Work Stream: Durability of LLIN in the Field

Recent developments regarding methodology to measure LN survival (longevity) in the field

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5th Work Stream Meeting
15th November 2013
ASTMH meeting, Washington, DC
Recent Developments

- At last VCWG meeting need for guidance on how to calculate LN survival was emphasizes
- Draft document with review of existing evidence was prepared for VCTEG
- Presented and discussed at 1st VCTEG meeting, Geneva 3-5th July 2013
- After revisions presented to MPAC in September 2013
- Approved and officially published on WHO website
Why is this guidance needed?

- What we need is the “median survival” of an LN product in a given situation as a measure of durability.
- However, current guidance documents only explain:
  - How attrition (net loss) should be measured
  - How condition for each surviving LN should be assessed and summarized in a “proportionate Hole Index”
  - But not how these are to be combined into one metric
Objective of the Document

- Provide technical guidance
  - Not policy or strategy document
  - Not stand-alone, but complementing existing guidance documents
- Meant for researchers or M&E staff involved in the analysis of durability related data collections
  - Not for program managers
What are the issues?

- Need to always combine attrition and integrity measures
  - But only include a certain part of attrition
- Categorize pHI
  - To make it more robust
  - To identify those nets still “servicable”
- Need to include precision of estimates
  - To show that one product is really performing better than another
Attrition and Integrity

- If only integrity is considered, “durability” would actually appear to be improving as LN start to be discarded.
- If only attrition is considered “durability” could be driven by peoples perception.
- Retrospective and prospective studies can not be compared unless both, attrition and integrity, are considered as the contribution of each differs by study type (Hawthorne effect).
Attrition and Integrity

- Physical condition of nets based on proportionate Hole Index from two cross-sectional surveys and one longitudinal study in Western Uganda
Attrition and Integrity

- Only that part of attrition should be considered that relates to the “durability” of the LN product
  - LN given away to be used by others are NOT lost, they only are at a different location
  - These nets must be excluded from the estimation as their fate is unknown
Attrition and Integrity

- Reason for loss from post-campaign and retrospective durability surveys in Nigeria (N=780)
Categorize phI

- phI results are NOT normally distributed and mean or median is not a very useful way to describe the outcome.
- Values are NOT comparable if different size categories or weights are used.
- Unless there is a cut-off that can be used to define which nets are no longer “servicable” (or which are “torn”), the data can NOT be used to estimate median survival of LN.
Precision of estimates

- Procurement decisions are very sensitive and without robust evidence of a statistically significant difference between LN products durability-based choices can not be defended
What about insecticidal effectiveness?

- Following in-depth review of evidence and option VCTEG recommends to not include insecticidal effectiveness in the measure of “median LN survival” until
  - A test is available that can be done in the field on all samples without removing or destroying the net
  - A better understanding of the minimal effectiveness is available, i.e. the level of insecticide at which no additional epidemiological protection is achieved
The suggested solution
Attrition

- Collect attrition data from all studies, retrospective (recall) and prospective
- Differentiate the main reason for loss
  - Given away for others to use
    - Family
    - Friends
    - Stolen
    - Sold
  - Discarded or destroyed
    - Accidentally destroyed
    - Thrown away (buried, burnt etc.)
    - Used for other purposes
Cut-off for pHl

<table>
<thead>
<tr>
<th>Category</th>
<th>pHl value range</th>
<th>Approximate total hole surface area in cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>If circle*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If rectangular*</td>
</tr>
<tr>
<td>Good</td>
<td>0-64</td>
<td>&lt;79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;100</td>
</tr>
<tr>
<td>Acceptable</td>
<td>65-642</td>
<td>80-789</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-1,000</td>
</tr>
<tr>
<td>Torn</td>
<td>643+</td>
<td>&gt;790</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;1,000</td>
</tr>
</tbody>
</table>

- Create additional category for analysis by combining “good” and “acceptable” nets to
  - “servicable” = pHl < 643
**Cut-off for pH1**

- This categorization creates dichotomous variables that are easy to deal with statistically.
- It also increases the robustness of the pH1 result.
Estimating LN survival
Estimating LN survival

1. Calculate “survival to time x”, i.e. at the time point of the survey
2. Plot time points against hypothetical survival curves and estimate “median LN survival” from two or more data points
Survival to time x

- From attrition and integrity data for each net

\[
\text{% surviving to time x} = \frac{\text{# of LN present and “serviceable” at time x}}{\text{# of LN originally received and not given away at time x}} \times 100
\]
Plot survival outcome
### Estimating median survival

- From at least 2 points of which the lowest should be 85% or lower

\[ t_m = t_1 + \frac{(t_2 - t_1) \times (p_1 - 50)}{(p_1 - p_2)} \]

<table>
<thead>
<tr>
<th>Time point</th>
<th>Time in years</th>
<th>Functional survival</th>
<th>Median survival using last two data points (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>93.3%</td>
<td>n.a.</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>83.4%</td>
<td>4.1 (3.7 to 4.5)</td>
</tr>
<tr>
<td>3</td>
<td>2.4</td>
<td>68.2%</td>
<td>3.2 (3.0 to 3.5)</td>
</tr>
<tr>
<td>4</td>
<td>3.1</td>
<td>53.2%</td>
<td>3.3 (3.0 to 3.5)</td>
</tr>
<tr>
<td>5</td>
<td>4.3</td>
<td>31.6%</td>
<td>3.3 (3.0 to 3.6)</td>
</tr>
</tbody>
</table>
Estimating median survival

- Data from ongoing three year retrospective durability study in Nigeria
Where to find the documents

- At MPAC website of WHO

http://www.who.int/malaria/mpac
Next Steps

- Develop SOPs and make templates and tools available
- Support countries and researchers to apply this methodology
- Facilitate dissemination of results
- Encourage more research
  - On importance of hole size and position for mosquito entry
  - On when an LN “fails” entomologically and epidemiologically
  - On predictive textile tests for expected field performance of new products