

# Posters Presented at the 13th RBM VCWG Meeting 7-9<sup>th</sup> February 2018 in Geneva

**“Temporal pattern of LLIN campaign household registration and implications for in- process assessment”**

**Godwin Aidenagbon<sup>1</sup>**

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## **Abstract**

Household mobilization for the issuance of net card is a key component of LLIN mass campaigns in Nigeria. Only those issued with net cards are eligible to receive free nets during the campaign. Analyzing data from the I-9a form (Daily monitoring and supervision checklist) administered by independent monitors over the 9 day period, the study shows that distribution activities reach a peak on the 3rd day of distribution with mobilizers exhausting their net cards leading to missed households and communities. The study recommends intensive monitoring in the first 3 days of household mobilization and the allocation of net cards based on projected populations of distribution point catchment areas.

**“Innovative application technology proven to break DENV and ZIKV transmission – current status”**

**Peter DeChant<sup>1</sup>, Seleena Benjamin<sup>1</sup>, Jacques Dugal<sup>1</sup>, Banugopan Kesavaraju<sup>1</sup>, Heiko Kotter<sup>1</sup>, and Steven Krause<sup>1</sup>.**

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## **Abstract**

A cornerstone of the successful response to a 2016 outbreak of Zika virus in Florida, USA; was wide area larvicide spray (WALS) of Bti strain AM65-52 WG to control of container mosquitoes, specifically *Aedes aegypti* and *Ae albopictus*. This technology was first developed in Singapore and Malaysia where backpack sprays were demonstrated to reduce dengue incidence (Tan et al. 2012). WALS has since been adopted in the USA where it is successfully integrated into dengue control programs (Pruszynski et al. 2017), and response to Zika virus (Likos et al. 2016). This poster covers global development of WALS technology and the current state of the art for use WALS of Bti strain AM65-52 WG. Ground and aerial application platforms, spray systems, drop spectra, and mission strategies will be discussed as well as monitoring and evaluation methods.

**“Impact of 3 common species of aquatic plants on survival of malaria vector mosquitoes, *Anopheles quadrimaculatus* and its effect on the efficacy of boric acid sugar baits”**

**Rui-De Xue<sup>1</sup>, Kai Blore<sup>1</sup>, & John C. Beier<sup>1</sup>**

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## **Abstract**

The purpose of this study was to investigate the sugar feeding of the malaria vector, *An. quadrimaculatus* Say by measuring the impact of different aquatic plants on survival. At the same time, the potential use of boric acid in toxic sugar bait application to the leaves of the plants was evaluated. Mean survival rates of mosquitoes after 120 h feeding exposure on 3 common aquatic plant species, *Thalia geniculata*, *Pontederia cordata*, and *Limnobium spongia* were 10.55%, 1.86%, and 6.21%, respectively. No significant differences in mortality between mosquitoes feeding on separate plant species were detected. Toxic sugar bait efficacy was evaluated

via leaf dip bioassay to compare mortality at 24 h between mosquitoes feeding on leaves treated with toxic sugar bait formulation (1% boric acid, 10% sucrose) and leaves dipped in 10% sucrose. Mortality was significantly higher for treated leaves of *T. geniculata* and *P. cordata*, but not for *L. spongia*. One-way ANOVA analysis showed no significant difference in efficacy between toxic sugar bait-treated leaves of all 3 plants.

#### **“Games to facilitate IRM knowledge acquisition and planning in vector control and elimination programmes”**

*Kirsten Duda<sup>1</sup>, Edward Thomsen<sup>1</sup>, Claire Dormann<sup>1</sup>, Busiku Hamainza<sup>2</sup>, Delenasaw Yewhalaw<sup>3</sup>, Michael Coleman<sup>1</sup>*

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#### **Abstract**

Operational failure of vector control is inevitable if we do not proactively mitigate the impacts of insecticide resistance. Best practice guidelines for insecticide resistance management (IRM) are available from the WHO. However, these guidelines are not widely implemented in malaria endemic countries. Additional resources to communicate IRM best practices was identified as a priority of the Roll Back Malaria Vector Control Working Group meeting in 2016. ResistanceSim is a novel approach to improve IRM competencies among vector control stakeholders by allowing users to play a realistic simulation game to test out vector control strategies. ResistanceSim is being evaluated within the context of 2.5 day packaged IRM training course. The course has been conducted in Ethiopia and Zambia with the primary target audience of vector control programme staff. The course consists of mini-lectures, group discussions, and ResistanceSim gameplay sessions. The primary outcomes of this study are knowledge acquisition and retention, measured by knowledge tests pre- and post-course; self-efficacy, measured through a questionnaire administered pre- and post- course; and transfer of skills to the work environment. The impact is being evaluated using semi-structured interviews conducted one month after the course has finished. This gaming-enhanced IRM training course, using the serious game ResistanceSim, increased both knowledge and self-efficacy of the participants in the short term. Participants generally indicated that they felt engaged and immersed in the course material and expressed repeated interest in having additional games developed to support their work. Facilitated training sessions using games could be the next novel approach of communicating information in vector-borne disease control programmes, from training microscopists to read blood slides, to demonstrating how a spray operator should properly perform indoor residual spraying. With the current increase in mobile technology across sub-Saharan Africa, games have the potential to have a transformative impact on malaria control and elimination.

#### **“The WIN Initiative: A Global Network to Combat Insecticide Resistance in Arbovirus Vectors”**

*Claire Durot<sup>1</sup>, Vincent Corbel<sup>1</sup>, Jean-Philippe David<sup>2</sup>*

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#### **Abstract**

Arbovirus transmitted by *Aedes* mosquitoes, such as dengue, Zika, chikungunya and yellow fever have been re-emerging all over the world. Vector control, mainly by the use of insecticides, play a key role in disease prevention but the use of the same chemicals for decades, together with the dissemination of vectors resulted

in the global spread of insecticide resistance. A coordinated approach is imperative to detect and manage insecticide resistance and to deploy alternative strategies for vector control. Initiated with the support of the WHO Special Programme for Research and Training in Tropical Diseases (TDR) and the Department of Neglected Tropical Diseases (NTDs), the Worldwide Insecticide resistance Network, WIN (<http://win-network.ird.fr/>) brings together 19 internationally recognized institutions in vector research to track and combat insecticide resistance in mosquito vectors of arboviruses at a global scale. The missions of WIN are i) to establish a global resistance surveillance system for arbovirus vectors, ii) to fill knowledge gaps and identify research priorities on insecticide resistance, and iii) to assist WHO and national authorities in decision-making on insecticide resistance management and deployment of resistance-breaking tools. Since its creation in March 2016, the WIN has organized an international conference on vector resistance in Brazil and produced in-depth reviews to support the development of a global plan for insecticide resistance management in arbovirus vectors. The WIN is now entering into a new era by developing a membership organization open to new academia, public health agencies, international organizations, industries, NGOs, etc. to put insecticide resistance back in the vector control agenda.

### "The Host Decoy Tray: exploiting visual, olfactory and thermal stimuli of hosts to improve surveillance of outdoor biting malaria vectors"

Xiaoyu Yu<sup>1</sup>, Maurice Ombok<sup>2</sup>, Nabie M. Bayoh<sup>2</sup>, Neil F. Lobo<sup>1</sup>, Martin Geier<sup>3</sup>, Frances M. Hawkes<sup>4</sup>

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#### **Abstract**

Human Landing Catches (HLC) are the reference method for studies of vector behavior. However, there are concerns regarding potential exposure of collectors to mosquito-borne pathogens and dependence of results on collector skill. Beyond HLC, there are no reliable methods for accurately sampling outdoor biting malaria vectors, posing problems for understanding disease transmission dynamics in areas where outdoor biting may be contributing to residual malaria transmission. Sampling tools based on vector behavior could provide new ways of capturing mosquitoes for outdoor disease surveillance. This study tests the performance of a new standardized mosquito trap, the Host Decoy Trap (HDT), to sample host-seeking mosquitoes both outdoor and indoor. The HDT utilizes three host-associated stimuli to attract mosquitoes and induce landing behavior: host odours, body temperature, and visual stimuli. A 6x6 Latin square compared the performance of three mosquito collection methods (a commercial HDT prototype, a locally produced HDT, and HLC) in both indoor and outdoor settings. Collections took place over 24 nights (6pm to 6am), in western Kenya, where *Anopheles arabiensis* and *Anopheles funestus* are locally important vectors. In total, 497 *Anopheles* mosquitoes were collected, dissected, and identified to species using PCR. *Anopheles* abundance outdoors did not differ significantly between the commercial prototype HDT and the HLC outdoors, indicating the HDT has potential as a replacement sampling method for outdoor biting mosquitoes. There was no significant difference in outdoor *Anopheles* catch between the commercial prototype and the version of the HDT made with locally available materials, suggesting the tool could be readily produced in resource-poor settings and contribute to community vector surveillance and possibly control. However, the HDT did not perform as well as the HLC indoors. The HDT and other tools based on quantified vector behavior have potential to improve mosquito surveillance and control options in outdoor settings.

### "Is targeted reactive vector control a non-inferior substitute for generalised indoor residual spraying in areas of very low malaria transmission – results from a cluster randomised trial"

Immo Kleinschmidt<sup>1, 3</sup>, Jackie Cook<sup>1</sup>, John Govere<sup>3</sup>, Phillemon Matebula<sup>3</sup>, Khumbulani Hlongwana<sup>6</sup>, Natasha Morris<sup>7</sup>, Jaishree Raman<sup>2, 3, 4</sup>, Eunice Agubuzo<sup>2, 3</sup>, Ishen Seocharan<sup>7</sup>, David Bath<sup>10</sup>, Joseph Biggs<sup>5</sup>, Alpheus Zitha<sup>9</sup>, Elliot Machaba<sup>8</sup>, Matimba Zita<sup>3</sup>, Aaron Mabuza<sup>9</sup>, Philip Kruger<sup>8</sup>, Chris Drakeley<sup>1</sup>, Maureen Coetzee<sup>2, 3</sup>.

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### **Abstract**

**Background:** In areas of very low, pre-elimination malaria transmission the low number of incident cases make it difficult to sustain resources for spraying all houses annually with insecticide (generalised indoor residual spraying (GIRS)). An alternative that may be more sustainable is to target IRS (TIRS) reactively only at houses in the immediate neighbourhood of incident cases as they arise. **Methods:** Of 62 clusters consisting of settlements of approximately 5000 persons each in the provinces of Mpumalanga and Limpopo in South Africa, half were randomly allocated to receive the currently practised GIRS whilst the other half received reactive TIRS in response to every passively reported local case. TIRS was designated to be carried out in the immediate neighbourhood (about 8 houses) of each index case. Non-inferiority of TIRS was assessed in comparison to GIRS based on passive case incidence in the two study arms. The margin of non-inferiority was defined as 1 case/1000 per year. Dried blood spots were collected from neighbourhoods of index cases, and in randomly selected neighbourhoods where there were no cases to determine, using serology, whether new cases arise predominantly in areas of previous exposure to parasites. **Results:** There was no evidence of a difference in malaria incidence between study arms ( $p=0.512$ ). There was evidence that targeted IRS was non-inferior to generalised IRS within the pre-specified margin of 1 case per 1000 ( $p=0.001$ ). **Interpretation:** Targeted reactive spraying appears to be a safe, more sustainable method of deploying IRS in this area of very low transmission (~1 case per 1000 per year).

### **“Effectiveness and feasibility of reactive focal mass drug administration vs. reactive case detection, with and without reactive IRS in response to passively identified malaria cases: results from a cluster randomised trial”**

*Henry Ntuku<sup>1</sup>, Davis Mumbengegwi<sup>2</sup>, Kathryn Roberts<sup>1</sup>, Patrick McCreesh<sup>3</sup>, Jenny Smith<sup>1</sup>, Petrina Uusiku<sup>4</sup>, Stark Katokele<sup>4</sup>, Ronnie Bock<sup>2</sup>, Cara Smith Gueye<sup>1</sup>, Lisa Prach<sup>1</sup>, Oliver Medzihradsky<sup>1,5</sup>, Brooke Whittemore<sup>3</sup>, Hugh Sturrock<sup>1</sup>, Mi-Suk Kang Dufour<sup>6</sup>, Bryan Greenhouse<sup>6</sup>, Adam Bennett<sup>1</sup>, Immo Kleinschmidt<sup>7,8</sup>, Roly Gosling<sup>1</sup>, Michelle S. Hsiang<sup>1,3,5</sup>*

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### **Abstract**

**Background:** Reactive case detection (RACD) consisting of testing and treating individuals around passively detected cases is a commonly used strategy to reduce or interrupt malaria transmission in low endemicity settings. Other interventions such as reactive-focal mass drug administration (rfMDA), or reactive focal vector control (RAVC) using IRS may be more effective. **Method:** A cluster randomized controlled trial with a 2x2 factorial design was conducted in 56 clusters (enumeration areas) in the Zambezi district of north-east Namibia

to compare rfMDA using Artemether Lumefantrine (AL) vs. RACD, and RAVC using Actellic CS vs. no RAVC in the surrounding 500m of index cases. A single annual round of IRS using DDT was conducted in all houses throughout the study area, as per government policy i.e. the two focal reactive interventions in response to cases, were in addition to annual generalised IRS. **Results:** rfMDA alone reduced malaria incidence by 28% (rate ratio=0.72; p=0.37), RAVC alone reduced incidence by 29% (rate ratio=0.71, p=0.28), and rfMDA combined with RAVC reduced incidence by nearly 50% (rate ratio=0.52; p=0.23). **Interpretation:** The two reactive interventions (rfMDA and reactive focal IRS) were found to be feasible, safe and acceptable. Although the results lack statistical significance, they show that the two interventions were additive in their effect. A larger study of longer duration should be conducted to provide stronger evidence for this promising intervention in low transmission malaria settings.

### “Species- and genus-level estimates of wild mosquito lifespan”

**Ben Lambert**<sup>1</sup>, **Ace North**<sup>2</sup>, **Charles Godfray**<sup>2</sup>

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#### **Abstract**

Since Ronald Ross’ discovery in 1897 that mosquitoes transmit malaria, field entomologists have collected a great deal of information about mosquito ecology. Despite this tremendous effort, there still remain significant gaps in our knowledge. Epidemiological models are sensitive to how long mosquitoes live in the wild. Whilst it is possible to directly determine the mean lifespan of mosquitoes in laboratory colonies, it is widely believed that these measurements are not representative of wild mosquitoes. Historically, two approaches have been used to estimate the lifespan of wild mosquitoes: mark-release recapture experiments (MRRs), and studies based on the dissection of wild-caught female specimens. Although both these approaches provide valuable information on mosquito longevity, they are expensive to carry out, and often yield inaccurate estimates. In my poster, I will present the results of two meta-analyses of previously-published works – one of MRR experiments (database compiled by [1]), the other of dissection-based studies (we compiled this database using a literature search). These experiments span over a century of field experiments, encompassing MRR studies carried out during the construction of the Panama Canal, and mass mosquito dissection experiments conducted in Soviet Russia. By synthesising information from a large body of sources, this allows us significant insight into the length of time that mosquitoes live in the wild. Since we have information on study characteristics, we are able to estimate mosquito lifespan by species and sex, and investigate the influence of climatic factors on longevity. Because the data we analyse comes from two experimental methodologies, each of which makes different assumptions to determine lifespan, we are also able to critically appraise the MRR and dissection approaches.

### “Community-led implementation of integrated malaria control in southern Malawi”

**Robert S. McCann**<sup>1</sup>, **Henk van den Berg**<sup>1</sup>, **Michèle van Vugt**<sup>2</sup>, **Dianne J. Terlouw**<sup>3</sup>, **Kamija S. Phiri**<sup>4</sup>, **Peter J. Diggle**<sup>5</sup>, **Themba Mzilahowa**<sup>4</sup>, **Lucinda Manda-Taylor**<sup>4</sup>, **Steven Gowelo**<sup>4</sup>, **Monicah Mburu**<sup>1</sup>, **Alinune N. Kabaghe**<sup>2</sup>, **Michael G. Chipeta**<sup>5</sup>, **Tumaini Malenga**<sup>4</sup>, **Willem Takken**<sup>1</sup>

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#### **Abstract**

Sub-optimal coverage of malaria interventions limits the potential for achieving malaria elimination. Additionally, bed nets and indoor residual spraying are not universally sufficient for elimination, especially in areas with outdoor transmission or insecticide resistance. Community engagement strategies may increase the use of interventions by populations at risk through increased acceptability and understanding. Integrating additional vector control interventions with current strategies could lead to further reductions in transmission. We have established a multi-disciplinary project with an emphasis on community engagement and locally-appropriate integrated vector management to address these challenges in a rural community of 25,000 people in southern Malawi. Community engagement has been facilitated by training community volunteers as health animators and supporting the organisation of village-level committees in collaboration with a non-governmental organisation working in the community. Larval source management (LSM) and structural house improvements (HI) are implemented as additional vector control interventions. We are measuring the effectiveness of LSM and HI using a randomised block, 2x2 factorial, cluster-randomised trial design from May 2016 through April 2018. The effectiveness of the community engagement was assessed through participant observations, focus group discussions, in depth interviews, and standardized surveys. The community engagement strategy used in this setting was feasible. The training of local volunteers facilitated the involvement of the greater community, and community member input allowed for adaptations of the interventions to the local ecological and social settings.

**“Motivators of long lasting insecticidal net use in malaria endemic and epidemic counties in Kenya: insights from a malaria qualitative study”**

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**Abstract**

**Background:** Malaria remains a major cause of morbidity and mortality in Kenya with more than 70% of the population at risk of the disease. The Kenya Malaria Strategy 2009-2018 recommends distribution of long-lasting insecticidal nets (LLINs) for universal coverage as a key vector control strategy. LLINs are distributed in malaria endemic and epidemic-prone areas through mass campaigns (once every 3years); routinely through Antenatal clinics and child welfare clinics and retail points. Sixty-three percent of households own at least one LLIN but only 48% slept under an LLIN the night before the Kenya Malaria Indicator Survey (2015). **Objectives:** To determine motivators associated with net use among pregnant women aged 15 to 49 years, decision makers and caregivers of children under 5 years in highland malaria epidemic, coast and lake malaria endemic counties in Kenya. **Methodology:** Purely qualitative approach using a hybrid conceptual framework combining the Health Belief Model and 3 Delays Model. Twenty one focus group discussions and 12 in-home visits were conducted amongst decision makers and care givers of children under 5 years, and pregnant women aged 15-49 years. Key informant interviews were conducted among 32 knowledgeable stakeholders. The recorded data was transcribed verbatim, coded and analysed using Nvivo. **Results:** Key motivators of net use included perceived risk and net availability. Past experiences through death of a relative/friend, miscarriages and high malaria treatment expenses increased net use. Most nets were acquired through mass net distribution and from health facilities during Ante-natal care visits. Net use communication campaigns, cold/wet seasons and pest control also increased net use. **Conclusion and Recommendation:** Previous bad experience and perceived risk are the main motivators for net use. Communication should use this by showing adverse effects of Malaria and target primary caregivers and key decision makers on net use.

**“Acoustic larvicide for permanent drinking water applications”**

**Herbert Nyberg<sup>1</sup>**,

1 New Mountain Innovations

**Abstract**

Rapid development in tropical areas is stressing water sources and driving the need for containers such as cisterns and caixa daugas that provide excellent habitats for larval breeding. Acoustic Larvicide, a non-chemical resistant tolerant, target specific intervention kills larvae and pupae with acoustic resonance. This low cost solution operates continuously with solar or domestic power with complete control in any size water container. It is set and forget and very low cost.

**“Profile of mosquito vectors from indoor pyrethrum spray in Northern Namibia”**

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**Abstract**

In Namibia, three main mosquito vectors belonging to the *Anopheles gambiae* complex has been reported in only three regions Kunene, Omusati, and Ohangwena. In addition, no information is available on other species including *Anopheles funestus* that is present in Southern Africa. Here we present data from indoor sprays in nine regions in Northern Namibia where malaria disease is endemic. In total, 1,141 adult mosquitoes were collected from all seven regions from the eastern to the western corridor of Northern Namibia; Kunene, Omusati, Oshana, Oshikoto, Ohangwena, Kavango and Katima-Mulilo. The rooms of residents were sprayed after which mosquitoes were collected and stored at -20C and later -80C for identification. The vectors were identified morphologically by examining the pattern of the wings, the legs, the thorax and the abdomen. *Anopheles caroni* accounted for the highest overall frequency vectors sampled (72.8%). The other species in decreasing frequency were: *An. gambiae* complex (22.7%), *An. squamosus/cydippis*, (1.3%), *An. Ruarinus* (1.2), *An. dancalicus* (1.1%), *An. rhodensiensis* (0.17%), *An. ardensis* (0.17%), *Aedes mosquito*(0.1%), *Culicine mosquito* (0.1%), *An. salbai* (0.1%) and *An. maculipalpis* (0.1%) and *An. telebrosus* (0.1%). The vectors were specific to the different regions distributed as follows: *An caroni* was seen in all regions sampled whereas *An gambiae* complex were seen only in Kunene and Kavango. All the rare species were also region/district specific.

**“The impact of pyrethroid resistance on the efficacy and effectiveness of indoor residual spraying for malaria control in Africa”**

*Ellie Sherrard-Smith<sup>1</sup>, Pete Winskill<sup>1</sup>, Jamie T. Griffin<sup>2</sup>, Thomas S. Churcher<sup>1</sup>*

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**Abstract**

There are growing concerns that malaria control is threatened by the spread of mosquitoes’ being resistant to pyrethroids. Pyrethroids are currently the only class of insecticide used on bednets and have been used historically for indoor residual spraying (IRS). Alternative IRS products are available, though their cost-effectiveness is unclear given differences in the initial efficacy and decay over time of these alternative products. A systematic meta-analysis of experimental hut trial data is used to; i) characterise the entomological efficacy of the most widely used existing and new IRS compounds and; ii) quantify the effect of resistance to

pyrethroid-IRS products. An established transmission model for Plasmodium falciparum malaria is then used to predict the public health impact of IRS campaigns with distinct types of insecticides. A simple framework is devised to help African malaria control programmes to choose the most cost-effective IRS product according to local endemicity, seasonality of transmission, level of resistance, bednet use and alternative malaria control interventions.

Thank you to V. Corbel, C. Penner, A. Djènontin, M. Rowland, E. Constant, P. Müller and Jason Richardson for sharing data. This work was funded by the Integrated Vector Control Consortium (IVCC).

### “Mesto new vector control IRS sprayer”

**Wolfram Wagner<sup>1</sup>**

1 Mesto

#### **Abstract**

Poster shows new certified IRS sprayer available in Q2 2018.

### “Interceptor® G2: A novel LN for malaria control and beyond”

*James W. Austin<sup>1</sup>, Susanne Stutz<sup>2</sup>, Egon Weinmueller<sup>2</sup>, Volker Frenz<sup>2</sup>, Karin Fischl<sup>2</sup>, Mark Rowland<sup>3</sup>, Richard Oxborough<sup>3,4</sup>, Matt Kirby<sup>3</sup>, Raphael N’Guessan<sup>3,5</sup>, Corine Ngufor<sup>5</sup>, Abdoulaye Diabate<sup>6</sup>, Koama Bayill<sup>6</sup>*

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#### **Abstract**

The use of long-lasting insecticidal bed nets or LNs, has unequivocally proven to be an important and successful tool for the mitigation of malaria. However, a negative consequence of the widespread use of LNs has been the accompaniment of selection which further exacerbates well-known resistance issues to neuro-toxic chemistries (like pyrethroids) for mosquitoes. Interceptor® G2 is a novel net unique among LNs, because it is truly the first net which includes two discrete adulticides. This unique combination can provide significantly better efficacy to resistant mosquitoes. Field testing results from Benin, Burkina Faso and Tanzania have unequivocally demonstrated significantly higher efficacy to resistant mosquito strains (40-60% increased mortality to resistant strains). This net, developed by BASF through a partnership with IVCC holds great promise as a remarkable LN that can complement any area-wide efforts to reduce malaria transmission unlike any other LN currently in the market and affording improved protection to its users.