Roll Back Malaria Vector Control Working Group (RBM VCWG) 12th Annual Meeting, 8-10th February 2017 Moevenpick Hotel, Rue de Pre Bois 20, 1215 Geneva

Co-chairs: Jacob Williams and Gerhard Hesse
Coordinator: Konstantina Boutsika
Rapporteur: Vanessa Chen-Hussey

Day 1: Wednesday 8th February 2017

Session 1: Introductions and Objectives

Chairperson: Gerhard Hesse

Welcome and Introduction –Jacob Williams, RBM VCWG/Tropical Public Health Practice LLC

Jacob Williams opened the meeting and invited new participants to introduce themselves. He noted a gradual flattening of global funding for malaria control and the increasing competing demands of other mosquito-borne diseases such as Zika, dengue and lymphatic filariasis. He therefore stressed the need to leverage the already built capacities and competencies for malaria vector control, as opportunity for cost-effective multi-disease approaches, premised on shared vector ecology and/or shared epidemiology of disease transmission.

Meeting Objectives and Agenda – Gerhard Hesse, RBM VCWG/Bayer CropScience

He reminded the agreed RBM VCWG purposes which are: (i) to align RBM partners on best practices to reach and maintain universal coverage with effective vector control interventions, (ii) to disseminate the normative and policy-setting guidelines of the World Health Organization (WHO), by helping to translate these norms and standards to international and country-level partners, (iii) to support the generation of evidence to inform global policy and guidelines, (iv) to protect the efficacy of existing tools and simulate the development of new tools, (v) to coordinate the support to malaria endemic countries with regard to implementing WHO guidelines, and (vi) to provide an essential forum where diverse partners of the vector control community from the public sector, the private sector, research and academia, and civil society, can come together, to reach a common consensus.

The main objectives of the 12th VCWG meeting are (i) to discuss and agree on a SMART Work Stream work plans and present these to the VCWG, (ii) to discuss the Work Stream work plans and (iii) to discuss the way forward for 2017 and 2018. Consequently, the meeting was split into three parts, starting with general updates and plenary sessions, followed by the individual Work Stream meetings during which SMART work plans will be discussed and agreed, and ending with plenary feedback on the Work Stream meetings and work plans for 2017/18.

Latest News from the RBM Partnership – Elhadj As Sy, Secretary General, International Federation of Red Cross and Red Crescent Societies

Following the 2013 external evaluation, the RBM Board approved the adoption of a new structure and mechanisms to address the key areas for improvement, overseen by the Transition Oversight Committee. Since December 2015, members of the new RBM board have been nominated and selected, and the Board met 4 times; a new set of RBM bye-laws and TORs is planned for the Partner Committees and Working Groups; legal status has successfully transitioned to UNOPS; 3 new Partner Committees have been set up; a permanent management team including a new CEO has been recruited; progress has also been made in resource mobilisation and communication.

New RBM board and CEO consist of 15 individuals with deep expertise and experience, and representation across the partnership. The new CEO assumed responsibilities on 1 February 2017. The new RBM architecture comprises a Partnership Board which forms the governing body accountable to Partners, and a CEO who functions as the day-to-day manager of the Partnership and leads the management team - a small, flexible team designed to support the Board and implement strategy efficiently. Direct Partner engagement will be improved by the reorganisation of Partner Committees (advocacy and resource mobilisation, strategic communications, country and regional support), Country and Regional Frameworks (support to malaria-affected countries) and Working Groups (facilitate and streamline specific bottlenecks and coordinate technical area implementation efforts).

An important next priority for the CEO and RBM Board is to clarify the linkage of Working Groups to the RBM structure and processes for accountability. This will involve the review of principles of operation, guidance on membership and accreditation, and interaction with Partner Committees. In the interim, Working Groups will continue to operate and they did previously. Details will be kept updated on the RBM website, and feedback and suggestions for the future of the Working Group is encouraged via the Interim Support Team. Suggestions for improving these lines of communication are also welcome.

Global Vector Control Response – Tessa Knox and Raman Velayudhan, World Health Organization, & Steve Lindsay, Durham University

Eighty percent of the world's population (4.5 billion) are at risk of vector borne disease (VBD), and since 2012, every WHO Region reports at least one VBD. Major gains have been made in malaria control, resulting in 1.2 billion fewer cases between 2001 and 2015, compared to 2000. Similar success has been seen in onchocerciasis and lymphatic filariasis. However, *Aedes* borne diseases represent an increasing challenge, and the spread of Zika, dengue and Chikungunya show the deficiencies in the current global vector control response. The challenges to control include systemic, structural, informational, environmental, political and financial limitations, and movement of people and goods.

The UN Sustainable Development Goals (SDGs) are an opportunity to reposition VBD and vector control on the agenda for the future. Vector control can be linked to seven of the seventeen SDGs: 1 – No poverty; 3 – Good health and well-being; 6 - Clean water and sanitation; 8 – Decent work and economic growth; 11 Sustainable cities and communities; 13 Climate action and; 17 Partnerships for the goals.

The rationale for *WHO Global Vector Control Response (GVCR)* starts with the burden of VBD, an estimated 17% of all infectious disease. Most are preventable, but the full impact of vector control is limited by inadequate delivery of interventions, a lack of public health entomological capacity, poor coordination within and between sectors, weak monitoring systems, and a limited evidence base. Integrated Vector Management (IVM) aimed to respond to some of these issues, but uptake has been poor, due in part to the complexity of communicating IVM, limited human capacity to advocate, plan and implement, fragmented global and national architecture and insufficient political buy-in. Therefore the GVCR aims to go beyond current delivery of IVM, whilst being simple, practical and actionable.

The GVCR is being coordinated by three departments within WHO; the WHO Global Malaria Programme; the WHO Department for Control of Neglected Tropical Diseases and the Special Programme for Research and Training in Tropical Diseases. The steering committee is led by Professor Thomas Scott and Dr Ana Carolina Santelli. Four drafts of the GVCR and online consultation have already been completed by a group representing the constituencies since June 2016. A fifth draft is expected to be ready for discussion at the World Health Assembly in May 2017. The GVCR vision is a world free of human suffering from VBD. The specific goals of the GVCR are to reduce mortality due to VBD by 75% by 2030; reduce case incidence due to VBD by 60% by 2030 and prevent epidemics of VBDs in all countries. These goals are very well aligned with the 3rd SPG. The foundation of the GVCR relies on enhanced vector control capacity and enhancing basic and applied research. The pillars of action are (1) Strengthen inter- and intra-sectoral action and collaboration, (2) enhance vector surveillance and monitoring and evaluation of interventions, (3) scale up and integrate tools and approaches, and (4) engage and mobilise communities. These will require country leadership, advocacy, resource mobilisation and partner coordination, regulatory policy and normative support.

The priority activities for 2017-2022 are to align national and regional vector control strategic plans with the draft global vector response. This will involve national vector control needs assessments, appraisal of national entomology and cross-sectoral workforces (capacity building), training in public health entomology and support for institutions to provide that training, national agendas for basic and applied research, multi-sectoral engagement with vector control, strengthened national vector surveillance systems, national targets for protection of at-risk populations, and national plans for

community engagement and mobilisation. These activities will be revised and updated for 2023-2030.

In conclusion, to ensure that all countries achieve success irrespective of their current disease burden, capacities and resources will need country leadership of vector control to be successful, and action within and between countries should be harmonised and strengthened. Policies should not be limited to the health sector and should always be evidence based, with an emphasis on the adoption of novel tools when validated and integrated, as well as community- based approaches.

Discussion

- It was noted that it was particularly good to have *Aedes* control included in the work. This is an opportunity to change the way we do vector control globally; to not limit VCWG work to malaria, but acknowledge that realities on the ground point to a need for a more comprehensive approach that incorporates related co-morbid disease transmission in countries. This approach will not only enable sustainable vector control but also will help keep personnel and resources in place where malaria is declining and approaching elimination.
- It was queried whether the existing timeframe to validate new tools is sufficient to enable timely access by countries to reach disease reduction targets, particularly those related to epidemic reduction. The need for fast-tracked evaluation process was urged. In response, the examples of *Oxitec* and *Wolbachia* were cited to demonstrate continued efforts to fast-track evaluations of new tools. The need to demonstrate disease level impact of new tools was emphasized.
- There was a call for greater publicity and communication tools targeting political leadership. WHO indicated that a short 2 page document will be available, alongside the final draft of the GVCR, to enable decision makers to quickly grasp the key points.
- It was queried whether there was any mechanism to coordinate cross-border activities, and in particular, address the reluctance to share data. Confidential data sharing, such as currently exists for dengue outbreaks, could be explored.

Individual Work Stream Meetings

2nd IVM, Evidence and Capacity Work Stream meeting
10:30-13:30, Wednesday 8th February 2017
Co-leaders: Josiane Etang and Michael Macdonald

Work stream mandate and priorities – Josiane Etang, Fraunhofer Institute for Molecular Biology and Applied Ecology, Justus Liebig University and Michael Macdonald, Consultant

The framework for the IVM E&C Work Stream is to (i) generate and share evidence on effective and efficient deployment of prior, existing and new vector control interventions and practices; (ii) generate and share evidence on integration of all vector control tools, including lessons from other regions and disease eradication programs; and (iii) work with WHO and RBM partners to build entomology and vector control capacity at all levels in endemic countries. Five potential projects

were presented. These projects will be consolidated with activities from other work streams where there is overlap (e.g. capacity-building) and refined into specific work stream plans.

Project 1. Identification and networking institutions and resources for public health entomology capacity-building – Michael Macdonald, on behalf of Florence Fouque, WHO/TDR and Leonard Ortega, WHO/GMP who are leading these efforts but unable to attend the current session

As one specific activity, the work stream will collaborate with the WHO Regional Offices, GMP and TDR and partner networks, including ANVR, ALMA, ACTMalaria, APMEN/APLMA, PAMCA and AMCA, to build a directory of entomology and vector control training institutions, programs and resources. The intended outcome is to improve networking, share best practices and advocate for public health entomology.

Discussion

- It was noted that country training networks should be included as in some cases, such as India, where these resources are already well organised.

Project 2. RBM and the Global Vector Control Response – Tessa Knox, World Health Organization

It is anticipated that the GVCR will be endorsed by the World Health Assembly in May 2017. While not yet officially launched, looking forward there will be opportunities for the RBM VCWG to work with WHO to roll out the GVCR to countries at risk of the major vector-borne diseases, including *Aedes*-borne diseases.
Building on the presentation during the first day's plenary session, the GVCR includes ten priority activities where member states have reached consensus. From these ten activities, there are several areas for potential RBM VCWG contribution, e.g.:

1. <u>National and regional vector control strategic plans developed/adapted to align with draft global vector control response</u>

    The RBM VCWG can provide technical support for the strategic plan development and help develop "business plans" for implementation.

2. <u>National vector control needs assessment conducted or updated and resource mobilization plan developed (including for outbreak response)</u>

    The VCWG partners working at the country level can help and support the vector control needs assessment once that instrument has been finalized and disseminated.

3. <u>National and regional institutional networks to support training and/or education in public health entomology and technical support established and functioning</u>

    There are several specific areas where the VCWG can provide significant support. This includes: exchange programmes; creating stronger linkages with the AMCA and with Industry, including equipment and insecticide manufacturers to provide training to ensure quality implementation; and to capitalise on established networks and Vector Control working groups in regions such as PAMCA, APMEN, and the "Elimination 8" as well as with the leadership networks, ALMA and APLMA.

4. National agenda for basic and applied research on entomology and vector control established and/or progress reviewed

Members of the VCWG can provide technical input to the national basic and applied research agendas.

5. National vector surveillance systems strengthened and integrated with health information systems to guide vector control

Expertise can be provided for state-of-the-art integrated entomological surveillance systems, engaging established systems such as in the "Eliminate 8" countries and systems currently under development, including. Members of the VCWG can also provide technical input to improve country-level *Aedes* surveillance.

Discussion

- While there is not yet a global working group for GVCR advocacy this might be established by the WHA if thought necessary. A key component is for Ministries of Health to have dedicated funding for national-level multi-sectoral vector control taskforces. In terms of cross-ministry cooperation, in addition to the usual collaboration with Agriculture, Education and Environment, there are opportunities to engage Ministries of Tourism and the tourism industry who often have large financial risks regarding vector-borne disease outbreaks and control.
- How will countries adapt their existing separate strategy plans for malaria, Lymphatic Filariasis, Leishmaniasis, and *Aedes*-borne diseases and realign these according to the GVCR? The feedback from countries has been very positive and they understand this may require a large amount of planning and coordination. Although the work required will vary from country to country, there is not proscription for countries to do this; the GVCR aims to build an enabling environment.
- Will donors also welcome this change for integrated approaches that will benefit multiple vector-borne diseases, whereas now most funding channels are siloed for a single disease? It was decided that this needs to be specified in the national needs assessment to encourage for example, collaboration between malaria and dengue programmes.

Project 3. Capacity-building to manage Insecticide Resistance in the WHO Africa Region – Josiane Etang, with apologies from Birkinesh Ameneshewa, WHO AFRO who was unable to attend

The African Network on Vector Resistance (ANVR) was established in 2000, involving national malaria control programmes and supporting research institutions and coordinated by the WHO Regional Office for Africa. Among the key activities of the network's 2016-2017 roadmaps, are those related to Pillar V of GPIRM: "to ensure enabling mechanisms (advocacy, human and financial resources) are in place." Problems identified included the weak entomological capacity at the national level; insectaries and entomology laboratory facilities available in some countries were not fully operational; and collaboration among researchers and with the national control programmes was sometimes weak.

Action points that came from the November 2016 meeting include: (1) produce WHO technical guidance for countries on the minimum indicators for entomological surveillance; (2) develop a vector surveillance operational manual supported by an operational plan; (3) encourage collaboration and planning between countries in the same regional block; and (4) strengthen the collaboration with research and academic institutes.

These action points are currently being managed by WHO through ANVR. In 2016, support has been given to countries for entomological training of 163 health workers, 33 Master programmes and 21 PhD students. However, an important gap remains in terms of human and financial resources, and collaboration between training institutions and programmes.

The question raised during the presentation of this project was: How could members of the VCWG work with AVNR to reinforce country capacities and improve links among national training and research institutions and national vector borne disease control programs to monitor and manage insecticide resistance?

The priority needs previously identified were: (1) advocacy for malaria vector control research and training to become a priority of Funding Agencies at the global level; (2) put in place a mechanism for elaboration of competitive projects through consortia; and (3) produce multi-country proposals and liaise with funding agencies to mobilize the required budget.

Discussion

- It was suggested that the work stream help to improve data quality management by reviewing standardised procedures for carrying out resistance testing, and for collecting and reporting the data.
- It was remarked that the availability of materials for resistance monitoring (papers, tubes, kits) has usually been a challenge. A response was made that procurement has recently moved to an online system, which is intended to speed the process. However, WHO is maintaining a single source to ensure quality control. A suggestion was made that using WHO country offices for procurement can also help supplies move faster through the supply chain.
- An action point was suggested that the work stream create an online clearing house of the training available during the year. This would allow the information to be pooled and would help identify areas where partners from industry can contribute.
- It was suggested that basing basic entomology training within university would make courses more attractive to participants. It was remarked that finding support from universities might pose a challenge.
- It was remarked that although the training of entomologists was receiving attention, their subsequent career path was often being neglected, which will lead to the loss of these candidates from the field.
- It was suggested that the work stream aims to coordinate resistance management with agricultural sector efforts.
- An action item was suggested to review existing training documents and collate them for repurposing.

Project 4. APMEN Vector Control Working Group: Best practices for entomological monitoring and outdoor/ residual transmission across regions – Christina Rundi, Ministry of Health, Malaysia, Jetsumon Prachumsri, Mahidol University, Thailand, Michael Macdonald and Allison Tatarsky, University of California, San Francisco

A meeting was held in Bangkok in November 2016 to discuss entomology in malaria elimination across the Asia-Pacific Region. One of the goals was to share best practices to help national programs shift the entomological surveillance and vector control strategy from control to elimination. This requires capacity building (HR and systems, job opportunities, training, career pathway and mentoring), risk-area stratification (expand and decentralise, mosquito identification,

increased use of GIS and remote sensing), and foci investigation (entomology links to epidemiology). For vector control, this requires adapting tool and strategies for the specific contexts including outdoor transmission, which was the subject of the second two days of the meeting.

The Asia Pacific Malaria Elimination Network (APMEN) is a network of countries (18 at present), stakeholders and partners (over 20 at present) in the Asia-Pacific region. It was started in 2010, and is a platform for collaboration, information exchange and capacity building, committed to work towards regional malaria elimination by 2030. Since last year it had been included under the Asia Pacific Malaria Leaders' Alliance (APLMA).

The Mekong Outdoor Malaria Transmission Network (MOMTN) links programs and partners to share best practices to meet the challenge of outdoor transmission across the region. The MOMTN builds upon the RBM VCWG work stream on outdoor transmission, begun in 2011 with information on previous meetings available on the VCWG website.

An action plan to aid collaboration with APMEN to meet common challenges across the regions was presented (1) strengthen vector biology research and Vector Control tool development through best practice exchange and coordinated research agenda; (2) enhance integration of anthropological approaches, community participation and engagement; (3) enhance access to necessary tools and capacity through information exchange and coordinated programming, and (4) address market and regulatory challenges through improved communication with regulators and industry.

Discussion

- There is funding for capacity building, but not for research aspects, so that is one area where funds will be sought.
- Within the Asia Pacific region there are some areas such as insecticide resistance where the current surveillance needs to be expanded and improved.
- There was a query as to whether there was any way to address the infrastructure deficiencies in certain countries, particularly in the short term. One of the activities of APMEN has for example been a pocket guide for the identification of malaria vectors.

Project 5. Vector Control in Humanitarian Emergencies – Valentina Buj, UNICEF and Richard Allan, The MENTOR Initiative

Humanitarian Emergencies cover three types of vector control settings: destroyed cities, populations within camps, and unsettled spontaneous refugee and displaced person populations. A case study on the vector control strategy used in South Sudan was presented. Two camps in South Sudan, Malakal and Bentui Internally Displaced Persons Camps faced severe malaria outbreaks in 2015 and 2016. The tools used to combat this were Indoor Residual Spraying, Larval Source Management, LLINs, fly control (to combat trachoma and diarrhoeal diseases) and IEC (information, education and communication). LLIN coverage was 100% and IRS carried out successfully, but with no effect on malaria transmission at all. In 2016, the IRS active was changed from lambda-cyhalothrin to primiphos-methyl. The result was a dramatic improvement in control in this settled camp situation.

In other emergency relief contexts, mobile communities need a different suite of tools. Some of the solutions have been tested and documented for decades as outlined in the 2013 WHO publication: "Malaria control in humanitarian emergencies – An inter-agency field handbook. Second edition" These tools include Insecticide Treated Plastic Sheeting, "Demuria" LLINs (specially designed for outdoor sleeping), permethrin-treated top sheets and blankets. Uptake of these tools has been slow, as the UN and many donors require additional WHO approval as is currently provided for more

standard tools such as IRS, LLINs and larvicides. The work stream can help by (1) creating an evidence-base for the use, acceptance and performance of these additional vector control tools; (2) advocate greater use of these tools so they can be field-tested and adapted; (3) share best practices for the delivery and monitoring of the efficacy and effectiveness of these tools; and (4) build donor support for improving vector control in humanitarian emergencies.

Discussion

Action items were suggested for the following:

- Clarify the risk of vector-borne disease exposure scenarios and link these to the products that exist and are approved (IRS, LLINs, LSM) but underutilised.
- Determine the level and type of evidence required of new products used in these settings in order for them to be recommended for broader procurement and implementation.
- Develop a research framework to provide guidance on how to implement good quality monitoring alongside the intervention roll-out.
- Help manufacturers and donors to overcome market stability, regulatory and political barriers that impede the practical roll out of these tools.

4th Housing and Malaria Work Stream meeting
10:30-13:30, Wednesday 8th February 2017
Co-leaders: Steve Lindsay & Lucy Tusting

Welcome - Steve Lindsay, Durham University

Steve Lindsay opened the meeting. It was announced that Mariana Stephens has handed over co-chair duties to Lucy Tusting. Mariana's work was greatly appreciated and she will be missed. New attendees were asked to introduce themselves.

Review of Work Plan 2016-2017 and Work in Progress – Lucy Tusting, University of Oxford and Steve Lindsay, Durham University

Updates on the 2016-2017 work plan were given:

- *Advocacy for inclusion of housing in strategic plans*: The Global Vector Control Response 2017-2030 emphasises the role of housing and will be presented to the World Health Assembly in May 2017. A preliminary expression of interest to the UK BBSRC to establish a network of experts in housing and vector-borne disease was successful; full application due February 2017. The UN Conference on Housing and Sustainable Urban Development (Habitat III) was held in October 2016 in Quito, Ecuador and concluded with the adoption of the New Urban Agenda, which links with Sustainable Development Goal 11 to set global standards in sustainable urban development. Vector-borne disease was included in the New Urban Agenda. Steve Lindsay and others wrote an associated blog post on opportunities for *Aedes* control. Networking and informal discussions on housing and malaria have been ongoing.
- *Updating housing recommendations:* It was discussed last year whether the 2015 consensus statement should be updated with more specific recommendations; no action has yet been taken.

- *Visiting funders to share ideas on housing & malaria*: Work Stream members responded to a funding priority consultation at UKAID; visit to BMGF in Seattle took place in Nov/Dec 2016 to investigate potential for developing house screening products.
- *Six monthly updates*: A newsletter was circulated in December 2016 and will be continued.
- *Stakeholder visits to study sites in Tanzania and Gambia*: Successful visit from NMCP to the RooPfs study in The Gambia, June 2016.

Updates were then given on three on-going projects with discussion and questions in turn:

1. **Multi-country analysis of housing and malaria**
   Lucy Tusting and colleagues' paper will be published in PLOS Medicine on Feb 21st. A cross-sectional analysis was carried out using Demographic and Health Survey and Malaria Indicator Survey data from 21 African countries. Key findings were that improved housing was associated with reduction of 9-14% in the odds of malaria infection in children compared to unimproved housing. In comparison, ITN use was associated with a 15-16% reduction in malaria infection in children.

- It was queried whether any interaction was found between housing quality and ITN use. This was explored in the analysis, but no association was found.
- The cost of improved housing was queried and it was remarked that incremental housing improvements are occurring in many places as incomes increase, with potential to leverage these changes.
- It was stressed that the aim is not to replace LLINs with improved housing, but to use them together as complementary interventions.
- It was requested whether the group could advise on what questions on housing should be added to MIS. Further discussions were planned, but an interim response was given that the questions should include whether the eaves were open or closed, and whether there was screening on doors and windows.

2. **Roo*Pf*s study in the Gambia**
   This is an ongoing randomised controlled trial involving 800 traditional houses, of which 400 were randomised to receive ventilated metal roofs, screened windows under the eaves and ventilated front doors with screening, and 400 remained unmodified controls.

- It was remarked that scale up of this intervention could be a challenge.
- It was remarked that there is a need to come up with new products, for example a screened door and new types of screen that are resistant to damage.

3. **Importance of cross-ventilation**
   The results of Jim Sutcliffe's study on the effects of cross ventilation were presented. The key findings were that the approach of mosquitoes to ITNs is affected by airflow. In still air, mosquitoes landed on the roof of the ITN, whereas with airflow, increased landing was observed on the sides of the ITN. This has implications for assessment of net durability as holes are more often found at the sides of ITNs, and also on next generation ITNs where the roof and sides of a net may be treated with different active ingredients.

Policy Update – Steve Lindsay, Durham University

It was proposed that the scope of the work stream should be broadened from housing and malaria to vector-borne diseases and the built environment, the primary focus remaining on housing and malaria. It was announced that a new RBM working group on multi-sectoral approaches to malaria

control is planned, which would be highly relevant to this Work Stream since improving housing and the built environment is a cope component of multi-sectoral intervention.

An update was also given on SDG11 and the New Urban Agenda, which focuses on sustainable urban development and building cities resilient to natural hazards. Vector borne diseases are a natural hazard that should be given consideration alongside other natural hazards such as flooding and earthquakes. *Aedes* borne diseases, which tend to be more urban, are particularly relevant.

- It was asked what connections exist between this group and urban planning organizations. No participants came forward and this was raised as a huge limitation of the Work Stream that urgently needs to be addressed by reaching out to the housing sector.
- It was asked if the work stream could produce minimum specifications for an "anti-mosquito house".
- It was asked how advice may be tailored to different communities, when there is such variation between and within countries in terms of house design and mosquito behaviour.
- It was remarked that air flow should be a key consideration as ventilation can affect the uptake of LLINs and risk of acute respiratory infections.

Housing improvements in Namibia – Tara Seethaler, Clinton Health Access Initiative

An update was given on a small scale roll-out project aiming to test the operational feasibility of housing improvements in Namibia. The project has multiple partners and donors (CHAI, ARCHIVE global, DXA studio, MNM UK and BMGF), and was carried out in close associated with government ministries. A literature review, surveys & FGDs were carried out first before the implementation of housing improvements which is currently on-going. A manual was produced on improvements including screening windows, doors and eaves, sealing gaps in walls, and mending roofs. Early results suggest that the cost per structure is $20-29 inclusive of labour and materials. Key messages are to think carefully about building materials (using local materials as far as possible) and that community engagement is critical. The next steps are to continue roll-out and conduct monitoring and evaluation during 3 and 6 month follow-ups, including epidemiological data.

Discussion

- It was remarked that cross-ministerial engagement was implemented as early as possible in the planning of the project, and proved very important in support for scale up.
- It was remarked that community engagement was equally important and was conducted through focus group discussion, surveys, and by recruitment of technicians from within the local community.
- It was queried whether the local community pay for improvements themselves? It was responded that the interest from the local community was not necessarily in spending money, but there was a willingness to dedicate their own time. Need to choose materials and methods carefully to allow maintenance by householders themselves.

Discussion: How do we strengthen links with the housing sector? - All

Strengthening links with the housing sector is a huge challenge but is necessary for the success of the Work Stream's goals. Steve Lindsay, Lucy Tusting and others have submitted an application to the UK BBSRC to develop a network of experts in vector-borne disease and the built environment, which will include funding for small scale projects, particularly focusing on sub-Saharan Africa. The following suggestions were made by meeting participants:

- Development of strategic documents on inter-sectoral action for vector-borne disease, including the housing sector and WASH, in order to engage top-level political involvement to help gain the cooperation of different departments.
- Development of an advocacy document to encourage vector borne disease programmes to include housing improvements.
- The Work Stream could draw on lessons from Chagas work in Latin America [Martha Quinones to give names of PAHO contacts].
- The Work Stream should think about how strategies might vary between rural (engaging local populations) and urban (codes for building) areas.
- Encourage social housing providers and engineers to implement mosquito proof housing improvements, possibly through technical guidance (such as that produced by CHAI) and also vocational training for local communities.
- There must be engagement with the private as well as the public sector.
- It was asked how good the epidemiological evidence base would have to be to recommend certain improvements. Following the lead from VCAG requires Phase III Randomised Controlled Trials which are not always practical for environmental interventions.
- The Work Stream could link with the WHO Environmental and Social Determinants of Health (PHE) Unit as they have requested expert guidance on housing.
- The Work Stream could seek donor funding to kick-start inter-sectoral meetings. Co-benefits should be highlighted when trying to promote inter-sectoral cooperation.
- Local housing adaptations and indigenous house design should be incorporated within interventions to improve uptake.
- Link with vocational training institutions in country, formal and informal.
- The Work Stream should identify and engage with private sector associations and companies, e.g. screening manufacturers [Action: Sean Blaufuss].
- Solar energy providers could advocate for housing improvements alongside solar tech. Payment in instalments could make more affordable e.g. Kenya mobile phone company example [Action: Alex Hiscox].

Discussion: Work Plan 2017-2018 – All

The discussion was structured around four areas: (i) strengthening links with the housing sector (covered above), (ii) updating housing and malaria recommendations, (iii) encouraging basic and applied research on vector-borne disease and the built environment and (iv) information exchange:

Updating housing and malaria recommendations

The Work Stream released a Consensus Statement on housing and malaria in 2015 together with UNDP and UN-Habitat. Since the recommendations were not detailed, it was discussed whether the statement should now be updated.

- Specifications (for example for robust screening) and maintenance recommendations should be included.
- It was asked how housing interventions would fit with existing vector control interventions, considering for example the effect of ventilation on ITN use.
- Local situations should be taken into account; blanket recommendations may be inappropriate.
- This work is covered by two new planned WHO guideline documents on (i) housing and health, to include vector borne disease, and (ii) vector control interventions for malaria control, to include housing.

- An advocacy statement would be helpful to encourage vector borne disease programmes to include housing improvements into activities.
- Existing and past housing byelaws could be explored.
- LLIN delivery could be prioritised to communities where housing improvements had not yet been put in place.

Encouraging basic and applied research on vector-borne disease and the built environment

- Important research topics were identified: air flow, pathways for scale up, sustainable/comfortable improvements, deflection of mosquitoes from improved houses to unimproved houses, coverage required for any mass effect.
- Information on building materials and their performance in the tropics could be gathered from contacts with industry.

Information exchange

It was asked if there was a better way of keeping everyone updated and sharing work outside RBM. Suggestions included MalariaWorld.

Any other business

- Update on Lake Victoria Initiative: This was a regional initiative to improve WASH, led by multiple agencies with engagement at ministry level; currently on hold.

2nd New Challenges, New Tools in Vector Control Work Stream meeting
14:30-17:30, Wednesday 8th February 2017
Co-leaders: Michael Reddy & Fredros Okumu

Updates on Work Plan - Mike Reddy, Bill & Melinda Gates Foundation and Fredros Okumu, Ifakara Health Institute

The New Tools and New Challenges for Vector Control Work Stream was set up last year to examine the limitations of our current approaches to vector control. An update on the Work Stream Activities was given:

- Consolidating evidence on New Challenges and New Tools for Malaria Control UCSF team has completed a comprehensive review of 22 vector control tools other than IRS and LLINs. The final report "Expanding the Vector Control Tool Box for Malaria Elimination" is expected in Feb 2017.
- Mutual learning and idea sharing between south-east Asia and Africa. Engagement was initiated by Dr Mike Macdonald and Dr Jeffry Hii. Fredros Okumu attended the Joint International Tropical Medicine Meeting in Bangkok in December 2016 to present the African perspective on new challenges and new tools. The Asian team has been invited to Geneva in Feb 2017. There are already groups in SE Asia working on outdoor transmission, and a joint meeting for all groups is planned through WHO-TDR.
- Symposia on New Tools and New Challenges during PAMCA conference side meeting. The VCWG-NTNC symposium covered new tools, current challenges. A second meeting was held on the last day of PAMCA to address the role of PAMCA in meeting these challenges.
- Develop draft guidelines for measuring residual malaria transmission and its drivers. The aim of this activity is to develop draft standardised guidelines to quantify malaria transmission

and its drivers across different settings. A partnership was formed with VectorWorks JHU during a meeting in July 2016, to combine resources to achieve similar goals. TDR is planning a similar effort in 2017, and engagement with TDR is planned for Feb 2017 Geneva meeting. A meeting of all interested groups will then be held in Africa in late 2017.

Updates on expanding the vector control toolbox: gaps and opportunities - Allison Tatarsky & Yasmin Williams

A desk review and modelling based approach was applied to understand gaps in vector control (beyond ITNS and IRS) in order to identify potential solutions and to accelerate progress to elimination. The five work streams were:

1. Geospatial modelling to determine the extent of residual transmission. This was done in partnership with the MAP project, to identify areas where transmission does persist despite high coverage of nets.
2. A Systematic Literature Review to determine the evidence that exists to date and what gaps remain. The review looked into 21 vector control tools (excluding ITNs and IRS) and trials showing epidemiological outcomes, or entomological outcomes. Out of 17,912 abstracts, 155 studies were eligible for inclusion. Only 7 of 21 vector control tools have gone through a Phase III evaluation.
3. A technical review of aerial application to establish the potential for aerial spraying for *Anopheles* control.
4. Transmission modelling to identify the optimal combinations of tools. The Vector Control Optimisation Model simulates the addition of a new VCT into the local setting. Modular Analysis and Simulation for human Health is a model that takes into account environmental heterogeneities.
5. Case study series to help identify the enabling factors for the implementation of new tools. Case studies were taken from the US, Australia, and malaria endemic countries. Best practice showed; entomological and operational capacity; entomological intelligence linked with spatial, epidemiological and cost data; evidence-based and decentralised decision making; sustainable financing; meaningful community engagement; strong leadership and management at all levels; links with research institutions.

The outcome is an ongoing development of a shortlist of “ready” tools with potential for impact

- Environmental Management
- Larviciding
- Mosquito-proofed housing

These tools are needed immediately while R&D of other less researched tools is carried out. The RBM VCWG New Tools, New Challenges work stream was asked to consider moving beyond the traditional research models to develop a learning-by-doing approach for emerging vector control tools.

Summaries available on website: http://www.shrinkingthemap.org/what-we-do/vector-control

Discussion

- It was queried why the mapping component concentrated on SSA which has stable transmission and where elimination is not currently achievable. SSA was used for the mapping component as this area has the best available data. But the rest of the project was location agnostic. Exploring across different settings is a good research priority.

- An explanation of "learning-by-doing" was requested. A model might be to set up an intervention trial, maybe with a control, but with huge emphasis on data collection and heavy M&E. This allows methods and interventions to be adapted as needed, but does lack rigor as compared to RCTs. It may allow more rapid movement forward when facing elimination targets.

Everything you need to know about residual malaria transmission in 10 minutes – April Monroe, Johns Hopkins University Center for Communication Programs

Residual Malaria Transmission (RMT) occurs where high ITN uptake and IRS are being carried out, but malaria transmission is continuing. RMT studies are taking place in Africa (Ethiopia, Kenya, Tanzania, Ghana, Cameroon and Burkina Faso), SE Asia (Vietnam and Thailand), Americas (Brazil and Peru) and the Western Pacific (Papua New Guinea). An outline of the Special Programme for Research and Training in Tropical Diseases (TDR) was given, which aims to quantify and characterise RMT across settings. Three more studies funded by PMI were outlined, in Zanzibar, Ghana and Ethiopia. All these groups are using different strategies to assess human behaviour, entomological and epidemiological outcomes. Other RMT activities include geospatial modelling and mapping and an entomological surveillance framework. RMT has been discussed at the Mekong outdoor malaria network workshop (Nov 2016), and a TDR investigators dissemination workshop is planned for Sept 2017 in Tanzania.

The VCWG were asked to consider the following opportunities: a dedicated forum to share results and discuss methods across groups, settings and funders, re-establishment of outdoor transmission networks in other regions, consensus building around best practiced, standardised methods/tools for use across settings.

Discussion

- It was queried whether the parasite species involved differed between different settings, which was confirmed.
- An explanation of the map presented was requested. Red areas were those predicted to have high residual transmission, so would be areas where new tools other than LLINs and IRS are necessary. Blue areas have low RMT and represent areas where LLINs might still be useful. It was confirmed that insecticide resistance was included in the model as a driver of RMT. The definition of "residual transmission" used in the model was queried. There has been some debate over the definition of RMT and it might be an issue worth discussing across the group. The working definition for the model is the same as WHO definition.
- It was queried what indicators should be measured to detect RMT. It was stated that we need a platform to discuss best practice and to bring scientists together to discuss these issues.
- Request for future meeting to have more results from on the ground research. Evaluations of new tools are required before recommending them to country programme managers. A bigger picture view of the research is needed allows a call for discussion of the work going on and comparison of methods.
- The large number of researchers in this area led to a query of whether there is duplication of work. But a lot of institutions are already collaborating, so effort is not necessarily being duplicated.

Anopheles species identification: an old and continuing challenge – Basil Brooke, National Institute for Communicable Diseases (on behalf of Maureen Coetzee)

Identification of species within complexes requires molecular identification and is becoming more necessary in order to tailor interventions to differing behaviour profiles. However, there is a tendency to rely heavily on molecular identification at the expense of morphological work. Collections from five African countries were identified morphologically, and non-vectors were put through molecular assays. It was found that it was very common to get misidentifications. These findings make it clear that there should be sound morphological identification first, before molecular assays are used. It was reported that Maureen Coetzee is planning to update the morphological keys (Gillies & Coetzee 1987) and would appreciate feedback from users of the keys.

Discussion

- It was reported that morphological identification (including voucher specimen collection) is planned in SE Asia through IP & PMI, and that the work stream should help link up these researchers to help revive these basic skills.
- It was asked whether any sequence data would be included in the work. The first step will be to produce a hard copy guide, which will be followed by an electronic version which could incorporate sequence data.
- It was asked when the guide will be available. The current dichotomous keys and the PCR are currently correct to use, but it is important that morphologically identification happens first, followed by PCR where appropriate.
- It was asked what could be proposed for storage of specimens for later identification, especially in areas where trained entomologists are rare. It was reported that this is one aspect of training courses provided by NICD, and also should be embedded in vector control programme.
- It was asked whether this key would differ from the existing IRD interactive key, and whether there was a plan to produce a simplified key. It was responded that although simplified keys are a possibility, good taxonomic skills are still required and there are no real short cuts.

Ivermectin for malaria elimination: 2016, a year of exponential growth – Carlos Chaccour, Barcelona Institute for Global Health

Three high-level assessments were made last year. A technical consultation with WHO was done to define key data that is missing before a policy recommendation can be made, and the development of a draft TPP. MPAC evaluated TPP (Sep 2016), which will be resubmitted in March 2017. MalERA refresh included endectocides in their publication from the Panel no Diagnostics, drugs, vaccines and vector control in malaria elimination and eradication. The MMV has included endectocides under TCP-6 as a new development in antimalarial target candidate and product profiles. More information is available on MESA track. The effect of ivermectin has been established on *Anopheles aquasalis, An. darlingi, An. dirus, An. minimus, An. sawadwongporni, An. campestris*. The IVERMAL trial has published partial results that show no adverse events following very large doses (9x higher than normal) and in combination with DHA-PIP. The effect on mosquito survival was longer than the drug itself lasts in the body, most likely due to metabolites. There is measurable effect for 28 days on mosquito mortality. RIMDAMAL ivermectin intervention was given to >5 years, but 20% reduction in incidence of malaria observed in under 5s. IMSEA trial 16 volunteers looked at safety of multiple drug regimens as well as mosquito mortality. The antimalarial effect of ivermectin extends to the parasite where it inhibits liver infection. There is research into formulations such as the Bellinger star-shaped pill that can release a drug over 2 weeks. Dosing is being reviewed as current weight

based dosing hampers co-formulations. When used in a veterinary setting, although protective in the first instance, can reduce the efficacy of human-centred control measures and sustain R0 above 1. Future work priorities should be focussed on the technical (gaps in pharmacokinetic knowledge and dosing; metabolites; other endectocides); study design (outcomes and size: what is required to assess this intervention properly) and regulatory and policy.

Discussion

- A query was raised as to why Merck was not supporting this work. They are donating a lot of drug for LF and onchocerciasis, but this kind of work may be out of their scope at present.
- It was asked what the safety profile of ivermectin was in children given that most malaria in SSA is in children <5 years. A safety assessment has recently been submitted, but it is also important to note that the treatment in adults can give protection to children.
- It was asked whether the impact comes from mortality or sterilising. Mortality effect is short-lived, and sterility is longer lasting, but both together work to reduce malaria.

Progress on a Randomised Controlled Trial for evaluation of Eave Tubes – Matt Thomas, Penn State University

Eave tubes are an intervention where the eaves are blocked and an insert installed that doubles as ventilation and insecticide netting. The odour plume from the eave tube turns the house into a lethal lure. Window screening was also carried out. The netting uses an electrostatic charge to bind with insecticide powder. Phase I and II are completed, and III is underway. Forty villages will be monitored over 2 years by active case detection, parasite clearance and time to first infection. Data will also be collected on entomology, the physical environment, social science and an economic analysis. Despite massive pyrethroid resistance, a pyrethroid (10% beta cyfluthrin) was selected as this was the only insecticide tested that caused 100% mortality, with no decline in efficacy after 5 months.

Discussion

- It was asked whether the trial was powered to detect an effect over and above LLINs, as this was given to the controls. The effect size was estimated from phase II work and the trial should be sufficiently powered.
- The safety of the manufacturing process of the inserts was queried. The insert are made within a closed system, and the operatives also wear all appropriate PPE.
- It was asked how the pyrethroid worked even though mosquitoes are resistant. The electrostatic charge on the netting binds the insecticide powder, which then transfers to the insect. Therefore contact with the insecticide is much more prolonged than compared to nets or IRS.
- The choice to use a pyrethroid in an area with high resistance was questioned. It was responded that the initial plan was to use a non-pyrethroid, but beta-cyfluthrin worked the best. Non-pyrethroid products did produce 100% mortality, but persistence did not last 3 months. However the product profile is very flexible and the active on the insert can be changed frequently. It was suggested that the loss of efficacy in non-pyrethroids could be due to vapour pressure, and microencapsulation may help to overcome this.
- It was asked whether dust would adhere to net and reduce efficacy. The nets are treated to saturation, so no new particles should adhere, within the lifespan of the insert.
- It was asked how long installation took. One eave tubes can be installed in about a minute. Installation of window screens is slower as windows are not standard size. With a team of 10-15 people it takes 1-2 week to treat a small village, and 3-4 weeks for a large village.

Updates on Spatial Repellents for Malaria Elimination – Neil Lobo, University of Notre Dame

Spatial repellents provide a bubble of personal protection, and could be suitable for use against day time biters and to combat resistance. Trials in China and Indonesia have shown effects on disease transmission. But results were more varied in Cambodia. More research is needed on coverage, efficacy variation with bionomics and diversion before global recommendations can be made. An update was given on an ongoing project in Indonesia and Peru to generate this evidence base. However, information on the diversion effect and insecticide resistance will be missing as these parts of the study have been discontinued. At present the results are still blinded.

Discussion

- It was reported that there is some baseline data from the African sites, but no more.
- It was asked how the study design catered for both dengue and malaria. The dengue and malaria study designs are completely different to deal with the different disease transmission dynamics. The movement of individuals was not taken into account within the dengue trial, as it is household based.
- It was asked what kind of emanatory was being used. The emanatory is Shield from SC Johnson, containing transfluthrin and lasting 3 weeks, and being replaced every 2 weeks.
- It was asked what other interventions are in place. It was responded that country level interventions are already in place as recommended, so spatial repellent effect is over and above this.
- It was asked whether indoor air concentration of transfluthrin was being monitored. It was responded that it was not.

2nd LLIN Priorities Work Stream meeting
14:30-17:30, Wednesday 8th February 2017
Co-leaders: Hannah Koenker & Lucy Paintain

Introduction – Hannah Koenker, Johns Hopkins University Center for Communication Programs

The goal of the LLIN Priorities Work Stream is to maintain high levels of ownership and use of serviceable LLINs in endemic countries through distribution, LLIN durability and next generation nets.

Prioritization for ITN distribution in resource-constrained settings – Melanie Renshaw, the African Leaders Malaria Alliance

Universal coverage with vector control was a top priority for countries applying for GF funding 2014-2016. When funding was allocated, almost 50% ($1.5 billion) was on vector control, within that most of the funding ($996 million) was spent on LLIN campaigns and a further $272 million went to continuous distribution of LLINs. Guidance for countries was to front load resources allowing time later on to fill gaps in funding as required. Countries gave equal prioritization to continuous distribution and campaign distribution needs. Incompletely funded campaigns responded (except in 1 case) by retaining universal coverage as a goal, and to make higher burden geographical areas a priority. In the period 2018-2020 malaria allocation Nigeria, DRC, Tanzania, Kenya, Ethiopia, South Sudan and Niger together have a shortfall of around 75 million LLINs. Additional resource mobilization support will be provided.

Economic, Financial, and Donor costs of continuous distribution channels – Josh Yukich, Tulane University

The scale up in ITN coverage has been hugely successful despite some heterogeneity and a question over the sustainability of coverage. This analysis looked at the cost of providing continuous distribution through case studies of different strategies (school based, ANC/EPI and community-based); review and meta-analysis of existing data; and finally using those outcomes to carry out cost-effective comparisons. In terms of cost drivers, the distribution of costs has not changed much over time as LLINs remain the largest cost for mass or continuous distributions. Country contributions were much higher in continuous distribution systems compared to campaign delivery, around 15-40%. Taking a general view, it seems that continuous distribution costs may not be significantly higher than campaigns. Current information indicates that CD strategies can be effective at delivering nets. The next steps are to determine the additive costs, and what the relative cost-effectiveness of these approaches is in terms of public health impact in varied epidemiological settings.

Continuous Distribution Discussion - All

- It was queried whether areas left without nets in countries' GF prioritisation were low burden. It was responded that the gaps in coverage were in areas of high burden. Therefore, it is between these areas of high burden that prioritisation that decisions had to be made. However, it was emphasised that although prioritisation decisions were made at planning stages, these did not translate to implementation as the gaps in resources had been filled by the time of the campaign.
- The success in filling the funding gaps was not due to luck but down to a lot of hard work from countries and from within the RBM partnerships.
- All countries did prioritise ANC and EPI (infants and pregnant women) before moving onto targeted geographical distribution. There was no examination in the analysis of the added benefit in terms of presence of nets bringing more women into ANC.
- One of the primary obstacles to CD are stock-outs, where not enough nets are allocated to ANC. Distribution through both ANC and EPI are required to make good progress to universal coverage.
- This prioritisation analysis allowed the Global Fund guidance to be reviewed, although it was found that the situation varied so much from country to country that very detailed advice would not be appropriate.
- It was queried whether the costs of next generation nets have been examined. The expectation is that the cost per unit will be higher, so the question is whether the cost-effectiveness is enough to make that worthwhile. This has not really been scrutinised in detail yet, specifically with regards to next generation nets. However, the overall cost estimates are very sensitive to the unit cost of nets when this is varied in sensitivity analyses.
- It was asked whether CD or campaigns was more effective in rolling out nets. Although both approaches have advantages, the big difference between them came from the level of investment from the country which was much higher in CD. The effectiveness was not looked it in this study, other data does suggest that CD is better at sustaining coverage.
- The broader costs/benefits of campaign versus continuous distribution were not considered e.g. the cost to the health system of campaigns diverting resources; broader health system strengthening benefits of integrated delivery of nets through routine services.

LLIN Durability Assessments: What we've learned and what's next? Evidence-based results from 8 countries – Laura Norris, PMI/USAID and Olivier Briet, Swiss TPH

This review by PMI brings together durability monitoring data from 21,000 LLINs across 37 sites in 8 countries. Methodologies were varied, all were prospective rather than retrospective, but both cross-sectional and longitudinal studies were included, as well as differing levels of randomisation in the selection of nets, and different household survey tools, lab and field hole counting and categorisation.

Key findings:

- Net attrition varied widely between countries.
- Net durability was very similar across brands, with high variation within and between countries.
- There were large disparities between lab and field categorisation of holes.
- In terms of bio-efficacy, there were large differences between countries for the same brands.
- The total AI measured by GC or HPLC was again more variable by country rather than by brand. Most came out below target, although this might be due to late sampling.
- Comparing bio-efficacy and AI by brand showed very little correlation at lower doses, although there is better agreement at high doses.
- Questionnaire data showed that damage and destruction was not the main cause of net loss. Other major reasons included movement to another location, or nets that were stolen or sold.
- Nets that have a long survival because they are stored away do not provide any malaria protection, whereas a net that is used frequently, but is then discarded due to damage, has actually provided more malaria protection.

ABCDR Study – Functional survival and methodologies for bio-efficacy testing – Sarah Moore, Swiss TPH and Ifakara Health Institute

The ABCDR study examined 3,420 households in 8 districts in Tanzania to reflect the range of epidemiological settings found in the country. The blinded study is powered to look at attrition, physical degradation, bio-efficacy and chemical content of Olyset, PermaNet 2.0 and NetProtect nets over 3 years. After 3 years, 32% of nets were 'unserviceable' by WHO definitions according to proportionate hole index. One net brand (data currently blinded, but should be presented at the end of the year) performed less well, mostly down to the difference in pHI (median pHI double that of the other two brands). Work is currently underway to look at the impact of hole location as well as hole size on mosquito entry. In addition, data is being examined to see at what point householders discard a net because it is 'too holed' to use, and whether this corresponds to mosquito penetration. Government universal LLIN distribution has reached 80% of households in the study sites within the past 12 months, but many new nets are being stored rather than used, and the point at which a switch is made to a new net is also being examined. Qualitative work is also ongoing on net care and repair.

Durability Monitoring of LLINs Discussion – All

- The hole size assessment is definitely variable, which is to be expected particularly between lab and field data. But when this is translated into categories (good, damaged and too torn), then nets tend to fall into the same category regardless of who or how the hole assessment has been done.

- It was queried whether any of the sample sizes in the studies included in the PMI review were large enough to look at intra-country variability. Some are big enough, although this has not yet been looked at.
- It was also queried whether it was clear from the PMI review which brand was the best performer in the field. The data was too confounded to make any clear recommendation and it is clear that any such data needs to be collected in each country due to the significant between-country variations in durability of the same net brand.
- The non-use of nets seems to be a huge problem, and deserves greater attention. This has implications for the cost effectiveness.
- It was noted that the target dose for new LLINs is some amount of g/kg or mg/m2, +/- 25%, and that these tolerance limits are built into the specifications. ITNs are not expected to retain initial doses of insecticide over their entire lifetime. Therefore, measuring levels of AI in older nets with an expectation that it should be the same as the levels in a new net is not appropriate or useful.
- More detailed information on net size, shape and colour should be gathered and more attention paid to the community preferences in order to increase net usage.

I2I Update – Angus Spiers, Innovation to Impact

An update on Innovation to Impact (I2I) was given. I2I is a process initiated to look at the bottlenecks in getting new vector control products through to getting a WHO recommendation. Three key issues were identified; the disincentives for innovation in the current system; improving efficiency of the evaluation process; and putting in place some quality control process. A number of work streams have helped achieve these goals, including in Good Laboratory Practices (GLP) accreditation, industry engagement, country-level impact and procurement plans. This has led to enhanced or accelerated processes in Vector Control Advisory Group (VCAG) evaluation of new tools, guidance on dossier requirements, Pre-Qualification (PQ) led dossier assessment, and normative guidance from WHO Neglected Tropical Diseases (NTD) and Global Malaria Programme (GMP), as well as new data generation through GLP sites, manufacturing site inspections, post-marketing quality management and collaborative registration with national regulatory authorities.

The road to standardized quality control for LLIN – Stuart Turner, Quality Inspection Unit, UNICEF

Quality assurance (QA) is process driven during manufacturing, whereas quality control (QC) looks at the outcome product of these processes. QA is an assessment of the social aspects (such as pay and conditions, child labour), a factory tour (health and safety, fire safety, environmental issues) and the application of QMS (ISO 9001:2008). The QC checks whether the product meets chemical and mechanical standards, container stuffing, etc. A standard pre-delivery inspection (PDI) process was initially a response to differing results of inspections within UNICEF, but was rolled out to other agencies (including Global Fund, PMI, PSI) and in October 2016 the WHO Vector Control Products Quality Assurance Group agreed to formally move forward with a standard PDI approach. Although the process is standardised, the decision on the outcome of these tests is with the procuring agency. Next steps include adapting new QA processes for new ISO 9001:2015, which are the International Standard covering quality management systems.

Regulatory Processes Discussion – All

- Comment that I2I has helped fill a gap on the manufacturers' side. On the buyer's side, there remains a gap where decision-making is very difficult without data being gathered and assessed in the same way by the same agencies. Who guides country decisions on which PQ approved net to use?

- The new system will not fix the problems associated with transport and storage, as at present there is little data on the problems that occur.
- With next generation nets, informed procurement will need better data than is presently available.

Work Plan and Next Steps – Hannah Koenker and Lucy Paintain

1. Host conference calls to keep updated on ongoing work.
2. Look at net use by season – so surveys in December can be scaled to predict net use in July – challenged as an activity for this work stream.
3. How do we take net use into account when assessing net durability?
4. Every country should collect its own durability data.
5. Provide a platform for information exchange – what data are missing, who can provide the data or the networks.
6. Next generation nets & PQ process transitions: help prioritise and focus attention on key issues.
7. Look at scenarios of continuing universal net coverage with next generation nets. What are some of the likely scenarios for need for new products identify the likely funding gaps and how they could be bridged.
8. Better comparison between brands could help stimulate competition on pricing and would help decision makers in charge of net procurement.

Day 2: Thursday 9th February 2017

2nd IRS IRM Priorities Work Stream meeting
08:30-11:30, Thursday 9th February 2017
Co-leaders: Mark Hoppé & Dereje Dengela

Welcome and introduction – Mark Hoppé, Syngenta

Mark Hoppé opened the meeting and passed on apologies for absence from Dereje Dengela.

Spatiotemporal patterns of Insecticide Resistance – Mike Coleman, Liverpool School of Tropical Medicine and Malaria Atlas Project

The aim of MAP-IR is to produce regional risk maps of insecticide resistance; investigate drivers of selection and generate estimates of variation in resistance. Key findings of this exercise included that observation that clusters of resistance may correlate better to clusters of entomologists rather than where resistance is occurring. Publication bias was also evident, with large reporting on KDR a few years ago, but very little today despite the fact that KDR is still present in mosquito populations. Previous resistance data was stratified by species, however it was suggested that different categories such as behavioural profiles be used instead. Further work is planned to attempt to make data available and usable, and also to generate more data for *Aedes aegypti.*

Discussion

- It was asked whether country offices could be approached to see if some of the missing data does already exist. Some country office data have already been used, although there is some resistance to data sharing.

- It was asked whether the standard IR tests using 3-5 day old mosquitoes is appropriate, given these are unable to transmit malaria. Resistance testing protocols have continually changed (which has made the modelling quite complicated), but this project is not aiming to drive programme change.
- A comment was made that all data should be submitted to the WHO offices, even if it is being collected primarily for research. This enables data to be collated. It was remarked that MAP-IR has received data from offices, and has cleaned and geo-referenced it before feeding back.

Update on the Worldwide Insecticide resistance Network – Florence Fouque, WHO The Special Programme for Research and Training in Tropical Diseases

Worldwide Insecticide Resistance Network (WIN) was set up in 2015 to (1) identify areas where resistance challenges vector control and where resistance is under-reported, (2) fill knowledge gaps on insecticide resistance in arbovirus vectors through commissioned reviews, and participate to the discussion on research priorities, and (3) assist national authorities in decision-making for insecticide resistance management and deployment of alternative control tools. A workshop was held in Brazil in December 2016 attracting 160 participants from 30 countries, and also recorded 73,000 live web viewings. The first commissioned review on the "contemporary status of insecticide resistance in the major *Aedes* vectors of arboviruses infecting humans" is planned to be published in June 2017. Other reviews are planned on (1) global trends in the use of public health and agriculture pesticides and impact on insecticide resistance in mosquito vectors, (2) insecticide resistance management strategies applicable to mosquito vectors, (3) alternative methods for the control of mosquito vectors, and (4) defining the global framework for the development of an international consortium for monitoring and management of insecticide resistance in mosquito vectors.

Discussion

- It was asked how can WHO engage the private pest control sector, as this sector carry out a lot of *Aedes* control. Although it is not a TDR task to engage with the private sector, WIN has already successful reached out to these groups as evidenced by the workshop in Brazil. It was remarked that WIN has not yet engaged with the agricultural sector.

Implications of insecticide resistance for malaria vector control: outcomes from a WHO-coordinated multi-country evaluation – Tessa Knox, GMP, WHO

There is a lack of evidence of a link between insecticide resistance and any reduction in the effectiveness of malaria interventions (ITNs and IRS). Studies examine this questions were completed in Africa, and are ongoing in India. More information on the methods is available at Kleinschmidt et al. *Malaria Journal.* 2015; 14:282. The findings suggest those using nets had a reduced malaria prevalence and clinical incidence of malaria, but there was no evidence of a relationship with insecticide resistance. In Sudan, there was no observed benefit to sleeping under a LLIN, but a switch from pyrethroid IRS to a non-pyrethroid spray was associated with a halving of the risk of malaria. Limitations of the work include the standard resistance indicator (WHO tubes); a lack of information on species composition and behaviour; and typical rather than worst-case background resistance levels. The implications of this research are that universal coverage with LLINs is essential; but even with high coverage transmission is likely to continue and new tools and strategies are required. Countries are urged to develop IR management plans. Further information is available from full presentations from 65th ASTMH in Atlanta: videos on MESA knowledge hub.

Discussion

- It was stressed that there is no room for complacency, net still appear to work here, but none of the sites had really high levels of resistance, and we have no data about what would happen in this setting.

Exploring the epidemiological impact of insecticide resistance – Matt Thomas, Penn State University

A series of experiments was presented exploring the effect of normal exposure to a LLIN on resistant mosquitoes. Free flight tests were carried out with a person under a LLIN, which showed very high (80-90%) mortality from a 1 hour exposure, despite cone tests on these strains giving very low levels of mortality. It was also found that sub-lethal insecticide exposure reduced feeding by up to half, and also reduced response to the host for at least an hour. Field studies with strains showing 1700x resistance, found increased exit, mortality and a reduction in blood-feeding compared to untreated nets. When these finding are incorporated into a plot of mortality vs. feeding across different levels of ITN coverage, it suggests that with 80% coverage, and only 40% mortality, a reduction in malaria transmission is still possible, with feeding impairment, 20% mortality can still result in control. This may explain why insecticide resistance has not transferred directly into a detectable change in malaria transmission. It should be noted that the impact of resistance is very sensitive to coverage, and as resistance increases, these findings suggest control failure will accelerate, possibly reach a tipping point, particularly in areas of low LLIN coverage.

Evidence based IRM – John Vontas, Agricultural University of Athens & Institute Molecular Biology Biotechnology/FORTH

A number of parallels between insecticide resistance in agricultural and public health were highlighted. Resistance molecular assays are sophisticated and a full suite can be very expensive ($15-20 per mosquito), however they provide potentially valuable information. So although there is a temptation to rely solely on bioassays, molecular tools can be highly useful if used in conjunction with the bioassays. Molecular diagnostics can detect underlying mechanisms: an important evidence for IRM. The choice between carrying out molecular assays on individuals or pooled samples was addressed and it was reported that quantitative assays on pooled mosquitoes can give operationally relevant data.

The impact of IRS on malaria control in India – RS Sharma, former Scientist/Additional Director at HOD, Centre for Medical Entomology & Vector management, India

A history of IRS India was given, starting in 1953. It became a responsive programme following spike in malaria 1976. IRS is largely carried out in rural areas only (66 million people), which does not target the urban vector *An. stephensi*. Activities also include insecticide resistance status monitoring for many species for three classes of insecticides. This is used to inform the IRS microplan, to rotate insecticides to areas of susceptibility. Malaria is declining in all districts from 2006 to 2013.

Discussion

- It was reported that many African IRS projects have made progress using GIS (e.g. MSPRAY). It was reported that India is also following this, with for example, volunteer health workers giving mobile updates on malaria cases.

NgenIRS project update – David McGuire, IVCC

The NgenIRS project aims to increase uptake of third generation IRS, by increasing demand through short term co-payment (2/3 cost); improving market forecast and decreasing market volatility. It is a global partnership between the manufacturers (at present Syngenta only, but at least two more

expected) and 12 African countries. The number of countries taking part tripled between 2016 and 2017. $5.8 million spent in co-payment, allowing an extra 2 million people to be protected by 3GIRS. In some countries, the co-payment allowed conversion from carbamates to 3GIRS, and others it resulted in expansion of IRS. All targets were met or exceeded. Challenges: 3GIRS is much more expensive, and there is a concern of resistance especially where Actellic has been used for 5+ years. Only currently 1 product and 1 partner, timing of expansion is uncertain. At present there is a larger demand for the project than can be afforded with insufficient funds for co-payment. In 2017, an additional 6.5 million people will be protected compared to 2016 which requires $11.3 million in co-payments.

IRM MOOC – proposal for the creation of an IRM training course – Mark Hoppé, Syngenta

There have been repeated calls for more training on IRM, right from the top down to practitioners. GPIRM is the main resource at present. However, IRM is an applied science and there is need to translate theory into practice. The target audience would be very large and geographically disperse, from net distributors through to decision makers, logisticians, financiers, monitors and students taking these roles in the future. An online approach would be suitable. MOOCs (Massive Open Online Courses) aim to deliver education to an unlimited audience and provide educational opportunity to those without formal education. Last year 58 million people attended over 7000 MOOCs. The proposal is to set up an IRM MOOC, open and delivered free, lasting 10-12 hours, 3-4 weeks, delivered in an engaging multi-media approach, with facility for interaction between participants in a moderated forum. Learning outcomes would be an understanding on IRM theory and practice. It is hoped that leading experts will be involved and the course will be endorsed by the wider vector control community (although no endorsement by industry or one academic organisation). The FutureLearn platform is likely to be used. Once produced, the material can be used probably for 3-4 years before a major revision is used. The next steps will be to first identify a core team, then a steering committee to ensure the scientific integrity of the course. Resources will also need to be identified, including funding. A syllabus will need to be generated, probably using GPIRM as a basis. Then a producer will need to be appointed, the course produced, approved and delivered. Mark Hoppé requested confirmation from the work stream on the willingness of key institutes to endorse and promote the MOOC (particularly to key target audience), availability of funding; and any potential legal or intellectual property issues to be flagged.

Discussion

- It was noted that the LSTM serious game has many overlaps with this, and it may be possible to tie in, maybe by encouraging students to play at the beginning and end of the MOOC.
- It was asked if certification and testing was part of the platform. The FutureLearn platform does allow certification, but students might have to pay for this. Although it is hoped that the target audience would be provided with a certificate of course completion free of charge.
- It was asked what might be available in French, Spanish or Portuguese, and noted that Coursera offer different language courses. Coursera were investigated as a potential platform, but were rejected as they have a much more commercial attitude and students would have to pay for the MOOC.
- Janet Hemmingway offered help and also suggested refinement through a small group first before large scale release.

Open Discussion/idea generation, "how can we practically implement the GIPRM?" - All

- Idea of an IRS newsletter was put forward, where presentations, publications could be highlighted to the rest of the work stream.
- A query was made about the impact of aged nets on insecticide resistance. That has not been explored formally yet, but it is possible that you would move more quickly to control failure, so epidemiological consequences might increase with aging. So it is possible that a more frequent switch may be required. It was suggested that wash resistance data may be an interesting addition to the model.
- It was asked whether Matt Thomas's results could be extrapolated to IRS. For example, in monitoring programmes, a switch is made at a 90% threshold, should that be reduced? It was acknowledged that this is a very important discussion to have, but at present we don't have a full understanding of what the best strategy might be. With IRS, the main difference is that there is a blood feed followed by exposure, rather than exposure followed by a blood feed. So you would expect much less effect on feeding inhibition form IRS, therefore IRS is likely to be more sensitive to resistance.
- It was remarked that resistance management should start before resistance occurs, the 1000 genomes project, which has now sequenced ca. 3000 Anopheles, shows that resistance mechanisms may already be present in *An. gambiae* populations. So the strategy should be to get multiple modes of action out at once, rather than in sequence.

7th Larval Source Management Work Stream meeting
08:30-11:30, Thursday 9th February 2017
Co-leaders: Ulrike Fillinger and Silas Majambere

Welcome and introduction of agenda – Silas Majambere, Innovative Vector Control Consortium

The LSM work stream aims to update the evidence base and protocols for LSM, and to assess and help develop local capacity to integrate LSM into existing vector control where appropriate. The objectives of the meeting were to (1) review the draft work plan, (2) discuss and agree to the projects, (3) identify how the projects can be put into action, (4) identify key contacts, networks and volunteers to implement the activities and, (5) to identify sources of funding. Projects in the draft work plan are:

A. Advocating for environmental management including habitat modification and manipulation and inter-sectoral collaboration as priority intervention in LSM.
B. Review of all available larvicides/pupicides/surface films for control of immature mosquitoes.
C. Review and recommendations of using state of the art technology for LSM.
D. Reviewing operational LSM in vector control programmes.

Brief overview of the history of the LSM work stream – Steve Lindsay, Durham University

LSM is the bedrock of mosquito control in parts of Europe and USA, and has proved effective in the past. However, there were demands for evidence of effect before advocating its use in disease-endemic countries. A Cochrane review (September 2013) found up to 75-90% reduction in incidence in appropriate settings. Further evidence is still needed to evaluate the feasibility of LSM in rural Africa where larval habitats are more extensive. A WHO larval source management operational

manual was produced in July 2013, advocating its use alongside conventional LLIN and IRS tools. Advocacy was also carried out with a series of talks at a RBM-sponsored LSM Symposium at MIM. LSM needs multi-sectoral collaboration and action to reach a wider audience.

The potential of larval control in malaria elimination – Moh Seng Chang, University Malaysia Sarawak

LSM can be used in the pre-elimination phase as a supplementary tool to reduce vectorial capacity, in the elimination phase; LSM can be targeted at malaria foci to prevent re-establishment of transmission. Larval control is an opportunity for community participation in elimination efforts. Malaria elimination in Vanuatu focused on the five southern Islands, this case study looked at LSM in elimination efforts in one of these islands, Tanna. There is only one local malaria vector, *Anopheles farauti*, which breeds in brackish water usually confined to <0.5km from the coast. LSM was carried out in the dry season when the mosquito population was already low as well as the wet season. Larvicide treatments were carried out every 3 months and man-made breeding sites were targeted by community efforts.

Discussion of LSM in malaria elimination context – All

- A comment was made that the current interim statement on larval control that talks about "few, fixed and findable" breeding sites discourages countries from carrying out LSM. A review of this is urgently required. A strong statement from WHO RBM advocating LSM is needed in order to generate funding and push the adoption of LSM by more control programmes, and in particular elimination programmes. One approach would be to tackle the cost-effectiveness of LSM. In addition, the GCDPP 2014 statement recommends LSM. The work stream could produce a consensus statement that is put forward for approval. [Assigned to Jacob Williams and Steve Lindsay].
- It was asked how the work stream could help the implementation of LSM in countries that want to use LSM. Support is needed to help countries justify the use and scale up of LSM; this can include health benefits outside malaria.
- Resistance management needs to be built into all approaches of LSM, and we need to get away from the idea of LSM being equated with larviciding and push the environmental management side as well.

Environmental management for malaria control. Engineering approaches to larval source management – Ulrike Fillinger, International Centre of Insect Physiology and Ecology, Kenya and William Jobin, Consultant

The African Development Bank is planning to invest $24 billion by 2025 on water resource development. These projects will be required to include vector control in their design and implementation. There are proven LSM methods for the design and operation of dams and reservoirs. These include water level fluctuations, water flushing, ground levelling, steep banks, self-draining structures, clearing ditched. Contact reduction can be addressed by thinking about the location and design of human settlements. Intra-ministry boards can be formed to borrow funds for these projects so that vector control can be included.

Discussion and approval of project A in LSM work plan (Advocating for environmental management – Ulrike Fillinger and All

- It was queried whether the cost-benefit analyses for these dams and in particular the addition of vector control to these projects have been carried out yet and whether the data could be mined and used to build an evidence base for LSM. That data may not have been

collected or available, but we should make contact with Dr Mubarack Diop at the AfDB in order to explore this. [To action Eve Worrall].

- It was suggested that case studies are gathered of how engineering LSM solutions have helped in the reduction of disease transmission.
- It was queried whether DRC is included in these projects and whether the transport sectors have been included in areas where rivers are used for navigation. DRC projects were confirmed.
- A number of HEP projects were set up along the Mekong, and a lot of thought was often given to environmental management, but there was a missed opportunity to consider the resettlement programmes and LSM that can be carried out in those locations. This work stream should link up with the HEP companies to ensure this is not missed again.
- There is a need for smaller engineering project as well as these large civil projects.

Presentation, discussion and approval of projects B and C in LSM work plan (Review of larvicides, review on modern LSM strategies) – Silas Majambere, Innovative Vector Control Consortium and All

- An action point was suggested to review the larval control methods that are available and how these should be chosen for control programmes. The group need to remain independent of any particular brands. The European, American and Australian Mosquito Control Associations carry out a lot of LSM, and may be able to contribute knowledge and on-the-ground experience. A lot of the information is already available in WHOPES reports, but it seems that it will be useful to bring together all the information in one place. Brand names are not necessary for this, although registration information by country would be helpful. It was suggested that the work stream could provide guidance on how countries can evaluate LSM methods for themselves. Reference standards for resistance should also be included [Volunteers: Peter DeChant, Norbert Becker].
- An action point was suggested to review new technologies used in LSM (such as GIS, drones). A brief description of a small-scale project in Zanzibar was given. It is important to note that drone work may in the future require certifications or licences and timescales for these needs to be worked into projects.

Reviewing operational LSM in vector control programmes - Eve Worrall, Liverpool School of Tropical Medicine, Ruth Du Plessis, Liverpool School of Tropical Medicine

The number of countries reporting the use of LSM appears to be increasing. Randomised controlled trial evidence of effectiveness can generate policy adoption, but the gap between policy adoption and implementation is funding. Donor funding is already stretched by LLINs, so funding often comes from national governments and the private sector. However, these funding streams do not demand the level of monitoring and evaluation.

A scoping exercise was carried out in five countries who already report having adopted LSM. The Ministry of Health policy documents and reports, and GF reports were reviewed. Targeted environmental management (small scale) was the most widely used approach, followed by larviciding and larvivorous fish. The drivers for using LSM were insecticide resistance, water sanitation and successful pilot projects. Where specific funding was allocated to LSM, this came from government sources.

The next steps will be to review policy and funding of other countries and widen the search strategies to other funders. In addition efforts will be made to obtain missing data.

Presentation, discussion and approval of project D in LSM work plan (Reviewing operational LSM in vector control programs) – All

- An action point was suggested to help build the evidence base further, by providing guidance on how to quantify the impact of LSM through an M&E framework.
- Lobby WHO to add more questions and collect more data regarding LSM as at present it seems largely ignored.
- Ask donors to broaden monitoring and evaluation to include larviciding.
- A request was made to help countries to build capacity for LSM; the cost of the product is often low compared to the implementation costs. Following on, a request was made to track where the money that was spent on larviciding actual went. Where money flows back into the communities, funding may be more forthcoming. Getting access to this data may prove difficult.
- A request was made that the work stream makes a guideline to help harmonisation of data collection between donors.
- An action point was made for the work stream to produce a document for the guidance and advocacy of larviciding in emergencies [Action: Alice Cowley, MENTOR Initiative].

Session 2: Feedback from the work stream meetings and discussions

Chairperson: Jacob Williams

IVM Evidence and Capacity Work Stream - Co-chairs: Josiane Etang & Michael Macdonald

The mandate of this work stream is to generate and share evidence to promote effective delivery and integration of malaria vector control interventions and support related country capacity strengthening. Five projects were proposed during the meeting and the work plans discussed.

1. Capacity building

Update directory of entomology and vector control training institutions, programs and resources. GMP & TDR are building a directory of institutions and facilities providing vector control training at all levels. This is aimed at practical field entomology and vector control. This work stream can contribute by helping develop a survey instrument ready for March 2017, and through subsequent dissemination via VCWG networks and partners, including the training programs offered by Industry for their specific vector control products. The work stream will collate and link with the GVCR Needs Assessment in time for the GVCR launch at the WHA.

2. Support roll-out of Global Vector Control Response

WHO anticipates that the GVCR will be endorsed by the World Health Assembly in May 2017. Contributions to the GVCR are intended to focus on capacity-building and vector control including *Aedes* control activities. First, technical support can be provided in the national vector control strategic plan development process, including business plan development, for aligning national and regional vector control strategic plans with the GVCR. In addition, it is expected that the VCWG will participate in the vector control needs assessment. In order to support the national and regional

institutional networks to support training, the work stream will seek funding for exchange programmes; promote stronger linkages with AMCA; facilitate spray equipment and insecticide manufacturers to provide training to ensure quality implementation; and to capitalise on established networks (Vector Control working groups in regions, E8, ALMA and APLMA). Technical input will be provided for basic and applied research on entomology and vector control. Expertise will be provided for state-of-the-art integrated entomological surveillance systems to help strengthen national vector surveillance systems for both malaria and *Aedes*-borne diseases.

3. AFRO/ANVR insecticide resistance

Five activities are scheduled or ongoing, these are to (1) Devise a formal process for linking national training/research institutions to vector borne disease control programs in order to facilitate capacity building; (2) Identify and fill human and infrastructure capacity gaps; (3) Reinforce the training capacities of research institutions; (4) Organize insecticide resistance management hands-on training sessions for vector borne disease control programs and other staff; and (5) Coordinate the mobilization of resources for insecticide resistance management.

Three new activities were proposed: (1) Work with Swiss Tropical Institute/Swiss Development Cooperation to support the development of a global capacity building platform in collaboration with WHO/ GMP; (2) Contact AMCA, industry associations and agricultural sector to request support for insecticide resistance management training courses; and (3) Work with academics and member countries to establish insecticide management training programs in universities.

A link will be made with the IRS IRM work stream plans for training.

Timelines, milestone, people responsible and budgets will be set up within the next month in order to guide progress over the next year.

4. Share best practices for entomological monitoring and outdoor/residual transmission across regions - Dr Christina Rundi, APMEN Vector Control Working Group

There are many common issues between APMEN and the RBM VCWG. Closer communication, possibly through on-line video conferences among key members, should be arranged.

There are three APMEN working groups that may be able to share research goals: the vector control working group, *vivax* working group, and the surveillance and response working group. APMEN is working on capacity building to address outdoor/residual transmission and vector control methods for mobile populations as well as insecticide resistance. IVM training has been supported, but additional funding, technical support and mentoring is needed for trainees after they return to their workplaces. Areas of potential collaboration with the RBM VCWG include:

- Strengthen vector biology research and tool development through exchange of best practices and coordinated research agenda.
- Enhanced integration of anthropological approaches, community participation and engagement for vector control as well as more effort to link epidemiology and entomology together in elimination efforts.
- Enhance access to necessary tools and capacity through information exchange and coordinated programming.
- IVM Training: At present the Malaysia Ministry of Health provides some funding for IVM training, but more resources are required, especially to support trainee activities after they return to their workplaces. Sumitomo also provides financial support for the training. There have been vector research grants and co-support with WHO WPRO for training workshops in

vector control for elimination. Better collaboration is possible through allowing Fellows to be attached to institutions and linked with research projects. APMEN has also supported the publication of a pocketbook developed by AFRIMS for the morphological field identification of common vectors in the region. There have also been APMEN case studies and country briefings and an atlas.

- There are opportunities to address market and regulatory challenges through improved communication with regulators and industry, more market intelligence, and innovative market solutions. APMEN recognizes the importance of Industry dialogue and has traditionally invited the private sector to workshops.
- There are many individual country and programme investments in GIS, remote sending and hazard mapping both within and outside the health sector that could be coordinated and strengthened.

5. Vector Control in Humanitarian Emergencies – Richard Allan (MENTOR)

Actions to move forward centre around the interagency working group of Health/Shelter/WASH organisations who work in humanitarian crises. These actions include: (1) expansion and improved use of standard vector control tools (IRS, LLINs, LSM), including technical support for implementation, evaluation and result dissemination; (2) improved learning around existing supplementary vector control tools for humanitarian crises (ITPS, treated blankets, etc.), including standardized evaluation SOPs, collation and dissemination to regulatory bodies and procurement agencies; and (3) provision of field platforms for evaluation of new tools and strategies, including collaboration with Industry and Product Development Consortia, academic operational research partners, WHO and regulatory authorities.

There is a need to standardise the way vector control tools are used and to make rational decisions of which are most appropriate tools for a particular context. There is a need for an evidence base for operational feasibility, use and impact. This working group can help the development of WHO vector control guidelines to ensure humanitarian emergencies are included, and to work with manufacturers to share information on the use of their existing products in the field and testing protocols for new products under development.

Products developed for humanitarian emergencies may also benefit the market for residual/outdoor protection those exposed to vectors and sleeping or working in situations where traditional LLINs, IRS or LSM may not be sufficient or may not be practical. There are opportunities for the two sectors, those working on humanitarian emergencies and those working on outdoor transmission, can collaborate.

An action point was suggested for a summary of evidence for vector control in Humanitarian Emergencies be produced. A forum such as VCWG is a place where informed practice can be formalised from the research data.

This part of the meeting closed with a request that participants interested in any of the five projects proposed in the IVM E&C works stream contact the principals to finalize the activities and help push the agenda forward.

LLIN Priorities Work Stream - Co-chairs: Hannah Koenker & Lucy Paintain

The goal of this work stream is to maintain high levels of ownership and use of serviceable LLINs in endemic countries by focusing on (i) distribution approaches, (ii) LLIN durability and (iii) next generation nets. The presentations were summarised and the questions that were discussed were highlighted.

- Ongoing Questions from Previous Years
    - The impact of net preference on ITN use? In SSA there appears to be no programmatic effect of preferences on use, which has implications for procurement.
      Discussion
      Net preferences are not being accommodated. Can the work stream find a small piece of work on ways of facilitating between manufacturers and consumers? A paper will be presented at VCTEG, and also submitted for peer-review and publication.
    - The cost/value of sustaining ITN access over time vs. dropping between repeated campaigns. Much discussion around distribution decisions. How are existing nets in houses taken into account in successive campaigns when households may accumulate nets, storing new ones for later use?
    - What is the impact of location of net holes on overall durability; impact of durability on ITN retention and use (or vice versa), and what drives household decisions to switch to a new net?
    - Deployment of next-generation nets – monitoring and evaluation requirements.
    - Insecticide resistance is a common issue across work streams, but it is everyone's challenge.
- LLIN Distribution
    - Implications of net cost for continuous distribution – how many NGN would be needed in various scenarios? How many needed for wholesale replacement? How many for targeting/mosaic?
    - If richer quintiles have low malaria risk and are buying untreated nets, is that a bad thing? Do we need to reach them with free ITNs?
    - If countries increase continuous distribution between campaigns to maintain coverage, then at successive campaigns, there will be more existing nets. Are these accounted for? Ignored? New ITNs stored by households until they are needed? Implications of storage for ITN durability/bio-efficacy? Move to fully continuous strategy?
- Communication
    - There is a need for working group to focus on key issues during and after pre-qualification transition process.
    - Will LLIN durability monitoring and post-spray monitoring feed into post-marketing surveillance and PQ process? If so, how?
    - All LLINs used to be the same, but this is changing. There is a need for clarity on which are most appropriate in different settings.
      Discussion
      It was suggested that additional swatches from the roof of LLINs be taken when

conducting bio-efficacy analyses and chemical content testing, as this is more relevant to mosquito exposure to the nets.
It was queried whether low net durability countries correlate with areas where nets are lost at a higher rate.

- Targets and Target Setting
  - Reaching 80% of households with 1 ITN for 2 people is 'unreachable', 62% seems to be max immediately after a strong universal coverage campaign. So should target be lowered and to what level?
  - How to measure community effect.
  - Look for places where LLIN access is low – how has transmission been impacted?
  - Seasonal ITN use in Senegal 2014-2015 – use of nets amongst those with access was lower in dry season, but very high by late rainy season.
  - What is the impact of reduced use in the low transmission season, if any?
    Discussion
    The 80% figure is from modelling, and country programmes who do not reach this level should know it is probably not a disaster. It may be that imperfect coverage is what is protecting nets from more widespread insecticide resistance.
- MERG question for VCWG
  - Dipping and retreating dropped from standard Malaria Indicator Survey questionnaire, so there is now no difference between ITN and LLIN. MERG is proposing to drop LLIN category, so only reporting on ITN and other.
  - Brand data will still be collected to allow additional analysis.
    Discussion
    Support for "LLINs" as this acronym is already known. Support for ITNs as this is a more flexible name and is closer to the description of the product and future products. Consensus with "ITNs".
    Suggested that the question about source might as well be dropped as responses are not useful. Response to maintain the question but ensure that response options are standardized to be useful across countries. Request to add a question to pregnant women section specifically whether they received a net during their pregnancy. That question should be useful for distinguishing between nets from public and private sector.

Action Plan

- Conduit for issues arising and being flagged for action/research by partners.
- Report back to partnership on progress.
- Small(ish) doable actions in the next 12 months.
- HK and LP will transform discussion into a Work Plan.

Housing and Malaria Work Stream - Co-Chairs: Steve Lindsay & Lucy Tusting

A recap of work in progress was given, including: (1) a multi-country analysis of housing & malaria to be published in February 2017 in PLOS Medicine, (2) Roo*Pf*s study in The Gambia, (3) house construction in Namibia and (4) research on the importance of cross-ventilation, as well as relevant policy issues. The discussion of broadening the Work Stream from "malaria and housing" to "vector-borne disease and the built environment" was reported. An overview of Sustainable Development

Goal 11 was given and the need to engage with the urban development/housing sector highlighted. Multi-sectoral collaboration is critical for this Work Stream.

The Work Stream meeting discussion was structured around four areas: (i) strengthening links with the housing sector (covered above), (ii) updating housing and malaria recommendations, (iii) encouraging basic and applied research on vector-borne disease and the built environment and (iv) information exchange.

A draft work plan was presented based on the meeting and also outstanding items from last year.

1. Strengthen links with housing sector
    a. Application to UK BBSRC-MRC to develop a network of stakeholders in housing and vector-borne disease [Steve Lindsay, Lucy Tusting].
    b. Explore opportunities to present at housing meetings; identify existing housing networks; invite housing experts to the Work Stream.
    c. Link with manufacturers to explore potential for advocacy and intervention scale-up: (i) house screening product manufacturers [Sean Blaufuss] and (ii) solar power companies [Alex Hiscox].
    d. Scoping study of building companies/suppliers operating in sub-Saharan Africa [Steve Lindsay].
2. Support the development of housing and vector-borne disease recommendations
    a. Support the development of two new WHO documents: (i) WHO Housing and Health guidelines (to include vector-borne diseases) and (ii) WHO guidelines on malaria vector control (to include housing) [coordinate with Nathalie Roebbel, Christian Kraef and Martha Quinones].
    b. Explore the need for an updated RBM consensus or advocacy statement [Steve Lindsay and Lucy Tusting].
3. Encourage basic and applied research on vector-borne diseases and the built environment
    a. RBM members to identify potential collaborators in vector-borne diseases & the built environment [All, Martha Quinones].
    b. RBM members to develop & submit research initiatives on vector-borne diseases & the built environment [All].
4. Information exchange
    a. Circulate biannual update on housing and vector-borne disease.
    b. Share information through MalariaWorld [Matt Thomas].

Discussion

- An update was given on a Swiss Development Corporation grant to support the development of scoping work on multi-sectoral approaches to malaria and a new RBM working group on multi-sectoral approaches; a workshop is planned for June. This would ideally incorporate the work done by this Work Stream and allow the broadening of the scope of work.
- A deck of presentations could be created for Work Stream members to use if presenting to housing groups, to ensure a coordinated message on vector-borne disease.
- There might be opportunity to incorporate vector-borne disease considerations within low-cost house building ongoing in Ghana through discussions with the Ministry of Health.
- It was queried what exactly comprises the housing sector. The definition includes architects, city planners and construction companies.

- There are likely to be many country specific bye-laws that might be integrated into larger scale recommendations.
- The Work Stream could collaborate with engineers for disaster relief as they often build permanent facilities.

Day 3: Friday 10th February 2017

Keynote Presentation

Lessons learnt in malaria elimination in Sri Lanka - Devika Perera, Regional Malaria Officer, Sri Lanka

The presentation described the experience of achieving malaria elimination in Sri Lanka. The malaria transmission landscape presented a variety of vectors and breeding sites. Near eradication was reached in 1963. Challenges to eradication included non-immune migratory population, new vector breeding sites through irrigation, spread of chloroquine resistant plasmodium and temporary housing styles associated with slash and burn/ rice farming. In 1994, control strategies were introduced, including early detection, rapid treatment, selective and sustainable vector control using pyrethroids, larvivorous fish, flushing of canals, space spraying, and ITNs; epidemic forecasting; capacity building and operational research. In 1999, a RBM initiative was launched and a goal of eradication set in 2008, by 2011, cases had reduced by 99.9%. In the elimination phase, LLINs were introduced and IRS scaled back. Success factors included active case detection with full time microscopists and blood-slide verification, a national malaria database, ACTs only being available through the malaria campaign, follow up of patients, inter-sectoral cooperation, standardised SOPs and SOWs, regular training for clinicians (especially important when malaria became uncommon); chemo-prophylaxis for travellers and awareness campaigns. Entomological surveillance shows high preponderance of anopheles, so targeted control is used when a case is detected. Pyrethroid resistance has been detected, so future vector control needs to take this into account. The malaria control program in Sri Lanka proved the efficacy of a mosaic spraying with different insecticidal modes of action in the past.

Discussion (questions, answers and remarks)

- *Were there any agricultural changes in Sri Lanka coincident with the disappearance of malaria*? - There was a movement from slash and burn paddy farming to vegetable farming supported by irrigation.
- *How does the ministry of irrigation become engaged with project*? - Each ministry was shown how they contributed to the malaria burden, which created a high buy in from all ministries involved.
- *How big of an issue was outdoor transmission in Sri Lanka?* - The vector is mostly indoor biting and resting. Some behaviour change was observed, but most transmission seemed to remain indoors.

- *Is 1 LLIN per family sufficient for a family size of 5-6?* - The provision of nets was perhaps not sufficient to cover the whole population, but by ensuring every house had an LLIN the community effect was relied on.
- Blood examination rate is and remains high at 15%, this is through ACD in risk groups (travellers, pregnant mothers).
- *Was the decline in malaria associated with switch from thatch to tiled roofs?* - This is unknown, but there are several studies showing that improved housing has reduced both malaria and dengue.
- It was remarked that a malaria team is still needed to maintain elimination, and recruitment continues, as lessons from the 1960s show, a rapid response to imported cases is necessary.
- *Is there is any residual asymptomatic population?* - Two studies have been published using PCR analysis on samples from high risk areas, showing no evidence of asymptomatic cases. However, imported cases are often asymptomatic.
- *Did weather influence past epidemics?* - It has been found that vector breeding has changed, and mosquitoes have been moving up the hills to cooler areas. Therefore epidemics are still possible if detection is relaxed.
- It was remarked that there is a tailored response to imported cases in different groups, whether returning peacekeeping troops, tourists, labourers or asylum seekers.
- *Has there been a change in the mind-set in Sri Lanka now that malaria is eradicated?* - Dengue is still a huge problem, so vector control is still a high priority for Sri Lankans.
- *How did conflict impact on the programme planning and did the resolution of the conflict help movement to malaria elimination?* - The use of mobile clinics during the conflict was challenging, but also movement of soldiers helped spread malaria around the island. After peace in 2009, control efforts were much easier with increased access and security.
- *As there were a huge variety of activities, has each activity type been evaluated for its impact separately?* - Each intervention, was evaluated separately, but not necessarily on a strictly evidence based framework.
- *How was rotation of insecticides done within the mosaic spraying*? - Each of the three insecticides was used for three years and then rotated.

Feedback from the work stream meetings and discussions (cont.)

IRS IRM priorities work stream meeting - Co-chairs: Mark Hoppe & Dereje Dengela

Mark Hoppe gave apologies for absence from Dereje Dengela, and presented a summary of key points and actions. Presentations were given on: spatio-temporal risk mapping of IR; an update on WIN, a multi-country evaluation of IR and disease burden; the operational impact of IR; evidenced based IRM; IRS in India; and the NgenIRS project.

The work plan was presented with the main focus on a Massive Open Online Course (MOOC) on IRM. This is an attempt to turn the GPIRM into a more understandable and accessible resource for anyone with an interest in applied IRM. The target audience will be those who currently or in the future deliver IRM programmes. The course should be 10-12 hours over 3-4 weeks. The delivery date is expected for early 2018. In addition an IRS newsletter will be produced with space for IRS news, links to presentations and short practical information.

Discussion

- It was commented that the scope of GPIRM needs to be broadened with examples that capture lessons from agricultural IR management. This will be recommended for the MOOC's consideration.
- There was consensus that more varied vector data should be collected (including excito-repellency and feeding inhibition etc.) to help in the design of better programmes.
- It was commented that with the current tools, IRM is rather limited and the MOOC might be limited in practical information. There are more tools coming, and the MOOC will help prepare programme managers and practitioners for the arrival of these tools.

Larval Source Management Work Stream - Co-chairs: Ulrike Fillinger & Silas Majambere

Previous achievements, the Cochrane review and Operational Manual were highlighted. It was agreed that LSM is not just a malaria control tool, it has been used successfully already against other vectors and this stream should not focus solely on *Anopheles*. The draft work plan was reviewed, including volunteers to realise projects and some discussion of funding.

Work Plan

1. Draft a consensus statement as RBM VCWG work stream with the aim to change WHO position on LSM.
   Negotiate the language at global level, and remove statement of 'fixed, few and findable' which prevents countries from allocating (donor) funds for LSM; request position change to state that 'ground application of larvicides is not appropriate for larger flooded areas'. Statement needs to include updated information (LSM meta-analyses data, from Lucy Tusting; Labiofam Bti now WHOPES approved; opportunities of integrated mosquito-borne disease control; cite GPIRM recommendation to include LSM for resistance management.
   - To action: Chairs (draft, March 2017); Jacob Williams & Steve Lindsay (final draft May 2017).
2. Advocating for environmental management including habitat modification and manipulation and inter-sectoral collaboration as priority intervention in LSM.
   - To action: Ulrike Fillinger (to reach out to Public Health Engineers); Ulrike Fillinger, Bill Jobin, Robert Bos, Jacob Williams, Steve Lindsay, Eve Worrell (to develop a way forward for advocating EM and inter-sectoral collaborations for mosquito control).
3. Update and expand spread sheet of WHOPES approved larvicides as source of information; Compile SOPs on how to test larvicides how to test for resistance.
   - To action: TBA (Establish a database); Peter DeChant and Norbert Becker (Compile SOPs).
4. Review state of the art technology for LSM (GIS, satellite imagery, motorised application equipment, aerial application, drones).
   - To action: Silas Majambere (identify and contract reviewer, Feb-May 2017); TBR (produce review, June-Dec 2017).
5. Review operational LSM in vector control programmes – evidence of impact, and what training and support needs are there.
   - To action: Eve Worrell, Ruth (Identify which countries use LSM and identify research products that could increase evidence base., Jan-Jul 2017); A support letter from RBM and some finding would be desirable in order to reach out to country programmes.
   - To action: Eve Worrall (consult for LSM indicators to be reported to WHO, Feb-May.

- To action: Eve Worrall (estimate financial resources, Dec 2017-Feb 2018).
- To action: TBR (develop an assessment tool to see how countries monitor impact, 2018).
- To action: TBR (review evidence of impact of current national LSM programmes, 2018).
- To action: TBR (establish a list of LSM experts, Feb-May 2016).
- To action: TBR (increase visibility of LSM work stream, Jul-Dec 2017).
- To action: TBR (needs assessment for national programmes, Oct 2017-May 2018).
- To action: TBR (establish a training platform, 2018); first prepare a letter to AMCA to request help (Jacob Williams, Feb 2017).

6. Develop guidelines for LSM in emergency situations.
   - To action: Alice Cowley (needs assessment, Feb-June 2017).
   - To action: TBR (draft guidelines, July-Dec 2017).

Discussion

- It was remarked this was a good opportunity to review the WHO manuals 1 and 66. This will require linking up with engineering experts. Funding for this may be available from the BBSRC grant application if successful and from the SDC multi-sectoral fund.
- Indian manual on LSM and expertise on *Aedes* control was offered by Rajander Sharma.
- It was noted that offering lots of separate training courses can make it difficult for people to attend, so integrating LSM into existing curricula could be a good solution.
- It was suggested that a student could be contracted to write the review.
- It was commented that transport ministries have been overlooked before, but should be included in inter-sectoral cooperation.
- It was commented that better harnessing of the capacity that already exists (for example by Africa-led projects) would help develop capacity and coordinate efforts across the region.
- It was suggested that NGOs should also be approached for information on who is carrying out LSM on the ground (including the ALMA secretariat). There is an MSF meeting on 10 March 2017 in Barcelona for innovations in vector control and it would be good to get LSM on to the agenda.
- It was commented that private institutions carrying out LSM are another potential source of guidelines and data.
- It was suggested that a robust M&E framework be incorporated into revised guidelines so that some of the more observational and operational results can be incorporated into the evidence base. (Anne Wilson volunteered to lead on M&E aspect).
- It was noted that training was part of the discussion in two other work streams, so perhaps it would be appropriate for the chairs to come together and move together as a group to deal with these training needs.
- It was suggested that the lobbying for a specific budget within emergencies for vector control. Donors are often happy to fund conventional tools (LLINs and IRS), but getting donors to prioritise other activities like LSM is more difficult. A dedicated vector control budget might help the emergency response be more flexible.

New Challenges, New Tools in Vector Control Work Stream - Co-chairs: Michael Reddy & Fredros Okumu

A round up and highlights of the presentations was given alongside the discussion points that were raised during the meetings. These were the (1) Updates on expanding the vector control toolbox:

gaps and opportunities; (2) Everything you need to know about residual malaria transmission in 10 minutes; (3) *Anopheles* species identification: an old and continuing challenge; (4) Ivermectin for malaria elimination: 2016, a year of exponential growth; (5) Progress on a Randomised Controlled Trial for evaluation of Eave tubes; and (6) Updates on Spatial repellents for malaria elimination, Neil Lobo.

Discussion and Work Plan

1. Re-examine the definition of Residual Transmission

How should the definition of residual malaria transmission take insecticide resistance into account? Is the current WHO definition appropriate? Should we just call this "persistent malaria"?

- The definition assumes maximum coverage of major tools, so remaining transmission can be considered as residual. The existing definition says the mosquitoes must be susceptible to those tools. So RMT is very difficult to define in areas with high insecticide resistance. The only purpose of RMT is to have a practical tool to guide programmes. There can be a number of explanations for the transmission remaining after LLIN/IRS scale up. While insecticide resistance is one explanation, outdoor transmission is another, so it would be desirable to have a definition that did not exclude any possible cause behind RMT.
- It was pointed out that all the maps of RMT presented, were based on modelling. The resolution of these maps is too large to be of any use to country and district programme managers, and more fine scale data is required for these operatives.
- The definition is often not used well. The common definition is more simply, what is left after interventions have been implemented. The current WHO definition constrains many practitioners, so if it not useful, it might be changed. It was suggested that when the term is used, a definition is given as to what it means in that context.
- Proposal to use the term 'operational failure' this covers IR, and also problems with roll out of tools, or inappropriate use of tools.
- The current definition has a good handle on the problem. We need to facilitate a way for countries to decide whether they have residual transmission. WHO should be challenged to provide criteria that to arrive at the definition.
  - To action: Yousif Himeidan, Manuel Lluberas, Nakul Chitnis and Christian Lengeler.

2. Joint meeting for RMT partners to share findings from Africa and SE Asia

- Objection to the sponsoring of TDR as this would exclude private sector (product manufacturers). A solution might be to have the TDR meeting, immediately followed by another meeting. Clarification was given that WHO cannot sponsor private sector attendance, but they are welcome to attend open sessions of the meeting.
  - To action: Establish consensus about methodologies for measuring residual transmission.
  - To action: Examine the value of parasite surveys in residual transmission measures.
  - To action: Develop a consensus on new tools that can be used in residual transmission settings.
  - To action: Develop a consensus on how to assess RMT in migratory communities in SEA.

3. Identify examples of vector control tools that are amenable to learning-by-doing

- A plea was made not to neglect rigorous evidence collection. Meta-analysis of vector control too often shows how badly trials are often run and, it this approach runs the risk of generating more data that cannot be used to justify recommendations. We still need randomised controlled trials to show protection against disease. Learning by doing may be

more appropriate to country level M&E, post roll out. Some interventions (e.g. drainage) do not lend themselves to RCTs, so an approach like LBD may work here.

- The WHO is currently recommending some approaches that are yet to gain full robust evidence. But in order to give country managers some guidance, these were included. Although these were included now, we should still move on to provide that evidence.
- Clearest examples of LBD come from monitoring and evaluation evidence.
- Some tools have good evidence and are ready for use, but need further assessment in terms of field deployment. So here guidance can be given on the type of evidence that needs to be gathered.
  - To action: Allison Tatarsky, Pete Gething and Nakul Chitnis.

4. Update of current keys for mosquito identification

Planned work by Prof. Maureen Coetzee. In addition contributions / sharing of experiences on mosquito taxonomy and identification are requested, and sharing of sequence data and information on new species. Improved capacity for taxonomy and vector identification is required

- To action: Neil Lobo and Seth Irish.

The way forward for 2017

Chairperson: Jacob Williams & Gerhard Hesse

Action Plan

Work plans are being finalised using a common format. Consultation/collaboration between the co-leaders will be necessary to streamline activities and avoid duplication. All delegates were urged to contribute where they can. The co-chairs of the VCWG and the WS co-leaders will actively drive that process.

A new RBM Board and CEO have been appointed and communication and cooperation need to be strengthened now. Jacob Williams announced that he was beyond the second year of his co-leadership of the VCWG. The elaboration of new procedures linking the Work Groups to the RBM Secretariat (refer presentation by Mr Elhadj As Sy, Secretary General) includes adjustment and harmonized terms of reference for the working Groups. Elections for Jacob's position will be opened, once the terms of reference have been adjusted and approved by the new RBM Board.

Discussion

- A question was raised on how the discussions at VCWG are transformed into action as the working group does not have the same mandate as VCAG. In response, it was noted that an objective of the working group is to formulate recommendation and position statements on vector control that can be presented to WHO for consideration. This process has proved successful in the past. For examples, recent WHO publications and statements on larval source management largely originated from the VCWG. In addition, VCWG constituent partners are engaged in implementation at the regional and country levels. Consensus and shared experiences at VCWG level could and should facilitate technical support by constituent partners. The VCWG needs to be more pro-active in a constructive manner related to technical and strategic discussions with the mandated decision makers.
- There was a vibrant discussion on whether the remit of the VCWG should be formally expanded to include other related mosquito borne diseases (eg. *Aedes*), it was felt that the

expansion could be captured in the vision of the group and how activities are conducted, rather than a formal re-labelling the VCWG, which could alienate our core malaria constituency. The matter is likely to come under the re-evaluation of the terms of reference underway this year. It was clear that the extension to NTD's outside of the Aedes / arbo viral complex is not considered for the time being.

- A formalized link with other groupings such as the *Stop Dengue Initiative* would be worthwhile to further explore areas to strengthen collaboration and avoid duplication in global vector control efforts.
- A comment was made to explore ways to avoid the instances of replication at this year's meeting and to adjust the meeting format for the future. The response was that this meeting and agenda was special because of the dominance of the work plan discussion and the need to have parallel meetings for two WS at a time because of time constraints. Future meeting agenda will be more balanced and less repetitive.
- A suggestion was made to place practical regulatory issues on the agenda of the Group. As WHOPES is changing to a more practical prequalification system, it was recommended that those changes are allowed to settle (6-8 months) before further engagement from our side.
- It was commented that there was no discussion at the meeting on how recent governmental changes in major donor countries, may influence the future of funding for vector control. Questions were raised over our response to the scaling back of funding. The need to redouble efforts to urge disease endemic countries to augment annual budgetary allocations to vector control was raised and that every opportunity must be used (including RBM Board meetings) to strongly urge positive country response.

Any other business

Members were asked to complete the feedback survey.

The meeting relayed its strong appreciation and thanks to Konstantina Boutsika for the excellent organisation of the meeting, thanks to Vanessa Chen-Hussey for the challenging task being the rapporteur, to the Co-chairs for the coordination work during 2016 and the Co-leaders for the preparation of the work stream agendas of the meeting. The VCWG co-chairs thanked all members for their attendance and contributions.

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List of acronyms

AI	Active ingredient
ANC	Ante-natal clinic
APMEN	Asia Pacific Malaria Elimination Network
BBSRC	Biotechnology and Biomedical Sciences Research Council
BMGF	Bill & Melinda Gates Foundation
Bti	*Bacillus thuringiensis* subsp. *israelensis*
CD	Continuous Distribution
EPI	Extended programme of immunisation
GMP	Global Malaria Programme

GPIRM	Global Plan for Insecticide Resistance Management
I2I	Innovation to Impact
IR	Insecticide resistance
IRM	Insecticide resistance management
IRS	Indoor residual spraying
IPM	Integrated Pest Management
ITN	Insecticide-treated net
IVCC	Innovative Vector Control Consortium
IVM	Integrated vector management
LLIN	Long-lasting insecticidal net
LSM	Larval source management
M&E	Monitoring and Evaluation
MDG	Millennium Development Goal
MERG	Monitoring and Evaluation Reference Group
MESA	Malaria Eradication Scientific Alliance
MPAC	Malaria Policy Advisory Committee
NGO	Non-governmental organisation
NMCP	National Malaria Control Programme
PAMCA	Pan African Mosquito Control Association
PBO	Piperonyl butoxide
PMI	President's Malaria Initiative
RBM	Roll Back Malaria
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SSA	Sub-Saharan Africa
TDR	WHO Special Programme for Research and Training in Tropical Diseases
TOC	Transition Oversight Committee
TPP	Target product profile
USAID	United States Agency for International Development
VCAG	Vector Control Advisory Group
VCWG	Vector Control Working Group
WHA	World Health Assembly
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme