

Potential topics for the Multisectoral Working Group

The MSWG present a great opportunity to expand the reach, effectiveness and diversity of policy and technical options for vector control.¹ Multisectoral engagement for vector control is a core element of the WHO Integrated Vector Management framework² and the more recent Global Vector Control Response.³ An excellent previous example of multisectoral engagement was PEEM – the Panel of Experts on Environmental Management. Originally, this was WHO/FAO/UNEP but later included UNHabitat⁴. Now we have great opportunities, not just with FAO, UNEP and UNHabitat but also now with UNDP, UNICEF and UNHCR. The following topics were gathered from preliminary discussion with colleagues in the VCWG and further elaborated and referenced, and from previous writings and communications. This draft needs to be further refined by prioritization and outlining specific action points, but is a start for discussion.

Agriculture and food security

This may have that greatest opportunities for building fruitful collaborations. Food security, especially as it relates to climate change, will be one of the greatest development issues for Africa in the coming years – vector control needs to be part of it. A family free of malaria is more food secure.⁵ Malaria prevention, including provision of LLINs, should, like seed, fertilizer and pesticides, be part of every agricultural development initiative in areas of endemic malaria.

There needs to be more research on malaria's impact on agricultural households and there is ongoing work to improve methodologies. One step in the right direction is a study by Gunther Fink (now at Swiss TPH) on agricultural productivity and economic impact of having access to LLINs in Zambia.⁶ The role of women and African agriculture may be of particular interest in the interface with malaria, care-giving and preventive services. The often cited, overarching figure that "60-80% of agricultural productivity in Africa is done by women"⁷ has been disputed. There is large variation across the region, ranging from 30% in the Gambia to 60-80% in parts of Cameroon; there is also variation on the season and crop.⁸ The real overall figure may be slightly less than half.⁹ Nevertheless, the impact malaria prevention on agricultural productivity, including the impact on women, their health and their role as caregivers may be an important strategic linkage for the MSWG. This can be approached along four areas:

Policy. The MSWG can help ensure malaria is included in food security policy forums, for example the USAID 'Feed the Future' program,¹⁰ the International Food Policy Research Institute¹¹, UNICEF,¹² WHO,¹³ and FAO.¹⁴

Industry: the MSWG can engage with FAO, World Food Programme, Ministries of Agriculture and the Commercial Crop Science partners, including CropLife,¹⁵ to expand their agricultural outreach to include malaria prevention. There are further discussions below on opportunities for the MSWG to work with the IVCC-led initiative *ZERO by 40*: "*ZERO by 40 is the world's leading agricultural companies coming together to develop innovative vector control tools in order to help eradicate malaria—by the year 2040*".¹⁶

One area of interest is the rapidly developing field of “Precision Agriculture” or “digital farming”¹⁷ adapted for vector control, including for larval source management¹⁸, risk area stratification, pesticide and information management.

Agricultural development. The MSWG should engage with CGIAR¹⁹ to revitalize the excellent work pioneered by the System-wide Initiative on Malaria and Agriculture²⁰, by ICIPE/Kenya²¹ and UNEP/GEF²². This could include urban agriculture, and management of *anopheline* larval habitats possibly through the Farmer Field Schools as previously done in Sri Lanka.²³

Agroforestry should also be included. For example, in sub-Saharan Africa removal of aquatic habitats of *Anopheles gambiae* by growing eucalyptus should be investigated. The issue of malaria in rubber plantations in SE Asia²⁴ is also an important topic, as is the global impact of deforestation and reforestation more broadly, depending on the local vectors

Likewise, agricultural drainage needs to be investigated for the reduction of malaria in sites where malaria is extremely high. This requires collaboration with malariologists, agricultural engineers and local communities. There may well be solutions in SSA where good drainage can reduce malaria and increase crop productivity.

Nutrition. The MSWG should also engage with the UN initiative “Scaling Up Nutrition”²⁵, led by David Nabarro for several years (David was the first director of RBM). The multisectoral and multi-stakeholder vision and principles of SUN, echo the founding principles of RBM.²⁶ The MSWG should be able to engage to inculcate malaria-prevention elements into SUN’s family health and women’s empowerment activities.

Fisheries and natural resources. Cutting across food security and natural resource management, inappropriate use of mosquito nets distributed for malaria control for fishing is considered an important issue and may be linked to declines in fish catches both in terms of quantity and quality leading to threatened food security in some areas.²⁷ It has been recognized that the key policies likely to influence future impacts of mosquito nets for fishing are multisectoral: in health, regarding net distribution and natural resource management regarding restrictions on use. There is a need for research a collaborative, interdisciplinary approach to development of both localized and broad-scale policy.²⁸ As part of the RBM VCWG LLIN Priorities workplan this can be addressed in the MSWG engagement with health, natural resources management, nutrition and aquaculture development partners.

Insecticide Resistance Management and judicious use of pesticides

Agriculture. Several studies have documented the contribution of agricultural pesticides to insecticide resistance in malaria vectors.²⁹ The WHO Global Plan for Insecticide Resistance in Malaria Vectors, GPIRM “Near-term Action plan, calls for collaboration between the health and agriculture sector for monitoring, coordinated action and research.

In particular, the *Agricultural Integrated Pest Management* is far advanced compared to public health for insecticide resistance management – this can be a great benefit for our core principles of IVM, that the less reliance we can have on single modes of action the better. GPIRM Pillar IV on research states: *Scientific theory and experience from agriculture provide enough encouraging information on currently available IRM strategies to allow the design of such strategies for*

*malaria vectors.*³⁰ Several colleagues in the VCWG who have been engaged in this IPM/IVM and insecticide resistance discussion who can facilitate these connections for improved understanding and practice of resistance management. This includes both the role of chemicals that can include alternative modes of action, as framed in the CropLife “insecticide modes of action”,³¹ extending push-pull concepts developed in Agriculture,³² to further development in vector control,³³ and the incorporation of non-chemical means of pest and vector control.³⁴ Specific collaboration related to modifying housing and the peri-domestic environment have been well developed by the housing workstream of the VCWG and is discussed in more detail below.

Private Pest Control Operators. Possibly more of an issue for *Aedes* control compared to measures for *Anopheles* vector control is the role of the private pest control industry who are often very active fogging around tourist resorts. Some suspect they could be major drivers of *Aedes* insecticide resistance; we would find it mutually beneficial with more direct communication. There are umbrella groups such as The Federation of Asian and Oceania Pest Managers’ Association³⁵ where some of our RBM and APMEN VCWG colleagues have engaged and where we could follow up. The upcoming 2nd WIN international conference on “Integrated approaches and innovative tools for combating insecticide resistance in arbovirus vectors”³⁶ may provide ideas for the MWSG to engage with this often neglected sector.

Domestic pesticide use. Little information is available on domestic pesticide use and potential impact on malaria vectors. For example, 2011 PMI was supporting Malawi to spray pirimiphos-methyl EC at the same time the Ministry of Agriculture was passing out free packets of pirimiphos-methyl 2% dust for stored maize. Other examples are from Madagascar where PMI was supporting spray of alpha-cypermethrin and distribution of deltamethrin nets. It was noted that homeowners were using a variety of pyrethroids in and around the house, e.g. a cypermethrin for the vegetable plot, a deltamethrin for the citrus and a cyfluthrin for other crops. As we endeavor not to spray pyrethroids in houses with pyrethroid nets, we should also conduct an inventory (possibly through the retail pesticide sector, or through household surveys during the IRS operations) on all these other pyrethroids that may be in domestic environment.

Improving insecticide stewardship in vector control. The safe and effective use of vector control interventions is just as important to mosquito control and Insecticide Resistance Management (IRM) as it is to the health, safety and environmental aspects of insecticide use. Pesticide stewardship is outlined in the International Code of Conduct for Pesticide Management.³⁷ This includes, transport, storage and distribution; integrated pest management; responsible use; container management; managing obsolete stocks and resistance management. The FAO/WHO Joint meeting on pesticide management has developed a series of technical guidelines related to each of these steps.³⁸ In the Agrochemical industry association CropLife International, IRM activities (IRAC) are covered by the Stewardship Department which includes training materials for each of these elements.³⁹ Public Health Pesticide Stewardship is extremely important for vector-borne disease control programs beyond just malaria – especially for *Aedes* control that may be employing larvicide and space sprays. The MSWG will engage with CropLife, and with WHOPES and FAO to support stewardship capacity-building for vector-borne disease control programs

Business Sector

GBCHealth Corporate Alliance for Malaria in Africa. Previously the VCWG had several collaborative projects with GBCHealth Corporate Alliance for Malaria in Africa⁴⁰ and helped with the 2011 RBM *Business Investing in Malaria Control: Economic Returns and a Healthy Workforce for Africa*, the sixth report in the Roll Back Malaria Progress & Impact Series.⁴¹ On a country level there were good examples in Nigeria through GBCHealth, in Ghana through AGA⁴², in Myanmar and the Greater Mekong Sub Region through the Myanmar Health Development Consortium⁴³ and in Tanzania the Johns Hopkins “Malaria Safe” Projects.⁴⁴ Now, the “Goodbye Malaria” initiative⁴⁵, founded by Sherwin Charles of Nando’s offers a great opportunity for the MSWG to re-vitalize our connections with the business sector.

Commercial Mosquito Net Sector. ITN distribution strategies narrowed for several years and are just now modestly expanding. Prior to Global Fund support, the WHO/RBM ITN distribution strategy focused on building partnerships among the public sector, the commercial sector and NGOs.⁴⁶ Considerable efforts were made through the USAID NetMark project, DfID, the Canadian IDRC, the Swiss Development Cooperation and others to develop these partnerships and strategies with one of the larger examples being the Tanzania National Voucher Scheme.⁴⁷ After the initial waves of episodic mass free LLIN distributions made possible through support from the Global Fund PMI and other donors, the need for “between-campaign” continuous distributions became apparent. The 2017 WHO guidance considers ANC, EPI and other child health clinics as high-priority continuous LLIN distribution channels where these services are used by a large proportion of the population at risk of malaria. The guidance makes brief mention of private and commercial sector channels “as long as these are well-regulated to ensure product quality in line with WHO Recommendations.”⁴⁸ To mitigate potential sustainability risks for centrally-procured mass free distributions, the MSWG can revisit some of these earlier collaborations to explore strategies for growing a more general and diverse market for treated mosquito nets.

Insurance industry. A specific potential, but untapped collaboration may be with the insurance sector. It was noted in a 2017 meeting with an insurance person from the large insurer AAR⁴⁹ who told me that 45% of their outlays were for malaria. They now require a confirmed diagnosis by RDT before making a claim payment. There is an opportunity with the Community Health Fund to use the risk-analysis for the actuarial tables to stratify malaria risk and intervention targeting in the country. An editorial in the 12 April 2017 edition of “The Citizen” noted that only 20% of Tanzanians had health insurance and it is mostly those in formal employment who enjoy health coverage.⁵⁰ Whereas Rwanda’s *Mutuelles de santé*, covers 91% of the population.⁵¹ Nevertheless, the insurance industry could contribute to advocacy through the realization of the economic and financial aspects of malaria prevention. They may even be able to offer financial credits for procurement of ITNs or cut premiums, as we do in the US for non-smokers, for families with ITNs.

Product development partners. Manufacturers and product development consortia have been core members of the RBM VCWG since it was formed. The IVCC-led ZERO-by-40 initiative, the Innovation to Impact,⁵² opportunities for product development in the emergency relief sector, as well as the APLMA Vector Control Platform for the Asia-Pacific⁵³ offer opportunities for broader engagement in the development, field testing and improved market access for new vector con-

trol products and strategies. In addition to the entomological, epidemiological and regulatory aspects of product development, social studies is an important and often neglected area of potential collaboration. We in public sector involved with vector control have much to learn from the methods of Human Centered Design⁵⁴ and how this is applied to understanding community uptake of vector control.⁵⁵

Tourism.

The opportunities for engagement with the tourism industry may be much more for *Aedes* control. VCWG colleagues recently published a paper on the impact of Zika on the tourism industry of Belize⁵⁶ where “A majority of respondents agreed that control of mosquitoes and mosquito-borne illnesses is central to the success of their tourist-based industry.” Cambodia, or Bali present other examples. In 2016 the suggestion was made to the Cambodia dengue control program to look beyond the usual program donors and approach the tourism industry. In 2015 there were 4.8 million tourists visiting Cambodia who contributed \$3 billion to the Cambodian Economy. In Siem Reap (Angkor Wat) there were 2.1 million visitors staying in 710 hotels. If the Ministry of Tourism would levy even a very small tax per hotel room for mosquito surveillance and control, one could develop a very solid program for the town and also use the money to support *Aedes* control in other parts of the country. In the tourist locations you could also provide training to hotel maintenance staff to control *Aedes* in and around the properties and also work with the Private Pest Control Operators to inform them to ensure they are using the correct products and techniques. Programs need to change the way we think about funding, ADB, USAID etc. and look at the sectors who would have the most economic interests in an effective *Aedes* program – it could be worth millions of dollars to Cambodia tourism.⁵⁷

The MSWG can bring together ministries of tourism, chambers of commerce and tourist industry representatives, along with vector-borne disease control programs to explore opportunities for collaboration

Emergency Relief.

We started last year with the initiative on Vector Control in Humanitarian Emergencies. Details are available in the report.⁵⁸ We hope to further develop this initiative through the MSWG.

Environment and Climate: GIS, Remote Sensing and Risk Area Stratification.

Remote sensing and geospatial analysis is advancing very quickly outside the Ministries of Health, mostly for forestry, agriculture, water-resource management and urban planning. Especially given the heterogeneity of transmission risk-areas and the specific environmental determinants of the vectors in the Greater Mekong Subregion (GMS) as well as in Africa and the Americas, malaria programs need to engage with these broader efforts. For example. in the GMS each of the VBDCs is individually developing GIS and in some countries, Remote Sensing capacity. In Myanmar, JICA is working with the Japan Aerospace Exploration Agency (JAXA) to support malaria risk-area stratification, building upon the current tropical forest monitoring system with JAXA’s Advanced Land Observing Satellite-2 (ALOS-2).⁵⁹ The Clinton Health Access Initiative (CHAI) is supporting GIS in Cambodia, Vietnam and Lao PDR (where Institute Pasteur/Lao has also supported risk-mapping). Vietnam has its own extensive remote sensing center in the Ministry of Natural Resources and the Environment.⁶⁰ In Thailand the Health Geolab Collaborative⁶¹ includes Mahidol University colleagues engaged malaria operational research and training. Regionally, USAID supports the *University Network for Geospatial Analysis Initiatives*, whose moto is “Connecting

Space to Village in the Lower Mekong Region”.⁶² Likewise, in Southern Africa, as part of the E8 initiative⁶³ the DiSARM - Disease Surveillance And Risk Monitoring project is advancing the use of GIS and remote sensing to better target and monitor vector control interventions.⁶⁴ The MSWG will be in a good position to develop regional cross-sector initiatives amongst the technology partners and users in non-health sectors to expand this much needed technology to vector borne disease control programs.

Housing

Housing is emerging as an important environmental deterrent for malaria transmission. The VCWG has a work stream on “malaria and housing” providing several technical and policy resources.⁶⁵ The impact appears to be both a reduction of house entry (e.g. eave screening) and through a reduction in favorable indoor-resting microclimates when switching from thatch roofs to metal and mud walls to cement. An analysis by Tuesting et. al. of DHS and MIS data from 21 countries and 29 surveys including 140,000 children in 84,000 houses showed children in improved housing had 9-14% lower odds of malaria than traditional houses.⁶⁶ Related to housing is the Water/Sanitation sector in particular for *Aedes*-borne diseases as vector control now appears in “The New Urban Agenda”.⁶⁷ The regional 2014 Global Fund *Letter of Interest* for the “Multisectoral control and elimination of malaria in the Lake Victoria Basin” was built on the foundation of the UNHabitat Wat/San project in the small towns and urban centers around the lake.⁶⁸

Microfinance schemes. These micro-credit schemes may be an opportunity for engagement between the housing sector and VBDC programs. For example in Tanzania the Habitat for Humanity (HfH) “Makazi Bora” program⁶⁹ provides micro-loans for incremental improvements to houses, e.g. to build a foundation, to put on a new roof, to install water tanks and a sanitation system, even small business loans and skills training if part of the house is used as a shop or kiosk.⁷⁰ In 2017 Makazi Bora had about 600 clients and have provided loans to about 6,000 families over the course of the project since 2009. HfH is part of a 12-member “Housing microfinance working group Tanzania”⁷¹ where they lobby for better housing policies, building standards, water and sanitation. HfH also has a program for “Mazingira” loans for improving landscapes, including water and sanitation in the peridomestic environment. There are several specific actions that could be facilitated through these groups, including insecticide-treated “Eave Tubes”;⁷² mosquito control in the peridomestic environment, especially pits dug for brick-making and plastering, ideal larval habitats for *Anopheles gambiae*⁷³ and for issues around safe-water storage to prevent *Aedes aegypti* proliferation.

Education.

There is a long history of malaria collaboration with the education sector for school health programs⁷⁴, and for vector control interventions, both for malaria and LLIN distributions⁷⁵ and for *Aedes* control, for example in Vietnam⁷⁶ and more recently Cambodia.⁷⁷ Likewise through TDR⁷⁸ and the Africa Network for Vector Resistance there are opportunities for improving the links between vector control programs and regional networks for training and research.

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