Assessing the Durability of Long Lasting Insecticidal Nets: On-going Monitoring and Research in 8 PMI Countries

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The US President’s Malaria Initiative: ITN Program Investments

- **2008 to 2010**: PMI procured 39 million ITNs for distribution in all 17 PMI countries
- **FY 2012**: PMI has allocated $128 million for 22 million ITNs
  - 5 million for universal coverage
  - 17 million for continuous distribution
- Including distribution costs and BCC/IEC to encourage net use, ITNs represent about **one quarter** of PMI’s total budget
Why is there such interest in LLIN durability?

• Providing evidence based guidance to a country:
  – To inform its procurement decisions for the most suitable net in terms of net technical specifications and cost-effectiveness
  – To plan the replacement of worn out nets in an ongoing LLIN program
  – To understand factors associated with durability of LLINs to guide BCC interventions (e.g. care and repair) and to assist industry in improving net design
PMI Multi-Country OR Project: Status, Preliminary Results

Data collected:
- Survivorship
- Physical integrity (hole data) at six months
- Insecticidal content and activity

Malawi
- 5 LLIN products; distributed in July 2009

Kenya
- 7 LLIN products; distributed in December 2009

Senegal
- 3 LLIN products; distribution in 2011
Methodology

• Different net products distributed to different villages

• Follow ups conducted every 6 months
  – Complete census of all nets distributed
  – Randomly select 30 nets of each type for estimating number of holes and insecticidal activity
    • Malawi: 3 hole categories
    • Kenya: Measured each hole at widest point + distance from bottom
Malawi LLIN Durability Study: 6 Month Follow-up

% of Nets

LLIN brands

A  B  C  D  E

Destroyed
Lost/Stolen
Unknown
Given/Taken Away
Net Present
LLIN Durability Studies Kenya and Malawi (2010):
Nets with a Least one Hole at 6 Months Follow-Up

% of Nets with at least 1 Hole of any size

% of Nets with at least 1 Hole of any size

LLIN brands

Kenya
Malawi
Median Number of Holes per Net

**Malawi**

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<thead>
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<th></th>
<th>6 Month</th>
<th>12 Month</th>
<th>18 Month</th>
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<tbody>
<tr>
<td><strong>A</strong></td>
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<td><strong>C</strong></td>
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<td>6</td>
<td>15</td>
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<td><strong>D</strong></td>
<td>1</td>
<td>3</td>
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<td><strong>E</strong></td>
<td>0.5</td>
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6 Month Follow Up

Malawi
18 Month Follow Up

Malawi
Estimation of Hole Index

Malawi

• Hole index estimated by assuming all holes were circles (area = \( \pi r^2 \)) and summing for all holes on each net
  – Small holes = 1.25 cm in diameter (1.2 cm\(^2\))
  – Medium holes = 6 cm in diameter (28.3 cm\(^2\))
  – Large holes = 20 cm in diameter (314.2 cm\(^2\))
Mean Hole Index

Malawi

Avg. Hole Index (cm²)

6 Month 12 Month 18 Month

A
B
C
D
E
Can we predict net durability in the field?

• No correlation between number of holes or hole index with:
  – Fabric type
  – Denier
  – Burst strength
Other PMI-supported LLIN-Durability Monitoring Activities

- Zambia
  - Permanet 2.0 studied for holes and deltamethrin
  - Nets used 27 to 44 months with many holes in nets
  - Deltamethrin levels high even after 27 to 44 months of use.

- Mozambique
  - 2 LLIN products; distributed November 2008
  - Three year follow up completed in November 2011

- Angola
  - 1 LLIN product; distributed January 2011
  - 1 year follow up in January 2012

- Rwanda-Not yet started
- Benin-Not yet started
What Could Preliminary Findings Potentially Mean for PMI Programs?

• Some indications that many nets may be lasting less time than the expected 3 years

• Care and repair issues need to be investigated more closely and incorporated into program action to extend useful life of LLINs

• To fully use the data generated to guide programs, it is essential to define a threshold for failed net. Additional OR investment critical
CDC/NCSU LLIN Durability Test Development

• Collaboration between CDC and North Carolina State University, College of Textiles (Raleigh, NC)

• Objective: to design laboratory test methods that predict LLIN deterioration rates, with:
  – Minimal changes to ISO methods and instruments
  – Rapid and reproducible results

• Recommend and test strategies to improve LLIN durability.

• Expected completion: 9/2012.

• Principal investigator: Steve Smith

• Funded by CDC Innovation Fund.
Priority: Defining the Threshold

• Resolve definition of “failed” net on an individual net

• Define “useful life” for a population of nets (e.g. 50% or 80% survive for $x$ years)

• Priority for research: Interaction between insecticidal activity and location, size and number of holes for personal protection
Questions/Comments?