amp | The Alliance for Malaria Prevention

EXPANDING THE OWNERSHIP AND USE OF MOSQUITO NETS

Choosing tools and methods for post-campaign assessment of ITN coverage, access and use

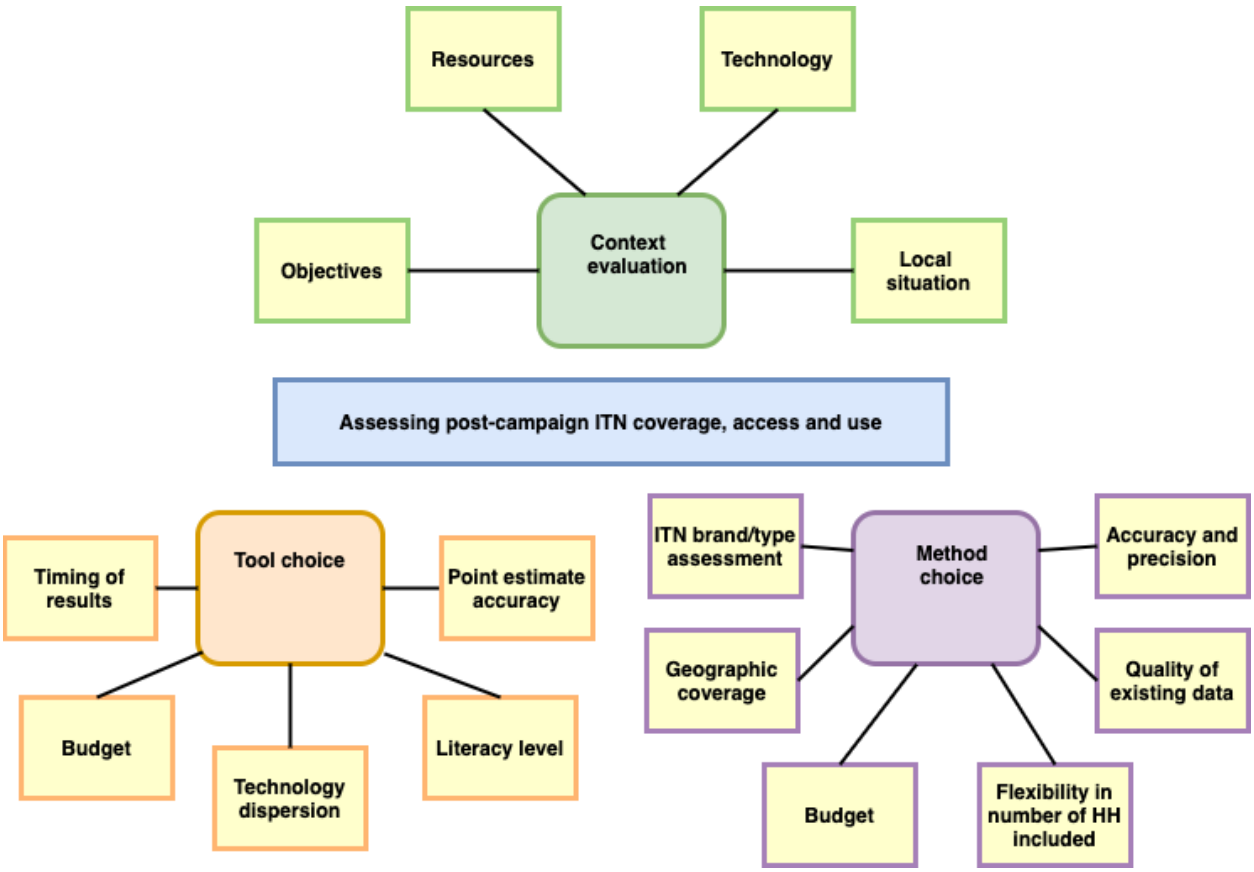
June 2021

Background

While insecticide-treated net (ITN) access and use are generally assessed every two to three years in malaria-endemic countries through national population surveys like the Demographic and Health Survey (DHS), Malaria Indicator Survey (MIS) and Multiple Indicator Cluster Survey (MICS), national programmes may still desire data on campaign performance to inform planning or demonstrate results to donors. This is especially true when household surveys will be conducted more than one year after a campaign, or funding or security issues indicate a substantial risk that the survey will not take place at all.

This document will guide national malaria programmes and their partners in:

1. Assessing key aspects of the context of the planned post-campaign assessment
2. Choosing the most appropriate campaign assessment tool
3. Deciding on the most appropriate methodology to employ



Context evaluation

The first step in planning to assess ITN coverage, access and use after a campaign is to define the key aspects of the context of the assessment. The information gathered in this context evaluation is essential for identifying the most appropriate tool and method to use for the post-campaign assessment.

Objectives

- **Who** – is the motivator for post-campaign assessment: a donor or partner request, or is it internally motivated?
- **What** – is the focus on assessing: ITN coverage, access or use, or some combination of these three?
- **When** – are results needed: immediately post-campaign, or prior to a future campaign?
- **Where** – are results needed: at the national or subnational level? Are certain areas or populations targeted for the post-campaign assessment for specific reasons or past experiences?
- **Why** – is the assessment done: to ensure quality of programme implementation/return on investment (ROI), improve future campaigns, or both?

Resources

- Is a dedicated budget available for post-campaign assessment? How much is this budget? If not, can funding be reprogrammed for this activity? How much?
- Are resources available for post-campaign assessment – printers for paper data collection, phones/tablets for digital data collection, data collection or analysis software already purchased by national malaria programme or partners, computers for data entry/analysis?
- What skills do staff available to plan and implement the assessment (including those to be involved in developing the protocol or overseeing or conducting the assessment) already have? Literacy, experience with technology and methods?
- What are the available sampling frames (including sampling frame used for microplanning for the campaign being assessed and any other estimates of the target population available from other programmes, household surveys or censuses)?
- What are the available data sets for modelling? What are the most recent data sets coming from the census, DHS, MIS or MICS? Are data available from recent campaigns for ITNs or other public health interventions in the area of interest? Can national malaria programmes provide useful data, such as information on net distributions during and after the campaign or programme data from antenatal care (ANC) clinics on ITN coverage, access and use?

Technology

- What is the coverage and reliability of the internet network in the area of interest? (note: World Bank provides national level data on percentage of population using the internet)[1]
- What is the coverage and reliability of the mobile network in area of interest?
- What is the penetration of mobile phones? (note: in some countries, the most recent DHS survey collected data on whether female respondents own a mobile phone)[2]

[1] https://data.worldbank.org/indicator/IT.NET.USER.ZS

[2] Rotondi V, Kashyap R, Pesando LM, Spinelli S, Billari FC (2020). 'Leveraging mobile phones to attain sustainable development'. PNAS June 16, 2020. 117 (24) 13413-13420.

- What is the penetration of smartphones?

Contextual factors/local situation

- What other partners are working on malaria control or other programmes requiring population assessments in the area of interest? What are the preferred tools or methods for post-campaign or other assessments employed by these partners?
- What are school attendance rates currently in the area to be assessed? What are ANC clinic attendance rates?
- Are there any gender considerations around post-campaign assessment in the area of interest? Should post-campaign assessment teams of a certain gender be employed? Should household (HH) contacts of a certain gender be sought out?
- How are households defined in the campaign you are assessing? How are they defined by household surveys or censuses conducted in the area of the post-campaign assessment?
- Are there periods where household members may not be staying in the households, for seasonal work, for instance? What are these time periods in the area of interest? Which types of household members might not be living in the households during these periods?

Tool choice

The second step in planning to assess post-campaign ITN coverage, access and use is choosing the tool or tools to be used. A matrix has been developed to support tool selection (Appendix A, Excel file).

In Appendix A, available tools have been categorized into the following paper data collection options, which differ in how data are entered digitally:

- Decentralized data entry (MeasureSMS, community-based data collection)
- Centralized data entry (Excel, Access, specific DHIS2 instances)

Direct digital data collection tool categories include the following, which differ both in how data are collected and by cost:

- Telephone Audio Computer Assisted Self Interview (TACASI) (various TACASI providers)
- Free, open-source smartphone/tablet data collection (various tools)
- Fee-based smartphone/tablet data collection (various tools)

On the basis of your post-campaign ITN coverage, access and use assessment context evaluation results, you will be asked to provide scores for the following five criteria. Scores can range from zero to five, with zero indicating that the criterion is not relevant to your situation and five indicating it is the most relevant or important factor to consider. Each criterion should be considered independently, such that the same score can be indicated for multiple criteria as appropriate (i.e. all five criteria can have the same score or different scores).

- **Need rapid results** – the importance of having post-campaign assessment results in a short timeframe to inform mop-up activities and demonstrate campaign effectiveness; a score of five means that having rapid results from the post-campaign assessment is a top priority.
- **Budget size** – the level of budget available, or able to be reprogrammed if planning takes place early enough for post-campaign assessment; a score of five means the budget is available and sufficient for post-campaign assessment.
- **Level of technology dispersion/access** – the availability of internet, mobile phone and/or smartphone in the area where the post-campaign assessment will take place; a score of five

means that access to internet, mobile phones, and/or smartphones is sufficient in the post-campaign assessment area to enable reliable population estimates using telephone surveys. Research[3,4,5] has shown population estimates derived from mobile phone survey data in countries with mobile penetration at or above 75 per cent can be broadly representative of the population with proper weighting, while populations with lower mobile penetration produce progressively less reliable estimates.

- **Need low-literacy solution** – the degree to which low-literacy solutions will be needed for post-campaign assessment; a score of five means that finding a low-literacy solution is essential for the success of the post-campaign assessment.
- **Need accurate point estimates** – the importance of having accurate, reliable point estimates of ITN coverage, access and use from the post-campaign assessment; a score of five means accurate population estimates are a top priority.

A total score will be automatically calculated for each tool category, with the highest score indicating the tool category suggested for use in your post-campaign evaluation. The choice of a specific tool within the indicated category should be driven by the context evaluation results. For instance, hardware and software that have already been purchased or used by the national malaria programme or other planning partners are a good choice, as staff will already be familiar with them and purchase costs will be mitigated or eliminated.

Method choice

The final step in planning to assess post-campaign ITN coverage, access and use is choosing the appropriate methodology. A matrix similar to the one created for aiding tool choice has been developed to support method selection (Appendix B, Excel file).

In Appendix B, potential methodologies have been categorized as follows:

- Simple random sampling (randomly selecting households from the entire population covered by the ITN campaign without any stratification)
- Convenience sampling (for example, easiest households to reach geographically – closest to main roads, etc.)
- Easy access group sampling (includes antenatal care clinics [ANC] or school surveillance)
- Purposeful sampling (includes enhanced supervision of lots or clusters with poor previous ITN campaign performance or suspected to have performed poorly in the ITN campaign being assessed)
- Random digit dialling (paired with TACASI tool)
- Fixed percentage sampling (selection of a fixed percentage of the population covered by the ITN campaign for assessment)

[3] Sibai AM, Ghandour LA, Chaaban R, Mokdad AH (2016). 'Potential use of telephone surveys for non-communicable disease surveillance in developing countries: evidence from a national household survey in Lebanon'. BMC Med Res Methodol 16**,** 64. https://doi.org/10.1186/s12874-016-0160-0

[4] Leo B, Morello R, Mellon J, Peixoto T, Davenport S (2015). 'Do mobile phone surveys work in poor countries?' CGD Working Paper 398. Washington, DC: Center for Global Development. http://www.cgdev.org/publication/do-mobile-phone-surveys-work-poor-countries-workingpaper-398

[5] L'Engle K, Sefa E, Adimazoya EA, Yartey E, Lenzi R, et al. (2018) 'Survey research with a random digit dial national mobile phone sample in Ghana: Methods and sample quality'. PLOS ONE 13(1): e0190902. https://doi.org/10.1371/journal.pone.0190902

- Multi-stage probability sampling cluster surveys (includes updated 2018 guidance on Expanded Programme on Immunization [EPI] cluster surveys)
- "Classic" lot quality assurance sampling (LQAS) with lot-level corrective action (classifies ITN access and/or use as appropriate or not and takes any corrective action at the lot level)
- "Cluster" LQAS with cluster-level corrective action (classifies ITN access and/or use as appropriate or not and takes any corrective action at the lower cluster level)
- Statistical models of ITN access and use (includes NetCALC, MAP and PATH models)

A more in-depth description of each methodological category and its strengths and weaknesses is provided in the next section.

Based on your post-campaign ITN coverage, access and use assessment context evaluation results, you will be asked to provide scores for the following seven criteria. As with the tool selection matrix, scores for each criterion can range from zero to five, with zero indicating the criterion is not relevant to your situation and five indicating it is the most relevant or important factor to consider. Each criterion should be considered independently, such that the same score can be indicated for multiple criteria as appropriate (i.e. all seven criteria can have the same score or different scores).

- **Need to assess ITN type/brand** – the importance of assessing the specific type/brand of ITN accessible to or used by household members, often to distinguish campaign nets from ITNs from other sources; a score of five means that assessing ITN type/brand is a top priority.
- **Need to cover a large geographic area** – the importance of assessing ITN access and use across a large geographic area; a score of five means that the area where ITN access or use is to be assessed is very large.
- **Budget size** – the level of budget available, or able to be reprogrammed, for post-campaign assessment; a score of five means the post-campaign assessment budget is available.
- **Need flexibility on number of households included** – the importance of being able to determine the number of households included in the post-campaign assessment; a score of five means having the flexibility to include a larger or smaller number of households in the post-campaign assessment is a top priority.
- **Availability of existing data** – availability of existing data sets that could contribute to modelling ITN coverage, access and use, including both the availability and quality of existing data; a score of five means that existing data sources are available and of high quality.
- **Need accurate point estimates** – the importance of having accurate point estimates of ITN coverage, access and use; a score of five means accurate point estimates are a top priority.
- **Need higher precision** – the importance of having narrow confidence intervals or low variance in estimates of ITN coverage, access and use, which could be helpful when comparing campaign efficacy over time or between programmes or locations; a score of five means higher precision is a top priority.

A total score will be automatically calculated for each method category, with the highest score indicating the method category suggested for use in your post-campaign evaluation. The choice of a specific method within the indicated category should be driven by context evaluation results. It might be helpful, for instance, to draw on resources like staff, data, hardware or software available from other programmes or initiatives that may have recently conducted an assessment in the same area for other purposes.

Method definitions, strengths and weaknesses

Simple random sampling

Summary: Random, non-stratified sampling of households to assess ITN coverage, access and use.
Strengths: Can reduce the time needed to develop the sampling strategy when compared with stratified randomized or systematic sampling strategies and allows sight validation of types/brands and number of ITNs. Does not rely on existing data.
Weaknesses: Requires large numbers of households to achieve representative sample of all households covered by the campaign, which can greatly increase costs, particularly if there is a need to cover a large geographic area. Will not provide accurate or precise estimates without very large sample sizes.
Risk of bias: Bias may be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: This sampling method is not recommended.

Convenience sampling

Summary: Non-random, non-systematic sampling of a convenient set of households to assess ITN coverage, access and use; for example, selection of households closest to post-campaign assessment team homes or in more accessible areas.
Strengths: Can reduce travel costs for the post-campaign assessment team and eliminate time needed to develop a randomized or systematic sampling strategy. Allows sight validation of types/brands and number of ITNs and does not rely on existing data.
Weaknesses: Results in a sample of households unlikely to be representative of all households covered by the campaign, reducing accuracy of estimates of ITN coverage, access and use. Likely smaller number of households leads to lower precision and difficulty covering a large geographic area.
Risk of bias: Estimates of ITN coverage, access and use may be biased if accessible households are also more likely to be registered or to pick up ITNs from distribution centres during campaigns (selection bias). Bias may also be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: This sampling method is not recommended.

Easy access group sampling

Summary: Collection of information from students or pregnant women on access to and use of ITNs in their households and the source of these ITNs.
Strengths: Can cover a large geographic area and include many households, increasing precision of results. Can approximate random or systematic sampling of households with a member attending classes, schools or ANC clinics in the area of the post-campaign assessment and result in accurate point estimates under certain circumstances (high school/ANC attendance, dedicated time for surveys during regular school day/clinic visit in season with highest attendance, effective training of teachers/clinic staff administering surveys, inclusion of appropriate questions). Is lower cost than large-scale post-campaign assessment by post-campaign assessment teams and does not rely on existing data.
Weaknesses: Reliable results have been shown using school sampling only for overall household ITN ownership and use, not for number of ITNs in the households or in use the night before[6]. The reliability of ANC clinic sampling results has not yet been validated in the published or grey literature. These

[6] Ndyomugyenyi R, Kroeger A (2006). 'Using schoolchildren's reports of bed net use monitored by schoolteachers as a proxy of community coverage in malaria endemic areas of Uganda'. Trop Med Int Health. 2007 Feb;12(2):230-7. doi: 10.1111/j.1365-3156.2006.01767.x

methods may require more time to train teachers or clinic staff to collect data and take time away from school lessons/clinic visits, and it may take more time to collate results (high numbers of classes/clinics involved, paper data collection likely). Often difficult to define catchment area for schools/ANC clinics and may require additional questions and data manipulation to identify particular villages or areas with poor ITN access and use post-campaign. Does not allow for sight validation of types/brands and number of ITNs.
Risk of bias: May lead to biased estimates of ITN coverage, access and use if households that are harder-to-reach and less likely to be enumerated or to pick up ITNs from distribution centres during campaigns are also less likely to have members attending school/ANC clinic (selection bias). Estimates may also be biased if students'/pregnant women's responses are modified to be more socially acceptable or "correct" (observer bias). It is also possible that respondents will not accurately remember the number of ITNs in their households or who uses them (recall bias).
Recommendation: May be a lower-cost option if focus is on less complex indicators such as overall household ownership of ITNs, and if area to be assessed has very high school and/or ANC clinic attendance.

Purposeful sampling

Summary: Non-random, systematic sampling of households based on certain characteristics. An example is assessment of ITN coverage, access and use only in sampling units, clusters or households believed to be at higher risk of low ITN coverage, access and use due to past assessment results or poor campaign implementation.
Strengths: May be less expensive and faster than other in-person surveys because fewer households are assessed. If sampling units, clusters or households are correctly identified to be at high risk of low ITN coverage, access and use, it can quickly identify likely issues to inform mop-up and other corrective activities. Allows sight validation of types/brands and number of ITNs and does not rely on existing data.
Weaknesses: Results in a sample of households which are unlikely to be representative of all households covered by the campaign, reducing accuracy of estimates of ITN coverage, access and use. Likely smaller number of households leads to lower precision.
Risk of bias: May lead to biased estimates of ITN coverage, access and use if the high-risk clusters, sampling units or households assessed demonstrate lower ITN coverage, access and use than the entire population of households covered in the ITN campaign (selection bias). Bias may also be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: May be a fast and lower-cost option if low ITN coverage, access and use is strongly suspected in certain areas and the objective of your assessment is to inform mop-up and other corrective activities shortly after campaign completion. Not a good option for assessing overall post-campaign ITN coverage, access and use.

Random digit dialling

Summary: Random selection of final digits of phone numbers in the area of interest to call for collection of data on post-campaign ITN coverage, access and use via TACASI tools.
Strengths: Significantly less expensive and potentially faster than in-person surveys. Can increase number of households assessed for little additional cost, improving precision of ITN coverage, access and use estimates, and may avoid responses meant to please the interviewer. Research[7] indicates good accuracy for simple indicators such as household possession of at least one ITN, and statistical methods

[7] Yukich J, Elisaria E, Wisneiwski J, Worges M, Festo C, Mrema J (2018). Mobile phone monitoring of malaria vector control coverage: Technical Report (MOMOVEC Study Report).

like post-stratification and raking[8] (procedures to adjust sample weights to reproduce known population distributions of characteristics like age, sex and socioeconomic variables, resulting in a closer match between the sample and the population of interest) can be employed to account for non-response. Does not rely on existing data.
Weaknesses: Results in sample of households which is unlikely to be representative of all households covered by the campaign, reducing accuracy of estimates of ITN coverage, access and use. Requires sufficient mobile phone penetration and network coverage in the area of interest. Research[9] indicates less accuracy for more complex indicators like household ownership of one ITN per two people. It is subject to key-pad response entry errors, and calls are often not completed, resulting in more missing data. Analysis is complex, and methods do not allow sight validation of types/brands or number of ITNs. Data collection can take two to four weeks, depending on required sample size, and it is difficult to target particular regions.
Risk of bias: May lead to biased estimates of ITN coverage, access and use if random digit dialling respondents are more likely to be enumerated or to pick up ITNs from distribution centres during campaigns than non-respondents (selection bias). It is also possible that respondents will not accurately remember the number of ITNs available in their households or who uses them (recall bias).
Recommendation: The most feasible option when low/no budget available, particularly when a large geographic area must be covered, but mobile phone penetration/mobile network coverage must be sufficient in the area to be assessed. A good option for assessing simple indicators such as overall household ITN ownership when mobile penetration and network coverage are sufficient, but less recommended for complex indicators including number of household members or sleeping spaces and number of ITNs available or used the previous night.

Fixed percentage sampling

Summary: Sampling of a percentage of households covered by campaign to be assessed for ITN coverage, access and use. Can employ different sampling methods including random, purposeful, convenience and multi-stage sampling, and can be used to both measure and classify coverage.
Strengths: Sampling method is flexible and intuitive and allows sight validation of types/brands and number of ITNs, improving accuracy of ITN coverage and access estimates. Allows inclusion of large numbers of households if the campaign covered a large number of households, increasing precision of ITN coverage, access and use estimates, and may cover a large geographic area depending on sampling scheme.
Weaknesses: May be significantly more expensive and time-consuming for assessment of ITN coverage, access and use when compared to other sampling methods, as there is no flexibility in the number of households to be assessed, resulting in larger samples when assessing larger campaigns. Lack of specification of sampling strategy means simple random sampling can be used, resulting in a sample that is unlikely to be representative of the original households covered by the campaign in the case of a large campaign, reducing accuracy of estimates of ITN coverage, access and use.
Risk of bias: If original campaign covered large geographic area with low population density, simple random sample of five per cent or lower of households covered by the campaign could result in a sample that is not representative of the entire area of interest (i.e. some areas could be left out entirely), leading to biased estimates of ITN coverage, access and use if either high or low performing

[8] Deville, J. C., Särndal, C. E., & Sautory, O. (1993). 'Generalized raking procedures in survey sampling'. Journal of the AmericanstatisticalAssociation, 88(423), 1013-1020.
[9] Yukich J, Elisaria E, Wisneiwski J, Worges M, Festo C, Mrema J (2018). Mobile phone monitoring of malaria vector control coverage: Technical Report (MOMOVEC Study Report).

areas are excluded (selection bias). Bias may also be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: This option is likely the most expensive at five per cent and only possible with a large available budget for post-campaign assessment. It may be more appropriate when the geographic area and number of households covered by the campaign are more limited and implementing partners are familiar with and/or advocate this method. Costs can be decreased by choosing lower fixed percentages (i.e. two or one per cent), but simple random sampling of such small percentages would be more likely to result in a non-representative sample, leading to biased estimates of ITN coverage, access and use.

Multi-stage probability sampling cluster surveys

Summary: Probability proportionate to size (PPS) sampling of larger sampling units or clusters, followed by further PPS sampling of smaller sampling units and, finally, of households. Subsequent analyses are weighted to account for the probability of selection, resulting in a random sample. This category includes the sampling methods recommended in the 2018 update to the EPI cluster survey methodology. Previously EPI recommended surveys of 30 clusters containing seven respondents in each, with assessment teams selecting households to include by standing in the centre of a cluster and spinning a bottle to determine a direction in which to walk to start systematically sampling households until reaching seven respondents, and analyses that were assumed to be self-weighting. The 2018 update is assumed throughout this document, as it accounts for PPS by weighting analyses and avoids the sampling bias inherent in spin-the-bottle sampling, where more central households more likely to be sampled may also have been more likely to be provided with ITNs during the campaign.
Strengths: Can accurately assess post-campaign ITN coverage, access and use with a high level of precision due to selection of a sample representative of the population where the campaign was conducted. Allows sight validation of types/brands and number of ITNs, can cover a large geographic area, and allows flexibility in choosing numbers of clusters and households within clusters to power the assessment of different research questions.
Weaknesses: Is more costly and time consuming than methods that do not involve post-campaign assessment teams revisiting households, is not as intuitive as some other methods, and requires complex weighted analyses.
Risk of bias: Bias may be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: If budget is available for this option, it is effective in producing accurate and precise estimates of ITN coverage, access and use over a large geographic area, and allows flexibility in the numbers of clusters and households included to power the assessment to respond to different research questions.

"Classic" LQAS with lot-level corrective action

Summary: Developed in industry, LQAS uses sampling to classify adequate ITN coverage, access and use at the level of the sampling unit called a "lot". Planners can specify the desired sample size and must decide on limits for lots to be considered adequate in terms of ITN coverage, access and use. In this case, indicators are evaluated and corrective measures, such as mop-up or intensified social and behaviour change activities to promote ITN hanging and use, are taken at the lot level. As an example, each district might be treated as a "lot", with e.g. 19 households randomly selected within the district, and a pass/fail threshold set at an upper level of 80 per cent. A lower threshold is set at a level that should not go undetected (e.g. of 50 per cent). This sample size of 19 is small but provides at least 90 per cent sensitivity and 90 per cent specificity for the results.

Strengths: Can classify lots as having adequate or inadequate ITN coverage, access and use quickly and at lower cost than other methods involving post-campaign assessment teams, allowing rapid intervention at lot level to inform mop-up and other corrective activities. Can cover a large geographic area and allows sight validation of types/brands and number of ITNs. It also allows flexibility in the number of stages, lots, clusters and households included in order to power assessment of various research questions.
Weaknesses: Does not provide accurate population level estimates of ITN coverage, access and use. The sampling method is not as intuitive as other methods, a large number of households are not included, and classification of lots depends heavily on thresholds set for adequate ITN coverage, access and use. Random selection of 19 households usually requires visiting 19 villages/communities/settlements. Results from different lots should be reported individually (and not combined) if lots are not selected using probability sampling.
Risk of bias: The selection of lots, clusters and households must each be done randomly (not via convenience sampling) to avoid selection bias. Bias may also be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: Fast, less expensive method to evaluate a representative sample of the population covered by the campaign using post-campaign assessment teams. Recommended for situations where post-campaign assessment aims to inform mop-up and other corrective activities. This 19-household method LQAS will not provide point estimates unless 10 or more lots are combined (if lots were selected using probability sampling). Generally, 200—300 households are needed to get point estimates with confidence intervals of plus or minus 10 per cent or narrower.

"Cluster" LQAS with cluster-level corrective action

Summary: "Cluster" LQAS uses multi-stage sampling to select households instead of simple random sampling of households in the 19-household "classic" method described in the section above. The results from the "classic" and "cluster" LQAS are of the same type, i.e. pass/fail or classification for each lot. Different number of clusters and households per cluster can be used to adjust the sensitivity and specificity of the classification scheme. However, the most commonly used version of the cluster LQAS by WHO uses six clusters of ten households per cluster (60 households total) and a three-level classification system (pass with more than 90 per cent coverage, intermediate with 80—90 per cent coverage, and fail with less than 80 per cent coverage). Similar to the "classic" method, indicators are evaluated and corrective measures, such as mop-up or intensified social and behaviour change to promote ITN hanging and use, are taken at the lot level.
Point estimates and confidence intervals from LQAS. Point estimates and confidence intervals can be calculated for a sampling frame if the lots are selected with probability sampling and the number of households is at least 200—300. With a sample of 200 households, confidence intervals of plus or minus 10 per cent are usual when the design effect of the indicator is 2.0. Therefore, confidence intervals will be practical (plus or minus 10 per cent or less) if four cluster six by ten LQAS lots are combined (total of 240 households). For example, if one cluster six by ten LQAS lot is done in all four districts in one region, then point estimates and confidence intervals can be calculated for the region.
As in the "classic" version, the results of lots selected with purposeful or convenience sampling should be reported individually and should not be combined with those lots selected with probability sampling or with other lots selected with purposeful or convenience sampling.
Strengths: Can classify clusters as having adequate or inadequate ITN coverage, access and use more quickly than with classic LQAS and at lower cost than other methods involving post-campaign assessment teams. Travel time is reduced (e.g. six locations, versus 19 in the classic LQAS example) within the district. Can cover a large geographic area and allows sight validation of types/brands and

number of ITNs. Also allows flexibility in the number of stages, lots, clusters and households included in order to power assessment of various research questions. This method also produces meaningful point estimates and confidence intervals at the higher level (in this example, at district level). Therefore, this LQAS method can provide "pass/fail" results at the district or sub-district level and point estimates and confidence intervals at district or higher levels. Another strength is that a complete WHO field manual is available[10] that allows national programmes to conduct the method without need for consultants.
Weaknesses: Does not provide point estimates of ITN coverage, access and use at the cluster level. The classification of clusters depends heavily on thresholds set for adequate ITN coverage, access and use. A statistician may need to be consulted if national programmes want to change the break points (more than 90 per cent, 80—90 per cent, less than 80 per cent) for the three-level classification schema in the WHO manual.
Risk of bias: The selection of lots, clusters and households must each be done randomly (not via convenience sampling) to avoid selection bias. Bias may also be an issue if households report receiving fewer ITNs than actually received in an effort to obtain additional nets.
Recommendation: Fastest, least expensive (even faster and less expensive than LQAS with lot-level corrective action) method to evaluate a representative sample of the population covered by the campaign using post-campaign assessment teams. Recommended for situations where post-campaign assessment aims to inform mop-up and other corrective activities, particularly when results are needed quickly and when the budget is more limited. Not recommended for post-campaign assessments with the objective of providing accurate point estimates of ITN coverage, access and use at the cluster level.

Statistical models of ITN access and use

Summary: Statistical models providing estimates of ITN coverage, access and use over time based on assumptions regarding net decay and population changes and data from various sources including past population or programme surveys, censuses and data from net manufacturers (such as those included in the Net Mapping Project[11]) and national malaria programmes. Existing models include NetCALC, the Malaria Atlas Project (MAP) model, and a model developed by PATH. These models can use data available immediately following a campaign (for instance data on ITNs distributed to households during the campaign, and data on distribution from previous campaigns) to predict coverage, access and use right away. Models can also use data from post-campaign surveys and other sources available months or years after a campaign to predict post-campaign ITN coverage, use and access as time passes based on net decay assumptions.
Strengths: Do not require primary data collection, resulting in lower costs than for other post-campaign assessment methods. Can cover large geographic areas and large numbers of households, provide high precision, and can provide point estimates of ITN coverage, access and use whose accuracy depends on the quality of data used and appropriateness of model assumptions. Depending on available data and the level of development and testing of the model used, results can be obtained rapidly after campaign implementation.
Weaknesses: Accuracy of ITN coverage, access and use estimates depends largely on quality of data used in the model, particularly for population estimates, on the process used to transform nets-per-capita into ITN access and on model assumptions. Cannot sight verify types/brands and number of ITNs; analysis is complex.
Risk of bias: To the extent that the parameterization of the model or data collection for underlying data sets contained biases, model results may be biased.

[10] https://polioeradication.org/wp-content/uploads/2016/09/Assessing-Vaccination-Coverage-Levels-Using-Clustered-LQAS_Apr2012_EN.pdf
[11] https://allianceformalariaprevention.com/net-mapping-project/

Recommendation: Viable option when no budget is available, but very reliant on the availability and accessibility of high-quality existing data and on model assumptions. Timing of results in particular is dependent on availability and quality of data.

Additional considerations

This guidance for selecting tools and methods for assessing post-campaign ITN coverage, access and use assumes thorough and correct implementation of methods and use of tools outlined. Any deviations from the intended use of the tools and methods chosen can carry additional risks of bias and result in different performance levels than those anticipated in this document. For example, sub-population sampling will not produce accurate point estimates of ITN coverage, access or use if ANC surveillance is carried out in areas with poor ANC clinic attendance or school surveillance in areas with poor school attendance, just as random digit dialling will not produce accurate estimates if conducted in areas with insufficient mobile penetration or an unreliable mobile network. Any multi-stage cluster sampling methods carried out without using PPS sampling at each stage and appropriate weighting of analyses will result in unreliable estimates of ITN coverage, access and use. LQAS methods will only be as reliable as the criteria chosen to classify lots or clusters with adequate ITN coverage, access and use.

Finally, measures should be taken to ensure your post-campaign assessment results are the highest-level quality data possible. If paper data collection with digital data entry is the most feasible solution, some options for ensuring high quality data are collected include:

- **In-field data entry** – data are entered and reviewed by data entry staff in the field with laptops in order to detect errors while team are still in the field and can return to households to correct any errors.
- **Double data entry** – independent entry of data from each paper questionnaire by two separate data entry staff followed by comparison of the two entries for inconsistencies. In case of disagreement, original paper form to be checked for correct data.

In the case of electronic data collection, the following strategies for monitoring and improving data quality during the post-campaign assessment should be considered[12]:

- **Human-centred design –** involve programme staff who will be using the data collection tool in its development, iterative revision and pilot testing.
- **Display conditions and skip logic –** configure electronic data collection forms to include display conditions and skip logic patterns to limit questions and data to be collected only to those relevant to the particular households being assessed.
- **Data validation –** require responses for critical data items, limit open-ended or free text responses as much as possible through use of drop-down menus or check boxes, use validation rules to require certain types (i.e. numeric or text), ranges or lengths of responses as relevant, cross-check data already entered to maximize internal consistency, and provide helpful instructions or explanations when data entered do not meet a validation rule.
- **Automated responses –** set up system to automatically calculate values rather than requiring the user to conduct any calculations by hand and use metadata like timestamps and GPS coordinates automatically captured from the device to automatically complete relevant fields.

[12] Kenny A, Gordon N, Griffiths T, Kraemer JD, Siedner MJ. Validation Relaxation: 'A Quality Assurance Strategy for Electronic Data Collection'. J Med Internet Res. 2017;19(8):e297

- **Outlier identification –** set up data system to identify duplicate or missing forms and/or fields, track data over time to identify outliers, and validate entered data using metadata like timestamps and GPS.
- **Automated feedback loops –** ensure users receive notification when forms have been successfully submitted, automatically send notification when data quality issues are identified, and automatically generate reminders for users to complete or submit data collected.