

**Roll Back Malaria Vector Control Working Group (RBM VCWG)
11th Annual Meeting, 3rd-5th February 2016
Moevenpick Hotel, Rue de Pré Bois, Geneva**

**1st LLIN Priorities Work Stream Meeting
14.30-17.30, Thursday 4th February 2016
Moevenpick Hotel, Rue de Pré Bois, Geneva**

**Chairs: Hannah Koenker & Lena Lorenz
Rapporteur: Lucy Tusting**

Introduction - Hannah Koenker, Johns Hopkins University Center for Communication Programs, USA and Lena Lorenz, London School of Hygiene & Tropical Medicine, UK

The goal of the work stream is to maintain high levels of ownership and use of serviceable long-lasting insecticide-treated bednets (LLINs) in endemic countries by focusing on (i) distribution approaches, (ii) LLIN durability and (iii) new and next generation LLINs. Completed 2015 outputs from the *Continuous Distribution of LLINs in the Field* and *Durability of LLINs* work streams include: (i) defining best practices for measuring LLIN durability and (ii) producing tools for national malaria control programmes (NMCPs) that wish to start monitoring durability (including a guidance note on operationalizing durability monitoring in the field for malaria programs to monitor field performance and plan LLIN distributions; tools to collect and use durability data; capacity building training modules/a manual on durability monitoring). Ongoing activities from the *Continuous Distribution* work stream are to: (iii) compare the economic costs of different continuous distribution mechanisms, (iv) identify next steps and research for developing a private sector role/market, (v) understand how to optimize distribution systems over the long term, (vi) publish evidence from continuous distribution pilots and (vii) feed into Harmonization Working Group (HWG) technical guidance to ensure best practices. Ongoing activities from the *Durability* work stream are to: (viii) validate the resistance-to-damage score to inform net replacement decisions, (ix) establish an online repository of durability data for scientific and operational exchange and (x) articulate the link between insecticide resistance and durability issues; these need to be looked at together, especially as resistance grows.

Other important topics include net preferences and implications for procurement (Vector Control Technical Expert Group paper requested), identifying behavioural challenges with nets, improving bed net purchase and usage experience, innovation for more durable LLINs, preparing for effective deployment of new and next generation nets, sharing updates, ensuring partners remain coordinated, identifying key issues requiring normative World Health Organization (WHO) guidance and contributing to their development.

LLIN market analysis in Kenya - Anne Musuva, Population Services Kenya, Kenya

This bednet market analysis aimed to understand the scope of the total bed net market (both public and private sectors) and to determine the capacity of and barriers to private sector expansion of the LLIN market and potentially engage in keep-up strategies with the public sector. During April to September 2015, 23 key informant interviews were done with donors, manufacturers (both local

and international), importers, regulators and the Ministry of Health. A retail outlet survey was done in all four zones using a semi-structured format to approach 1610 outlets. A stakeholder workshop was conducted also. The study found that the NMCP was the main body responsible for policy and regulation. Overall, mass nets accounted for a 53% share of the market, free routine nets for 31%, social marketing for 9% and commercial nets for 7%. There are 64 net brands in the Kenyan market with 3 LLIN brands. 33.5% of retailers cannot differentiate between LLINs and untreated nets. Retail perceptions and challenges in the commercial sector were discussed. Recommendations are to explore more sustainable approaches to universal coverage, to increase ownership and sustainability, to better target free nets/subsidies through a total market approach, to expand social marketing and to introduce a mid-tier priced LLIN. Additionally, a public-private partnership could aid communication efforts to differentiate LLINs and drive their use, local manufacturers could be engaged to start phasing out untreated nets, particularly in endemic areas and the government could relax the regulation of treated netting imports.

How can continuous distribution demonstrate value for money? - Albert Kilian, Tropical Health LLP, Spain

Mass campaigns have been essential to reach current levels of success. Current WHO guidance mentions a long-term shift to continuous distributions, but there is no particular emphasis on this. In practical terms, most countries use mass campaigns with continuous distribution through antenatal clinics (ANC) and the extended programme of immunisation (EPI). Yet as universal coverage is reached and campaigns are repeated, the system becomes inefficient and poor value for money. Using NetCALC it has been estimated that continuous distribution would save 18-25% of the total annual cost of mass distribution in sub-Saharan Africa. It was recently estimated that 21% of ITNs were over-allocated in 2013 (Bhatt *et al.* 2015 eLife). Distribution strategies should reduce waste by better targeting LLINs where needed, filling gaps without oversupply and responding to varying net survival. Countries need to be guided in implementation with a stronger emphasis on more efficient and reactive systems.

Discussion

- It was queried whether mass campaigns should be discontinued or whether longer cycles should be introduced. It was clarified that a system that combines both continuous and mass distribution is not optimal and that we need a system that is more flexible overall and that relies only on continuous distribution in certain areas.
- There is a gap between policy and practice in continuous distribution; research by Katherine Theiss Nyland is examining why the policy of distribution through ANC and EPI is not done in many settings.
- We have the technology to manufacture long-lasting netting materials in local factories.

LLIN durability monitoring toolkit - Hannah Koenker, Johns Hopkins University Center for Communication Programs, USA and John Gimnig, Centers for Disease Control and Prevention, USA
WHO Pesticide Evaluation Scheme (WHOPES) guidelines on durability monitoring were published in 2011 and the President's Malaria Initiative (PMI) has supported monitoring in eight countries since 2008/2009. A pooled analysis based on existing data is currently ongoing. PMI contracted VectorWorks to develop a toolkit for ITN durability monitoring under PMI, incorporating lessons learned. The rationale was that net durability has been studied using a variety of study designs but it

is important to standardize the approach for cross-comparability and simplicity. Durability monitoring allows PMI and others to identify places and/or products that perform under expectations. The toolkit is not for selecting specific nets.

The toolkit contains a Q&A on how to carry out durability monitoring; a durability monitoring guideline; data collection instruments including a template protocol, survey questionnaire, consent and recruitment scripts; field worker training manuals; guides for data cleaning and analysis and report templates. Data to be collected include: (i) the number and brand of nets examined, by years in the field, (ii) the number of nets not found, percent survivorship or attrition, disaggregated by reason for loss, (iii) years (or months) since distribution, (iv) size and number of holes (by WHO hole size category), and location if laboratory analysis is performed and (v) data on household use, care and repair attitudes and behavior and socioeconomic position. Outcome measures include: (i) total estimated area of damage and proportional hole index for each individual net, (ii) proportion of surviving nets in serviceable condition as defined in WHO/Malaria Policy Advisory Committee (MPAC) guidance, (iii) estimated survival at each time point combining attrition and integrity as defined in MPAC guidance, (iv) graph of survival estimates against hypothetical survival curves using the tool provided by the *Durability* work stream, (v) estimation of median LLIN survival if more than two data points with survival <85% are available. Study design considerations and follow-up strategy were outlined. The next steps are to coordinate support for countries carrying out durability monitoring and to further develop the www.durabilitymonitoring.org toolkit.

Effects and costs of switching from standard to PBO LLINs - Thomas Churcher, Imperial College London, UK and Eve Worrall, Liverpool School of Tropical Medicine, UK

*PBO LLINs are treated with both a pyrethroid and piperonyl butoxide (PBO). WHO released guidelines on PBO LLINs in December 2015. Work to estimate the effects and costs of switching from standard to PBO LLINs was presented. First, a meta-analysis was done of all experimental hut trials where mosquito mortality was simultaneously assessed using a bioassay. This indicated that bioassays may be a useful tool for programmatic monitoring of resistance. A second meta-analysis of experimental hut trials comparing pyrethroid-induced mortality with and without PBO nets indicated that for *Anopheles gambiae* there is an added benefit of adding PBO as pyrethroid resistance increases, but not at very high levels of resistance; whereas there is no overall benefit for *An. funestus*. Finally, a meta-analysis was done of experimental hut trials that directly compared a standard LLIN with a PBO LLIN (either Olyset vs Olyset Plus or PermaNet 2.0 vs PermaNet 3.0. Mortality roughly matched what was predicted from the bioassay data. Building on the model outlined in Griffin *et al.* 2010, the epidemiological impact of switching to PBO LLINs has been modelled. While PBO LLINs appear to have an increased efficacy in certain settings, at this point the evidence is too limited to justify a complete switch from pyrethroid-only LLINs to PBO LLINs across all settings. To build the evidence base to support accelerated deployment of PBO LLINs, pilot ‘explanatory’ implementation is necessary. However, this should only be undertaken in areas where malaria prevalence in children aged 2-10 years exceeds 20% and mosquito mortality in bioassays with pyrethroids is <80%. Pilot implementation should not be undertaken unless accompanied by robust evaluation.*

With regards to costs, the WHO recommendation highlighted that PBO nets are likely to cost more than standard LLINs and that that this must not undermine universal coverage with vector control. UNICEF data from 2010-2015 shows that PBO nets are more expensive than standard LLINs.

Standard LLIN prices have fallen by 53% (in real terms) since 2010, while PBO prices have fallen by 15%, so the price differential has increased. To consider what this price differential means for LLIN coverage, a simple model has been built, using costs of LLIN distribution from the White *et al.* systematic review of the cost-effectiveness of malaria control interventions. This simple model shows that commodity price alone does not predict the extent of coverage loss; it is necessary to know the ratio of commodity to other costs within the programme. The greater the percentage of total cost that is accounted for by commodities (i.e. LLINs), the greater the coverage loss will be. This model shows that coverage loss increases as the price differential increases. To estimate the epidemiological impact, work is underway using a transmission dynamics model to identify the number of cases averted with each type of net at different coverage levels under different endemicity and resistance scenarios.

Discussion

- There was extensive discussion over the potential role of PBO LLINs and the need for their appropriate evaluation.
- It was clarified that prevalence, LLIN coverage data and level of resistance measured by a bioassay are the three criteria needed to assess whether there will be an additional benefit of PBO LLINs.
- Investment in monitoring and evaluation will be increasingly critical as new tools enter the market. Recommendations are needed to establish how such evaluations should be funded, whether via ongoing programme monitoring or at the research level.
- Durability monitoring guidance needs to be collated and easily accessible by NMCPs.
- It is increasingly difficult for manufacturers to keep innovating and manufacturing LLINs and policy makers, academics and NMCPs need to be aware of the risk of losing suppliers.
- The discussion highlighted the importance of maintaining durability of LLINs in the field and distributing LLINs more efficiently, in order to translate the savings made into new products where needed.

Next steps for the work stream:

1. Assemble all durability guidelines together and recommend updates to durability guidelines as the science develops, including data on care and repair.
2. Work with the Alliance for Malaria Prevention (AMP) to identify LLIN distribution options for low-transmission urban areas.
3. Create maps combining insecticide resistance and prevalence data to inform distribution strategies e.g. to identify areas for PBO LLIN piloting.
4. Provide a decision framework for new LLINs to communicate simply the evidence and recommendations to national program managers.
5. Lay out a clear series of steps are needed to move forward with new LLINs, including description of the minimum data requirements; ensure common understanding of constraints and processes.
6. Identify monitoring and evaluation needs for new LLINs once they are rolled out, including monitoring physical durability, bioefficacy and epidemiological outcomes.
7. Function as a forum to share information and results:
 - Share results of evaluations (including costing) of large-scale continuous distribution.
 - Provide updates on I2I work on the LLIN qualification process.

- Share results of inter-lab validation of resistance-to-damage scores and make this resource available via the durability toolkit.
- Share results of work on preferences for LLIN types (post VCTEG).
- Provide updates on ongoing work on mosquito net fishing and its effects on aquatic life and livelihoods and other net misuse.

Day 3: Friday 5th February

Session 3: Feedback from the work stream meetings

Chairperson: Jacob Williams

1st LLIN priorities work stream meeting - Hannah Koenker, Johns Hopkins University Center for Communication Programs, USA and Lena Lorenz, London School of Hygiene & Tropical Medicine, UK

Proposed work stream activities:

1. Assemble all durability guidelines together and recommend updates to durability guidelines as the science develops, including data on care and repair.
2. Work with AMP to identify LLIN distribution options for low-transmission urban areas.
3. Create maps combining IR and prevalence data to inform distribution strategies e.g. to identify areas for PBO LLIN piloting.
4. Provide a decision framework for new LLINs to communicate simply the evidence and recommendations to national programme managers.
5. Lay out a clear series of steps, including description of the minimum data requirements that are needed to move forward with new LLINs; ensure a common understanding of constraints and processes.
6. Identify M&E needs for new LLINs once they are rolled out, including monitoring physical durability, bioefficacy and epidemiological outcomes.
7. Function as a forum to share information and results:
 - Share results of evaluations (including costing) of large-scale continuous distribution
 - Provide updates on I2I work on the LLIN qualification process.
 - Share results of inter-lab validation of resistance-to-damage (RD) scores and make this resource available via the durability toolkit.
 - Share results of work on preferences for LLIN types (after VCTEG).
 - Provide updates on ongoing work on mosquito net fishing and its effects on aquatic life and livelihoods and other net misuse.

Discussion - All

Durability:

- A recent paper provides a protocol for measuring durability in the field (Sagnon *et al.* 2015 *Trials*). One suggested action point was to assemble a database of protocols online.
- Efforts to predict durability from measurable characteristics (e.g. bursting strength, denier) have proved unreliable. Maybe there should be less focus on methods to measure durability and more focus on monitoring durability in the field.
- Arguably, the more lasting a LLIN the more problematic this is from a resistance perspective.

LLIN advocacy:

- Work was published this year on impact of LLINs on agricultural productivity. LLINs should be advocated as part of the food security / poverty reduction package.
- Catholic Relief services did LLIN distribution through its food security stream and this has been written up.
- LLINs printed with religious figures or cartoon characters might be better looked after or sought after.

Measuring insecticide resistance:

- WHO susceptibility monitoring guidelines have been revised.
- We need to be able to better characterise resistance to understand where problem areas exist and the intensity of resistance in those settings.