN distribution; A practical checklist for using routine data to measure vector control impact

School-based ITN distribution (1) Policy, People and Resources: Why some countries have scaled up school-based distribution, others have not, and subsequent recommendations - Ketty Ndhlovu (NMCP Zambia)
A number of National Malaria Programs have conducted pilots to inform their scale-up of Continuous Distribution channels. ITN school-based distribution (SBD) channels have been piloted by several National Malaria Programs (NMPs). To explore how countries determine whether to scale up SBD following pilot trials, PMI VectorLink conducted interviews with NMPs, implementing partners, donors and global experts. The countries were divided into three groups: those which have scaled up, those which have piloted and those which are considering piloting. The aim of the study was to explore how countries determine whether to scale up SBD following pilots and provide recommendations for NMPs, implementing partners, and donors.

30 key informant interviews (KIIs) with NMP, Ministry of Education (MOE), donors, logistics and implementing partners, and research organizations and analysis was conducted with Dedoose. Key results demonstrate that SBD can add to the pool of nets in the household and pupils can be 'change agents'. Some groups are not included in SBDs (e.g., the elderly and houses without schoolchildren) and should not be forgotten. Some people think that the net is for the pupil and not the other members of the household. There is lack of resources for both ITNs and implementation in SBDs, lack of donor partner commitment for SBD and inadequate planning and implementation at scale for SBD. Existing stakeholder commitment in the country and/or well-established malaria project were

key factors for program success.

Country Group	Policy	People	Resources
A	Fully available	Fully available	Fully available
B	Fully available	Partially Available	Partially Available
C	Fully available	Partially Available	Not available

Recommendations from the study include:

- Pilots should not be undertaken without a clear pathway to scale-up.
- Consider leveraging a Project or NGO/INGO type of organization to accelerate start-up.
- Promote CD more effectively.
- Ensure appropriate quantification for SBD and other channels (one size does not fit all).
- Consider how to reach those who are ineligible for SBD.
- Review the eligibility of teachers to receive a net.
- Use experts from scaled-up countries to provide technical assistance.

School-based ITN distribution (2) Case study: Liberia's experience with school-based distribution: pilot & scale-up - Chrispin Williams (NMCP Liberia)

Malaria is endemic in Liberia with all year-round transmission. ITNs are the main approach to vector control. The National Strategic plan 2021-2025 is to ensure 80% population is protected by malaria preventative measures. Strategies in place include mass campaign and routine distribution of nets. A mass campaign (with pyrethroid nets) was carried out in 2018, for which ITN access ranges from 26% to 53% across the country. As a result of high reported resistance to pyrethroids and susceptibility to Chlorfenapyr, there was a country-led decision to deploy Interceptor G2 for mass campaign and routine distribution. The mass campaign was conducted in April 2021 with national coverage of 95%. Currently awaiting data from MIS 2022 to determine ITN access.

The SBD strategy was finalized and validated in August 2022 and targeted teachers and school coordinators of grades 1,5 and 9 for Interceptor G2 deployment. Pilot implementation took place Nov 2021-Feb 2022 using a multi-partner approach. Partners included NMCP, PMI, Ministry of Education (School Health Division, Read Liberia, Breakthrough action & Ministry of Health (Health Promotion Division), GHSC-PSM, School Administration, Parent Teacher Association and Country Health Teams.

The campaign reached 124 out of 137 schools (90%) and distributed ITNs to 45,801 students & 2,527 to teachers. Lessons learned:

- Difficulty in obtaining school enrollment data centrally -> engaged school coordinators to get counts of students for distribution.
- On-site supervision and daily partner coordination addresses delays.
- Picking up nets from the Central Medical Store on the day of the distribution delayed delivery to schools ->revised the strategy to use temporary storage hubs working closely with the County Health Teams.
- Involvement of PTAs & school authorities as school coordinators helped clarify myths on ITN use.

Recommendation	Liberia experience
Pilot should not be undertaken without a clear pathway to scale-up	PMI commitment to support SBD scale-up
Involve a project or NGO/INGO to accelerate start-up	Engaged Read Liberia as an implementer,
Promote continuous distribution more effectively *(as potential alternative to mass campaigns)*	Need to collect information on SBD scaling (and ANC and EPI distribution) to determine effectiveness, at least in specific counties
Ensure appropriate quantification for SBD and other channels	Had challenges getting enrollment information from MOE; partnering with READ Liberia coaches & school coordinators to provide enrollment prior to distribution during the pilot.
Rethink SBD and how to reach those who are ineligible	Needs further consideration as part of scaling
Review eligibility of teachers to receive a net	All teachers received a net during pilot; changing to single teacher sponsor per class & school coordinator in scale-up.
Use experts from scaled-up countries to provide technical assistance.	Liberia needs more technical assistance in this area

The SBD strategy for scaling up includes ongoing distribution (Dec 2022-April 2023), prioritizing two counties (Bong & Nimba) with high school enrollment and low ITN access. This involves working directly with the County Health and Education Teams and selecting grades 1st, 5th and 9th from eligible schools. Costing implementation will inform future expansion.

Remaining challenges include funding, limited field staff for monitoring and supervision and need for TA guidance. Next steps will include coordinating with MOE and partners to resume distribution, planning around school calendar, continuing SBC orientation in remaining districts within counties and identifying & engaging technical assistance from experts with SBD scale-up experience (in-person or virtual support).

Discussion – All

- It was asked if the speaker could expand on the Zambia specific experience in acquiring resources for SBD.
  - *It was responded that the pilot SBD was small scale and going forward will aim to scale up at the sub-national level. Currently there are inadequate resources to support scale up, so this is the most significant challenge.*
- It was asked what the rationale was behind distributing to grades 1, 5 and 9 in Liberia?
  - *It was answered that the decision to distribute to 3 grades was based on enrolment data from the Ministry of Education as 3 classes accounts for high school enrolments according to levels of education.*
- It was asked to provide further information on how campaigns determine how children use the nets (e.g. they may repurpose them) and if there were engagement plans which support the children's household to guide use of the nets?
  - *It was answered that the campaign worked with parents and teachers responsible for disseminating information to ensure the correct guidance was provided to households.*
- It was asked whether there was an alternative distribution channel for houses which do not receive the nets through SBDs (e.g. elderly).
  - *It was answered that multiple methods of distribution will be needed for full coverage, especially if we are moving away from mass campaign strategies.*

Practical checklist for using routine data to measure VC impact – VCWG WS1

Progress in high burden countries has slowed down due to multiple factors such as funding gaps, leading to gaps in intervention coverage, & increasing insecticide resistance. To combat resistance, national malaria programs & partners are deploying new vector control interventions (next gen ITNs and long-lasting non-pyrethroid IRS formulations). Monitoring the impact of vector control interventions can support tailoring of vector control programs and in some cases, reviewing trends in routine malaria case data may lead to unexpected findings, such as increases in cases in the period after an intervention. Systematically compiling and analyzing all available data can help to properly investigate and identify possible reasons for observed trends in malaria cases and a checklist of key questions, indicators and data sources can guide these investigations.

Checklist area	Specific questions
1. Location & context	a. What specific administrative areas (and level) are you interested in analyzing?
	b. What time period are you interested in analyzing? (i.e. including before/after intervention?)
	c. What are the climate trends in the area? What are any other geological markers that may impact malaria burden?
	d. What do we know about population-based factors, such as migration, industry, etc., that may contribute to differences in malaria burden?
2. Malaria case burden trends	a. What are the trends in malaria cases or malaria case incidence?
	b. What threats exist to interpreting case data, such as missing values, outliers or inconsistencies?
3. Entomological trends	a. What are the primary vectors in the areas of interest?
	b. What are the trends in vector density indicators?
	c. What are trends in sporozoite rate, EIR and parity?
	d. What are trends in insecticide resistance?
4. Vector control Interventions	a. What intervention was implemented?
	b. When were the interventions implemented?
	c. What was the coverage of the intervention?
	d. What is individuals' exposure to the intervention? Including ITN use, time spent indoors and under ITNs, mosquito locations Intervention exposure
	e. How long do we expect the vector control intervention to be effective?
5. Other interventions	a. What other interventions may also impact trends in malaria case burden, outside of vector control interventions?

The use of this checklist was demonstrated through a fictional example. Participant feedback of the checklist is encouraged including ways to strengthen the checklist.

Task Team 2: Addressing biological threats; new insecticides for vector control (for IRS and ITNs) Facilitators: Christen Fornadel (IVCC), Julia Mwesigwa (PATH)

Session 4: Vectron T500 hut and community trials; Sub-lethal exposure to chlorfenapyr kills *Plasmodium* parasites in surviving insecticide-resistant *Anopheles* mosquitoes; Estimating the malaria prevention impact of dual active ingredient ITNs: Results from the New Nets Project pilot evaluations

Non-inferiority experimental hut and community (Phase III) cluster randomized indoor residual spraying evaluation trials of Vectron™ T500 against malaria vectors in Tanzania - Njelembo Mbewe (LSHTM, KCMUCo), Patrick Tungu (NIMR, Tanzania)

VECTRON™ T500 is a wettable powder formulation used for Indoor Residual Spraying (IRS) containing 50% of broflanilide as an AI. The efficacy and effect of VECTRON™ T500 against malaria vectors were evaluated in experimental hut and community randomized trials in Lower Moshi in Tanzania.

Concrete and mud plastered experimental huts and the three trial arms were negative control (water sprayed),

Actellic® 300CS (AI pirimiphos-methyl) WHO PQT VCP listed and VECTRON™ T500. Monthly wall cone bioassays were conducted with insecticide susceptible and pyrethroid resistant *Anopheles gambiae* s.s. strains for residual efficacy in terms of 72h mortality and wild free flying *Anopheles arabiensis* (*An. arabiensis)* collections were conducted in huts for non-inferiority comparison of VECTRON ™ T500 to Actellic® 300 cs in terms of 72h mortality. Results showed:

- VECTRON™ T500 was non-inferior to Actellic® 300CS in terms of mortality.
- Residual activity of VECTRON™ T500 was longer on concrete than on mud plaster.
- Residual activity of VECTRON™ T500 was similar against susceptible and resistant strains. Hence no evidence for cross resistance between broflanilide and pyrethroid.
- VECTRON™ T500 will be an important addition to the current arsenal of insecticides used for malaria vector control and can be used for insecticide resistance management via rotations.

Next, the methodologies and results of the non-inferiority community cluster randomized trial (CRT) were presented. This was a non-inferiority trial, to show that spraying VECTRON™ T500 will not result in vector densities higher, by a non-inferiority margin of 50%, than those (per trap per night) in the reference arm (Fludora® Fusion (WP-SB) a WHO PQT-VCP listed IRS product). The primary outcome of the study was the reduction in vector density (abundance) and secondary outcomes included the duration of activity on walls, seasonal sporozoite rates, entomological rates (EIR), number of infective bites per person post-intervention.

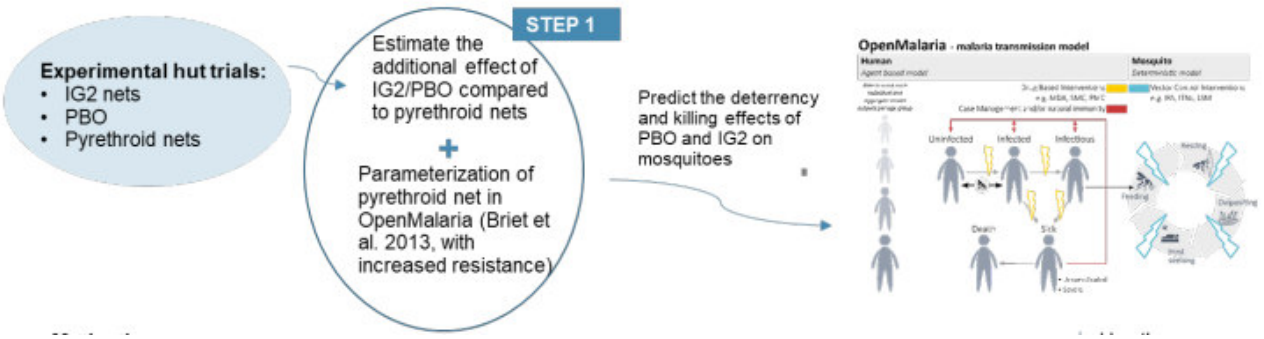
Overall spray coverage was 96%. Analysis of residual bioassay data showed there was no statistical difference in residual activity between insecticide treatment, survey number and mosquito strain. There was a statistical difference in residual activity between wall types (cement, mud). For reduction in mosquito abundance, both IRS products show 90% efficacy compared to pre-intervention period. There was no evident decrease in sporozoite rate post intervention and the strong decrease in mosquito density is the main contributor to the fall in EIR.

In conclusion:

- Following WHO criteria, VECTRON™ T500 was non-inferior to Fludora® Fusion in terms of its ability to reduce vector density and EIR.
- The main contributor to the reduction in EIR was the reduction in vector density rather than reduction in sporozoite rate.
- The long-lasting efficacy of 12 months of the candidate VECTRON™ T500 represents an important development to the IRS intervention class.

Sub-lethal exposure to chlorfenapyr kills *Plasmodium* parasites in surviving insecticide-resistant *Anopheles* mosquitoes - Pie Mueller (Swiss TPH)

Entomological studies carried out in Benin and Tanzania show efficacy of IG2 ITNs. The OpenMalaria transmission model was used to reproduce the Tanzanian randomized control trial (RCT) *in silico.*



Effect of IG2 in RCT is greater than expected from hut trials. Does chlorfenapyr provide additional transmission blocking effects even if a mosquito survives a sub-lethal dose? Must consider the insecticide mode of action and Chlorfenapyr role in disrupting the production of ATP.

To determine the chlorfenapyr dose that induces 30-50% mortality, modified WHO tunnel assays were conducted using chlorfenapyr only and untreated net samples against Pyrethroid-resistant *Anopheles gambiae s.s. kdr.* Mortality was scored 9 days post blood meal. Results showed net samples with 200 mg/m^2 induced the desired mortality. The experiment repeated with blood from gametocytaemic carriers and in addition to scoring mortality 9 days post blood meal, scoring oozysts and sporozoites was also conducted. Results showed a decrease in proportion of infected mosquitoes and intensity of infection post chlorfenapyr exposure.
In conclusion:

- Chlorfenapyr substantially reduces the proportion of *Plasmodium*-infected mosquitoes and the intensity of infection at sub-lethal doses.
- Chlorfenapyr will further decrease the occurrences of malaria in communities beyond killing mosquitoes.
- A possible explanation is that chlorfenapyr disrupts ATP production not only in the mosquito but also in the *Plasmodium* parasite.
- Ongoing studies are further exploring the nature of this mechanism and chlorfenapyr's overall ability to affect malaria transmission.

Estimating the malaria prevention impact of dual active ingredient insecticide-treated nets: Results from the New Nets Project pilot evaluations - Joe Wagman (PATH)
The New Nets Project pilot evaluations have been conducted in Burrkina Faso, Nigeria, Rwanda and Mozambique (Northern and Western).

Key findings include:

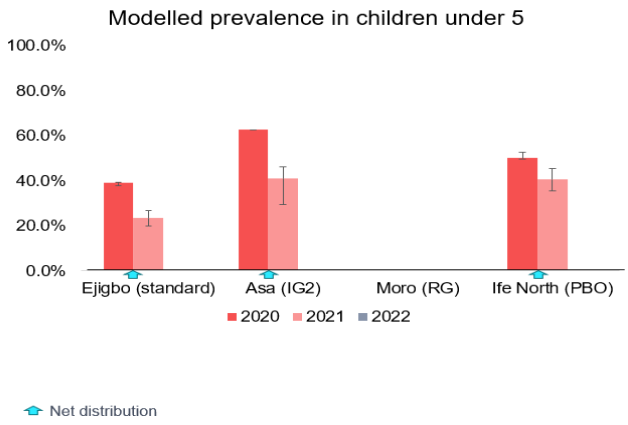
- Mass ITN distributions (universal coverage campaigns) are strongly associated with increases in ITN access and use and decreases in malaria transmission - regardless of ITN type.
- In areas with moderate to high transmission and pyrethroid-resistant vectors:
    - Distribution of IG2, PBO, or RG ITNs seem more effective at controlling malaria than distribution of standard, pyrethroid-only ITNs (through 1 year).
    - This improved control is more sustained with IG2 (and with PBO in Burkina Faso).
- Increased impact may be less pronounced in settings like Rwanda with overall low malaria burden and low levels of pyrethroid resistance.
- ITN durability likely affecting the duration of effect for RG and PBO (polyethylene) ITNs – at least in Southeastern Africa.
- These pilot study results align well with results from the cluster randomized trials in Tanzania and Benin.
- No indications of major changes required to distribution systems to accommodate new net types.
- Costs of distribution remain driven by costs of net products.
- New products can be price competitive with Standard LLIN with copayment.
    - Dual-AI nets are currently price-competitive without a copayment with PBO nets.
- Cost effectiveness of new nets will depend on sustained price reductions and deployment in places with enhanced effect.

In Burkina Faso, preliminary results show there were greater reductions in under 5 prevalence in the IG2 and the PBO districts. After controlling for rainfall, clustering, and other covariables, the formal difference in differences analysis suggests that there were greater reductions in all ages malaria incidence reported in the routine health system in the IG2 and PBO districts compared to the standard ITN district (though only the year 2 IG2 reduction

was statistically significant at p=0.05).

In Northern Mozambique, preliminary results show that there were significantly greater reductions in under 5 prevalence in the IG2 and RG districts through one year; however, these trends were relatively short-lived, not sustained through the second year. After controlling for rainfall, clustering, and other covariables, the formal difference in differences analysis suggests that there were greater reductions in all ages malaria incidence reported in the routine health system in the IG2 and PBO districts compared to the standard ITN district (though only the year 2 IG2 reduction was statistically significant at p=0.05). Regional differences highlighted through the sustained decreases in prevalence in the IG2 district. Estimates of ITN durability at 24 months show estimated median lifespan for IG2 to be highest (2.5 years) followed by PBO and RG (1.8 years for both). This contributes to explaining the waning impact observed after 1 year for PBO and RG.

In Nigeria, modeling was used to adjust for the impact of seasonal malaria chemoprevention (SMC). Modeled prevalence assuming no SMC in Asa and Moro. Moro estimates not yet available—validation for pyriproxyfen model ongoing. Estimates of ITN durability after 12 months showed high survival of campaign nets in serviceable condition after 12 months (96.5-100%).



In Rwanda, bed net use was already high before the campaign. Preliminary results suggest that there were significant reductions in all ages prevalence in all districts at year one in this very low burden setting. There was a good opportunity to evaluate IRS in combination with ITNs and during the second year, there was a substantially greater reduction in all-ages prevalence in the IG2 and the Standard + IRS districts. After controlling for rainfall, clustering, and other covariables, the formal difference in differences analysis suggests that there were greater reductions in all ages malaria incidence reported in the routine health system in the IG2 and IRS districts compared to the standard ITN district.

Cost and cost effectiveness approaches were conducted and the Incremental Cost effectiveness of switching from standard ITN (LLIN) to Next Generation Nets was calculated using observational studies and modeling. Generalized (vs. no-ITN) calculated from modeled data.

Preliminary results to date show:

- No indications of major changes required to distribution systems to accommodate new net types.
- Costs of distribution remain driven by costs of net products.
- New products can be price competitive with Standard LLIN with subsidy.
- Cost effectiveness of new nets will depend on sustained price reductions and deployment in places with enhanced effect.

Discussion – All

- It was asked how the effects seen on chlorfenapyr exposed mosquitoes (reduced proportion of infected mosquitoes and intensity of infection) can be fully attributed to chlorfenapyr and not other insecticides (which may have the same effect)?
    - *It was answered that some effects have been shown for other insecticides, but a greater effect is observed for chlorfenapyr. Further work needs to be done to fully understand the direct and indirect effect on the parasite.*
- It was asked what the reason was for the higher functional lifespan of the nets in Nigeria compared to the other countries in the trials?
    - *It was answered that in Nigeria, bed net use was much lower.*

Task Team 3: Capacity building, localization, and private sector involvement for sustainable vector control Facilitators: Jessica Rockwood (International Public Health Advisors), Samuel Asiedu (AGAMal)

Session 5: Vision for vector control capacity building. Local resource mobilization to support ITN distribution in Nigeria. Experience of a malaria elimination project.

Capacity building, localization, and private sector involvement for sustainable vector control: October 18, 2022 special session outcomes and next steps, vision for capacity building - Develop a checklist for countries - Supporting small pesticide companies - Jessica Rockwood, Samuel Asiedu

The Task Team 3's vision is to have active involvement of the private sector in sustainable vector control towards malaria elimination. The objective of the Task Team is to support VCWG members in their efforts to foster sustainable ITN and IRS interventions through the capacity strengthening of NMPs, local partners, and the private sector.

On 18 October 2022, a special session overview took place to undertake a deeper dive into private sector organizations involved in vector control activities with national malaria programs, learning from their motivation, successes, and challenges. Full report available at: https://endmalaria.org/special-session-engaging-private-sector-vector-control

Examples of Malaria Control Programs With Private-Sector Involvement

Country	Organization	Intervention
Malawi	Illovo Sugar	IRS
	Mulanje Mission Hospital	IRS and LLINs- for hospital catchment area
Ghana	AngloGold Ashanti	IRS, bed net distribution, environmental management, insecticide resistance management, education, surveillance
	Benso Oil Palm Plantation	IRS and LLINs for staff on its plantation
Uganda	Uganda National Oil Company -UNOC	VC for its work force
	Quality Chemicals, with guidance from the NMCP	IRS -New initiative in collaboration with the NMCD, IRS will be implemented o full recovery basis – commercial purpose project
DRC	Tinke Fungurume Mine	IRS and LLINS for mine workers
Brazil	Mineração Novo Astro S/A	Vector control and surveillance services, investments in staff, provision of equipment
Mali	Société d'Exploitation des Mines d'Or de Sadiola	IRS, larviciding, breeding site removal, household malaria education
Zambia	Zambia Sugar	IRS, malaria case management, IPTP, education and behaviour change communication
	Konkola Copper Mines, Mopani Copper Mines	IRS, malaria case management, IPTP, education and behaviour change communication
	Roan Antelope, Mufulira, Nkana-Kitwe, and Nchanga mines	IRS, malaria case management, IPTP, education and behaviour change communication
Chad, Angola, Cameroon	ExxonMobil, Petronas, Chevron	Insecticide-treated bed nets, chemoprophylaxis among nonimmune workers
Equatorial Guinea	Marathon Oil	IRS, bed net distribution, ACT introduced free of charge to children and pregnant women, IPTP, training of medical staff, communication campaign
Philippines	Shell	IRS, insecticide-treated bed net distribution, diagnostic and treatment provision, capacity building

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7594257/

Next steps for private sector engagement include:

- Assess national capacities to engage private sector (PS) (NMPs/National Vector Control Committees).
  - Build on national strengths and build necessary capacity to involve PS.
  - Consider how to engage the PS in vector control.
- Support Private Sector to develop programs.
  - Capitalize on core strength of PS.
- Develop a checklist for countries and private sector partners in vector control.
  - Assessing full engagement (e.g., AGAMal model) or in-kind participation (e.g., Zambia EMC model).
- Support small pesticide companies – assessing the case for engagement.

VCWG membership input requested to inform what items should be included in a checklist for countries and private sector partners to assess engagement and fill gaps in vector control and what is needed to support the development of small pesticide companies. Email Sam Asiedu (sasiedu@agamal.org) and Jessica Rockwood (jrockwood@iphadvisors.com) with answers to the following:

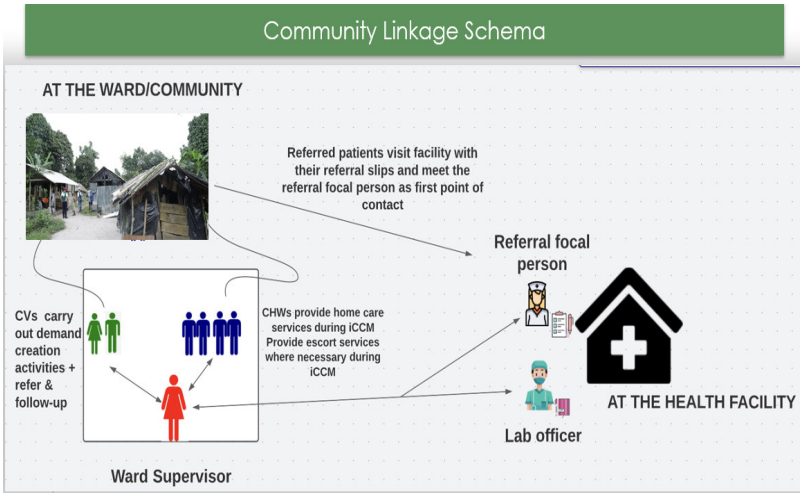
- What items should be included in a checklist for countries and private sector partners to assess engagement and fill gaps in vector control?
  - Will this differ by country and/or region?
- What is needed to support the development of small pesticide companies?
  - What are potential gaps and solutions?

The Bonny Island Malaria Elimination Project - Anastasia Isodje (Nigeria LNG, Ltd.)

Bonny Island is a semi-urban community in Rivers State, Nigeria and host community to Nigeria LNG Ltd. (NLNG) 6 train natural gas liquefaction plant. The company is currently funding three healthcare corporate social responsibility projects (CSR) on the Island, including the BNYMEP to make Bonny Island Nigeria's first malaria-free zone.

The report of the malaria burden on the healthcare facilities and community led to the decision by the company's executive management to eliminate malaria from Bonny Island. The following assessments were considered the irreducible minimum for the project conceptualization: Health Systems Assessment, Bonny Malaria Indicator Survey and Advocacy Communication, Social Mobilization Mapping/Profiling and insecticide resistance survey (in collaboration with PMI).

Key baseline findings highlighted gaps in the health system, malaria prevalence of 5.4%, hot spots in low-income settlements of >32% and the poorest communities most affected. An Operational Management Committee was set up to drive community action and to ensure every household is reached with every intervention.



In early 2022, a mass ITN distribution campaign was conducted (nets supply and distribution assistance from PMI). And reduction as high as 99% was observed on the island – community structure and engagement contributed to this. Post ITN campaign, social and behavior change communication was conducted, with findings showing overall 78% slept under nets.

Local resource mobilization to support ITN distributions: Lessons learned from Nigeria - Leveraging host government and state resources (transport, IEC, etc.) - Augustine Firima (MSH Nigeria)

Management Sciences for Health (MSH) currently implements several malaria projects including the Global Fund Malaria New Funding Model (NFM) 3 Grant which implemented an ITN campaign in Delta in 2022. Over the last several years, the NMEP and in-country partners have made giant strides with local ownership for net campaigns in Nigeria, with this presentation focusing on the unique success stories of Local Resource Mobilization (LRM) in Nigeria.

Local resource mobilization is important to improve domestic funding by host governments for sustainable malaria programming, in the light of reduced donor support occasioned by the dwindling economic situations around the world, improve funding for malaria control by 25% annually, as outlined in the National Malaria Strategic Plan (NMSP) 2021-2025 and strengthening government ownership and funding of malaria programs toward malaria control and elimination. The LRM approach implemented involved sourcing for material, human and social resources.

The methodology involved central level coordination by NMEP, constitution of the national Campaign Implementation Team (CIT), State Campaign Team, and state ITN Campaign Coordination Network (ICCN). Additionally, entry meetings were conducted with relevant stakeholders at the state level by implementing Partners, development of key messages (led by demand creation work stream) for resources mobilization, scheduling resource mobilization visits with relevant stakeholders by the demand creation team and follow up of key stakeholders on their commitments/pledges.

Donor and implementing partner support led to the development of costed malaria-specific workplans, securing support during microplanning and implementation of ITN campaign and orientation and engagement of LGA health promotion officers and media practitioners to create awareness and sensitization about campaign activities. Significant achievements were made at state and local government level for the mobilization of material, human and social resources:

Material

- The state government in Delta state supported the ITN campaign process from microplanning to implementation supported by the GF malaria grant.
- Approximately 58 million naira cash ($132,450) was released for the implementation of ITN campaign in Delta state in 2022.
- Warehousing and storage of ITNs at state, Local Government Area (LGA) and community levels.
- State and LGA augmented transportation for personnel during the campaigns, especially in hard-to-reach areas.
- Provision of free training locations at the LGA and ward levels.
- Funding of some trainings, especially during microplanning.

Human

- The state and local governments released their staff at the facility levels to implement the ITN campaigns.
- The state and local governments mobilized volunteers who implemented various stages of the ITN campaign.
- Support for high-level executives to participate in supervision, ensuring early and prompt resolution of bottlenecks.

Social

- Identification and investiture of strategic stakeholders as Net Ambassadors to advocate for fund release at state and Local Government Area (LGA) levels.

- Launching Ceremonies (state and LGA levels).
- Sensitization of communities through multiple channels (airing of jingles, live radio and TV discussion programmes, town and street announcements and community mobilization).

Lessons learned include:

- Early engagement through advocacy and planning with government stakeholders has led to increased ownership.
- Use of appropriate advocacy tools such as realistic budgets and costed plans have contributed to increased domestic resource mobilization.
- Selection of prominent stakeholders as Net Ambassadors has assisted in domestic resource mobilization drives.
- Increased partner support and coordination has contributed to enhanced ITN campaign implementation.
- Advocacy to traditional and religious leaders led to increased community ownership, including mobilization of additional resources such as storage of ITNs and transportation support at community levels.
- Advocacy and regular engagements with security agencies (NPF, DSS, NSCDC, and local security groups) provided routine surveillance for the campaign nets and support devices. They helped to track down suspected misconducts, uncovered alleged attempts of net and device diversions. They also helped to resolve security issues during the campaign.

Discussion - All

- It was asked how to leverage budgets to support work plans from oil companies in Nigeria and what percentage of budgets is allocated to countries for greater support towards NMEPs?
    - *It was answered that the current budget is raised by NLNG, with support provided by PMI for vector management however recently allocation of budget to combatting the risk of importation. Other stakeholders contribute to the program such as delivery of nets to villages from Chiefs council and local government etc.*
- It was asked what lessons learned, regarding engaging the private sector can be shared?
    - *It was answered that there is an increasing need to support the movement to form private sector engagement committees at the state ministry level. Strategies should be put in place to outline what is expected of private sector government committees and tap into their resources accordingly. Creating a culture of accountability, transparency and an inviting environment for the private sector to engage with.*

Wrap up and next steps (Allan Were)

The session was wrapped up by Allan Were, who gave thanks to all presenters, participants, meeting organizers and a special mention to Konstantina.

Tuesday 7 February 2023

Work Stream 2 (WS2): Expanding the Vector Control Toolbox - Leads: Sheila Ogoma (Abt Associates) & Derric Nimmo (IVCC)

The next few years are going to be an exciting time for innovations in vector control. Dedicated work by a range of stakeholders means that we can expect several new tools to be available soon, with new active ingredients to combat resistance development, targeting different life stages, outdoor biting control, improved surveillance, and generally improved usability and longevity of products. This session will showcase some of these new innovations and provide a platform for discussions on how we can best use these tools to combat malaria.

Introduction: work stream updates - Sheila Ogoma, Derric Nimmo

Sheila Ogoma (SO) and Derric Nimmo (DN) welcomed participants to the second day of the VCWG meetings and

introduced the Task Teams in work stream 2.
Task Team 1: Larval source management, Leads: Jennifer Armistead (PMI) and Prosper Chaki (IHI/ PAMCA).
Task Team 2: Innovation in vector control and vector surveillance, Leads: TBD.
Task Team 3: Anthropology and human centered design (interface between vector control and human behavior), Lead: April Monroe (JHUCCP).

The agenda for WS2 is to showcase work by a range of stakeholders on new tools to be available soon, with new active ingredients to combat different types of resistance, targeting different life stages, outdoor biting control, improved surveillance, and generally improved usability and longevity of products. The Expanding the Vector Control Toolbox (EVCT) work stream 2022 activities included a landscape analysis on Larval Source Management (LSM) and anthropology and human centred design in the context of vector control. EVCT plans for 2023 include further LSM activities (landscape analysis and consolidating existing knowledge gaps pertaining to LSM implementation) and innovations / discussions. This will focus on developing a document outlining an overview of innovations, Task Team on attractive sugar / odour baits, an outline of research on genetically modified and gene drives mosquitoes, endectocides, spatial and topical repellents and finally innovations in mosquito sampling. There is a call for Task Team members and leads for the above.

Task Team 2: Innovations in vector control and vector surveillance - Facilitators: Sheila Ogoma & Derric Nimmo

Closing the gap - Jason Richardson (IVCC)
There are 3 major global trends contributing to the "gap", these are urbanization, the growth of hard-to-reach populations and climate change. The number of people fleeing their homes has doubled in a decade and malaria and other vector-borne diseases are a major threat to populations in hard to reach areas. 36 million Africans forcibly displaced by conflict and repression and invasion and expansion of *Anopheles stephensi* has been reported in urban centres and refugee camps. Humanitarian emergencies are driven by climate and conflict, examples in Pakistan, Myanmar and Sudan, all suffering from increases in vector borne diseases.

Climate disasters will continue to increase vulnerability, potentially causing more migration and the African continent is facing a faster rate of natural disaster events than the rest of the world. The World Bank projects

there will be 86 million climate change migrants in Africa by 2050 and in Jan 2023 the World Economic Forum called for coordinated action. Urbanisation is one of the leading global trends of the 21st century that has a significant impact on health. Potential increase in *Anopheles stephensi* and *Aedes*-borne virus transmission. In order to address these emergency situations we must appropriately assess risk and if warranted, authorize the emergency use of promising tools. Looking forward, flexible and creative problem solvers needed as routine vs emergency responses require different approaches. Responses must be locally driven, layered and aggressive.

Selected tools with high potential (already in production and commercially available) include larval control, Attractive Toxic Sugar Baits (ATSBs), passive emanators, targeted IRS and treated textiles. Volatile emanators (spatial repellents) show strong evidence of community impact beyond repellency and show clear reduction in vectorial capacity even in temporary shelters. Newly developed products lasts more than 6 months and minimal behavior change is required. Improved larviciding and delivery of larvicides is being implemented by multiple country programs (Goodbye Malaria, AGAMal, PMI) and the work stream, PAMCA and IVCC are working to clear obstacles limiting the potential impact. IRS is used in emergency settings by expanding sprayable structures to include internally displaced persons (IDP)/refugee temporary shelters and tents. Practical guidance is required for emergencies addressing adaptation of labels and spray methods to safely and effectively treat shelters. ATSBs are a new product class with RCTs running in Zambia, Kenya and Mali targeting a submission to VCAG & PQ by end of 2024.

In conclusion

- Local solutions: All ideas rely on local entomologists to test and adapt the IVM package based on observations of what works.
- Act now: While we wait for results from multi-year epidemiological studies and the development of new tools, let us use known and promising new mosquito control tools to make an impact today.
- We have options: Local teams need to test current and close to market tools which might include:
    - Smart use of larvicides with good targeting and monitoring.
    - Spatial repellents indoors and in temporary shelters.
    - IRS for temporary shelters.
    - Insecticide treated textiles.
    - …and even smartly delivered space sprays in emergency settings.

Spatial repellents: Roadmap to global recommendation of spatial repellents for public health use - John Grieco (University of Notre Dame)

Spatial repellents provide a continuous release of active ingredient over time and space, provided added value (by addressing daytime, early-evening and indoor/ outdoor vector biting), have varied modes of action and are innovative (new actives, alternate target sites and exploitation of post-exposure effects).

Data from large scale clinical required to close the knowledge gaps on spatial repellents. Results presented for dengue evaluation in Peru and malaria evaluation in Indonesia. Both trials utilized intervention produced by SC Johnson, passive emanators using Transfluthrin (2 weeks in duration). Primary outcomes in Indonesia show up to 65.6% protective efficacy in overall infection (first and all subsequent) in clusters with entomology collections and a 16,4% and 11.3% reduction in anopheline attack rate indoors and outdoors, respectively. Primary outcomes in Peru show 34.1% protective efficacy against *Aedes*-borne virus (ABV) infection in subjects susceptible to Zika or wholly susceptible or monotypic to DENV and a 28.6% reduction in indoor adult *Aedes aegypti* (*Ae. aegypti)* female mosquito abundance (significantly different than control). Recommendations from the Indonesia and Peru trials posted in 10th and 12th VCAG meeting reports.

In 2018 trials funded for evaluating spatial repellents against malaria (Kenya and Mali) and *Aedes*-borne viruses

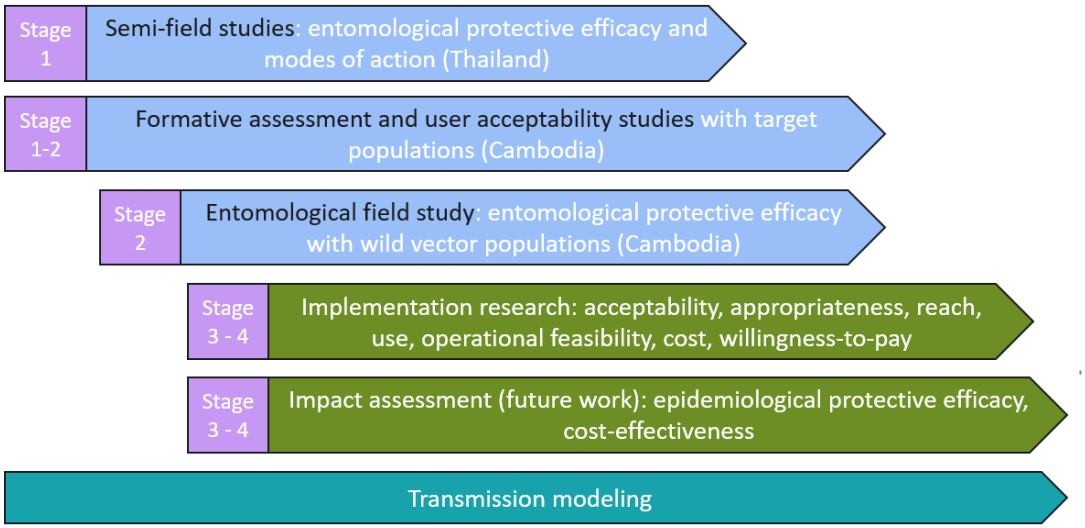
(Sri Lanka). There is hope of funding for a 4th trial in Uganda for humanitarian assistance. The intervention was "MOSQUITO SHIELD" (4 week in duration). In Kenya the interim analyses on first time infections has been completed and results are currently being reviewed by Unitaid. The Mali trial is currently in month 8 of a 24 month follow up, final analyses of protective efficacy anticipated March 2024. In Sri Lanka, the cluster mapping and delineation is completed. The Operational Use trial in Uganda awaits a green light based on Kenya interim analysis, anticipated completion by Q4 of 2024. This trial will inform optimal distribution channels and cost-effectiveness for operational implementation.

Shifting the conventional paradigm on evaluating interventions - Neil Lobo (University of Notre Dame, UCSF)
Project BITE is working to shift the paradigm on protection from mosquito borne diseases to understand gaps in protection, take a staged approach to intervention evaluation and evaluate interventions based on their modes of action. The trial is taking place in Cambodia, where there is persistent transmission among forest goers, dwellers and rangers.

1. Understanding where and when people are exposed to mosquito bites allows for targeting and tailoring intervention strategies and layering of multiple interventions.
   Design intervention package that addresses each / all spatial and temporal exposures.

2. Taking a staged approach to intervention evaluation allows for evidenced based decision making, evaluation of multiple paradigms and products, targeting and tailoring and community input. It is responsible, ethical, cost effective and contributes to understanding remaining gaps in protection.

Inspiration: Framework for rapid assessment and adoption of new vector control tools. Vontas, Moore, Kleinschmidt, et al., Trends in Parasitology, 2014.



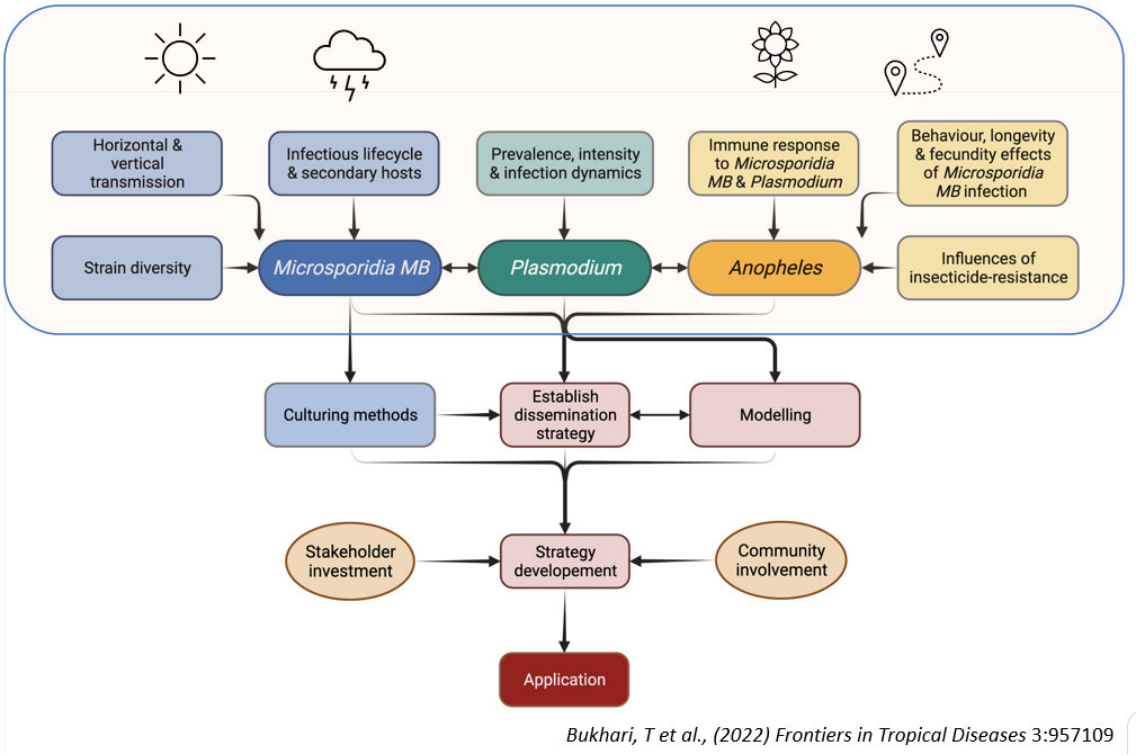
3. Evaluating interventions based on their mode of action ensures secondary endpoints are fair to the intervention, targeted and tailored and contributes to understanding intervention-related gaps in protection. Secondary endpoints should consider alternative metrics of protective efficacy to landing, such as feeding inhibition.

An entomology field study was conducted in Mondulkiri, Cambodia between October to November 2021. Results from the field study show all six interventions significantly reduced risk of landing by at least 50%. The VPSR1 alone and the combination of three products reduced mosquito landings by nearly 95%. Currently implementation

research in Cambodia is ongoing (Sep 2022-2023) in which distribution conducted by local government / implementation partners of the forest pack (topical repellent and passive VPSR; etofenprox treatment for clothing) in active *P. falciparum* hotspots. The primary aim will be to assess intervention reach, fidelity, acceptability, appropriateness, coverage, and use of BITE tools among high-risk populations. Secondary aims include exposure risks, safety, gaps in protection, economic studies, operational feasibility, facilitators and barriers to potential scale-up.

Microsporidia MB for malaria control - Syeda Tullu Bukhari (ICIPE)

Microsporidia MB belongs to *Microsporidia* and was found to occur at a high intensity and with low to moderate prevalence (0–9%) in *An. arabiensis* in Kenya. *Microsporidia MB* is vertically (45 to 100%) and horizontally (by mating) transmitted with no fitness cost. *Microsporidia MB* impairs *Plasmodium* transmission.



Bukhari, T et al., (2022) Frontiers in Tropical Diseases 3:957109

This presentation focuses on environmental factors and horizontal transmission. Field collection conducted in Ahero, western Kenya of blood-fed indoor mosquitoes were reared following laboratory protocol.

A higher average daily temperature was correlated with lower *Microsporidia MB* and a higher proportion of *Microsporidia MB* negative mosquitoes were *Plasmodium* positive.

Microsporidia spread in *Anopheles* in ecological and malaria zones in Kenya. Mosquito sampling was conducted in the rainy season in four agro-ecological zones:

- A – Busia - Humid zone & Lake malaria endemic region.
- B – Bungoma - Humid zone & highland malaria endemic region.
- C – West Pokot - Semi-arid zone & malaria epidemic zone.
- D – Turkana – Arid zone & seasonal malaria region – Turkana country.

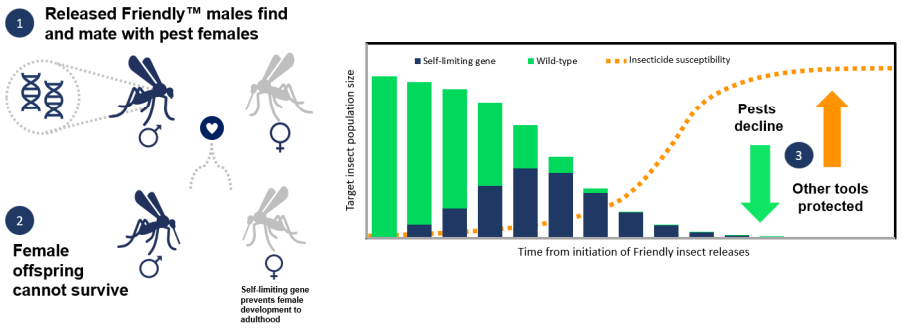
Results showed there is variation in *Microsporidia MB* prevalence across different agro-ecological zones and *Microsporidia MB* has been found in four species of *Anopheles.* The factors influencing the spread of *Microsporidia MB* include the efficiencies of vertical and horizontal transmission, attractiveness of MB-positive males, mating rate of females and males and male death rate. There is no difference in mating rate across age groups, 3-4 old females are unable to transmit *Microsporidia MB* and male to female transmission of *Microsporidia MB* is more efficient. A higher number of females mated with *Microsporidia MB* +ive males irrespective of Rhodamine feed and the mating rate of *Microsporidia MB* +ive males is higher than *Microsporidia MB* –ive males and they survive longer. Additionally, vertical transmission is mediated by ovary infections as *Microsporidia MB* is present in *o*varies of infected mosquitoes

Next steps include analysing the survival of *Microsporidia MB* +ive adult males, developing *Microsporidia MB* populations in semi field systems and scaling up the screening process (MALDI-TOF).

Self-Limiting Mosquitoes: A new tool against the invasive malaria vector, *Anopheles stephensi* - Kevin Gorman (Oxitec)

The Oxitec mission is to build a healthy, sustainable and equitable future for humans on this planet by forging a new category of safe, sustainable, chemical-free, highly effective biological pest control solutions. Over 1 billion Oxitec mosquitoes have been deployed with >95% public approval in diverse project areas. They are the first company to launch a genetically modified (GM) mosquito solution commercially (in Brazil). The technology used can be applied to a range of insects and agricultural pests. Oxitec is currently developing vector control tools for two malaria vectors that pose threats in the Americas, Africa and Asia: *Anopheles albimanus (An. albimanus)* (dominant rural malaria vector in Meso-America) and *An. stephensi* (invasive new urban vector, threat to cities across Africa).

Addressing the *An. stephensi* threat is urgent, with 126 million people at risk of this new urban malaria threat. Resistance and outdoor biting may compromise the effectiveness of insecticide-treated bednets and indoor residual spraying. Urban-colonising *An. stephensi* caused dramatic rise of malaria in Djibouti City since 2012, which has resulted in the launch of Oxitec's Djibouti Friendly Mosquito Program, which has partnered with Le Programme National de Lutte contre le Paludisme (PNLP) (national lead in the fight against malaria in Djibouti.)



and L'Association Mutualis (not-for-profit organization serving the public health needs of communities in Djibouti).

The Djibouti program follows a phased approach towards field pilots of Friendly™ *An. stephensi* in Djibouti. Labs have been conducting surveillance work since 2021 to identify behavior and population dynamics of *An. stephensi* in the community. Highlights of data – lack of seasonal dynamics and high prevalence. Data highlights include seasonal population dynamics, dictated by rainfall and temperature, good capture rates of adult male and female *An. stephensi* with BG traps and human lures and ovitrap monitoring and lab processing optimization is continuing. Wild-Type mark-release-

recapture studies are being conducted to determine dispersal and longevity of *An. stephensi* in urban versus rural habitats. Field pilots provide critical proof points for dispersal and mating and release numbers and Oxitec hope to release self-limiting mosquitoes in Djibouti in 2024, followed by regional expansion to address wider threats.

Discussion - All

- It was asked how cost-effectiveness is considered for layering interventions?
  - *It was answered that currently this is funded by donors and the evaluation of cost-effectiveness is ongoing.*
- It was asked what the funding model for the Djibouti Friendly Mosquito Program is?
  - *It was answered that Oxitec products in Brazil are commercial, however a different model is used for Anopheles stephensi in Djibouti, funded by philanthropic donors. This is not a commercial venture and therefore delivered and implemented very differently.*
- It was asked whether EIR was monitored in addition to landing rates when evaluating the layering of interventions?
  - *It was answered that in the example discussed in Cambodia, there was a low transmission rate so this was not a useful parameter however in higher transmission settings this ideally would be monitored.*

Task Team 3: Anthropology and human centered design (interface between vector control and human behavior)
Facilitators: April Monroe

Task Team updates - April Monroe (John Hopkins Center for Communication Programs)
Task Team 3 objectives are to 1) provide a platform for engagement and exchange among professionals and groups working on vector control and human behavior, 2) document lessons learned, best practices, and information gaps for considering human behavior in vector control and 3) support opportunities to expand application of human-centered approaches among professionals and organizations working in vector control.

Task Team activities have so far included the provision of a forum for discussion and dissemination within VCWG, increased coordination with RBM Social and Behavior Change Working Group, documented application of indicators for measuring patterns of human and vector interaction, identified social and behavioral considerations for *An. stephensi* interventions in Africa, facilitated human-centered design workshop and curation of resource list of experts and groups working on human behavior for vector control.

Update on list of experts - Beatrice Egid (LSTM)
A list of experts was compiled to provide a summary state of knowledge on who is working on human behavior in the context of vector control. This provides the opportunity to integrate social sciences more centrally in vector control studies, share expertise across contexts, diseases and approaches and find potential collaborators to build partnerships. The list consists of experts from cross-disciplinary backgrounds, with expertise in a variety of vector control methods, wide geographic spread and varying levels of experience (5-15 years). Participant feedback on ideas for utilizing the list are encouraged.

Over-spraying in IRS trials: a real or imagined problem for IRS assessment? - Mark Rowland (LSHTM)
Indoor residual spraying (IRS) is assessed on the quality and quantity of insecticide - too much and the target dose is breached - too little and the applied dose may fall short of requirements. IRS field trials should ensure rigorous training of spray field operators before trials begin however recent trials have produced evidence of over-spraying application rates greater than the target application rates. In experimental hut and community trials, application rate is estimated by fixing filter paper discs to walls by quantifying the spray-dose applied per square metre (by HPLC), and by comparing how much it deviates from the target dose. This is the standard WHO method for trialling

IRS products.

A large community trial was conducted in Tanzania 2021-2022 using Mitsui, VECTRON™ T500 (broflanilide) and Envu/Bayer, Fludora® Fusion (chlothianidin/deltamethrin). Professional training of field labour was conducted by IMCC 'Integrated Malaria Control Consulting' (South Africa) on IRS spraying and campaign techniques over a two-week period. However results showed evidence of over-spraying despite rigorous training. To establish possible causes of over spraying a mixed-method approach was used:

1) The quantity of insecticide, applied to filter papers, by operators spraying the walls of sentinel houses.
   Results suggest clusters were over-sprayed by 3.4-fold and 2.9-fold according to the filter paper method for both Vectron and Fludora respectively.
2) Qualitative investigation: focus groups conducted by the social science team on spray operators.
   Challenges identified around filter discs viewed as a test, resulting in varying tactics such as removing discs from the walls, and also reduced spraying speed on mud walls where discs were hanging loosely.
3) Estimation of volume of IRS treatment sprayed per house by the pump volume sprayed.
   Results show by the volume method, the operators were on target for both Vectron and Fludora suggesting the over-spraying was when spray operators, whether unconsciously or consciously, 'hovered' momentarily over the filter discs creating an illusion of over-spraying over the entire wall surface.
4) Cone tests to compare residual mortality wall bioassays of houses.
   Results show in sentinel houses, both Vectron and Fludora gave full mortality in cone bioassay for over a year.
5) Correlation of insecticide mortality with chemical content of treated walls of houses.

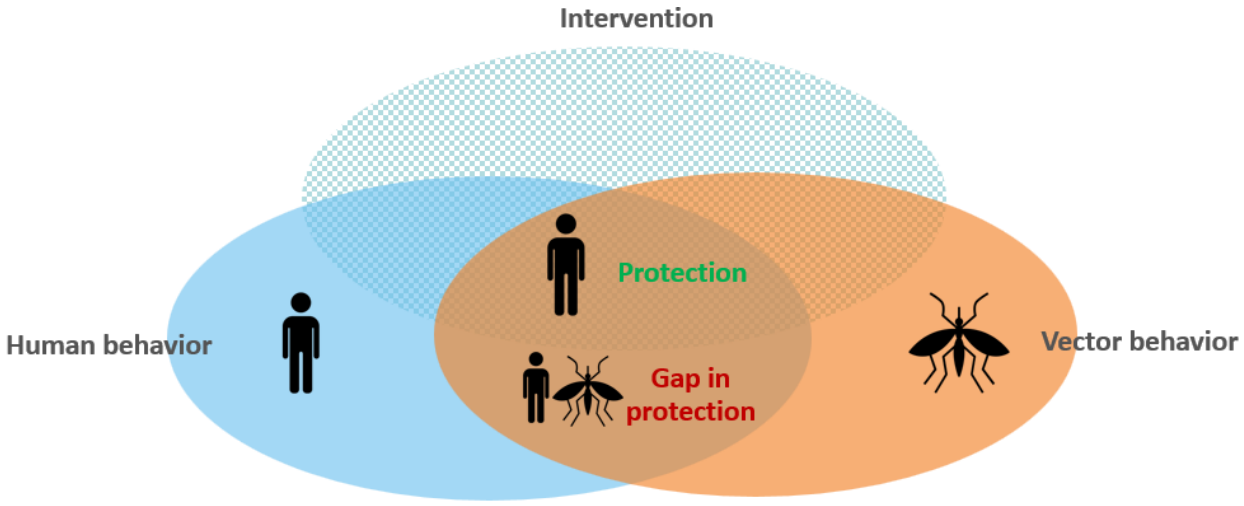
In conclusion, the Filter Paper method and spray pump method appear complementary; both are valuable and both should be deployed in future EHT and community trials.

Discussion - All

- Insightful comments and discussion were had regarding the importance of decolonizing global health and ensuring this principle is integrated into research projects.

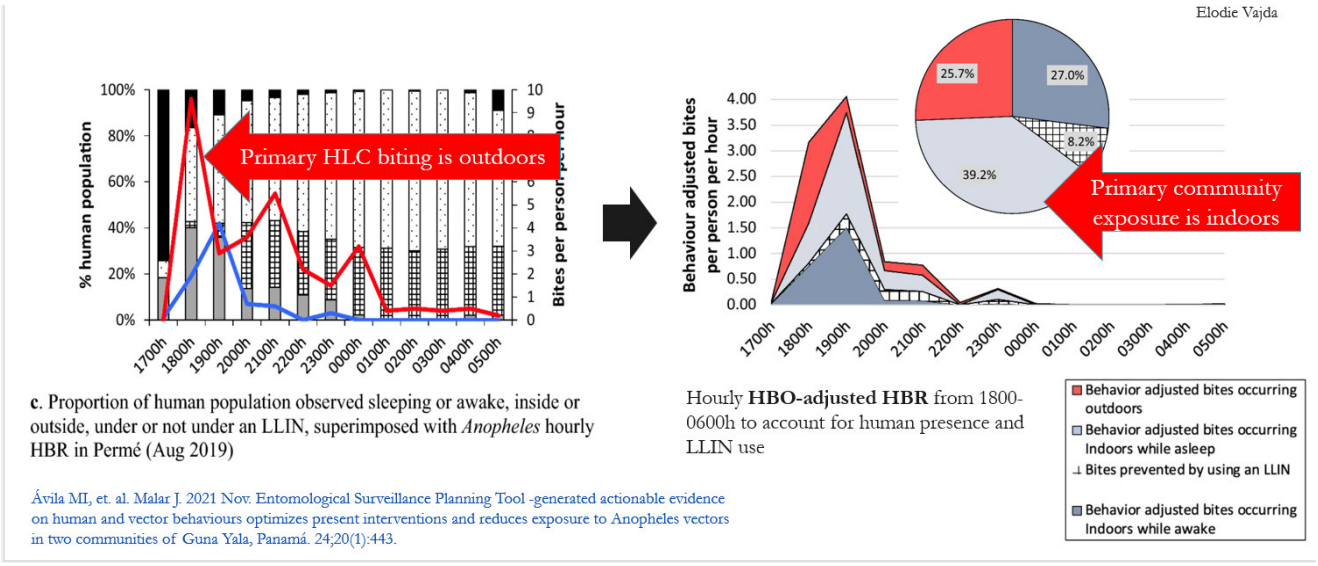
Using data to inform optimal selection of core interventions: Human behavior and exposure to mosquitoes- Neil Lobo (University of Notre Dame, UCSF)

Interventions work based on their overlap with vector behavior and human behavior is an important factor in exposure. It is key to consider where humans and vectors (behaviors) are overlapping, what are these human activities and how do these behaviors impact intervention usage / functionality. Therefore we must integrate vector and human behavior data to identify gaps in protection.



When vector biting data is analysed with human behavior data we obtain the adjusted HBR for each activity, which quantifies protection and gaps in protection.

A case study in Panama showed that quantified spatial and temporal exposure resulted in reduced exposure.



c. Proportion of human population observed sleeping or awake, inside or outside, under or not under an LLIN, superimposed with *Anopheles* hourly HBR in Permé (Aug 2019)

Hourly **HBO-adjusted HBR** from 1800-0600h to account for human presence and LLIN use

Ávila MI, et. al. Malar J. 2021 Nov. Entomological Surveillance Planning Tool -generated actionable evidence on human and vector behaviours optimizes present interventions and reduces exposure to Anopheles vectors in two communities of Guna Yala, Panamá. 24;20(1):443.

Following these findings, the most suitable intervention was deployment of bed nets with Social Behavioral Change Campaigns (SBCC) which resulted in reduced exposure and increased number of bites prevented.

A case study in Ethiopia showed heterogeneity in exposure profiles between migrant populations and residents highland and lowland populations demonstrating the need for different interventions between communities. In Indonesia, human behavior analysis demonstrated protections by spatial repellents with 28% reduction in the human behavior adjusted landing rates in intervention versus control clusters. The multiple intervention paradigm previously discussed in Cambodia was revisited, explaining that exposure space and activity were categorized into 'Temporary structure', 'Outside temporary structure' and 'Forest', which all require a different combination of interventions. Forest packs address all spatial and temporal exposure based on these findings.

The value of human behaviour observational studies) (HBOs) is to understand exposure better, evaluate the functionality of an intervention, evaluate how an intervention is not functioning, inform layering of interventions and highlight the important of the human behavioural component.
Credit to studies:
Bangladesh – Household level human behaviors can direct exposure.
Ecuador – Primary indoor exposure with exophagic vectors.
Indonesia – Human behavior analysis demonstrated protections by spatial repellents.
Namibia – Exposure based on human-vector interactions by site.
Panama – Quantified spatial and temporal exposure resulted in reduced exposure.
Ethiopia – Ongoing: Target group specific and site differences in exposure.
Cambodia – Ongoing: evaluation HBOs with VPSR, TRs, ITCs.

Discussion - All

- It was asked what factors influenced the behavioral changes between highland and lowland residents in Ethiopia?
    - *It was answered that this may have to do with housing structure and temperature for sleeping however further observations would be needed to provide further insight on this.*
- It was suggested that the Task Team share methods for Human Behavior Observation research to avoid duplication. It would be great to see these methods included in decision making however there is a need to ensure standardization between methods.

Task Team 1: Larval source management. Facilitators: Jennifer Armistead (PMI) & Prosper Chaki (IHI/PAMCA)

Climate change increases the risk of malaria transmission in South Africa - Monique Shanahan (University of Pretoria Institute for Sustainable Malaria Control)
Malaria is responsible for ~247 million infections globally and climate and land use change will intensify global rates of malaria transmission and vector distributions (prolonged seasonal transmission and geographical expansion). Larger scale analysis often under- or over-estimate local relationships between climate change and malaria and including a wider range of species increases our understanding on malaria transmission and vector ecology patterns. The aim of this study is to improve the current understanding of how climate change and land

use will influence vector habitat suitability and identify the overlap of vector habitat suitability with areas predicted to be suitable for malaria transmission.

The modelling methodology looked at vector species presence 1990-2020, 11 abiotic variables (temperature, precipitation, vegetation, waterbodies, land use etc) and used the Ensemble Model BIOMOD2. Shared Socioeconomic Pathways scenarios defined as SSP2 (medium population growth, medium land use) and SSP3 (high population growth, high land use). Projections for malaria transmission suitability considered staked vector habitat suitability, seasonal transmission and SSP2 vs SSP3. Valuable papers for methodology include 'Global land use for 2015-2100 at 0.05 degree resolution under diverse socioeconomic and climate scenarios' and 'Shifting transmission risk for malaria in Africa with climate change: a framework for planning and intervention'.

Results found important variables influencing vector habitat suitability in Africa included mean annual precipitation, mean annual temperature and physiological and/or behavioural variations. Stacked suitability layers for five focal vectors show increasing vector habitat suitability in South Africa (Kwazulu-Natal, Limpopo, Mpumalanga, Eastern Cape, Free State, Gauteng and North West). Moderate malaria transmission predicted in KwaZulu-Natal, Limpopo, Mpumalanga, Eastern Cape, Free State, Gauteng and North West Provinces. Seasonal malaria transmission was predicted in KwaZulu-Natal, Limpopo, Mpumalanga, Gauteng and North West Provinces. No endemic malaria transmission was predicted in any states. 5.36 - 32.1 million people predicted to be at risk of moderate malaria transmission and 0.25 - 7.9 million people predicted to be at risk of seasonal malaria transmission.

In conclusion:

- Vector species suitable habitat projections.
    - Temperature and precipitation driven.
    - Physiological and/or behavioural variations.
- Projections for suitable malaria transmission under current climate change models will be more prominent in the south and eastern regions of Africa.
- Findings correlate with Ryan *et al*. (2015 and 2020).
    - Temperature is a driving factor for malaria transmission.
- Aiding public health programmes to anticipate and adapt current malaria control programmes in key risk areas that require more intensive surveillance and resource allocation.

Assessing entomological impact of a pilot larval source management using aerial spraying with drones in two districts in Madagascar - Joseph Chabi (Abt Associates)

The objectives of this study were to 1) assess the cost, logistics, cost-effectiveness and feasibility of larvicide application by drone in Madagascar, 2) assess whether supplementary larviciding of aquatic/rice field habitats using Bti (VectoBac® WDG) at 30.2g/L (453.5g in 15L) in combination with pyrethroid-based ITNs (deltamethrin-based DawaPlus 2.0,Yahe LN and YorKool, and Alpha-cypermethrin based SafeNet) provides additional control of malaria vectors in Madagascar by reducing larval and adult densities, indoor and outdoor human bite rates, sporozoite rate, and entomological inoculation rate (EIR) and 3) assess whether supplementary larviciding reduces malaria transmission, as measured by routine data and cross-sectional prevalence surveys (with RDTs) conducted by the Pasteur Institute of Madagascar at baseline in December-January and end in July.

Preparatory spraying steps include mapping, selection of targeted spray areas and controls, determination of application frequency and provision and preparation of logistics and resources. Entomological monitoring took place in 12 sites (6 treated and 6 untreated) in each district and methods included larval surveys, adult mosquito collections and larval bioassays.

The bioassays conducted with both Bti stock solution and water from the sprayed sites showed high me larval bioassays mortality at least between 24h and 48h for the larval habitat water at higher concentrations, while the solution of Bti was overall effective after a dilution of 1/34 times. This implies that the mosquito larvae could be killed after 24h post ingestion of the larvicide. In addition, in the situation of rainfall or irrigation after treatment, the product could still be effective at about 20 times of dilution of the larval habitats meaning that there is limited impact of the level of irrigation or rainfall on the effectiveness of the Bti. Decrease of larval density observed from the first day post spray (D1) to at least day 5 in the sprayed sites compared to the baseline and throughout the spray cycles showing good efficacy of Bti within the week1 after which the larval habitats could be recolonized. There was an increase in larval density in the remaining habitats after the spraying ended implying continuous follow up to maintain effectiveness.

Additionally, there was reduced vector density with decrease of human biting rates in sprayed sites compared to controls and higher outdoor biting than indoor in both sites calling for awareness and community education. Cumulative decrease over spray time showed the added value of continuous spraying and rebound of vector density after stopping the treatment, which is in line with the larval density trends. Overall, LSM has shown efficacy and should be consider as appropriate complementary strategy in the country. Though effort should be made to preserve the gain by continue the treatment as there is vector population recolonization after weeks

Enhanced survivorship and fecundity of malaria vector around irrigation scheme in Ethiopia - Dawit Logita (University of Hawassa, Ethiopia)

Water Resource Development (WRD) project like irrigation schemes are key to ensure food security and promote economic growth in the developing world however, such land use change blamed to worsen VBDs burden like malaria through altering ecological settings in favor of parasites & its vector. Ethiopia has been experiencing extensive irrigation schemes however the impact of such projects on malaria transmission risk has been poorly studied. The objectives of this study were to determine effects of environmental modification due to irrigation on the larval ecology and survivorship and fecundity of malaria vector in Ethiopia.

The study site was an irrigated sugarcane plantation in a malaria endemic area. A repeated cross-sectional study was conducted during both dry and wet seasons where 6 clusters of irrigated and non-irrigated areas were surveyed for accessible mosquito breeding habitats. Collected larvae were transported to insectaries and reared for species identification. *Anopheles gambiae* were collected for survivorship study, which followed 2 experimental set ups.

Results showed a difference in *Anopheles* larval occurrence between the irrigated and non-irrigated areas could partly be due to difference in microclimate between the two settings. There was a much higher proportion of *Anopheles gambiae s.l* in irrigated areas however this difference was not observed for other *Anopheles* species. The study showed no significant difference in survivorship, development, and pupation rate, indicating both areas are supporting immatures mosquito development & survival. Fecundity was 96.2% higher in irrigated area than non-irrigated area, the longer survival & higher fecundity in the irrigated area indicates that *An. gambiae* s.l is well adapted to the environmental conditions, increasing vectorial capacity and malaria transmission intensity.

Limitations of the study include overlooking breeding water bodies, lacking chemical and biological characterization of habitats and lacking climate data. For the survivorship study, only wet season data was analysed and possible overestimated survival rates due to confined experiment. In conclusion, environmental modification due to irrigation scheme significantly enhanced the malaria vectors breeding habitat diversity, positivity, and larval abundance and adult *An. gambiae* s.l survivorship and fecundity.

Recommendations include:

- Local-specific vector monitoring and surveillance systems should be design in WRD project areas.
- Targeting major *Anopheles* breeding habitats might enable more efficient use of available resources to control malaria through LSM.
- Supplementary interventions should be implemented in WRD areas.
    - Further research work on survivorship in different seasons, climate data, biological & chemical characteristics of larval habitat.

Distribution and dynamics of *An. arabiensis* breeding sites in three health districts with high malaria incidence, Diourbel, Touba and Kaolack (Senegal) - Fatou Ndiaye (LEVP/UCAD)

Senegal remains a leader in piloting and scaling up new recommendations and innovative strategies in the fight against malaria and the NMCP has adopted a national strategic plan (NSP) since 2016. This involves massive and systematic distribution of ITNs and IRS in some districts. There is high incidence of urban malaria in central western Senegal (Diourbel, Kaolack and Touba). The general objectives of this study were to suggest alternative/complementary approaches to LLINs/IRS and reduce malaria burden in the urban settings. Specific objectives include identify, locate and characterize larval habitats of malaria vectors to better guide the NMCP in the implementation of targeted interventions with higher impact. Larval habitat surveys were conducted in Diourbel, Kaolack and Touba.

Results for spatial distribution and typology of *An. arabiensis* larval habitats found the majority of breeding sites in Diourbel were located in Keur Cheikh Anta (43.75%) and Thierno Kandji (34.37%), while few larval habitats (10%) were recorded in Keur Serigne Mbaye Sarr and its outskirts. In Diourbel, the larval habitats consisted mainly of natural water bodies (Flooded houses and streets). A total of 83 breeding sites were found in Boukhatoul Moubarak and Heliport either inside or in the immediate surrounding areas of houses. The surveyed larval habitats were man-made water basins, followed by ponds and puddles and temporary larval habitats (flooded buildings under construction, human and animal footprints and open septic tanks). In Touba, atypical larval habitats were found and were mostly represented by man-made water storage basins, built inside the house compounds to store drinking water or water used for domestic activities such as laundry, bath or for the livestock, due to the scarcity of water in the city, especially during the dry season. In Kaolack, a total of 30 larval habitats, including 12 natural surface water bodies, 2 anthropogenic, and 16 flooded areas and / or houses were found. The breeding sites were mainly anthropogenic and in general constituted by flooded areas and/or houses and were located in Ndorong. While natural breeding sites made of surface water bodies were more frequent in the Parcelles Assainies. In Kaolack, larval habitats consisted by natural water bodies or anthropogenic habitats. The natural surface water bodies consisted mainly of flooded houses and streets.

Results for positivity and productivity rates of anophelines breeding sites found that across all three sites the highest proportion of positive larval habitats was recorded during the rainy season. The lowest proportion of positive larval habitats was noted in August and November. The lowest average larval densities were recorded in August (29 larvae / litre) and November (23 larvae / litre). The peak mean larval density was observed in September.

In conclusion:

- Larval habitats in the three cities studied were fixed, findable (georeferenced) and few toward the end of the rainy season.
- Temporary larval habitats displayed peak productivity during the rainy season due to the importance of anthropogenic activities.
- Permanent larval habitats likely plays the maintenance of anopheline larvae productivity in the absence of rainfall.

- In Touba, atypical *An. arabiensis* larval habitats (Water Storage Basins) were found and likely maintain the production of anopheline larvae after the rainy season.

Key recommendations are that larviciding should be conducted in permanent and temporary larval habitats and regular application of a biological or chemical insecticide should be conducted of *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* (Bs).

Discussion - All

- It was asked how are we going to achieve sustained, cost-effective vector control with larval source management?
  - *It was answered that there is a need to consider the Africa-specific context for larviciding, map larvae distribution for a sustained amount of time and integrate community engagement into control activities. Building up strong databases can help to overcome context specific challenges.*
  - *It was expressed that there is a need to contextualise and sustain efficacy in the field of larval source management. Past methods must be challenged and adapted for appropriate use in the future to avoid repetition of mistakes in vector control.*

Wrap up Facilitators: Sheila Ogoma & Derric Nimmo

New work stream co-lead, the future of WS2; what would be most useful to everyone - Sheila Ogoma, Derric Nimmo

SO and DN wrapped up the session by revisiting the EVCT work stream activities in 2022 and plans for larval source management and innovations in vector control in 2023. Participants were reminded that there is a call for Task Team members and leads and that themes outlined for 2023 are adaptable and open for engagement / discussion.

Tuesday 7 February 2023

Work Stream 3 (WS3): Implementing the Global Vector Control Response - Leads: Anne Wilson (LSTM) & Chadwick Sikaala (SADC Malaria Elimination 8 Secretariat)

Introduction: Work Stream 3 updates – Anne Wilson (LSTM), Chadwick Sikaala (SADC Malaria Elimination 8 Secretariat)

The Global Vector Control Response 2017-2030 aims to reduce the burden and threat of vector borne diseases that affect humans by implementing effective locally adapted sustainable vector control.

Work Stream 3 consists of 4 Task Teams:

1. Integrated vector management – Leads: Jo Lines & Charles Mbogo.
2. Capacity and collaboration – Leads: Tanya Russell & Nelson Cuamba.
3. *Anopheles stephensi* response – Leads : Melissa Yoshimizu, Sarah Zohdy & Susanta Ghosh.
4. Vector control in humanitarian emergencies – Leads: Dana McLaughlin & Joe Lewinski.

The key characteristics of IVM include 1) integrated approach, 2) evidence-based decision making, 3) intra- and inter-sectoral collaboration, 4) advocacy, social mobilisation and legislation and 5) capacity building.

The IVM Task Team identified the impact of agriculture on malaria transmission dynamics to be high on the agenda for the calendar year 2022 to 2023. Several virtual meetings were held during the year to refine the objectives and focus areas. Impact of agriculture on mosquito vectors – with an initial focus on rice was identified to be a key thematic area of focus. The Task Team requests for additional membership; particularly those with interest in IVM to bring in innovation and strengthen the Task Team capacity. The capacity and collaboration Task Team aim

at highlighting both gaps and opportunities to advocate to the broader community for support. Over the year, the Task Team discussed key thematic topics identified during the previous conferences. The key theme is to support strengthening of capacity for collaboration between research institutions/academia and NMCPs.

The *Anopheles stephensi* response Task Team conducted meeting in Dec 2021 and April 2022 and Task Team leads have now been identified. Observations from these meetings and conclusions for VCWG ways to support include:

1. Increase visibility of capacity building efforts underway by other organisations (e.g. WHO, PMI).
2. Identify research gaps and support visibility of research groups working on this topic.
3. Identify and share information on tools / approaches which are relevant to tackling *An. stephensi*.
4. Encourage higher level political support to recognise the urgency and mobilize alternative funding sources beyond malaria vector control.
5. Engage other sectors beyond vector control and develop a VCWG led consensus statement.
6. Explore funding opportunities in combination with broader urban malaria threat and *Aedes* control.
7. Explore what learnings there may be from other bodies dealing with invasive species.

The vector control in humanitarian emergencies is a new Task Team building on previous discussions at VCWG meetings. Implementation will be through an established Roundtable series on Reducing Malaria in IDPs and Refugees led by Dana McLaughlin & Joe Lewinski.

Task Team 1: Integrated Vector Management. Leads: Jo Lines (LSHTM) and Charles Mbogo (KEMRI)

Suppressing the breeding of malaria vectors in African rice fields – Kallista Chan (LSHTM)
Rice growing areas are known to offer breeding habitats for some malaria vectors thereby supporting malaria transmission. These rice growing communities, in the future, may offer challenges in malaria elimination settings. The Ministries of Health in Africa are planning to eliminate malaria while the Ministries of Agriculture plan to scale up rice growing to ensure food security. The paddies paradox (rice fields generate a large amount of malaria vectors, but the amount of malaria in rice communities remains unaltered or is decreased) has been re-examined. Roll out of malaria interventions with the aim of reaching universal coverage has now highlighted increases in malaria in rice growing areas that were previously masked by increased socioeconomic status in rice growing areas compared to non-agricultural areas.

Meta analysis was conducted to determine the association between between rice and *An. gambiae* s.l. relative ratios of *An. gambiae* s.l. human biting rate (HBR), sporozoite rate (SR) and entomological inoculation rate (EIR) between rice and non-rice growing areas were calculated. This showed in rice growing areas, there was higher HBR and EIR however with lower SR. The change in malaria prevalence over time was analysed by comparing pre / post 2003 studies (chosen to reflect scale up of malaria interventions post 2003). Results showed a higher risk ratio after the scale up of control interventions. Risk ratios were also higher in areas with lower baseline prevalence. In conclusion, the relationship between rice and malaria will probably be an emerging problem for Africa and integration of the agricultural and public health sectors will be important to solve this problem.

Modified rice cultivation practices, include alternate wetting and drying irrigation, can control malaria vectors in some settings. In a number of rice growing areas, LSM studies have been conducted but there are still major gaps, including effect of rice cultivation practices on mosquitoes, optimising rice yield and considering water use, greenhouse gas emissions (GHG), weed production, soil conditions etc. Systematic review and meta-analysis of field experimental studies was conducted to analyse publication period and geographical region of larviciding, biological control and environmental management / rice cultivation practices studies, as well as reviewing their effectiveness.

Experimental trials were conducted in Cote d'Ivoire (CIV) and Tanzania (TZN) to assess the effect of rice growing techniques on mosquito density, water consumption, rice yield and GHG emissions. Intermittent irrigation techniques (AWD – Alternate wetting and drying) showed no rice yield differences, no effect on mosquito densities in CIV but reduced late-stage malaria vectors in TZN by 72.3% (this difference could be accounted to soil type and drainage time). AWD reduced water use by 41-71% (across both trials and countries) and produced 41% less methane. AWD also produced 2-fold more nitrous oxide but yield-scaled global warming potential was still less.

The effect of rice cultivation practices on malaria vector productivity:

Land preparation	Minimal tillage	-
	Puddling of <7 days	-
Crop establishment	Direct seeding (vs. transplanting)	+
Water management	Intermittent irrigation (active or passive drainage)	- (late stage)
	Active drainage: intermittent irrigation of 3-day wet and 3-day dry cycles	- (in one field trial)
	Passive drainage: alternate wetting and drying irrigation at 15 cm	- (in one field trial)
Pest management	Pesticide application	-
Nutrient management	Fertiliser application	+
Weed management	Herbicide application	+

Impacts of climate-adapted rice cultivation on malaria vector ecology - Harrison Hardy (University of Greenwich)

Rice agroecosystems provide habitats conducive to malaria vector breeding and Africa is increasing its rice production capacity. System of Rice Intensification (SRI) is a set of interdependent agronomic practices that modify current plant, soil, water, and nutrient management. This is a climate-adapted methodology that aims to increase rice yields whilst reducing agricultural inputs. The SRI agroecosystem is a fundamentally different environment so are the vector species also fundamentally different. Sampling (larval dipping and emergence trapping) was conducted in four SRI and four non-SRI fields in the Mkindo irrigation scheme in Tanzania.

Preliminary data and analysis show SRI is associated with higher vector densities and productivity. Larval abundance in SRI fields increased with time, but little variability over time in non-SRI. SRI increased larval abundance may be explained by a greater availability of discrete habitats – i.e. more small pools forming. Species composition data found the same species present in each cultivation type, *An. coustani* was found in non-SRI, while the majority of Anophelines in SRI were *An. gambiae s.l.*, likely *An. arabiensis*. The available surface area of water was more variable in SRI fields, compared to non-SRI, over time and no observed appreciable differences in pH, dissolved oxygen, salinity, or temperature. Total dissolved solids were generally higher in SRI and more variable over time. In conclusion, the SRI agroecosystem appears to be a more productive habitat for malaria vectors.

The impact of organic fertilisers on developing larvae was analysed. Larval exposure to chicken dung may reduce *An. gambiae s.l.* fitness and population density whereas cow dung may enhance *An. gambiae s.l.* fitness and increase population density. Dual choice assays showed significantly fewer eggs laid in both cow and chicken dung infusions, with greater effect at higher concentration, suggesting both cow and chicken dung demonstrated a putative deterrent effect. Relatively, chicken dung was more deterrent. Although both dung types resulted in reduced oviposition rates, the effects are complex and if there is a gradient in dung application across a landscape, vector density may be increased where dung application is lowest.

Key takeaways are:

- SRI practice may unintentionally exacerbate malaria transmission burden.
- Organic fertiliser application may affect vectorial capacity via modulation of vector life history traits.
- Both cow and chicken dung may deter oviposition. Chicken dung may be used for vector suppression, cow dung should be avoided.
- Further research is needed to confirm these findings.

Extra talk: Integrated Vector Management – An overview of experiences from Zambia - Emmanual Kooma (Zambia NMEP)

This presentation shared an overview of the experiences learnt using IVM in Zambia over a period of 6 years. Tools used include vector control, case management, surveillance monitoring and operational research. Vector control partners meet once every quarter. Multistakeholder engagement involves collaboration of the private sector with local authorities and ministries. Local authorities have implemented larviciding and environmental management as well as social behavioural change interventions. IRS, larval source management and other vector control interventions are also run under private partnerships. The private sector has adopted biological control of mosquitoes in southern Zambia. Working with research institutions/academia, evidence-based decision-making efforts in integrating chemical and non-chemical larval control efforts have strengthened. Multisectoral approach efforts have been seen to promote the Ministry of Health to implement IVM.

Discussion - All

- It was asked why the year 2003 was chosen for the rice and agriculture meta-analysis by Kallista Chan.
    - *It was answered that this year was chosen to reflect the scale up of vector control activities and coverage in Africa.*
- It was asked what role the Ministry of Agriculture currently plays in modifying rice cultivation practices to minimize the impact on malaria?
    - *It was answered that Africa Rice have worked closely with the MoA and further evidence is needed to advocate for this problem. Data attributing malaria cases to rice cultivation practices may be required to strengthen the case for action.*

Task Team 2: Capacity and collaboration. Leads Tanya Russell (JCU, Australia) & Nelson Cuamba (NMCP Mozambique). Session was facilitated by Wilson Chauke (member of the Task Team) in the absence of the leads.

Applying a standardized, molecular entomology data labelling system in Ghana to effectively integrate into central DHIS2 database - Obum Kojo Edem (PMI, VectorLink)

The PMI VectorLink project uses entomological data to inform and monitor vector control interventions. Molecular data, including species identification, detection of sporozoites and genetic marker of insecticide resistance, inform implementation of targeted vector control. Molecular data management is complex, often fragmented, and rarely integrated into existing entomology and vector control information systems. Systems previously used in Ghana include handwritten labelling on Eppendorf tubes and Ziplock bags, mosquito data

entered on paper forms and paper forms later entered into excel for analysis.

The objectives of this study were to implement a mosquito labeling system to enable direct links between the entomological collection and the molecular data sets within a central DHIS2 database, called VectorLink Collect, ultimately increasing sample tracking and data use. A dual system was implemented, allowing field technical teams to register mosquitoes in the field across 8 sentinel sites using QR codes. Results of the dual code system showed it efficiently printed and distributed 2,080 collection labels per month, allowing for faster mosquito sample processing and timely available results on DHIS2 dashboard. Pre-printed collection labels replaced manual writing on bags eliminating an estimated 5 errors per month and auto-population from scanning replaced duplicated manual data entry in the laboratory, eliminating approximately 46 errors per month in Excel and on tubes. A dashboard developed on VectorLink Collect to immediately report on commonly used molecular entomology indicators, eliminating routine external data analysis. This allowed for data to be visualized more routinely and tracking of data was very useful. Retesting can be done earlier ahead of reporting time if needed.

In conclusion, the pilot improved mosquito sample labeling standards and enabled bulk upload of molecular data into the global DHIS2-based system. VectorLink Ghana has expanded this QR Coding approach to samples for insecticide resistance testing. PMI VectorLink project plans to expand the system to other PMI focus countries to improve integrated data analysis. The system is cost effective and uses accessible software, such as MS excel, open-source DHIS2, and a WHO-developed application, called Bulk Load.

Resilience against future threats through vector control (RAFT) – Jo Lines (LSHTM)

RAFT is a 6 year research consortium to address urgent and emerging challenges in mosquito-borne disease control. It's focus is malaria and arboviruses in sub-Saharan Africa and southeast Asia and it is funded by the UK government. It's three problem statements are: 1) insecticide resistance and malaria, 2) a rapidly changing world, and 3) vectors that thrive in an urban environment. Its objectives are to to manage insecticide resistance by ensuring the targeted deployment of most effective and cost-effective malaria vector control interventions in African countries and to enhance strategic preparedness for emerging and future mosquito-borne threats in SSA and SEA, through increased awareness, technical understanding and operational planning amongst vector control programmes and donors.

Outputs include:

- Evidence for LLIN product choice: To identify the "locally most effective and cost-effective LLIN", taking into account the specific insecticide resistance mechanisms in the target locality. This will be achieved through experimental hut studies, genetic analysis, mathematical modelling and economic analysis.
- Environmental change on mosquito-borne diseases: Reviews: to improve knowledge on VBD threats amongst researchers, policymakers and implementers and field research on land-use/land cover (LULC) and VBD.
- South-South networking: Between African, Asian and Latin American country experts to strengthen national capacity in awareness and preparedness for arboviruses.

New and emerging threats identified are rice and malaria in Africa, urbanisation and *An. Stephensi* in Africa. Actions to combat these threats include:

New research	• Experimental hut trials to evaluate how different insecticidal nets perform according to local resistance (vector genomics) • Field studies to characterize *Aedes* bionomics • New eDNA surveillance tool for rapid assessment surveys of *An. stephensi*
Decision-making frameworks	Co-designed with NMCPs (and global net-buying agencies) to identify the most cost-effective LLINs against mosquitoes with insecticide resistance
Provide accessible state-of-knowledge evidence reviews	To improve awareness and knowledge on changing mosquito-borne disease threats amongst researchers, policymakers and implementers
South-south exchange	Between African and Asian country experts to strengthen national capacity in preparedness and control of arboviruses
Country case studies	National action plans, self-assessment workshops

Extra Talk: Capacity building and collaboration system in Ghana – Otubea Owusu-Akrofi (Ghana NMCP)
In Ghana, training is conducted at the district level for ITNs, IRS, larval source management and other vector control interventions. There are strong collaborations with research institutions and universities. In order to achieve malaria elimination, capacity building is needed at the district, regional and national level for training of entomologists and entomology technicians. Data collection and analysis in real time is being enhanced by the number of sentinel sites, with the aim to enhance the NMCP entomology database system to optimise data sharing and collaboration.

Task Team 3: *Anopheles stephensi* response. Leads: Melissa Yoshimizu (USAID), Sarah Zohdy (CDC), Susanta Ghosh (Mangalore University India)
The emergence of *An. stephensi* threatens efforts towards malaria elimination and a rapid and systematic data-driven response is needed. Objectives of this Task Team are to 1) encourage coordination and collaboration, 2) ensure rapid and informed progress on mitigation/containment/elimination, 3) ensure lessons learned can be transferred/shared and 4) identify clear action items for near future.

Consensus statement: global vector control response to invasive *Anopheles stephensi* – Anne Wilson (LSTM)
There have been increasing reports of *An. stephensi* from different countries and this invasive malaria vector species represents a threat to malaria control and elimination across Africa, the Middle East and in Sri Lanka. The joint initiative of RBM VCWG and MSWG recognises the urgency to respond to *An. stephensi* and calls on RBM partners and other to support the fight sharing of knowledge and best practices. It aims to support work of WHO, UN-Habitat and others by facilitating sharing of knowledge and best practices.

The VCWG/MSWG can support the response to *An. stephensi* using the GVCR pillars of action and foundations / enabling factors. Some examples of how the VCWG and MSWG can support efforts against *An. stephensi* include:

1. Strengthening of inter and intra sectoral actin and collaboration.
    a. Support multisectoral collaboration through sharing guidelines and best practices, and supporting project formulation and access to financing.
2. Enhancing vector surveillance and monitoring and evaluation of interventions.
    a. Facilitate networking between universities/research institutes and national programs.
    b. Share guidelines on vector ID.
3. Scaling up and integrating tools and approaches.
    a. Support information sharing on new and existing products, delivery approaches, and monitoring and evaluation.

4. Engaging and mobilising communities.
    a. Share information on SBCC for *An. stephensi* control.
    b. Advocate for the importance of human behaviour for effective control.
    c. Collate information on social science experts to support research and programs.
    d. Share best practices from community-based source reduction programs for *Ae. aegypti*.
5. Enhance vector control capacity and capability.
    a. Facilitate networking between centers of excellence, training and research institutions to build human and laboratory capacities for *An. stephensi* surveillance and control.
6. Increase basic and applied research.
    a. Forum for networking and sharing data.
    b. Facilitate identification of research gaps.

Participants are encouraged to share the Consensus Statement widely, provide feedback on how to make the statement actionable and join the Task Team.

MESA landscape review – Helen Nwanosike (ISGlobal)
MESA gathers and shares knowledge to catalyse research and inform decisions responding to the needs of malaria-endemic countries. MESA Track is a living database of global malaria projects with updated information on institutions, project sites and funding. Deep Dives can be conducted for in-depth profiling of critical topics, useful planning for and informing policy-making processes and a tool to analyze the research landscape and identify evidence gaps.

An *Anopheles stephensi* landscaping review was conducted. It's objectives were to:
1) Describe the geographic scale and scope of ongoing *An. stephensi* research and other projects.
2) Overview of the distribution of active *An. stephensi* surveillance or monitoring programmes.
3) Describe the funding sources for projects.
4) Document the list of questions under evaluation.
5) Identify or draw on any overlaps between the urban malaria deep dive and *An. stephensi* deep dive.

Research areas were categorised into gene modification, vaccine production, transmission blocking dynamics, genomics, invasive species, surveillance, drug production and insecticides. Gene modification received the most total funding, transmission blocking dynamics had the most total projects and insecticides received the least total funding and had the least total projects. The top 3 funding sources were the NIAID, DARPA and NIHR and USA had the most funding per Project Site. The lead research / academic institution was Liverpool School of Tropical Medicine and the lead National institution was Ethiopia NMEP. Unfortunately, eighty nine percent of principal investigators were male, suggesting a need to identify strategies for accelerating involvement of women in sustained support for vector control interventions.

In total, there were 60 projects, with $66.1M total funding ($9.57M active) and seventy four percent of total funding contributed by the NIH. Ethiopian NMEP and Yemen NMCP were the only national programmes captured. Requests for *An. stephensi* research and activities (via mesa@isglobal.org) to be published on the MESA app. MESA hosted a virtual forum on the threat of *An. stephensi* on 21st Feb.

- It was asked whether a specific, separate deep dive was carried out for the invasion in Africa.
    - *It was answered that some of the categories within this deep dive (invasive species) will pertain to the current invasion in Africa and Sri Lanka but other categories are more general.*
- It was asked how relevant to the current outbreaks is the work already conducted in Pakistan, Iran and Western India. Suggestion to study this literature to explore pertinence to the Africa situation.
    - *It was answered that it is important to source research / data from countries with experience to*

try to determine which interventions will be effective and realign objectives.

- It was asked how funding and activities are being reprioritized to combat the *A. stephensi* invasion.
    - *It was responded that time to respond also is dependent on country specific actions e.g. Ethiopia has developed and action plan already. However further discussion is required for resource prioritization.*

Panel Discussion: *Anopheles stephensi* response in Africa – Hmooda Kafy and Hamza Sami (Sudan), Seth Irish (WHO), April Monroe (John Hopkins University CCP), Richard Allan (Mentor Initiative), Kevin Gorman (Oxitec) and Susanta Ghosh (ICMR-NIMR)

The panelists shared insightful discussions about the *Anopheles stephensi* invasion and country responses. This included, describing the actions of the WHO's global response. WHO has developed an initiative to, increase collaboration, strengthen surveillance and provide guidance to countries. It is important to note that we are pushing to understand how to implement the appropriate response and to correctly estimate the risk *An. stephensi* poses to malaria control. The Malaria Threat Map shows points where *An. stephensi* has been found (and has not been found) and shows where surveillance is comprehensive. Vector Alert has been updated to provide information to countries to help them appropriately respond to *An. stephensi* and provide country specific guidance. *An. stephensi* quarterly calls are taking place which provide information about reports of invasion and shares findings about control. WHO are planning a partners meeting next month in Ethiopia, where countries can discuss control. In the coming year, working to conduct a deeper dive to understand what has been done in the past and how this can be applied in the future. The establishment of *An. stephensi* in India was first described in 1901, with progress made to describe the specific characteristics up until 1987. In 1971, the National Malaria Program was established and the urban malaria scheme was launched alongside state specific activities. The malaria scheme largely focuses on larval source management and the implementation of control activities at the household level. All vector activities must be approved and implemented by local authorities. Moving forward, 90% of cases are now *P. vivax*, rather than *P. falciparum* which poses different challenges and requires blood-based treatment. Surveillance systems in India are weak which is one of the key challenges to malaria control. *An. stephensi* was first detected in Sudan in 2018, triggering the establishment of a network of surveillance systems. The Ministry of Health has also supported the procurement of equipment and training to facilitate the surveillance of *An. stephensi* larvae and adults. Collaboration with partners, such as the WHO, to support the response is ongoing. Community engagement is a key factor of vector control.

The *An. stephensi* invasion was also discussed in the context of humanitarian settings. We live in a world that is dramatically changing with massive populations displaced internally and internationally around the world in VBD endemic countries. There is increasing awareness of vectors emerging in urban context settings. In Yemen, work for *Aedes* control, confirmed the presence of *An. stephensi* – making up 5% of all mosquitoes in cities across camps and permanent housing settings. Lessons learnt from *Aedes* emergence include the knowledge that invasive vectors can move fast in urban settings due to population movement, urbanisation process and displaced populations creating breeding sites in containers. There is an opportunity to manage the vector manually at household level with targeted larviciding. An evaluation of long lasting larvicides is currently being conducted. There is a strong need to break down the silos, and harness other sectors, such as WASH and waste management, to mobilise funding and resources.

Oxitec are exploring the use of friendly mosquitoes in response to the *An. stephensi* invasion. This method shows promise for urban *Aedes aegypti* control, however *An. stephensi* can fly further than *Aedes* so this needs to be considered. This solution could be particularly effective in helping to achieve elimination, in areas where chemical control is less effective. In order for these methods to succeed, a holistic approach with multiple control strategies, including effective monitoring, needs to be implemented. From a regulatory perspective, political will is required to shape regulatory pathways (these exists for GM crops but not currently for GM insects). As demonstrated by

Oxitec's success of releasing modified *Aedes aegypti* in Brazil, milestones can be achieved if there is enough political will, and community support. Control must be implemented in a socially acceptable and culturally acceptable way, considering context-specific needs.

Correctly communicating risk is a key factor in community engagement at both the individual and household level. In order to build trust, threats should be communicated when identified, along with methods of self- protection. Specifically for the *An. stephensi* response, it is important to communicate the need for communities to protect themselves in both the dry and rainy season and the variation of risk compared to other malaria vectors (breed in the urban environment etc.). Many interventions will be novel and therefore should be succinctly explained to communities with specific details around how communities can implement control measures (e.g. remove or cover standing water). The appropriate channels of risk communications should be identified for vulnerable or more at risk groups (construction workers, miners, agricultural workers etc.).

Task Team 4: Vector control in humanitarian emergencies - Leads Dana McLaughlin (UN Foundation) and Joe Lewinski (CRS)

Thanks to partners and facilitators for setting up this newest work stream in response to the need to identify the most vulnerable populations and harness / optimise tools to these settings.

Update on Roundtable 1+2 Series Presentation – Joe Lewinski and Dana McLaughlin

Reducing malaria in IDPs and Refugees

In mid-2022, there were more than 102 million displaced people globally, with almost two-thirds living in malaria-endemic regions. In 2021, malaria was the second most common cause of morbidity among refugees in the 20 countries reporting through the health information system.

Roundtable 1: Improving cross-sectoral solutions for malaria in IDPs and refugees (Sep 2022, Washington DC).
Roundtable 2: Addressing the needs of displaced and last mile populations in Global Fund malaria grant applications (Dec 2022, Kenya).
Roundtable 3: Reducing malaria in displaced populations through improved tools and innovations (Feb 2023, Ghana).

Recommendations for donors

- Improve pre-stocking of malaria commodities to respond to humanitarian emergencies more quickly.
- Increase coordination and use of pooled funding.

Recommendations for countries

- Create an intercountry and cross-border coordination framework to allow countries to share experiences.
- Ensure the inclusion of refugees and IDPs in the country's health service delivery planning.

Recommendations for humanitarian partners

- Improve coordination of data from humanitarian organizations to target malaria interventions to IDP and refugee populations.
- Work through community-based actors who are better placed to meet the recurrent needs of populations in challenging operating environments.

Next steps will involve consolidating the report from round table discussions, continuing multisectoral coordination and providing support for IDP and refuge inclusion in upcoming Global Fund grants.

UN Foundation analysis on IDP / refugees in GF grants – Dana McLaughlin (UN Foundation)

Malaria, HIV/AIDS and tuberculosis (TB) present unique risks to refugees and internally displaced persons (IDPs).

High levels of mobility, inadequate living conditions with increased exposure to diseases or vectors, and reduced access to health services due to ongoing conflict and socio-economic, cultural, language or gender barriers, all contribute to increased risk of exposure. Furthermore, sustained conflict and crisis can cause the collapse of primary health systems, limit activities to prevent the transmission of malaria, TB, and HIV, and disrupt the delivery of vital medical commodities. As one of the largest financiers of global health programs, The Global Fund to Fight AIDS, TB and Malaria is a vital source of support to ensure refugees and IDPs have access to quality disease prevention, treatment and care services. Malaria remains a leading cause of morbidity and mortality among refugees and IDPs. Almost two-thirds of refugees, internally displaced persons, returnees and other persons affected by humanitarian emergencies live in malaria-endemic regions.

The results of this analysis showed since the last funding cycle, Refugee and IDP mention has increased substantially across the 3 diseases. The number of applications mentioning displaced populations without detailing activities targeting them has decreased. Overall, Refugee and IDP inclusion in malaria funding requests has improved substantially since the previous funding cycle. The inclusion of activities for refugees has increased from 36% to 81%. The inclusion of activities for IDPs has increased from 17% to 69% and only two of the 63 malaria applications mentioned refugees and IDPs without detailing specific programming activities for malaria.

Looking ahead to the NFM4 funding cycle, there are aims to:

- Conduct conversations about refugee and IDP inclusion in national plan creation, grant proposal development, and implementation processes with representatives and community leaders from refugee, IDP and other displaced populations in addition to humanitarian agencies.
- Inclusion is not enough: overcoming socio-economic, cultural and language barriers.
- Leverage inclusive community-based workforce for social behavior change communications, case management, referral and treatment adherence support.
- Expand use of Global Fund emergency grant funds and re-programming during grant cycle to address the evolving needs of new displaced populations.

Expanded vector control toolbox in humanitarian settings: Vector control for malaria prevention during humanitarian emergencies: a systematic review and meta-analysis – Louisa Messenger (University of Nevada)
Humanitarian emergencies lead to large-scale population movement, food insecurity and severe health system disruptions. Humanitarian emergencies may increase risk of malaria epidemics and incidence of severe disease; when immunologically naïve individuals are displaced into high transmission areas. Evidence for malaria vector control tools during humanitarian emergencies insufficient for WHO to develop policy recommendations; recommendations for ITNs and IRS based on proven efficacy in non-emergency situations. The primary review objective was to evaluate the impact of different vector control interventions on malaria disease burden during humanitarian emergencies. Literature was retrieved from 10 electronic databases and 2 clinical trial registries using ~200 search terms and grey literature from 29 technical groups/NGOs, 24 donors, stakeholders and policy makers and 6 industrial partners searched.

Eligible studies included studies from 9 countries (5 sub-Saharan Africa, 2 Eastern Mediterranean, 2 South-East Asia) and with a total of 616,611 participants. All emergencies were due to conflict, 7 vector control tools were evaluated, most studies from 1990s-2005 and 9 randomized Vs 13 non-randomized studies (RCTs not feasible during emergency situations).

Findings for use of ITNs showed evidence of large reduction in *P. falciparum* case incidence and prevalence. As well as likely reduction in *Plasmodium vivax* case incidence and little to no difference in *P. vivax* prevalence. Findings for use of IRS showed evidence is very uncertain about the effect of IRS on *P. falciparum* incidence and may result in little to no difference in prevalence. The evidence is very uncertain about the effect of *P. vivax*

incidence and prevalence.

Evidence is very uncertain about the effect of insecticide-treated clothing and insecticide-treated plastic sheeting on *P. falciparum*. However insecticide treated cattle showed to likely result in a large reduction in both *P. falciparum* and *P. vivax* case incidence and prevalence. Limitations of these findings should be considered. Insecticide-treated chaddars and top-sheets likely result in large reduction in *P. falciparum* case incidence and may reduce *P. vivax* incidence and topical repellents likely reduce *P. falciparum* infection incidence but may result in little to no difference in *P. vivax* infection incidence.

Key discussion points include:

- High certainty evidence for ITN deployment in chronic humanitarian emergencies – reduced *P. falciparum* and *P. vivax* by 45% and 31%, respectively.
- Similar effect sizes reported from meta-analyses of ITNs during non-emergencies.
- Significant pragmatic barriers to ITN use during emergencies, including inadequate sleeping arrangements/over-crowding, ITN mis-use/illegal trade of donated goods, poor durability due to harsh conditions and inadequate IEC/BCC about net care.
- Lower certainty evidence for IRS - similar to non-emergency settings.
- IRS has some advantages over ITNs during emergencies (when shelter structures are appropriate), due to less behavior change, more choice of insecticides for resistance management, community-level protection and reduces other vector species (e.g. sandflies) and nuisance pests.
- Low certainty evidence for ITCs/ITPS, topical repellents and chaddars.
- Greater investment from the private sector needed for 'niche' vector control tools.

Study design / data collection limitations include:

- Studies may lack a true control group – unethical during emergencies not to distribute vector control interventions equitably; comparisons to adjacent villages/communities instead.
- Vector control tool deployment in emergencies often accompanied by improvements to malaria diagnosis/treatment and health facility access; resource allocation assumed to be equal; overestimation of vector control intervention effect size.
- Refugee settlement infrastructure, road access assumed to be uniform; data not captured systematically.
- Challenging to design prospective studies in emergencies (especially acute); cannot collect baseline data, design protocols, obtain ethical approval, map study areas, stratify intervention deployment.

Limitations of available literature include:

- Studies conducted in chronic/protracted emergencies of 10+ years.
- Majority of randomized data from Asia (13/22), with less from sub-Saharan Africa (9/22); key differences in vector behaviour, particularly exophilic/exophagic, anthropophilic/zoophilic tendencies.
- Most studies used pyrethroid insecticides before widespread insecticide resistance.

Despite study limitations, this systematic review can be used as a benchmark. It has contributed to 2 new WHO policy recommendations in relation to use of IRS and ITNs in humanitarian emergency settings.

Laboratory and semi-field efficacy evaluation of permethrin-piperonyl butoxide treated blankets against pyrethroid-resistant malaria vectors - Salum Azizi (KCMUCo), Jovin Kitau (WHO Country Office, Tanzania)

With widespread insecticide resistance in malaria vectors, there is need for alternative control tools that are not only suitable for temporary settings but also effective against insecticide resistant malaria vectors. Therefore in this study the efficacy of pyrethroid-PBO blankets was evaluated in experimental huts against pyrethroid resistant *Anopheles gambiae* s.s. The laboratory experiments were conducted at the KCMUCo-PAMVERC Insecticide Test Facility in Moshi Tanzania; while experimental hut study was carried out at the facility's field site in Lower Moshi.

Lab bioassays were carried out on pyrethroid susceptible and resistant strains of laboratory-reared *An. gambiae* s.s. and experimental hut trials were conducted on pyrethroid resistant *An. gambiae* s.s. Main outcome measures: blood feeding inhibition, knockdown (KD) and mortality.

In the laboratory studies, KD had the longest RT and follows the expected dynamic of insecticide bioavailability in the treated fabrics. The RT for the PBO–permethrin blanket was confirmed to be 2 days. The permethrin-PBO blankets induced higher mortality to a resistant strain compared to the permethrin and control blankets.

In the experimental hut studies, all treatments killed significantly more mosquitoes (31.7%–87.3%) than the untreated blanket ($p<0.05$). In the order: Olyset® Plus (94.0%), PBO-permethrin blanket with Olyset® net (77.9%), washed Olyset® net (56.3%), unwashed treated PBO-permethrin blanket (53.7%), and lastly washed PBO-permethrin blanket (38.4%). Significant blood feeding inhibition was detected with all treatments compared to the negative control ($p < 0.05$), in the order: Olyset Plus (94.0%): PBO–permethrin blanket + Olyset Net (86.5%), Olyset Net (67.5%), (0X) PBO–permethrin blanket (40.3%), (10X) PBO–permethrin blanket (35.1%).

In conclusion:

- Treated blankets significantly induced mortality against mosquitoes both at laboratory and semi-field trials relative to untreated blankets.
- Noticeably, in the experimental hut trial, mortality in the new permethrin-PBO blankets trial arm was comparable to standard Olyset LLIN arm.
- The results indicate potential benefits of the PBO blankets if widely used, and calls for further technological adjustment to improve wash fastness and validation by a large-scale field trial to assess the epidemiological impact of the intervention, durability and acceptability of this new vector control strategy for malaria vector control.

Phase III study on durable wall lining in Liberia – Richard Allan (Mentor Initiative)

Durable wall linings (DWL) with dual purpose (2 generations) are designed to protect displaced communities returning to their homes, and stable communities alike, provide aesthetic home improvement that is desired by rural households, be installed onto the surface of inner walls, of rural houses, screen eve gaps, windows, ceilings, kill resting mosquitoes (mode of action = IRS), significantly reduce malaria and provide consistent delivery and dosage of insecticide over multiple years.

A clustered RCT was conducted in Liberia to determine the malaria control efficacy of DWL. The primary objective was to determine if DWL has an additional protective effect in an area of pyrethroid resistance and the secondary objectives were to compare surface bio-availability of insecticides and entomological effectiveness over the study duration. Participants were children 2-59 months and the active arm of the study was 50 houses per 20 experimental clusters, all of which received LLINs with the previous 12 months, and had internal walls and ceilings lined with DWL.

The DWL was Vestergaard, non-woven polypropylene, fenpyroximate (a NADH-coenzyme Q reductase inhibitor (IRAC 21a)) and abamectin (acts on the glutamate-gated chloride channel (IRAC 6)). Neither used in mosquito control previously and the non-woven material had no additional surface treatments. Surveys conducted every 6 months, with the exception of 6 months after baseline due to Ebola virus disease restrictions. Participants were tested for *P. falciparum* infection with SD Bioline Pf RDT and the epidemiological survey was repeated after DWL installation at 12, 18 and 24 months. Baseline resistance profile in wild-caught mosquitoes conducted (WHO guidelines). Bioefficacy (12 & 24 months) against *An. gambiae s.l.* mosquitoes was determined by collecting larvae, rearing to adults and conducting WHO cone bioassays.

Results showed installation of DWL resulted in a significant reduction of *P. falciparum* malaria prevalence 12 months later in the 28 Upland clusters of the study (RR = 1.3, p=0.022). This effect was not seen in the 12 Coastal clusters at 12 months (RR = 1.3, p=0.344). A difference between study arms was not observed at 18 or 24 months following the baseline survey. This reduction in control effect coincided with a significant reduction in bioavailability of insecticides on the DWL after 12 months.

In conclusion, DWL is feasible to install and easy maintain with high levels of acceptance, even in an Ebola epidemic. It is a highly adaptable tool that can be installed into a wide range of structures. It is designed for returnees, but applicable for most communities / structures in stable settings. It significantly helps to prevent malaria infections in inland high transmission settings (uplands) and it may provide multi-year protection with further chemical/materials development.

Discussion – All

- It was asked what has been learnt from experiences in evaluating the use of novel tools in humanitarian settings?
    - *It was answered that this is a very important conversation to have around novel tools that can provide community level protection. We must re-evaluate the standard of requiring RCTs to evaluate control tools for these specific settings as these set unrealistic standards.*

Co-chairs Justin McBeath and Corine Ngufor thanked participants and the work stream leads. A reminder was given for participants to attend the field trip or the joint VCWG / MSWG workshop the following day.

Wednesday 8 February 2023
Session 3: Round Table Discussion
Projecting towards 2030 - the role of vector control in a new malaria landscape
Panel members: AGAMal: Samuel Agyei, BASF: Susanne Stutz, BMGF: Helen Jamet, IVCC: Derric Nimmo, NMEP: Keziah Malm, PMI: Sarah Zohdy

Participants welcomed by Co-chairs Justin McBeath and Corine Ngufor and introduced to the round table discussion panellists. An overview of the session structure was given.

Question for Keziah Malm: Let's envisage the scenario where Ghana hits its targets with the current 5-year national strategic plan and is at the stage of developing the next 5 year plan which will carry over into 2030. What are the strengths of the current vector control approach that you think would need to be maintained? What do you think might need to change in the next 5 year strategy?
In Ghana, the NMCP is moving to the NMEP, despite only being half way through the current 5-year national strategic plan. Strengths of the current plan include the use of effective tools (such as IRS and ITNs) which have helped to reduce malaria parasite prevalence. There is a need to integrate new tools which address outdoor transmission as well as new insecticides which will address the resistance issues arising, and these points will be carried into the next grant cycle. Showing the impact of larval source management is becoming increasingly important and will need to be integrated into the movement towards elimination in the next 5 year plan.

Question for Helen Jamet: From the Foundations perspective, thinking ahead to 2030 what are anticipated as the big picture concerns and priorities in relation to the future role of vector control? Is there anything that you want to particularly reflect on?
Focusing on trying to maintain and accelerate the gains achieved in the last few years is key to ensuring the path towards effective malaria control. In particular staying ahead of the development of resistance though ensuring the most efficacious products are developed, assessed, produced and scaled up as effectively as possible so we

are able to rotate insecticides in response to resistance. It is important to collect and analyse the appropriate data for informed decision making through community engagement and ensuring subnational tailoring of data collection. We must become more comfortable with ambiguity and move away from one size fits all approach to meet context demands. It is particularly important to keep industry engaged, which can be done through collecting clear data to inform decision making. The types of tools needed to lead to elimination must address residual and outdoor transmission, however budgets are not increasing and products are becoming more expensive, so how can we fill this gap? We must harness the engagement of more funders, new markets and work alongside the private sector for implementation of novel control products. In addition to research and development, there is a need to build country capacity through training of people and institutions to ensure there are enough trained people in all aspects of vector control (data analyses, epidemiology, molecular biology etc.). We must also build career trajectories for entomologists to promote transferable skills and avoid losing valuable people from the field. When considering lessons learnt from other diseases, we cannot shutdown the research and development pipeline and we must promote the rotation of tools to mitigate against insecticide resistance. There are exciting new tools, such as gene drive and self-limiting tools, which require in-country capacity for scale up and roll out.

Question for Derric Nimmo: 2030 must be in the strategic thinking of IVCC, can you elaborate a little on what IVCC is doing today and how that helps to prepare for what might happen or might be needed in that future time-period?

IVCC is continuing its core strategy in development of insecticides, to help combat the constant challenge of resistance. Specifically, focusing on novel active ingredients or repurposed insecticides from agriculture and animal health. IVCC work with a range of partners to achieve this goal e.g. private partners and partners in product development, academia and field facilities to facilitate the testing of products that are being bought to market. IVCC receive financial support from a range of donors, over a wide variety of projects, with current focus on ITNs and ATSBs. For ITNs, we have witnessed high selection pressure for the development of widespread resistance to several classes, highlighting the desperate need for novel or repurposed active ingredients. This has been shown in presentations over the past couple of days, showing the results for the InterceptorG2 bed net. IVCC have an ambitious but simple goal of supporting the development of 3-4 efficacious, safe and affordable long lasting nets to bring to market by 2030. This will allow for vector control programmes to maximise product lifespan and impact. There are multiple factors causing to increased cost of nets, resulting in the need to manage expectations of net prices moving forward.

Current tools have focused on indoor transmission and there is a significant need to fill the gap in addressing outdoor transmission. ATSBs could fill this gap and are currently undergoing epidemiological studies, with the

hope to be PQ listed in the next couple of years if successful. Another aim of IVCC is to optimize access and use of tools in endemic countries and build sustainable markets. IVM will be essential to achieving this and will have a great impact moving forward.

Question for Sarah Zohdy: Acknowledging the perennial uncertainty around funding - is PMI already anticipating that situation and what activities are you already undertaking to facilitate that kind of understanding and decision making for the future?
PMI partners with and supports national malaria programs for implementation of vector control programmes and continues to support evidence informed deployment of traditional and new tools. PMI's 5 year strategic plan involves investing in local institutions and communities to increase capacity for entomological data collection and monitoring, specifically ensuring the correct data is collected on insecticide resistance and vector bionomics. Recently entomological data collection has expanded to include human behaviours to guide decision making and ensure subnational tailoring approaches are appropriate. Once products are made available and policy recommendations are made, the PMI strategy pivots to support countries to make decisions about using tools in the correct locations. PMI technical guidance is expanding this year to include new tools such as larval source management and topical repellents, which may be implemented in PMI partner countries. PMI facilitate the evaluation and optimisation of control tools

Question for Samuel Asiedu: What would you like to see in place to help operational decision making when faced with a large array of choice in available tools? What is AGAMal doing to prepare for that future?
As an organisation, AGAMal work with national malaria programmes and operational decision making is informed by guidelines national programmes have created. Currently, AGAMal review guidelines of vector control interventions in country (ITNs, IRS and larval source management) and takes into consideration future perspective. New guidelines are to include outdoor biting using ATSBs and other novel interventions, however the decision to use these new interventions will be dependent on the availability of clear guidelines. Once this is done – are there the resources to implement what is available? There is a significant need to start negotiating with donors and ensure they adapt funding to new guidelines / protocols for the implementation of new tools. There is a need to build internal local capacity in humans and adapt tools, strengthen laboratories, use entomological data to influence the decisions being made. Donors and the private sector must be flexible and willing to support new tools and specifically need to improve the efficiency of programmatic implementation and production of these tools. Can something similar to IVCC's program to influence the price of insecticides be replicated? Other challenges which need to be addressed include non-localised new tools and local production needs to be established for longevity and sustainability e.g. producing in country larvicides for LSM. We must work on barriers to make tools much more available for in country production.

Question for Suzanne Stutz: Can you share with us a little bit of reflection on the development stages and timeline associated with that please? Could you speak about some of the general things that a company such as yourselves needs to take into account in order to commit to development of something which might have a launch date beyond 5 years?
IG2 is not progress, it is success. The project began in 2006, moving to a proof of concept contract to facilitate the production of chlorfenapyr. The first samples were developed in the lab in 2008 and in 2011 the contract was signed for the development of IG2 with partnering organizations. In 2017, WHOPEs requested data from 2 RCTs, in 2 locations and across 2 seasons. The collection of this epidemiological data was a very new challenge to the company, and thanks to the support of the new nets project, they were able to supply nets to Tanzania in 2019, followed by Benin. Both RCTs ended in 2021 and 2022 respectively. The product is now better than initially hoped for and a report was recently published proving the public health value. It creates capacity for rotating products to maximize the longevity of existing and novel products. In order to mitigate against replicating the issues had with pyrethroid resistance, we must speed up and streamline development processes. To facilitate this, there is a

need for commitment from all stages of the development pipelines and hierarchy.

Discussion – All

Question 1: From a funding perspective, what is being done to support the decolonization of malaria vector control and product development activities?

- Helen Jamet (BMGF) responded that more work is being done across disease areas to base more work in endemic countries. The current northern-centric model can only be decentralized by putting the correct policies in place to facilitate this. From a grants perspective, pairing of southern and northern institutions hopes to build capacity and ensures talent remains in country. The correct balance for funding of northern and southern institutions needs to be identified. Further work needs to be carried out to support product development in-country, specifically promoting integration with the private sector in Africa.
- Derric Nimmo (IVCC) discussed examples of IVCCs role in capacity building to promote work at the CRO level, as well as ongoing field work studies which aim to transfer experience and build capacity from product development and testing to be carried out in-country. Further improvements are still needed.

Question 2: What support is being provided for small companies to maintain the product development pathway themselves? It was also commented that countries need more choices.

- Keziah Malm (NMEP) responded that significant changes need to be made to the product development process to mitigate against using up a product before using the next and mitigate against further resistance problems. WHO need to support in-country choices for context specific product development.

Question 3: Can we use basic entomological evidence / entomological proxies to predict epidemiologic impact without the requirement for 2 RCTs for new products?

- Helen Jamet (BMGF) responded that entomological proxies to predict epidemiological impact will help to drive more products through the pipeline and grantees are currently working on developing this for bed nets, some of this data will be published and there will be a WHO meeting later this year to review it. Collecting data through operational field studies, aligned with modelling work and solid post marketing surveillance systems will be useful for informed decision making and provide the confidence needed in the product development pathway. For example, ATSBs do not have as much supporting data as bed nets and further data needs to be collected to prove the health impact before large investments will be made. Hope to see first in-class products develop entomological metrics aligned with epidemiological data to set proxies for follow on products to be measured against. This is a very important point that needs to be addressed to speed up this process.

  Suzanne Stutz (BASF) responded that we need to be inventive to prove new products work. Many lessons were learned during the Interceptor G2 process which will facilitate the development of other products moving forward.

Question 4: Capacity building and south-south collaboration has come a very long way but we still have a long way to go. Capacity building is now moving towards capacity sharing e.g. in Kenya there are many examples of training and sharing of expertise being conducted in country.

- Sarah Zohdy (PMI) responded that capacity building and sharing has come a very long way and is becoming very apparent at the community level. PMI is continuing to invest in this and taking the opportunity to leverage this expertise.

Question 5: Should the emergency use authorization of products to bypass the current criteria for approval of products (2 RCTs)?

- Sarah Zohdy (PMI) responded that this is an important discussion point around lessons learnt about product use in emergency settings. In order to be better prepared, better data should be collected to inform decision making. This meeting is a useful platform to have these discussions and ultimately strengthen global capacity.

Question 6: Is there a specific plan to tackle outdoor transmission in Ghana?

- Keziah Malm (NMEP) responded that the use of larval source management and repellents to combat outdoor transmission has now been moved to a core intervention (previously was recommended by WHO as complementary). Larviciding is being implemented in 106 districts and looks to expand further. There are also efforts to collaborate with Burkina Faso (details of this are currently being refined) and both inter-and intra-country efforts are being strengthened to move towards elimination.

Question 7: From a national malaria control / elimination program perspective, can you gather quality data to facilitate the utilisation of resources?

- Keziah Malm (NMEP) responded that subnational tailoring means different things to different countries and a key thing to making this work is having the right data to inform stratification. Ensuring countries have the correct resources for local communities to collect this data is key (capacity and logistics). Countries should be able to invest their own money to do this according to their context. National programmes should leverage the private sector to support their national agenda. In order to engage the private sector, we must present data demonstrating direct benefits to them (corporate social responsibility, health impact to workers etc.). For example, this is currently being done in the mining industry but should be further explored at the country level.

Panellists provided final remarks and reflections on the morning discussions:

Samuel Asiedu reflected that change is the only constant thing we can find in our lives. Although we may have boundaries set by institutions and networks, we must take a bold step out of our comfort zone and create a positive future for malaria interventions and support individual agendas to reach malaria elimination. Every sector needs to be informed on how better to collaborate to combat malaria.

Suzanne Stutz reflected that progress and change has been very positive and many lessons have been learnt in previous years from both malaria and COVID-19 control. A key learning is the need to improve the speed of product development. This is not an individual task and should be a joint effort from a multisectoral level.

Helen Jamet reflected that we are constantly getting better at managing change. This is demonstrated through annual strategy reviews, which are a pivotal point of reflection to ensure we are following the correct path.

Derric Nimmo reflected that we must understand the challenges of and barriers towards of managing change. The cost of goods is a significant challenge moving forward but communication is key to understand the whole architecture of the challenge at every stage of the pipeline / product life cycle. Forums / events like this are essential to facilitate this.

Keziah Malm reflected that each year we improve with working towards change, improving data collection, human capacity, collaboration etc. Hopeful through improved understanding of the challenges we have we can change towards elimination and eventually eradication.

Sarah Zohdy reflected on the importance of communication, collaboration and coordination. We must establish the evidence base and recognize the challenges we need to overcome and initiate change.

Work Stream highlights, next steps

Work Stream 1: Enhancing the impact of core interventions (ITNs and IRS)

Leads: Allan Were and Mary Kante

Mary Kante expressed thanks and appreciation to presenters, participants and coordinators who have attended the meeting. Specifically the development of the working stream with team leads has been a great innovation to

drive progress.

ITNs and IRS is at an important and critical junction for the deployment of core interventions and a lot of progress has been seen recently. There are new products in the pipelines along with recommendation. Many people within this room have contributed to overcoming the challenges associated with the operation deployments of ITNs and IRS and have facilitated in meeting deployment targets despite the unprecedented challenges we have seen during the last few years. One of the key challenges the work stream is continuing to address will be focusing on making sense of all the information and collaborating to have a meaningful discussion about what this information really means. Participants are encouraged to reach out to Task Team leads to join the work stream as additional inputs are always welcome.

Work Stream 2: Expanding the vector control toolbox
Leads: Sheila Ogoma and Derric Nimmo

Work stream 2 has presented a range of fantastic presentations about innovative new tools, human-centered designs and LSM. A range of new innovative tools are becoming available which will contribute to the control and elimination of malaria. The presentations on human centered design demonstrate the important of understanding products in the field and how they can be better designed to ensure effective use. The presentations on LSM have demonstrated the important of climate change and impact to mosquito distributions. LSM has made a lot of progress and is now being considered within programmes as a core control intervention. While acknowledging the achievements of the work stream, it is also important to acknowledge the challenges which include recruitment of Task Team leads and coordinating impactful discussions and activities. Thank you to the Task Team leads for all of their hard work and thank you to those that have shown interest in joining the work stream within this meeting.

Work Stream 3: Implementing the global vector control response
Leads: Chadwick Sikaala and Anne Wilson

Thank you to all work stream members and Task Team leads who have led the sessions. The first Task Team (IVM) demonstrated the importance of rice and malaria and the need to increase rice yield while not increasing malaria transmission. If anyone at VCWG is working on characterization of larval habitats in rice growing areas then please reach out to Jo Lines and Kallista Chan to discuss involvement in the Task Team. The second Task Team (Capacity and collaboration) presented on the capacity building activities being conducted regarding programming and documentation of case studies and resources. This is a very valuable Task Team and participants are encourage to join and contribute to the work being conducted. The third Task Team (*Anopheles stephensi*) is keen to support and help implement the WHO *An. stephensi* Initiative by enhancing collaboration, surveillance, information exchange and research prioritization. The final Task Team (malaria control in humanitarian emergency settings) is looking to support in information exchange and the optimization of vector control tools in humanitarian settings. If anyone is interested in contribution to any of the work streams discussed at VCWG, please reach out.

Way forward in 2023-2024 - Moderators Corine Ngufor, Justin McBeath, Konstantina Boutsika
JM announced the changes to the Co-chair position as he will be stepping down and a new election process to be launched soon. Final thanks to sponsors, coordinators and local teams hosting the meeting. There is ambition and aspiration to continue meetings in endemic countries moving forward to maintain the momentum of in-country participants at the meeting.

Any other business
Konstantina Boutsika expressed final thanks to other meeting facilitators including, but not limited to, Keziah

Malm, Christian Atta-Obeng and the team's help, Justin McBeath and Corine Ngufor, all co-chairs / co-leads and translators. Wishing participants safe travels home and thanking them again for their participation at the meeting.

List of acronyms and initialisms

ABV	Aedes Borne Virus
AGAMal	AngloGold Ashanti Malaria Control Limited
AI	Active Ingredient
ARMPC	Advocacy and Resource Mobilization Partner Committee
ATSB	Attractive Toxic Sugar Bait
BMGF	Bill & Melinda Gates Foundation
Bs	*Bacillus sphaericus*
Bti	*Bacillus thuringiensis israelensis*
CHAI	Clinton Health Access Initiative
CIT	Campaign Implementation Team
CRSPC	Country / Regional Support
CRT	Cluster Randomised Trial
DHIS2	District Health Information System 2
DRC	Democratic Republic of Congo
DWL	Durable Wall Lining
EVCT	Expanding the Vector Control Toolbox
FAO	Food and Agriculture Organisation
FR	Funding Request
GF	Global Fund
GHS	Ghana Health Service
GMP	Global Malaria Program
GMP	Genetically Modified
GVCR	Global Vector Control Response
HBO	Human Behaviour Observation
HBR	Human Biting Rate
i2i	Innovation to Impact
ICCN	ITN Campaign Coordination Network
IPTi	Intermittent Preventative Treatment during infancy
IPTp	Intermittent Preventative Treatment
IRI	Institute for Climate and Society
IRS	Indoor Residual Spraying
ISGlobal	Barcelona Institute for Global Health
ITNs	Insecticide Treat Nets
IVCC	Innovative Vector Control Consortium
JAG	Joint Action Group
KII	Key Informant Interviews
LLINs	Long Lasting Insecticide Nets
LRM	Local Resource Mobilization
LU/LC	Land Use / Land Cover
MDA	Mass Drug Administration

MoE	Ministry of Education
MoH	Ministry of Health
MSWG	Multi-Sectoral Working Group
MTR	Mid Term Review
NGO	Non-Governmental Organisation
NMEP	National Malaria Elimination Programme
NMESP	National Malaria Elimination Strategic Plan
NMP	National Malaria Program
NTD	Neglected Tropical Disease
PAMCA	Pan-African Mosquito Control Association
PBO	Pyrethroid-piperonyl Butoxide
PMI	President's Malaria Initiative
PNLP	Le Programme National de Lutte contre le Paludisme
PQT	Pre-Qualification
PQT/VCP	Prequalification Unit Vector Control Product Assessment Team
RAFT	Resilience Against Future Threats
RBM	Roll Back Malaria
RCT	Randomised Control Trial
RDP	Request for Determination of Pathway
RFP	Request for Proposal
SBCC	Social Behavioural Change Campaign
SBD	School Based Distribution
SCPC	Strategic Communications Partner Committee
SEA	South East Asia
SMC	Seasonal Malaria Chemoprevention
SNT	Subnational Tailoring
SSA	Sub-Saharan Africa
TA	Technical Assistance
TRP	Technical Review Panel
VCAG	Vector Control Advisory Group
VCP	Vector Control Product
VCR	Vector Control Response
VCWG	Vector Control Working Group
WASH	UNHCR Water Sanitation and Hygiene
WHO	World Health Organisation
WHO/JMPS	WHO Joint Meeting on Pesticide Specifications
WHOPEs	World Health Organisation Product Evaluation
WHOPES	World Health Organisation Pesticide Evaluation Scheme