National Malaria Control Program Ministry of Health Republic of Liberia

Alliance for Malaria Prevention

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Overview on ITN Durability Monitoring performed in Liberia

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Duranet DM: Introduction

- ✓ **Estimating insecticide treated bed net (ITN) durability and average useful life are key tasks that National Malaria Programs should perform to inform ITN replacement frequency and safeguard vector control investments.**
- ✓ **The physical and insecticidal durability of standard pyrethroid DuraNet® ITNs distributed in Liberia's 2018 mass campaign were monitored from August 2018 to April 2021 in Grand Gedeh and Lofa counties to estimate median ITN survival and identify determinants of performance.**
- ✓ **DuraNet® ITNs are 145-dernier polyethylene net treated with alphacypermethrin (5.8 g/kg w/w ±25%).**

Background

April 2018	Aug. 2018	April 2019	Aug. 2020	April 2021
0	1-6	12	24	36
Distribution	Assess Attrition Integrity **Subsample:** (30 nets per site) Bio-assay	Assess Attrition Integrity **Subsample:** (30 nets per site) Bio-assay **Subsample:** DawaPlus 2.0 only 30 nets Chemical residue	Assess Attrition Integrity **Subsample:** (30 nets per site) Bio-assay **Subsample:** (30 nets per site) Chemical residue	Assess Attrition Integrity **Subsample:** (30 nets per site) Bio-assay **Subsample:** (30 nets per site) Chemical residue

Design:
The Same ITN brands monitored in areas with **different environmental and population** characteristics.

Duranet DM: Methods

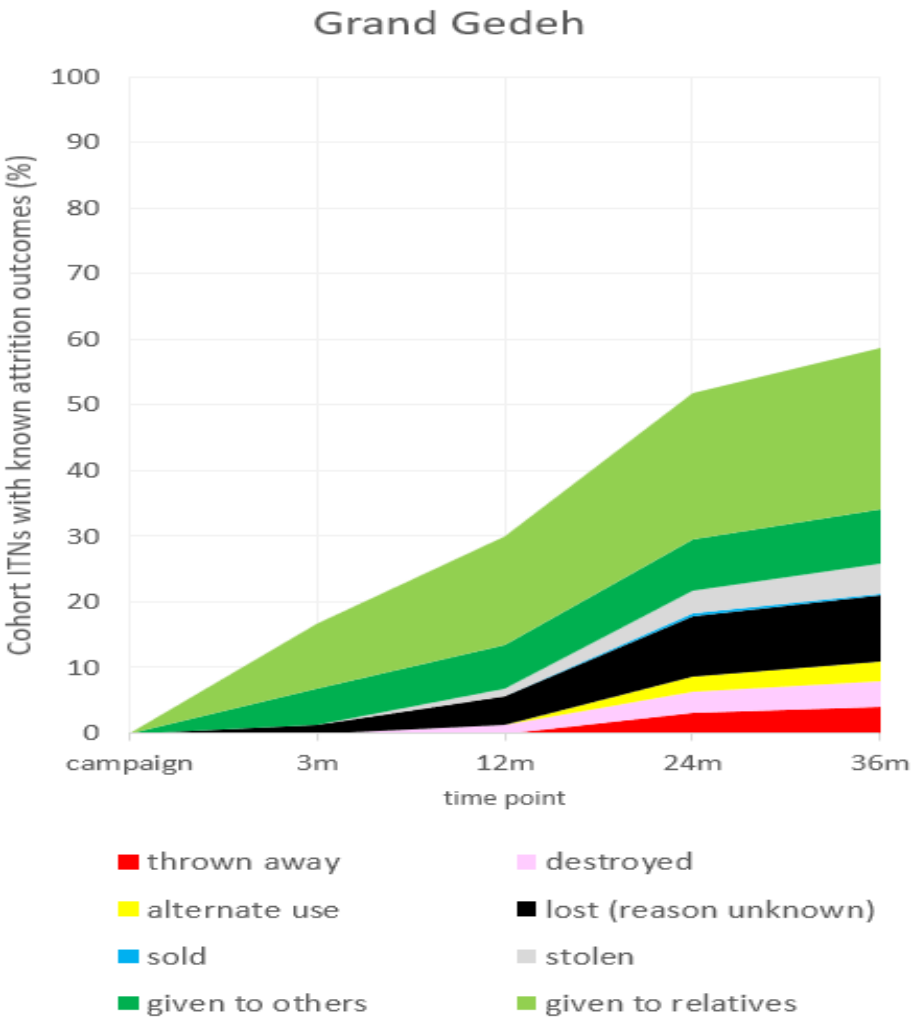
- ✓ **ITNs were enrolled three months after the campaign and followed up through annual assessments for 36 months.**
- ✓ **DuraNet® campaign ITNs from neighboring households were withdrawn from study sites for insecticidal effectiveness testing at each annual assessment.**
- ✓ **Primary outcomes were the percentage of cohort ITNs surviving in serviceable physical condition (as measured by the proportionate Hole Index, pHI) and the percentage of ITNs achieving optimal insecticidal effectiveness (KD60≥95% or mortality≥80% in cone bioassays).**

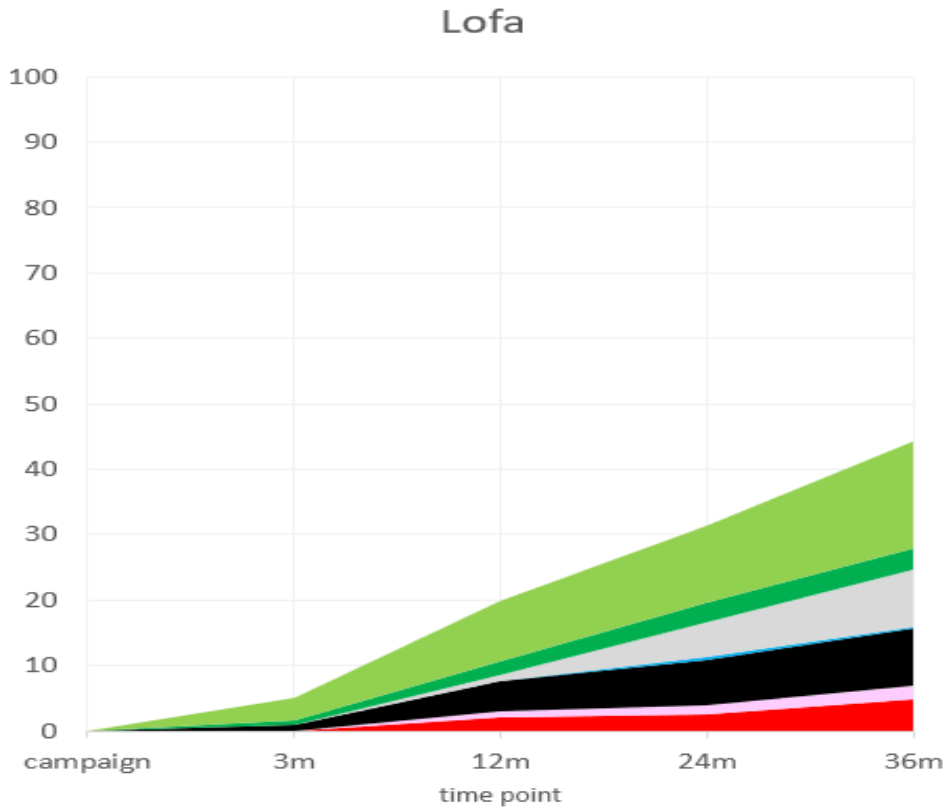
Method

- ✓ At 36-months, half of the 744 enrolled cohort ITNs had a known outcome and contributed to physical ITN survival estimates.
- ✓ Total attrition at 36-months was 59% in Grand Gedeh and 44% in Lofa.
- ✓ Attrition due to wear and tear was 11% and 7% in Grand Gedeh and Lofa, respectively.

INSECTICIDE TEST ROOM

Duranet DM: Attrition causes





Duranet DM: Attrition

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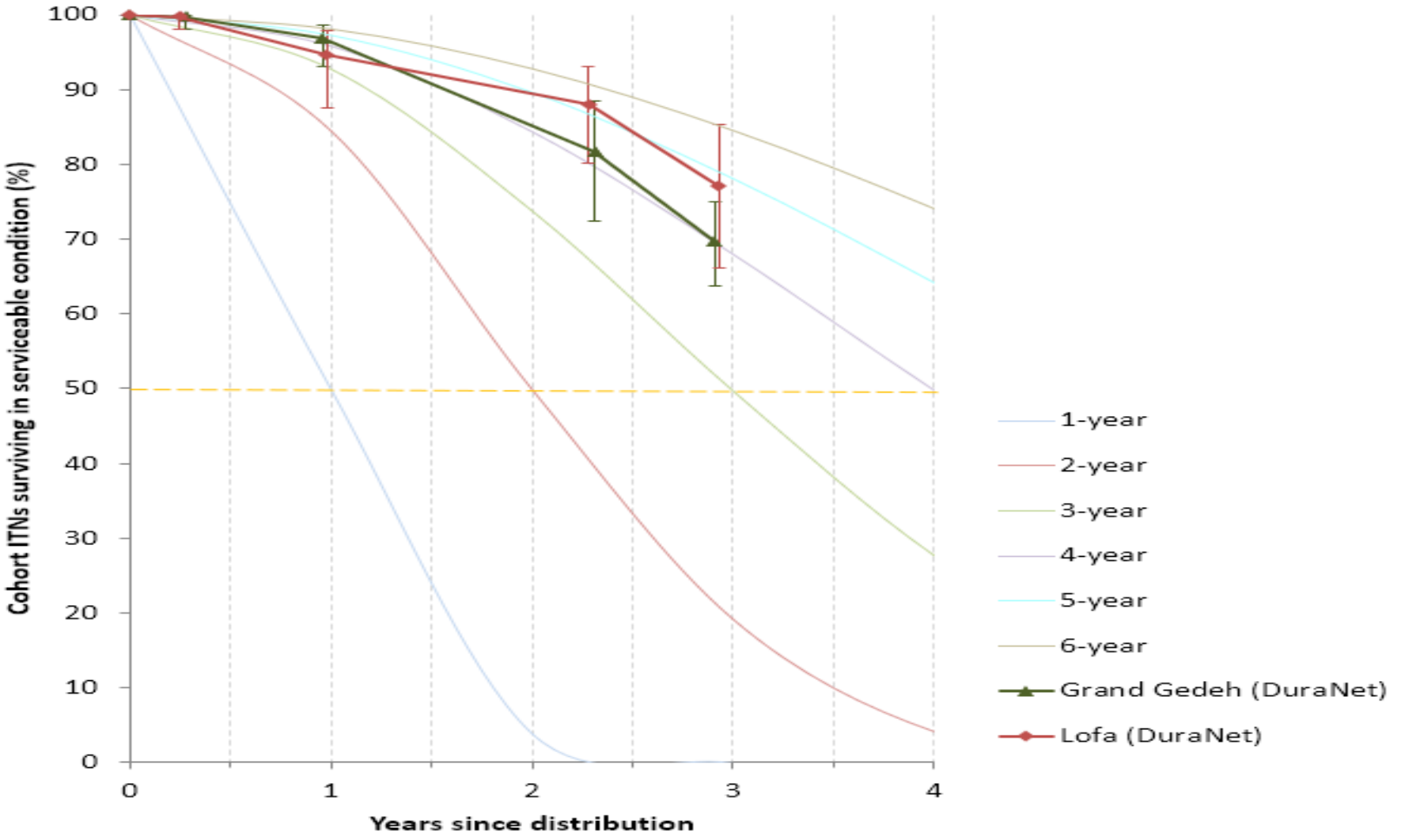
Duranet DM: Physical survival

- ✓ **At 36-months, 9% (Grand Gedeh) and 11% (Lofa) of remaining cohort ITNs were classified as "torn" by their pHI scores.**
- ✓ **Considering attrition and physical integrity, the percentage of ITNs surviving in serviceable physical condition was 70% in Grand Gedeh and 77% in Lofa.**
- ✓ **These results correspond to estimated median lives of 4.6 years and 3.9 years, respectively**

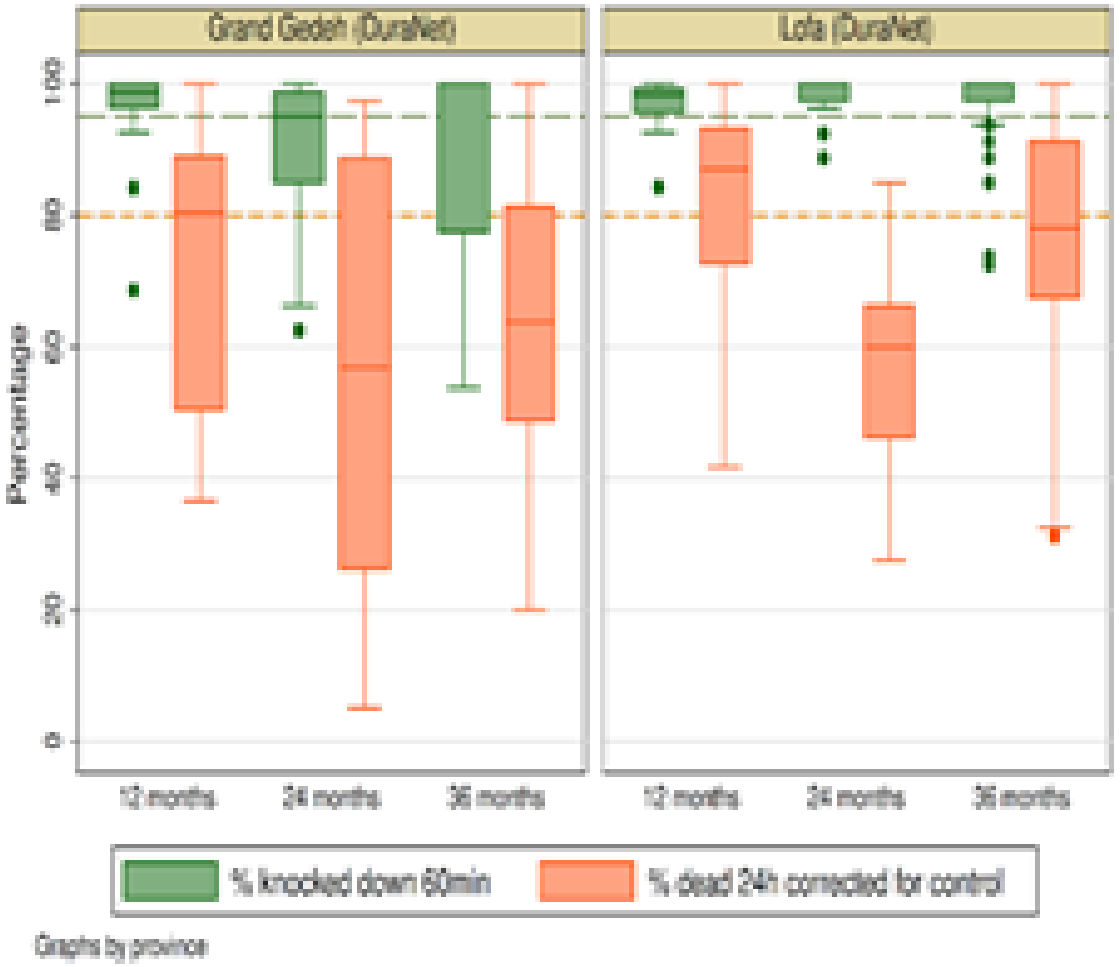
Duranet DM: Physical survival Graph



-Duranet MD: Insecticidal effectiven

Optimal insecticidal effectiveness at 36-months was 60% in Grand Gedeh and 83% in Lofa.

Results from Grand Gedeh showed greater variation for both measures at all rounds.



Duranet DM: Conclusions

- In these two counties in Liberia, **median ITN survival was greater than the assumed three years** used for planning purposes and was driven by low levels of attrition due to wear and tear and high physical integrity over 36-months.
- A high proportion of **ITNs remained optimally insecticidally** when considering WHO thresholds.
- While few significant differences in household environment and net care practices were identified between sites, this study adds to the literature highlighting the **positive association between favorable net care attitudes and better ITN survival** outcomes.
- Results can help the NMCP in **planning ITN distribution strategies** to reach and sustain target coverage levels.
- **A manuscript for the standard DM study is forthcoming**

Streamlined Durability Study (SDM) of IG2 Nets

- ✓ **Mass campaign Nets distributed in June 2021 in Liberia**
  - ***“”these 12th month data are still very preliminary.””***

Status of Insecticide Resistance in Liberia

- *An. gambiae s.l.* populations were resistant to the tested pyrethroid (alpha-cypermethrin) in all the 15 counties.
- Despite an increase of susceptibility after a pre-exposure to PBO as synergist, full susceptibility was observed in the counties. PBO also improved the susceptibility of the vector in some sites, but the final mortalities were still less than the 98% threshold.
- *Anopheles gambiae* s.l. is susceptible to chlorfenapyr in all sites. The tests performed using chlorfenapyr showed an increase of mortality rates from 24hours to 48hours and full susceptibility occurred at 72 hours post-exposure.
- Based on these data, the country decided to replace Duranet (standard pyrethroid net) by IG2 net (coated with Alpha-cypermethrin and chlorfenapyr).
- A manuscript for insecticide resistance study has been drafted to completed by molecular data.

SDM Study Sites and Timeline

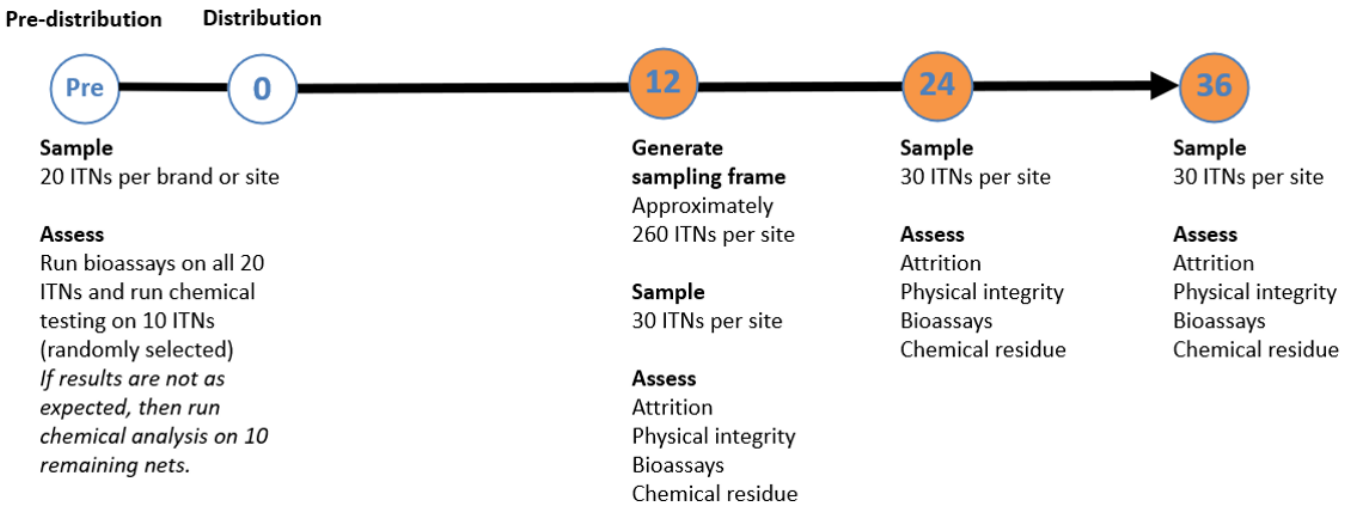
Study Site	ITN brand	ITN type	Campaign distribution date	Pre-distribution	12-month study round	24-month study round	36-month study round (endline)
Bomi	Interceptor® G2	Dual AI	June 2021	July 2021	June 2022	June 2023	June 2024
Bong	Interceptor® G2	Dual AI	June 2021	July 2021	June 2022	June 2023	June 2024

SDM 12th month survey completed in Bong and Bomi counties

Net samples cutting scheduled for next week (CDC, PAMVERC)

Streamlined DM Overview IG-2

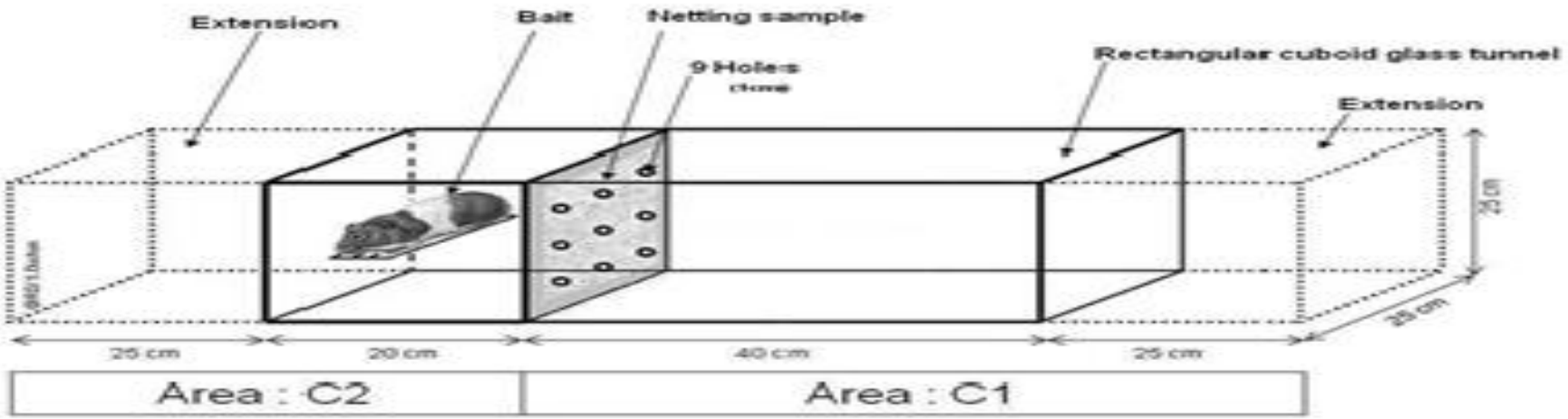
The **Streamlined DM** approach should be considered in countries that have previously collected DM data and are primarily interested in evaluating bioefficacy, particularly for new types of nets.



Supported ITN durability monitori

- ✓ Streamlined Durability Monitoring (SDM) of ITNs after the national IG2 net distribution in June 2021
  - ✓ SDM ongoing in two sites:
    - ✓ Suakoko District/Bong,
    - ✓ Suehn Mecca District/Bomi)
    - ✓ 30 nets per site are withdrawn for the bioassays and chemical content analysis
  - ✓ 12th month SDM completed:
    - ✓ Chemical content analysis performed at CDC Atlanta
    - ✓ Bioassay (Tunnel Test) done by PAMVERC - Benin

Tunnel Test Setup for ITNs samples testing



IG2 Net samples were tested by PAMVERC Lab in Benin using Lab colony resistant strain mosquitoes.

Preliminary Results of 12th month SDM

Site	Survey round and time since distribution (months)	Total Attrition (%)	Attrition wear and tear (%)	Nets in Serviceable Condition (%)	72- hour mortality against resistant mosquito strain (%)	Blood feeding inhibition (%)	Mean chlorfenapyr chemical content. (g/kg)	Reduction compared to manufacturer target dose. (%)
Bomi Interceptor® G2	First: (13.2)	24.8%	10.1%	96.7%	93.4	92.8	2.7	44%
Bong Interceptor® G2	First (12.5)	24.4%	4.5%	93.3%	85.8	88.4	2.7	44%

Attrition due to wear and tear: *(also known as discarded nets) includes nets that were destroyed, thrown away or used for other purposes.*

Serviceable net *: net with holes in a good condition to provide protection to the end user.*

Blood feeding inhibition: *Blood-feeding inhibition is assessed by comparing the proportion of blood-fed females (alive or dead) in treated and control tunnels. In Bomi 92.8% and Bong 88.4% of Resistant strain mosquito were not able to feed on guineapig during tunnel test.*

Physical Integrity of Observed ITNs

Description	First round (12 months)
Bomi	N=30
ITNs with any holes	13 (43.3%)
ITNs classified as “Good”	26 (86.7%)
ITNs classified as “Too torn”	1 (3.3%)
ITNs classified as “Serviceable”	29 (96.7%)
Among ITNs with any holes	N=13
Median pHI for ITNs with any holes	24
	First round (12 months)
Bong	N=30
ITNs with any holes	20 (66.7%)
ITNs classified as “Good”	21 (70.0%)
ITNs classified as “Too torn”	2 (6.7%)
ITNs classified as “Serviceable”	28 (93.3%)
Among ITNs with any holes	N=20
Median pHI for ITNs with any holes	55

Conclusion on SDM preliminary results

- ✓ At 12 month, more than 20% of the nets were lost due to various reasons
- ✓ Mortality and blood feeding inhibition (BFI) of the 12th month nets was high ➔ positive result
- ✓ More than 40% reduction in chlorfenapyr content at 12th month and could be a bit concerning.
- ✓ More than 90% of the nets found were kept in good or serviceable condition
- ✓ 88.3% of the nets passed for either the 72h mortality or BFI WHO criteria
- ✓ However, it is equally important to state that despite this reduction, 72-hour mortality and BFI are still very high (72mort: 86-93%; BFI: 88-93%).

Next steps

- ✓ **Preparation ongoing for 24th month SDM – UL-PIRE- PSI-VL-NMCP**
- ✓ **NMCP and Partners will continue to support streamlined durability monitoring of IG2 nets distributed in 2021**
- ✓ **The contribution of IG2 nets on malaria transmission will be assessed after 24th and 36th surveys using DHS, climate, ITN, Entomology data.**

Thanks

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