RBM Vector Control Working Group

Seventh Annual Meeting, 6 to 8 February 2012

Rapporteur: Dr. John Silver

Summary

The 7th annual RBM Vector Control Working Group (VCWG) meeting brought together more than 150 participants from national programs, commercial partners, academia, NGOs, foundations, multi-lateral and bi-lateral organizations to address a number of specific technical and programmatic challenges. While there was continued progress in malaria vector control over the past year, the gains are fragile. Three major challenges include: Insecticide Resistance; "outdoor" or "residual" transmission beyond the reach of our traditional control measures of Indoor Residual Spraying (IRS) and Long Lasting Insecticidal Nets (LLINs); and third, increasingly constrained funding. Just at the time when pyrethroid resistance is increasing the immediate costs of control, and when the LLINs deployed by mass campaign over recent years need to be replaced, many programs face severe funding constraints and asked to do more with less. The VCWG with its diverse partnership aims to complement the normative and policy-setting role of the WHO Global Malaria Programme (GMP) to build consensus, establish and strengthen partnerships and work towards solutions to these challenges.

The 7th annual meeting was structured around eight work streams:

- *Insecticide Resistance*
- *Outdoor Malaria Transmission*
- *Continuous LLIN Distribution Systems*
- *Durability of LLINs in the Field*
- *Capacity Building for Indoor Residual Spraying*
- *Larval Source Management*
- *Optimizing Evidence for Vector Control Interventions*
- *Entomological Monitoring and Integrated Vector Management*

This was the largest VCWG meeting to date, reflecting not just the strong interest and critical role of vector control in global malaria efforts, but also the wide diversity of interests and experiences from the public and private sector, from Asia, Africa, the Americas and Europe. Following is a report of the discussions in plenary and in the individual workstream meetings. More information and follow up with each of the work streams is available at: http://www.rollbackmalaria.org/mechanisms/vcwg.html

Day One: February 6, 2012

Session 1: Introductions and Objectives

Chair: Dr. Michael Macdonald

Dr. Macdonald opened the meeting with introductions and objectives. This was the largest VCWG meeting to date with more than 150 persons registered. There were however many more colleagues with the national programs and national research and training institutions not able to travel for the

meeting. The focus of the VCWG needs to be on support to country-level implementation, not just discussions in Geneva with no output. The overall objective of the meeting was to discuss current and emerging issues that should be addressed by the VCWG and establish a 2012 work plan coordinated with WHO-GMP and other partners. The specific objectives of the meeting were:

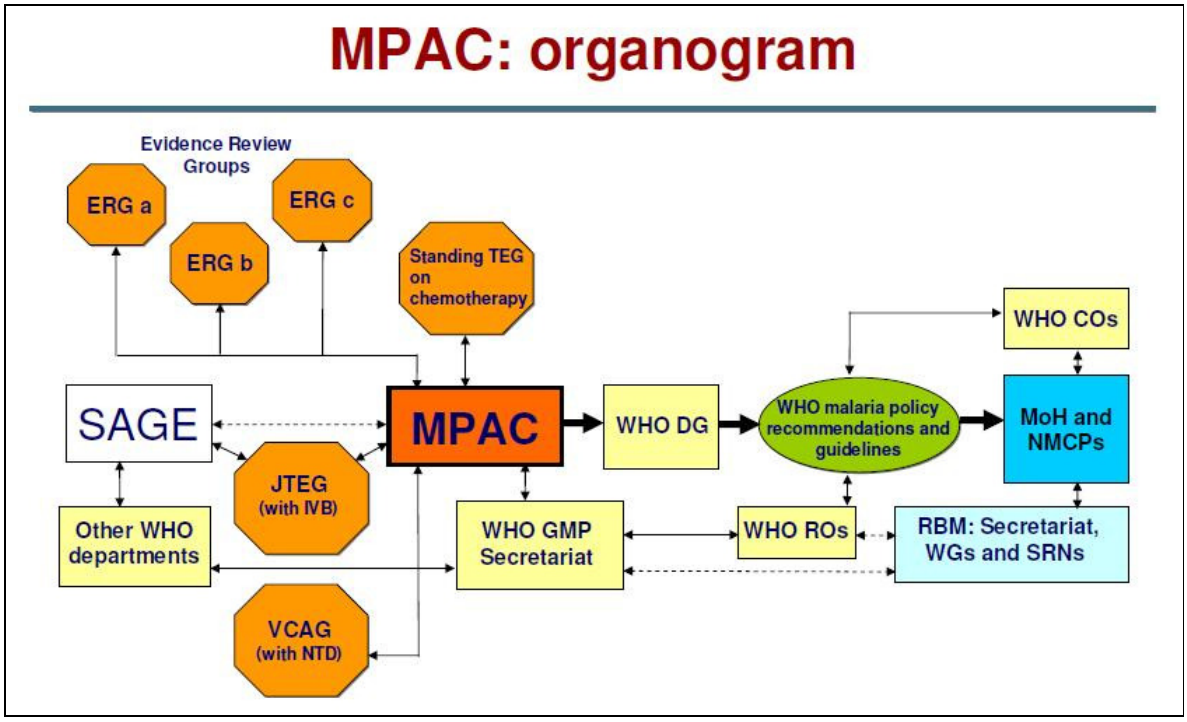
- Expand and solidify partnerships amongst the various constituencies of the working group
- Advance Work Stream products
- Identify challenges and adapt efforts to meet these challenges

Jan Van Erps welcomed participants on behalf of RBM and acknowledged the contribution of Swiss Agency for Development Corporation (SDC) and Swiss Tropical and Public Health Institution (Swiss TPH) in supporting the work of the VCWG.

Sustaining the gains in malaria control and elimination: the critical role of vector control – Dr. Robert Newman, Director WHO Global Malaria Programme

Dr. Newman presented a review of progress in malaria control, as reported in the World Malaria Report 2011, and introduced participants to the newly-formed Malaria Policy Advisory Committee (MPAC). Despite significant progress, Universal Coverage with LLINs has not yet been achieved, even if we only consider the proportion of households with at least one net as the indicator. Of the estimated US$ 6 billion needed annually for malaria control, only around US$ 2 billion is currently available. The global financial crisis means that there is a real risk that funding will not be maintained in the future.

The Malaria Policy Advisory Committee (MPAC) will provide independent strategic advice and technical input to WHO for the development of policies related to malaria control and elimination. It comprises 15 members, with a broad range of expertise, professional affiliation and geography. Members are nominated by a selection committee and appointed by WHO for three-year terms, renewable once. The Committee will meet twice a year, with the inaugural meeting on 31 January – 2 February 2012.



Major challenges facing WHO-GMP and the malaria community were identified as follows:

- Political commitment
- Financial resources
- Procurement and supply chain management
- Sustaining high intervention coverage
- Health system capacity
- Delivering quality case management in the private sector
- Human resource capacity
- Antimalarial drug resistance
- Insecticide resistance
- Inadequate surveillance; burden estimation controversies
- Delivering results in highest burden countries

Insecticide Resistance is a major challenge. Dr. Newman included a brief description of the Global Plan for Insecticide Resistance Management in malaria vectors (GPIRM). The GPIRM is a global strategy to coordinate action against insecticide resistance and ensure continued effectiveness of current and future vector control tools on transmission, morbidity and mortality. The GPIRM is expected to be launched in May 2012. Its major goal is to maintain effectiveness of malaria vector control in the long-term; and in the near-term to preserve susceptibility of major malaria vectors to pyrethroids and to other classes of insecticides, at least until a range of new classes is made available for large-scale vector control.

Dr. Newman then described opportunities in malaria control:

- Malaria elimination
- New uses for existing tools. Example: Seasonal Malaria
- Chemoprevention
- Fostering innovation: new tools
- Integrated community case management
- Improving efficiency and value for money. Example: a 5-year LLIN could potentially save >US$ 3 billion
- Stratification:
    - Using data for decision making
    - Determining the optimal intervention mix for different epidemiological settings
- Universal diagnostic testing, improved case management, and strengthened surveillance

Discussion

The role of larval source management was discussed. It was acknowledged that several countries are under political pressure to use larviciding on a wide scale. This has prompted WHO-GMP to prepare an interim position statement that was shared at the first MPAC meeting and will be published shortly. In response to requests from African Ministers of Health, interim guidance on larval control has also been developed by WHO-AFRO and will be shared with member states imminently. In addition, a Cochrane review on published trials of larviciding is on-going. Currently, WHO-GMP considers there to be insufficient generalized evidence available to support a policy recommendation for its implementation. There is general consensus that larviciding has a role, only where breeding sites are few, fixed and findable (three ‘F’s).

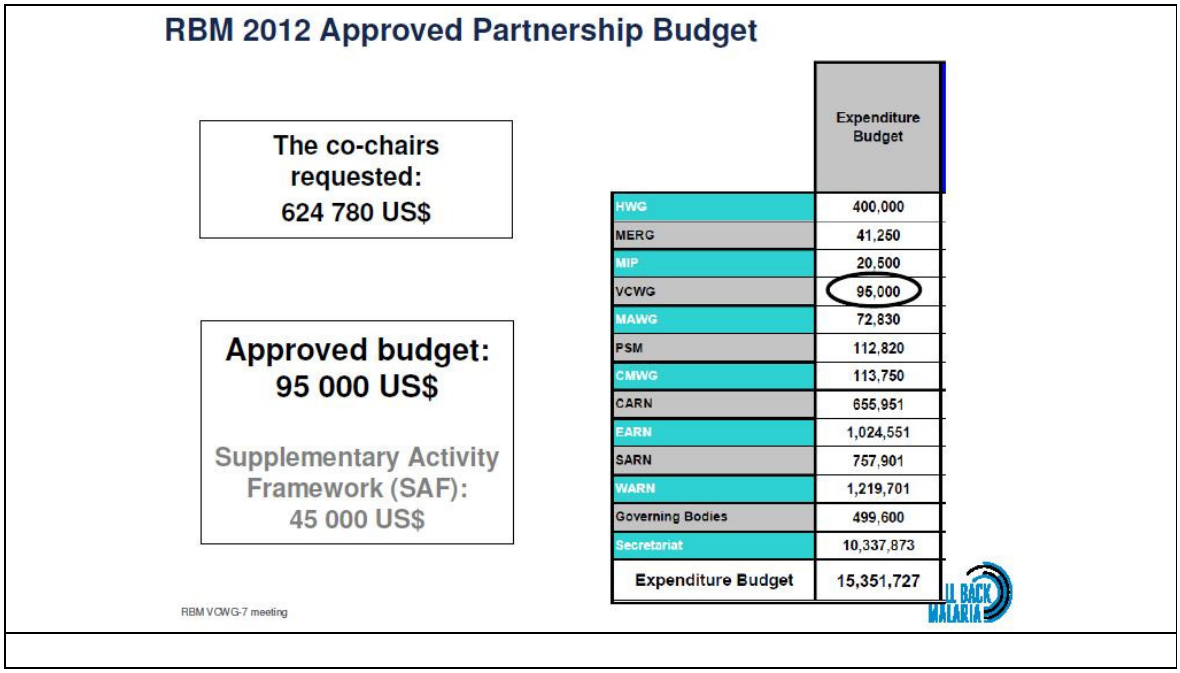
Vector Control currently comprises 60% of the total budget for the Global Malaria Action Plan. There was concern that as currently formulated, the MPAC includes only two standing committees, dealing with chemotherapy of malaria and antimalarial drug resistance. This gives the impression that entomology and vector control is not currently prioritized at the highest decision-making and policy setting levels. Participants requested that clear mechanisms be identified through which the vector control partnership can work effectively with GMP and the MPAC. It was noted that the MPAC is still very new, and while it does include entomologists and vector control specialists, a standing Technical Expert Group on Vector Control may be considered if that is seen as a useful mechanism.

VCWG website – Dr. Konstantina Boutsika, Coordinator RBM VCWG and Swiss TPH

Dr. Boutsika provided participants with an update on the status of the VCWG website. The VCWG subsection of the RBM site was launched in March 2011. From March-December 2011 the site was visited 7753 times. The VCWG and the Harmonization WG web pages belong to the most requested resources among RBM mechanisms. An analysis of the specific sections visited indicated that Insecticide Resistance page is the most popular followed by the Continuous LLIN Distribution Systems page. Most of the visitors accessed the site are from Europe (49%), followed by Americas (23%), Africa (14%) and Asia (8%).

VCWG Budget – Dr. Konstantina Boutsika, Coordinator RBM VCWG and Swiss TPH

Participants were given an overview of the 2011 RBM budget and the allocations to the VCWG and its individual work streams, followed by a description of the 2012 budget envelope. Total allocations to the VCWG for 2012 are US$ 95,000 representing a significant decrease compared to 2011 (US$ 310,876).



	Expenditure Budget
HWG	400,000
MERG	41,250
MIP	20,500
VCWG	95,000
MAWG	72,830
PSM	112,820
CMWG	113,750
CARN	655,951
EARN	1,024,551
SARN	757,901
WARN	1,219,701
Governing Bodies	499,600
Secretariat	10,337,873
Expenditure Budget	15,351,727

Discussion

While acknowledging the restricted levels of funding available from RBM for the VCWG and other working groups, it was stressed that the VCWG can not depend solely on RBM for financial support. The successes achieved by some of the work streams in mobilizing resources from partners outside of

RBM were cited as positive examples that indicate that the VCWG is a mechanism valued by partners. The restricted funding landscape raises the question as to what mechanisms can be established by the VCWG to support the effective utilization of the funding available from partner organizations. The VCWG Secretariat will discuss potential mechanisms of partner support that will still ensure transparency and balance.

Participants were informed that UNDP has formally brought to the attention of WHO that there have been eight recent large tenders for pesticides for vector control, of which seven failed Quality Control. This clearly has major implications for public health. Quality Assurance/Quality Control is also an issue for RDTs, LLINs, and other commodities. This is especially important for national programmes purchasing commodities with their own resources. Quality Assurance and Quality Control is a relatively new issue for the VCWG and merits further discussion within the relevant work streams. It was noted that WHO will soon be publishing guidelines for the procurement of public health pesticides.

Session 2: Progress on work plan

Chairperson: Konstantina Boutsika

Alliance for Malaria Prevention –Dr. Jason Peat, Senior Health Officer Malaria, IFRC

Dr. Peat described the core activities and structure of the Alliance for Malaria Prevention (AMP) and the key components of the AMP 2012 Work Plan, including:

- Mentoring programme
- Dissemination of AMP toolkit version 2.0
- 2012 trainings
- Deployment of technical assistance
- Closer collaboration of working groups

Two workshops are planned for the third quarter of 2012: Scale Up and Sustaining Gains and Logistics, with a joint session on procurement. The AMP is also planning thirty-one Technical Assistance missions to countries, including for the first time, missions to countries outside Africa. These missions are expected to cover implementation (including continuous distribution), logistics, communications, Monitoring and Evaluation.

Dr. Peat also identified key areas for enhanced collaboration with the VCWG, particularly around country support, joint advocacy and fundraising, “sustaining the gains”, and implementation of continuous distribution mechanisms for LLINs.

Discussion

The global financing crisis and its impact on vector control interventions was identified as a key issue for the VCWG. Many countries are already expressing concerns that recent gains may be lost due to the funding crisis. The importance of national governments committing more resources to malaria control in the face of reduced external funding was also emphasized. The African Leaders’ Malaria Alliance was identified as a key mechanism through which this could be achieved; it was reported that financing was the main theme of the recent ALMA Heads of State meeting held in Addis Ababa in January 2012. At this meeting, Heads of State committed to increasing national resource allocations to malaria control, e.g. through the World Bank International Development Association (IDA) credit and grant program. Heads of State also committed to increasing collaboration with the private sector, including collaboration for innovations and long-lasting nets. The appointment of a new general

manager to the Global Fund was cited as an opportunity to ensure that sustainability of malaria financing remains on the agenda of the international community.

The integration of mass distribution and continuous distribution mechanisms was a key theme of the discussions following the presentation. It was noted that the "Continuous Distribution" work stream has developed good collaboration with AMP, but it remains important to learn more how campaign mechanisms have changed over the years in order to better design and integrate continuous distribution systems. Much innovation has gone into the operational aspects of LLIN distributions, but this may be an area in which more documentation and dissemination of experiences and lessons learned is required.

The innovation process with regard to new LLIN technologies was also discussed. Participants were informed that WHO, in collaboration with the Bill and Melinda Gates Foundation and the Innovative Vector Control Consortium is working to analyze the innovation process and identify best practices from other industries with a view to producing a 'road map' for innovation in vector control. It was acknowledged that the development of new LLIN technologies is a very complex and time-consuming process that needs to take into account a wide range of testing, regulatory, market and other factors, such that five years is not a long timescale for development of LLINs.

Given the increasing need to demonstrate "value-for-money" in programmes, innovation and product quality improvement in relation to procurement tenders is also required to move beyond selection based solely on price-per-unit, and not include, for example durability in the field. In order to support this shift there is a need to ensure that operational data feed into the procurement decision-making process, but currently this is not happening. NMCPs do not have sufficient capacity to collect these data at present and appropriate data collection mechanisms and other support are urgently required.

The persistent gap between net ownership and consistent utilization was identified as a key area in which significant gains can potentially be realized through improved BCC.

Disposal of used LLINs and LLIN packaging was discussed. It is still not clear if this is a priority issue but is being taken up by the AMP and GMP. Interim guidance on disposal is available on the GMP website and discussions are on-going with manufacturers.

Insecticide Resistance – Prof. Janet Hemingway, Director Liverpool School of Tropical Medicine

Prof. Hemingway reported that coordination among partners, particularly around the GPIRM and related guidelines for insecticide resistance management, has been a major function of the work stream during 2011. The GPIRM is expected to be released in May 2012. There will then need to be a great deal of partner support, including from RBM, to help with the country-level implementation. The WHO guidelines on insecticide resistance monitoring have been revised and will also soon be published.

A Cochrane Review of the impact of insecticide resistance on LLIN effectiveness has been commissioned. The methodology for the review has been agreed and 600+ papers have been identified, although relatively few studies are in the format required for a Cochrane Review. The draft review is currently with the Cochrane Review team and should be published soon. The Work Stream is also working closely with WHO on resistance-breaking products and how these can be tested.

Discussion

Participants requested information on the key findings of the Cochrane Review. In response, it was reported that while there are insufficient data to determine the impact of insecticide resistance on malaria transmission, data do exist to demonstrate the effects on various entomological indices.

Concerns were raised regarding the future prospects for insecticide-resistance monitoring and testing in light of the restricted funding situation. For example, following cancellation of the Global Fund Round 11, countries are being supported to apply for transition funding, which will be very much restricted in comparison to a full funding round. The RBM Harmonization Working Group is concerned that given the funding restrictions, insecticide resistance testing (and other supporting components) may be dropped, with preference given to securing the maximum number of commodities. There is a clear need for advocacy with countries and the Global fund to guarantee funding for monitoring. Good data on the impact of insecticide resistance will be vital in advocating for funding. Evidence from Bioko Island and other IRS operations where there has been a change in insecticides based on insecticide resistance monitoring shows how resistance monitoring is essential for procurement and programmatic decisions, ultimately saving costs. Pooling financial and technical resources for entomological monitoring across a range of partners or across neighboring countries should also be explored.

Lessons Learned and the Way Forward – Dr. Michael Macdonald, Malaria Advisor, USAID

Dr. Macdonald briefly described the evolution of the VCWG from its early incarnation as the Working Group on Insecticidal Nets (WIN) in 2003, which was a relatively small group with a narrow focus on ITN delivery, to now the much broader VCWG partnership covering a wider range of vector control interventions and entomological monitoring through the eight work streams.

The three major issues of 2011 confronting malaria vector control are the two technical challenges of Insecticide Resistance and the limitations of IRS and ITNs in responding to 'residual' or outdoor transmission, and the fundamental programmatic challenge current global financial crisis and restricted funding for malaria control. Each of the eight work streams addresses these three challenges within their individual work plans.

Outdoor Malaria Transmission – Prof. Marc Coosemans, Institute of Tropical Medicine, Antwerp

A review of the progress made by this work stream during 2011 was presented, including efforts towards information sharing on operations research for outdoor transmission and coordinated entomological monitoring across the Greater Mekong subregion, encompassing Myanmar, Thailand, Lao PDR, Cambodia, Vietnam and Yunnan Province China. The two-day regional meeting planned for November 2011 was postponed to March 2012 due to the flooding Bangkok. A one-day meeting was held in Phnom Penh that reviewed the knowledge base on outdoor transmission and its control in Cambodia and identification of researchers, institutions and on-going studies. Plans for 2012 for the Work Stream include:

- Outdoor Transmission Workshop 12-13 March 2012 organized by the Faculty of Tropical Medicine, Bangkok;
- Inventory of institutions and researchers in the Mekong region;
- Compilation of regional research;
- Review of residual transmission in the Mekong Region and elsewhere (Institute of Tropical Medicine/Antwerp)
- Development of strategies for research and development

Discussion

The role of larviciding in addressing residual and outdoor transmission was discussed. It was noted that in some cases the 'three Fs' criteria (*Few, Fixed and Findable*) are fulfilled. For example, historically, *An. minimus* has been eliminated in some villages in Southeast Asia by installing siphons and improving drains to flush larvae out of the breeding sites. Clearly this approach would not be suitable for other vector species with different larval ecologies such as *An. dirus*. Larviciding and environmental management are potential control mechanisms for countries in North Africa and the Middle East where the breeding sites are limited and were programs are moving towards elimination.

Given that residual transmission or outdoor transmission is emerging as an issue in some northern and southern African countries, particularly those that are aiming for elimination, it was suggested that representatives from these countries be invited to attend the March 2012 meeting.

The importance of human behaviour in relation to outdoor transmission was also discussed. It was noted that in many communities people do not retire until late in the evening; in cases people work away from home or sleep outside in situations where ITN are either impractical or otherwise rarely used. A recent study initiative in Cambodia provided extra nets to households to allow those travelling to the forest or sleeping in the fields access to take a net with them. It was felt that supplying these extra nets was helping to reduce transmission among this population.

Human landing catches is one of the few reliable collection methods available to investigate outdoor transmission. There is however uncertainty among many Research Ethics Committees and Institutional Review Boards, on the ethics and risk/benefit involved. Further guidance from WHO would be useful in this area.

It was acknowledged that despite the importance and complexity of outdoor and residual transmission of malaria, the work stream had been relatively under-financed. As control of "indoor transmission" with LLINs and IRS becomes more successful, particularly in Africa, the relative importance of outdoor transmission may increase and necessitate more operations research and more funding for this area of vector control.

Continuous LLIN Distribution Systems – Prof. Don de Savigny, Head of Unit Swiss TPH

Dr. de Savigny began with an introduction to the concept and need for continuous delivery systems. It was noted that while continuous distribution is insufficient to achieve universal coverage, periodic campaigns alone are insufficient to maintain universal coverage. For this reason, "Distribution Campaigns" and "Continuous Delivery" have equal priority in attaining and sustaining the goal of universal coverage. The eight products produced by the work stream in 2011 were briefly described.

1. Consensus Statement on Continuous Distribution Systems
2. Review of LLIN procurement and distribution through GF grants
3. Continuous Long Lasting Insecticidal Net Distributions: a guide to concepts and planning
4. Implementers' Guide for Continuous Delivery of LLINs via ANC, EPI, and other routine health services
5. Lessons in Brief – Kenya
6. Lessons in Brief – Malawi
7. Lessons in Brief – Tanzania
8. In-depth case study: Ghana and Tanzania

The total budget and expenditure for 2011 activities was US$ 106,000, no funding was provided directly from the RBM VCWG budget, but was obtained from partners, including USAID NetWorks

project, SDC Swiss Agency for Development and Cooperation, WHO EPI and the vital contribution of partner's volunteering their own time and effort to the workstream.

Discussion

The linkages between the work of the AMP and the Continuous Delivery work stream were discussed. Work stream products were developed in close collaboration with the AMP and will be used at the AMP trainings, which are also co-facilitated by the Continuous Distribution work stream members. AMP will use the products in their Technical Assistance to countries.

It was proposed that given the different context in Asia and the Western Pacific in terms of public sector and private sector distributions, treated and untreated nets, experience sharing between the programs in African with programs and colleagues in Asia and the Western Pacific would be informative and beneficial.

Durability of LLINs in the field – Dr. Albert Kilian, Senior Expert Tropical Heath

Progress against the five objectives of the 2011 work plan for this work stream was reviewed; significant progress had been achieved in relation to developing consensus on a methodology for assessment of net condition in the field and reaching agreement on improved textile testing for all netting materials. For the planned activity to assess net conditions in the field, consensus was reached on hole measurement, tools and training materials were produced; recommended hole assessment protocols were published in WHOPES Guidelines. With regard to textile laboratory testing, a meeting was held in Lyon February 2nd and 3rd, attended by twenty-six participants, including five textile testing experts / institutes. Progress was also made in evaluating current knowledge on LLIN durability (review expected to be completed in the second quarter of 2012) and in maintaining communication and disseminating work stream products.

Discussion

The key factors influencing durability of LLINs in the field have been identified as initial damage caused by burning with candles, kerosene lamps, etc and also rodents in some rural areas. Unfortunately, very little data are available on these two key aspects beyond what is obtained through owner recall. There is a clear need to link these factors with lab-testable criteria.

The issue of defining and measuring the epidemiological point at which a net should be replaced was discussed. Participants were informed that a trial is being planned, but due to the high number of confounding variables that need to be taken into account, the process is complex. CDC is also looking at the interaction of physical durability and insecticide persistence on epidemiological performance of the net and reports that physical durability again appears to be the most important factor. Washing may also have an impact in some cases, especially where the pH of the washing water and detergents is high. WHOPES testing is also looking at long-scale durability. The first set of data has been published on Interceptor nets, with others to follow over the next 30 months.

Currently, there is no formal mechanism for countries using the guidelines and protocol to feed data on durability back to WHOPES, the VCWG, or other partners. Better communication is needed with end-users of the guidelines.

Information on the interplay between net cost and durability, and the impact on the overall cost of achieving and maintaining universal coverage (e.g. unit cost per life-year of protection) was requested. Preliminary data suggest that more durable nets could cost up to between 1.5 and 2.5 times the

current unit costs, but because of their improved durability would not increase the overall cost of maintaining universal coverage.

The issue of waste, both in relation to disposal of old nets and also net packaging was raised. It was reported that there is little evidence that old nets are dumped in the environment. More usually, they are 'recycled' and used for alternative purposes. The AMP will further discuss the waste and packaging issue at its February 2012 meeting.

Indoor Residual Spraying – Dr. Shiva Murugasampillay, Medical Officer WHO/GMP

Dr. Murugasampillay reviewed recent IRS progress as reported in the 2011 World Malaria Report. Globally, IRS protected 185 million people, representing 6% of the population at risk in malaria endemic countries. Funding for IRS comes predominantly from national resources, the Global Fund and US President's Malaria Initiative. The work stream reported achievements against each of the objectives in the 2011 work plan, some of which are presented below:

Advocacy & Financing Sub-Group
The sub-group collaborated with GBCHealth and the Corporate Alliance on Malaria in Africa, who provided significant financial support for *The Business Case for IRS: A Private Sector Workshop on Comprehensive Malaria Control*. The workshop, held in Johannesburg in October 2011, presented the business case for IRS, provided technical updates and explained how companies can most efficiently and cost-effectively incorporate IRS into their malaria control efforts. The Advocacy & Financing Sub-Group also developed communication materials for IRS were developed with partners from the Southern Africa Development Community (SADC) and RBM Southern Africa Regional Network (SARN). The Namibia Minister of Health is acting as a champion to help mobilize funds and support for IRS from within the African Union, SADC and the West African regional group ECOWAS.

Evidence & Reporting Sub-Group
A full review of published studies on the entomological and epidemiological impact of IRS is in progress. A Protocol for Rapid Impact Assessments and multi-country reviews has been developed. Documentation on chemicals used for IRS, including DDT, pyrethroids, organophosphates and carbamates, and on the resistance status of the local vectors is being developed. Indicators and a standard form for country reporting have been developed to support country reporting.

Supervision, Monitoring & Evaluation Sub-Group
A draft supervision check list, draft indicators and reporting forms and draft standards and a checklist have been developed to improve IRS supervision.

No progress was reported by the Commodities, Procurement & Supply Sub-Group.

Discussion

As regards documentation and reporting, it was acknowledged that much information on IRS programmes is available at the local level, but due to a lack of capacity to compile and report at regional and national levels, this information is not being disseminated. This is essentially a Health Information System issue and not confined to IRS.

It was noted that countries in SE Asia are increasingly requesting guidance on the role of IRS in elimination or pre-elimination. The need for guidance also relates to the design of appropriate strategies for "graduating" or transitioning IRS to a consolidation and maintenance phase.

As noted earlier in the plenary session, quality control appears to be a significant issue in relation to insecticide procurement. The IRS work stream needs to work closely with the RBM Procurement and Supply Chain Management working group to ensure adequate country program support.

Larval Source Management – Prof. Steve Lindsay, Durham University

Prof Lindsay presented the Larval Source Management (LSM) work stream progress in 2011, including a work stream meeting held at the American Society of Tropical Medicine and Hygiene, in Philadelphia, USA. The meeting covered the following:

- Historical use of LSM
- Cochrane Review of LSM
- Role of LSM in malaria control today
- Presentation of the draft WHO position statement on larviciding
- Group discussion of the WHO position statement

The ASTMH meeting concluded that the draft WHO position statement needed more work to take into account contextual differences (e.g. where the breeding sites were "*Few, Fixed and Findable*") to reflect existing evidence for the efficacy and cost-effectiveness of LSM; countries need technical guidance on determining if LSM has the potential to play a complementary role in their overall malaria vector control efforts, and if so, technical guidance on implementation and evaluation. There is a need for tools to support: a) evidence-based decision making related to LSM b) good management of LSM initiatives and c) quality control of larval control products. There is evidence that in some situations LSM has an impact. The Cochrane Review of LSM revealed a 69% reduction in incidence (in the six eligible studies with data), a 75% reduction in parasite prevalence (in six studies), but no evidence for reduction in spleen rates (three studies). Entomological analysis is currently being finalized and the draft will be submitted to Cochrane Group by end February 2012.

The other three deliverables have all been postponed until 1st Quarter 2012: the decision-making framework for LSM, development of the template on country case studies, and development of an operational manual on LSM.

Discussion

Discussions on the potential role of LSM in malaria control led to a consensus that it is not to be recommended as a stand-alone intervention, but can potentially play a role in specific ecological circumstances to address persistent transmission 'hot-spots' during the elimination phase, including through aerial application of larvicides. LSM could also potentially aid in combating both physiological and behavioural resistance.

The suitability of the Cochrane methodology for evaluating community protection interventions such as IRS and LSM was questioned. While it was agreed that the methods are not optimally suited to these types of intervention, from a policy-makers' perspective a Cochrane review carries a lot of influence and may be the only acceptable option. It was suggested that there is nothing in the Cochrane review methodology that prevents the examination of long-term mass effects, but the types of trials required are likely to be very expensive. It was acknowledged that before significant investment is committed to LSM, we need evidence on cost per DALYs averted. Also, because LSM is primarily a complementary intervention, its impact needs to be evaluated in terms of the additive effect and cost-effectiveness on top of the primary interventions. It was noted that despite a lack of solid evidence in many situations, some countries are already planning to implement large-scale larviciding operations and therefore require guidance.

Several brief examples of the successful use of LSM were discussed, including those in urban areas in Dar es Salaam, Tanzania and Khartoum, Sudan.

A proposal was made that the WHO "Manual on environmental management for mosquito control, with special emphasis on malaria vectors" (1982); and the "Manual on larval control operations in malaria programmes" (1972) be revised and updated.

Entomological Monitoring and IVM –Dr. Raman Velayudhan, Scientist Vector Ecology and Management WHO

Dr. Velayudhan presented the IVM work stream, describing the process for producing guidance on national IVM policy development and ultimately its uptake by national programmes. The example of a combined lymphatic filariasis and malaria control programme was described. Here the three essential components, institutional arrangements, regulatory frameworks and decision-making criteria and skills have been developed. Key available IVM publications include "The Handbook for IVM", "Guidance for policy development on IVM" and the "Core structure for training curricula for IVM". A Monitoring and Evaluation guide for IVM and case studies are currently under development.

Discussion

Participants felt that there was a need to measure the impact that vector control interventions for malaria have had on other tropical diseases, including lymphatic filariasis. It was reported that in Tanzania the vector of tick-borne relapsing fever, *Ornithodoros moubata*, has been virtually eradicated. This could be another example worthy of documenting.

A major theme of discussions was the need to strengthen capacity for entomological monitoring, as this expertise is vital in supporting the continued use of insecticide-based control methods. It was noted that a relatively small proportion of the funding currently going into countries for the implementation of vector control interventions would be required to establish and maintain the requisite levels of entomological expertise. It was reported that the EMRO Regional Commission has developed a resolution in this area and WHO-EMRO is working with countries to set aside funding. North Sudan is apparently the only country in Africa to have 2 MSc level entomologists in each district, as well as 75 sentinel sites. The North Sudan experience is worth documenting, including the positive experiences in maintaining staff commitment and retaining trained staff.

Summary – Dr. Michael Macdonald

In presenting his summary of the first day of the meeting, Michael identified three key, cross-cutting challenges to malaria vector control that the VCWG needs to address in the coming months and years:

- The financial crisis and its impact on programme implementation and sustainability, plus the need to further optimize the use of limited resources for maximum impact
- The spread of insecticide resistance
- Limitations of current IRS and LLIN interventions: the need to address outdoor and residual transmission.

The need to facilitate and secure more participation of African programme staff at international meetings was emphasized.

Day Two: Work Stream Meetings February 7, 2012

3rd Insecticide Resistance Work Stream Meeting

Chair: Prof. Janet Hemingway
Rapporteur: Dr. John Silver

Summary of Discussions

The Insecticide Resistance work stream session focused on two items: reviewing the recommendations and the technical guidelines for insecticide resistance management.

The Guidelines includes a revised definition of 'resistance', such that mortality rates of <98% indicate possible resistance and trigger additional testing and increased sample sizes in order to confirm the situation. Two options were presented:

Option 1	Option 2
98-100%: susceptible 90-97%: resistance to be confirmed – increase sample sizes <90%: resistance confirmed	98-100%: susceptible <98%: resistance to be confirmed

While no universal consensus was achieved, the majority view was that option 2 is likely to be more appropriate to give an earlier warning that additional monitoring is required**.**

The rationale for proposing the new definition is that to wait for the old threshold of <80% to confirm resistance means that it would be too late to do anything to mitigate the development of resistance, including switching of insecticides if deemed appropriate.

Discussion

Some participants expressed concern regarding the practical application of the proposed GPIRM. It was also noted that the next significant funding opportunity through which countries could mobilize funding to implement the proposed activities would probably be in 2015. What should we be advising countries to do in the meantime with limited funds? In response, it was suggested that from an insecticide resistance management perspective, maintaining current levels of coverage with a product that is not working, is probably worse than introducing a new, effective product at lower coverage levels.

Participants suggested that there be economic case studies to model the potential costs and benefits of introducing the insecticide resistance management strategies proposed in the GPIRM. It was also proposed that there be a mechanism to provide technical assistance for countries to implement GPIRM. It was also suggested that there be a mechanism to provided laboratory support services for entomological monitoring and insecticide resistance monitoring related to the GPIRM for those countries with limited laboratory capacity.

The CDC Bottle Assay and the use of synergists within that assay were discussed. Participants were informed that the new WHO insecticide resistance testing guidelines recommend that the WHO Tube Assay remains the standard for the early detection of insecticide resistance and that the CDC Bottle assay could be used for further research into the level and mechanisms of resistance. These revised guidelines urge caution, as the testing and interpretation of results can be complex. It was

acknowledged that synergist products are now becoming available and countries will begin to make decisions on whether or not to purchase them and are likely to seek expert guidance. It was therefore proposed that the work stream convene a group to gather more information on synergists.

Final Conclusions and Summary – Prof. Maureen Coetzee

Discussions

The GPIRM recommendations were discussed**.**
The criteria for interpretation of WHO susceptibility data and use of synergists, to be published in the revised guidelines, were discussed and changes made to the document**.**

Actions and 2012 Work Plan

- Publication of Cochrane review on impact of insecticide resistance on net efficacy expected at the end of Q1, 2012
- A sub-group to be appointed to draft guidelines on use of synergists to monitor resistance in the field – to be put out under the auspices of GMP
- Discussion required with WHO-GMP on establishing a competent core of TA for supporting countries for IR monitoring in line with GPIRM
- Work up economics case of using rotations over a 10-15 year period to support advocacy
- Establish a direct link into the RBM harmonization and advocacy working groups
- Work with GMP on establishing a user-friendly and sustainable global database of insecticide resistance

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3rd Capacity Building Activities for IRS Work Stream Meeting

Chair: Dr. Shiva Murugasampillay
Rapporteurs: Dr. Elissa Jensen, Dr. Richard Tren, Dr. John Silver

Work Stream Review of 2011

Evidence & Reporting Sub-Group

Kleinschmidt and Maharaj summarized available literature on the impact of IRS in low (South Africa), moderate (Maputo, Mozambique), and high (Zambezia, Mozambique and Bioko Islands) transmission areas. In all three cases, the epidemiological and entomological impact of IRS was impressive. In S. Africa, where IRS is the primary intervention (no LLINs), parasitemia is virtually zero. In Maputo, the prevalence decreased from 60% to 10% and *An. funestus* and *An. gambiae* were virtually non-existent; IRS was the primary intervention for the first two years of the case study. In Zambezia a high transmission area, the protective effect of IRS alone was 50% and the protective effect of IRS and LLINs was 60% (PLoS One, in press).

Indoor spraying in Bioko Island in Equatorial Guinea a very high transmission area contributed in part to a reduction in prevalence by 50%; LLINs and treatment were also available. Populations of *An. funestus* declined to nearly zero. Due to resistance to pyrethroids, twice-yearly spraying with a carbamate was implemented in Bioko in 2011. Not surprisingly, results indicate that prevalence of

infection increases as median time since last spray round increases. It is possible that twice-yearly spraying in Bioko is not sufficient. There is a need to combine IRS with other vector control interventions such as LLINs. LLIN coverage levels are low, in part due to expiry of the current tranche of distributed LLINs.

Discussion

- Scaling down IRS is challenging. In South Africa, the IRS program has been running for 65 years, and even without parasitemia, continues largely because of political/social demands. Zanzibar was to begin scaling down the IRS program in 2010, yet blanket spraying continues. It will be important to capture lessons learned from scaling down in South Africa, Zanzibar and other countries. It will also be important to scale up both surveillance and parasite control as IRS is reduced.
- Only four studies were allowed for inclusion in the Cochrane Review on the Impact of IRS. In 2012, this sub-group will be conducting a systematic review to allow for inclusion of other studies. However, given the widespread use of nets, the impact of IRS in the presence of nets will have to be considered.
- It was noted that the impact of IRS has been known for decades. The goal of updating the Cochrane Review is therefore to compile the evidence and have it easily accessible in one document.
- While the discussion was centered on IRS in Africa, in India IRS has been implemented for decades. Despite widespread resistance and low coverage of IRS, incidence has decreased dramatically.
- The WHO would like IRS programs to collect impact data (incidence and/or prevalence). The question is which methods should be employed for data collection (e.g., designated sentinel sites, routine facility data, or community-based prevalence survey).

Advocacy & Financing Sub-Group

Tren summarized progress from 2011 and highlighted key issues. In 2011, this sub-group initiated and with GBCHealth organized an RBM co-sponsored IRS Private Sector meeting in Johannesburg. There are now many examples proving the business case for IRS in the private sector and the meeting sought to expand the number of private companies undertaking IRS programs. One of the requests from the meeting was for national regulators to harmonize and align the registration and regulation of malaria control products to reduce costs of discovery and development. Policy positions were prepared for SADC, the Ministers of Health Conference, and E8 Meetings. The sub-group also engaged with the Global Fund to increase the profile of IRS reporting; participated in the Stockholm Convention's 5th conference of parties to ensure ongoing access to DDT and to eliminate reference to any premature phase-out of DDT.

Discussion

- As an intervention, IRS has not received the same high-level support as LLINs.
- It will be critical to increase funding from the private sector, public sector, and national governments.
- Donor funding has displaced country funding for IRS in some countries. For example, most IRS programs used to be completely funded by national governments (e.g., Ethiopia). The majority of funding for IRS is now coming from the Global Fund and PMI. Advocacy is desperately needed to increase commitment by national governments.
- There was discussion of developing indicators for private sector involvement in IRS.

- There was general agreement that an IRS work stream should plot out IRS funding streams/commitments over time to better understand the financing of IRS and to prioritize the concept of additionality of funds. However, as several working group members noted, the reality is that governments expect donor funding for malaria control. One participant pointed out that, in Ghana, the Global Fund grant for HIV is co-funded by the Government of Ghana. Should the Global Fund consider mandating co-financing of malaria grants by national governments?
- Several participants noted that private companies are interested in supporting IRS programs, but they do not want to take over programs; they are instead interested in helping national governments. Companies understand the return on investment (ROI) of preventing malaria, and are often mandated by corporate social responsibility. The group should consider ROI as an indicator for the private sector. In addition, private sector partnerships should be emphasized more in West Africa.
- The group agreed that, while high-level advocacy (e.g., ALMA) for IRS funding is needed, grassroots demand is equally important. Governments need to see the demand from communities.

Training & Capacity Building Sub-Group

Lluberas discussed two tracks for capacity-building: Track 1 to train advanced/research entomologists, and Track 2 to train field entomologists. Proper training and supervision of spray operators is also important, as spray operators remain the face of the intervention and they are key to community acceptance. Structures, supervision, and training are required when "mobilizing small armies".

Discussion

- Various countries and various partners have SOPs and operational manuals. There may be a need to review these and have one operational and training manual available through this sub-group. Countries can then adapt the manual for their own program. Given the need for frequent updating, this manual should be disseminated electronically.
- PMI noted that they have a standard operations manual (located at http://www.pmi.gov/technical/irs/index.html , "IRS Training Guide for Spray Operators").
- IVCC is supporting the development of an insecticide quantification kit that would allow for immediate monitoring of bioefficacy of insecticides on sprayed surfaces. This kit will be helpful in providing feedback to spray operators. However, this kit has not been validated by manufacturers, and it does not currently allow testing for all active ingredients.
- There was discussion on whether training is more urgently needed for spray operators or mid-level managers/decision-makers. The group generally agreed that the latter is more critical, and training should include how to report, how to supervise, and how to use data to drive decisions.

Supervision, Monitoring & Evaluation Sub-Group

The sub-group discussed the following:

- Should there be standard entomological and epidemiological indicators in country's IRS M&E plans? While selection of indicators is ultimately driven by NMCPs, and most IRS programs (whether donor-driven or country-driven) do have some standard indicators (e.g., number of houses sprayed and number of people protected), there may be value in standardizing these indicators. In addition, there is a critical need for inclusion of both epidemiological and

entomological impact indicators (e.g., prevalence, SPR, and vector density before and after spraying and residual life of insecticide).
- There is currently a draft checklist available for supervisory visits.
- In 2011, there was supposed to be an IRS program review (distinct from Malaria Program Reviews (MPRs)) in Liberia and Sierra Leone. These never took place. There was an IRS program review in Botswana, which has not yet been shared outside the national government. Malaria program reviews also look at IRS.
- PMI/Tanzania is planning a mid-term evaluation of their IRS program in collaboration with the NMCP in August 2012.

Country Progress and Performance

Country presentations were made by:

- Tanzania (Aram). The PMI-funded IRS program had a dramatic impact on slide positivity rates (SPRs), as measured by district hospitals, and Tanzania will begin stratifying transmission zones to allow more precise scaling up of IRS. Challenges include the emergence of pyrethroid resistance, whether LLINs and IRS are cost-effective when combined, and the exit strategy from areas previously sprayed with low SPRs.
- Zanzibar (Molteni). After several rounds of PMI-funded IRS, malaria prevalence is less than 0.07% according to the 2010 MIS. The NMCP is now trying to identify criteria for where to scale back IRS. Criteria could include net usage at 80% or more, presence of effective surveillance, outbreak control/emergency preparedness in place, etc. The challenge of how to communicate reasons for scale back to community members will have to be addressed. A complex malaria case notification system has been established to better characterize and identify (via GPS) malaria cases.
- Uganda (de Alwis). Twice yearly application of carbamates is used, with PMI support. After one year (starting in November 2010), SPRs decreased significantly and have not risen. The MOH is looking to expand IRS to three western districts with Global Fund support.
- Malawi (Youngs). Best practices for IRS programs should include precise geographical reconnaissance to allow exact quantifications for insecticides; community involvement; and capacity building of NMCPs at every step. In 2011, the PMI-funded project leveraged the Illovo Sugar Estate to secure fuel when fuel shortages threatened implementation of IRS. In addition, similar to experiences from other countries, insecticide resistance drove up program costs in 2011. The country switched from a pyrethroid to an organophosphate (the latter being five times the cost).

Discussion

- One needs to be cautious in assuming that scaling back or targeting IRS will result in cost savings, as increased surveillance and increased reliance on technology may need to be employed.
- Prevalence data analysis has been a cornerstone of programs in South Africa, India, Sri Lanka, Bioko, etc. Programs and partners, including PMI, should strive to better assess impact on malaria incidence and prevalence.
- In Tanzania, there is discussion of testing those who are already coming in for other tests (e.g., immunizations), to allow a sampling of children in sprayed areas.
- Efforts to scale down in Zanzibar have been tremendously challenging.
- The Malawi program has not yet collected impact data, but is reviewing current data from local hospitals.

Development partner presentations were made by:

- Global Fund (Lee): $100 million has been allocated for IRS across Global Fund grants (contrast to $1 billion allocated for LLINs). Of the $100 million, $34 million was concentrated within the Eastern African and Indian Ocean region, and $15.1 million in southern Africa. In addition, of the $100 million, 30% remains unspent. This could be partially due to delays in disbursement, rather than problems with absorptive capacity. Representatives from different organizations based in various countries raised the concern that MOHs had been discouraged from including IRS in Global Fund grants.
- President's Malaria Initiative (Jensen): Approximately 25% of the PMI portfolio went to support IRS in 2011. With FY11 funding, this represented $114 million. As PMI has expanded and many countries entomological and epidemiological profiles are changing, key challenges include how to better target IRS in the presence of nets and insecticide resistance and how to better quantify capacity. In addition, PMI presented results from a cost analysis from 2008 - 2010, demonstrating economies of scale when more than 150,000 structures were sprayed. http://www.pmi.gov/technical/irs/index.html
- Mentor (Richard Allan): IRS in emergency malaria control. (Presenter could not attend the meeting, but sent a power point presentation.) In Emergency situations, IRS can be used especially where LLINs are not appropriate, such as camps, emergency shelters, schools, hospitals etc. Essential supplies for delivery of IRS need to be standardized in emergency situations. Mentor and BASF delivered IRS in IDP camps in Liberia in 2003, Banda Aceh in 2005. Other examples include Somali refugee and IDP camps after floods in 2011 as well as North East Kenya in 2011 and Southern Sudan in 2012.

Discussion

- Will any IRS programs be in jeopardy due to Round 11 issues? Countries can tap into the Transitional Funding Mechanism.
- It is up to countries to make the case for IRS in Global Fund grants.
- Several discussants noted the Global Fund had rejected IRS portions of grants because the TRP did not see value in overlap of IRS and LLINs, which is contradictory to the latest evidence (e.g., Hamel's article on the clear benefit of combining IRS and LLINs).
- Given level or dwindling malaria funding, is support for IRS may be diminished. Ultimately, NMCPs decide what combination of interventions to deploy. However, IRS has not received the same advocacy as LLINs from the highest levels, and in order to reach the goal of near-zero deaths, IRS is needed. We should be implementing according to evidence of impact under the auspices of integrated vector control.
- There is concern that the vector control community is still pitting IRS against LLINs, despite the WHO imperative to operate under the auspices of integrated vector control.
- With the GPRIM recommendations, short-term costs of IRS will due to the higher costs of non-pyrethroid insecticides. There is potential that coverage will decrease, therefore improved targeting is essential.
- There is the potential to include an informational note to the TRP to present literature on the combined use of IRS and LLINs.
- At a minimum, this sub-group should distill the Hamel et al paper into a one-page summary and disseminate to the VCVG.
- Impact data collection not only helps guide programs in decision making (where to start spraying, where to stop, etc.), but it will also serve as a useful advocacy piece.

Priorities for IRS Work Stream Sub-Groups

Supervision, Monitoring & Evaluation Sub-Group

Participants: Shiva Murugasampillay (lead), Doris Youngs, Ranjith Alwis (Apologies: John Govere, John Bosco Rwakimari, Sam Awololo)

Issues:

1. **Evaluation**
   - Tanzania was looking for guidance for TOR and support for a mid-term program evaluation of the IRS program
   - Evaluation needs are different such as the needs of the national IRS program or PMI IRS projects but they need to be aligned around one evaluation
   - There are different types of evaluation. In Uganda PMI project there are quarterly and annual review against the annual plan
   - Need for defining the IRS standards and there is the ideal standards and the practical standards
   - A draft checklist is in place to guide the IRS program evaluation but we need a manual to go with the tools
   - AngloGold Ashanti has an IRS program audit tool which can be also used to help
2. **Supervision**
   - This is a weak area in programs and there is a need for an evaluation strategy and policy regards when and how.
   - Need to link the supervision tools with the training manual.
   - IRS programs are old and new but can also learn from the work on supervision in other health areas
3. **Monitoring**
   - No time to discuss

Objectives for 2012

- Finalize the tools for supervision of IRS programs and spray operations
- Finalize the manual for evaluation of IRS programs for work stream sub-groups.

Evidence & Reporting Sub-Group

Participants: Raj Maharaj (co-lead), Immo Kleinschmidt (co-lead), Elissa Jensen, Johnson Odera, Rune Bosselmann)

2012 Objectives & Activities

1. **IRS Systematic review on evidence of impact**
   - Update information collected as part of the Cochran review by Lengeler
   - Include articles not included in the Cochran review
   - Improve documentation for evidence & reporting as widely as possible
   - Identify target audience for reporting
   - Identify gaps in the data, shortfalls and challenges in the published literature

   Lead: Immo Kleinschmidt and Raj Maharaj
   Timeline: End October 2012

2. **Evaluating impact of IRS impact**
   - Conduct an analysis of available data
   - Identify gaps in the data
   - Standardise data collection tools and methods of data collection
   - Standardise key reporting indicators

Lead: Elissa Jensen
Timeline: February 2013

3. Guidelines for implementing IRS programmes

- Identify situations where IRS programmes can be initiated
- Define criteria for continuing implementing IRS programmes
- Identify circumstances where IRS can be scaled down or stopped.
- When can LLINs replace IRS to sustain low malaria cases?
- Can elimination be achieved without IRS?

Lead: Johnson Odera and Rune Bosselmann
Timeline: December 2012

Issues raised but not discussed:

- Targeting IRS ecologically, entomologically and epidemiologically – why, when, where and how to target IRS
- Ensuring routine annual country reporting on IRS, access, coverage, impact and quality
- Strategies for managing resistance within IRS programs
- Combining IRS with LLINs, larval control and space spraying
- Transitioning from IRS for malaria control to generic mosquito control

Training & Capacity Building Sub-Group

Participants: Manuel Lluberas (lead), Fabrizio Molteni, Ziad Akle, Inigo Garmendia, Dereje Dengela, Martin Akogbeto, Kim Vu, Bradford Lucas.

2012 Objectives & Activities

1. Identify sources and access to IRS operational and training manuals designed for mid-level managers, collect as many as possible and produce a harmonized and standardized manual (or produce if none can be located).
2. Identify consultant to dedicate time to complete number one above.
3. Identify programs with a training facility and look into the possibility of having them become a regional training facility. Training facilities are foreseen in Eastern Africa (Tanzania is a candidate), southern Africa (South Africa (is a candidate), West Africa (Nigeria?), Asia (Manila or Bangkok?) South America (Ecuador?).
4. Prepare curricula for use in these training centers based on the operational manual identified in number 1 above.
5. Designate funding for program managers to attend and present their programs at international conferences like the American Mosquito Control Association (late February of the year), the Society for Vector Ecology (in the Fall of the year), the European SOVE or similar.

Issues raised, but not discussed:

- How can national programs systematically conduct IRS funding and commodities gap analysis to support resource mobilization
- Innovation in IRS delivery – does IRS have to be done by an NMCP?
- Strengthening IRS program coordinators and IRS working groups

Advocacy & Financing Sub-Group

Participants: Richard Tren (lead), Steve Knowles, Robert Ainslie

2012 Objectives and Activities

1. Raise profile of IRS as key IVM intervention among ECOWAS Ministers of Health and WARN
2. Raise profile and visibility of IRS among African leaders, with a focus on co-financing of donor-funded IRS programs
3. Improve documentation of the business case for IRS and present to Chambers of Mines in West Africa
4. Prepare policy document on financial implications for IRS of insecticide resistance.

Issues raised, but not discussed:

- IRS funding and commodities gap analysis
- Tracking and advocating for increased funding for IRS
- Monitoring the threats to IRS and monitoring public perceptions of IRS

Commodities, Procurement & Supply Management Sub-Group
This sub-group could not convene due to absence of leads

Issues raised:

- Quality of insecticides being supplied that do not meet WHOPES standards, e.g. recent procurements by UNDP
- There are also quality issues of application equipment

Both of these issues will be followed up jointly with the RBM procurement and supply management group.

Final Conclusions and Summary – Dr. Richard Tren

Discussions

- Strong entomologic and epidemiologic evidence supporting IRS in high, moderate and low transmission settings
- Advocacy efforts have raised the profile of IRS at national, regional and international level. Compelling business case for private sector funding of IRS programs. Funding for IRS programs has increased, principally from US PMI and Global Fund
- Abundant training materials and IRS guidelines but urgent need to consolidate these documents, make available to spray programs, including in electronic format
- Presentations from Tanzania, Zanzibar, Uganda demonstrate impressive scale-up in IRS with evidence of rapid reductions in parasite prevalence

Key Issues

- When to scale up & scale down IRS?
- Standardizing indicators for IRS, including impact indicators
- Need to compile evidence through case studies, publications
- Donor funding has displaced local funding, urgent need to increase domestic IRS funding

- IRS funding has increased, but some GF money allocated for IRS remains unspent
- Cost implications of resistance will be considerable

Actions and 2012 Work Plan

Sub-Group: Evidence & Reporting

1. IRS Systematic review on evidence of impact
2. Evaluating impact of IRS
3. Guidelines for targeting IRS programmes (when to start, when to stop)

Sub-Group: Supervision, Monitoring & Evaluation

1. Finalize the tools for supervision of IRS programs and spray operations
2. Finalize the manual for evaluation of IRS programs for work stream sub-groups

Sub-Group: Training & Capacity Building

1. Harmonize, standardize IRS training manuals designed for mid-level managers
2. Identify programs with a training facility and look into the possibility of having them become a regional training facility. Training facilities are foreseen in Eastern Africa, southern Africa, West Africa, Asia, South America
3. Prepare curricula for use in these training centres based on the operational manual identified in number 1 above
4. Designate funding for program managers to attend and present their programs at international conferences like the American Mosquito Control Association (late February of the year), the Society for Vector Ecology (in the Fall of the year), the European SOVE or similar

Sub-Group: Advocacy & Financing

1. Raise profile of IRS as key intervention among ECOWAS Ministers of Health and WARN
2. Raise profile and visibility of IRS among African leaders, with a focus on co-financing of donor-funded IRS programs
3. Improve documentation of the business case for IRS and present to Chambers of Mines in West Africa
4. Prepare policy document on financial implications for IRS of insecticide resistance

APPENDIX

GROUP WORK GUIDE

Advocacy & Financing Sub-Group

Co-Chairs: Dr. Richard Tren/Dr. Patrick Moonasar

Purpose of group work is to continue to expand the network on individuals and institution to participate actively and contribute ideas, suggestions regards problems, challenges , solutions and in contributing to scaling and sustaining high quality IRS for malaria control and elimination. The group should review progress in the IRS work stream sub-group-IRS **Advocacy & Financing** products and plans for 2011 and develop products and plans for 2012.

2011 Objectives & Activities:

- To increase the financing for IRS

        - Private sector IRS workshop – raising profile of IRS in the private sector, increasing commitment to IRS
        - Increase public funding for IRS from Global Fund & other donors
        - Increase domestic funding for IRS
- To raise the profile of IRS (Mobilize AU, SADC, ECOWAS and other sub-regional groups on IRS)
- To enable the use of public health insecticide (Ensure ongoing availability and use of DDT and other insecticides for IRS)

Key issues for discussion for 2012 products and work plan

- IRS network and champions
- Who are the champions for IRS?
- How do we keep an IRS network active? E-mail, Blogs, Monthly scheduled teleconferences, annual conferences, secretariat?
- Case studies on IRS progress and impact
    - Is there sufficient information on the successes of IRS programs – if not, which case studies would best educate the public, funders etc. and advance the IRS agenda?
- Private sector IRS:
    - How to build on and expand private sector initiatives in Southern Africa?
    - How to establish a private sector hub for West Africa?
    - What should we be asking and expecting of the private sector? What should the private sector ask of RBM, donors etc?
    - Do we know how much IRS is conducted by private companies? If not, what sort of survey needs to be done?
    - AngloGold Ashanti in Ghana and Mozal-BHP Billiton in Mozambique are working models, are there opportunities for other mutually beneficial arrangements between national programs, private companies and major development partner
    - Are there new/different models for delivering IRS? e.g. NGOs, Private vector control companies , franchises etc ?
- Difference between long term IRS national programs and short term IRS projects
- IRS Funding and commodities gap analysis
    - How many people are currently protected by IRS? Do we have a target for increasing people protected?
    - Has any national program or organization done a needs assessment or funding and commodities gap analysis? If not, how should this be done, when and where? Can it be funded?
- Tracking and advocating for increasing domestic financing for IRS
    - Do we know the level of domestic funding for IRS? If not, can it be measured? Do we want to set a target for domestic IRS funding?
    - Who can be a champion for increased domestic IRS funding?
- Mobilizing additional international IRS financing from GF and DFID
    - Can we find champions for IRS funding from new/different donors?
- What are the threats to IRS and what can advocacy do to fix them?
    - Rising costs of insecticides, access to insecticides
    - Lack of trained personnel
    - Lack of domestic funding for IRS from African nations.
    - Global Fund focus on more effectiveness and efficiency and performance in investment
    - Uncertainty about continued donor funding from major G8 donors
- Public perceptions of IRS –What should IRS advocacy goals be?
    - Do we want to change perceptions in malarial countries or in donor countries?

Evidence & Reporting Sub-Group

Co-Chairs: Dr. Raj Maharaj/Dr. Immo Kleinschmidt

Purpose of group work is to continue to expand the network on individuals and institution to participate actively and contribute ideas, suggestions regards problems, challenges , solutions and in contributing to scaling and sustaining high quality IRS for malaria control and elimination. The group should review progress in the IRS work stream sub-group **Evidence & Reporting** products and plans for 2011 and develop products and plans for 2012.

2011 Objectives & Activities:

- IRS systematic reviews of entomological/epidemiological impact
- Retrospective multi-country review of selected IRS outcome and impact indicators
- Review and update list of insecticides currently used in IRS
- Review and update standard M&E procedures for IRS

Key issues for discussion for 2012 products and work plan

- Can we advise countries on when to start IRS, how long to continue IRS and the circumstances under which IRS can be scaled back or stopped?
    - In areas where there has been a rapid reduction in malaria transmission, are LLINs sufficient to sustain low malaria cases?
    - Can elimination or pre-elimination be achieved without IRS? If so, where, when and under what circumstances?
- Targeting IRS ecologically, entomologically and epidemiologically (Why, Where, When and How)
- IRS systematic reviews on evidence of impact
    - What are the priorities for improving documentation? Are we trying to show that IRS works or are we trying to show where, when and how IRS works best?
    - Who are we trying to convince with publications on IRS?
    - What are the shortfalls? Is there a lack of data or a lack of capacity to analyze and publish the data?
- How to ensure routine annual country reporting on IRS, access, coverage, impact and quality and supporting development of regional data bases on IRS?
- How do we evaluate impact of IRS impact (Defining end points and methods of data collections)
- What are the strategies for managing insecticide resistance within IRS programs?
- What is the evidence on use of combinations of IRS with LLINs, larviciding and space spraying for maximum vector control?
- When is the time for transitioning from IRS for malaria vector control to generic mosquito control

Training & Capacity Building Sub-Group

Co-Chairs: Dr. Manuel Lluberas

Purpose of group work is to continue to expand the network on individuals and institution to participate actively and contribute ideas, suggestions regards problems, challenges , solutions and in contributing to scaling and sustaining high quality IRS for malaria control and elimination. The group should review progress in the IRS work stream sub-group **Training & Capacity Building** products and plans for 2011 and develop products and plans for 2012.

2011 Objectives & Activities:

- Review/develop IRS Program Managers Regional Training Programs
- Produce national training program for spray operators
- Provide guidance on building structures, system and capacity building

Key issues for discussion for 2012 products and work plan

- IRS Operational manual & IRS Training manual and training materials
  - What are the minimum standards/ bench marks and guidance for delivery of national IRS programs?
  - Can training tools be upgraded – can video & animation be used?
  - What is min. standard of capacity by level for national IRS programs?
  - Has a needs assessment been done? If not, can it be done and at what cost?
  - Can we develope and use IRS capacity building assessment tools
  - What are main gaps? Who can fill them?
- IRS Southern Africa & West Africa regional training and support centres
  - Is a bricks & mortar centre needed?
  - Would a roving team and/or database of IRS trainers/supporters be more efficient & effective?
  - What sort of sponsorship could make these centres a reality?
- How can national programs be supported by simple IRS Planning and proposal development tool to support more effective long term strategic and annual IRS program planning and management
- How can programs systematically conduct IRS Funding and commodities gap analysis to support resource mobilization?
- Innovation in IRS delivery (private sector, NGOS etc)
  - Does IRS have to be done by an NMCP?
- How to strengthen country IRS program coordinators-TOR and Training
- How to strengthen country IRS Working groups (TOR, Chair, Secretariat, Composition, Functioning etc).

Supervision, Monitoring & Evaluation Sub-Group

Co-Chairs: Dr. John Govere /Dr. John Bosco Rwakimari

Purpose of group work is to continue to expand the network on individuals and institution to participate actively and contribute ideas, suggestions regards problems, challenges , solutions and in contributing to scaling and sustaining high quality IRS for malaria control and elimination. The group should review progress in the IRS work stream sub-group, **Supervision, Monitoring & Evaluation** products and plans for 2011 and develop products and plans for 2012.

2011 Objectives & Activities:

- Develop standard supervisory checklist
- Standardize minimum operational, entomological, epidemiological and social indicators for monitoring IRS
- Standardize tools, checklists for IRS program review, pilot in 2 countries.

Key issues for discussion for 2012 products and work plan

- IRS program and spray operation supervision tool
- IRS Program evaluations-audits
  - What sort of peer-to-peer reviews can be done on IRS programs?

- Is funding available for IRS program reviews – what regional/domestic funding could be leveraged?

Commodities, Procurement & Supply Management Sub-Group
Co-Chairs: Dr. Rabindra Abeyasinghe/ Dr. Gerhard Hesse

Purpose of group work is to continue to expand the network on individuals and institution to participate actively and contribute ideas, suggestions regards problems, challenges , solutions and in contributing to scaling and sustaining high quality IRS for malaria control and elimination. The group should review progress in the IRS sub-group products-**IRS Commodities, Procurement & Supply Management** and plans for 2011 and develop products and plans for 2012.

2011 Objectives &Activities:

- Develop lead time of 4 months supply planning for IRS chemicals & compression sprayers
- Simplify specification and standardize tender format for IRS chemicals & compression sprayers.

Key issues for discussion for 2012 products and work plan

- How can all program and partners be supported to work to use WHOPES specifications for insecticides and hand compression pumps?
- How program can be supported to developed five year and annual quantification of need in insecticides and equipment to support resources moblization and timely ordering and supply.
- Quality control of insecticide and pumps
  - Is there sufficient quality control & oversight at domestic level? Is quality of insecticide and/or pumps compromising IRS? If so, what can be done to improve oversight?
  - Are WHOPES approved quality assurance and quality control centres being used by countries and partner?
  - How do we address reported quality problems by manufacturers?

3rd Durability of LLINs in the Field Work Stream Meeting

Chair: Dr. Albert Kilian
Rapporteur: Dr. John Silver

Summary of Lyon Meeting – Dr. Albert Kilian

The Durability of LLINs in the Field work stream session commenced with an update on the outcomes of the recent meeting in Lyon with textile experts and manufacturers.

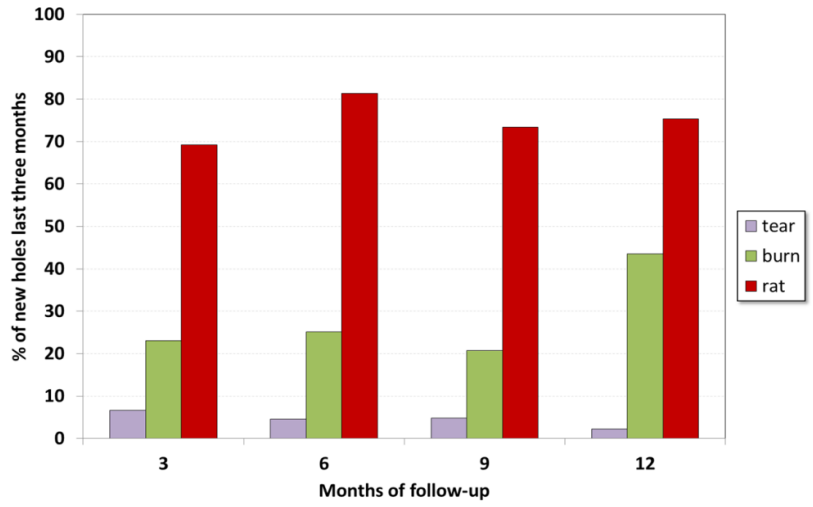
The meeting was convened in response to the increasing interest in including quality (durability) as criteria in LLIN procurement decisions and the need to therefore have available precise and accurate data on cost/useful life, or alternatively laboratory test(s) that reflect performance in the field and support minimum standards and grouped specifications. Two key objectives of the meeting were:

- To understand current conceptual and methodological issues around “durability”

- To review existing options of textile testing that would better reflect the real life situation

Determination of durability in the field requires knowledge of the combination of attrition due to damage and the proportion of surviving nets that are still "functional" or "not too torn". Cross-sectional surveys can measure attrition and integrity if done well but have problems associated with reliance on owner recall. Prospective studies are good at measuring integrity but seriously underestimate attrition as nets are kept longer than normal. We have currently no good methods to distinguish cause of holes through surveys (need qualitative approaches).

Available field data show that there is high variation in net performance between geographic areas, between villages (clustering), and within households. Behavioural and non-product related factors are significant (burn holes, rodent damage).



Field studies reveal that there are four principal initial causes of holes: tears, burn holes, animal damage, opening seams. It is possible that pre-damage through other factors related to ageing (Heat, abrasion, chemical, UV) could be important. Only if textile testing reflects the dominant stress on net (modes of failure) will there be a correlation between lab results and field data.

A range of currently available textile testing methods were described, including: burst testing, shrinkage, tensile testing with hooks, dynamic or slow nail testing, fire tests, and abrasion testing. A combination of several of these tests may lead to a test that better mimics durability in the field.

The Lyon textile meeting concluded that the way forward is to:

- Collect well-defined field data from representative locations ASAP in accordance with WHO-GMP guidelines to be analyzed for attrition, physical condition and tested in lab
- Develop methods (validated field tools) to distinguish cause of holes in the field in early phase of destruction
- Evaluate the actual proportional contribution of each "mode of failure". Then determine suite of (weighted) tests reflecting cause pattern
- Target is to have minimal standards (cut-off) for different aspects of net performance set by WHOPES
- Find better ways to define the magnitude of rodent problem and options for interventions

Discussion

The issue of the importance of rodent damage in rural locations was discussed extensively. Rodents appear to damage the net from all sides, top and bottom. They do not appear to eat the net, but do appear to take the material away, possibly for nest-building. Anecdotal evidence suggests that rodent damage is not an issue in Kenya and therefore more data is required and mechanisms developed to identify the extent of rat infestation in a specific area.

A question was raised regarding whether there was any evidence that net owners repaired damaged nets. In response, it was noted that there are few published data, but the rate of repair appears to be very low, and efforts are ongoing to better understand the reasons for lack of maintenance. There is no apparent difference in the incidence of maintenance of nets depending on whether nets were obtained free of charge or purchased by the owner. A study in Nigeria will look at the potential for increasing lifespan of nets through maintenance and repair.

The ease with which the cause of damage to nets can be accurately identified in the field was discussed and it was concluded that this can be done if inspectors are well trained, but ideally it would be better to develop some form of independent microscopic identification of causes. Asking owners why there is a hole in their net may not provide accurate information.

WHOPES is currently reviewing the guidelines for pesticide procurement and it was suggested that this would be a good opportunity to reflect some of the recent findings on net durability in the document.

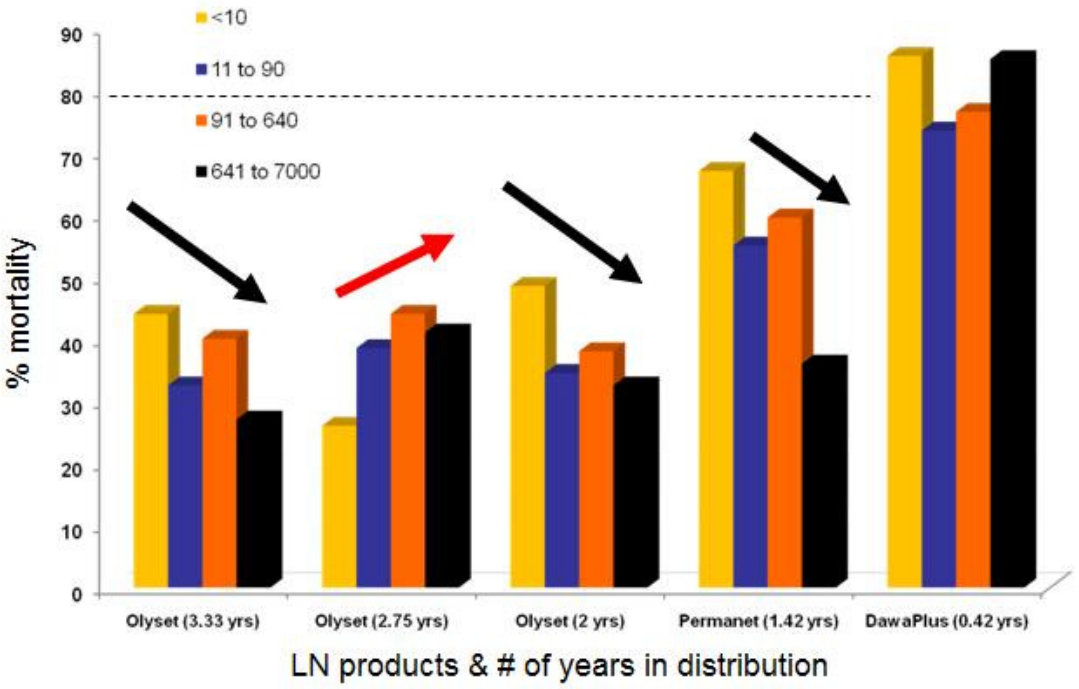
Effective Lifetime of LLIN Mass Distributions – Dr. Olivier Briët

This presentation described the results of a modeling study to determine some of the factors that affect the effective lifetime of a mass net distribution. Model parameters included intensity of transmission, attrition of nets, net coverage and utilization, various aspects of mosquito behaviour, rate of hole formation, among others. The annual Entomological Inoculation Rate at the commencement of the distribution was found to be the most important factor in determining the effective lifetime of the distribution. In conclusion, the required frequency at which mass LLIN distributions need to be undertaken varies more with the local entomological situation than with LLIN quality.

Monitoring LLIN Durability in Palawan – Dr. Jeffrey Hii

Data on retrospective field studies of durability of three LLIN products in the Palawan islands were presented. Household interviews revealed that LLINs are widely used, with 75-95% of respondents reporting sleeping under the net every night throughout the year. Burn holes and holes formed at the hanging point were the commonest forms of net damage observed across all net products.

A comparison of hole index with mortality in bioassay tests revealed that increasing hole indexes correlate with decreasing bioefficacy of LLINs, albeit with a few exceptions.



Discussion

Participants noted that the number of holes was similar in younger and older nets and this suggests that most damage appears to occur at the beginning of use, perhaps due to nets being novel to the users.

The dirtiness of nets does not appear to affect bioefficacy and this was also observed in studies in Uganda.

Assessing the Durability of LLINs – Dr. John Gimnig

Data were presented on LLIN durability studies in several PMI-supported countries. The studies on several net products revealed no correlation between the number of holes or the hole index with fabric type (polyester vs. polyethylene); denier; or burst strength.

The presentation also described a collaboration between CDC and North Carolina State University College of Textiles (Raleigh, NC) to design laboratory test methods that predict LLIN deterioration rates, with: Minimal changes to ISO methods and instruments; and rapid and reproducible results. Results should be available by September 2012.

Field Data from Uganda and Chad – Dr. Albert Kilian

Data were presented on hole index and attrition rates for 75 and 150 denier nets used by refugee communities in Chad. Some data from a cross-sectional study in Uganda looking at the effect of

physical condition of nets on parasitaemia in children under five were also presented. Preliminary results suggest that there is no clear association between physical condition of nets and childhood parasitaemia.

Discussion

Participants raised the question as to what could the work stream feasibly contribute in the next 12 months, given the lack of funding from RBM. The following activities were proposed:

- Follow-up results of the Lyon textile meeting
- Ensuring that available information, publications and studies are shared
- Networking and coordinating studies and sharing information

It was suggested that the Global Fund should be a key audience for this type of information, in order that it can be factored into procurement decisions, instead of relying solely on price, as is currently the case. It was noted that high level discussions are now taking place and there is increasing recognition that the cheapest price should not be the only factor in procurement decisions.

Establishing standards for net durability and developing categories of performance (minimum / good / excellent) is critical as this would allow for standards to be applied to new products in the pipeline, not just existing products. Establishment of standards is likely to take a minimum of 12 months.

Albert Kilian expressed his willingness to continue as Chair of the work stream, but invited members to submit an interest in the position of co-chair.

Final Conclusions and Summary – Dr. Albert Kilian

Discussions

- Update on the Lyon textiles meeting
- Update on field results on LLIN durability

Key Issues

- Current absence of correlation between lab and field data (especially bursting strength) linked to high variability and uncertainty in relation to behavioural and ecological factors, including incidence of burn holes and rodent damage to nets
- A wide variety of potential tests exist or can be created that can simulate any potential mechanism of damage
- Only if textile testing reflects the dominant stress on net (modes of failure) will there be a correlation between lab results and field data
- Need to analyze damaged nets in the lab to verify the exact modes of failure and their respective contribution
- Physical durability is more important than insecticidal deterioration in determining durability of nets in the field

Actions and 2012 Work Plan

1. Follow-up textile meeting and support collecting or making available of nets for testing and development towards improved textile standards

2. Improve field methods to specify cause of holes
3. Explore potential of BCC interventions
4. Encourage and support studies on epidemiological effects
    - At which level of holes + insecticide does protection cease
    - What determines entry of vector into torn nets
5. Networking, advocacy and dissemination
6. Establish work stream co-chair

3rd Larval Source Management Work Stream Meeting

Chair: Prof. Steven Lindsay

Rapporteurs: Ms Lucy Tusting & Dr. John Silver

Summary of 2nd Meeting, Philadelphia, December 2011 – Prof. Steve Lindsay (LSHTM)

Steve Lindsay briefly summarised the main conclusions of the 2nd meeting.

Cochrane Review of LSM for Malaria Control – Ms Lucy Tusting (LSHTM)

Lucy Tusting gave an update on the Cochrane Review, the objective of which is to compare mosquito larval source management (excluding biological control with fish) for malaria control with no larval source management, applied either alone or in combination with other malaria control interventions. 13 studies are eligible for inclusion in the final analysis. There is evidence that LSM is associated with a 69% reduction in incidence (95%CI 58-77% (in six studies) and a 75% reduction in prevalence of parasitaemia (95%CI 49-88%) (six studies). There is no evidence for a significant reduction in prevalence of splenomegaly (three studies). Due to unreported data, meta-analysis is not possible for the following entomological outcomes: EIR, human biting rate, density of adult anophelines.

Preliminary conclusions are that LSM reduces morbidity from malaria where breeding sites are fixed, discrete and easily identifiable; therefore, in some settings LSM may complement other methods of vector control in malaria control and elimination programmes. However LSM requires major financial, technical, and operational inputs. The main limitation of the review is the lack of well-conducted trials. Participants were requested to help contact study authors to collect further data. The final steps are to finalise the entomology data, submit a draft review (end February 2012), update the search and submit for final review. The authors are: John Gimnig (CDC), Julie Thwing (CDC), Steve Lindsay (LSHTM), Ulrike Fillinger (LSHTM), Lucy Tusting (LSHTM), Kimberly Bonner (CDC), Rob Newman (WHO) and Christian Bottomley (LSHTM).

2011/2012 Work Stream Deliverables – Prof. Steve Lindsay (LSHTM) and Dr. Shiva Murugasampillay (WHO)

The Work Stream was allocated funding from RBM for four 2011 deliverables:

a. 2nd meeting at ASTMH, Philadelphia, December 2011
b. Decision-making framework for deciding if LSM should be used
c. Country case-studies on LSM
d. Operational manual on LSM

The first task was completed in December 2011. The completion date for the remaining three has been postponed (with agreement from RBM) until the end of April 2012, to allow the results of the Cochrane Review to be taken into account. Steve Lindsay and Shiva Murugasampillay presented draft structures for these three deliverables to gain input from the Work Stream.

Decision-Making Framework

The decision-making framework will be a booklet designed for program managers to assist in decision-making on whether LSM should be considered for vector control. A possible template for this would be the Insecticide Resistance Action Committee (IRAC) 2011 publication 'Prevention and Management of Insecticide Resistance in Vectors of Public Health Importance'. The following structure was proposed:

- What is LSM?
- Evidence for efficacy
- Economics of LSM
- Minimum requirements before embarking on LSM
- Where to do LSM and where not to
- When to start LSM and when to stop
- What's needed for implementation
- What's needed for monitoring
- Role in IVM

Discussion

The following were considered by participants to be important: (1) basic product characteristics, (2) an emphasis that this handbook is only for malaria and (3) differentiation between urban and rural. It was also suggested that advice on the selection of methods and materials for LSM (e.g. environmental modification vs larviciding) could be included. The framework should also describe how LSM can be integrated into general city improvements and emphasise that LSM is not a standalone intervention. The framework could highlight where there is likely to be the greatest need for LSM, i.e. locations where LLINs and IRS have reached their maximum practical effect and in situations where LLINs and IRS are insufficient. As malaria declines, LSM will play a role in targeting 'hot spots' of transmission. LSM should be integrated into the control of other insects and disease vectors. Participants also noted that outdoor transmission is significant in some places; the community must take charge of LSM in the context of IVM because the old, colonial vertical style of management no longer has a place; and local ecology is very important in deciding where LSM is appropriate.

Participants were informed that with regards to the WHO position statement, around 100 people were consulted, of which around 50 replied. Comments have been taken into account and the latest draft is very different to previous drafts. The position statement originated from the position that the question was not whether or not LSM is appropriate, but a question of where it is and is not indicated. These areas need to be conservatively described. It is generally agreed that LSM will be most effective where breeding sites are few, fixed and findable, but it is not yet clear how best to identify these areas. However LSM is likely appropriate in urban and highly arid areas. The latest draft has also evolved to focus on larviciding and Africa only, due to the huge diversity of vector species worldwide. The suggestion of extracting data from the studies rejected for the Cochrane review is considered useful in this respect.

It was noted that because larvicides constitute a wide range of substances they may therefore be a useful tool for the management of insecticide resistance. It was noted that when deciding where LSM should be conducted, whether or not it will work is a more important factor than whether or not there is a need due to factors such as insecticide resistance.

Caution was advised when considering whether or not to set up a LSM program. It would be sensible to begin LSM in country by building up infrastructure for LSM in urban areas, where LSM will more likely be effective but where there is not necessarily high malaria transmission or a resistance problem.

Case-Studies

These will be exemplars of what it takes to run a successful LSM program for those interested in establishing a LSM program. The following locations were suggested: (1) Malindi, Kenya, (2) Dar-es-Salaam, Tanzania, (3) Zambia and (4) India (LSM in Urban MCP). The case-studies could have the following structure:

1. **Background**: topography, climate, urban or rural, primary and secondary vectors, main type of breeding sites, local health system
2. **Description of intervention**: baseline mapping, type of LSM, frequency and duration of application, structure of program, funding, community involvement
3. **Data on co-interventions**: e.g. coverage with LLINs, MDA
4. **Effect of intervention**: baseline and post-intervention data on human clinical and entomological outcomes

Other case studies suggested by the Work Stream were (1) Mauritius, (2) winter larviciding in Swaziland, (3) Niger, (4) dengue in South America, (5) the Amazon, (6) Angola, (7) Nigeria, (8) Cape Verde, (9) Oman.

LSM in Khartoum, Sudan – Mr Hmooda Toto Kafy (NMCP)

Hmooda Toto Kafy gave a presentation on the LSM program in Khartoum, Sudan, the aim of which is to reduce parasite prevalence in the city (population 6m) to less than 0.1%. The LSM program has significant community participation and political support and an annual budget of US$600,000. It relies on the repair of broken water pipes, removal of water basins by law, environmental management, biological control with *Gambusia* fish, use of intermittent irrigation and clearance of irrigation canals. It has had a significant impact and parasite prevalence declined from 7.8% to 0.4% between 1995 and 2008, alongside a reduction in the incidence of reported malaria.

Discussion

It was suggested that in the programme described, nuisance biting by *Culex* mosquitoes may be driving community involvement.

A participant noted the similarities with the Chagas elimination program in South America

It was pointed out that if the target population is 6m, and the annual cost is US$600,000, then the program has a low annual cost per person (US$1).

Participants were informed that amongst the responses to the position statement, it was interesting to see that of those in favour of LSM, some thought community support was important while others thought the community cannot be relied upon to target LSM in the right place.

A proposal to post a YouTube video of the Khartoum presentation was made.

Operational Manual

Shiva Murugasampillay presented a draft outline of the operational manual, which will be a complete toolkit for program managers, detailing what is required for LSM. The distinction was made between policy (what should be done and why) and operational guidance (how LSM should be conducted and to what coverage and standard). Since LSM is already being conducted on a large scale, this operational manual will help ensure that it is done efficiently and of the right coverage and quality.

The purpose of the manual is to provide step-by-step operational guidance on the overall management of an LSM programme, together with practical guidance on larvicide application and environmental manipulation and modification, to enable national programmes to:

- develop or refine strategies and operational tactics;
- develop or update training materials;
- conduct LSM programmes;
- review coverage, quality and impact of LSM programmes.

The manual will have the following chapters:

i. Introduction
ii. Chapter 1 (POLICY): objectives, indicators, outcomes and impact (policy, strategy and standards) - for national policy makers and programme managers.
iii. Chapter 2 (MANAGEMENT): LSM program planning, organization and management, including stewardship and safe use of larvicides - for both national programme managers and district LSM coordinators.
iv. Chapter 3 (IMPLEMENTATION): application guidelines - mainly for district LSM coordinators, supervisors and field team leaders.

The suggested content for the chapters was as follows:

Introduction
(1) Malaria control and elimination, (2) vector control for malaria control, (3) vector control for other vector borne diseases, (4) vector control for mosquito control, (5) integrated vector management, (6) urban malaria control, (7) larval source management for malaria control & elimination, other vector borne diseases and mosquito control .

It would be logical to use previous WHO manuals on environmental management to avoid replicating work [e.g. WHO (1982) Manual on Environmental Management for Mosquito Control; Lindsay, S. W. et al (2004) Environmental management for malaria control in the East Asia and Pacific (EAP) Region]. Old documents on insecticide resistance could also be added as annexes.

It was noted that a fundamental issue is whether or not this manual will focus on 'mosquito abatement' or 'anopheline mosquito control' and it was pointed out that in urban settings it is not possible to conduct anopheline control alone. It is necessary to target culicines also, since the local population will not understand the difference between species. It was also suggested that the manual should not focus on general mosquito abatement or the reduction of nuisance biting, but simply highlight these as issues.

Participants suggested the following for inclusion / reflection in the manual: a Programmatic Environmental Assessment of larvicides; importance of political support; importance of monitoring; importance of community compliance, especially when water treatment, for example, is involved;

some discussion of environmental regulations; the role of LSM in managing insecticide resistance; more detail on different vector species.
It was suggested that the order of the three main chapters could be reversed and monitoring methods added to the end of each.

A question was raised as to why LSM in rural areas is not included. In response, it was noted that the evidence for the efficacy of LSM is questionable in rural areas; however, there are some examples of LSM being appropriate in rural areas. It is sensible to begin LSM programs only where they will be most effective i.e. urban areas. The manual could have a chapter on rural LSM.

Chapter 1 - Policy
(1) definitions of LSM, (2) mosquito life cycle and morphological features of target larvae, (3) goals and objectives of LSM, (4) performance framework with indicators on input, process, output, outcome, (5) evidence base for integration of LSM (vector ecology, malaria transmission ecology, physical environment, demographics, economics, health system and national program capacity), (6) decision making for LSM (why, where, when, operational synergies with other interventions such as IRS and LLIN, role in urban areas).

The use of a ratio measure, e.g. population per breeding site (i.e. the more people per breeding site, the more cost-effective LSM will be) would be a useful addition. High population density was important in the success of the rural Kenya study [Fillinger et al 2009. Integrated malaria vector control with microbial larvicides and insecticide-treated nets in western Kenya: a controlled trial. Bull WHO 87:655-665]. However there is not yet a rule of thumb for this. One possible rule of thumb might be that LSM will be most effective in areas of high population density (i.e. urban areas).

The operational strategy for LSM needs to be laid out in this chapter.

Chapter 2 - Planning and Management
- Situation analysis and baseline surveys
  - Adult anopheline surveys
  - Larval surveys: identification and mapping of water bodies and larval breeding sites (GPS, GR); larval sampling methods (location, access, size-hectare, number and productivity)
  - Epidemiological survey
  - Mapping population at risk: density and distribution of households and related human activity
  - Establishing a database
- Selection of target areas for LSM (large scale or limited)
- Selection of LSM methods and tools, application equipment
- Planning, organization and delivery of LSM programs
- Inter-sectoral collaboration – links with local government, agriculture department, etc
- IEC and community mobilization (communities & schools)
- Recording, reporting and monitoring and evaluation

The advantages of aerial application could be added to this chapter. The importance of sensitisation of the local community should be emphasised (IEC). Political commitment is also important because it is required for inter-sectoral collaboration.

It was suggested that a short and accessible SOP of 'how to do LSM' is necessary to prevent the manual becoming too long.

Chapter 3 – Implementation
Step 1. Finding and recording larval source habitats

Step 2. Reporting on pre-management larval and adult surveys
Step 3. Community information, education and mobilization
Step 4. Prioritizing habitats for modification and manipulation
Step 5. Treating larval source habitats
Step 6. Reporting on habitats modified, manipulated or treated
Step 7. Reporting on post-management larval and adult surveys

Discussion

It was suggested that specific technical details must be documented in this chapter for different larvae species e.g. type of larvicide, frequency of application. It must also be stated that supervisors must check sites post treatment. However, it was also felt that the manual should be fairly general because vector species are so variable. Due to the complexity involved in the selection of control materials and tools, this section needs to be reviewed in great detail. It was noted that a program manager considering buying a product would not seek advice from a long RBM document, but instead would want shorter term, shorter documents on specific products from WHO, and this was suggested as a role for WHOPES; however, it was noted that WHOPES will not recommend specific products for purchase, it will simply test products. It was felt that the manual must still recommend products recommended by WHOPES. The importance of emphasizing data collection and operational reporting in the document was acknowledged; however, it was noted that attempts to collect data from countries using a standardised form on LSM activities in 2011 were not fruitful. This data would be very useful if it could be collected because it is not currently clear what is being done in different countries.

A first draft of the operational manual should be ready by the end of April.

Bibliography
Cochrane review, WHO documents, country documents, private sector documents, LSM pilots and case studies

Annexes
Sample larval survey forms, larval treatment forms, LSM supervision check list

The following will be consulted in the drafting of the manual: country programs, WHO teams, research and academic institutions and the private sector.

The following volunteered or were nominated to contribute to the manual:

Introduction
Lucy Tusting (LSHTM)
Rose Peter (Arysta Life Science / Nexvet)
Steve Lindsay (LSHTM)

Chapter 1 – policy
Charles Mbogo (KEMRI)
Chioma Amajoh (Ministry of Health, Nigeria)
Shiva Murugasampillay (WHO)

Chapter 2 – planning and management
Aramis Martinex Arias (Labiofam)
Chiomah Amajoh (Ministry of Health, Nigeria)
Norbert Becker (German Mosquito Control Association)

Steve Lindsay (LSHTM) (standard operating procedure)
Ulrike Fillinger (volunteered by Steve Lindsay)
(Michael Macdonald also suggested partners from US mosquito abatement)

Chapter 3 – Implementation
Egon Weinmueller (BASF)
Hmooda Toto Kafy (NMCP, Sudan)
Jacob Williams (RTI)
Peter DeChant (VBC)

Steve Lindsay thanked all participants. The date of next meeting is to be decided.

Final Conclusions and Summary – Mr Hmooda Toto Kafy

Discussions

- Cochrane review update. Results indicate that LSM can reduce morbidity where breeding sites are fixed, discrete and identifiable
- Update on LSM programme in Khartoum. LSM associated with a reduction in parasite prevalence from 7.8% to 0.4%. Full results to be documented and published

Actions and 2012 Work Plan

1. Booklet to support decision-making on use of LSM for NMCPs and NGOs. Additional contents suggested by work stream members: Selection of methodologies and materials for LSM, integration of LSM into other sectors (e.g. city improvements), role of LSM in targeting hot spots and in managing resistance, importance of community
2. Country case studies on LSM. Proposed: Malindi (Kenya), Dar-es-Salaam (Tanzania), Zambia, India. Additional suggestions from work stream: Mauritius, Swaziland, Cameroon, Niger, Amazon, Cape Verde
3. Operational manual on LSM for programme managers (lead: Shiva Murugasampillay)

4th Optimizing Evidence for Vector Control Interventions Work Stream Meeting

Co-chairs: Prof. Christian Lengeler & Dr. John Gimnig
Rapporteur: Dr. John Silver

Durable Wall Linings – Dr. John Gimnig

The presentation described a CDC randomized trial of insecticide-treated wall linings in western Kenya. The study was conducted in six pairs of villages, with one village in each pair randomized to receive wall linings. All households had ITNs. 1700 house structures were fitted with wall linings. There was no evidence of pyrethroid resistance at the start of the study. Adjusted protective efficacy of wall linings and ITNs against ITNs alone was 38% overall, 31% in children aged 6 months to 4 years, and 42% in children aged 5-14 years.

Participants were also informed that a study on durable wall linings planned to commence in Liberia had been stalled due to detection of high levels of pyrethroid resistance, in spite of an absence of vector control for many years. It is expected that the trial could recommence within 12 months with a non-pyrethroid insecticide.

Discussion

It was suggested that the reported effects of the Kenya study may be somewhat conservative, given that the study villages are small and close to each other.

It was acknowledged that the future of durable wall lining products treated with deltamethrin is likely to be limited; however it is important that trials continue in order to obtain proof of concept and support the development of guidelines and indicators prior to introduction of wall linings as a new category of intervention.

Spatial and Individual Repellents – Dr. Sarah Moore

Results of studies to determine the potential for use of repellents as a complementary intervention to address residual malaria transmission were presented. Results of trials of topical repellents in Pakistan, Bolivia, Peru/Ecuador, Thailand and Tanzania are variable, with significant protection reported in Pakistan (*P. falciparum* and overall malaria) and Bolivia (*P. vivax* only).

As a result of the difficulties of ensuring compliance and correct use of topical repellents, spatial repellents may ultimately be a preferable option. The presentation described the aims and objectives of the Advancing Repellents to Recommendation (ARR) team, as follows:

Aim: To attain formal acceptance and recognition for the use of spatial repellent strategies from global health authorities as a valuable vector control tool for disease transmission intervention, by providing the evidence needed for decision making

Objective 1. Document spatial repellency (SR) as an effective mechanism of action for vector control

Objective 2. Demonstrate a spatial repellent will impact disease at community level

Results of a recent trial in China of transfluthrin coils alone, or in combination with LLINs against both *P. vivax* and *P. falciparum* were presented, showing good protective efficacy.

	Control	Coils	LLINs	Coils + LLINs
P. falciparum Incidence (1000 person years)	6.45	1.46	0.55	0.36
Odds Ratio of being *P. falciparum* positive (95% Confidence Interval [CI])	1	0.23 (0.10, 0.49)	0.09 (0.03, 0.28)	0.05 (0.01, 0.23)
Age-adjusted OR (95% CI)	-	0.23 (0.11, 0.50)	0.09 (0.03, 0.28)	0.06 (0.01, 0.23)
p-value§	-	0.0002	<0.0001	<0.0001
Protective efficacy (95% CI)	-	77% (50, 89)	91% (72, 97)	94% (77, 99)
P. vivax Incidence (1000 person years)	7.00	1.46	1.66	0.53
Odds Ratio of being *P. vivax* positive (95% Confidence Interval [CI])	1	0.20 (0.09, 0.44)	0.21 (0.10, 0.47)	0.07 (0.02, 0.24)
p-value	-	<0.0001	0.0001	<0.0001
Protective efficacy (95% CI)	-	80% (56, 91)	79% (53, 90)	93% (76, 98)

§ P-values for unadjusted and age-adjusted odds ratios were identical.

Outdoor Malaria Transmission and Repellents – Prof. Marc Coosemans

The design of a study to determine the added value of repellents to LLINs for malaria control / elimination in Cambodia was presented. The study includes entomological, epidemiological and social science components.

Added Value of Combining IRS and LLINs – Dr. Sarah Moore

Results of an experimental hut trial in Tanzania were presented. Combining LLINs and IRS tended to increase the number of mosquitoes collected in exit traps, except in DDT sprayed huts. Icon Life was the most effective LLIN, killing twice as many mosquitoes (adjusted analysis). Actellic ™ was the most effective IRS insecticide with excellent overall mortality (adjusted analysis). There was limited extra advantage of combining LLINs with DDT; however, combining untreated nets with DDT was advantageous. These entomological results are in agreement with clinical data that show >50% less risk of malaria among those using LLINs and living in sprayed houses, relative to those living in sprayed houses but not using nets, as reported in Bioko and Zambezia:

Bioko: Bendiocarb IRS + deltamethrin LLINs; OR = 0.46, (95% CI = 0.76–0.81)
Zambezia: DDT IRS + Olyset or PermaNet; OR = 0.34 (95% CI = 0.21–0.56)

IRS and LLINs in combination in Tanzania – Dr. Mark Rowland

Results of a study being conducted in Muleba district in rural Tanzania was presented

Study design

	Year 1: Baseline	**Year 2: Intervention**
Arm A	IRS+LLINs	IRS+LLINs
Arm B	IRS+LLINs	LLINs

Hypothesis
The two study arms will show equivalence (non-inferiority) in terms of malaria prevalence and anaemia.

The primary outcomes include: Prevalence of malaria infection in children 0.5-14 years and Mean haemoglobin (g/dL) in children under 5 years. The secondary outcomes include: EIR, vector density, insecticide resistance; Perception, acceptance and usage of LLINs and IRS; Seroconversion rate.

Preliminary results from the pilot and baseline surveys indicate relatively high levels of parasite prevalence (23% in July), despite IRS coverage of 95% and ITN coverage of 93%. Insecticide resistance testing revealed the following mortality data in *Anopheles gambiae* s.l. across clusters:

0 to 38% to lambdacyhalothrin
12 to 40% to DDT
11% to permethrin (tested in 1 cluster only)
72 to 90% to the carbamate bendiocarb
As a result of high resistance, bendiocarb is being used in year 2 of the study.

Discussion

It was noted that in the 2nd year of the study, the IRS compound is changing from lambda-cyhalothrin to bendiocarb and then IRS is being withdrawn. This will make it more difficult to disentangle the results of these two changes.

Update on Effectiveness of Combined Vector Control – Dr. Immo Kleinschmidt

The design of a two-arm study comparing LLINs with LLINs + IRS in Sudan was described. Initially, the study was designed as a three-arm study, but the IRS alone arm had to be removed following a universal coverage LLIN distribution campaign. Randomisation was restricted to ensure that the study arms were balanced on the following cluster specific indicators: baseline prevalence of infection, existing ITN use, kdr frequency, cluster population size and proximity of health facility (y/n)
66 clusters (33 in each study arm) have been randomly selected as sentinel clusters for collecting phenotypic insecticide resistance data. Preliminary data indicate 1,242 confirmed malaria episodes from 6,021 person years of follow-up, with an overall incidence of 206 per 1000 person years. Overall reported net usage by cohort members is 86%.

Steve Lindsay very briefly described a new trial being undertaken in the Gambia. The trial will be a two-arm study comparing LLIN and LLIN + DDT IRS. 73 village clusters have been selected with 2km separation between villages. 7800 children aged 6 months – 13 years have been recruited and LLIN and IRS coverages are at 80% and 90% respectively. Initial data are due next year.

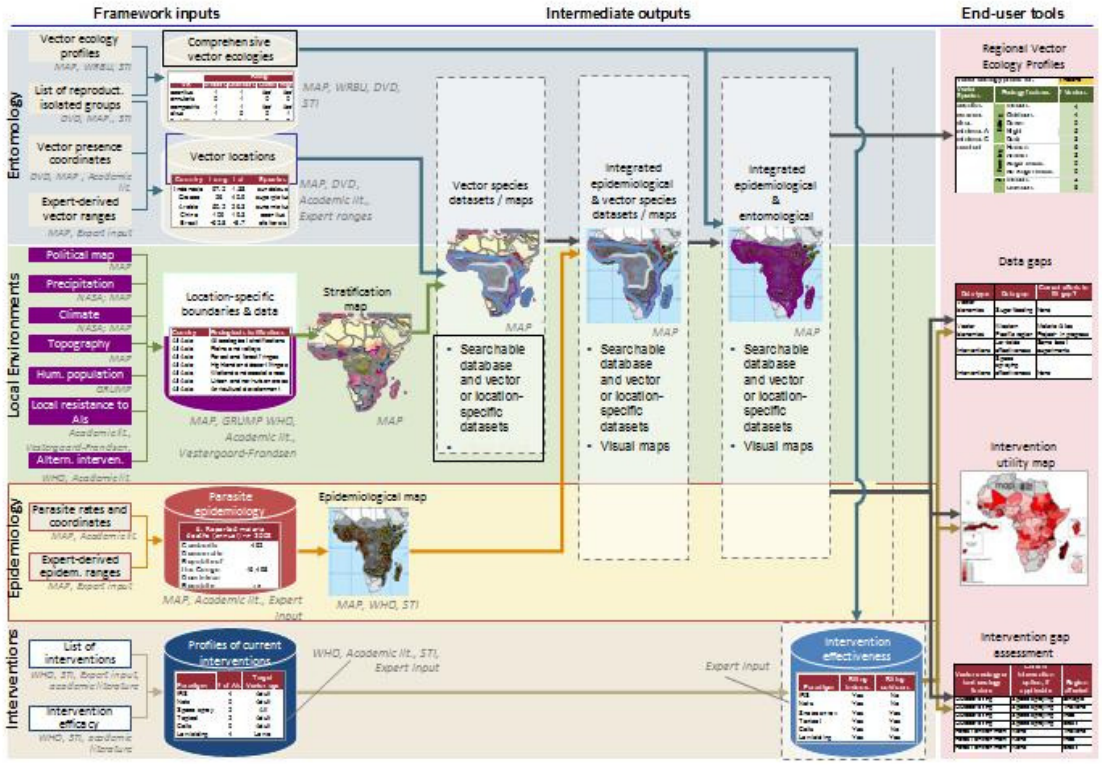
Discussion

Participants acknowledged that the preliminary results from these trials show promise, but the next step is to move towards providing appropriate guidance to national programme managers on how to implement this combination intervention. This needs to be included in the work stream work plan.

Vector Ecology and Control Network VECNet – Dr. Tom Burkot

Tom Burkot described the composition and goals of VECNet. VECNet is a consortium of institutions to analyze malaria transmission and its reduction by one or several vector control interventions. The goals are to:

1. Establish a Digital Library of malaria-specific data
2. Establish an Integrated Modeling Platform
3. Analyze data to estimate the potential impact of vector control tools on a spatially explicit scale



VECNet will comprise data on entomology, environment, epidemiology and interventions and will incorporate several end-user tools to facilitate detailed analysis at different geographical scales. Participants were invited to contribute data to the VECNet Digital Library and use the data to run simulations.

New Intervention Paradigms – Dr. Tom McLean

Tom McLean presented on the work of the IVCC towards developing a framework for validation of new intervention paradigms and product categories in vector control interventions. The purpose of the framework is to: guide our thinking and that of our collaborators, stakeholders and funders as to the type and scale of evidence, supporting activities and technology development at each stage of the development of new vector control intervention paradigms and product categories in order for new ideas to grow efficiently from concept to established intervention.

The distinctions between intervention paradigms, product categories and products were described, followed by a description of the stages in development of a new product, namely:

- Development of Intervention Concept and Draft TPP
- Proof of Concept
- Verification of Epidemiological Efficacy and Confirmation of TPP
- Policy Endorsement and Product Category Adoption

Discussion

It was proposed that in future, wherever a randomized control trial is conducted, it should include an economic analysis. At early stages of product development, the intervention is often not economically

cost-effective, as was the case with LLINs initially. However, use of robust economic analysis would show that costs could potentially be brought down over time, or that benefits are sufficiently long-lived to enable amortization of costs over a sufficiently long period. If the benefit is large enough, then donors could potentially step up even where costs are initially considered to be 'too high' (e.g. the case of switching from CQ to ACTs).

It was noted that there are two key opportunities for donors to intervene in the development process, namely at the R&D stage, and in post-production funding. There are whole series of new formulations and novel products in pipeline that would not have been possible without use of donor money to absorb risk at early stage. On track to develop 3 totally new chemical modes of action by 2020. Exciting.

Manufacturers expressed some concerns that there are already enough rules out there inhibiting manufacturers from bringing new technologies to market and that a new framework was not required. In response it was stated that the framework is designed to offer a process to facilitate a smooth and more rapid transition to a WHO policy statement, which is ultimately what we all want to see.

Key Issues

- High levels of LLINs everywhere means it is no longer possible to have an IRS-only comparison group; major implications for all new Vector Control products
- Fast development of resistance to pyrethroids has significant implications for IRS study arms (not much we can do in relation to LLINs)

Final Conclusions and Summary – Dr. John Gimnig

Key Issues

- High levels of LLINs everywhere means it is no longer possible to have an IRS-only comparison group; major implications for all new Vector Control products
- Fast development of resistance to pyrethroids has significant implications for IRS study arms (not much we can do in relation to LLINs)

Actions and 2012 Work Plan

1. Consensus statement on the combination of LLINs with IRS
2. Follow up progress with current studies /trials and determine when appropriate to present review of the work
3. Continued involvement in development of IVCC framework for new VC paradigms
4. Participation in wider efforts to shape VC development pipeline initiated by WHO/GMP
5. Assess significance of rapidly developing resistance to pyrethroids for the testing of new VC tools
6. Harnessing the power of modeling for answering specific questions on evidence of impact of new VC interventions and/or their combination

Day Three: Work Stream Meetings February 8, 2012

5th Continuous LLIN Distribution Systems Work Stream Meeting

Co-chairs: Dr. Jayne Webster & Mr Kojo Lokko
Rapporteur: Dr. John Silver

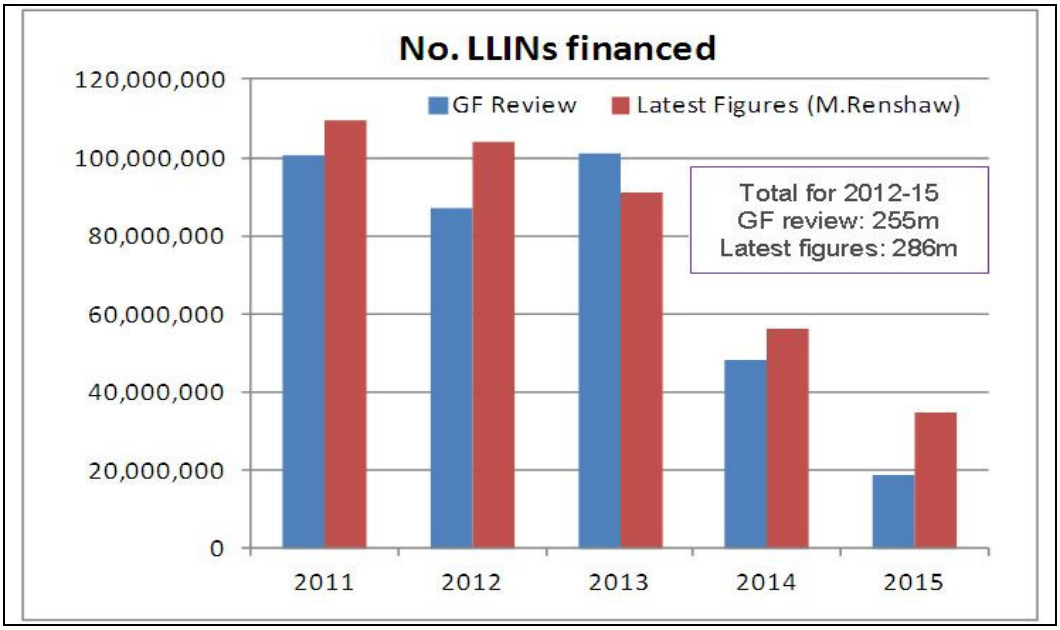
Consensus Statement – Dr. Matt Lynch

Matt Lynch presented a brief summary of the Consensus Statement on Continuous Distribution Systems for Insecticide Treated Nets, which reconfirms the partnership's commitment to universal coverage, with the goal of reducing transmission.

Global Funding Commitments 2011-2016 – Ms Lucy Paintain

Lucy Paintain presented a summary of a review of available data, primarily from Global Fund applications, on the numbers of LLINs to be delivered through campaign or continuous mechanisms and a comparison with the predicted need for 2011-16. Data from Global Fund proposals indicate that around 50% of nets are distributed through campaigns and less than 30% through continuous distribution mechanisms, with around 20% with no specified distribution mechanism.

Approximately 295m LLINs were distributed between 2008-10, and an additional 360m are already funded for 2011-16 (R10 Phase2 disbursements permitting). Between these two time periods, the proportion of LLINs allocated for delivery through continuous channels increased from 21.6% to 41.5%. Available data on committed funding for LLINs and planned distributions indicates a number of countries will not achieve 80% universal coverage target by 2016.



Data from RBM Roadmaps indicate around 80% of nets to be delivered through campaigns. The unfunded gap for 2012-2016 calculated from Global Fund proposals is around 30 million units and from RBM roadmaps is closer to 60 million. The NetWorks LLIN model (NetCALC) predicts a gap of

around 240 million units for the period 2012-2016. The higher estimate from the NetWorks model is likely to be due to the inclusion of countries without Global Fund proposals or grants. The latest available data indicate that if the current funding situation persists, major problems with LLIN gaps will be experienced from 2014 onwards.

Concepts and Strategy – Dr. Kate Kolaczinski

Development of a tool to help national programmes maintain high ownership of LLINs through development of a continuous distribution strategy was presented. The guide includes a descriptive framework for continuous distribution strategy options, overviews of the characteristics of the key distribution mechanisms, strategy matrices and a decision table. Once all possible appropriate channels have been identified the document then gives guidance on prioritization and then guides planners in the use of NetCALC to identify the most appropriate mix of distribution strategies for the specific country context.

Discussion

There was some discussion on the applicability of the tool in countries or geographical areas within countries where IRS is used. In response it was stated that the tool is not designed to support design of an overall prevention strategy, but as continuous distribution remains relevant whether IRS is being implemented or not, means that the guides can be adapted to the specific country situation. The guide is not meant to be prescriptive and the decision frameworks should allow for identification of all potential distribution mechanisms. It was noted that IRS infrastructure could potentially be used to support continuous distribution of LLINs.

Continuous Distribution Strategy Development – Ms Hannah Koenker

The presentation described some experiences with modeling continuous distribution approaches using NetCALC; Field visits to assess operational feasibility; and costing exercises. An example of the process undertaken in Ghana was presented and this resulted in the following selection of mechanisms, which when implemented together should support coverage in excess of 85%.

- Free distribution
    - ANC delivery to pregnant women
    - EPI delivery to 18-month olds at 2nd measles
    - Age 4 delivery during Child Health Promotion Week
    - Primary school distribution at grade 2 and grade 6
- Full cost
    - Secondary school students as part of prospectus (school supply list)
    - Retail
- Subsidized
    - To be determined

An examination of different scenarios for maintaining universal coverage in Tanzania was also presented. Modeling predicts that coverage under the national voucher scheme alone would stabilize at around 25-30% (cost US$ 179m). Universal coverage campaigns can achieve national coverage of 70-80% (cost US$ 440m), but at a local scale, coverage is highly variable from year to year, due to the timing of distributions in different zones. Commercial subsidized sales could maintain coverage at around 35% (cost US$ 214m). A combination of the national voucher scheme with school-based distributions to primary and secondary school students could potentially maintain coverage around

80%+ at a cost of US$ 466m. The model does not take into account external threats, including loss of sustained funding, Insecticide resistance/IRS, net durability, population changes.

Optimizing Dissemination and Use of Work Stream Products – Mr Kojo Lokko

Kojo Lokko led a discussion on how best to optimize dissemination and adoption of the work stream products at country level. The following proposals were considered:

- AMP to use the tools and support the countries to use them; the tools are included in the AMP toolkit
- Identification of champions within countries to disseminate knowledge of the existence of the tools
- Focal persons in the Sub-Regional Networks – EARN and SARN meetings due to be held in February 2012
- The Global Fund Technical Review Panel and GF proposal development consultants should be sensitized on the tools
- A distance learning module for NetCALC should be available by end 2012

It was noted that any advocacy around the tools would need to address the financial and other resources required to fill any identified gaps and support implementation of the selected strategies.

Update on Philadelphia 2011 – Dr. Jayne Webster

Jayne Webster presented a summary of the discussions held at the ASTMH meeting in Philadelphia in December 2011. Four priorities were identified at the meeting:

- Current funding context and the fact that major problems in maintaining coverage are anticipated from 2014. Producing a joint editorial with AMP to emphasise the fragile nature of the gains made to date was proposed
- Novel approaches to financing
- Business case meeting to include financiers
- Evidence base
- Potentially revisit the ITN Framework documents produced by WIN in light of the current financial constraints to see if they can be updated and adapted to the current situation

Discussion

As regards the proposed editorial, it was suggested that the work stream engage with MAWG on this issue. A white paper may also be useful to inform technical partners. The Friends of the Global Fund (Africa) were also suggested as a good contact.

Participants were reminded that the RBM Board has produced a Resource Mobilization Strategy that examines many of the potential innovative financing mechanisms.

Business Schools were suggested as potential partners in assisting the work stream to document the links between reduced malaria and increased availability of household disposable incomes as part of the case for private and public sector investment. Harvard and the Office of the Special Envoy are currently preparing investment case studies for Ministers of Finance and Heads of State.

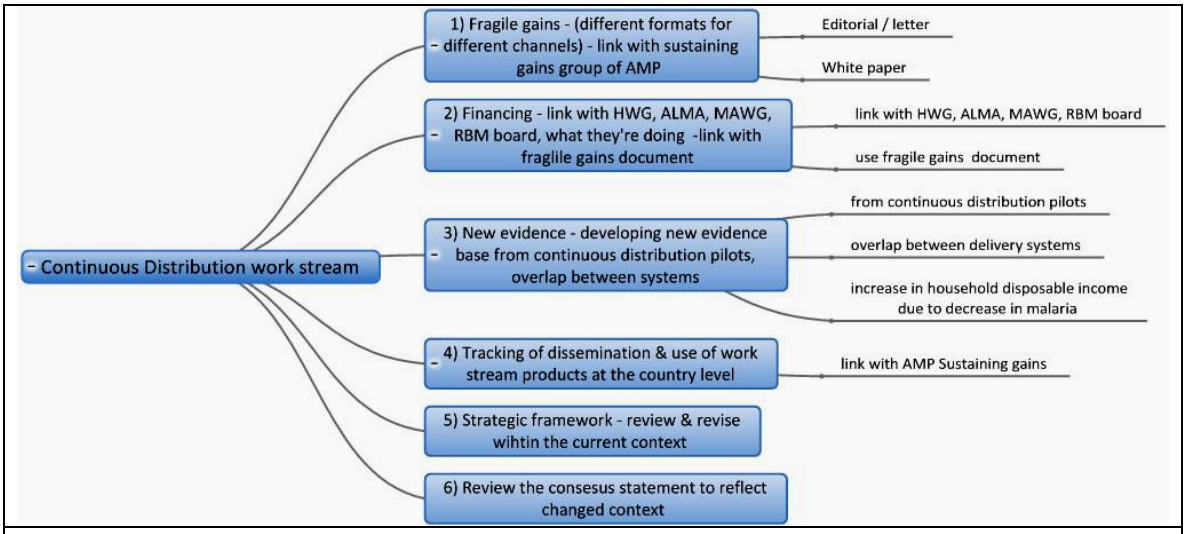
The RBM HWG is supporting several countries to apply for the Transitional Funding Mechanism, which should mobilize some resources, although considerable less than the cancelled Global Fund Round 11.

ALMA is following up on the January 2012 Heads of State meeting recommendation to hold a high-level financing meeting and ALMA and other partners are also working with Ministers of Finance through the World Bank Spring meeting to support use of IDA16 and other funds to fill gaps. MAWG has also recently completed IDA training re utilization of IDA 16 and 17 funds for malaria control.

It was noted that countries are keen to use domestic resources for malaria control where commodities are produced locally. Heads of State are keen to develop employment opportunities and increase investment and African nations are likely to be more open to cost-sharing options if it creates local employment. ALMA/GF/UNIDO recently held a well-received meeting on promotion of local manufacturing and ALMA is now working with the AU to move forward on this important topic.

There was also a suggestion to consider adding an additional paragraph / addendum to the consensus statement that better reflects the current situation. Several participants stressed that any additional paragraph should not discuss any reduction in existing coverage targets, as this would represent a backwards step.

Actions and 2012 Work Plan



4th Entomological Monitoring and IVM Work Stream Meeting

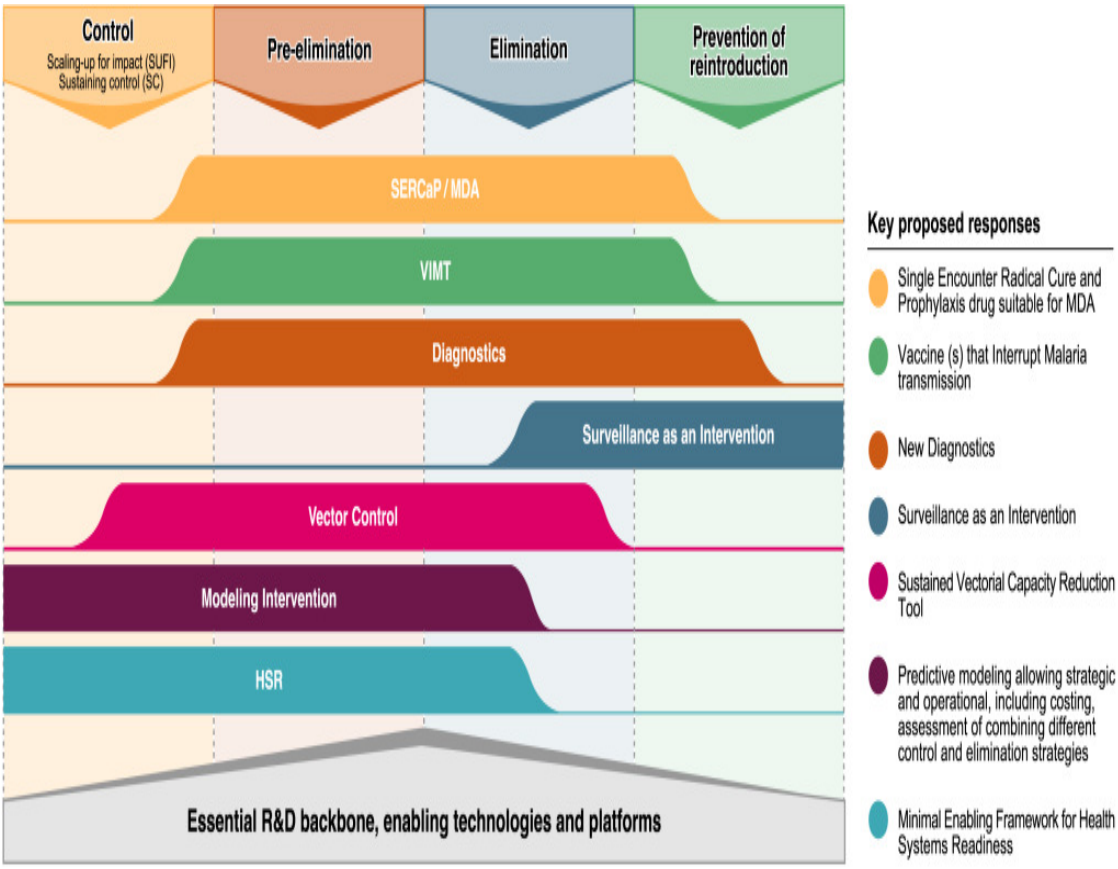
Co-chairs: Dr. Jacob Williams & Dr. Raman Velayudhan
Rapporteur: Dr. John Silver

The group meeting began by reviewing the progress made in IVM activities especially for advocacy, capacity building and networking of IVM. The meeting also took note of the publication of three key documents by WHO recently. These are guidance on policy development for IVM, core curriculum for IVM and the Handbook on IVM.

The major issues discussed by the group are below:

1) Entomological monitoring for malaria elimination

The role of entomological surveillance in malaria elimination was discussed. Dr Williams introduced the topic and highlighted the role through the publication of Alonso *et al* 2001:



The main role of entomological surveillance is to prevent and reduce spread of residual transmission or new active foci. It also plays a role in:

- Early warning & detection system (currently epi-focus)
- Implications for vector control/contribution
    a. ID early indicators on VC
    b. Reorienting program management and implementation
        Deploying appropriate intervention mix to prevent or control outbreak
    c. Pre-emptive intervention strategy
    d. Reducing lag time b/n outbreak and deployment

2) Capacity building

Dr A.P. Dash gave a presentation on the initiative of south East Asia region to address IVM. A two week course was organised at the vector control research centre Pondicherry to train program managers on IVM. Over nine countries from SEAR attended the workshop which also included field

activities. Participants have commented the course very well and plans are underway to hold follow up activities.

The meeting also heard the plans of global alliance to hold a follow up workshop in Africa and RTI/USAID to hold another workshop in American region.

3) WHO position statement on Lymphatic filariasis – Malaria Integrated Vector Management

The World Health Organization (WHO) promotes integrated vector management (IVM) to improve the cost effectiveness of vector-control operations, and to strengthen the capacity of programmes, partnerships and intersectoral collaboration in their efforts to control vector-borne diseases. The IVM approach aims to contribute to achieving the global targets set for vector-borne disease control by making vector control more efficacious, cost-effective, ecologically sound and sustainable.

This position statement addresses the use of IVM for two of the most important vector-borne diseases: malaria and lymphatic filariasis. The IVM approach is useful and appropriate for jointly managing control activities against malaria and lymphatic filariasis in terms of planning, implementation and monitoring, particularly in areas where both infections are transmitted by the same species of mosquito vectors. IVM may concurrently reduce the incidence of both diseases so that control efforts have synergistic effects. In this way, IVM enables resources to be used more efficiently to control multiple vector-borne diseases and thus they have a greater impact on public health than would be the case with control programmes aimed at a single disease. The multi disease strategy can be applied to other vector-borne diseases within the framework of IVM and an integrated approach to controlling neglected tropical diseases.

Malaria and lymphatic filariasis are the two vector-borne diseases that account for the largest global burdens of mortality and morbidity, respectively. More than half the world's population is at risk of at least one of these diseases. There is overlapping geographical distribution of these diseases in large areas of Africa, Asia and the Americas. Historically, there is evidence that efforts to control malaria have inadvertently resulted in the interruption of transmission of lymphatic filariasis in some areas, such as the Solomon Islands. *Anopheles* mosquitoes transmit both malaria and lymphatic filariasis and many other types of mosquitoes also transmit lymphatic filariasis. Vector-control methods can effectively reduce transmission of these infections. In Africa, where *Anopheles* mosquitoes transmit both the malarial and lymphatic filariasis parasites, scaling up coverage of insecticide-treated mosquito nets and implementing indoor residual spraying will reduce the transmission of both these diseases. The *Culex* mosquito is the most widespread and important vector of lymphatic filariasis in Asia, eastern Africa and the Americas. This mosquito can be readily controlled by improved sanitation. In addition, malaria vector control activities using insecticide-treated mosquito nets and indoor residual spraying will impact *Culex* mosquitoes and reduce transmission of both lymphatic filariasis and malaria. Using an IVM approach allows programmes to control malaria and lymphatic filariasis to coordinate and benefit from each programme's activities, thus enhancing their overall impact on public health. In particular, the recent and unprecedented scaling up of coverage of malaria vector-control activities that has occurred since 2006, especially in Africa, is likely to have substantial additional public-health benefits in sustaining the elimination of lymphatic filariasis. These benefits must be taken into account in assessing the cost effectiveness of interventions that are jointly targeted against the vectors of both diseases. The strategies of all vector-control programmes should be based on IVM. Vector control implemented as a multidisease approach through IVM is recommended for malaria and lymphatic filariasis in:

- Areas co-endemic for malaria and lymphatic filariasis;

- Areas where the vectors of malaria and lymphatic filariasis are both affected by the same vector-control interventions (insecticide-treated mosquito nets, indoor residual spraying, and larval control).

As part of their integrated strategy to control multiple diseases, WHO will be organising a planning meeting with member countries in Accra, Ghana in March 2012.

4) Monitoring and Evaluation of IVM

The WHO has developed a guidance document on M&E of IVM. The main purpose of this document is to guide countries in the monitoring and evaluation of the implementation of their national IVM strategy, which will help them making improvements where required. The secondary purpose is to propose standard methods that will facilitate the monitoring and evaluation at the regional and global level. The document developed is in line with the operational framework presented in the *Handbook for integrated vector management*. The specific target audience is the multidisciplinary technical working groups tasked with the development of procedures for monitoring and evaluation of IVM as well as those involved in carrying out the monitoring and evaluation activities. The challenge in M&E is how to measure the 'transformation of vector control'; how to assess the positive change taken place in each of IVM's components, from policy to capacity building. Therefore, the expected outcomes should be defined, and indicators that are specific to these expected outcomes and that will be easy to measure should be identified. Table 1 outlines the proposed outcome indicators of IVM. These indicators are discussed in detail in the document which is expected to be published soon.

Table 1. Proposed outcome indicators, arranged according to the main components of integrated vector management (IVM)

Component of IVM		**Outcome indicator**	**Data type**
Policy	1	National IVM policy in place	L
	2	National policy on pesticide management in place	L
Institutional arrangements	3	National steering committee on IVM in place	L
	4	National coordinating unit on vector control in place	L L
Organization and management	5	Standards for professions and a career track in vector control and public health entomology in place	L
	6	Number (and percentage) of targeted staff with job descriptions that make reference to vector control	N
Planning and implementation	7	National strategic and implementation plan on IVM in place	L
	8	Number (and percentage) of targeted staff trained on IVM	N
	9	Epidemiological surveillance system on vector-borne diseases in place	L
	10	Number (and percentage) of targeted sentinel sites with functional vector surveillance and insecticide resistance monitoring	N
	11	Number (and percentage) of operational research priorities on vector control that have been addressed	N

	12	Number of operational research outcomes on vector control that have been utilized by implementation programmes	N
Advocacy and communication	13	Advocacy meetings on IVM in place	L
	14	Number (and percentage) of targeted stakeholders that have allocated resources for vector control	N
Advocacy and communication	15	Number (and percentage) of targeted villages that received campaigns on behavioural change on vector control	N
	16	Number (and percentage) of targeted villages where communities have been mobilized on vector control	N
Capacity-building	17	Certified training courses on IVM and judicious use of pesticides in place at national or Regional level	N

L, logical data (yes/no); N, numerical data

Impacts of IVM are expected in terms of a reduced risk of transmission, a reduced disease burden, and an improved cost-effectiveness of operations, improved ecological soundness and sustainability. Indicators to measure the impact in these areas are proposed in Table 2,.

Table 2. Expected impacts and proposed indicators for measuring impact of integrated vector management (IVM)

Expected impact	Impact indicator
Reduced risk of transmission	Vector-related parameters
Reduced disease burden	Prevalence rate and incidence rate of vector-borne disease
Cost-effectiveness	Cost per disease case averted per year
Ecological soundness	Toxic units of insecticide used per disease case averted per year
Sustainability	Strategy in place that enables continued mobilization of resources for vector control

The meeting discussed these indicators and made some suggestions to improve the document further.

5) Develop a position paper on Landing catches

The meeting discussed the need for WHO /GMP to develop a position paper on ethical consideration for the use of human landing catches for monitoring and evaluation of the vector control interventions. It was suggested that RBM VCWG should create a small team to evaluate data assessing risk of these methods and work closely with NIH, CDC and other stakeholders to develop a concept note for submission to GMP.

Actions and 2012 Work Plan

1. Manuals: 3 documents
2. Guidance on “minimums”: Competencies and skill sets; entomological M&S; program evaluation
3. Training: IVM TOT course organised in SEARO
    a. Modules for lower levels
    b. Post graduate courses in India (two groups)

4. Support Country Needs Assessment: PAHO Workshop on Vector Control Needs Assessment leading to support for select countries on VCNA
5. Meeting Ghana: Develop framework to assess impact of MVC investment on lymphatic filariasis and Loa-Loa endemic countries (5-9 March 2012)

3rd Outdoor Malaria Transmission Work Stream Meeting

Co-chairs: Prof. Marc Coosemans & Dr. Chusak Prasittusuk
Rapporteur: Dr. John Silver

Current Situation – Prof. Marc Coosemans

Marc Coosemans reviewed the current situation and magnitude of outdoor malaria transmission, and described some of the potential control tools. He reminded participants of the residual transmission that is not currently addressed through the use of IRS and LLINs as a result of early and outdoor biting behaviours of vectors and also human behaviours that increase risk, such as forest work and remaining outdoors until late in the evening. Mosquito behaviour is highly variable within species such that it is not possible to define a species as 'exophagic' or endophagic' or as an early or late biter. There are many examples of where the populations of the same vector species exhibit different biting behaviours from one location to another. Vector control can select species and/or subpopulations that bite early or bite outdoors. Tools available to address the issue of residual transmission include:

- Topical Repellents (DEET, Picaridine (KBR3023), P-Mentane-3,8-diol, IR3535)
- Spatio-repellents (metofluthrin fan vaporizer)
- Insecticide treated hammocks, nets
- Insecticide treated clothing
- Treated Plastic sheeting
- Mosquito Coils/vaporizers
- Others?

The available evidence on the efficacy of topical repellents and also treated hammocks was briefly reviewed.

Raising the Proof of Principle – Prof. Marc Coosemans

Novel PHPs may include new active ingredients as well as new application technologies and some of these new approaches (e.g. spatial or even topical repellents for transmission control) will require epidemiological studies to demonstrate efficacy in reducing malaria transmission and/or disease, and will require new evaluation guidelines and criteria. Study designs can include: individual randomized trials, household randomized trials, and community randomized trials. The advantages of different study designs were reviewed and a specific example of a study design to test topical repellents in addition to LLINs was described.

Discussion

Several issues were raised in relation to the described study of topical repellents, including the following:

Participants felt that the trial would be very useful towards generating proof of concept and hoped that there would be future trials on space repellents, as this would address some of the issues around adherence that are encountered when using topical repellents. Yes, methods to evaluate spatial repellents will vary by product and mode of action.

It was noted that for both personal and spatial repellents, availability of alternative hosts can be very important in determining the ability of a trial to detect a mass effect through entomological monitoring and that this was likely to be the case for many species in SE Asia. It was reported that in the trial described, *An. dirus* is the main vector and only rarely bites animals.

The importance of being able to disentangle individual effects from any community mass effect was also mentioned. This could potentially be achieved through knowledge on the compliance profile of those in the treatment arm. In the trial described, all bottles of repellent are marked and traceable and compliance could be measured by household consumption of repellent. In addition the social science component of the study should also provide information on compliance.

Prevalence of use of household sprays and insecticide coils in the study community was raised. In response it was stated that use of these interventions is low in the study province. However, it was acknowledged that a major challenge to the study will be adherence, as use of topical repellents is also new in this province. A team from the NMCP will develop materials to encourage use of repellents and LLINs.

The role of a placebo in this kind of trial was discussed as it would allow for the trial to be blinded, which is obviously desirable, however, it is very easy for participants in the trial to identify if they are using the product under test or a placebo and difficult to prevent individuals or households exchanging products.

The importance of obtaining as broad a range of inputs from as wide a range of disciplines as possible at the design stage was stressed.

Participants suggested that a compendium of study designs to support countries to systematically investigate personal protection measures would be useful.

Adherence and Sustainability of Interventions Based on Personal Protection – Prof. Marc Coosemans

The third presentation examined the gap between product efficacy and community effectiveness and described the steps on the “effectiveness ladder”, which result in considerable efficacy losses as one moves from the laboratory to real life conditions.

Discussion

An ongoing trial in Myanmar was described in which forest workers are issued with permethrin-treated blankets. In the study area there are around 30,000 confirmed malaria cases annually, 80% of which occur in forestry-related workers. These workers do have small huts in the forest, but most sleep outside and don’t use nets due to their bulk, and for fear of damaging the nets. All workers use blankets. In the trial 28 treated blankets were distributed and there are 150 controls. Results indicate a 75% reduction in biting by *An. dirus*.

Participants suggested that it would be useful to look at lessons learned on improving adherence with interventions in other intervention areas, e.g. hand washing with soap.

Participants requested further information on the extent to which people are outside at night and the impact on infection status in an African context. Participants were informed that the Peace Corps is being encouraged to contribute to answering this question in Ghana and a study by Killeen in Kenya is due to be published shortly.

In summary, there is a clear need to continue to stimulate innovative ideas and approaches and build the evidence base, e.g. for spatial repellents, attractants, and other tools for specific population groups. The role of networking and information sharing in the development of protocol designs is also very important.

Actions and 2012 Work Plan

- Outdoor Transmission Workshop 12-13 March 2012 organized by the Faculty of Tropical Medicine, Bangkok
- Inventory of institutions and researchers in the Mekong region
- Compilation of regional research
- Review of residual transmission in the Mekong Region and elsewhere (Institute of Tropical Medicine/Antwerp)
- Development of strategies for research and development

Summing Up – Dr. Michael Macdonald

Michael Macdonald closed the meeting with a few words describing the key issues for the VCWG over the coming 12 months. In particular, he stressed how the VCWG needs to consider how it can best evolve and adapt to the changing situation, particularly in relation to funding constraints and the impact of insecticide resistance. The need to implement improved communications, for example through conference calls, newsletters, etc. was also noted. As an official RBM body the VCWG needs to conduct elections for working group chairs during the next 12 months. We also need to begin to plan for next year's meeting. Michael thanked the Swiss Agency for Development and Cooperation (SDC) and the Swiss TPH for supporting Konstantina Boutsika and the VCWG Secretariat in helping to make the meeting run so smoothly and efficiently.