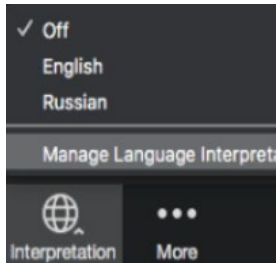
Housekeeping and translation guidance

Translation Instructions

- **Click the "Interpretation" icon** in the Zoom toolbar at the bottom of your screen (globe icon 🌐)



- **Select your preferred language**:
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- If participants want to speak or react, **please do so in the language of the channel you are on**.
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Housekeeping and translation guidance

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- **During the Q&A, use the "Raise Hand" feature** if you have questions or comments or use the chat
- **Recording:** This session is being recorded. After the webinar, we'll share the recording link with you, along with any slides or resources that were discussed.

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Contextualizing Recent Durability Monitoring Results for Dual-AI and PBO-synergist ITNs

November 7, 2024

PMI | U.S. PRESIDENT'S MALARIA INITIATIVE

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CDC

PMI Evolve
Evolving Vector Control to Fight Malaria

amp | The Alliance for Malaria Prevention

Panel

Moderator

- **Lilia Gerberg,** U.S. President's Malaria Initiative (PMI)

Presenters

- **Jackline Martin,** Pan-African Malaria Vector Research Consortium; Tanzania National Institute for Medical Research; and London School of Hygiene and Tropical Medicine
- **Jacky Raharinjatovo,** PMI Evolve project
- **Ketty Ndhlovu-Sichawle,** Zambia National Malaria Elimination Program; and Alliance for Malaria Prevention (AMP) Continuous Distribution Working Group

Agenda

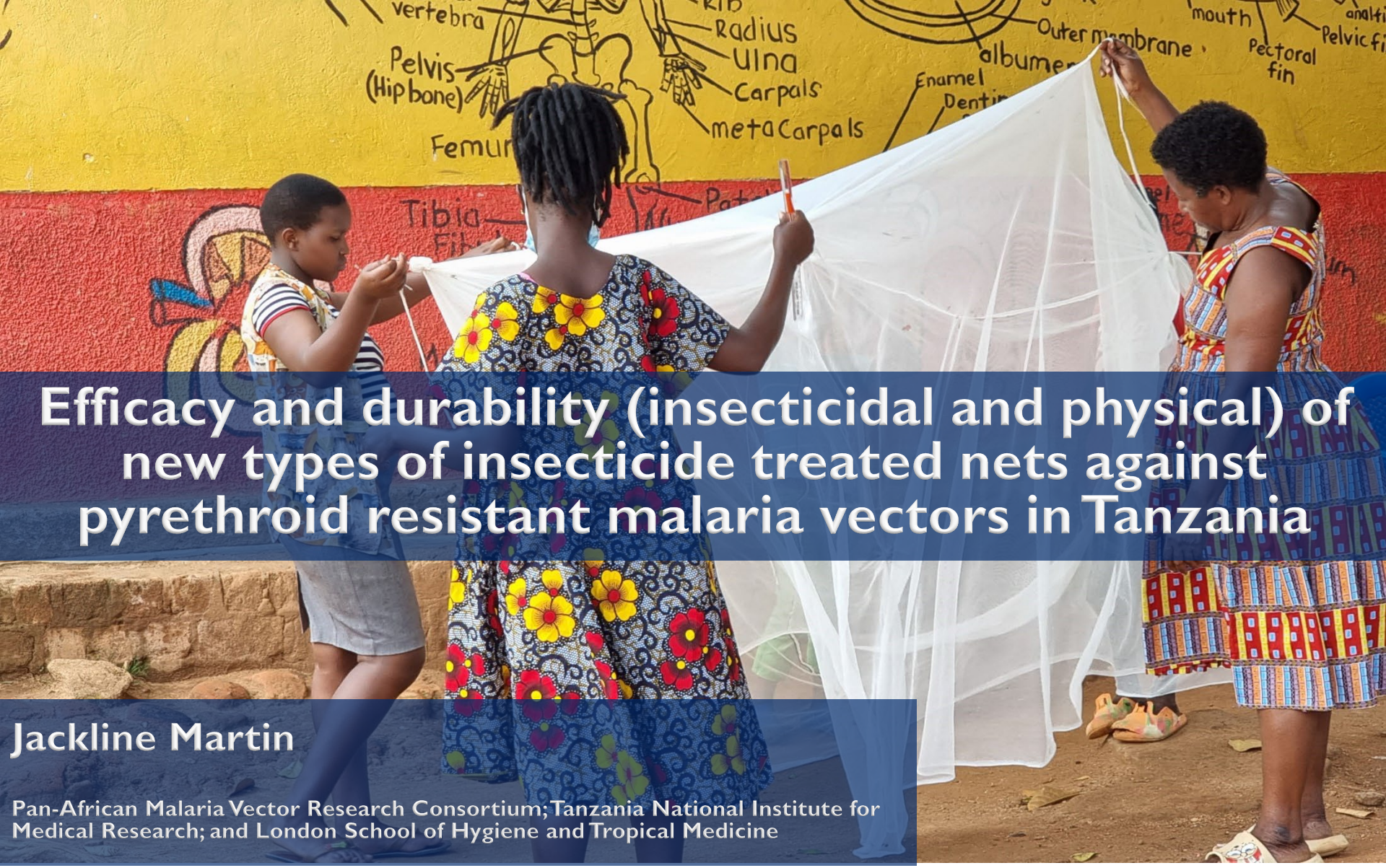
1. Efficacy and durability (insecticidal and physical) of new insecticide-treated nets against pyrethroid-resistant malaria vectors in Tanzania – **Dr. Jackline Martin**

2. Emerging trends in PMI Evolve durability monitoring data – **Jacky Raharinjatovo**

3. The role of continuous distribution in achieving and sustaining ITN coverage – **Ketty Ndhlovu**

4. Moderated discussion with questions from attendees – **Lilia Gerberg**

WEBINAR PRESENTATIONS



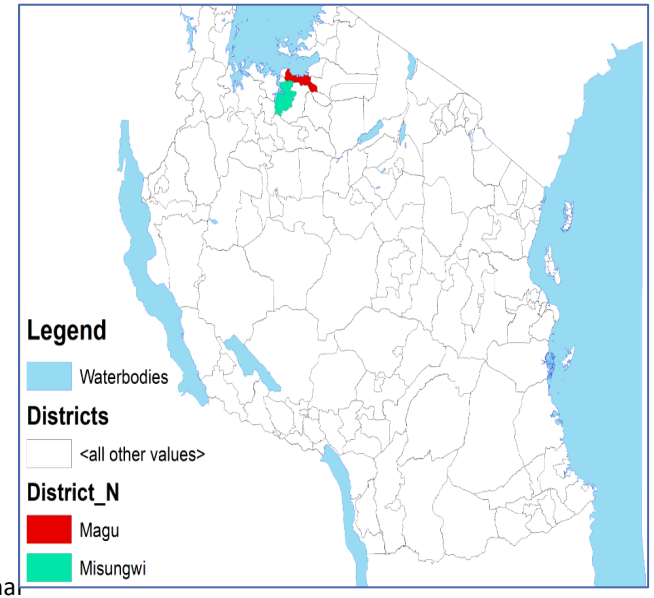
Efficacy and durability (insecticidal and physical) of new types of insecticide treated nets against pyrethroid resistant malaria vectors in Tanzania

Jackline Martin

Pan-African Malaria Vector Research Consortium; Tanzania National Institute for Medical Research; and London School of Hygiene and Tropical Medicine

Durability study nested in cRCT Tanzania

	Tanzania
	Description of product / approach
Population	Study site: Missungwi, Mwanza region,72 villages, 42,314 Households *An.gambiae* s.s, *An.arabiensis*, *An.funestus* Pyrethroid resistance **Mortality < 60%**
Distribution: Jan 2019 Surveys done for 3 years (2022)	Royal Guard, Interceptor G2 and Olyset Plus with standard net as a reference



RCT design

- 4 arms, 21 clusters per arm

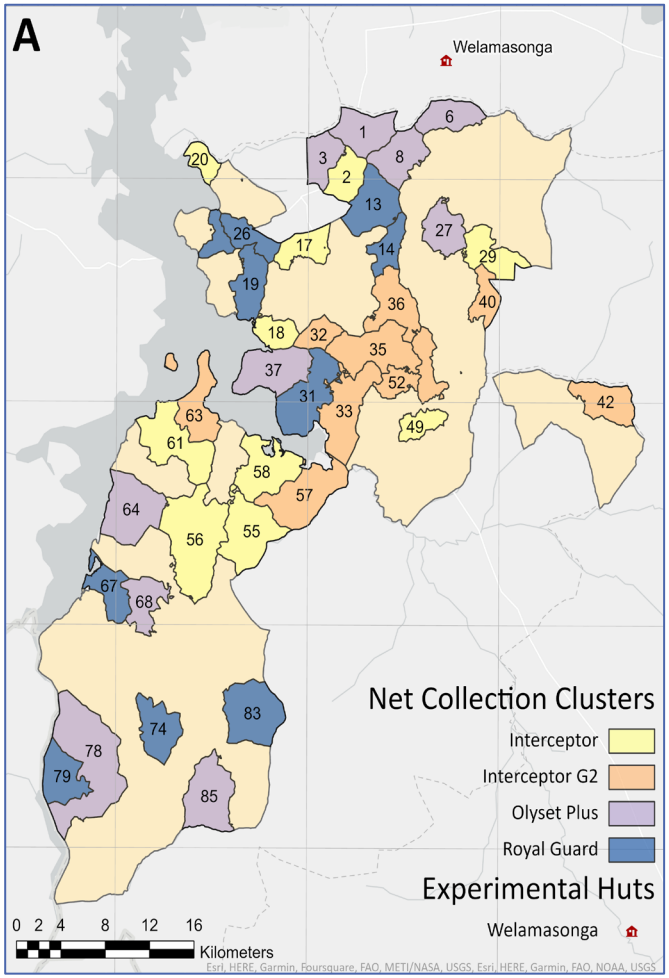
1. Malaria infection prevalence by RDT in children aged 6 months to 14 years measured at 12, 18, 24, 30 and 36 months
2. Malaria case incidence by RDT in children aged 6 months to 10 years (24 months follow up)
3. EIR and Anopheles density (36 months follow up)

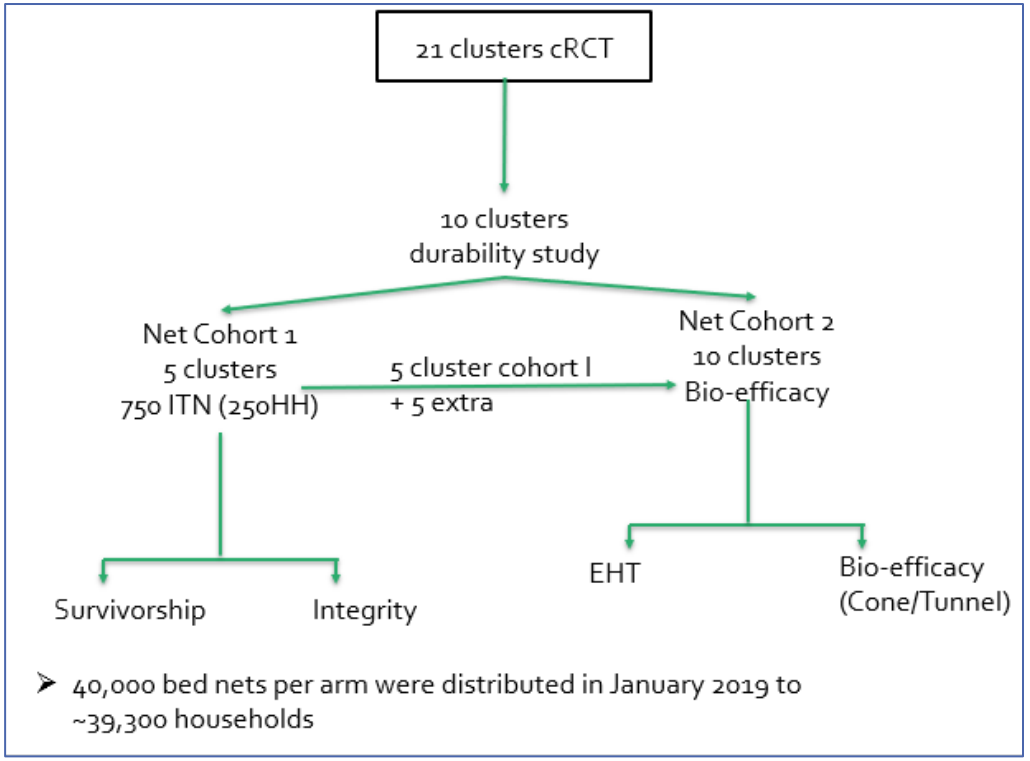
MATERIALS AND METHODS

Treatments evaluated

ITN Brand	Dose AI/m^2 of netting fabric	Fibre & Denier
Interceptor	Alpha-cypermethrin 200mg	100 Polyester
Interceptor G2	1. Alpha-cypermethrin 100mg 2. **Chlorfenapyr 200mg**	100 Polyester
Royal Guard	1. Alpha-cypermethrin 216mg **2. Pyriproxyfen 225mg**	120 Polyethylene
Olyset Plus	1. Permethrin 800mg **2. PBO 400mg**	150 Polyethylene

Study profile





- 40,000 bed nets per arm were distributed in January 2019 to ~39,300 households

Assessing attrition and textile durability

Category of holes	Hole size description	Hole size diameter
Size 1	Smaller than a thumb(finger)	0.5 – 2 cm
Size 2	Large than a thumb but smaller than fist (hand)	2 – 10 cm
Size 3	Larger than a fist but smaller than a head	10 – 25 cm
Size 4	Larger than a head	>25 cm

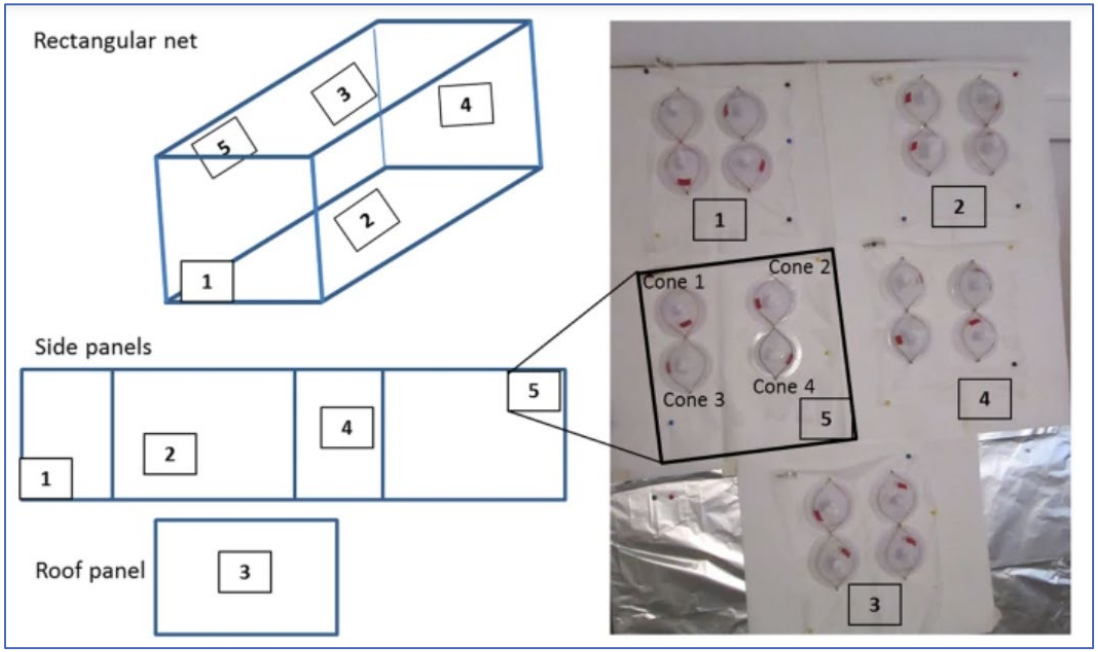
- Cohort I: 5 clusters per arm
- 250 HH were randomly selected (50HH per cluster)
- A total of 750 ITNs per arm 150 ITNs per cluster

Outcomes: hole index and attrition rate

Category	pHI value range	Total hole surface area in cm^2
Good	0-64	<100
Damage	65 – 642	100 – 1,000
Too torn	643+	>1,000

Bio-efficacy testing

- 30 dual AI ITN withdrawn from the community every 6 months
- Testing done at 0, 12, 24 and 36 months
- 1 piece for chemical analysis 2 pieces for bio-efficacy testing



Bio-efficacy testing – susceptible and resistant strains

- **Mosquito: Muleba-Kis (**resistant strain (kdr and MFO)
  - Interceptor G2
    - Overnight tunnel test
    - 2 replicates of 50 mosquitoes
    - one piece per nets (position 2)
  - Royal Guard & Olyset plus
    - 3 minutes cone
    - 4 replicates 5 mosquitoes per pieces (5 at 0- and 4-pieces other time point)
    - If mortality below 80% tunnel test performed

- **Mosquito: Susceptible Kisumu strain**
  - Pyrethroid content in Interceptor G2, Royal Guard and Olyset Plus were assessed in:
    - 3-minute cone
    - 4 replicates per net piece (5 at 0- and 4-pieces other time point)
    - If mortality below 80%, tunnel test performed

<u>Outcomes:</u>

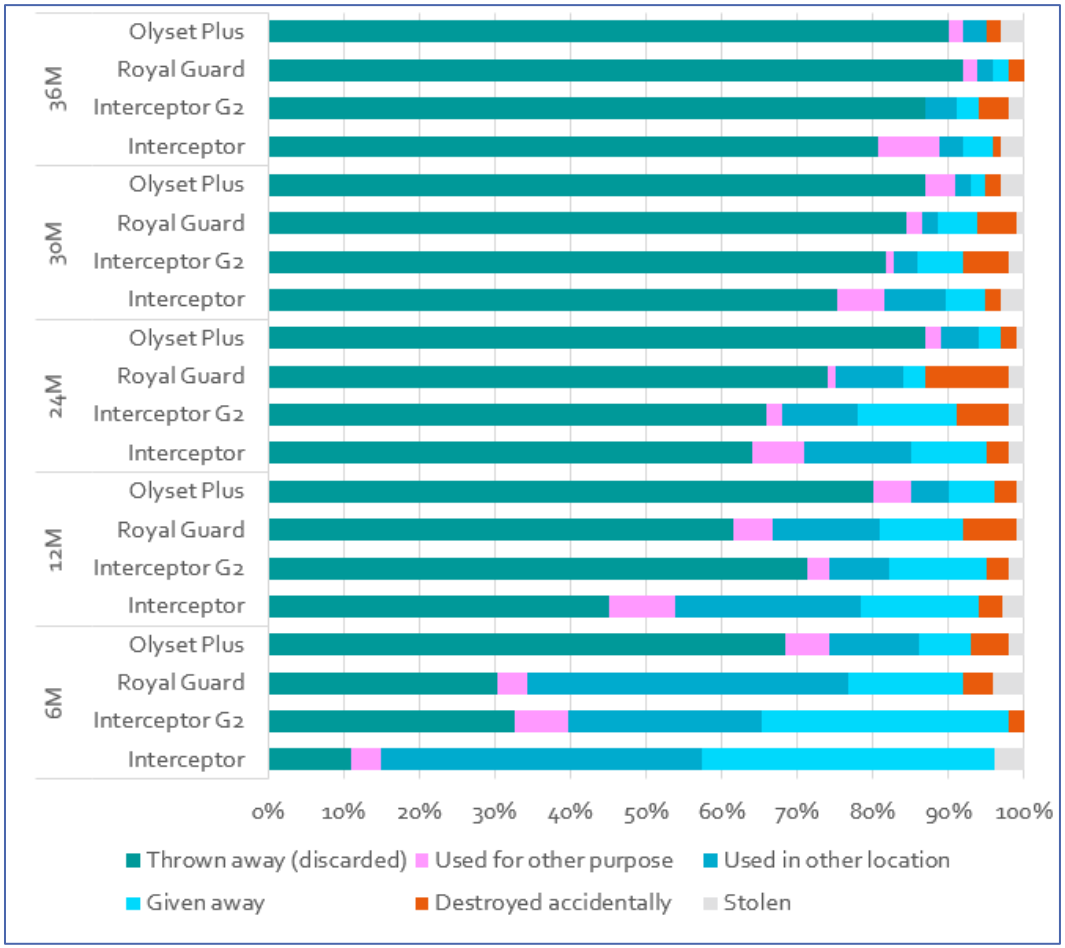
- 24 hrs mortality for Olyset Plus and Royal Guard and 72 hrs mortality for Interceptor G2
- BF inhibition (Tunnel)
- Reduction in fecundity

Hut trial - ITNs rotation

- Total of 30 ITNs per treatment were collected from the field at 12, 24 and 36 m post distribution.
- 6 treatments were assessed and rotated every week over 6 weeks
  - Untreated net (negative control)
  - Interceptor (positive control) field collected
  - Interceptor new with 6 holes
  - Interceptor G2 t0, t12, t24 & t36
  - Royal Guard t0, t12, t24 & t36
  - Olyset Plus t0, t12, t24 & t36
- Hole size were counted for the field collected nets as for cohort 1 nets
- For new dual AI ITN 6 holes were made (4 x 4 cm)
- 4 hut trial for each time point net: increase power with repeated measure and also allow to look at impact on different species (*An.gambiae* s.s., *An.Arabiensis* and *An.funestus*)

RESULTS

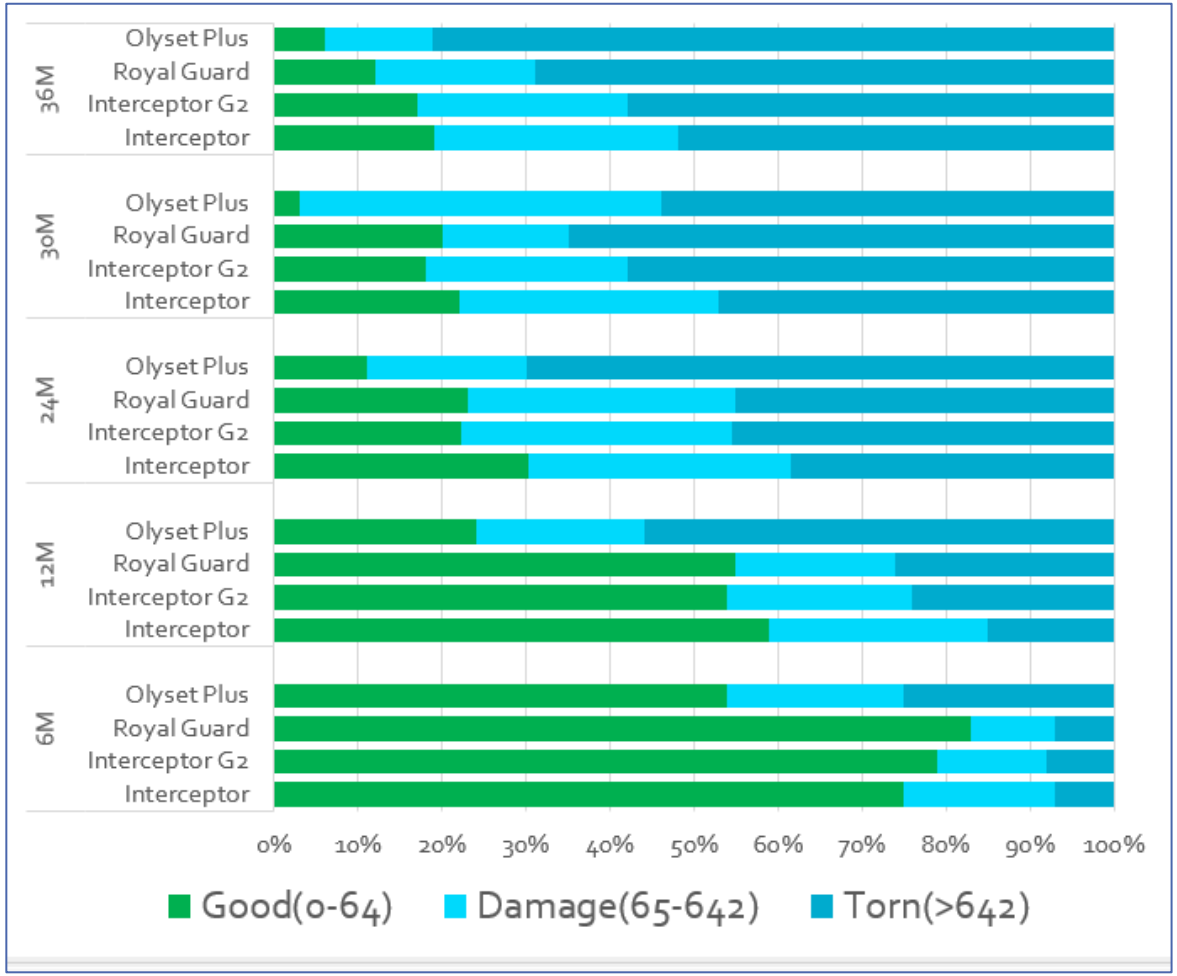
ITNs attrition and functional survival



Net type	Median functional survival with 95% CI
Interceptor®	1.9 [1.9 - 2.0]
Interceptor® G2	1.9 [1.9 - 1.9]
Olyset™ Plus	0.9 [0.9 - 1.0]
Royal Guard®	1.9 [1.9 -1.9]

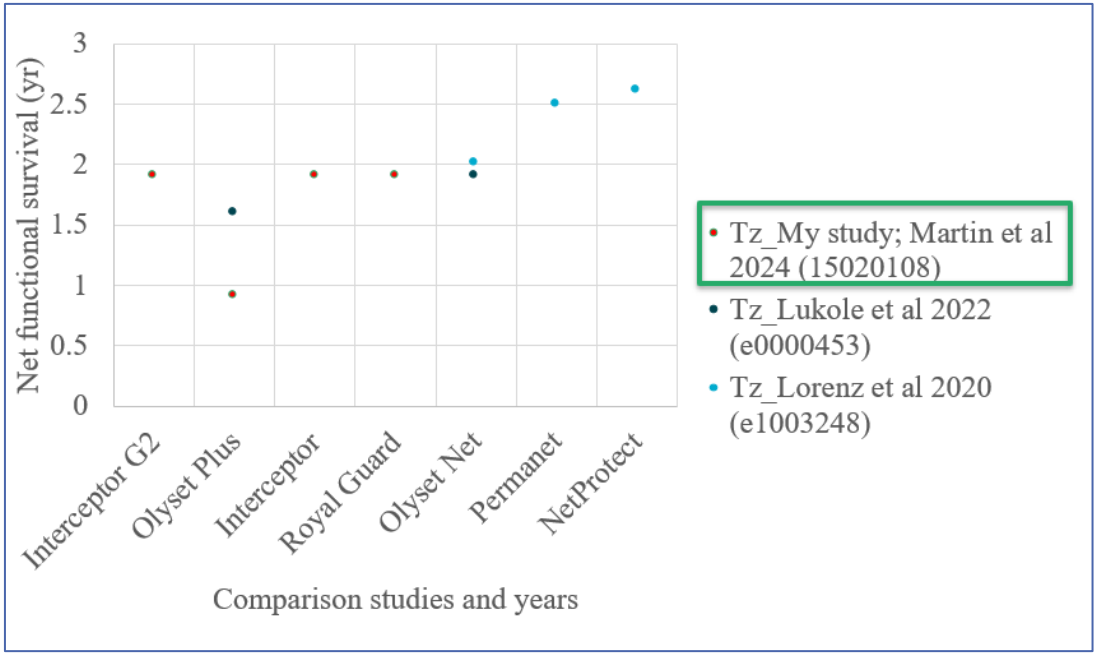
- Higher proportion of Olyset Plus (60%) no longer present in HH after 36M compared to standard net and other nets
- All net has functional survival less than three years

Fabric integrity of ITNs



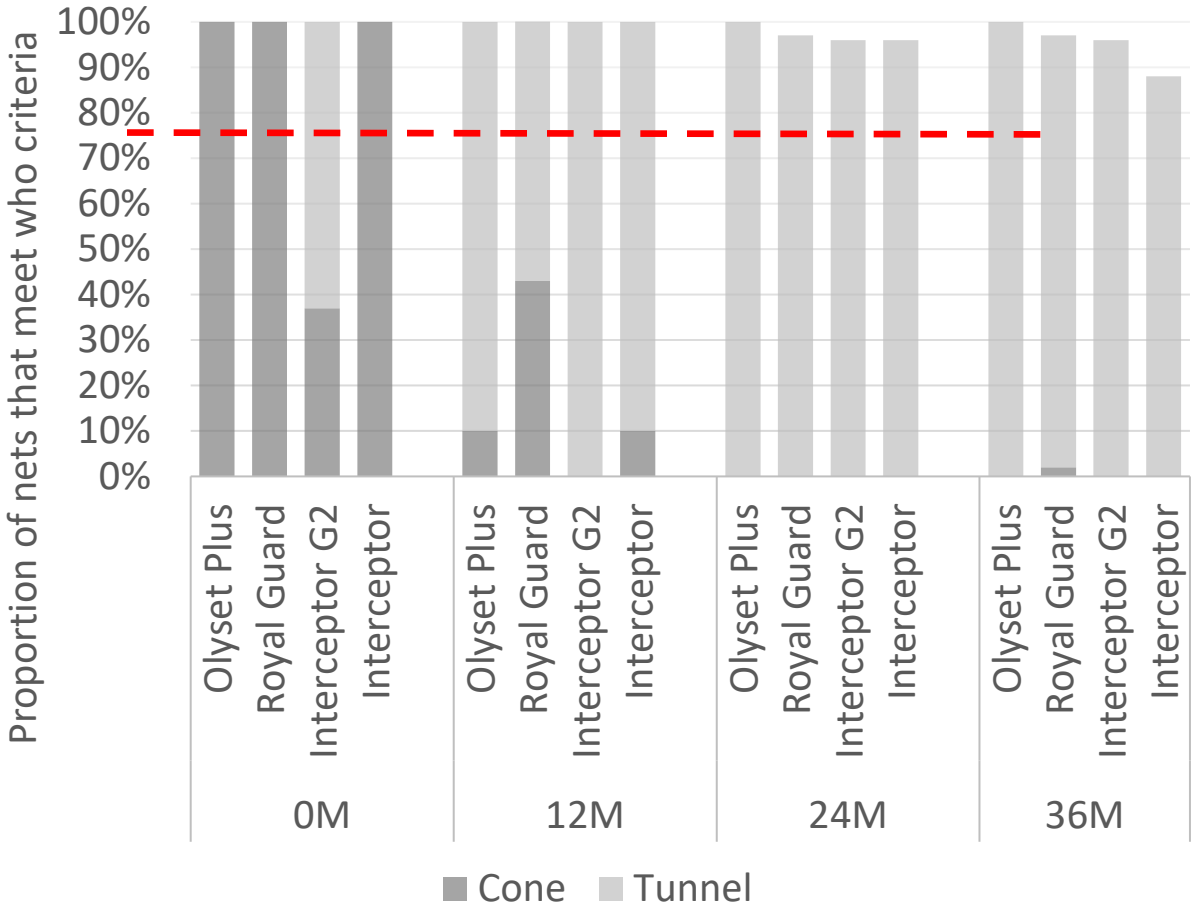
- Proportion of good and damaged decrease over time for all the nets.
- At each time point Olyset Plus had the largest proportion of torn nets compared to other nets.

Comparison of fx of ITN in different studies



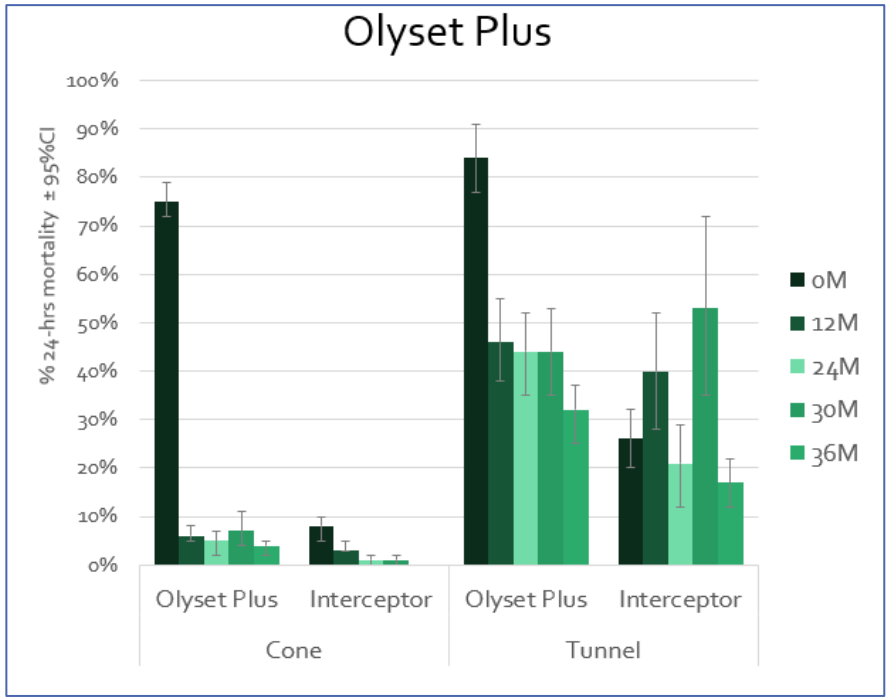
- Thesis reported functional survival of Interceptor G2 to be 1.9 years (Martin et al 2024).
- Similar results with low functional survival was reported in Benin (Ngufor et al 2024)
- Other part of Tanzania (Lukole 2023)

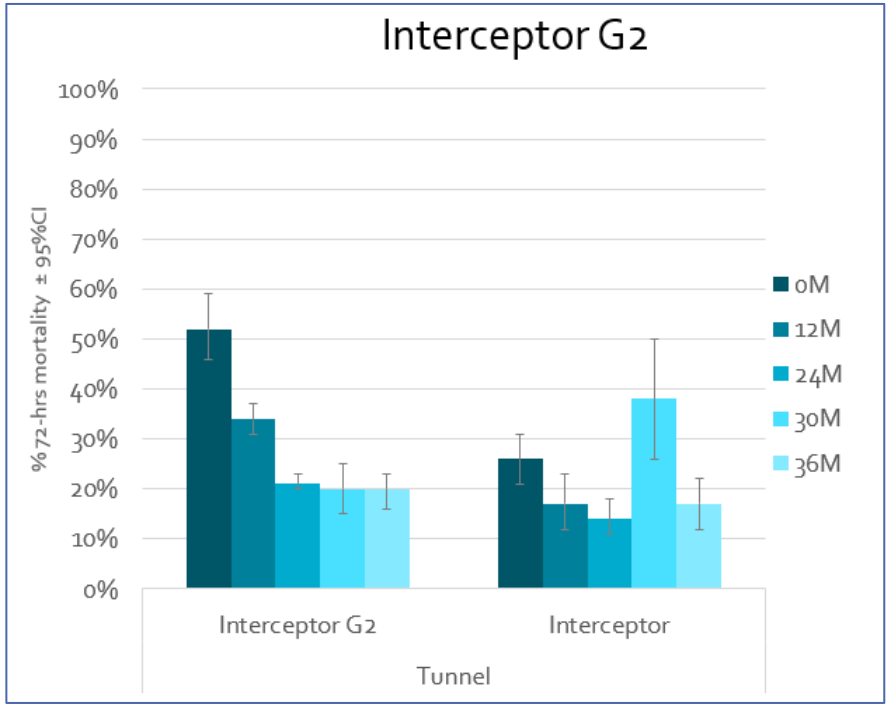
ITNs passing WHO criteria against Kisumu strain



- All nets passed WHO bio-efficacy criteria
- Majority of net pass-through BFI

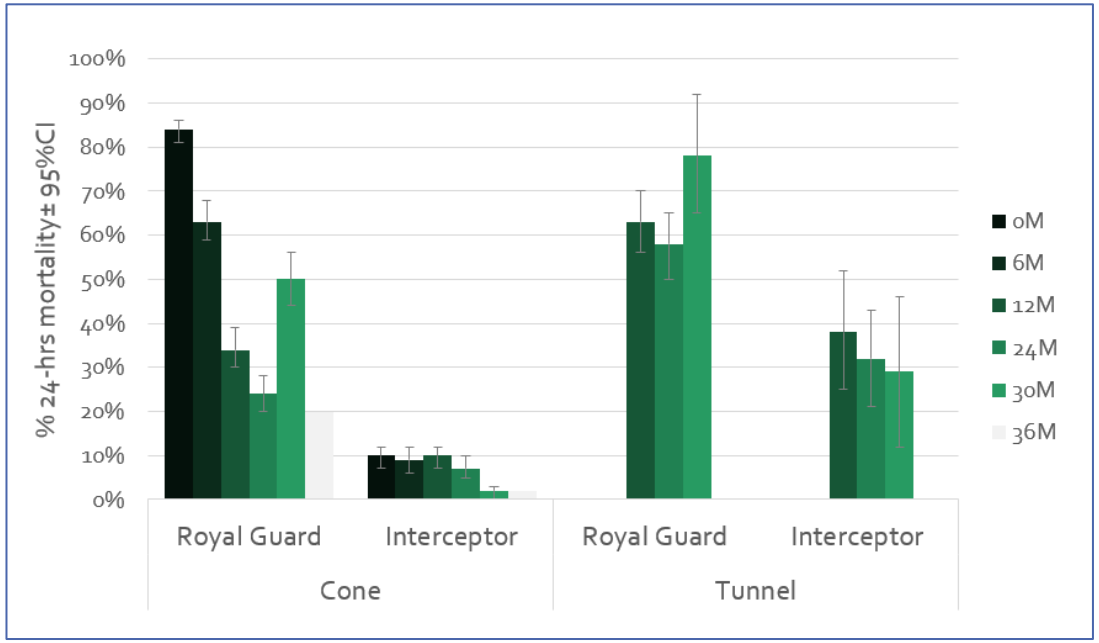
PBO-Pyr and CFP-Pyr mortality against the resistant strain

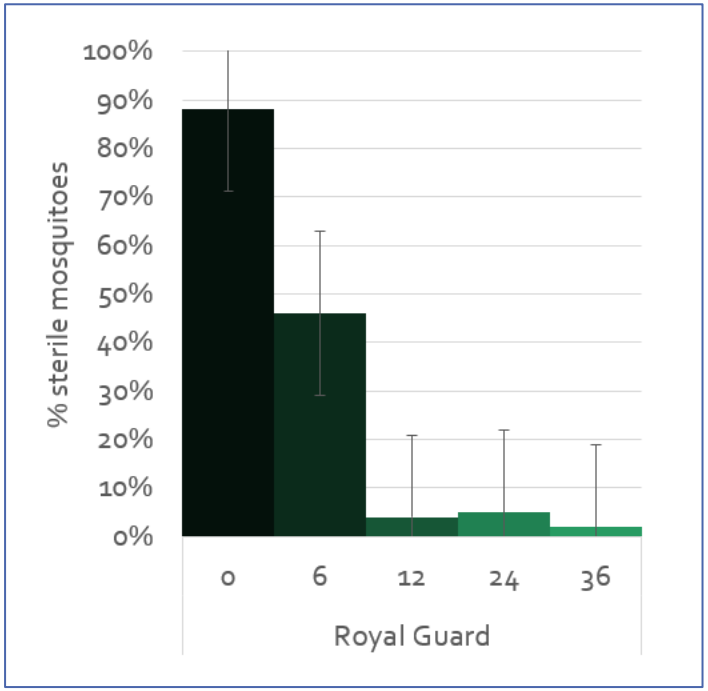




- Higher mortality observed in Olyset Plus when these nets were new unwashed.
- Interceptor G2 were superior to Interceptor up to 24 months

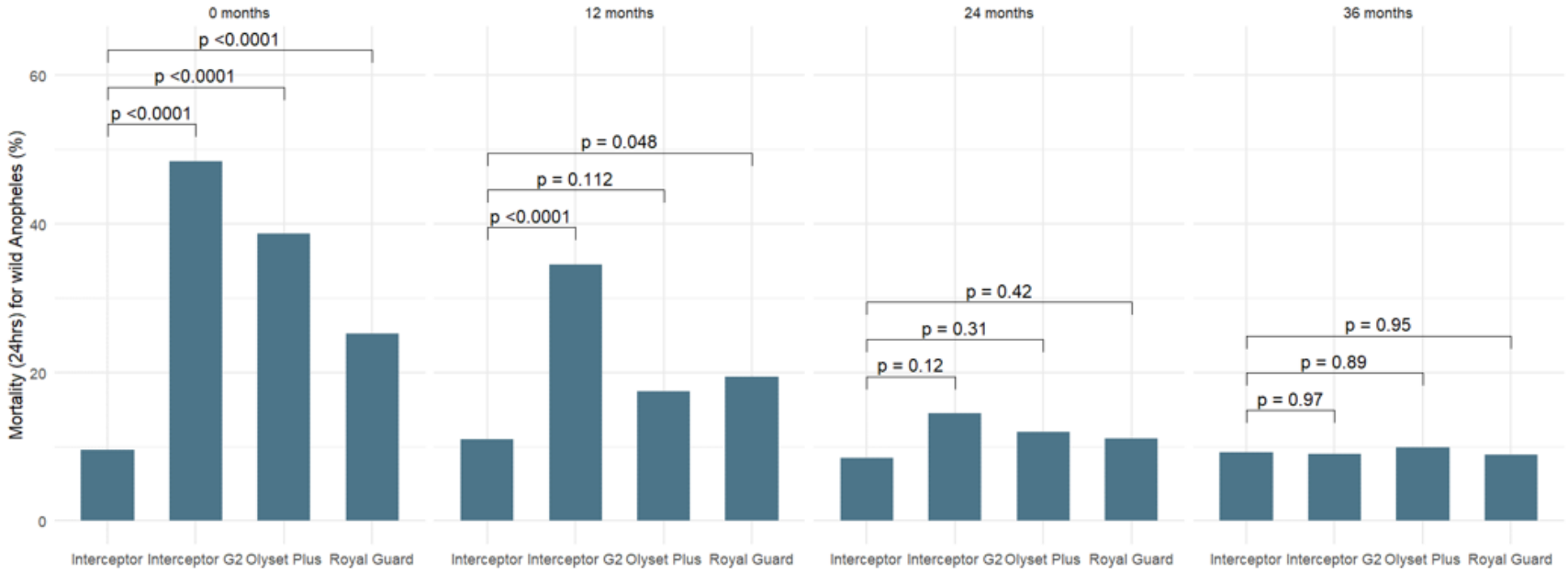
Mortality and sterility for Royal Guard nets





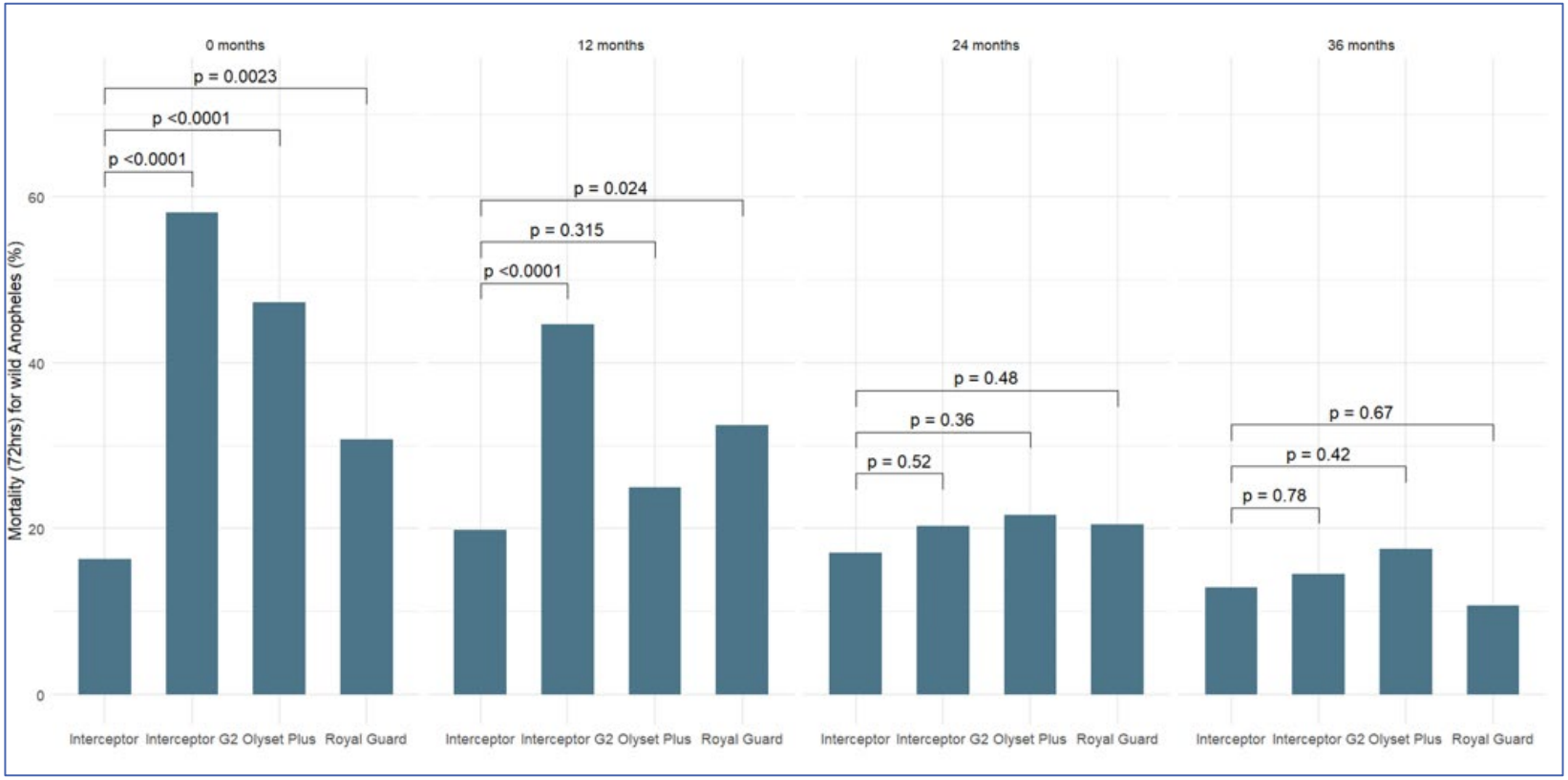
- Higher mortality was observed for new Royal Guard.
- Sterility effect was more than 80% for new net but diminished to <50% after six months of use.

EHT results: 24-hours mortality



- Species composition differ yearly and impacted mortality observed

EHT results: 72 hours mortality



- There were no variation in resistance using permethrin against *An.gambiae* s.l but high resistance intensity was observed in year two against *An.funestus*
- High resistance intensity was observed in alpha cypermethrin against *An.funestus* in year two

Comparison in performance between ITNs

Net type	Attrition rate 36m	Functional survival	Bio-efficacy_lab	Efficacy_EHT	RCT
Interceptor	62.9% [59 - 67]	1.9 [1.9 - 2.0]			
Interceptor G2	63.3% [59 - 67]	1.9 [1.9 - 1.9]	21% vs 14% (24 M)	44% (12 M)	36m
Olyset Plus	90.5% [88 - 93]	0.9 [0.9 - 1.0]	67% vs 7% (0 M)	38% (0 M)	12m
Royal Guard	81.9% [79 - 85]	1.9 [1.9 -1.9]	46% sterile 6 M	43% sterile 0 M	-

- Royal Guard induced significant mortality at up to 30m in cone assays while Olyset Plus lasted only for one year in cone.
- Interceptor G2 were superior compared to reference net up to 24 M in tunnel test and lasted for one year in EHT
- Attrition rate high in Royal Guard and Olyset Plus compared to control net with the tear and wear becoming the leading reason
- Functional survival for all nets were below three years.

Conclusions

Durability:

- Overall attrition and development of holes was in general higher in the dual a.i./PBO nets compared to standard net with Olyset Plus the worst of all

Bio-efficacy of second a.i. or PBO-Py

- Olyset Plus ITN exhibited higher initial mortality rates, and Royal Guard ITN demonstrated greater sterility effects compared to Interceptor, though only when new
- Interceptor G2 ITNs outperformed Interceptor against *An. gambiae* s.l. and *An. funestus* complex for up to 12 months in EHT and two years against *An. gambiae* s.s in laboratory assays
- The new dual ITN provided superior efficacy to standard net for maximum of two years and results to do not necessary align with the RCTs.
- Physical and insecticide durability (for the second ai/PBO) need to be extended.

Acknowledgements

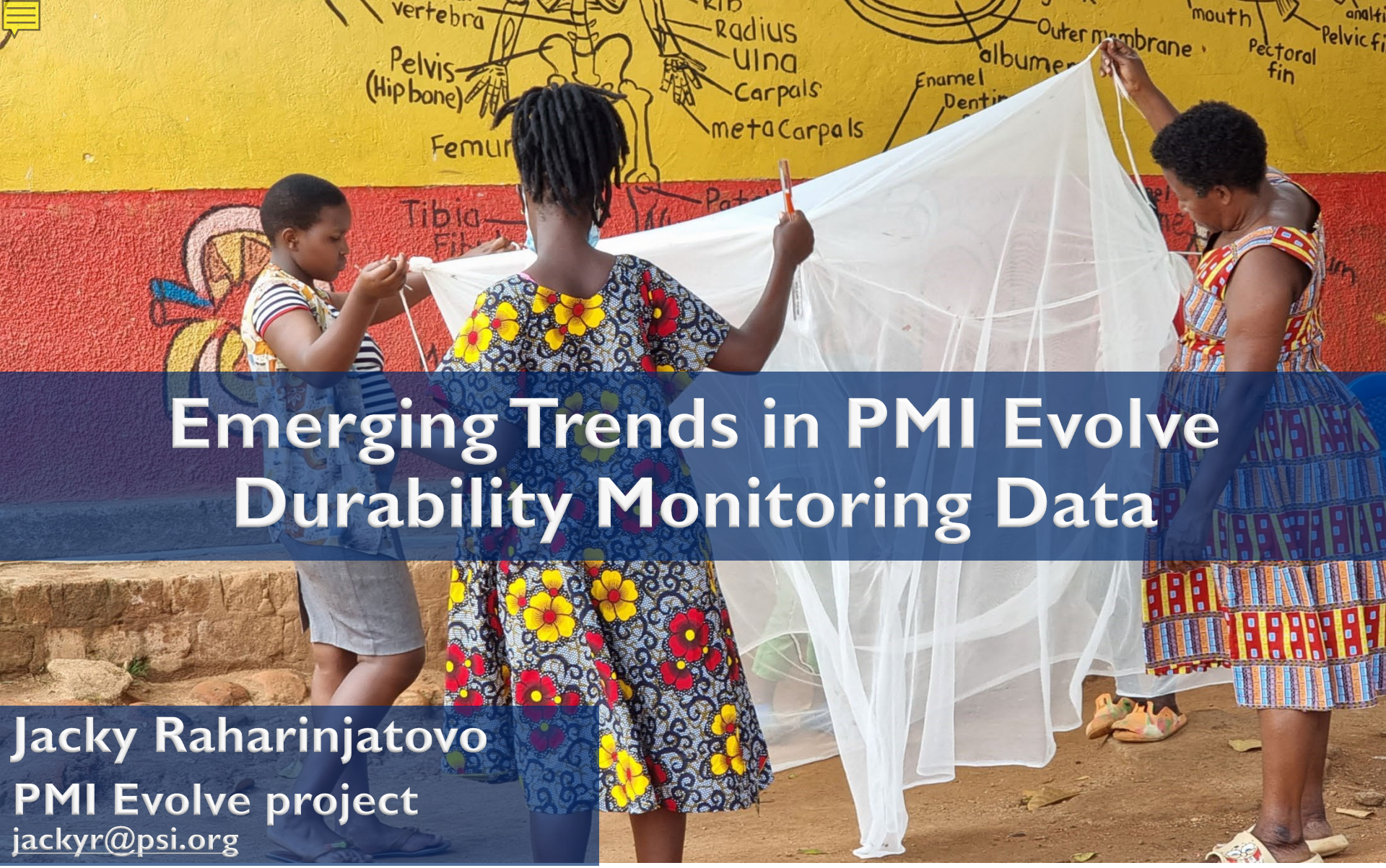
<u>To my supervisors:</u>

Prof. Natacha Protopopoff
Dr. Louisa Messenger
Dr. Nancy Matowo
Prof. Mark Rowland

PAMVERC team for their support

Community members

Volunteers for sleeping in the hut



Emerging Trends in PMI Evolve Durability Monitoring Data

Jacky Raharinjatovo
PMI Evolve project
jackyr@psi.org

Objectives

1. Provide some contextual information on ITN durability monitoring (DM) across the PMI Evolve portfolio

2. Examine bioassay and chemical content results from recent DM studies for and piperonyl butoxide (PBO)-synergist and chlorfenapyr (CFP) ITNs

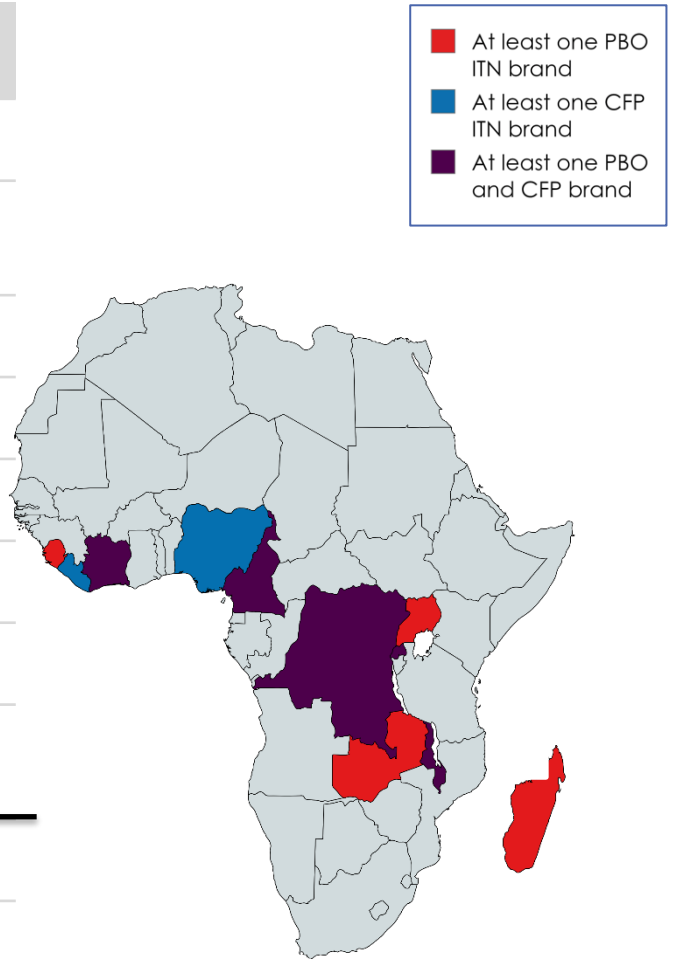
PMI Evolve DM Portfolio

CONTEXTUAL INFORMATION

Data collection trainee conducting interview during pilot testing in Sierra Leone. Photo credit: Raymond Sudoi

Ongoing standard and streamlined DM activities

Country	ITN Brand	'20	'21	'22	'23	'24	'25	'26
Sierra Leone	PermaNet 3.0 / Olyset Plus	BL	12m	24m	36m			
Rwanda	Olyset / Yahe / PermaNet 3.0 / IG2	BL	12m	24m	36m			
Uganda	PermaNet 3.0 / Royal Guard		BL 12m	24m	36m			
Cote d'Ivoire	PermaNet 3.0 / IG2		BL	12m	24m	36m		
Zambia	Olyset Plus / Veeralin		BL	12m	24m	36m		
DRC Tanganyika	SafeNet / Veeralin		BL	12m	24m	36m		
Liberia (SDM)	IG2			Rd1	Rd2	Rd3		
Madagascar (SDM)	PermaNet 3.0 / Yahe LN / SafeNet			Rd1	Rd2	Rd3		
Malawi (SDM)	Olyset Plus / IG2 / Royal Guard			Rd1	Rd2	Rd3		
Cameroon (SDM)	Duranet Plus / IG2				Rd1	Rd2	Rd3	
Nigeria (SDM)	IG2				Rd1	Rd2	Rd3	
DRC Nord Ubangi (SDM)	IG2					Rd1	Rd2	Rd3



Contextualizing DM data

Data collector conducting a household interview with a head of household in Sierra Leone. Photo credit: Raymond Sudoi

Net survival is context-specific and can vary between study sites in a country, even for the same product.

Since 2021, the PBO and dual ai categories make up >50% of ITNs distributed in SSA and more data on brands in these categories

Important to consider DM data alongside epidemiological data from ITN impact evaluations, RCTs and HMIS

Variability in mosquito strains, resistance profiles and laboratory conditions (e.g. lab temperature) making drawing conclusions from different studies difficult

Various bioefficacy indicators are being used for new ITNs (e.g. BFI for CFP ITNs)

No consistent correlation between declines in chemical content and mosquito mortality

PBO and CFP Bioassays and Chemical Results

Data collectors conducting an ITN hole assessment in Sierra Leone. Photo credit: Raymond Sudoi

24-hour mortality and PBO chemical content reduction for all PBO brands under study

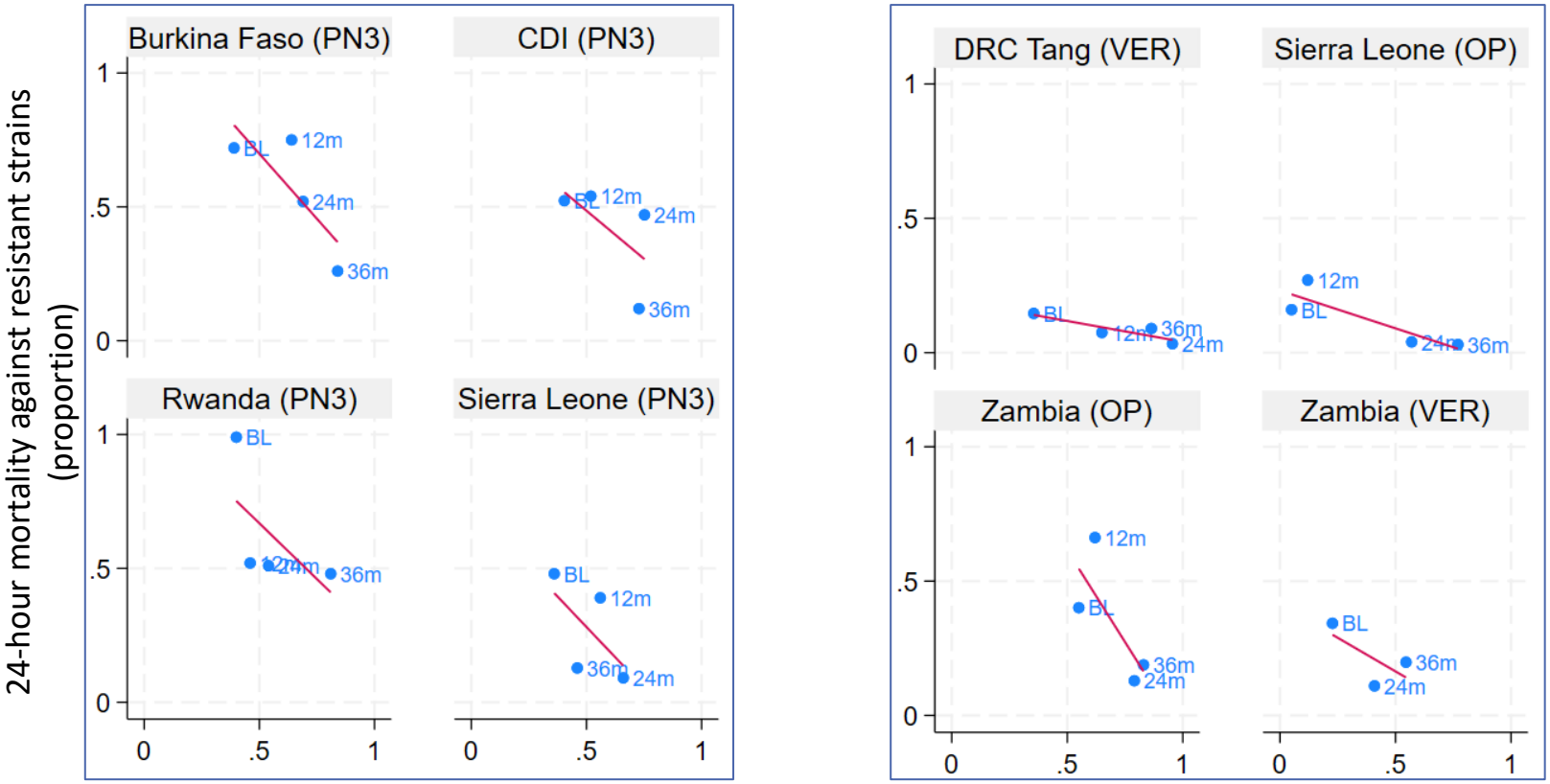
	24-hour mortality (all PBO ITNs)			
	Pre-distribution or baseline* **% *(Range)*** ***N, number of study sites***	**12-months % *(Range)* *N***	**24-months % *(Range)* *N***	**36-months % *(Range)* *N***
Susceptible strains	96.5% (76.1% - 100%) N=12	93.3% (64.5% - 100%) N=12	70.9% (47.1% - 100%) N=13	66.2% (4.6% - 98.8%) N=8
Resistant strains	64.4% (14.6% - 98.8%) N=13	52.2% (7.5% - 99.7%) N=13	37.6% (0.%0 - 99.9%) N=12	17.6% (0.9% - 48.0%) N=8

24-hour mortality for PBO ITNs measured through cone bioassays

*Pre-distribution bioassays/chemical testing completed for streamline DM studies. Baseline (ITNs in field for 1-6 months) bioassay/chemical testing completed for standard DM studies. Rounds combined for this analysis.

	Mean reduction in PBO content against the manufacturer target dose			
	Pre-distribution or baseline* **% reduction N**	**12-months % reduction N**	**24-months % reduction N**	**36-months % reduction N**
All PBO ITNs	** (28.6%) N=13	** (50.5%) N=12	** (66.3%) N=10	** (73.2%) N=8

24-hour mortality (against resistant strains) and PBO chemical content reduction, by country



PermaNet® 3.0: PN3
Veeralin ® : VER
Olyset ® Plus: OP

72-hour mortality and CFP chemical content reduction for Interceptor® G2 ITNs under study

	72-hour mortality (CFP ITNs)			
	Pre-distribution or baseline* % (Range) N, number of study sites	**12-months % (Range) N**	**24-months % (Range) N**	**36-months % (Range) N**
Susceptible strains	85.3% (43.3% - 99.1%) N=4	97.6% (93.3% - 100%) N=4	92.5% (80.0% - 100%) N=4	83.3% (56.5% - 100.0%) N=3
Resistant strains	78.5% (58.6% - 96.1%) N=8	64.1% (36.8% - 93.4%) N=6	59.6% (30.3% - 81.2%) N=7	57.8% (50.5% - 66.0%) N=3

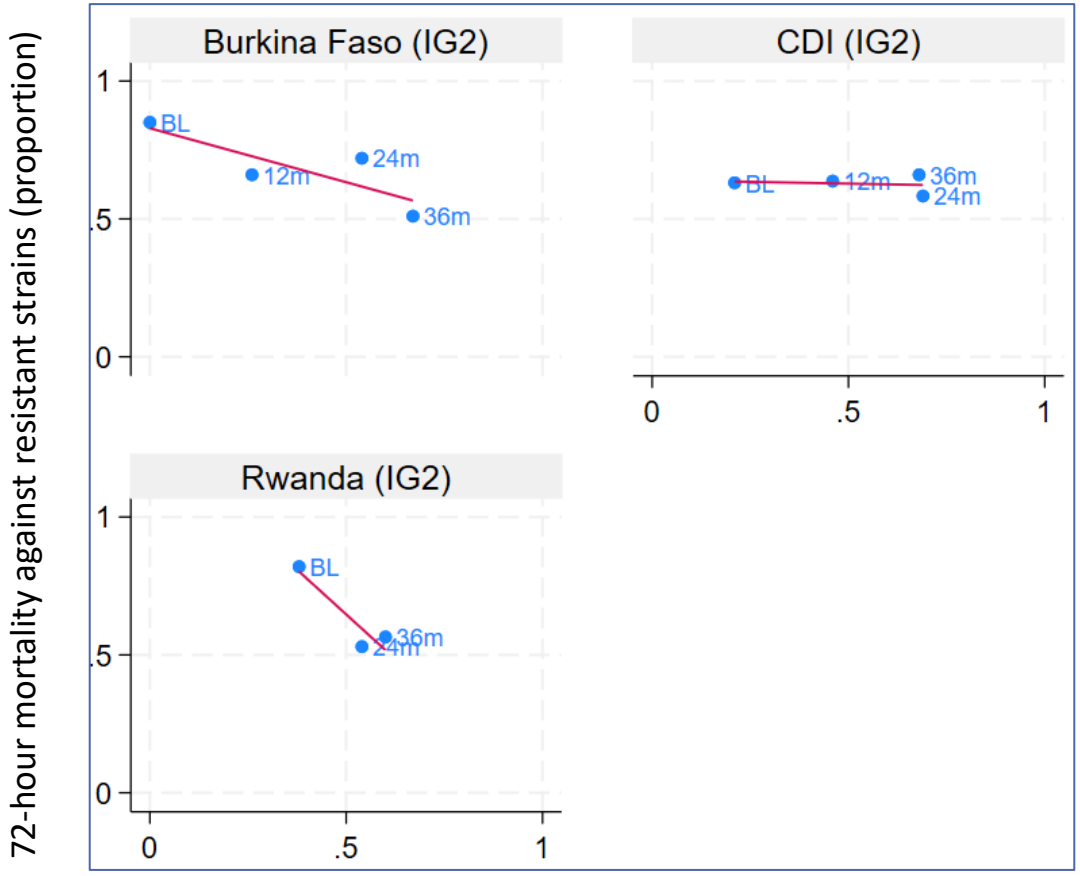
	Mean reduction in CFP content against the manufacturer target dose			
	Pre-distribution or baseline* % reduction from target dose (g/kg) N	**12-months % reduction from target dose (g/kg) N**	**24-months % reduction from target dose (g/kg) N**	**36-months % reduction from target dose (g/kg) N**
Interceptor® G2	16.0% (4.1) N=8	46.9% (2.6) N=5	62.1% (1.8) N=6	65.1% (1.7) N=3

72-hour morality was measured through tunnel tests

*Pre-distribution bioassays/chemical testing completed for streamline DM studies. Baseline (ITNs in field for 1-6 months) bioassay/chemical testing completed for standard DM studies. Rounds combined for this analysis.

Mean CFP target dose for Interceptor® G2 ITNs is 4.8 g/kg for 100D ITNs

72-hour mortality (against resistant strains) and CFP chemical content reduction, by country



Generally declining resistant strain 72-hour mortality as CFP content declines over time

Estimated median survival of ITNs from select completed PMI Evolve DM studies

Estimated median survival (years)					
PermaNet® 3.0	Burkina Faso (Orodoro)	Rwanda (Kickukiro)	Sierra Leone (Bo)	Uganda (Apac)*	Uganda (Mubende)*
	3.2	4	3.2	2.3	2.5

Estimated median survival (years)			
Interceptor® G2	Burkina Faso (Banfora)	Rwanda (Karongi)	Cote d'Ivoire[α] (Aboisso)
	2.6	3.1	4.8

Estimated median survival (years)		
Veeralin®	Zambia (Serenje)	DRC (Tanganyika)
	2.8	2.5

Estimated median survival (years)		
Olyset® Plus	Zambia (Nyimba)	Sierra Leone (Moyamba)
	2.0	2.2

*Interim data, study not yet finalized

[α] Cote d'Ivoire estimated median life high because ITN use was so low in our study clusters. At baseline, 75% of cohort IG2 ITNs in Aboisso were not hanging over a sleeping area. This reduced to 63%, 45% and 41% by the 12-, 24-, and 36-month rounds, respectively

Emerging evidence from Tanzania, Benin, and Uganda

"The results showed a better bio-efficacy for the 36-month-old Interceptor G2 nets compared to the Olyset Plus nets. However, given the reduced fabric strength for both LLINs evaluated, manufacturers should focus on improving physical integrity."

- Azizi S,, et al. Evaluation of Durability as a Function of Fabric Strength and Residual Bio-Efficacy for the Olyset Plus and Interceptor G2 LLINs after 3 Years of Field Use in Tanzania. Trop Med Infect Dis. 2023 Jul 25;8(8):379.

"The median ITN survival time for Interceptor® G2 (2.1 years) and Royal Guard® (1.6 years) in Benin is substantially lower than the 3 years…The insecticidal activity of the non-pyrethroid insecticides in both dual AI ITNs was short-lived compared to alpha-cypermethrin."

- Corine Ngufor et al., "The Physical and Insecticidal Durability of Two Dual Active Ingredient Nets (Interceptor® G2 and Royal Guard®) in Benin, West Africa; Results for a Durability Study Embedded in a Cluster Randomised Controlled Trial," August 9, 2024, https://doi.org/10.21203/rs.3.rs-4782261/v1.

"The pyrethroid content of all products remained relatively stable across timepoints but PBO content declined by 55% ($p<0.001$) and 58% ($p<0.001$) for Olyset Plus and PermaNet 3.0 respectively. Both PBO LLINs were highly effective against pyrethroid-resistant mosquitoes when new, knocking down all mosquitoes. However, bioefficacy declined over time with Olyset Plus knocking down 45.72% (95% CI: 22.84-68.62, $p=0.021$) and Permanet 3.0 knocking down 78.57% (95% CI: 63.57-93.58, $p<0.001$) after 25 months."

- Frank Mechan et al., "LLIN Evaluation in Uganda Project (LLINEUP) – The Durability of Long-Lasting Insecticidal Nets Treated with and without Piperonyl Butoxide (PBO) in Uganda," February 19, 2022, https://doi.org/10.1101/2022.02.17.480046.

Key Takeaways (1/2)

Field performance of new ITNs

- As was seen with pyrethroid-only ITNs, estimated median survival varies greatly by study site. Average estimated median survival for completed PMI Evolve-supported DM study sites with PBO or CFP ITNs is around three-years.
- Chemical content declined more than expected in our completed studies.
- Mortality decreases as chemical content decreases.

Recommendations

- WHO recommendations are clear around prioritization of new nets where pyrethroid resistance exists, as they are still more protective than PY-only ITNs. Additionally, RCTs have not shown negative epi trends commensurate with decreases in chemical content.
- Revised operational guidance on key post-market metrics (stratified by audience), would be useful so partners can support countries to systematically collect relevant data.

Key Takeaways (2/2)

Importance of continuous distribution channels

- Given latest survival time data, some countries have proposed conducting mass campaigns every two years.
- However, countries should focus on bolstering and scaling up continuous distribution channels (e.g. through ANC, EPI, schools etc…) to ensure ITN access between mass campaigns.

Looking forward

- Data from on-going DM studies will continue to be collected, processed and published.
- DM shifting to post-market data collection, reprioritizing data collection methodologies and types of data being collected. WHO to release post-market ITN surveillance guidance by the end of 2024.
- PMI Evolve will develop a multi-country pooled analysis paper in the coming year focusing on bioassay and chemical results.

The Role of Continuous ITN Distribution in Achieving & Sustaining ITN Coverage

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ITN Quantification and Coverage

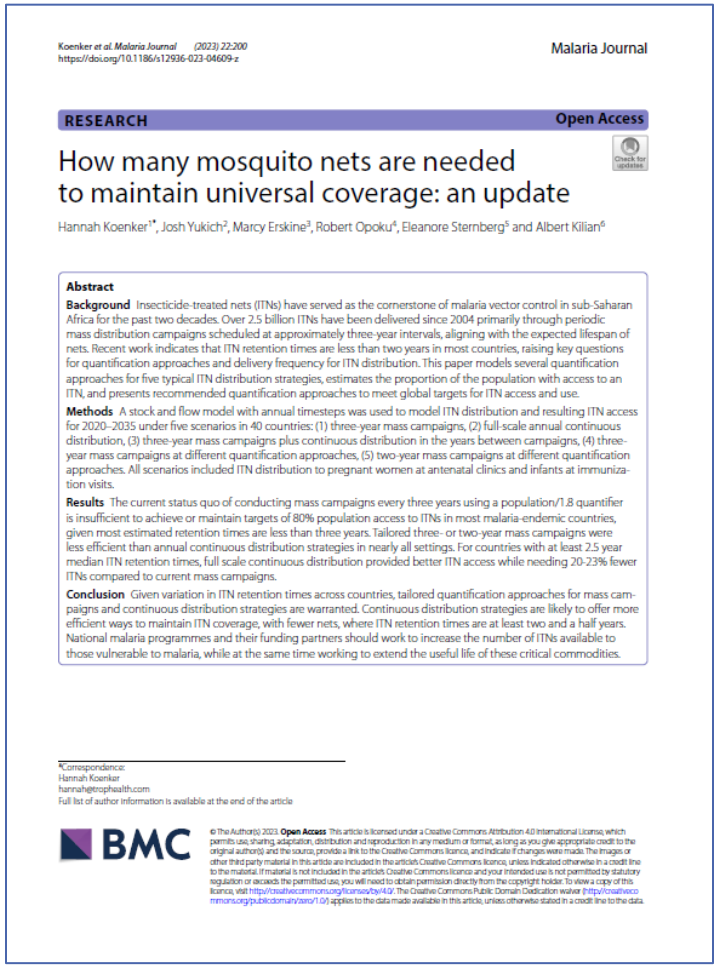
- Data from PMI Evolve-supported insecticide-treated net (ITN) durability monitoring studies across multiple countries, as well as other studies, show ITNs do not always last for the intended three years and that net durability is variable
- Most national malaria programs implement campaigns in three-year cycles which is not necessarily aligned to data for ITN durability and retention
- National malaria programs are operating in a resource constrained context where more frequent campaigns, which are resource intensive, are not a viable option in most cases
- National malaria programs need to ensure ITN access between campaigns through less resource intensive channels and ensure that these channels are optimally functioning

Table 3 Survival in serviceable condition at follow-up intervals

From: Variation of physical durability between LLIN products and net use environments: summary of findings from four African countries

Site	Baseline (95% CI)	12 months (95% CI)	24 months (95% CI)	36 months (95% CI)
MOZ Inhambane	99.7% (98.1–99.9)	98.0% (96.0–99.0)	85.3% (78.9–90.0)	57.3% (50.2–64.1)
MOZ Nampula	100% (–.–)	93.7% (90.6–95.8)	73.2% (62.7–81.7)	32.5% (23.5–43.1)
MOZ Tete	98.7% (96.3–99.5)	95.8% (90.7–98.1)	74.2% (64.2–82.1)	43.3% (27.2–61.1)
NGA Ebonyi	99.7% (98.0–100)	96.0% (92.5–97.9)	76.3% (67.9–83.1)	54.8% (41.4–67.6)
NGA Oyo	100% (–.–)	92.0% (86.0–95.6)	74.6% (60.2–85.1)	n.a.
NGA Zamfara	99.3% (97.9–99.8)	97.7% (95.7–98.8)	91.8% (84.1–95.9)	80.4% (72.7–85.9)
DRC Mongala	98.9% (96.7–99.7)	69.6% (59.5–78.1)	33.2% (23.5–44.4)	17.4% (10.7–26.9)
DRC Ubangi Sud	100% (–.–)	88.7% (84.8–91.7)	56.2% (45.7–66.1)	36.7% (29.4–44.7)
ZNZ Pemba	99.1% (97.8–99.6)	86.1% (78.7–91.2)	67.0% (60.6–72.6)	51.0% (44.5–57.4)
ZNZ Unguja	99.2% (96.7–99.8)	93.9% (89.6–96.4)	75.8% (67.1–82.8)	55.2% (46.2–63.9)

ITN Continuous Distribution Quantification



Koenker et al. Malaria Journal (2023) 22:200
https://doi.org/10.1186/s12936-023-04609-z

Malaria Journal

RESEARCH Open Access

How many mosquito nets are needed to maintain universal coverage: an update

Hannah Koenker[1*], Josh Yukich[2], Marcy Erskine[3], Robert Opoku[4], Eleanore Sternberg[5] and Albert Kilian[6]

Abstract

Background Insecticide-treated nets (ITNs) have served as the cornerstone of malaria vector control in sub-Saharan Africa for the past two decades. Over 2.5 billion ITNs have been delivered since 2004 primarily through periodic mass distribution campaigns scheduled at approximately three-year intervals, aligning with the expected lifespan of nets. Recent work indicates that ITN retention times are less than two years in most countries, raising key questions for quantification approaches and delivery frequency for ITN distribution. This paper models several quantification approaches for five typical ITN distribution strategies, estimates the proportion of the population with access to an ITN, and presents recommended quantification approaches to meet global targets for ITN access and use.

Methods A stock and flow model with annual timesteps was used to model ITN distribution and resulting ITN access for 2020–2035 under five scenarios in 40 countries: (1) three-year mass campaigns, (2) full-scale annual continuous distribution, (3) three-year mass campaigns plus continuous distribution in the years between campaigns, (4) three-year mass campaigns at different quantification approaches, (5) two-year mass campaigns at different quantification approaches. All scenarios included ITN distribution to pregnant women at antenatal clinics and infants at immunization visits.

Results The current status quo of conducting mass campaigns every three years using a population/1.8 quantifier is insufficient to achieve or maintain targets of 80% population access to ITNs in most malaria-endemic countries, given most estimated retention times are less than three years. Tailored three- or two-year mass campaigns were less efficient than annual continuous distribution strategies in nearly all settings. For countries with at least 2.5 year median ITN retention times, full scale continuous distribution provided better ITN access while needing 20-23% fewer ITNs compared to current mass campaigns.

Conclusion Given variation in ITN retention times across countries, tailored quantification approaches for mass campaigns and continuous distribution strategies are warranted. Continuous distribution strategies are likely to offer more efficient ways to maintain ITN coverage, with fewer nets, where ITN retention times are at least two and a half years. National malaria programmes and their funding partners should work to increase the number of ITNs available to those vulnerable to malaria, while at the same time working to extend the useful life of these critical commodities.

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- The status quo of conducting mass campaigns every three years using a population/1.8 quantifier is insufficient to maintain 80% population access to ITNs in most malaria-endemic countries.
- In this modeling study, 3-year mass campaigns with RCH reached 100% ITN access post-campaign but fell to 70% in the 3rd year post-campaign.
- For countries with at least 2.5 years median ITN retention times, full-scale continuous distribution provides better ITN access while needing 20-23% fewer ITNs than current mass campaigns.

Koenker H, Yukich J, Erskine M, Opoku R, Sternberg E, Kilian A. How many mosquito nets are needed to maintain universal coverage: an update. Malar J. 2023 Jun 30;22(1):200. doi: 10.1186/s12936-023-04609-z. PMID: 37391703; PMCID: PMC10314435.

ITN CD Quantification: Tanzania

- Model with a Tanzania-specific ITN decay rate used to calculate annual net crops for four different ITN distribution strategies

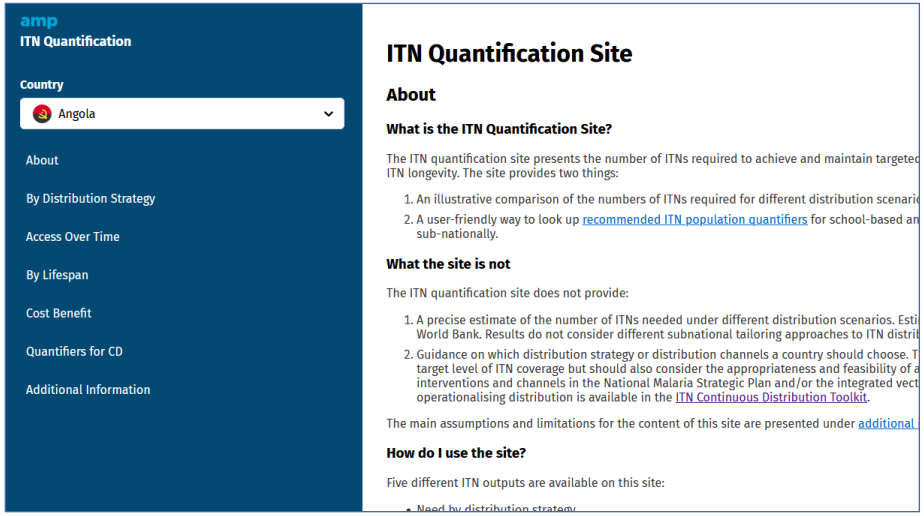
- Given an average net lifespan of 2.15 years:
  - Mass campaigns every 3 years will not maintain ITN access at target levels of 80%, even with strong RCH channels
  - ITN access can be maintained at 80% or above by quantifying SNP using "population × 15%" + RCH ITNs
    - Requires 14% fewer ITNs than a 3-year campaign strategy while providing more consistent ITN coverage.
  - Meeting the targets of 80% ITN use would require maintaining 90% ITN access, achievable using a "population times 22%" quantification approach for SNP

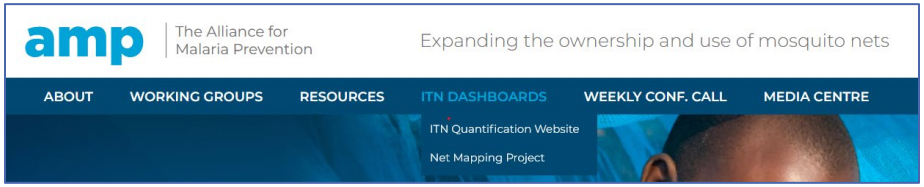
Table 1 ITNs required under different distribution scenarios with estimated ITN access achieved over 2022–2030

From: Annual distributions of insecticide-treated nets to schoolchildren and other key populations to maintain higher ITN access than with mass campaigns: a modelling study for mainland Tanzania

ITN distribution scenario	Quantification	Max ITN access	Min ITN access	Total ITNs required 2022–2030 mainland	% difference in net need vs 3 year campaigns	Person-years of ITN access
5-year mass campaigns + RCH	Campaign = population/1.8 RCH = population × 7%	90	35	120.5 m	– 22%	753
3-year mass campaigns + RCH	Campaign = population/1.8 RCH = population × 7%	100	71	154.4 m	Ref.	881
3-year mass campaigns + RCH + school between campaign years	Campaign = population/1.8 RCH = population × 7% School = population × 5%	100	80	174.6 m	+13%	914
4a. RCH + school targeting minimum 90% ITN access	RCH = population × 7% School = population × 22%	94	90	175.5 m	14%	918
4b. RCH + school targeting minimum 80% access	RCH = population × 7% School = population × 15%	90	80	133.2 m	– 14%	863

New AMP Resource for CD Quantification





https://allianceformalariaprevention.com/itn-quantification/index.html

The ITN Quantification Site can be used to:

- Compare ITN distribution strategies in terms of ITN access achieved and number of ITNs required
- Set ITN retention time and compare the number of ITNs required for a given ITN access
- Select the population-based quantification factor for continuous distribution channels, based on ITN strategy. This gives a simple rule of thumb quantification of "population divided by X", like we have for mass campaigns

CD versus Mass Campaign Cost

- Continuous distribution (health facilities, school, and community) structures present an opportunity to achieve and maintain coverage continuously without the need for (2 to) 3-year mass campaign cycles.

- How does CD cost compare with mass campaigns?
  - From a cost study of ITN distribution systems in 3 countries – Ghana, Mali, and mainland Tanzania involving 4 types of distribution models (Scates et al, 2020), mass distributions and continuous systems delivered ITNs at overlapping economic costs per net distributed
  - Mass distributions: USD 4.37–4.61
  - CD channels: USD 3.56–9.90, with two of the school-based systems and the mass distributions at the lower end of this range.

- From the perspective of international donors, the costs of the continuous distribution systems were, for the most part, less costly than the mass distributions (mass distributions: USD 4.34–4.55, Ghana and Tanzania 2017 school-based: USD 3.30–3.69, health facility-based: USD 3.90–4.55, combined community/health facility USD 4.55)

AMP's CD Working Group

- AMP's Continuous Distribution Working Group (CDWG) brings together partners, including PMI and the Evolve Project, to support efforts to expand ITN continuous distribution
- The CDWG is focusing on:
  - Supporting development of guidance on data-driven channel selection for national malaria programs
  - Providing guidance for ITN CD quantification (https://allianceformalariaprevention.com/itn-quantification/index.html)
  - Updating the ITN CD resources available on https://www.continuousdistribution.org
  - Merging the CD and AMP websites into a single platform for all ITN distribution channels
  - Developing resources and case studies highlighting successes, lessons learned and recommendations from countries piloting or implementing CD

Conclusions

- ITNs from modeling and DM studies do not last for the intended 3 years
- Implementation of mass ITN campaigns is time-consuming and expensive
- CD channels can achieve ITN coverage of 80-90% using population times 15 and 22 percent respectively
- CD costs are comparable to mass campaigns and sometimes cheaper

National malaria programs, in a resource constrained environment, will need to use the most effective and efficient channels for achieving and sustaining ITN access and use to achieve malaria targets

MODERATED Q&A SESSION

Thank you!

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