

Expected LLIN effective coverage years for Against Malaria Foundation (AMF) purchases including brand adjustments, 2019-2020

	Net type			
	Reference LLINs (1)	Generic LLINs (2)	FGO NetUs (3)	Other NetUs (4)
Effective coverage years for reference net (Pramethal 2.0) (5)	2.27	2.27	2.27	2.27
Adjustment to reference net coverage years (6)	0.00% (7)	-15.00% (8)	0.00% (9)	0.00% (10)
Estimated effective coverage years by brand	2.27	1.93	2.27	2.27
AMF purchase volume, 2019-2020 (11)	20,464,495	28,328,623	12,940,815	686,100
Percent of AMF purchase volume, 2019-2020	32.97%	46.55%	19.38%	1.10%
Weighted average of LLIN effective coverage years for an AMF distribution	2.11			

Comparing CTNs in trials with the PermaNet 2.0 LLIN

Case of Loss 1: Attrition	
CTNs	
Attrition over two years in nets trials	0. An assumption. It's likely that overall net coverage rates were higher in trials compared to AMP distributions. In the study that makes up the majority of the weight in the Cochrane review, attrition of originally distributed nets was low at 6% over 24 mos, but net coverage remained above AMP targets for the duration of the 2-year trial due to a high initial coverage rate and additional nets distributed over the study period. See
LLNs	
Average use years during year 1 after attrition	0.95. Rolling average of nets present at the beginning, middle, and end of the year (0, 6, 12 mos) that assumes each state persists for 1/3 of the year to approximate use over the entire year. This would need to be an integral to be fully accurate.
Average use years during year 2 after attrition	0.95. Rolling average of nets present at the beginning, middle, and end of the year (12, 18, 24 mos).
Average use years during year 3 after attrition	0.69. Rolling average of nets present at the beginning, middle, and end of the year (24, 30, 36 mos).
Case of Loss 2: Physical damage (holes)	
LLNs	
Percent of remaining net years lost due to physical damage during year 1 [12]	3.46%. Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (0, 6, 12 mos). Calculation assumes each state persists for 1/3 of the year to approximate use over the entire year. This would need to be an integral to be fully accurate.
Percent of remaining net years lost due to physical damage during year 2 [12]	19.37%. Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (12, 18, 24 mos).
Percent of remaining net years lost due to physical damage during year 3 [12]	24.52%. Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (24, 30, 36 mos).
Percent of remaining LLNs that are too torn during year 1 (after attrition)	3.30%
Percent of remaining LLNs that are too torn during year 2 (after attrition)	12.82%
Percent of remaining LLNs that are too torn during year 3 (after attrition)	23.95%
CTNs	
Reduction in physical damage over LLNs to some measure due to intensive training, monitoring, and repair	0.30. Assumption. None of the relevant RCTs of bednets reported data on holes in nets, so this input is highly uncertain. The aspect that LLNs in AMP distributions likely have more holes on average than the CTNs used in trials, because trial nets spent less time in the field and likely deteriorated more slowly due to increased training, monitoring, and repair. The benchmark physical damage to CTNs on our Veeragaard PermaNet
Percent of CTNs that are too torn during year 1 (on top of attrition)	0.02
Percent of CTNs that are too torn during year 2 (on top of attrition)	0.10
Truncated average percent of CTNs that were too torn due to physical damage during a trial year (on top of attrition)	0.05. Calculation using LLNs as a reference point.
Case of Loss 3: Insecticide Decay	
Average insecticide residual over 36 mos, LLNs	63.30%
Average insecticide residual over 36 mos, study duration, CTNs	66.70%
% difference in insecticide residual of LLN from CTN	-5.12%
Adjustment for insecticide loss [1]	0
Comparison Calculation: PermaNet 2.0 Relative Coverage Years	
Net coverage years provided by one year of participation in CTN RCT (arbitrary value)	1
Relative net coverage years of a PermaNet 2.0, year 1 [16]	0.98
Relative net coverage years of a PermaNet 2.0, year 2 [17]	0.77
Relative net coverage years of a PermaNet 2.0, year 3 [18]	0.62
Total that net equivalent coverage years over a 36-month PermaNet 2.0 distribution	2.27

Durability monitoring data for reference LLN (Vestergaard's PermaNet 2.0)

Case of Loss 1: Attrition	
Percent of LLNs surviving, 6 mos [19]	0.91 ***Data smoothed due to limited data points
Percent of LLNs surviving, 12 mos	0.84
Percent of LLNs surviving, 18 mos	0.75 ***Data smoothed due to limited data points
Percent of LLNs surviving, 24 mos	0.69
Percent of LLNs surviving, 30 mos	0.60 ***Data smoothed due to limited data points
Percent of LLNs surviving, 36 mos	0.57 ***Data corrected for our best guess of 36-month results for studies that drop out after 24 months. Fewer monitoring studies contribute results at 36 months than at 12 and 24 months post-distribution, and these 36-month long studies show substantially more nets surviving at 24 months than the studies that subsequently drop out before 36 months of monitoring. We therefore expect that these distributions would have been
Average use years during year 1 after attrition	0.92 Rolling average of nets present at the beginning, middle, and end of the year (0, 6, 12 mos) that assumes each state persists for 1/3 of the year to approximate use over the entire year. This would need to be an integral to be fully accurate.
Average use years during year 2 after attrition	0.76 Rolling average of nets present at the beginning, middle, and end of the year (12, 18, 24 mos)
Average use years during year 3 after attrition	0.62 Rolling average of nets present at the beginning, middle, and end of the year (24, 30, 36 mos)
Adjustments for nets not present that may be used elsewhere	
Of nets lost, % given away (year 1) [25]	0.9 Guess based on limited data (see call notes). A lot of people report giving nets away as the reason for loss in year 1, and this seems more likely soon after distribution.
Of nets lost, % given away (year 2)	0.5 Guess based on limited data (see call notes)
Of nets lost, % given away (year 3)	0 Rough assumption. Attrition is more likely to be due to net decay as time goes on.
Percent of nets given away that are used elsewhere [21]	0.5 Estimate - used to eliminate over-allocation and inaccurate self-reports from the count.
Adjusted average use years during year 1 after attrition	0.85
Adjusted average use years during year 2 after attrition	0.83
Adjusted average use years during year 3 after attrition	0.69
Case of Loss 2: Physical damage (holes)	
Percent too torn, 6 mos [22]	0.03 ***Data smoothed due to limited data points
Percent too torn, 12 mos	0.08
Percent too torn, 18 mos	0.16 ***Data smoothed due to limited data points
Percent too torn, 24 mos	0.22
Percent too torn, 30 mos	0.34 ***Data smoothed due to limited data points
Percent too torn, 36 mos	0.47 ***Data corrected for our best guess of 36-month results for studies that drop out after 24 months. Fewer monitoring studies contribute results at 36 months than at 12 and 24 months post-distribution, and these 36-month long studies show substantially more nets surviving at 24 months than the studies that subsequently drop out before 36 months of monitoring. We therefore expect that these distributions would have been
Percent of remaining net years lost due to physical damage during year 1	0.03 Calculation. Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (0, 6, 12 mos). Calculation assumes each state persists for 1/3 of the year to approximate use over the entire year. This would need to be an integral to be fully accurate.
Percent of remaining net years lost due to physical damage during year 2	0.15 Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (12, 18, 24 mos)
Percent of remaining net years lost due to physical damage during year 3	0.39 Rolling average of proportion of nets that are too torn at the beginning, middle, and end of the year (24, 30, 36 mos)

Correcting for less data at later monitoring points for reference LLIN (Vestergaard's PermaNet 2.0)

	% surviving	% too torn	% serviceable
All studies			
Average 6 mos post-distribution (2 studies)	50.14%	0.79%	89.43%
Average 12 mos post-distribution (8 studies)	83.82%	7.50%	77.28%
Average 18 mos post-distribution (1 study)	73.17%	10.70%	58.88%
Average 24 mos post-distribution (up to 3 studies)	68.68%	22.32%	53.35%
Average 30 mos post-distribution (2 studies)	53.87%	32.25%	36.36%
Average 36 mos post-distribution (up to 3 studies)	62.00%	24.30%	46.90%
Restricted to studies with results at 36 months			
Average 6 mos post-distribution, 36-month studies	n/a	n/a	n/a
Average 12 mos post-distribution, 36-month studies	86.42%	3.90%	83.05%
Average 18 mos post-distribution, 36-month studies	n/a	n/a	n/a
Average 24 mos post-distribution, 36-month studies	75.40%	11.44%	66.78%
Average 30 mos post-distribution, 36-month studies	n/a	n/a	n/a
Restricted to studies that drop out after 24 months			
Average 24 mos post-distribution, studies that drop out after 24 months	60.28%	33.15%	40.30%
24 mos post-distribution difference, non-36-month vs. 36-month studies	-2%	4%	-4%
24 mos post-distribution difference, overall vs. 36-month studies	-10%	4%	-2%
Change between 24 and 36 mos, 36-month studies	-15%	11%	-20%
Adjusted 36-month result			
Number of studies at 24 months	0	8	
Number of studies at 36 months	0	4	
Weight on non-36 month studies	44.44%	50.00%	
Projected results at 36 months for studies that drop out after 24 months	69.6%	29.4%	
Projected smoothed overall results at 36 months post-distribution	57%	47%	30%

Data on PermaNet 2.0 from Monitoring Studies

Distribution	Year										Average at follow-up point
	2011	2010-2013	2008-2011	2012-2014	2015-2017	2016-2019	2005-2008	2013	2017	2017	
Distribution year	2011	2010-2013	2008-2011	2012-2014	2015-2017	2016-2019	2005-2008	2013	2017	2017	
Monitoring points (months)	12, 18, 24, 30 [24], 12, 18, 24, 30 [24]	12, 24, 36 [24]	12, 24, 36 [24]	12, 24, 36 [24], 12, 24, 36 [24]	12, 24, 36 [24], 12, 24, 36 [24]	12, 24, 36 [24], 12, 24, 36 [24]	12, 24, 36 [24]	12, 24, 36 [24]	12, 24, 36 [24]	12, 24, 36 [24]	30 [24]
Sample size for PermaNet 2.0	489 [35]	500 per sector, 11	4000 [37]	5,889 in total, 1m	1440 [35]	Approx. 370 [40]	411 [41]	227 [42]	3513 [43]	270 [44]	130 inspected of 246 distributed [45]
Contributing relevant data (within and/or too term?)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	11
Adoption and pre-spread (eligible sites?)	Y	Y	N	Y	Y	Y	Y	N	Y	Y	
Other brands of nets studied	Clynet	Clynet	DawaPlus	DawaPlus	Yorbo Dawa Plus	Clynet			Clynet, NetProbes Aspirational, DawaPlus 2.0, Clynet	PermaNet 3.0, YorboNet, Royal Sentry [46]	
Survival #17											
Percent surviving, 6 mos post-distribution		n/a	n/a	0.92 [35]	0.89 [35]	0.90 [46]			0.95 [37]	0.9 [46]	95.14%
Percent surviving, 12 mos post-distribution	0.92 [35]	n/a	n/a	0.89 [35]	0.79 [34]	0.78 [35]			0.81 [36]	0.72 [36]	81.62%
Percent surviving, 18 mos post-distribution	0.72 [35]	n/a	n/a	0.77 [35]	0.47 [34]	0.73 [35]			0.63 [36]	0.72 [37]	72.17%
Percent surviving, 24 mos post-distribution	0.52 [35]	0.70 [31]	n/a	0.83 [35]	0.77 [35]	0.67 [35]			0.80 [36]	0.80 [36]	68.69%
Percent surviving, 30 mos post-distribution	0.33 [35]	n/a	n/a	0.64 [31]	0.67 [35]	0.55 [34]			0.58 [36]	0.748 [37]	53.67%
Percent surviving, 36 mos post-distribution											62.05%
Of nets lost, percent given away, 6 mos post-distribution						0.89 [35]			0.84 [37]		91.82%
Of nets lost, percent given away, 12 mos post-distribution						0.87 [35]			0.71 [36]		75.74%
Of nets lost, percent given away, 24 mos post-distribution						0.73 [35]			0.65 [36]		65.20%
Of nets lost, percent given away, 30 mos post-distribution	0.191 [35]					0.73 [35]			0.65 [36]	0.11 [31]	15.20%
Of nets lost, percent given away, 36 mos post-distribution											69.24%
Physical Integrity #8											
Some results available but skipped due to incompatible format? [35]		Y						Y			
Percent too term, 6 mos post-distribution			n/a	0.02 [36]					0.07 [37]		0.08
Percent damaged, 6 mos post-distribution			n/a	0.00 [36]					0.04 [37]		0.04
Percent too term, 12 mos post-distribution	0.10 [36]	0.22 [36]		0.08 [35]	0.08 [35]	0.01 [35]			0.05 [36]	0.13 [36]	0.07
Percent damaged, 12 mos post-distribution	0.25 [37]	0.23 [36]		0.08 [35]	0.23 [35]	0.07 [35]			0.17 [36]	0.10 [36]	0.156
Percent too term, 18 mos post-distribution	0.18		n/a	n/a							0.187
Percent damaged, 18 mos post-distribution	0.28		n/a	n/a							0.284
Percent too term, 24 mos post-distribution	0.25	0.55 [104]		0.17 [105]	0.19 [106]	0.03 [107]			0.15 [108]	0.22 [109]	0.223
Percent damaged, 24 mos post-distribution	0.38	0.37 [105]		0.19 [110]	0.32 [112]	0.12 [113]			0.35 [114]	0.30 [115]	0.289
Percent too term, 30 mos post-distribution	0.30		n/a	n/a						0.35 [116]	0.32
Percent damaged, 30 mos post-distribution	0.35		n/a	n/a						0.08 [117]	0.21
Percent too term, 36 mos post-distribution				0.25 [118]	0.04 [119]	0.32 [120]			0.21 [121]		0.24
Percent damaged, 36 mos post-distribution				0.25 [122]	0.21 [122]	0.34 [124]			0.11 [125]		0.28
Combined survival data (F2)											
Physical survival (proportion found in serviceable condition), 6 mos	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Average combine Combined average Difference
Physical survival (proportion found in serviceable condition), 12 mos				0.82	0.67	0.77	0.77		0.86	0.71	0.89
Physical survival (proportion found in serviceable condition), 18 mos				0.89	0.72	0.87	0.77		0.86	0.71	0.76
Physical survival (proportion found in serviceable condition), 24 mos				0.89	0.31	0.85	0.38		0.71	0.53	0.89
Physical survival (proportion found in serviceable condition), 30 mos				0.23		0.48			0.64	0.37	0.51
Physical survival (proportion found in serviceable condition), 36 mos											0.38
Physical survival (proportion found in serviceable condition), 36 mos											0.47
Other General Information											
				This study sample				Peer reviewed			
				*The presence of	Not peer-reviewed			Biased sampling			

Notes on qualitative and design factors in the study: Monitoring did not Heterogeneous The proportion of Nets also shows Results were var There may be so Not peer-reviewed There is data on: Not peer-reviewed Peer reviewed. Conflict between survivorship in Table 1 and lower attrition rates reported in Table 2. The paper cites 'Net displacement' as the main reason nets couldn't be found, and this may include households that moved elsewhere. Covers multiple net brands. No insecticide data

Comparison of insecticide loss in CTNs vs. LLNs in Uganda

CTNs	
Deltamethrin residual (% of original dose), 6 mos	10.00% Reading of Figure 2 in https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3212629/
Alpha-cypermethrin residual (% of original dose), 6 mos	33.00% Reading of Figure 2 in https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3212629/
Average insecticide residual in CTNs after 6 mos	33.50%
Average insecticide residual experienced during each coverage year	66.75% Average of fully treated net and residual at 6 mos. Assumes nets are re-treated every 6 mos per trial protocols
LLNs	
Insecticide residual (% of original dose) in LLNs, 12 mos	75.00% Rough average across brands reading of Figure 2 in https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3212629/
Insecticide residual (% of original dose) in LLNs, 24 mos	50.00% Rough average across brands reading of Figure 2 in https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3212629/
Insecticide residual (% of original dose) in LLNs, 36 mos	30.00% Rough average across brands reading of Figure 2 in https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3212629/ , taking into account that fewer brands were measured at this point and the ones that are measured were previously trending lower.
Average insecticide residual experienced during coverage year 1	87.50% Average of fully treated net and residual at 12 mos to obtain rough estimate of mid-year residual.
Average insecticide residual experienced during coverage year 2	62.50% Average of residual at 12 mos and residual at 24 mos to obtain rough estimate of mid-year residual.
Average insecticide residual experienced during coverage year 3	40.00% Average of residual at 24 mos and residual at 36 mos to obtain rough estimate of mid-year residual.
Comparison	
Average insecticide residual over 36 mos, LLNs	63.33%
Average insecticide residual over 24 mos, CTNs	66.75%
% Difference of LLN from CTN	-5.12%

[1] This category contains AMF's LLIN purchases that have received full product qualification from WHO based on completing a full set of mandated durability tests.

[2] This category contains AMF's LLIN purchases that have been prequalified by WHO based on manufacturing requirements and equivalency in performance to Reference LLINs in certain tests. LLINs in this group have not been tested as rigorously as Reference LLINs.

[3] This category includes enhanced ITNs containing piperonyl butoxide (PBO), in addition to standard pyrethroid insecticide treatments as found in LLINs. PBO nets are distributed in some contexts to combat high insecticide resistance.

[4] This category includes other enhanced ITNs that do not contain PBO, such as those that contain the insect growth regulator pyriproxyfen, in addition to standard pyrethroid insecticide treatments as found in LLINs.

[5] "Effective coverage years" refers to the duration for which we estimate an LLIN offers protection equivalent to conventionally-treated nets (CTNs) re-treated every 6 mos as used in trials.

[6] This factor captures our best guess of deviations in performance of other brands of nets from the PermaNet 2.0. See individual cell notes for further explanation.

[7] This category contains AMF's purchases of nets that have received full product qualification from WHO. This group includes our reference net, the Vestergaard PermaNet 2.0.

We haven't fully investigated the field performance of all of the LLIN brands in this category, but our best guess is that they would perform similarly to the PermaNet 2.0 in the field.

[8] This category includes net brands that have received product prequalification from WHO based on passing Phase I and sometimes Phase II tests, but haven't undergone Phase III field testing.

Our example net for this category is the Yorkool LN, which we estimate performs about 15% worse than the PermaNet 2.0. We calculate this value in this spreadsheet (https://docs.google.com/spreadsheets/d/1FSgCl6QEgDsl_-FwVd2jmvObh_Ko8y5_jXJo-kW4il/edit#gid=188040397&range=A54:B54) based on our interpretation of the limited field evidence available for the Yorkool LN net. We rounded this value to the nearest multiple of 5 to reflect our uncertainty about this input.

We have not researched other generic brands at the same level of depth, and we make the provisional assumption that they perform similarly to the Yorkool. Based on their generic status, we expect there to be limited supporting evidence currently available for the durability of these nets in the field, and it seems reasonable to us to apply the same moderate -15% performance penalty to them to account for this uncertainty.

[9] PBO nets are next-generation ITNs that contains piperonyl butoxide (PBO) in addition to permethrin insecticide. Our understanding is that besides the PBO component, these nets are functionally equivalent to regular LLINs with the same physical properties.

We have not yet completed an investigation of the durability of the PBO content in PBO nets, which would allow us to determine how long any additional protection conferred by the PBO lasts. We make the provisional assumption that PBO nets have equal lifespans to the PermaNet 2.0, since we expect the non-PBO components of these nets to perform the same as other LLINs.

[10] This category includes enhanced ITNs that do not contain PBO, such as those that contain the insect growth regulator pyriproxyfen.

We have not yet investigated these other types of nets as they make up a small part of AMF's purchases.

We make the provisional assumption that they have equal lifespans to the PermaNet 2.0.

[11] Source: <https://docs.google.com/spreadsheets/d/1xL2yhH3Z5MUv0iEDquNNhXuM5XxuM5McyjnePQ7t9Tvs/edit?usp=sharing>

We used AMF's recent purchases from 2018-2020 as a reference point because net types have become more varied over time, and we believe its more recent purchases may be more predictive of future purchases than its entire purchase history.

[12] Note that physical damage is assessed for surviving nets found in the household. The denominator for the proportion of nets that is too torn is therefore the number of surviving nets rather than the total number of nets originally distributed.

[13] Note that physical damage is assessed for surviving nets found in the household. The denominator for the proportion of nets that is too torn is therefore the number of surviving nets rather than the total number of nets originally distributed.

[14] Note that physical damage is assessed for surviving nets found in the household. The denominator for the proportion of nets that is too torn is therefore the number of surviving nets rather than the total number of nets originally distributed.

[15] This input is uncertain. Average insecticide residuals for LLINs and CTNs are similar over the duration of each distribution. Insecticide residuals in LLINs are probably higher on average than CTNs during the 1st year, but lower on average during the 3rd year. However, this evidence should be viewed with caution because insecticide content doesn't necessarily translate linearly into performance at inhibiting mosquito feeding/net effectiveness.

One underlying RCT, Habluetzel 1997, collected information on insecticidal activity. Measured mosquito mortality rates in bioassays were close to or exceeded the WHO optimal performance threshold at all monitoring points. "The efficacy of the netting in killing mosquitoes was assessed every 3 months by bioassay (WHO 1989). On each occasion 2500 field collected, freshly fed *Anopheles gambiae* females were exposed to 15 curtains in 5 villages and to 10 positive and negative control curtains. 1 and 3 months after the first treatment, mortality rates of 70% and 72%, respectively, were achieved. These did not differ from those obtained on freshly treated reference curtains (63% and 67%). 4 months after treatment the mortality rate increased to 96% and similarly high values (99% and 88%) were obtained 1 and 3 months after the first retreatment. Mortality rates of 85%, 96% and 97% were observed 2, 4 and 9 months after the second retreatment, confirming the high efficacy of the treatment." Habluetzel 1997, P. 857.

[16] Note that attrition and the proportion of too torn nets are calculated separately, and both need to be subtracted from the total cohort of nets originally distributed to determine the proportion of nets surviving in serviceable condition at a point in time.

[17] Note that attrition and the proportion of too torn nets are calculated separately, and both need to be subtracted from the total cohort of nets originally distributed to determine the proportion of nets surviving in serviceable condition at a point in time.

[18] Note that attrition and the proportion of too torn nets are calculated separately, and both need to be subtracted from the total cohort of nets originally distributed to determine the proportion of nets surviving in serviceable condition at a point in time.

[19] See here for inputs: https://docs.google.com/spreadsheets/d/1WdWR63BTX26bTZPN-QIWy8Xg3kQfyzOP6QzStm_NmH4/edit#gid=2119995988&range=R11:R16.

This input is based on the simple average of field monitoring data we collected from the literature on Vestergaard PermaNet 2.0 nets.

This information is aggregated from all PermaNet 2.0 monitoring surveys with relevant data on physical survival of nets that we've identified. A total of 12 studies contributed relevant data points. These data are aggregated in a rough way using a simple average of available results across each 6-month time period. However, not all surveys contribute all time periods or durability measures, so each point-in-time estimate is generally based on fewer than 12 contributing survey results.

Relatively few studies collect data in half-year increments at 6, 12, and 18 months post-distribution, so we have smoothed these values by averaging them with surrounding inputs.

[20] Largely a guess. These inputs are uncertain given limited evidence. Only three surveys contribute data on nets given away, and the estimates for the proportion given away are quite high in two of these. They're also cumulative over time. We've also chosen high inputs that fall over time, since we expect that few missing nets will be lost to wear and tear in the first year, but the proportion of nets discarded due to wear will increase considerably over time.

See here: https://docs.google.com/spreadsheets/d/1WdWR63BTX26bTZPN-QlWy8Xg3kQfyzOP6QzStm_NmH4/edit#gid=2119995988&range=P20:P22

[21] Some of the nets not found in the durability surveys may be in use elsewhere. In cases when surveys ask for self-reports about what happened to missing nets, respondents generally report that a substantial portion of missing nets was given away.

We believe that it's unlikely that all nets reported given away are actually in use, both because recipients may not want to report other causes of net loss and because other households may not need additional nets. However, it seems that net redistribution could be helpful in cases when some houses have an excess and others a shortfall.

This input accounts for the average proportion nets given away that is eventually used. The value we use here is a guess; the true value of this input is highly uncertain.

[22] Note that physical damage is assessed for surviving nets found in the household. The denominator for the proportion of nets that is too torn is therefore the number of surviving nets rather than the total number of nets originally distributed.

All inputs are the simple average across field monitoring surveys of Vestergaard PermaNet 2.0 LLINs that GiveWell has collected to date.

Relatively few studies collect data in half-year increments at 6, 12, and 18 months post-distribution, so we have smoothed these values by averaging them with surrounding inputs.

See here: https://docs.google.com/spreadsheets/d/1WdWR63BTX26bTZPN-QlWy8Xg3kQfyzOP6QzStm_NmH4/edit#gid=2119995988&range=P27:P48.

[23] NOTE: the paper doesn't explicitly mention the net brands evaluated, but the PMI database designated the polyester net studied as PermaNet 2.0.

[24] Pg 6, Table 3

[25] Nets were tagged 1 month post-distribution, and these intervals are counted starting from 1 month. So, technically follow up is at 6, 13, 19, and 25 mos.

Article reports data for the 13- and 25-month follow-ups only. See pgs 5-6, Table 2 and Table 3.

[26] Pgs 289-290, Table 1 and Table 2

[27] Pgs 5-6, Table 1 and Table 2

[28] Page 8, Table 1

[29] Pgs 29, 31, Table 12 and Table 13

[30] Pgs 29-30, Table 12 and Table 13

[31] "The study was carried out in July, 2008 [...] Distribution of PermaNet® was carried out in 2005 and 2006" Methods section.

[32] Pgs 3-4, Table 2 and Figure 1

[33] Pgs 6, 9, Table 1 and Table 3

[34] Pg 6, Table 7

[35] "A total of 999 LLINs were included in the study; 449 PermaNet and 500 Olyset nets." Pg 5

[36] Table 1 <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/1>

[37] http://www.ajtmh.org/content/journals/10.4269/ajtmh.14-0023#html_fulltext

[38] "The number of campaign nets found in the sampled houses was 5,669 in total." Pg 6

[39] "The total nets reported as received from the campaign by selected households was 1,440 LLIN." <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>

[40] I don't know how the number of nets distributed to households during the campaign was measured.

The number is not directly reported for PermaNet. Instead I take half of 739, the number of PermaNet and Dawa Plus nets distributed to households (p. 29)

[41] My understanding is that this is the number of nets distributed to households during the campaign, but the document is difficult to read. I don't know how this was measured.

Table 12, p 29. Unguja is the location where PermaNets were distributed.

[42] Table 1. Number of nets received in distribution (self-report)

[43] I do not understand the denominators used in Table 2. I do not understand why the n changes across time periods. If n is meant to be the number of nets (of any brand) still found at that date, I don't understand why n=8,269 at 10 months corresponds to attrition rates of less than 10%, because it should be $1 - 8269/10571 = 21\%$ according to my reckoning.

The text says: "A total of 3,393 households were randomised to which 10,571 nets were distributed (3,520 Olyset (33%), 3,513 PermaNet 2.0 (33%) and 3,538 NetProtect (33%))." Results section.

[44] "270 LLINs of each type were freely distributed in Zagnanado, at a rate of 30 LLINs per type per village."

[45] Table 2.

[46] "Each one of the selected households received one of the seven LLIN products: Aspirational®, DawaPlus® 2.0, OlysetNet®, PermaNet® 2.0, PermaNet® 3.0, Royal Sentry® and Yorkool®."

[47] This value is generally expressed as (number of nets found in the household at time X)/(number of nets originally distributed). Sometimes the number of nets distributed households is estimated by the number of

nets found in households soon after distribution or nets reportedly received by households.

[48] Total of Nets Still in Cohort, Table 2, p. 12. <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>

[49] 'Survivorship', Table 1, <https://link.springer.com/article/10.1186/s12936-020-3138-7/tables/1>.

May include households that moved or could not otherwise be located.

[50] This study didn't enroll nets until 12 mos after distribution, so no attrition is tracked up to this point.

[51] Average of all cell results for the polyester net. Table 3, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/3>

[52] 2009, Table 1, <http://www.ajtmh.org/content/table/10.4269/ajtmh.14-0023.T1?fmt=ahah&fullscreen=true>

NOTE: results are for PermaNet and Olyset combined. The paper reports that there was not a significant difference in survival between brands.

[53] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. 'Serviceable' nets are defined as the sum of nets in damaged but acceptable condition and those in good condition. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[54] A large number of households were lost to follow-up in this study. The attrition numbers are adjusted for the missing households and should be interpreted as attrition rates among households with follow-up.

Total of Nets Still in Cohort, Table 2, p. 12. <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>

[55] Attrition, Table 12, p. 29

[56] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[57] Table 2, Percentage attrition. Note that this value may not include nets given away.

[58] 'Survivorship', Table 1, <https://link.springer.com/article/10.1186/s12936-020-3138-7/tables/1>

May include households that moved or could not otherwise be located.

[59] NOTE: This attrition data is poor. Results are for PermaNet and Olyset nets combined, and they use 12 mos rather than at time of distribution as the basis.

Source: Table 4, ratio of number of nets surviving in each time period to number enrolled at 12 mos.

[60] NOTE: This attrition data is poor. Results are for PermaNet and Olyset nets combined, and they use 12 mos rather than at time of distribution as the basis.

Source: Table 4, ratio of number of nets surviving in each time period to number enrolled at 12 mos.

[61] Average of all cell results for the polyester net. Table 3, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/3>

[62] 2010, Table 1, <http://www.ajtmh.org/content/table/10.4269/ajtmh.14-0023.T1?fmt=ahah&fullscreen=true>

NOTE: results are for PermaNet and Olyset combined. The paper reports that there was not a significant difference in survival between brands.

[63] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. 'Serviceable' nets are defined as the sum of nets in damaged but acceptable condition and those in good condition. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[64] A large number of households were lost to follow-up in this study. The attrition numbers are adjusted for the missing households and should be interpreted as attrition rates among households with follow-up.

Total of Nets Still in Cohort, Table 2, p. 12. <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>

[65] Attrition, Table 12, p. 29

[66] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[67] Table 1

[68] Table 2, Percentage attrition. Note that this value may not include nets given away.

[69] NOTE: This attrition data is poor. Results are for PermaNet and Olyset nets combined, and they use 12 mos rather than at time of distribution as the basis.

Source: Table 4, ratio of number of nets surviving in each time period to number enrolled at 12 mos.

[70] A total of 246 LLINs were supplied to 130 selected holdings. After 30 months of distribution, 74.8% (n = 184) nets were physically present, whereas 25.2% (n = 62) nets were lost.

[71] 2011, Table 1, <http://www.ajtmh.org/content/table/10.4269/ajtmh.14-0023.T1?fmt=ahah&fullscreen=true>

NOTE: results are for PermaNet and Olyset combined. The paper reports that there was not a significant difference in survival between brands.

[72] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. 'Serviceable' nets are defined as the sum of nets in damaged but acceptable condition and those in good condition. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[73] Attrition, Table 12, p. 29

[74] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[75] Table 2, Percentage attrition. Note that this value may not include nets given away.

[76] Attrition, Table 12, p. 29

[77] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[78] Attrition, Table 12, p. 29

[79] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[80] Sum of the % of nets given away, stolen, and used in another location among nets lost. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-016-1154-4/tables/2>

[81] "After 30 months of distribution, 74.8% (n = 184) nets were physically present, whereas 25.2% (n = 62) nets were lost. The reasons for net losses were: disposal of nets due to wear and tear (19.1%), sold/stolen or given away (2.85%) and used for other purpose (3.25%). "

[82] Attrition, Table 12, p. 29

[83] Attrition, Table 12, p. 29
(The Unguja location is where PermaNet nets were distributed).

[84] These values are generally expressed as (number of nets meeting pHI condition category at time X)/ (number of nets surviving at time X).

The WHO proportionate hole index (pHI) rating system is as follows:

Good: $pHI \leq 64$

Damaged: $64 < pHI \leq 642$

Too torn: $642 < pHI$

[85] Some studies collect some data on holes in nets, but don't present pHI values or share of nets meeting formal definitions of physical condition.

[86] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[87] 'n (%) of nets in pHI > 642 'needs ('replacement' category)' divided by Tagged LLINs found at T6, Table 3, <https://link.springer.com/article/10.1186/s12936-020-3138-7/tables/3>

[88] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[89] All inputs in this section are from Table 4, results for "all nets". <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-016-1154-4/tables/4>

NOTE: pHI results are for PermaNet + Olyset nets in this study. There wasn't a statistically significant difference between net brands.

[90] Average of "Replace" category across all cells for the polyester net. Table 4, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/4>.

[91] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[92] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[93] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[94] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[95] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[96] n (%) of nets in pHI > 642 'needs ('replacement' category)' divided by Tagged LLINs found at T6, Table 3, <https://link.springer.com/article/10.1186/s12936-020-3138-7/tables/3>

[97] All inputs in this section are from Table 4, results for "all nets". <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-016-1154-4/tables/4>

NOTE: pHI results are for PermaNet + Olyset nets in this study. There wasn't a statistically significant difference between net brands.

[98] Average of "Serviceable" category across all cells for the polyester net. Table 4, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/4>.

[99] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[100] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[101] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[102] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[103] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[104] Average of "Replace" category across all cells for the polyester net. Table 4, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/4>.

[105] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[106] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[107] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[108] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[109] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[110] Average of "Serviceable" category across all cells for the polyester net. Table 4, <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-13-344/tables/4>.

[111] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[112] Average of all districts in Table 7, <https://www.pmi.gov/docs/default-source/default-document-library/pmi-reports/durability-monitoring-of-llin-in-madagascar-final-report-after-24-months-follow-up-2017.pdf?sfvrsn=4>.

[113] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[114] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[115] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[116] "Based on the pHI score, 74 (57%) nets were found 'good' (pHI is ≤ 64), 10 (8%) nets were in 'serviceable' condition (pHI is ≤ 642) and 45 (35%) nets were too torn and hence classified as having replaceable condition (pHI is > 642) (Table 6)."

[117] "Based on the pHI score, 74 (57%) nets were found 'good' (pHI is ≤ 64), 10 (8%) nets were in 'serviceable' condition (pHI is ≤ 642) and 45 (35%) nets were too torn and hence classified as having replaceable condition (pHI is > 642) (Table 6)."

[118] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[119] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[120] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[121] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[122] Average of results for Zamfara and Nasarawa states, which both received PermaNet 2.0 nets. Table 2, <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-015-0640-4/tables/2>.

[123] Physical condition (integrity) of surviving cohort nets, Table 13, p. 31

[124] Physical condition (integrity) of surviving cohort nets, Table 13, p. 30. The Unguja location is where PermaNet nets were distributed.

[125] This is an approximate figure, read off figure 1 (the relevant data are not provided in a table format).

[126] The calculations in this section differ from WHO durability monitoring protocols in that they include nets that households report are missing due to being given away in attrition. We adjust for the proportion of nets given away that we expect to have survived elsewhere on this sheet: https://docs.google.com/spreadsheets/d/1OzTick_Ua6KS8WM0ftLTRzGZd6tGePvUndCVX2tOx7M/edit#gid=175902001&range=A1.

[127] Table 1 and Abstract

[128] "After two years, an estimated 77% of the remaining LLINs in the peri-urban sites (Cyimo and Rusheshe) versus 49% of the LLINs in the rural sites (Bungwe, Bushenya, Rutabo, and Burima) fell into the 'replace' category. However, of greater interest than site specific differences in integrity, was the fact that after two years, an estimated 47% to as many as 90% of remaining LLINs fell into the 'replacement' category."

[129] "The tracking of the PermaNet 2.0 brand for the three rounds of data collection was made possible due to tagging of selected nets as baseline."