I. APMEN VCWG 2017 Annual Meeting Summary.

In July 2017, 64 participants representing 18 countries and 29 partner organizations took part in the Asia Pacific Malaria Elimination Network’s Vector Control Working Group’s (APMEN VCWG) annual meeting. The meeting was coordinated by the VCWG Secretariat, including the Faculty of Tropical Medicine at Mahidol University, Malaria Consortium, and the University of California San Francisco Global Health Group Malaria Elimination Initiative, in collaboration with, and under the leadership of, the APMEN Secretariat, and with funding from Sumitomo Chemical Company and the Bill & Melinda Gates Foundation.

This two and a half day event provided a platform for vector control specialists from APMEN country programs, partners in research, academics, and private sector representatives to deliberate together on current challenges and themes in malaria vector control in the Asia Pacific. The objectives of the meeting were (1) to foster a platform for information sharing about vector control and malaria elimination activities, (2) for country representatives to update each other on in-country experience of vector control in elimination settings, (3) to discuss current global activities in vector control, and (4) to explore how APMEN can continue to contribute to the vector control landscape, such as advocacy, capacity building, knowledge exchange, and research.

The theme of the first day of meetings was “Capacity strengthening for National Malaria Control Programs (NMCPs)”. Key updates from the World Health Organization on vector control, entomological surveillance, and malaria surveillance in elimination settings were presented by both Dr. Rabindra Abeyasinghe and Dr. Deyer Gonipath (Session 1). Of particular note is the forthcoming WHO Malaria Surveillance Operational Manual that stresses that as malaria transmission drops, spatial and temporal heterogeneities rise. To respond to this phenomenon, surveillance systems must shift from aggregate data by month over extensive geographical areas to producing near real-time individual case data over smaller-scale foci.

Global and regional networks for entomology and vector control were highlighted throughout Session 2. Dr. Chadwick Sikaala from the Elimination 8 (E8) Southern Africa Regional Initiative shared findings on a vector control capacity assessment exercise conducted by the E8. A key issue raised was the need to harmonize entomological and epidemiological indicators to establish a common reporting framework within E8 countries, APMEN countries, and potentially, between E8 and APMEN countries. Dr. Michael Macdonald described additional networks focusing on entomology, vector control and malaria elimination that APMEN could collaborate with, such as Roll Back Malaria (RBM), the Mekong Outdoor Malaria Transmission Network (MOMTN), the Pan-African Mosquito Control Association (PAMCA), the Society for Vector Ecology (SOVE), and others.

In alignment with broad consensus for enhanced partner and institutional collaboration for vector control and entomological surveillance, the WHO developed the Global Vector Control Response (2017) (presented by Dr. Abeyasinghe, Session 3). This document includes four pillars of action and ten key activities for 2017-2022 for entomological capacity building and community-based initiatives. All activities are designed to work
towards the overall aim of reducing malaria burden and the threat of vector-borne diseases through locally adapted and sustainable vector control strategies. Ms. Cecil Hugo, Dr. Jetsumon Sattabongkot Prachumsri, Dr. Ratchadawan Ngoen-klan, Dr. Jeffrey Hii, Mr. Manesh Sharma, Mr. Sam Siao Jing, and Mr Say Piau Lim, presented on regional training centers, technical expertise in the region for training, and academic institutions that do, and should continue to, play an important role in training programs on entomological surveillance and vector control implementation. Awareness of these programs and the resources to support trainees in the participation of such programs is essential to build capacity in the region. Day 1 concluded with group exercises to discuss and address entomological capacity building in the APMEN region, highlighting necessary training opportunities that APMEN should focus on moving forward. This also included recommendations regarding the role APLMA should take to promote inter-ministerial coordination for entomology capacity building (See Section II).

The theme for the second day of the meeting was “Technical issues and current research.” Session 1 of this second day focused on insecticide resistance monitoring (IRM). Technical talks (Dr. Abeyasinghe, Dr. William Hawley) on insecticide resistance (IR) management, including both WHO and CDC IR testing methods, highlighted that IR surveillance must be a core component of entomological surveillance. In particular, whereby priority for IRM should be given to regions where the IR seems to be greatest, entomological monitoring for IR in sites of low transmission must consider the important heterogeneity in transmission, and thus, have a more specific focal site monitoring. In concordance, improved decision-making algorithms for IRM must be formulated. A group discussion (Session 4) allowed for further input on the roadblocks in implementing IRM and on how to increase the frequency and efficiency of IR data sharing between countries and regions. This group work concluded that (1) IR mapping in combination with mapping of mosquito species and insecticide type must draw on various data sources, (2) APMEN could mediate the dissemination and sharing of data between countries, and (3) APMEN VCWF could put together a committee that examines unpublished IR data.

The fifth session of day 2 elaborated on three themes, (1) vector surveillance, (2) outdoor and residual malaria transmission, and (3) vector control tools, all under the shared umbrella of vector control and entomological surveillance in burden reduction and elimination settings. Under theme 1, tools and methods for improving the feasibility and efficiency of vector surveillance in various country settings were presented. Dr. Neil Lobo introduced an operational tool designed in the form of decision trees that addresses key entomological questions. This guide is to help country programs prioritize and make decisions regarding entomological activities (e.g. vector surveillance, IRM, vector bionomics).

Dr. Sikaala shared Zambia’s experience with implementing community based vector surveillance; they found that surveillance was most effective when community health workers were trained in basic field entomology in concordance with quality assurance checks carried out by a central team. Similarly, Dr. Rose Nani Mudin and Dr. Budi Pramono shared the successes and challenges faced by Malaysia and Indonesia in their respective community-driven vector control and surveillance schemes. Isolated communities and an impressive diversity of malaria vectors are reoccurring challenges faced by both countries.

For theme 2, Dr. Christina Rundi presented the APMEN 2013-2015 indoor and outdoor biting survey. The survey found that almost every participating country recorded outdoor transmission, and that very few of these countries have implemented outdoor vector control interventions. In a study (presented by Ms.
Hannah Edwards) carried out in Thailand and in Vietnam to quantify residual malaria transmission (RMT), a large proportion of biting occurred outside of sleeping hours. Moreover, the study found that *Anopheles* biting behavior varied between ecological sites (e.g. higher biting rate in forested village than in more urbanized village).

Presentations under theme 3 delved into net coverage and indoor residual spraying (IRS) (Dr. Vu Duc Chinh, Dr. John Lucas, and Dr. Michael Macdonald). Full coverage of long lasting insecticide-treated nets (LLINs) in APMEN countries to protect humans against the biting of *Anopheles* is often a challenge. For instance, net ownership does not necessarily translate into usage. To address this, Dr. Vu Duc Chinh explained that for Vietnam’s retreatment of conventional nets program, conventional nets are favored for treatment because household members purchase these nets and prefer such nets. Finally, a group effort to draft research ideas pertaining to the three themes discussed for the APMEN VCWF and member countries.

The seventh and last session of day 2 took a closer look at the private sector industry. Dr. Nick Hamon, Dr. Angus Spiers, Ms. Suwadee Keskovit, and Mr. Say Piau Lim elaborated on product development for malaria and dengue vector control. The presenters underlined the lengthy process of translating research findings for novel vector control tools to practical new vector control products, and to bringing such product onto the market in Asia. Major challenges hindering this process include a scarce expertise in several regulating bodies for public health products, and a lack of inter-ministry/department information sharing, deliberation, and consensus. A group work discussion provided inputs to APMEN position statement intended for the Asia Pacific Leaders Malaria Alliance (APLMA) on the requirements for registration of vector control products and other public health goods. For instance, it was suggested that APLMA should involve both vector control product regulators and NMCPs to stimulate the understanding of the needs and priorities for these products.

On the third and last day of the meeting, Prof. Theeraphap Chareonviriyaphap presented an overview of the Mekong Outdoor Malaria Transmission Network (MOMTN). Three of the roles of MOMTN include the strengthening of current entomology research, monitoring and evaluation capacities in the Greater Mekong Subregion, as well as supporting and facilitating mutual research that will answer to the challenges of outdoor transmission in the region. Prof. Theeraphap encouraged APMEN countries to join the effort and requested their support in designing more of the activities and in communicating more information pertaining to MOMTN’s scope.

Finally, the APMEN VCWG Business Meeting gathered member countries and partners. The meeting specifically focused on APMEN VCWG proposed initiatives and organization. Voting of the new APMEN VCWG Chair and Co-Chair took place; Dr. Christina Rundi was re-elected Chair, and Dr. Pradeep Srivastava was elected Co-Chair.

II. Moving Forward: Action Items and Recommendations.

Key courses of action and recommendations stemmed from the group work and discussions carried out throughout out this meeting. Some of the main action points include, but are not limited to, the following:

1. **Capacity-building strategies in entomology** for APMEN (Session 3):
• Improve inter-ministerial collaboration by: (a) mapping cross-sectoral collaborative networks for entomological research and training in APMEN countries, and (b) conduct country-level vector control and human resources assessments.
  o Carry out country-specific economic analyses to explicitly show costs savings of vector control investments.
• Assist with developing the entomological training curriculum by providing guidance on what entomological training would be necessary.
• Facilitate communication and coordination between programs and training/research institutions.
• Put forth both inter-agency and private sector cooperation.
• Promote relevance of careers in entomology amongst academic institutions.
  o Present documented successes and achievements.

2. **Capacity-building strategies in entomology** for APLMA (Session 3):
• Encourage universities to establish and manage entomology programs.
  o Create an entomology award to encourage academic and professional growth in entomology.
• Promote and suggest internships within the private sector; enhance collaboration between Ministries of Health and both the private sector and academic realm.
• Work towards ensuring sustainability of entomological careers inclusive of all vector-borne diseases.
• Advocate establishment of public health entomologists (PHEs) to governments.
  o Simultaneously highlight the importance of vector control to eliminate malaria.
  o Showcase other countries’ strong malaria programs as examples.

3. **Research priorities in medical/public health entomology** for APMEN VCWG research agenda (Session 6):
   **A. Vector Surveillance.**
   • Alternatives to Human Landing Catches (HLCs).
   • Methods to assess vector bionomics (e.g. behavior); and for associating human behavior with mosquito behavior.
   • Methods for linking entomology with epidemiology.
   • Methods for improving rapid identification of larvae, and mapping (training on GIS).
   • Identifying software for data analyses, collating, and management.
   • Community-based surveillance.

   **B. Outdoor Transmission.**
   • Appraise novel tools for control of outdoor transmission, including:
     o Spatial repellents,
     o Environmental management and engineering,
     o Livestock protection via semi-protective shelters.
   • Generate outdoor transmission indicators to assess outdoor transmission, via methods such as:
     o Blood meal analyses,
Xenomonitoring, 
MMR (Mark Release and Recapture).

4. Priority actions for improving IRM in APMEN countries (Session 4):
   - Measure pyrethroids resistance intensity; determine resistance mechanisms,
   - Address uncertainties in selection of sentinel sites for IRM.
     - Form a combination of sentinel and roving sites for IRM surveillance to capture vector species diversity.
   - Attend to issues around acquiring IR papers for IR assays.

5. Action items for addressing issues around registration and regulation of vector control products (Session 7):
   A. ALPMA.
      - Should honor a role in enhancing awareness of malaria elimination goals, and in accelerating the availability of newly developed vector control tools on the market.
        - APLMA is encouraged to reach out to various ministries for questions and data requirements related to vector control: e.g., Ministries of Health, M of Agriculture, M. of Public Works, etc.
        - Engage vector control product regulators and National Malaria Control Programs (NMCPs) to ensure both parties understand the needs and priorities for vector control products.
      - Advocate for the harmonization of national regulatory processes in APMEN countries to enable fast-tracked registration of WHO pre-qualified vector control tools necessary for malaria elimination.
        - ALPMA should work with WHO Regulatory Systems Strengthening team.
      - Should push for vector control products users will want to use.
      - Coordinate packaging requirements.
      - Promote flexibility from both countries and procurers.
      - Put forth private sector/corporate social responsibility (CSR).

   B. APMEN.
      - Connect and communicate with private sector.
      - Assess vector control products demand from APMEN countries and pool with that of from Africa.