Presentation number 453

Standardized monitoring of durability of Long-lasting Insecticidal Nets in five countries in Africa and Asia

Albert Kilian[1], Ana Paula Abílio[2], Emmanuel Obi[3], Ameir Khamis[4], Paul Mansiangi[5], Si Thu Thein[6], Sean Blaufuss[7], Lilia Gerberg[8], Hannah Koenker[7]

[1] PMI VectorWorks Project, Tropical Health LLP, Montagut, Spain, [2] PMI Vectorworks Project, National Health Institute, Maputo, Mozambique, [3] PMI Vectorworks Project, Tropical Health LLP, Abuja, Nigeria, [4] PMI Vectorworks Project, Zanzibar Malaria Elimination Programme, Stone Town, Tanzania, [5] PMI Vectorworks Project, School of Public Health University Kinshasa, Kinshasa, Democratic Republic Congo, [6] PMI Vectorworks Project, Population Services International, Yangon, Myanmar, [7] PMI Vectorworks Project, JHU Center for Communication Programs, Baltimore, MD, United States, [8] U.S. President's Malaria Initiative, U.S. Agency for International Development, Washington, DC, United States

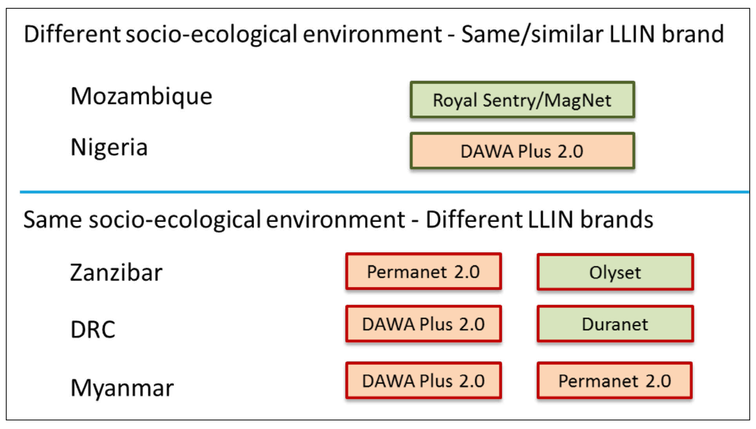
INTRODUCTION

Following the 2014 WHO recommendation on measurement of durability of Long-lasting Insecticidal Nets (LLIN) the U.S. President's Malaria Initiative (PMI) has developed a standardized protocol and tools to support countries and build their capacity to carry out monitoring of LLIN durability following their LLIN mass distribution campaigns.

METHODS

The basic design is that of a district-representative cohort of 345 campaign LLINs per site (15 clusters with 10 households) which is established within six months after distribution and followed with annual assessment of attrition, net integrity, and insecticidal effectiveness for 36 months. Primary outcomes are the proportion of cohort nets surviving in serviceable condition at each time point (see Figure 1) and the estimated median survival in serviceable condition in years. Details of the protocol and tools are found on **www.durabilitymonitoring.org**. The PMI-funded VectorWorks project is supporting five countries in durability monitoring with a total of 12 sites, three each in Mozambique and Nigeria and two each in the Tanzania/Zanzibar, Democratic Republic Congo (DRC), and Myanmar. There are two basic monitoring question as shown in Figure 2.

Figure 2: Monitoring question and LLIN brands



Assessment of insecticidal effectiveness was undertaken in entomological laboratories in-country using the standard WHO cone assay and where needed additional tunnel tests. In the African countries tests (30 samples per site and time point) were performed with a pyrethroid sensitive *Anopheles gambiae* Kisumu strain and in Myanmar *Aedes aegypti* Rockefeller strain. Insecticidal effectiveness was defined for the cone assay as follows:

Optimal effectiveness: KD60 ≥ 95% or functional mortality ≥ 80%
Minimal effectiveness: KD60 ≥ 75% or functional mortality ≥ 50%

In Myanmar additional chemical residue analysis was undertaken for the 24-month follow-up samples in the in-country laboratory of the Food and Drug Administration.

RESULTS

In the three locations where different LLIN brands were monitored, baseline data showed that the selected sites were indeed very similar with the exception of Northwest DRC where exposure to behavior change communication and the net care and repair attitudes were significantly better in Sud Ubangi where Duranet was monitored.

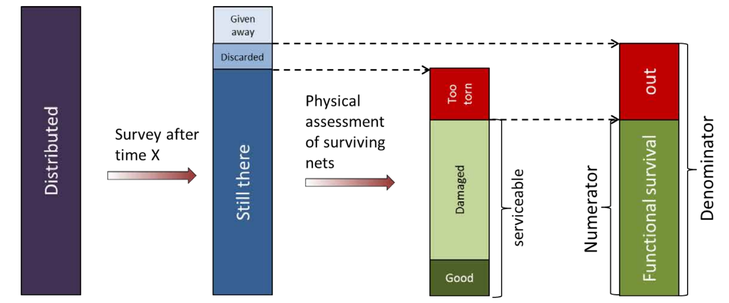
Details of the attrition of campaign nets and the physical condition of remaining nets are shown in the table below. Most of all-cause attrition was due to nets being given away. Attrition due to wear and tear (nets destroyed, thrown away, or used for other purposes) at 24 months varied between 2% of distributed nets in Zamfara, Nigeria and 33% in Mongala, DRC. The combined results of physical survival in serviceable condition and insecticidal effectiveness (inserted pie charts) is shown in Figures 3 and 4. The largest difference in median survival was seen in Nigeria for Dawa Plus 2.0 with a minimum of 2.7 and maximum of 5.6 years. The same net had even lower survival in Mongala, DRC with only 1.4 years. In Mozambique one site (Inhambane) performed significantly better than the other two. For the brand comparisons only Dawa Plus and Duranet in DRC showed a significant difference although PermaNet performed marginally better than Olyset in Zanzibar. Optimal insecticidal effectiveness was seen in >80% of samples in the four African countries after 24 months. In Myanmar (testing *Aedes aegypti*) only 60-70% of samples had minimal effectiveness, but chemical residue showed 98% with >15mg/m^2 deltamethrin.

CONCLUSION

The standardized methodology and use of the median survival as a measure of physical durability independent of time of follow-up allows direct comparison between countries and sites. Results for up to 24 months show that differences between locations (behaviors and environment) exceed differences between brands. However, in harsh environments such as Northwest DRC a significant difference in physical survival between a 100 denier polyester and 145 denier polyethylene LLIN was seen which can be attributed to both the textile qualities and behavioral differences. Insecticidal effectiveness was found to be sufficient after two years either by bio-assay or chemical residue.

Country	Province *District*	Survey and time since distribution (months)	All-cause attrition (%)	Attrition wear and tear (%)	Remaining nets in serviceable condition (%)
Mozambique	Tete	m12: 13.4	9.6	1.4	97.2
	Changara	m24: 24.1	21.7	6.9	80.7
	Nampula	m12: 9.7	26.3	2.5	96.6
	Angoche	m24: 21.5	51.5	12.3	91.8
	Inhambane	m12: 9.9	13.6	0.5	98.5
	Jangamo	m24: 21.9	34.7	6.2	93.4
Nigeria	Ebonyi	m12: 12.7	21.1	1.3	97.6
	Ishielu	m24: 25.2	38.5	10.1	88.8
	Zamfara	m12: 12.7	4.9	0.3	98.0
	Bakura	m24: 24.2	14.4	1.7	93.5
	Oyo	m12: 11.4	32.1	2.8	95.8
	Akinyele	m24:	In progress		
Zanzibar	Unguja	m12: 12.4	19.1	1.1	95.1
	North B	m24: 23.6	37.0	7.6	84.9
	Pemba	m12: 12.7	18.3	5.3	91.8
	Wete	m24: 23.4	33.3	10.6	77.6
DRC	Sud Ubangi	m12: 12.0	20.9	1.5	90.3
	Ndege	m24: 21.2	35.0	12.5	66.9
	Mongala	m12: 12.1	33.0	10.2	80.1
	Binga	m24: 20.8	57.9	32.5	62.3
Myanmar	Sangaing	m12: 12.0	21.4	1.8	97.6
	Tamu 1	m24: 24.0	26.7	3.8	90.2
	Sangaing	m12: 12.0	22.3	0.6	96.2
	Tamu 2	m24: 24.0	29.1	4.4	86.1

Figure 1: Definition of key outcome: LLIN physical survival in serviceable condition



$$\%\ \text{surviving to time x} = \frac{\#\ \text{of LN present and "serviceable" at time x}}{\#\ \text{of LN originally received and not given away at time x}} \times 100$$

Figure 3: Durability Monitoring in Countries with Comparison of same LLIN brand in different settings

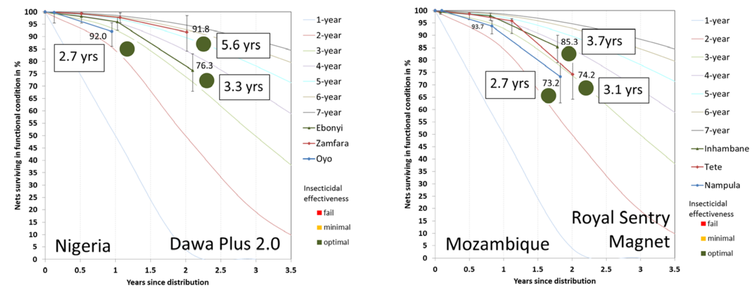
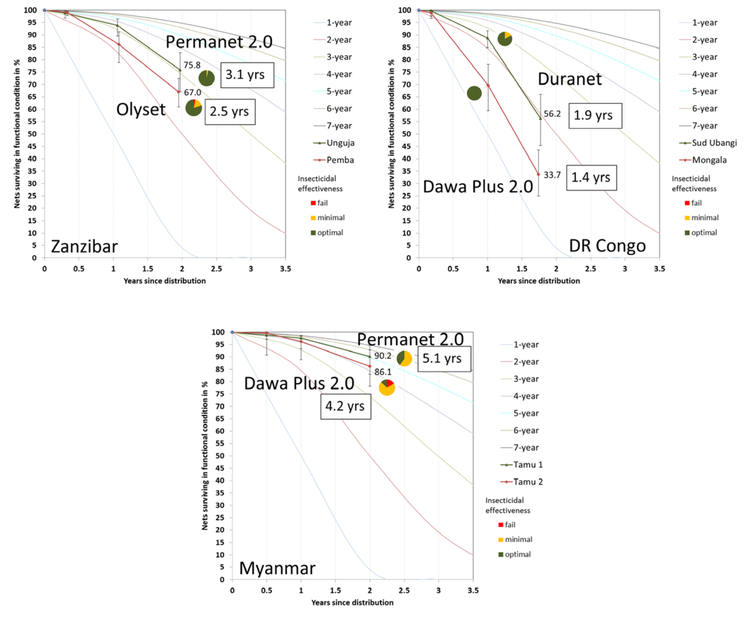


Figure 4: Durability Monitoring in countries with comparison of different LLIN brands in similar settings



This poster is made possible by the generous support of the American people through the United States Agency for International Development (USAID) and the President's Malaria Initiative (PMI) under the terms of USAID/JHU Cooperative Agreement No AID-OAA-A-14-00057. The contents do not necessarily reflect the views of PMI or the United States Government.

Contact: Albert Kilian, **albert@trophealth.com**