TROPICAL HEALTH

How many nets are needed to ~~reach~~ maintain universal coverage

Hannah Koenker, 8 May 2023

Introduction

ITNs are not lasting as long as expected - most countries have an estimated retention time of less than 3 years

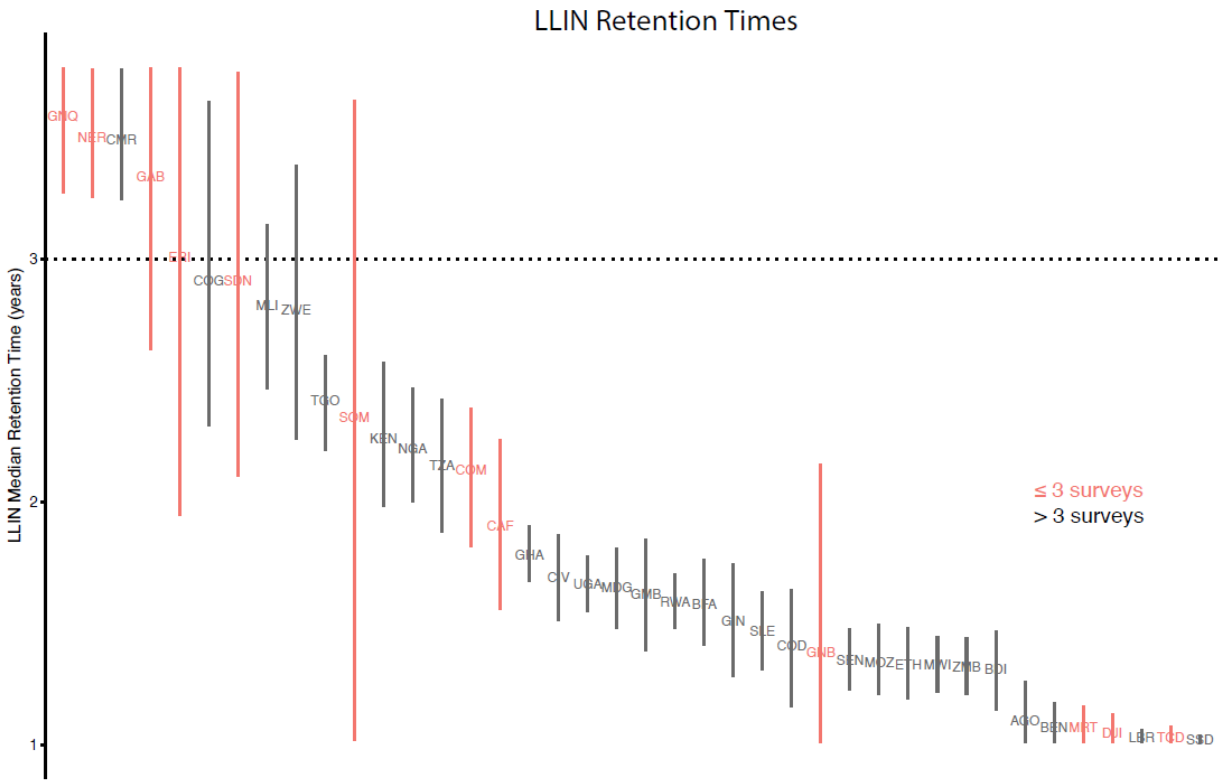
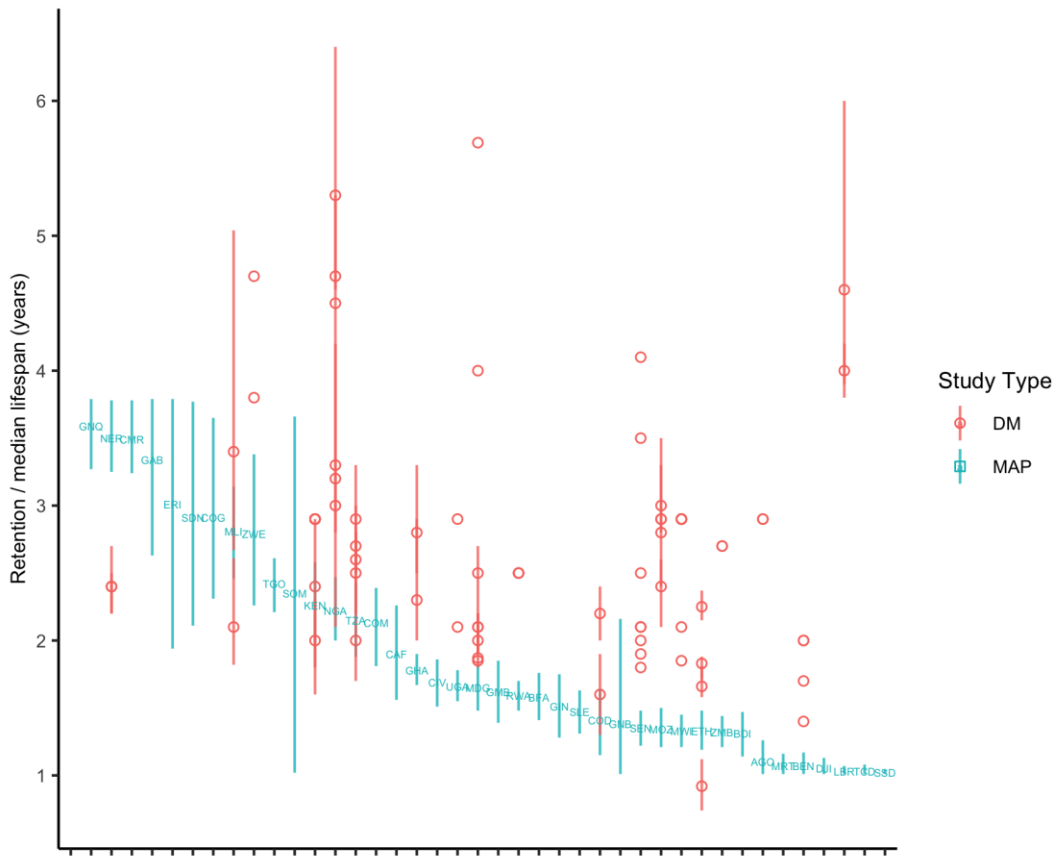


Figure 5: LLIN median retention times. Stock-and-flow estimates of median long lasting insecticide-treated net (LLIN) retention time by country, ordered from highest to lowest. Countries are labeled by ISO3 code. Vertical bars indicate 95% confidence interval width. Countries with fewer surveys have less stable model fits (see Appendix); those having fewer than three surveys are indicated in red. The lower bound of this parameter was capped at one year.

Bertozzi-Villa et al, 2021



Net lifespans in durability monitoring vs modeled retention times

Is it time to revisit population / 1.8 given what we've learned about ITN durability?

- The quantifier 1.8 was initially selected to account for the 47-59% of households who have an odd number of household members, reflecting the need to round up in these cases.
- Kilian et al originally recommended dividing by 1.6, in order to accommodate distribution challenges including outdated census information and the need to preposition full bales of nets rather than precisely subdividing them.
- In practice, WHO recommends "population divided by 1.8", and allows a buffer of up to 10% when the previous census is over 5 years old.

Key Questions

1. We do three-year campaigns, but nets last only 2 years - what does this mean for ITN access and protection?
2. In these cases should we switch to 2-year campaigns, switch to continuous distribution, or something else?
3. Should we do something different than population/1.8 for 3-year campaigns?
4. What quantification factor(s) can we recommend for campaigns and for continuous distribution, tailored to countries?

Continuous distribution needs an “easy” quantification approach

- We have no easy “population divided by X” quantifier for continuous distribution.
- Routine distribution to pregnant women and infants is already “easy”, as these populations are a) relatively consistent at around 4-5% and 4% of the population, respectively, and b) attendance rates at antenatal care visits (ANC) and immunization visits (EPI) are generally well-monitored through HMIS.
- Lack of an “easy” and serviceable quantification approach for CD has made it hard for countries to try out and scale up continuous distribution!

Objective

- What can we recommend as a good quantifier for each country to achieve its ITN access targets, either with campaigns or CD?

Methods

Projections of future coverage

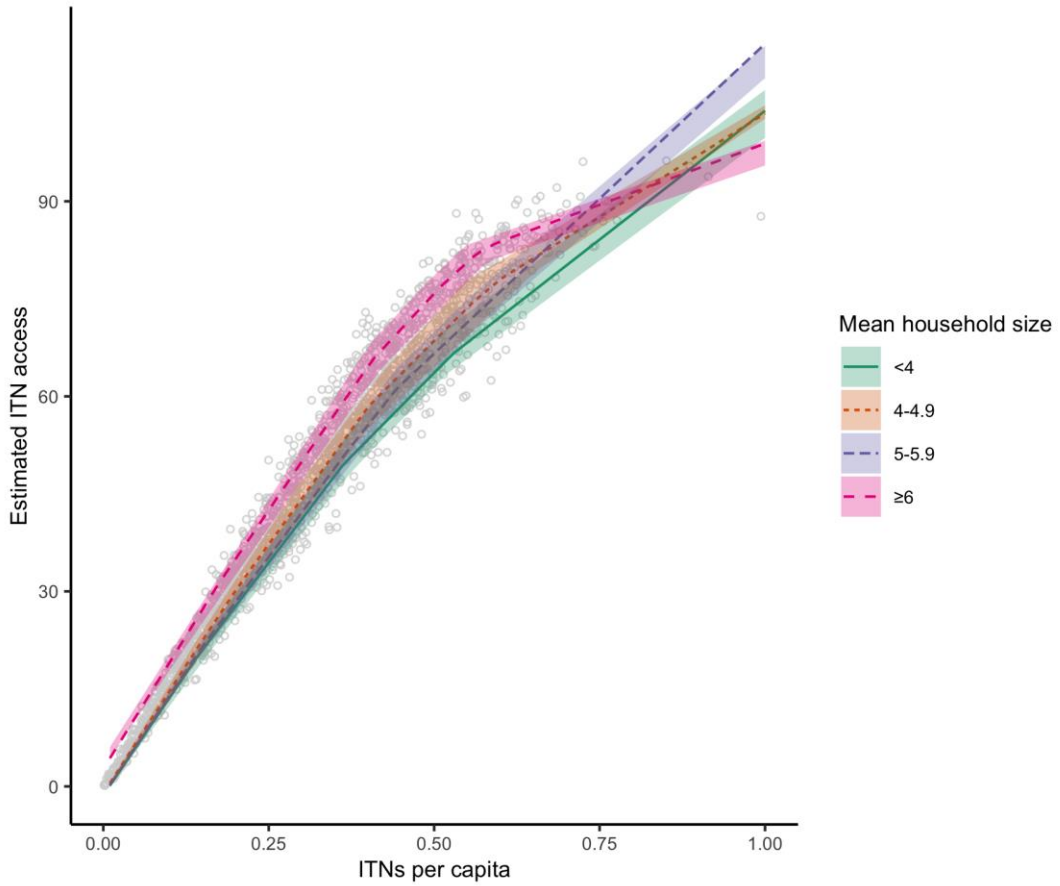
Scenario	Mass Campaign	ANC/EPI (routine)	Annual school/ community	Number of different models per scenario
1. “Status quo”	In 2022, 2025, 2028, 2031, 2034 at population / 1.8	2020-2035, varying from population x 5% to population x 7%	None	3
2. “Full-scale continuous”	In 2020, to establish high coverage at population / 1.8	2020-2035 using population x 6%	2022-2032 varying the CD quantifier from population x 0% to population x 50%	51
3. “Mass plus continuous”	In 2022, 2025, 2028, 2031, 2034 at population / 1.8	2020-2035 using population x 6%	Only in years between campaigns, varying the CD quantifier from population x 0% to population x 40%	41
4. “Varying 3-year mass”	In 2022, 2025, 2028, 2031, 2034, varying from population / 0.1-2.0	2020-2035 using population x 6%	None	20
5. “Varying 2-year mass”	In 2022, 2024, 2026, 2028, 2030, 2032, 2034 varying from population / 0.5-2.0	2020-2035 using population x 6%	None	16
			Total models	131

Note: ANC: antenatal care; EPI: expanded program on immunization; CD: continuous distribution

Distribution Scenarios and their ITN inputs

Estimating ITN access from net distributions and population

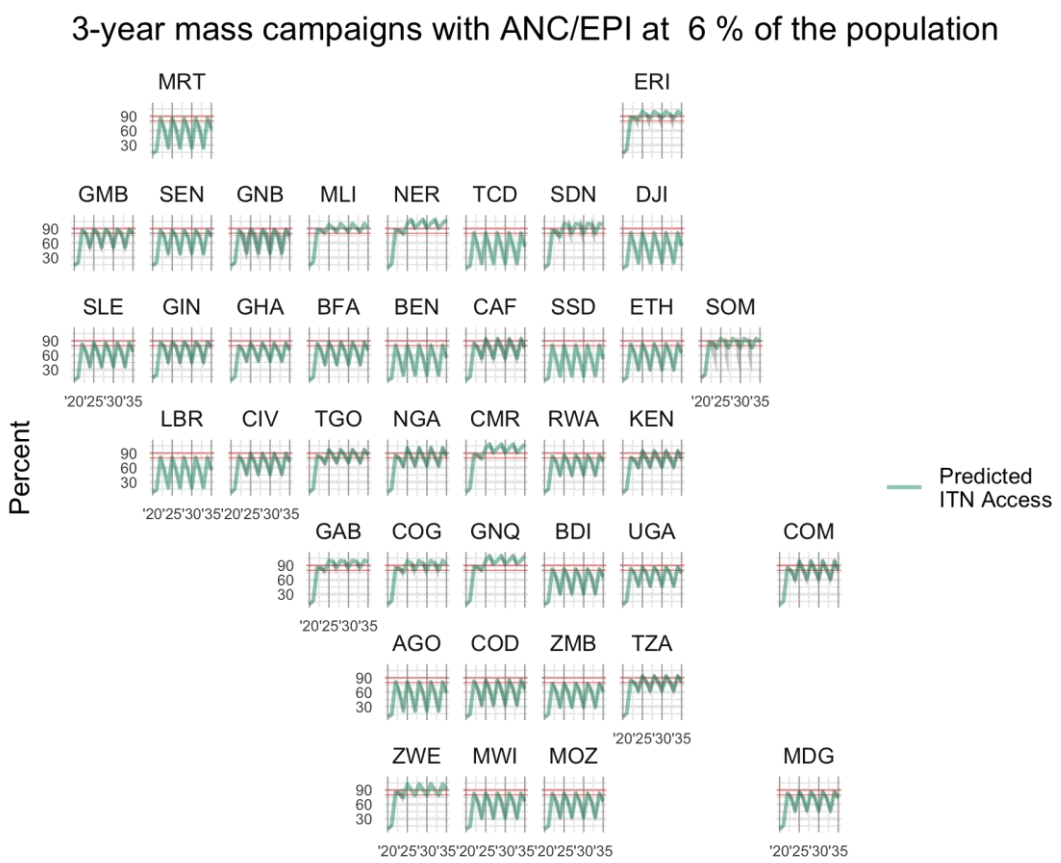
1. Deliver nets within the model based on the specific scenario
2. Each year's "crop" of nets are then decayed according to their country-specific lifespan
3. We then can calculate total nets per capita each year (any delivered + remaining ITNs from previous years)
4. From there we can convert nets per capita into ITN access (function at right)
   - important differences due to average household size



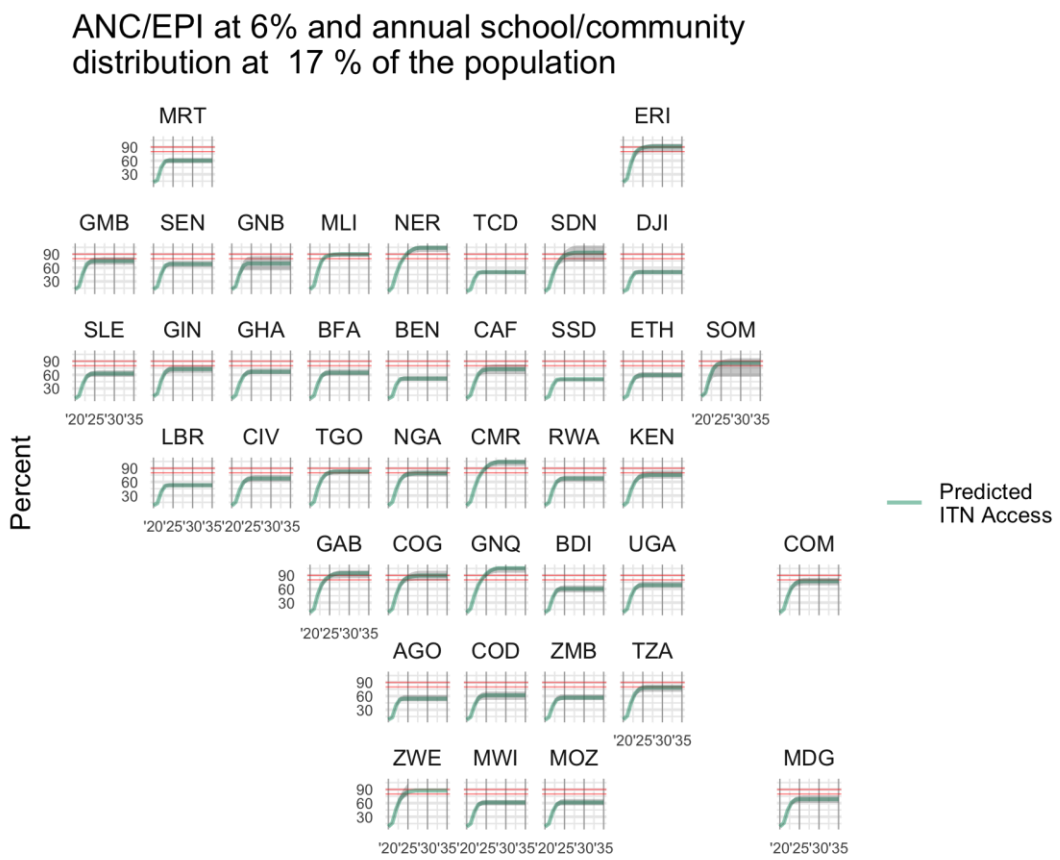
Converting nets per capita into ITN access

Results

ITN access for Scenario 1 & 2

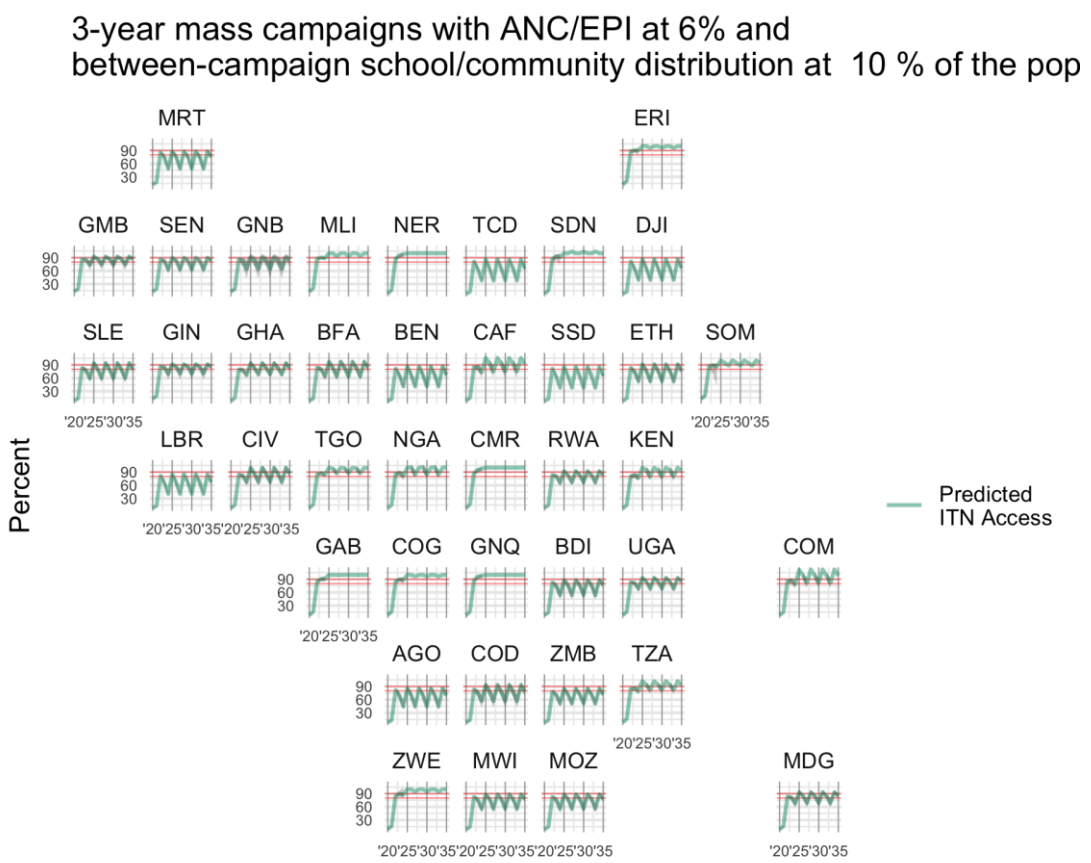


ITN access estimated for three-year mass campaign strategy, with ANC/EPI distribution at 6% of the population annually

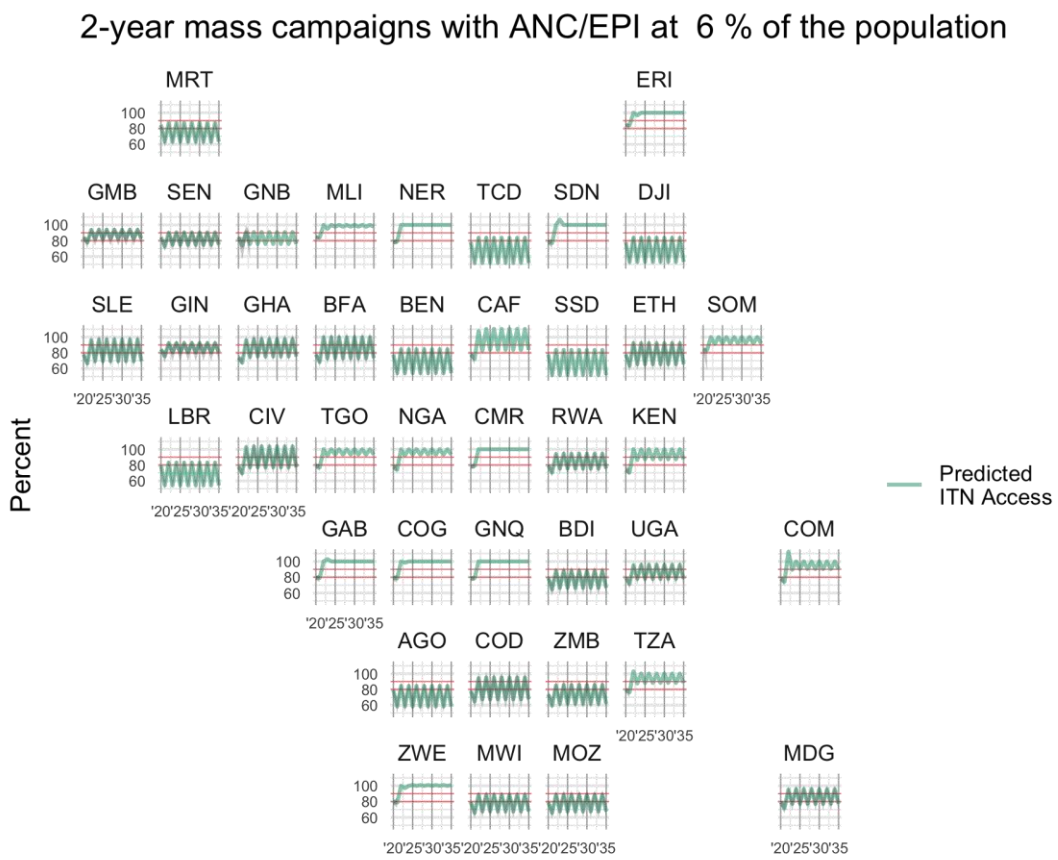


Estimated ITN access with annual ANC/EPI at 6% and full continuous distribution strategy at 17% of the population in nets each year

ITN access for Scenario 3 & 6



ITN access estimated for three-year mass campaign strategy, with ANC/EPI distribution at 6% of the population annually and CD between campaigns at population x 10%



Estimated ITN access for two-year campaigns (pop/1.8) with annual ANC/EPI at 6%

We are not distributing enough nets to maintain ITN access at 80%

- ANC-EPI distribution does not make a big difference in overall ITN access - but it's nonetheless crucial to protect vulnerable pregnant women and infants
- Retention times for ITNs are the key driver of differences in access between countries. Average household size also plays a (lesser) role.

Recommended quantification approach for continuous distribution strategies

- From the model results, we identify the "population x X%" quantifier" that achieves the target level of ITN access for the fewest ITNs.
- All scenarios assume that ANC and EPI delivery of ITNs is ongoing and provides nets to 6% of the population.
- However, quantifiers listed in the table represent only the continuous distribution channel

Minimum quantifier (population x quantifier, annually) to sustain ITN access at or above specified target level

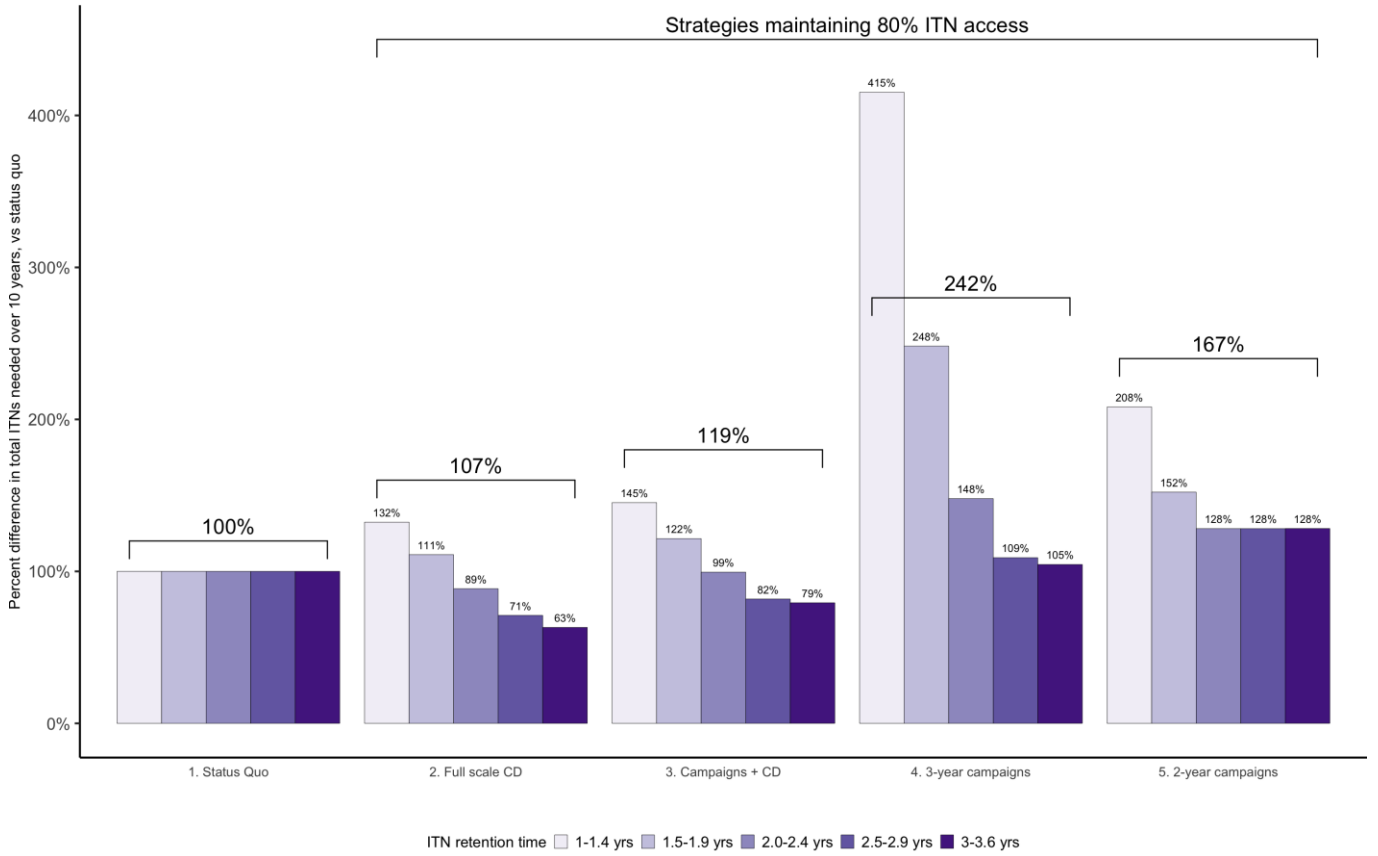
		Scenario 2 (full continuous distribution strategy)			Scenario 3 (continuous distribution between mass campaigns)		
		Targeted ITN access level:					
Country Code	Retention time (years)	70%	80%	90%	70%	80%	90%
LBR	1.0	28%	36%	46%	27%	35%	
GIN	1.5	19%	25%	38%	11%	16%	29%
TZA	2.1	16%	21%	27%	4%	11%	20%
TGO	2.4	14%	19%	25%	1%	8%	16%
COG	2.9	11%	15%	20%	0%	4%	15%
CMR	3.5	10%	13%	15%	0%	1%	9%

Note: Liberia has a blank value for Scenario 3 at the 90% ITN access target because the target level is not achievable in the model; it would require a quantifier greater than 40%

Recommended quantification factors for countries and scenarios

		Continuous Distribution ITNs = Population x X, annually		Mass Campaign ITNs = Population / X	
Country	Retention time (years)	Scenario 2: Full-scale continuous + routine	Scenario 3: Campaign + routine + continuous between campaigns	Scenario 4: Three-yearly campaigns	Scenario 5: Two-yearly campaigns
LBR	1.0	36%	35%		0.9
GIN	1.5	25%	16%	0.6	1.8
TZA	2.1	21%	11%	1.0	2.0
TGO	2.4	19%	8%	1.2	2.0
COG	2.9	15%	4%	1.5	2.0
CMR	3.5	13%	1%	1.7	2.0

How many nets are needed under the recommended scenarios?



Percent difference in total nets needed over 10 years, by scenario and ITN retention time

Discussion

Takeaways

1. Three-year campaigns are not achieving 80% ITN access and provide incomplete protection for countries with median ITN lifespans <3 years (most countries!)
2. To maintain high ITN access (>80%) with three-year mass campaigns, a lot more nets are needed at the time of the campaign (oversupply) so that households have other nets to use when the first ones wear out.
3. Full scale continuous distribution of nets could provide continuous ITN access at 80% or higher, with fewer nets compared to three-year campaigns campaigns, **for countries with ITN retention times of at least 2 years**
4. Tailored two-year campaigns are super inefficient, and would require 67% more nets than status quo with similar coverage outcomes.
5. Many countries still need more ITNs than we are currently procuring, if they want to reach 80% ITN access

How accurate are the retention times used in the analysis?

- All of these results hinge on the estimated retention times.
- ITN durability studies typically find longer median net lifespans compared to the MAP retention times
  - Liberia's retention time was estimated at 1.0 years, but an ITN durability study completed in 2021 observed a median survival in serviceable condition of 4 years.
  - Durability also varies within a country (Nigeria etc).
  - Programmes must consider potential differences in net retention behavior and net durability as they weigh their quantification decisions.
- Working on a matrix for each country showing quantifier needed at different net lifespans (e.g. if nets lasted 2, 2.5, 3 years)

What about making nets last longer?

- More durable nets would help
- Improved net care behaviors would also help
- Might not solve the whole problem though, since ITNs are fragile, and environments are tough

photo by Lars Plougmann

What about ITN use?

- This analysis uses a target of 80% population ITN access, but for ITN use levels to reach 80%, ITN access must be at least 90%
- Targeting ITN access at 80% will max out ITN use around 70% or lower.
- Donors and programmes must therefore evaluate what target levels of ITN use are necessary for success, and adjust ITN access targets upwards accordingly.

Limitations

1. Retention times for certain countries are based on a limited number of surveys. We account for the uncertainty of these estimates in the calculations of ITN access.
2. Localized durability monitoring studies sometimes find significantly longer median survival of ITNs than the retention times estimates, which could indicate subnational differences in ITN longevity or be evidence of analytical challenges in the ITN retention times or conversely, Hawthorne effect in the durability monitoring studies.
3. The relationship between nets-per-capita and ITN access is assumed to be consistent regardless of ITN distribution strategy, but it could be influenced by oversaturation of ITNs in certain types of households, as occurs with school distribution of ITNs.
4. Retention behavior is influenced by net availability (or lack thereof); with increasing availability of nets, households could be disincentivized to take care of their nets for longer, if new nets are readily available.
5. ANC and EPI performance may not be reaching 6% of the population if there are frequent stockouts, etc; this would have an overall small effect on ITN access.

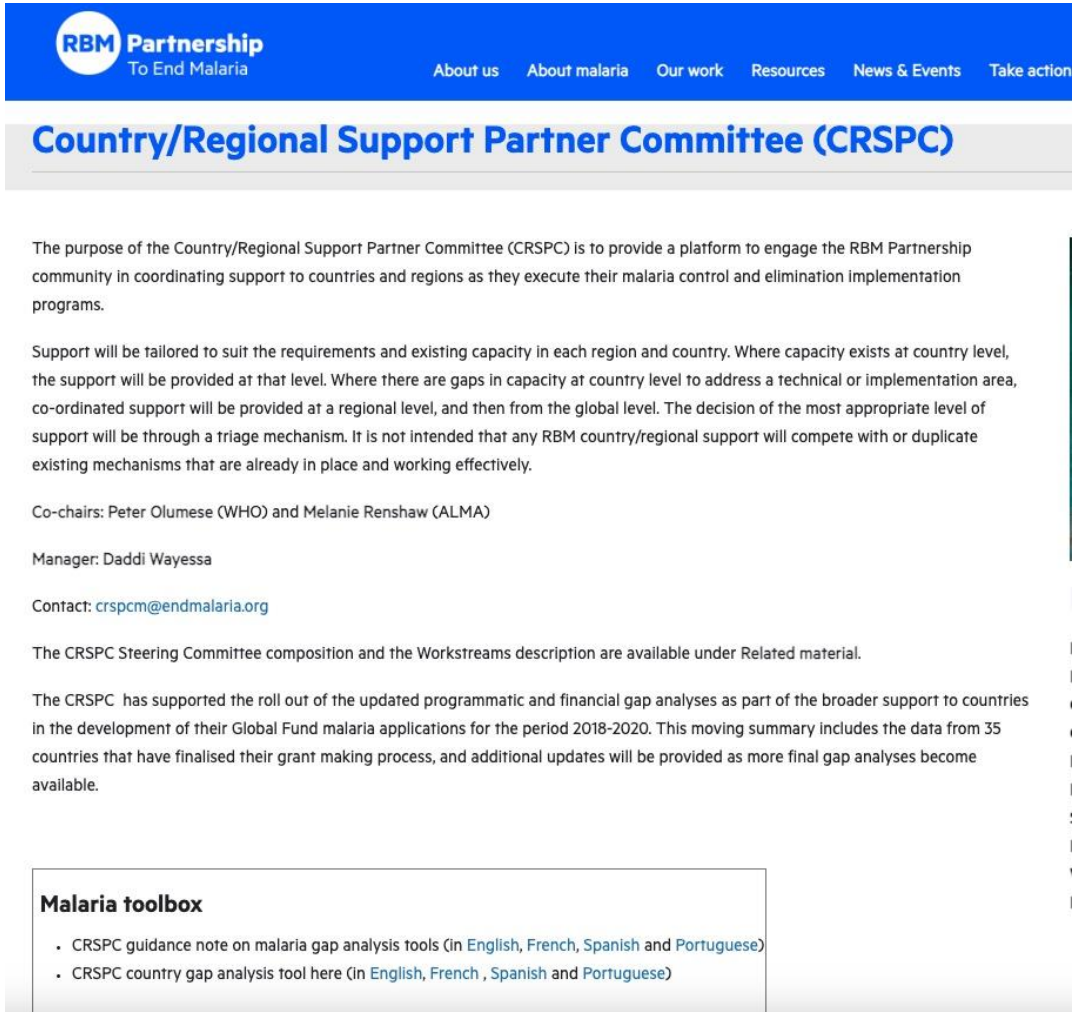
Conclusion

- Given variation in ITN retention times across countries, tailored quantification approaches for mass campaigns and continuous distribution strategies are warranted.
- Continuous distribution strategies are projected to provide better ITN access with fewer ITNs than currently procured for mass campaigns, in countries where ITN retention time is at least 2 years
- To reach target levels of ITN use of 80% of the population, ITN access must be maintained near 90% in most settings.
- National programmes and their funding partners should work to increase the number of ITNs distributed to those vulnerable to malaria, while at the same time working to extend the useful life of these critical commodities.

So What?

How to use these results

- Quantification guidance is part of the https://endmalaria.org/about-us-governance-partner-committees/countryregional-support-partner-committee-crspc



RBM Partnership To End Malaria

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Country/Regional Support Partner Committee (CRSPC)

The purpose of the Country/Regional Support Partner Committee (CRSPC) is to provide a platform to engage the RBM Partnership community in coordinating support to countries and regions as they execute their malaria control and elimination implementation programs.

Support will be tailored to suit the requirements and existing capacity in each region and country. Where capacity exists at country level, the support will be provided at that level. Where there are gaps in capacity at country level to address a technical or implementation area, co-ordinated support will be provided at a regional level, and then from the global level. The decision of the most appropriate level of support will be through a triage mechanism. It is not intended that any RBM country/regional support will compete with or duplicate existing mechanisms that are already in place and working effectively.

Co-chairs: Peter Olumese (WHO) and Melanie Renshaw (ALMA)

Manager: Daddi Wayessa

Contact: crspcm@endmalaria.org

The CRSPC Steering Committee composition and the Workstreams description are available under Related material.

The CRSPC has supported the roll out of the updated programmatic and financial gap analyses as part of the broader support to countries in the development of their Global Fund malaria applications for the period 2018-2020. This moving summary includes the data from 35 countries that have finalised their grant making process, and additional updates will be provided as more final gap analyses become available.

Malaria toolbox

- CRSPC guidance note on malaria gap analysis tools (in English, French, Spanish and Portuguese)
- CRSPC country gap analysis tool here (in English, French , Spanish and Portuguese)

CRSPC Guidance Note

- For countries where the census is greater than 5 years old, consider including a 10% buffer, or use data from previous campaigns to justify a buffer amount. Remember to include the date of the census and any underlying assumptions.

4. Continuous Distribution
   - WHO and the RBM Partnership recommend nets are also distributed through continuous distribution channels to maintain coverage between campaigns including schools, health facilities (distribution through ANC on first visit by pregnant women and to infants through routine EPI, usually alongside DPT3 or measles vaccination), communities (through community health workers) and others to ensure ITN access among specific population groups such as IDPs and refugees.
   - For full scale school distribution (instead of mass campaigns), the annual ITN need can be quantified by using 15%-22% of the population (with more detailed recommendations for specific countries available here in the Scenario 2 section). For school distribution between campaigns, quantification recommendations are available at the same link above, in the Scenario 3 section. The resulting number of ITNs should then be compared to the primary-school population and numbers of enrolled students in the various grades, using enrollment data from the Ministry of Education. Select the number of grades that best matches the numbers of ITNs to be distributed in schools. As enrollment rates can vary throughout the country, it's possible that some regions may need to use more grades to deliver the ITNs than other regions. If up-to-date enrollment information is not available in time for the planning process, the previous year's enrollment data can be used as a best estimate. In this case, a small (~2%, or calculated based on fluctuations in enrollment in previous years) buffer stock of ITNs can be delivered to each school to ensure all pupils in targeted grades receive an ITN.

     Note: Ensure that all assumptions for school-based distribution are well-described in the gap analysis table assumption section, including choice of grades, frequency and type of ITN.

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Full table for continuous distribution scenarios and their quantifiers

- Link to full table

Recommended annual quantifiers for continuous distribution channels. All scenarios assume that ANC and EPI delivery of ITNs is ongoing and provides nets to 6% of the population. However, quantifiers listed in the table represent only the continuous distribution channel, e.g. Angola would require both ANC/EPI distribution as well as continuous distribution quantified using population x 27% to maintain ITN access at levels of 70%.

Minimum quantifier (population x quantifier, annually) to sustain ITN access at or above specified target level							
		Scenario 2 (full continuous distribution strategy)			Scenario 3 (continuous distribution between mass campaigns)		
		Targeted ITN access level:					
Country Code	Retention time (years)	70%	80%	90%	70%	80%	90%
DJI	1.0	29%	37%	43%	27%	35%	37%
LBR	1.0	28%	36%	46%	27%	35%	
SSD	1.0	30%	37%	44%	28%	36%	38%
TCD	1.0	30%	37%	44%	28%	35%	38%
AGO	1.1	27%	35%	45%	25%	32%	39%
BEN	1.1	29%	36%	43%	27%	34%	40%
MRT	1.1	23%	30%	44%	21%	27%	38%
BDI	1.3	25%	32%	41%	19%	26%	36%
ETH	1.3	26%	33%	39%	20%	27%	27%
MWI	1.3	25%	32%	41%	19%	26%	35%
MOZ	1.3	25%	32%	41%	18%	26%	35%
ZMB	1.3	29%	36%	44%	23%	30%	38%
COD	1.4	25%	32%	38%	18%	24%	25%
GNB	1.4	20%	26%	39%	13%	19%	32%
SEN	1.4	20%	26%	40%	14%	20%	33%
GIN	1.5	19%	25%	38%	11%	16%	29%
SLE	1.5	25%	31%	32%	17%	23%	24%
BFA	1.6	24%	26%	31%	14%	21%	39%
GMB	1.6	19%	24%	37%	8%	14%	27%
MDG	1.6	22%	29%	32%	12%	19%	27%
RWA	1.6	23%	30%	38%	13%	20%	28%
CIV	1.7	23%	25%	29%	12%	18%	38%
UGA	1.7	22%	29%	32%	12%	18%	27%
GHA	1.8	21%	26%	32%	13%	20%	28%
CAF	1.9	18%	23%	27%	9%	15%	34%
COM	2.1	17%	21%	25%	6%	10%	38%
TZA	2.1	16%	21%	27%	4%	11%	20%
NGA	2.2	16%	21%	25%	4%	9%	37%
KEN	2.3	18%	23%	28%	6%	13%	20%
SOM	2.4	12%	16%	25%	0%	4%	15%
TGO	2.4	14%	19%	25%	1%	8%	16%
MLI	2.8	10%	14%	23%	0%	0%	11%
ZWE	2.8	13%	18%	20%	0%	5%	12%
COG	2.9	11%	15%	20%	0%	4%	15%
SDN	2.9	12%	15%	19%	0%	1%	32%
ERI	3.0	8%	14%	22%	0%	0%	10%
GAB	3.3	10%	14%	18%	0%	1%	10%
CMR	3.5	10%	13%	15%	0%	1%	9%
NER	3.5	10%	13%	15%	0%	1%	9%
GNQ	3.6	10%	12%	15%	0%	1%	8%

Recommended annual quantifiers for continuous distribution channels. All scenarios assume that ANC and EPI delivery of ITNs is ongoing and provides nets to 6% of the population

Thank you!