



U.S. President's Malaria Initiative

# Durability Monitoring of Long-Lasting Insecticidal Nets (LLINs) in Malaria-Endemic Regions of Zimbabwe

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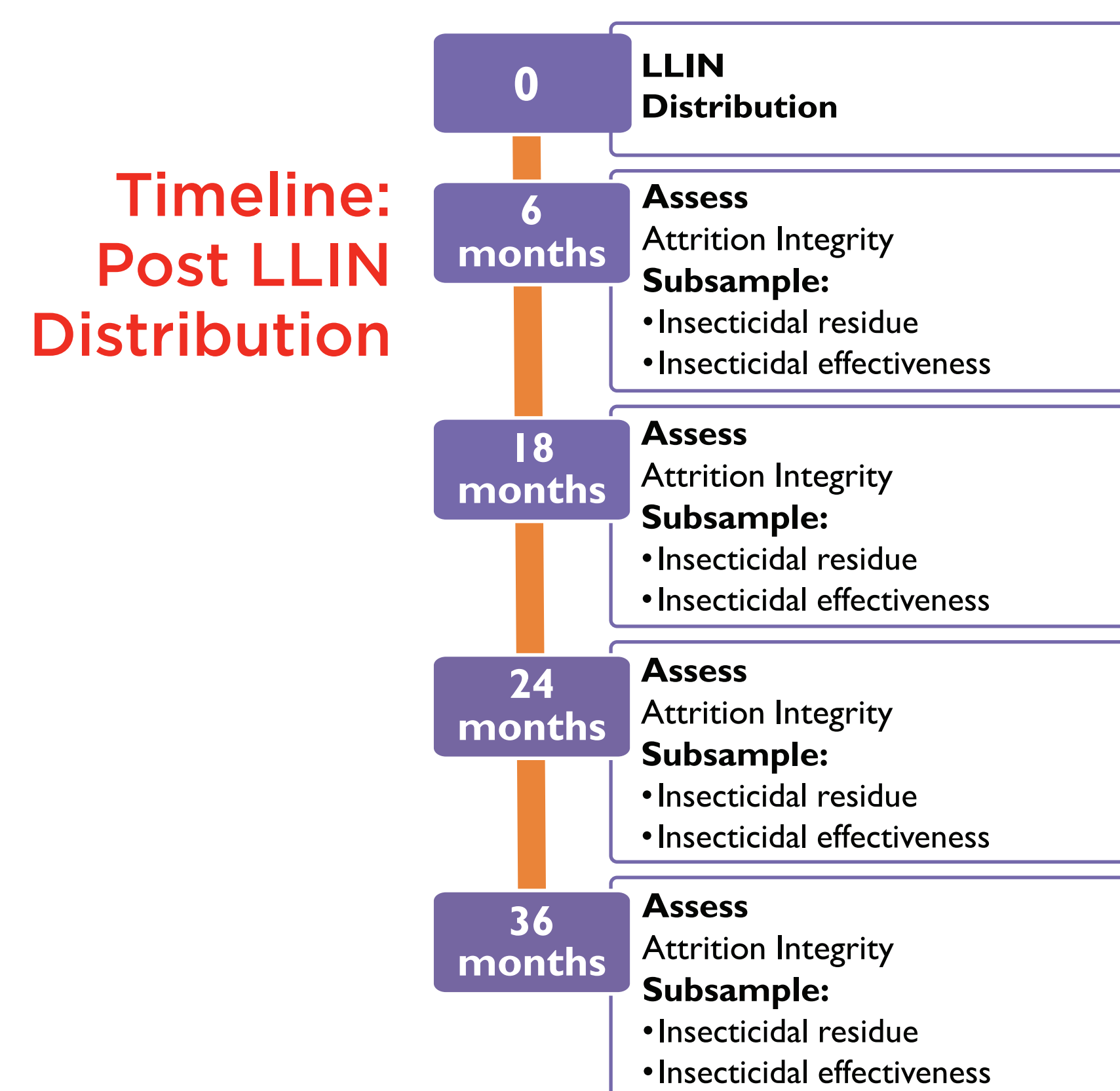
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## Background and Methodology

- Net Durability Study (NDS) initiated in February 2016.
- NDS followed LLINs distributed through school-based mini-campaign (Sept 2015).
  - 12 districts: Mashonaland Central Province (8) and Mashonaland West Province (4).
- Districts chosen to represent different sociodemographic and ecological profiles.
  - Rural, mining, peri-urban, and commercial farming sectors.
- Prospective, longitudinal study of a cohort of randomly selected LLINs.
  - 1,000 DawaPlus 2.0 and 1,000 DuraNet.
- Interviewed households using a structured questionnaire.
- LLINs assessed for fabric integrity, chemical content and biochemical efficacy.

## Study Objectives

- Assess physical durability (survivorship, attrition, integrity), insecticidal activity and content of DawaPlus 2.0 and DuraNet.
- Compare the physical durability of DawaPlus 2.0 and DuraNet LLINs across different priority sectors (peri-urban, commercial farming, rural, and mining).
- Identify major determinants of field performance.
- Describe net care and repair and their impact on overall net durability and insecticidal activity.
- Assess the impact of socioeconomic factors on LLIN performance in different priority sectors.



## RESULTS: CUMULATIVE ALL-CAUSE NET ATTRITION BY BRAND

Brand of LLIN	LLIN Cumulative All-Cause Attrition at Month 6	LLIN Cumulative All-Cause Attrition at Month 18	LLIN Cumulative All-Cause Attrition at Month 24	LLIN Cumulative All-Cause Attrition at Month 36
DawaPlus 2.0 (n= 923)	5.2%	19.5%	29.3%	42.9%
DuraNet (n= 911)	6.9%	23.7%	33.7%	46.8%
Total (n= 1,834)	6.1%	21.6%	31.5%	44.8%

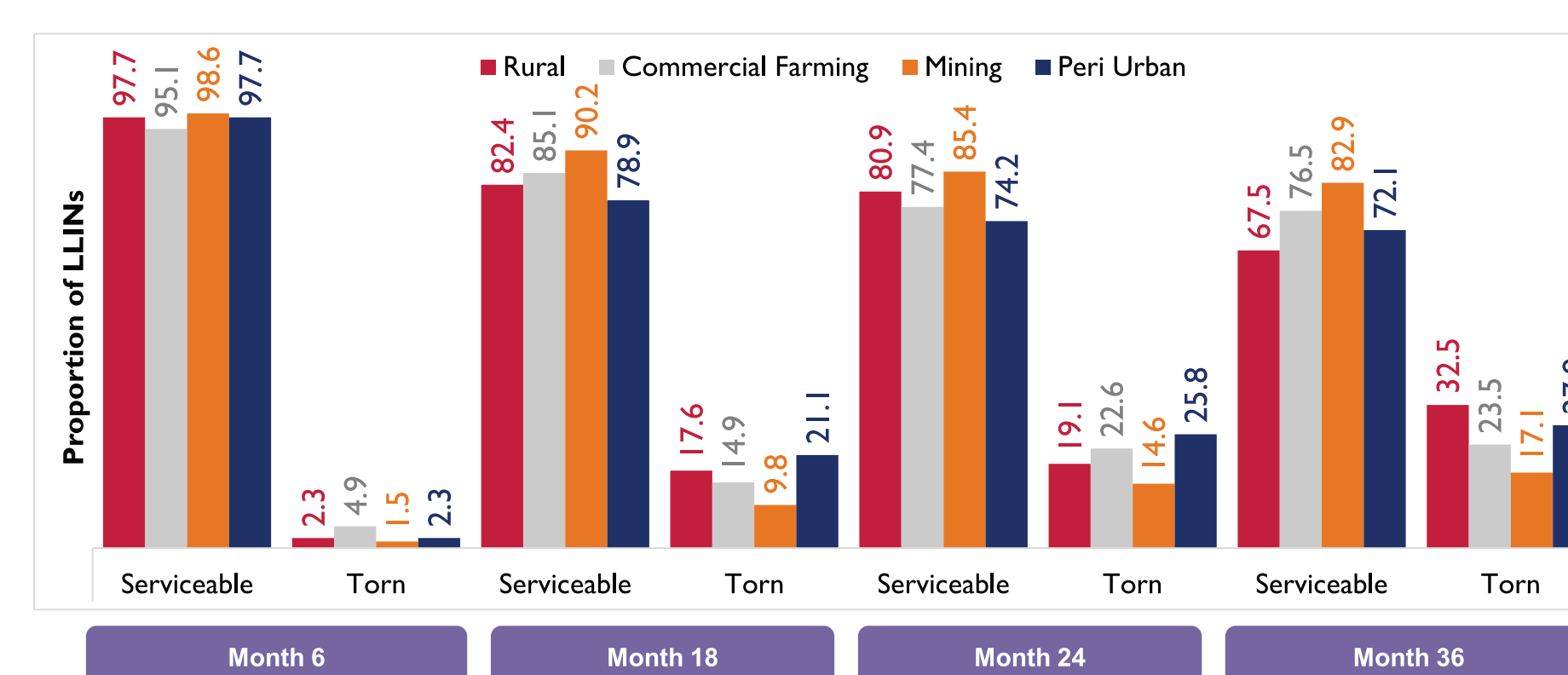
- 23 percentage-point difference in attrition (LLINs lost for any reason) from month 18 to month 36 was statistically significant at 10% level ( $p=0.089$ ).
- Across all four sectors, most common reason given for a net's absence at each time interval was that family members elsewhere were using it.

## KEY FINDINGS: PHYSICAL ASSESSMENT (FABRIC INTEGRITY) OF LLINs BY BRAND

Period	LLIN Brand	pHI Category		Total
		Serviceable = pHI<642	Torn = pHI>642	
Month 6	DawaPlus 2.0	844 (97%)	28 (3%)	869 (100%)
	DuraNet	834 (97%)	27 (3%)	857 (100%)
	<b>Total</b>	<b>1,678 (97%)</b>	<b>55 (3%)</b>	<b>1,726 (100%)</b>
Month 18	DawaPlus 2.0	592 (86%)	94 (14%)	686 (100%)
	DuraNet	526 (82%)	117 (18%)	643 (100%)
	<b>Total</b>	<b>1,118 (84%)</b>	<b>211 (16%)</b>	<b>1,329 (100%)</b>
Month 24	DawaPlus 2.0	454 (81%)	107 (19%)	561 (100%)
	DuraNet	334 (78%)	95 (22%)	429 (100%)
	<b>Total</b>	<b>788 (80%)</b>	<b>202 (20%)</b>	<b>990 (100%)</b>
Month 36	DawaPlus 2.0	241 (78%)	69 (22%)	310 (100%)
	DuraNet	184 (70%)	80 (30%)	264 (100%)
	<b>Total</b>	<b>425 (74%)</b>	<b>149 (26%)</b>	<b>574 (100%)</b>

- Over 78% of DawaPlus 2.0 net were in serviceable condition, compared with 70% of DuraNet ( $p=0.036$ ).
  - Compared with baseline (month 6), where there was no difference in the fabric integrity of the two brands—97% of both DawaPlus 2.0 and DuraNet LLINs were still serviceable.
- The proportion of LLINs in the torn category increased from 20% at month 24 to 26% at month 36.

## KEY FINDINGS: PHYSICAL ASSESSMENT (FABRIC INTEGRITY) OF LLINs BY SECTOR



- Over the 36-month period, the serviceability of LLINs decreased across the sectors in particular for rural areas.
- The number of torn LLINs increased particularly amongst the rural and periurban sectors.

## Results and Key Findings

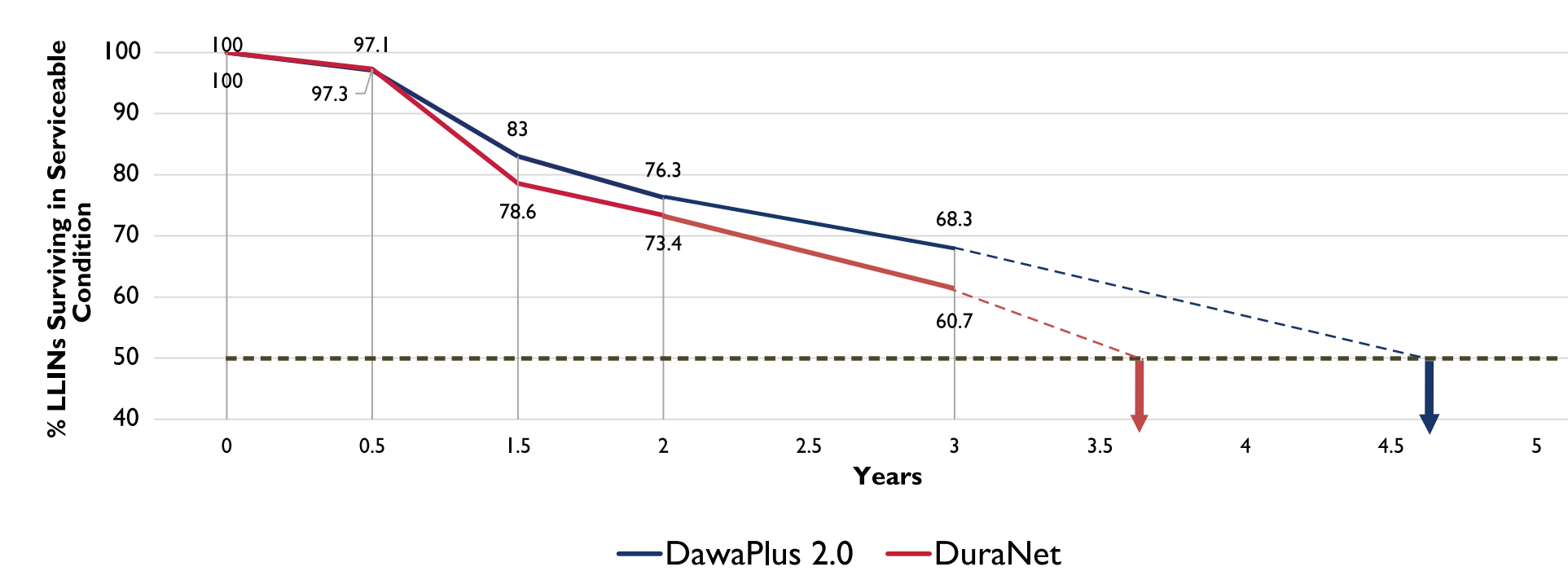
### KEY FINDINGS: PROPORTION OF CUMULATIVE NETS SURVIVING IN SERVICEABLE CONDITION

Period	Brand of LLIN	Number of Nets in Serviceable Condition	All Surviving and Attrited Cohort Nets	Percentage of Surviving Nets in Serviceable Condition
Month 6	DawaPlus 2.0	844	869	97.1%
	DuraNet	834	857	97.3%
	<b>Total</b>	<b>1,678</b>	<b>1,726</b>	<b>97.2%</b>
Month 18	DawaPlus 2.0	592	713	83.0%
	DuraNet	526	669	78.6%
	<b>Total</b>	<b>1,118</b>	<b>1,382</b>	<b>80.9%</b>
Month 24	DawaPlus 2.0	454	595	76.3%
	DuraNet	334	455	73.4%
	<b>Total</b>	<b>788</b>	<b>1,050</b>	<b>75.0%</b>
Month 36	DawaPlus 2.0	241	353	68.3%
	DuraNet	184	303	60.7%
	<b>Total</b>	<b>425</b>	<b>656</b>	<b>64.8%</b>

- Statistically significant cumulative decline in proportion of LLINs surviving in serviceable condition: 80.9% at month 18, 75% at month 24 and 64.8% at final time point ( $p=0.001$ ).
- At month 36, cumulative nets surviving in serviceable condition differed by brand: DawaPlus 2.0 (68%) and DuraNet (61%) ( $p=0.042$ ).

### KEY FINDINGS: MEDIAN SURVIVAL ESTIMATES AT DIFFERENT TIME POINTS

LLIN Brand	Month 6	Month 18	Month 24	Month 36
DawaPlus 2.0	8.6	4.4	4.2	4.7
DuraNet	9.3	3.5	3.8	3.8



- At month 36 (the final time point) the estimated median net survival was 4.7 years for DawaPlus 2.0 and remained at 3.8 years for DuraNet.

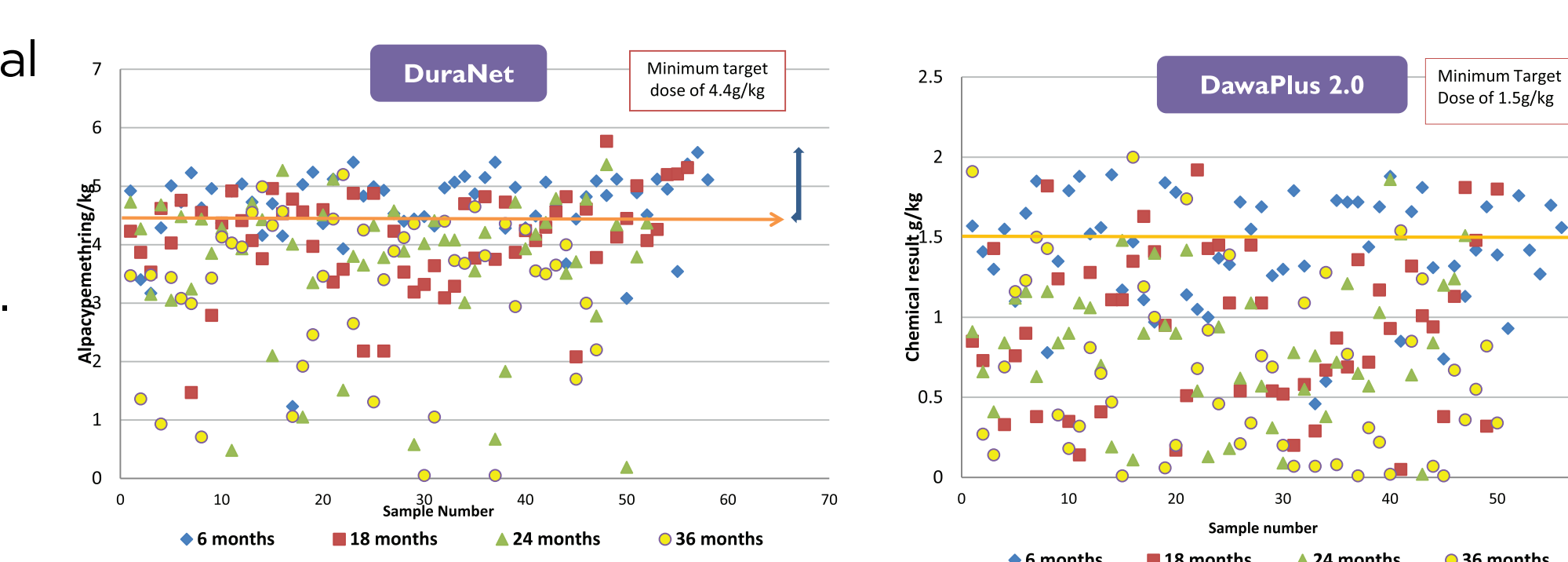
### LAB ANALYSIS: BIOASSAY ANALYSIS RESULTS

Period	LLIN Brand	Optimal Effectiveness	
		Mortality >= 80%	Optimal Effectiveness
6 months	DawaPlus 2.0	90.4%	90.4%
	DuraNet	90.6%	90.6%
18 months	DawaPlus 2.0	51.0%	51.0%
	DuraNet	98.1%	98.1%
24 months	DawaPlus 2.0	42.2%	42.2%
	DuraNet	88.5%	88.5%
36 months	DawaPlus 2.0	4.0%	4.0%
	DuraNet	85.1%	85.1%

- DuraNet showed better optimal effectiveness than DawaPlus 2.0 at all time points.
- At month 36, 4% of DawaPlus 2.0 had a significant decline from 42% at month 24 ( $p=0.001$ ).
- At month 36, the optimal effectiveness of between both nets differed significantly (85% for DuraNet vs. 4.0% for DawaPlus 2.0,  $p<.001$ ).

### LABORATORY ANALYSIS: CHEMICAL ANALYSIS RESULTS

- Results of the chemical analyses show that DawaPlus 2.0 lost chemical content quicker than DuraNet.
- Chemical content at month 36 differed significantly from month 6 baseline for the two brands:
  - 10% at endline vs. 46% at baseline for DawaPlus 2.0 ( $p<0.001$ )
  - 13% at endline vs. 78% at baseline for DuraNet ( $p<0.001$ ).



## Conclusions

- DuraNet brand had lower survivorship and seemed to physically deteriorate faster than DawaPlus 2.0.
  - However, when subjected to laboratory analysis for bioefficacy and chemical content, DuraNet performed better than DawaPlus 2.0.
- Fabric integrity continues to decline over time → reconsider reliance on ongoing serviceability of these LLINs three years after distribution.
  - Assessment findings also show that net repair behavior is limited
- Level of continued chemical content (potency) of DuraNet after 36 months → repairing serviceable nets would contribute to their continued effectiveness in malaria protection.
  - Also relevant for LLIN SBCC interventions, as well as distribution planning.
- LLIN survivorship declines over time, and may be insufficient to maintain the levels of LLIN coverage needed for programmatic impact → enhance efforts to roll out continuous distribution.
- Irrespective of sector, LLIN durability wanes over time → better washing and net repair practices could potentially extend the useful life of an LLIN.

## Key Recommendations

- Since chemical content of both net brands decreased over time and fell below threshold for minimal effectiveness dose (by month 24), reconsider the planned distribution-replacement cycle.
- Since the chemical potency of both LLIN brands is lost in less than three years, recommend further assessments to better define the effective life of an LLIN and the most appropriate replacement cycles.
- Assess the physical integrity of nets in conjunction with their chemical content to best recommend net replacement intervals
- Due to the observed high attrition rate, recommend enhancing routine net distributions after mass campaigns, to replace lost nets and those damaged beyond repair.
  - Consider implementing SBCC interventions alongside routine net distributions, for information about the utility of nets and the importance of net care.
- For future LLIN monitoring efforts, investigate whether nets reported as being used by family members still exist elsewhere and are in use.

