Developing LLIN Durability Criteria to Inform Procurement Decisions and Innovation

Background

Studies to date indicate that the limiting factor for the useful life of a long-lasting insecticide treated net (LLIN) appears to be the textile’s physical integrity (as opposed to insecticidal protection).\(^1\) However, only one test relating to general fabric strength (bursting strength) is currently part of the WHO Pesticide Evaluation Scheme (WHOPES) LLIN specifications. Specifications to prospectively evaluate LLIN field performance do not currently exist, though in recent years there has been growing interest in using correlating field performance with textile testing methods to achieve this. Textile testing methods underpin standards across a wide range of industries and products, including personal protective clothing\(^2\) and a diverse array of medical and healthcare products (e.g., wound dressings, respiratory masks).

In February 2012, the Roll Back Malaria (RBM) Vector Control Working Group (VCWG) LLIN Durability work stream convened a meeting bringing together relevant experts, including WHO, CDC, experts managing durability field studies, textiles experts, and LLIN manufacturers to explore the potential of field analysis and textile testing methods for the development of LLIN performance standards. Experts at this meeting determined that in order to develop Net Performance Guidance using promising field analysis and textile testing approaches, further work is needed to correlate actual field performance with textile testing methods. This was cited as important both to allow major donors and countries to optimize Value for Money (VFM) in procurement, and to provide suppliers with critical information on the causes of net deterioration to inform and catalyze innovation.

The approach outlined below was developed based on the outcomes of this meeting, extensive discussions with vector control experts, and input from leading textiles testing institutes and international standard-setting bodies. The ultimate goal of this work is to develop a robust predictive algorithm that can inform WHO Net Performance Guidance and allow for prospective evaluation of field performance.

Approach

Tropical Health LLP (led by Albert Kilian), Nonwovens Innovation and Research Institute (NIRI) and Results for Development Institute (R4D) - hereafter referred to as “the consortium” – will undertake work to develop a predictive algorithm that correlates LLIN field performance to textile testing methods, taking into account the impact of critical environment factors (i.e., climatic-ecological zones, net use practices, rodent presence) that may impact net life.

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\(^1\) A rigorous review of the persistence of insecticidal protection is required in order for an LLIN to obtain WHOPES-recommendation. Optimal bio-effectiveness against the vector must last at least three years, and for many products is likely to last 1-2 years longer.

\(^2\) To protect users from threats such as fire, dangerous chemicals, microbes, body fluids and mechanical threats such as projectiles and knives
The consortium will use a two-phase approach over a 16-month period:

**Phase 1: Determine common LLIN ‘modes of failure’ based on robust collection of net samples from the field**

- Obtain well-defined samples of multiple LLIN brands retrieved from the field, taking into account critical factors that may impact net deterioration, such as: climatic-ecological zones (e.g., dry-hot or humid-wet), socio-demographic information, house characteristics, net use practices, and presence or absence of rodents
- Examine LLIN samples through light and scanning electron microscopy to:
  - Determine the different mechanisms that lead to net damage and formation of holes and their proportionate contribution across different environments
  - Study the structural changes that take place in the net fabric as a result of different agencies of wear so that this process can be simulated in the laboratory

The approach will critically rely on net samples from existing studies, including those led by CDC and potentially WHOPES. Following completion of these activities, the consortium will undertake a rigorous review process to determine whether the analysis is sufficient to correlate modes of structural deterioration in the field to results in the laboratory. If sufficient evidence exists, the consortium will move on to Phase 2 activities as detailed below.

**Phase 2: Develop recommended LLIN textile testing methods and specifications**

- Design a predictive algorithm of textile tests that reflect the prevailing damage mechanisms and allow an assessment of the level of resistance of a particular product against relevant agencies of wear in the net. This will be weighted by the proportionate contribution of each mechanism and, depending upon the evidence, may vary by climatic-ecological or specific environment
- Determine a system of recommended ‘performance bands’ reflecting the expected performance of an LLIN in the field

Following completion of Phase 1 and 2 activities, the consortium will submit a final report to WHO. In parallel to the above activities, the consortium will also actively engage with major donors and purchasers to ensure the necessary policy changes are in place to facilitate VFM procurements following WHO Net Performance Guidance release.

**Integration with WHO Net Performance Guidance**

Development of this approach has been undertaken in close coordination WHO Global Malaria Programme (GMP) and WHOPES, hereafter referred to as WHO. WHO has agreed that the output from this project will be submitted to WHO to inform its development of Net Performance Guidance.

WHO will be presented with critical inputs for consideration in development of Net Performance Guidance, including the final report from this project, findings from upcoming WHO lab testings, and other relevant inputs including in-country field trials or data collected per the WHO Guidelines for monitoring the durability of LLINs. As noted immediately above, WHO is planning to undertake near-term lab tests to help provide information on fabric strength. This will include testing all WHOPES-recommended nets against a set of lab tests (e.g., tear strength, tensile strength, dynamic nail test). The outcome of this work will be a comparative table of textile parameters categorizing the relative strength of each net, recognizing this will not immediately be correlated with field data.

WHO will undertake a consultative process considering the inputs noted above, resulting in issuance of Net Performance Guidance in mid-late 2013.

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3 Details pending finalization; subject to the agreement of LLIN manufacturers and assuming no associated cost implications for WHOPES or their collaborating field institutions
About the consortium partners

*Tropical Health LLP* is led by Dr. Albert Kilian. He has carried out malaria and public health consultancies in over 10 countries in Africa and Asia and has intensive research experience with over 40 peer-reviewed publications. Dr. Kilian is the co-leader of the RBM VCWG LLIN Durability work stream and is acknowledged for his innovative work on all issues around monitoring the durability of mosquito nets. Tropical Health LLP will be responsible for the design and collection of LLIN field samples from countries.

*Nonwovens Innovation and Research Institute (NIRI)* was formed in 2005 as a University of Leeds spin-out operation and has extensive technical expertise in textile analysis and fabric engineering for materials used in human health. It has a successful track record of delivering technical analysis and development projects in sectors of medicine and healthcare and vector control. NIRI’s team includes specialists with both industrial as well as academic experience and expertise, spanning textile technology, textile testing and analysis, polymer chemistry, physics, and regulation of healthcare products. NIRI will lead the textile analysis portions of the work.

*Results for Development Institute (R4D)* is a non-profit organization whose mission is to unlock solutions to tough development challenges that prevent people in low- and middle-income countries from realizing their full potential. R4D has demonstrated strong experience in its growing practice of developing and implementing market dynamics solutions to increase global access to affordable, high-quality health commodities. R4D recently led an extensive analysis of the LLIN market, engaging with over 140 stakeholders from 56 public and private organizations. R4D will be responsible for project management and external stakeholder engagement.