Adapting the Malaria Behavior Survey (MBS) for Use in Lower Transmission Settings

Addendum to MBS Guidelines for Design and Implementation

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Introduction

The Malaria Behavior Survey (MBS) is a population-based, theory-informed survey used to provide a better understanding of socio-demographic and ideational (psychosocial) characteristics associated with malaria-related behaviors. The MBS is based on an adapted ideation model of strategic communication and behavior change, recognizing three dimensions of psychosocial factors influencing health behavior – cognitive, emotional, and social interaction. The ideation model posits that social and behavior change (SBC) programming can influence behavior by affecting one or more of the three dimensions of psychosocial factors, and that effective behavior change interventions should target ideational determinants to achieve maximum impact. MBS survey tools therefore include questions on the ideational constructs for each malaria-related behavior.

The MBS is designed to provide public health and SBC planners with valuable information across a range of malaria transmission contexts. However, areas with low transmission, defined as annual parasite incidence (API) of 100-250 cases per 1000 population, and very low transmission (<100 API per 1000 population), are distinct from other transmission contexts in several important ways. This includes:

1. **_Where_ cases are distributed**: low transmission contexts often experience increased focalization of malaria cases and reservoirs in certain geographic areas. While the cases may be geographically focalized, they may be in hard-to-reach locations.
2. **_Who_ is most likely to be infected**: there is often increased case focalization in adults, particularly men. Occupation-based exposure and risk of imported cases from population movement and seasonal migration are also key considerations. These populations may be hard-to-reach due to the nature of their work, for example in illegal hunting or logging.
3. **_What_ interventions are deployed**: while core interventions remain important, several additional interventions may be implemented by malaria programs in lower transmission settings to target malaria parasites and vectors. Approaches need to be tailored, underscoring the importance of context-specific data to inform SBC interventions.

The standard MBS survey tools and protocols may face limitations in capturing the necessary data given these distinctions; as such Breakthrough ACTION and the U.S. President's Malaria Initiative (PMI) have developed MBS questionnaires specifically tailored for lower transmission settings. The low transmission MBS provides an opportunity to customize the sampling approach and questionnaires to help malaria programs target interventions and support SBC activities and messaging more effectively.

This addendum describes and illustrates several adaptations to be considered when implementing the Malaria Behavior Survey (MBS) in low transmission settings. Information within this addendum can help public health planners determine the appropriate focus of activities designed to improve malaria-related behavioral outcomes while accounting for the unique context of a low transmission setting. Specifically, it provides a description of adaptations to:

1. Content of questionnaires
2. Process of stakeholder engagement

3. Sampling

Each section includes specific considerations relevant to low transmission settings and an example of how those considerations are being applied to planning for the first low transmission MBS in Zanzibar.

There is significant overlap between the standard MBS and low transmission MBS. This document is meant as a companion to the standard *MBS Guidelines for Design and Implementation*, reflecting only the unique considerations for low transmission settings. Recommendations included in this document were established through a consultative process with PMI.

Adaptations

Many elements and protocols of the standard MBS are maintained in the low transmission MBS, including the household survey format. This approach was retained to provide statistical strength and representativeness as well as to allow for comparison across multiple sites. However, adaptations to the content of questionnaires, who is interviewed from households, the protocols for stakeholder engagement, and defining sampling frames have been made to respond to the needs of low transmission settings.

Questionnaires

Rationale:

The interventions deployed, and target behaviors for malaria prevention, are often different in areas moving toward elimination compared to higher transmission contexts. Due to differences in case focalization and transmission patterns, there are several interventions that may be more common in low transmission settings, including larval source management, active case detection, and mass drug administration, and use of personal protection measures such as repellents. These interventions are often supplementary to core interventions, namely indoor residual spraying (IRS) and insecticide-treated nets (ITNs) and prompt case management. Additionally, possible exposure to malaria-infected mosquitoes outdoors, travel and migration, and occupation-based risk are important considerations. These differences are reflected in the low transmission MBS questionnaires. While the low transmission MBS questionnaires were designed to capture these overarching considerations, there can be considerable variation across different low transmission settings in terms of interventions deployed and groups and activities that may be associated with higher risk. It is therefore critical to further customize the low transmission questionnaires to the given context to ensure appropriate modules, questions, and responses as outlined in the stakeholder engagement section below.

Description of Key Changes:

Modules discussing larval source management, active case detection, and mass drug administration have been added to the women's and men's questionnaires. Each intervention module includes content relevant to the dimensions of psychosocial factors identified in the ideation model (cognitive, emotional, and social interaction).

Adaptations to other modules in the standard MBS questionnaire have been made to incorporate nighttime behavior, out-of-town travel, work environment, and malaria case management for adults. Malaria prevention measures have been expanded to include insecticide treated hammock nets, topical repellents, and insecticide treated clothing in addition to standard questions on ITN use. Each of these adaptations reflects nuances in malaria epidemiology in low transmission settings.

Table 1 lists the new and adapted modules and associated behaviors measured in the low transmission MBS questionnaires where content has been modified from standard MBS tools. If the module is not included in this table, the content remains identical to the standard questionnaires. This table also serves as a "menu" of available modules for local stakeholders to choose from when engaging on the low transmission MBS.

Table 1: Low Transmission MBS - New/Adapted Modules	
Module Name	**Measured Behavior**
Section I: Activity and Sleeping Patterns	Participating in nighttime activities including A) socializing/leisure; B) household chores; and C) large-scale nighttime events
	Engaging in work A) away from home; B) outdoors
	Spending time throughout the night A) indoors/outdoors; and B) awake/sleeping
	Traveling away from community
Section II: Malaria Prevention Measures (Note: behaviors included here are in addition to standard ITN behaviors)	Using a net or hammock net when sleeping outdoors
	Carrying a net when spending time away from home, including A) when traveling; B) while at worksite
	Using a net or hammock net when away from home, including A) while traveling; B) while at work site
	Using personal protection measures while outdoors, including A) repellents; B) treated clothing; and C) untreated clothing
Section III: Malaria Case Management (Note: module adjusted to focus on respondent for low transmission settings)	Care seeking at health facility or through community health workers for self after onset of fever
	Receiving malaria test for self at health facility or through community health workers when presenting with fever
	Being given malaria medicine
	Completing medication course as prescribed
Section VIII: Larval Source Management	Accepting LSM in community
	Participating in LSM activities (if applicable), e.g., treating water bodies within community as directed by local program
Section XIV: Active Case Detection	Providing personal information to health workers
	Accepting testing, even when not feeling sick
	Accepting treatment following positive test, even when not feeling sick

Section XV: Mass Drug Administration	Accepting distribution of medication
	Completing medication course as prescribed

Zanzibar Example:

In recent malaria surveillance and response guidelines issued by the Zanzibar Malaria Elimination Programme (ZAMEP), activities including Active Case Detection (in the form of reactive case detection), Mass Drug Administration, and Larval Source Management are described. Modules focused on these topics, as well as core interventions such as ITN use and IRS, are expected to be included in the Zanzibar low transmission MBS.

Decisions to include these modules will be made through consultation with the Zanzibar Malaria Elimination Programme and PMI. Content will also be customized to the Zanzibar context, including specific questions and responses related to nighttime activities, travel, and malaria prevention measures.

Stakeholder Engagement

Rationale:

While it is important to contextualize the MBS questionnaires in all contexts, low transmission settings may necessitate a higher level of customization compared to higher transmission settings. Stakeholders familiar with the local context play a critical role in ensuring the questionnaire content, geographic scope, and sampling strategy are designed to capture the information of interest.

The stakeholder engagement process should follow a similar process to the standard MBS. It is recommended that the research lead utilize **Table 1** as a menu of options when identifying relevant interventions and behaviors, as described in step 3 below. A review of the literature suggests that groups such as construction workers, seasonal migrants, nighttime workers, forest dwellers, or other subpopulations may represent higher risk groups within low transmission settings. Information regarding sub-populations of interest can help to refine modules within the low transmission MBS, including questions related to travel, migration, and occupation-based malaria exposure.

Description of Key Changes:

In low transmission settings, it is suggested that teams interested in implementing the low transmission MBS meet with local stakeholders to determine the following:

1. The geographic level at which transmission intensity data are available.
2. The geographic level (e.g., zone or region) at which the study can draw conclusions. This will be based on a combination of factors including the level at which transmission data is available, sample size considerations, and resources available.
3. Major interventions in place in the study area to accelerate transmission reduction.
4. Whether there is interest in capturing data from specific subpopulations.

a. If yes, determining which subpopulations are of interest and whether any supplemental research activities are needed.

The engagement process should begin as soon as possible after the decision is made to carry out an MBS. Items 1, 2, and 3 listed above are consistent with the standard MBS engagement process, although interventions in the study area may be different than in standard MBS settings. Given the range of tailored approaches deployed in lower transmission settings, a higher level of customization may be needed for the low transmission MBS. Study teams should build time into the process to customize the questionnaires through stakeholder engagement and feedback. The customization process often takes place over two Advisory Group meetings dedicated to questionnaire review. It is strongly recommended that all members of the advisory group separate 1-2 days to thoroughly review and familiarize themselves with the questionnaire **before** the advisory group meeting, as this leads to a higher quality dialogue and more expedient process.

Item 4, identifying subpopulations, refers to groups such as construction workers, seasonal migrants, night-time workers, forest goers, or other subpopulations that literature and local evidence suggests may be characterized by higher transmission risk. Information on these groups can be used to customize the content of the low transmission questionnaires.

While the low transmission MBS utilizes a household survey, malaria programs and partners can also consider carrying out supplemental research to specifically capture data from sub-populations of interest. Inclusion of a special population in an MBS study will merit a supplemental sample and will likely utilize purposive (versus random) techniques such as time-location sampling. Supplemental qualitative research may also be considered to uncover rich insights about the unique challenges and opportunities for malaria prevention, diagnosis, and treatment among higher risk groups and hard to reach populations. This decision will also need to consider additional cost implications.

Zanzibar Example:

Initial thinking regarding the geographic focus and content for the Zanzibar MBS is summarized in **Table 2** below. Final decisions will be made through a consultative process with an advisory group that includes representation from local PMI and ZAMEP offices. Local stakeholders will also provide detailed feedback on the questionnaire content to adapt to the local context.

Table 2: Stakeholder Engagement - Zanzibar MBS	
Task	**Result**
Determine geographic level (e.g. zone or region) at which transmission intensity data are available.	Transmission intensity data are available at the regional, district, and sub-district (shehia) levels.
Determine geographic level (e.g. zone or region) for which the study can draw conclusions.	Zanzibar will be treated as a single zone, stratified by urban/rural.
Identify current interventions in the study area to inform module selection **in addition to routine MBS modules**.	Interventions in the study area include: 1. ITNs 2. IRS 3. Mass Drug Administration 4. Active Case Detection

	5. Larval Source Management
Determine interest in capturing supplemental data from specific subpopulations.	Currently, there is no funding available to capture supplemental data from specific subpopulations. However, questionnaire content will be customized to capture information on higher risk groups and activities of interest.

Sampling Considerations

Rationale:

Malaria transmission patterns are different in low transmission settings, potentially resulting in greater clustering of cases. To address this, the study team should identify transmission intensity at each geographic unit (e.g., zone or region).

Sorting geographic units into quartiles will help identify the areas where transmission intensity is highest. "Oversampling" in these areas will help ensure that the team captures a sample that is representative of high transmission intensity areas (relative to the study area as a whole).

Due to focalization of cases in adult men compared to standard MBS settings, oversampling of men (relative to standard MBS protocols) is suggested, but the exact female:male ratio will depend on the context. Researchers may find it helpful to consult data on the rate of malaria cases by age group and sex to make this determination.

The standard MBS includes women of reproductive age (15-49 years) and men ages 18-59. The same age ranges should generally be used for the low transmission MBS. Expansion of the age ranges can be considered by the Advisory Group. However, given the additional ethical considerations for inclusion of adolescents, lowering the eligibility age should only be considered if there is a compelling epidemiological reason to do so in a specific low transmission context.

Description of Key Changes:

Sample size calculations and procedures are critical issues in survey research. These decisions can affect the data quality, interpretation of results, and cost-effectiveness of the study. A comprehensive literature review found that much of the existing research focusing on ideational factors in low-transmission malaria settings have used non-probability or convenience sampling techniques, which are not likely to yield representative results.

Similar to the standard MBS, the low transmission MBS assumes a multistage sampling design with selection at more than one stage, including for example, regions or zones, enumeration area (cluster), household, and then individual respondents. At each stage, the probability of each respondent being selected is known.

Determining required sample size in either the standard MBS or the low transmission MBS is based on several factors, including:

1. The geographic level at which the study will be able to make inferences.

2. Prevalence of behavioral or ideational indicators that the program plans to measure.
   a. These indicators should be relevant to the country's Malaria SBC strategy. In most cases, these will draw from indicators available in MICS or MIS studies.
3. Type of sample (i.e. whether a one-time or repeated cross-sectional design).

In addition to accounting for factors described above (the steps to do so are described in the standard MBS guidelines, section IV), it is suggested that teams implementing the low transmission MBS account for the distribution of malaria within the low transmission setting using an indicator of transmission intensity such as API. From there, two changes in sampling calculations are recommended:

1. Incorporate a booster sample (i.e. "oversampling") in quartile of geographic units characterized by highest intensity (e.g. highest API)
2. Increase proportion of male respondents compared to the 3 females:1 male ratio used in the standard MBS, to be closer to the distribution of cases in country.

In order to implement these changes, the following steps are recommended:

Step 1: Determine geographic level at which transmission data are available, and the study is able to make inferences.
Step 2: Determine transmission intensity at each geographic unit and sort units into quartiles based on transmission intensity.
Step 3: Incorporate booster sample in top quartile.
Step 4: Determine female:male ratio.

Steps 1 and 2 will be based on locally available data. The extent to which adjustments in steps 3 and 4 occur will be context-specific and determined in consultation with the principal investigator and study advisory group.

All other sample size formulas and calculations adhere to parameters of the standard MBS (see section IV of the standard MBS guidelines for more detail).

Zanzibar Example:

In Zanzibar, a one-time cross-sectional survey design was selected. Sampling decisions for the Zanzibar MBS include:

1. All Shehias were selected to be included in the sample frame using probability proportional to size (PPS) sampling technique and following the multistage random sampling approach of the standard MBS.

2. 21% of Shehias are within the top quartile of transmission intensity. The research team decided to oversample this population by doubling the sample size in the top quartile of shehias for the reasons outlined above. Weights will be applied during analysis to account for oversampling.

3. The female:male ratio for sampling was determined to be 1:1. This decision was based on prior research in Zanzibar[1] and through a consultative process with PMI.

Figure 1 on the following page provides detailed sample size calculations.

The Zanzibar MBS utilized a design effect of 1.6, primarily due to an expected low rate of refusal. The formula used to calculate the sample is available in section IV of the standard MBS guidelines. In Zanzibar, this formula was applied at the Shehia level based on transmission intensity.

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[1] Björkman, A., Shakely, D., Ali, A.S. et al. From high to low malaria transmission in Zanzibar—challenges and opportunities to achieve elimination. BMC Med 17, 14 (2019). https://doi.org/10.1186/s12916-018-1243-z

Formula used

% of women of reproductive age sleeping under bed net	D	Rh	Ri	Precision	z	Percent sleeping under net (p)	Required women in HH with net	% of households with net	Required total # of HH	# of women	# of men
Zanzibar	1.6	0.9	0.96	0.05	1.96	0.698	600	0.811	740	740	740

Dividing sample by high and low transmission areas in Zanzibar		Proportion of population in high transmission areas (calculated from top 25% of Shehias)	# of HHs out of 740 that will be in high transmission areas by population proportion	Increase proportion of high transmission sample by 50%	# of HHs needed in high transmission for oversampling by 50%	Increase proportion of high transmission sample by 100%	# of HHs needed in high transmission for oversampling by 100%	For oversampling by 100%, increase the final HH sample size by	New required total # of HHs	New # of women	New # of men for sample
925		0.213	158	0.320	237	0.426	315	158	898	925	925

Will round to 925 in sampling to account for nonresponse