

Household Survey Indicators for Malaria Control

April 2018



U.S. President's Malaria Initiative



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MEASURE Evaluation
The Demographic and Health Surveys Program
President's Malaria Initiative
Roll Back Malaria Partnership
United Nations Children's Fund
World Health Organization

Acknowledgements

This document is an update to the June 2013 version of the document, which was a product of the Survey and Indicator Task Force of the Roll Back Malaria Monitoring & Evaluation Reference Group (RBM MERG). The updates represent the consensus of RBM MERG partners and were spearheaded by Lia Florey, Cameron Taylor, Jui Shah, and Michael Paula, with notable contributions from Erin Eckert, Abdisalan Noor, Annē Linn, Fred Arnold, Yazoume Ye, and Allison Schmale.

The 2013 document was a collaborative effort with substantial input from Fred Arnold, Richard Cibulskis, Holly Newby, and Elizabeth Ivanovich. Important inputs were provided by Lia Florey, Samantha Herrera, Albert Kilian, Abdisalan Noor, Liliana Carvajal, Misun Choi, Erin Eckert, and Leopoldo Villegas. We would also like to thank all individuals and organizations involved in the preparation of previous versions of this document.

This publication was produced with the support of the United States Agency for International Development (USAID) under the terms of MEASURE Evaluation cooperative agreement AID-OAA-L-14-00004. Views expressed are not necessarily those of USAID or the United States government.

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Abbreviations

ACT	Artemisinin-based Combination Therapy
AIM	Action and Investment to Defeat Malaria
ANC	Antenatal Care
DHS	Demographic and Health Survey
GMAP	Global Malaria Action Plan
GTS	Global Technical Strategy
Hb	Hemoglobin
HMIS	Health Management Information Systems
IPTp	Intermittent Preventive Treatment in Pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
LLIN	Long-Lasting Insecticidal Net
M&E	Monitoring and Evaluation
MERG	Monitoring & Evaluation Reference Group
MICS	Multiple Indicator Cluster Survey
MIS	Malaria Indicator Survey
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SP	Sulfadoxine-pyrimethamine
U5MR	Under-five Mortality Rate
WHO	World Health Organization

1. Introduction

1.1 Background

Malaria continues to pose a tremendous public health problem globally, with an estimated 3.4 billion, or 40 percent of the world's population, living in areas of malaria risk [1]. The last 20 years have seen a resurgence of interest in malaria as a disease of major public health importance. This renewed commitment between 2001 and 2015 resulted in an estimated 1.3 billion malaria cases and 6.8 million malaria-related deaths averted, with remarkable progress in malaria prevention, diagnosis, and treatment [1]. However, much progress is still needed because as of 2015, 43 percent of people in sub-Saharan Africa remain unprotected by insecticide-treated nets (ITNs) or indoor residual spraying (IRS) [1]. Many malaria cases also go untreated by first-line artemisinin-based combination therapies (ACTs).

In 1998, the Roll Back Malaria (RBM) partnership was launched to coordinate the efforts of the international community to meet the goal of a world free of malaria. To achieve this goal, the partnership developed the Global Malaria Action Plan (GMAP) in 2008. By outlining strategies, costs, goals, and timelines for malaria control and elimination, the GMAP paved the way for progress. In 2015, the GMAP was followed by the World Health Organization's (WHO) Global Technical Strategy (GTS) 2016-2030 and the Action and Investment to Defeat Malaria (AIM) 2016-2030 [2, 3].

Specifically, the AIM contextualizes malaria in the broader development agenda and shows why malaria is not only a health issue, but also a developmental, economic, political, security, environmental, agricultural, educational, biological, and social issue [3]. Most importantly, the AIM provides malaria advocates at all levels (global, regional, national, and subnational) with a tool to mobilize collective action and resources [3].

The GTS and the AIM set goals and targets for 2030, with milestones for measuring progress for 2020 and 2025 (Table 1).

Table 1: Goals, Milestones, and Targets for Malaria 2016-2030

Goals	Milestones		Targets
	2020	2025	2030
Reduce malaria mortality rates globally compared with 2015	At least 40%	At least 75%	At least 90%
Reduce malaria case incidence globally compared with 2015	At least 40%	At least 75%	At least 90%
Eliminate malaria from countries in which malaria was transmitted in 2015	At least 10 countries	At least 20 countries	At least 35 countries
Prevent re-establishment of malaria in all countries that are malaria-free	Re-establishment prevented	Re-establishment prevented	Re-establishment prevented

World Health Organization (WHO). (2016). *Global technical strategy for malaria 2016-2030*. Geneva, Switzerland: WHO.

The GTS also contains a strategic framework that considers the diversity of the current disease burden at national and subnational levels. The framework comprises three pillars that seek to maximize the impact of today's life-saving tools: (1) ensuring universal access to malaria prevention, diagnosis, and treatment for all populations at risk; (2) accelerating efforts toward elimination and attainment of malaria-free status; and (3) transforming malaria surveillance into a core intervention [2, 3].

In order to measure progress toward the goals, milestones, and targets of the GTS, the strategic framework is accompanied by a set of 14 outcome and impact indicators.

RBM's Monitoring & Evaluation Reference Group (MERG) has synthesized these changes to the malaria measurement landscape in Table 2, which maps recommended indicators to the goals and pillars laid out in the GTS and the AIM. This table is based on the "blue table" frequently referenced from the original GMAP document, with updates based on the changing epidemiological context and improvements made in measurement techniques. Indicators that are underlined are specifically outlined as key GTS indicators. Indicators **in red** can be derived from household surveys and are particularly relevant to this manual.

Table 2: Mapping Key and Supporting Indicators to GTS Goals and Pillars

GTS/AIM Targets and GTS Framework Pillars	Key Indicators	Supporting Indicators	Data Source
GTS/AIM Goal 1: <i>Reduce malaria mortality rates globally compared with 2015</i>	<p><u>Malaria mortality rate: number of malaria deaths per 100,000 persons per year</u></p> <p>All-cause under-five mortality rate</p>	<p><u>Proportion of expected health facility reports received at national level</u></p>	<p>Routine health information systems</p> <p>Household surveys</p>
GTS/AIM Goal 2: <i>Reduce malaria case incidence globally compared with 2015</i>	<p><u>Malaria case incidence: number of confirmed malaria cases (microscopy or RDT) per 1,000 persons per year</u></p> <p><u>Parasite prevalence: proportion of the population with evidence of infection with malaria parasites</u></p>	<p>Annual blood examination rate</p> <p><u>Proportion of expected health facility reports received at national level</u></p> <p>Malaria test positivity rate</p> <p>Proportion of children aged 6-59 months with a hemoglobin measurement of <8 g/dL</p> <p>Parasite prevalence: proportion of children aged 6-59 months with malaria infection</p>	<p>Routine health information systems</p> <p>Special surveys</p> <p>Household surveys</p>
GTS Pillar 1: <i>Ensure universal access to malaria prevention, diagnosis, and treatment</i>	<p>Prevention:</p> <p>Proportion of population with access to an ITN in their household</p> <p>Proportion of population at risk that slept under an ITN the previous night</p> <p>Proportion of population protected by IRS within the last 12 months</p> <p>Proportion of women who received three or more doses of IPTp for malaria during their last pregnancy</p>	<p>Proportion of households with at least one ITN</p> <p>Proportion of households with at least one ITN for every two people</p> <p>Proportion of population at risk potentially covered by ITNs distributed</p> <p>Proportion of targeted risk group receiving ITNs</p> <p>Proportion of children under five years old who slept under an ITN the previous night</p> <p>Proportion of pregnant women who slept under an ITN the previous night</p> <p>Proportion of existing ITNs used the previous night</p>	<p>Household surveys</p> <p>Program records</p> <p>Household surveys</p> <p>Program records</p> <p>Household surveys</p>
	<p>Diagnosis:</p> <p><u>Proportion of suspected malaria cases that receive a parasitological test</u></p>	<p>Proportion of children under five years old with fever in the last two weeks for whom advice or treatment was sought</p> <p>Proportion of children under five years old with fever in the last two weeks who had a finger or heel stick</p>	<p>Routine health information systems</p> <p>Household surveys</p>

GTS/AIM Targets and GTS Framework Pillars	Key Indicators	Supporting Indicators	Data Source
	Treatment: <u>Proportion of confirmed malaria cases that receive first-line antimalarial treatment according to national policy</u>	Proportion of health facilities without stock-outs of key commodities by month Proportion receiving first-line treatment, among children under five years old with fever in the last two weeks who received any antimalarial drugs	Routine health information systems Household surveys
GTS/AIM Goal 3: <i>Eliminate malaria from countries in which malaria was transmitted in 2015</i>	<u>Number of countries that have newly eliminated malaria since 2015</u>		World Health Organization
GTS Pillar 2: <i>Accelerate efforts towards elimination and attainment of malaria-free status</i>	<u>Proportion of cases investigated (programs engaged in elimination)</u> <u>Proportion of foci investigated (programs engaged in elimination)</u>		Routine health information systems
GTS Pillar 3: <i>Transform malaria surveillance into a core intervention</i>	<u>Proportion of malaria cases detected by surveillance systems</u>	Proportion of private facilities reporting to national malaria surveillance system	Routine health information systems
GTS/AIM Goal 4: <i>Prevent re-establishment of malaria in all countries that are malaria-free</i>	<u>Number of countries that were malaria-free in 2015 in which malaria was re-established</u>	Program coverage indicators from Pillars 1–3	World Health Organization

Indicators that are **in red** are derived from household surveys

Indicators that are underlined are specifically identified as key GTS indicator

IPTp= intermittent preventive treatment in pregnancy, RDT=rapid diagnostic test

Household surveys generate 14 core indicators that can be used to measure progress toward GTS and AIM targets: 11 outcome indicators and 3 impact indicators (see Table 3). Some interventions, such as intermittent preventive treatment in pregnancy (IPTp), may not be implemented in all countries, so certain indicators may not be used in all settings. Indicators that are underlined are specifically outlined as key GTS indicators.

Table 3: Household Survey Indicators for Assessing Progress Toward GTS and AIM Targets and GTS Framework Pillars

Intervention	Indicator Description
Prevention	
Vector Control Through ITNs	1. Proportion of households with at least one ITN
	2. Proportion of households with at least one ITN for every two people
	3. Proportion of population with access to an ITN in their household
	4. <u>Proportion of population that slept under an ITN the previous night</u>
	5. Proportion of children under five years old who slept under an ITN the previous night
	6. Proportion of pregnant women who slept under an ITN the previous night
	7. Proportion of existing ITNs used the previous night
IPTp	8. <u>Proportion of women who received three or more doses of IPTp for malaria during their last pregnancy (UPDATED)</u>
Case Management	
Diagnosis	9. Proportion of children under five years old with fever in the last two weeks who had a finger or heel stick
Treatment	10. Proportion of children under five years old with fever in the last two weeks for whom advice or treatment was sought
	11. Proportion receiving first-line treatment, among children under five years old with fever in the last two weeks who received any antimalarial drugs
Impact Measure	
Morbidity	12. <u>Parasite prevalence: proportion of children aged 6-59 months with malaria infection*</u>
	13. Moderate-to-severe anemia prevalence: proportion of children aged 6-59 months with a hemoglobin measurement of <8 g/dL
Mortality	14. All-cause under-five mortality rate

Indicators that are underlined are specifically outlined as key GTS indicators.

* The GTS outcome indicator is “proportion of the population with evidence of infection with malaria parasite.” The available data from household surveys are for the population aged 6-59 months only, as phrased in the table.

1.2 Purpose and Content of Manual

The purpose of this manual is to provide detailed specifications for the indicators that can be measured through household surveys and the data that are required for their construction, as well as the issues related to their interpretation. Details of the data collection methods required for estimating these indicators through national-level household surveys are also provided. This manual is intended to maximize internal consistency and comparability of the indicators and the types of data collection methods used across countries and over time.

It should be noted that the indicators and measurement tools described in this manual were developed in the context of African countries with a high malaria burden. Although children under five and pregnant women are most at risk for malaria in these settings, programs are attempting to attain universal coverage and use of vector control interventions across all age groups. In other settings, such as Southeast Asia and Latin America, where the distribution of malaria is more focal, a more targeted approach to monitoring and evaluation (M&E) may be necessary, and large, nationally representative surveys to measure coverage may be less useful or may be

conducted less frequently. Likewise, the indicators to measure ITN use or IPTp may not reflect the preventive strategies used in some settings. This guide focuses on indicators for monitoring progress in Africa and other high transmission settings because of the critical need to track the scale-up of key interventions and provide evidence of their impact in areas with the highest disease burden and greatest investment in malaria control.

Technical strategies for the control and prevention of malaria have evolved according to new evidence from the field and changes in technical recommendations and strategic targets. As such, changes to household surveys are necessary. In 2018, this manual was updated to reflect the changes made to household surveys since 2013. Table 4 summarizes the main changes to household surveys and the updates to this manual.

Table 4: 2018 Updates to Household Indicators

Change	Rationale for Change
Remove questions related to IRS from standard household survey questionnaires.	<ul style="list-style-type: none"> ▪ IRS is typically focal and done in a small number of districts. Samples for household surveys are not typically designed to provide representative estimates at this scale. Thus, measures of IRS coverage from household surveys may not be meaningful.
Remove questions on re-treatment of bednets from standard household survey questionnaires.	<ul style="list-style-type: none"> ▪ Bednets that require annual re-treatment and the products used for re-treatment are no longer distributed. Long-lasting insecticidal nets (LLINs) are the only kind of treated bednets available. ▪ Current “LLIN” indicators will be renamed to use “ITN” terminology with appropriate notations.
Refer to “households with 1 ITN for every 2 people” indicator as “full household ITN coverage” instead of “universal coverage.”	<ul style="list-style-type: none"> ▪ This indicator produces a value of 1 or 0 for each household based on whether there are enough nets in the household to cover all household members. Even 90 percent coverage in a household would lead to a 0 value for the house. Thus, this indicator often has low values even in countries with high levels of ITN coverage, and the terminology of universal coverage is not as meaningful. ▪ The ITN access indicator provides an alternative way to look at progress toward universal coverage because it is a population-level indicator rather than a household-level indicator.
Remove language on source of dose from the IPTp indicator.	<ul style="list-style-type: none"> ▪ The original language specifying antenatal care as the source of the sulfadoxine-pyrimethamine (SP) dose developed when IPTp was a new intervention and SP was a first-line treatment in some countries. There was concern that women might report SP taken for treatment of malaria instead of for prevention. The intervention is now well-known, so this specification has been dropped.

2. Monitoring and Evaluation

2.1 Principles of Monitoring and Evaluation

Monitoring is a continuous process of gathering and using data on program implementation with the aim of ensuring that programs are proceeding satisfactorily or making adjustments, if necessary. It often uses program or project routine data to track inputs, processes, and outputs. Evaluation is a more comprehensive assessment of a program. It is normally undertaken at discrete points in time and focuses on the longer-term outcomes and impacts of programs. The overall goal of M&E is to improve program efficiency, effectiveness, and equity.

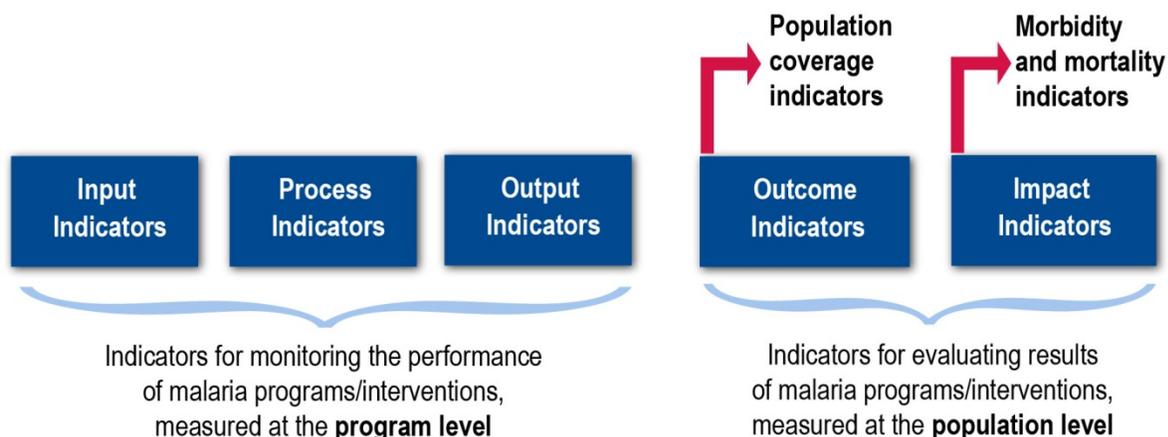
In the context of malaria, monitoring is used to verify, step-by-step, the progress of malaria control programs at various levels to determine whether activities are implemented as planned and to make adjustments if necessary. Monitoring typically comprises input, process, and output indicators at the program level. Input indicators are generally used to measure the level of resources available for use by the program or intervention, such as the funding to purchase ITNs. Process indicators are generally used to verify that a program or intervention is implemented as planned, such as verifying that ITNs are purchased and ready for distribution. It is expected that inputs and desired processes will lead to changes in output indicators, which are generally used to measure benchmarks of program-level performance, such as the number of ITNs distributed to a particular target population

Evaluation may assess whether activities have been undertaken as planned (normative evaluation) or may seek to determine whether changes in results are attributable to a particular malaria control program, as measured through outcome and impact indicators. Such evaluation is known as impact evaluation. Impact evaluation involves measuring changes in impact-level indicators, such as morbidity and mortality, and empirically linking the observed change with a specific program or intervention. This type of evaluation requires rigorous experimental design to make a causal association between program inputs and the resulting impacts. In public health, where programs operate in the context of existing communities and not in controlled trial settings, evaluators must use observational evidence to make inferences about causality. Difficulties in measuring malaria-specific morbidity and mortality consistently over time present further challenges to conducting impact evaluations.

For these reasons, emphasis is often placed on measuring changes in indicators at the outcome level, such as the level of ITN use among a particular target population that can be attributed to a program. There is substantial empirical evidence to support the efficacy of current technical strategies in different programmatic contexts. Hence, it is expected that increasing coverage of these key interventions will result in the desired reductions in morbidity and mortality. It is, therefore, crucial that countries implementing these interventions have clear definitions and appropriate tools for measuring the outcome indicators for population-level coverage as part of their overall M&E strategy. This guide provides basic information for measuring a selection of impact indicators to allow countries to assess whether scale-up of the key interventions has resulted in the intended impact at the population level over the longer term.

Figure 1 provides a sample schematic of the level and function of indicators typically used for M&E. Monitoring generally collects data on a regular basis (weekly, monthly, quarterly or annually), and evaluation occurs over a longer timeframe.

Figure 1: Level and Function of M&E Indicators



2.2 Household Surveys as a Data Source

Nationally representative, population-based household surveys are one source of data for measuring outcome and impact indicators. Complementary sources of data include health management information systems (HMIS), health facility surveys, and program data from national malaria control programs. Most HMIS and health facility surveys collect and aggregate data from the point of service, so they focus on populations seeking healthcare from public sector facilities; household surveys provide information across the entire population. Household surveys and HMIS should be seen as complementary, rather than competing, data sources because each can provide different types of useful information.

Three large surveys that currently collect data on malaria are the Demographic and Health Survey (DHS), the Multiple Indicator Cluster Survey (MICS), and the Malaria Indicator Survey (MIS).

Demographic and Health Surveys: DHS surveys are nationally representative, population-based household surveys that are routinely undertaken every four to five years to collect data on a wide variety of demographic and health indicators. Since 1984, more than 300 DHS surveys have been conducted in more than 90 countries. DHS surveys are designed to produce data that are comparable over time and across countries. DHS surveys include a household listing to ascertain the age, sex, and relationship to the head of household for all individuals in selected households. The surveys are designed to provide population level estimates by age groups, sex, urban-rural residence, regions, and wealth quintiles. DHS surveys in endemic countries include malaria-related questions that are required for the calculation of the indicators in this manual. Published reports, questionnaires, datasets, and other materials related to DHS surveys can be found online at <http://www.dhsprogram.com>.

Multiple Indicator Cluster Surveys: MICS surveys are mostly nationally representative, population-based household surveys developed by the United Nations Children’s Fund to support countries in filling critical data gaps for monitoring the situation of children and women. Initially designed to collect indicators marking progress toward the goals of the World Summit for Children, MICS surveys have been an important component of national data collection in many countries. They are currently conducted in rounds approximately every three years, and since the inception of the effort in 1995, 240 surveys have been conducted in approximately 100 countries worldwide. MICS surveys are designed to produce data that are comparable over time and across countries and are harmonized with data collected through other major household survey programs, such as DHS and MIS. The MICS survey package includes a module for malaria that allows the collection of necessary data for the construction of the indicators in this manual. A full net roster and ITN use among pregnant women, however, were

not included prior to Round 4 (2009-2011) of the MICS surveys. Published reports, questionnaires, and datasets related to the MICS surveys can be found online at <http://mics.unicef.org/>.

Malaria Indicator Surveys: In addition to the ongoing survey efforts of DHS and MICS, RBM partners have developed a standard MIS package for assessing the key household coverage indicators and morbidity indicators. This includes a core questionnaire and data tabulation plan, as well as related materials for organizing and conducting fieldwork. This stand-alone survey is designed to be implemented in a manner similar to the DHS surveys, producing nationally representative, population-based data from which most indicators in this manual can be constructed. The MIS surveys also produce a wide range of data for in-depth assessment of the malaria situation in countries. At the time of this publication, more than 60 national MIS surveys have been completed and are available at <http://www.malariasurveys.org>. The MIS survey questionnaire and other related materials are available online at <http://www.malariasurveys.org/toolkit.cfm>.

2.3 Sampling

To ensure that indicators and their accompanying standard errors can be measured accurately, it is recommended that sampling procedures follow methods similar to those used by the DHS, MICS, or MIS surveys. Such procedures typically entail a two-stage cluster sampling design with primary sampling units selected with probability proportional to size. These samples are typically stratified by region and by urban/rural residence, as stipulated by survey objectives. For further details of this general type of sampling method, please refer to the sampling guidelines for the DHS, MICS, or MIS surveys.

To remain consistent with global targets, the coverage indicators are intended to be measured among the population “at risk for malaria,” which in some instances may create complications for survey design.

Both the DHS and MICS surveys typically include all primary sampling units for an entire country in their sampling frames to ensure nationally representative estimates. In countries with endemic or epidemic-prone malaria throughout, it is appropriate to include all primary sampling units in the country in the sampling frame, given that pre-stratification by urban and rural residence is also undertaken. If a DHS or MICS survey is used to measure the indicators in countries with defined areas without endemic or epidemic-prone malaria, such as those with mountainous areas or deserts, it should be noted that national estimates will include populations not at risk for malaria. This will need to be taken into account when interpreting the values of national-level indicators for some countries. Please refer to the MIS Sampling Guidelines for a more detailed description of how best to construct a sampling frame for countries with widely varying levels of malaria endemicity. They are available at http://www.rbm.who.int/toolbox/tool_MISToolkit.html.

2.4 Interpretation

There are two particular issues that can affect the interpretation of results obtained from household surveys: malaria endemicity and seasonality.

Malaria Endemicity

The first issue that may affect the interpretation of indicator values involves the definition of the target population. As stated previously, the RBM targets stipulate that the coverage indicators are intended to be measured among the target population defined as those at risk for malaria. For countries in which malaria is endemic or epidemic-prone throughout, this issue should not be of particular concern as long as stratification by urban and rural residence is undertaken, as is typically the case with the DHS, MICS, and MIS surveys. In countries that contain large populations in areas absent of malaria, such as those with mountainous areas or deserts, national-level estimates, such as those obtained from the DHS and MICS surveys, will likely result in an underestimate of coverage for those at risk for malaria. In such a situation, it may be advisable to collect additional

information that can establish whether an enumeration area is within or outside a malaria risk area; then during data analysis, the analysis can be limited to survey domains that are deemed to be malarious.

Despite the difficulties associated with varying levels of endemicity, progress in malaria intervention coverage is generally monitored at the national level in high-burden countries in Africa, rather than among subnational at-risk populations. There are many important reasons for relying on national-level estimates of malaria intervention coverage. For many countries, it is difficult to accurately define at-risk areas and subsequently to identify households surveyed in those areas because surveys do not always geo-code the households or villages where survey interviews occur [4], or the geo-codes are randomly offset to protect confidentiality. In addition, the at-risk population will continue to change, and therefore it would be difficult to measure progress with the indicators proposed. Finally, if a strategy is being implemented in an effort to achieve elimination, high coverage levels must be sustained at the national level to continue to control malaria and prevent against future resurgence.

Consequently, indicator estimates obtained from DHS and MICS surveys will not be expected to correspond specifically to malaria endemic areas but will be nationally representative, even in those countries with non-malarious regions. The MIS guidelines should be consulted to incorporate an appropriate subsampling design in countries that include non-malarious regions.

Seasonality

A second consideration that affects the interpretation of the survey findings is the timing of survey implementation relative to the high malaria transmission season (rainy and early post-rainy seasons). MIS surveys are typically conducted during and immediately after the rainy season and should conclude no later than four to six weeks after the rains end, because this timeframe is associated with peak transmission. For operational reasons, however, both DHS and MICS surveys may be conducted during the dry season and therefore outside the peak malaria transmission period. As intervention coverage or usage levels may differ significantly between seasons, and malaria morbidity and mortality will differ by season, interpretation of the data obtained must take into account the seasonality of the survey period. It is also important to note that parasite prevalence data from surveys conducted outside peak transmission periods are not a reliable indicator of peak transmission; therefore, biomarker measurement is recommended during the malaria transmission season only. Further analysis of these data is needed to better understand the extent of the relationship between survey timing and intervention coverage. Notes on significant assumptions and potential biases associated with specific indicators are provided in Section 3, under the description of each indicator.

3. Guidelines for Constructing Indicators from Household Surveys

3.1 Prevention Using Insecticide-treated Nets

At full coverage under trial conditions, ITNs have been shown to reduce all-cause child mortality by 17 percent in sub-Saharan Africa and uncomplicated malaria cases among children under five by 50 percent across a range of malaria transmission settings [5]. ITNs also appear to display similar effectiveness under field conditions [6]. Efforts to scale up coverage of ITNs to reach universal use among the population at risk of malaria are underway in most African countries [2].

Traditionally, there have been two categories of ITNs: conventionally treated nets and long-lasting insecticidal nets (LLINs). Conventionally treated nets are mosquito nets that have been soaked with an insecticide within the past 12 months. An LLIN is a factory-treated net that does not require any re-treatment. It is designed to maintain efficacy against mosquito vectors for at least three years. Since 2007, WHO has recommended that malaria control programs and their partners procure LLINs only [7]. For the purpose of these guidelines, LLINs and conventionally treated nets are included in the category of ITNs. Past editions of this manual noted the differences between conventionally treated nets and LLINs. Recent modifications to the DHS and MIS questionnaires no longer ask about the re-treatment of nets and now assume that all treated nets are LLINs. The ITN terminology has been maintained for harmonization with international targets and for use in trend comparisons. The current version of these guidelines will treat ITN and LLIN terminology as synonymous. Untreated nets can still sometimes be found in markets in a few countries, but they are not considered part of a formal malaria prevention strategy. These nets, and any other nets that do not meet the current definition of an ITN, are classified as “any mosquito net.”

Table 5 summarizes the recommended indicators for tracking prevention using ITNs.

Table 5: Summary of Vector Control Indicators

Indicator	Purpose and Rationale of Indicator
1. Proportion of households with at least one ITN	Measures household ITN ownership
2. Proportion of households with at least one ITN for every two people	Measures the proportion of households that have a sufficient number of ITNs to cover all individuals who spent the previous night in surveyed households, assuming each ITN is shared by two people. In comparison with the previous indicator, it describes the intra-household ownership gap (i.e., households that own at least one ITN but do not have full household coverage).
3. Proportion of population with access to an ITN in their household	Provides an estimate of the proportion of the household population that could have slept under an ITN, assuming each ITN is used by two people
4. Proportion of the population that slept under an ITN the previous night	Measures the level of ITN use among all individuals who spent the previous night in surveyed households, regardless of whether those individuals had access to an ITN in their household. It can be broken down by five-year age brackets, gender, etc., for programmatic analysis. This indicator can be compared with the proportion of population with access to an ITN in the household to describe the magnitude of the behavioral gap in use of ITNs (i.e., the population that has access to an ITN but is not using it). This analysis is useful for informing ITN programs whether they need to focus on achieving higher ITN coverage, promoting ITN use, or both.
5. Proportion of children under five years old who slept under an ITN the previous night	Measures the level of ITN use of children under five years old
6. Proportion of pregnant women who slept under an ITN the previous night	Measures the level of ITN use by pregnant women
7. Proportion of existing ITNs used the previous night	Measures the use of ITNs owned by households. In certain instances, calculating the proportion of existing ITNs used the previous night will be useful for assessing the use of existing ITNs and determining the magnitude of non-use of ITNs at the time of the survey.

Table 6 provides details on the strengths and limitations of all ITN indicators.

Table 6: Strengths and Limitations of All ITN Indicators

Strengths	<ul style="list-style-type: none">▪ The household net roster can be used to collect data for all these indicators and can be added to any nationally representative sample survey of households.▪ Presence of a net is typically verified at time of interview.▪ Data are comparable across countries given that appropriate and consistent sampling procedures are followed and confounding factors are accounted for.
Limitations	<ul style="list-style-type: none">▪ Not all ITNs found in the household are fit for use.▪ No information is collected on the frequency of net washing or about the condition of the net (holes, tears, etc.), which can reduce its effectiveness.▪ Data may be difficult to interpret at the national level unless they are stratified by region and urban/rural strata because malaria transmission is most often localized.

Indicator 1. Proportion of Households with at Least One ITN¹

- **Numerator:** Number of households surveyed with at least one ITN
- **Denominator:** Total number of households surveyed

Purpose/Rationale

This indicator measures household ITN ownership.

Method of Measurement

The numerator for this indicator is obtained from asking the household respondent whether there is any mosquito net in the house that can be used while sleeping and from determining whether each net found in a household is a factory-treated net that does not require any re-treatment. Untreated nets are not included. The denominator is the total number of surveyed households.

Interpretation

This indicator provides a measure for household ownership of an ITN. It reflects the extent to which ITN programs have reached all households or, conversely, the proportion of households not yet reached.

¹ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

Indicator 2. Proportion of Households with at Least One ITN² for Every Two People

- **Numerator:** Number of households with at least one ITN for every two people
- **Denominator:** Total number of households surveyed

Purpose/Rationale

This indicator is used to determine the proportion of households with a sufficient number of ITNs to protect all individuals in the household.

Method of Measurement

The data for the numerator are obtained from determining whether each net found in a household is a factory-treated net that does not require any treatment (an LLIN) and then calculating the total number of ITNs in the household, in combination with information obtained from the household questionnaire that lists the number of individuals who spent the previous night in surveyed households.

The numerator is calculated by dividing the number of individuals who spent the previous night in each surveyed household by the number of ITNs owned by the household and then identifying those households that have a people to ITN ratio of 2.0 or less. The denominator is simply the total number of surveyed households.

Considerations

This indicator is based on the assumption that two people can sleep under one ITN.

This indicator produces a value of 1 or 0 for each household based on whether there is full household coverage or enough nets in the household to cover all household members. Even 90 percent coverage in a household would lead to a value of 0 for the house. Thus, this indicator often has fairly low values even in countries with high levels of ITN coverage.

Interpretation

In connection with the previous indicator (proportion of households with at least one ITN), it can be used to determine what proportion of households already reached with at least one ITN have a sufficient number of ITNs to protect all members in the household. If the difference between these indicators is substantial, programs need to assess whether current ITN distribution strategies should be revised to fill the gap.

² An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

Indicator 3. Proportion of Population with Access to an ITN³ in their Household

- **Numerator:** Total number of individuals who could sleep under an ITN if each ITN in the household were used by two people
- **Denominator:** Total number of individuals who spent the previous night in surveyed households

Purpose/Rationale

This indicator estimates the proportion of the population that could potentially be covered by existing ITNs, assuming that each ITN in a household can be used by two people in that household. It can be compared with Indicator 4, which measures the proportion of the population that slept under an ITN the previous night, to assess the extent to which available ITNs are used (i.e., the population with access to an ITN but not using it). This analysis is useful for informing ITN programs whether they need to focus on achieving higher ITN coverage, promoting ITN use, or both.

Method of Measurement

The data for the numerator are obtained from determining whether each net found in a household is a factory-treated net that does not require any treatment (an LLIN) and then calculating the total number of ITNs in the household.

The data for the denominator are obtained from the household questionnaire that lists all individuals who spent the previous night in surveyed households.

The calculation needs an intermediate variable, which is “potential users.” It can be calculated by multiplying the number of ITNs in each household by two. In households that have more than one ITN for every two people, the product of this calculation will be greater than the number of individuals who spent the previous night. In this case, the “potential users” variable in that household should be modified to reflect the number of individuals who spent the previous night in the household because the number of potential users in a household cannot exceed the number of individuals who spent the previous night in that household. For example, in a household with 10 people and four ITNs, there are eight potential users; however, in a household with five people and four ITNs, there are five potential users, even though the number of ITNs available could cover more than five people.

The indicator can then be calculated by dividing the sum of all potential ITN users in the sample by the total number of individuals who spent the previous night in surveyed households. An example of the Stata code used to calculate this indicator is provided in Annex 2.

Considerations

This indicator is based on the assumption that two people can sleep under one ITN. For example, a household with six residents will require three ITNs. It excludes surplus ITNs in households that have more than one ITN for every two people.

Interpretation

This indicator provides an estimate of the proportion of the total population that could have slept under an ITN. This indicator can be compared with the proportion of the population sleeping under an ITN the previous night

³ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

(Indicator 4). If the difference between these indicators is substantial, the program may need to focus on identifying the main drivers or barriers to ITN use to design an appropriate intervention for behavior change.

Indicator 4. Proportion of Population that Slept under an ITN⁴ the Previous Night

- **Numerator:** Number of individuals who slept under an ITN the previous night
- **Denominator:** Total number of individuals who spent the previous night in surveyed households

Purpose/Rationale

This indicator measures the level of ITN use of all age groups at the time of the survey. It is useful for tracking usage among all ages because coverage of entire populations will be required to accomplish large reductions of malaria burden.

Method of Measurement

The data for the denominator are obtained from the household questionnaire that lists all individuals who stayed in the household the previous night. The data for the numerator are then obtained from a listing of the same individuals in the house who slept under a mosquito net the previous night, in combination with information on whether it is a factory-treated net that does not require any treatment (an LLIN).

Considerations

This indicator may be biased by the seasonality of survey data collection, because survey fieldwork for DHS and MICS may be done during the dry season when net use is likely at its lowest, and fieldwork for MIS is designed to be done during the high transmission season when net use may be higher.

Interpretation

This indicator provides a direct measure of ITN use by all age groups at the time of the survey. It includes all individuals who spent the previous night in surveyed households, including visitors, regardless of whether those individuals had access to an ITN in their own households.

In connection with Indicator 3 (proportion of population with access to an ITN in their household), this indicator can be used to define the behavioral gap in use of ITNs (i.e., the population with access to an ITN but not using it) and distinguish it from the ownership gap (i.e., non-use because there are not enough nets in the household).

⁴ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

Indicator 5. Proportion of Children under Five Years Old Who Slept under an ITN⁵ the Previous Night

- **Numerator:** Number of children under five years old who slept under an ITN the previous night
- **Denominator:** Total number of children under five years old who spent the previous night in surveyed households

Purpose/Rationale

This indicator is used to measure the level of ITN coverage of children under five years old at the time of the survey.

Method of Measurement

The data for the denominator are obtained from the household questionnaire that lists every child under five who stayed in the house the previous night. The data for the numerator are then obtained from a listing of the same children in the house who slept under a mosquito net the previous night, in combination with information on whether it is a factory-treated net that does not require any treatment (an LLIN).

Considerations

This indicator may be biased by the seasonality of survey data collection, because survey fieldwork for DHS and MICS may be done during the dry season when net use is likely at its lowest, and fieldwork for MIS is designed to be done during the high transmission season when net use may be higher.

Interpretation

This indicator provides a direct measure of ITN use by children under five years old at the time of the survey.

⁵ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

Indicator 6. Proportion of Pregnant Women Who Slept under an ITN⁶ the Previous Night

- **Numerator:** Number of pregnant women who slept under an ITN the previous night
- **Denominator:** Total number of pregnant women in surveyed households

Purpose

This indicator is used to measure the level of ITN use by pregnant women.

Method of Measurement

The data for the denominator are obtained from a question asked of all interviewed women of reproductive age in the household about their current pregnancy status. The data for the numerator are then obtained from a listing of these women who slept under a mosquito net the previous night, in combination with information on current pregnancy status and whether the net is a factory-treated net that does not require any treatment (an LLIN).

Note that the MICS survey program did not collect data for this indicator prior to the inclusion of the household net roster in Round 4 (2009-2011).

Considerations

This indicator may be biased by the seasonality of survey data collection, because survey fieldwork for DHS and MICS may be done during the dry season when net use is likely at its lowest, and fieldwork for MIS is designed to be done during the high transmission season when net use may be higher.

In addition, is difficult to capture data on all pregnant women in a household survey because many women either do not know they are pregnant or may not want to divulge this information during early pregnancy. There may be some bias if any reluctance to discuss pregnancy is also associated with first births, adolescence, or other demographic factors.

Interpretation

This indicator provides a direct measure of ITN use by pregnant women at the national level.

⁶ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

Indicator 7. Proportion of Existing ITNs⁷ Used the Previous Night

- **Numerator:** Number of ITNs in surveyed households that were used by anyone the previous night
- **Denominator:** Total number of ITNs in surveyed households

Purpose/Rationale

This indicator measures the use of existing ITNs. In certain instances, calculating the proportion of existing ITNs used the previous night is useful for assessing the use of existing ITNs and determining the magnitude of non-use of ITNs at the time of the survey.

Method of Measurement

The data for the denominator are obtained from the household questionnaire that lists every ITN in each surveyed household. The data for the numerator are then obtained from a listing of every ITN and information on whether the ITN was used by anyone who stayed in the household the previous night.

Considerations

This indicator may be biased by the seasonality of survey data collection, because survey fieldwork for DHS and MICS may be done during the dry season when net use is likely at its lowest, and fieldwork for MIS is designed to be done during the high transmission season when net use may be higher.

Interpretation

This indicator provides a direct measure of the use of existing ITNs at the time of the survey. It complements indicators referring to the potential and actual ITN use in the population, provides an assessment of the level of non-use of ITNs, and identifies behavioral deficiencies of ITN use.

This indicator does not account for the possibility that some households may have an oversupply of ITNs or that some individuals may have slept outside of the household the previous night. In households where there are more ITNs than individuals sleeping in the household, not all ITNs will have been used the previous night.

⁷ An ITN is a factory-treated net that does not require any treatment (often referred to programmatically as an LLIN). See the start of Section 3.1 for explanation of the revised definition.

3.2 Intermittent Preventive Treatment during Pregnancy

Malaria infection during pregnancy is a major public health concern in malaria endemic areas with stable transmission, such as tropical Africa. Malaria during pregnancy can result in poor outcomes for mothers and their newborns, such as maternal anemia, low birth weight, and premature delivery [8]. Low birth weight is the single greatest risk factor for neonatal mortality and a major contributor to infant mortality [9, 10]. This increased risk of adverse outcomes for mothers and their newborns is typically greatest for the mother's first two pregnancies. In the presence of HIV infection, however, the risk associated with placental malaria appears to be independent of the number of pregnancies [11].

Effective strategies for preventing and controlling malaria during pregnancy, such as the use of ITNs and IPTp, have been shown to have a dramatic impact on the health of mothers and their newborns in areas of stable malaria transmission. ITN use has been shown to significantly reduce the prevalence of low birth weight deliveries as well as malaria-related morbidity among pregnant women [8, 12] (see Indicator 6 for an indicator on use of ITNs in pregnancy).

IPTp is the administration of a full course of an effective antimalarial treatment at specified time points to a defined population at risk of malaria, regardless of whether they are parasitemic, with the objective of reducing the malaria burden in the specific target population. WHO currently recommends IPTp with sulfadoxine-pyrimethamine (SP) for pregnant women living in areas of moderate to high transmission in sub-Saharan Africa. The first dose should be administered at an antenatal care (ANC) visit as early as 13 weeks into pregnancy. Each dose should be given by an ANC provider at intervals at least one month apart, and the last dose can be administered up to the time of delivery [13]. IPTp has been shown to significantly reduce the prevalence of anemia and placental malaria infections at the time of delivery [18–20]. SP is contraindicated in HIV+ women already receiving cotrimoxazole as chemoprophylaxis [14].

Due to the recent increase in SP resistance, discussions are underway to determine the continued efficacy of IPTp using SP [15]. SP has been shown to provide substantial benefit to pregnant women, even in settings where unknown, low, or moderate resistance has been observed [16]. Following the 2012 WHO recommendation regarding the frequency of IPTp and GTS indicators, the IPTp indicator in this document measures three or more doses rather than two or more doses.

Indicator 8. Proportion of Women who Received Three or More Doses of Intermittent Preventive Treatment during Their Last Pregnancy

- **Numerator:** Number of women who received three or more doses of SP to prevent malaria during their last pregnancy that led to a live birth in the last two years
- **Denominator:** Total number of women surveyed who delivered a live baby in the last two years

Purpose

WHO recommends that all pregnant women in areas of moderate to high malaria transmission in sub-Saharan Africa receive SP from an ANC provider, with at least one month between each dose, beginning as early as 13 weeks into pregnancy [13]. This indicator is used to measure the use of IPTp to prevent malaria during pregnancy among women who gave birth in the last two years.

Method of Measurement

Data from the women's questionnaires for all women in surveyed households who delivered a live baby in the last two years are used to calculate the denominator. The numerator is derived from the number of women who mention taking SP, the currently recommended prophylactic antimalarial drug for prevention (not treatment) during their most recent pregnancy (from among all listed births to women in the last two years).

Considerations

The currently recommended drug for IPTp is SP. To obtain accurate data for this indicator, it is important to differentiate between a treatment dose for prevention (as prescribed for IPTp) and actual treatment of an existing malaria infection. Although it is difficult to differentiate in the context of a survey interview, the latter is curative care and does not count as a standard IPTp procedure. Women taking antimalarial drugs, such as ACTs, which are not part of standard IPTp, are not considered to be covered by IPTp. IPTp questions in the standard questionnaire ask about SP only and not about other antimalarials, so women taking weekly chloroquine prophylaxis are also not considered to be covered by IPTp.

IPTp with SP is currently recommended by WHO for stable transmission areas in sub-Saharan Africa only [13]. This indicator does not provide information regarding at which stage during pregnancy IPTp was given. Previously, this indicator included information on the source of the SP doses (at least one dose received from an ANC visit), but this specification has been removed. The original language specifying the source of the SP dose was used when IPTp was a new intervention and there was concern that women might report medication taken for treatment of malaria instead of for prevention. The intervention is now well known, and this specification is no longer necessary. The question regarding the source of SP is still in the questionnaire, so it is still possible to disaggregate the indicator by the source of SP in survey datasets.

Retrospective questions about IPTp given during a previous pregnancy may be subject to recall bias. For example, a woman may not recall which type of antimalarial was given or how many doses she received.

Further, malaria is one of the main causes of stillbirth and spontaneous abortion, so there may be inherent bias in this indicator by only including those women with a live birth [19].

It is difficult to capture data on all pregnant women in a household survey because many women either do not know they are pregnant or may not want to divulge this information during early pregnancy. There may be some bias if any reluctance to discuss pregnancy is also associated with first births, adolescence, or other factors.

Interpretation

This indicator provides a measure of the proportion of pregnant women who receive IPTp during pregnancy. Although this indicator does not measure adherence to the WHO policy, which would require information on the stage of gestation at which each dose was taken, receipt of at least three doses of SP serves as a proxy measure of coverage. Data on one, two, and four or more doses of IPTp, which are also available through survey data, can aid in the interpretation of this indicator. Information on the source of the SP given for IPTp can be useful for programs, especially in settings where community-based distribution programs exist.

Health Management Information Systems as an Alternative Data Source

The primary disadvantage of surveys is that their results refer to pregnancies that occurred up to two years before the time of the survey to base the estimates on a large enough number of cases. Measurement through an HMIS captures IPTp at the current time, and analyses can be targeted to facilities where ANC is provided. Consequently, it is appropriate to collect data through both sources.

An IPTp indicator to be obtained from ANC registers is provided in WHO's *Malaria in Pregnancy: Guidelines for Measuring Key Monitoring and Evaluation Indicators* at:

http://whqlibdoc.who.int/publications/2007/9789241595636_eng.pdf. This indicator provides an alternative measure of IPTp delivered through ANC. It is important to note that a different denominator is used in the calculation of this indicator—pregnant women who access the health system; consequently, direct comparisons cannot be made between this indicator and the indicator described above.

3.3 Case Management among Children under Five Years Old

Access to Diagnostic Testing

Prompt parasitological confirmation by microscopy, or alternatively by rapid diagnostic tests (RDTs), is recommended in all patients with suspected malaria before treatment is started [14]. Antimalarial treatment given solely on the basis of clinical suspicion should be considered only when a parasitological diagnosis is not available. Treatment based on diagnostic testing is good clinical practice and has the following advantages over presumptive treatment of all fever episodes:

- Improved care of parasite-positive patients because of confirmation of infection
- Identification of parasite-negative patients, in whom another diagnosis must be sought and treated accordingly
- Reduced side effects, drug interactions, selection pressure, and potentially costs, by reducing the use of antimalarial medicine in parasite-negative patients
- Increased public trust in the efficacy of ACT when used only to treat confirmed malaria cases
- Enhanced public trust in the diagnosis and treatment of non-malaria causes of febrile illness
- Delayed onset of drug resistance

As malaria programs increase the coverage of interventions and the incidence of malaria decreases, the proportion of fevers not due to malaria increase. Hence, it becomes increasingly important to undertake diagnostic testing to identify and treat confirmed cases only.

Access to Effective Treatment

Prompt and effective treatment is a key element in successful malaria control because of the rapid onset of illness and severe health outcomes related to *Plasmodium falciparum* malaria, especially among children and non-immune populations [17, 18]. Antimalarial drug resistance has become a major challenge in providing an effective malaria treatment in many regions of the world. Resistance to traditional monotherapies, such as chloroquine, SP, and amodiaquine, is widespread across most of Africa. As a result, WHO recommends treating malaria due to *P. falciparum* using ACTs [14]. Understanding which antimalarial drugs are provided to children and the promptness with which they seek treatment after the onset of symptoms is important for monitoring prompt access to effective treatment.

Although the treatment guidelines have shifted from presumptive treatment, measuring confirmed malaria cases among children under five through survey instruments presents a number of challenges. Caregivers may never receive the results of diagnostic testing, and if they do, the results may not provide reliable information regarding malaria diagnoses [20, 21]. Due to these measurement challenges, the current version of this manual does not provide recommendations regarding the measurement of confirmed malaria cases, which would be the ideal basis for indicators related to prompt and effective treatment. Research is still needed to assess and improve methodologies to measure malaria cases through survey instruments. As an interim measure, the recommended indicator examines which proportion of antimalarial treatments are ACTs or other first-line treatments; first-line treatment is expected to include ACTs in most countries with *P. falciparum*, but it may be different in countries with non-*falciparum* malaria.

Summary of Case Management Indicators

- *Proportion of children under five years old with fever in last two weeks who had a finger or heel stick*
- *Proportion of children under five years old with fever in the last two weeks for whom advice or treatment was sought*

- *Proportion receiving first-line treatment, among children under five years old with fever in the last two weeks who received any antimalarial drugs*

Programs can also examine the indicator “Proportion of children under five years old with fever in the last two weeks for whom advice or treatment was sought within 24 hours from the onset of fever.” This indicator is available in DHS and MIS reports, although it is not a key recommended indicator.

These indicators replace those that were recommended in a previous version of this document, **Guidelines for Core Population-Based Indicators**. The previously recommended treatment indicators were as follows:

- *Proportion of children under five years old with fever in last two weeks who received any antimalarial treatment*
- *Proportion of children under five years old with fever in last two weeks who received antimalarial treatment according to national policy within 24 hours from the onset of fever*

These are presented in this document in Annex 1 as previously recommended indicators. These indicators were intended to capture the accessibility of antimalarial treatment to children under five years old with fever. With the scale-up of diagnostic testing, these indicators have become problematic because they do not take into account the fact that some febrile children will be given a diagnostic test and those children who test negative should not be given an antimalarial medicine. As a result, countries or areas with more accessible health services and diagnostic testing can produce lower values of the indicator than those with weaker health services. In addition, for those children who are not tested, the indicators do not provide a good guide to the appropriateness of treatment, because in most epidemiological settings the proportion of fever cases that have evidence of malaria parasite prevalence are low (less than 30 percent) [22]. Accordingly, those indicators are no longer recommended.

Details on the strengths and limitations of all recommended case management indicators are listed in Table 7.

Table 7: Strengths and Limitations of All Diagnostic Testing and Treatment Indicators

Strengths	<ul style="list-style-type: none"> ▪ The limited number of questions required to ascertain data for these indicators can be easily added to any nationally representative sample survey of households. ▪ Data are comparable across countries, given that appropriate and consistent sampling procedures are followed and confounding factors are accounted for.
Limitations	<ul style="list-style-type: none"> ▪ Data may not be based on reliable estimates of episodes of fever in the previous two weeks. ▪ Fever may not have been the result of malaria infection. ▪ Data based solely on the mother’s or caregiver’s information may miss fostered children or others living in a household without a parent or caregiver. ▪ Data based solely on the mother’s or caregiver’s information may not be reliable if she or he did not take the child for care, has low literacy, or lives in a context where a range of drugs are prescribed for malaria by healthcare providers.

Indicator 9. Proportion of Children under Five Years Old with Fever in Last Two Weeks Who Had a Finger or Heel Stick

- **Numerator:** Number of children under five years old with fever in the previous two weeks who had a finger or heel stick
- **Denominator:** Total number of children under five years old who had a fever in the previous two weeks

Purpose/Rationale

This indicator measures the extent to which children with fever obtain a parasitological diagnosis. Only a minority of fever cases that present to a health facility have evidence of malaria parasitemia when tested [22] and should be treated with antimalarial medicines. The majority of fever cases test negative and should not be treated with antimalarial medicines because of the following: (1) the true cause of fever should be ascertained and treated appropriately; (2) treatment of patients with negative test results causes wastage of high-cost, artemisinin-based medicines; and (3) treatment of patients with negative test results causes increased selective pressure for drug resistance, thereby accelerating the onset of drug resistance.

Method of Measurement

The data for the denominator include children under five who had a fever in the previous two weeks. These data are obtained in one of two ways, depending on the type of survey. Some surveys (i.e., MICS) use the household listing procedure, whereby every child under five who stayed in the house the previous night is identified. DHS and MIS surveys ask questions in the women’s questionnaire about all of their biological children under five years of age; thus, the denominator excludes non-biological children. The numerator is then obtained by asking all mothers or caregivers in the household whether any of the children who had a fever in the past two weeks received a finger or heel stick.

Considerations

A finger or heel stick may not have been conducted to diagnose malaria (for instance, these methods are also used to diagnose anemia). The most likely purpose of a finger or heel stick for this age group is malaria testing, especially when the child has a fever, so this should not be of considerable concern. The mother is not specifically asked whether the finger or heel stick was conducted for malaria testing due to concerns that an underestimate would result, because some women may not know whether the sample drawn was used for malaria diagnosis.

Interpretation

This indicator provides a proxy measure of the level of access to diagnostic testing for malaria infection for children under five years old. As countries scale up toward universal diagnostic testing, the indicator values reported are expected to increase but are unlikely to reach 100 percent because some fever cases will not seek care at places where tests are available, if at all. Most testing is done in public sector health facilities, and the value of the indicator will depend partly on the proportion of fever cases that attend such facilities.

Indicator 10. Proportion of Children under Five Years Old with Fever in the Last Two Weeks for Whom Advice or Treatment Was Sought

- **Numerator:** Number of children under five years old with fever in the previous two weeks for whom advice or treatment was sought
- **Denominator:** Total number of children under five years old with fever in the previous two weeks

Purpose/Rationale

This indicator captures national-level care-seeking behavior for the treatment of malaria among children under five years old.

Method of Measurement

The data for the denominator include children under five who had a fever in the previous two weeks. These data are obtained in one of two ways, depending on the type of survey. Some surveys (i.e., MICS) use the household listing procedure, whereby every child under five who stayed in the house the previous night is identified. DHS and MIS surveys ask questions in the women’s questionnaire about all of their biological children under the age of five; thus, the denominator excludes non-biological children. The numerator is then obtained by asking all mothers or caregivers in the household whether treatment was sought from any source for each of the children under five years old with fever in the last two weeks.

Considerations

The mother of a child does not always know the exact qualifications of or the type of provider and therefore may not be able to tell the interviewer this information. A limitation is that only one source of advice or treatment is recorded; for some children, care may have been sought from multiple types of providers between onset of fever and day of the survey.

Interpretation

Although *type of provider* is not a component of the indicator definition, program managers may find it useful to disaggregate this indicator by type of provider to determine whether treatment was sought by an appropriate provider.

The questionnaire also asks “*How many days after the illness began did you first seek advice or treatment for (NAME)?*” This allows program managers to examine the extent to which treatment is sought *within 24 hours from the onset of fever*.

This indicator does not determine why advice or treatment was not sought for some children.

Indicator 11. Proportion receiving first-line treatment, among children under five years old with fever in the last two weeks who received any antimalarial drugs

- **Numerator:** Number of children under five years old with fever in the previous two weeks who received first-line treatment according to national policy
- **Denominator:** Total number of children under five years old who had a fever in the previous two weeks who received any antimalarial drugs

Purpose/Rationale

This indicator assesses what proportion of antimalarial treatment received by children under five is in accordance with national malaria treatment policy. Understanding which antimalarial drugs are provided is an important component for monitoring access to effective treatment.

Method of Measurement

The data for the denominator include children under five who had a fever in the previous two weeks. These data are obtained in one of two ways, depending on the type of survey. Some surveys use the household listing procedure, whereby every child under five who stayed in the house the previous night is identified (MICS). DHS and MIS surveys ask questions in the women's questionnaire about all of their biological children under the age of five; thus, the denominator excludes non-biological children. This is combined with information obtained by asking all mothers or caregivers in the household whether any of the children who had a fever in the past two weeks were given an antimalarial treatment. The numerator is then calculated by determining the number of these children who were provided with any ACT or other first-line treatments according to national policy in countries with non-*falciparum* malaria.

Considerations

This indicator is not limited to confirmed cases. Furthermore, it does not measure treatment in children under five with fever in the past two weeks for whom advice or treatment was not sought and those for whom advice or treatment was sought but who did not receive an antimalarial drug. Depending on the availability and use of parasitological confirmation, many of the children in the latter group may not have received antimalarial drugs because their diagnostic test confirmed that their fever was not the result of malaria.

In addition, there is no way of knowing if antimalarial treatments were administered correctly.

Interpretation

This indicator measures the extent to which ACT or other first-line treatments are used to treat malaria as a proportion of all antimalarial treatments, and therefore it is a measure of effective treatment. Ideally, ACTs or other first-line treatments should represent almost all antimalarial treatments.

3.4 Impact Indicators

Data on anemia and parasitemia can be useful for assessing malaria morbidity. Parasite prevalence is malaria-specific and can provide an approximate measure of transmission [23]. Anemia prevalence can reflect malaria morbidity and responds to changes in the coverage of malaria interventions [24, 25]. The standard MIS includes anemia and parasitemia biomarker measurements. The DHS routinely collects anemia data from nationally representative samples and sometimes includes parasitemia measurements.

Monitoring trends in all-cause under-five mortality rates (U5MRs) using data from nationally representative household surveys, such as DHS and MICS [26], is a useful exercise; however, U5MR can be influenced by several factors and does not provide specific information on malaria mortality trends. MIS surveys do not have the statistical power to measure under-five mortality.

In assessing whether malaria control programs have had an impact on all-cause mortality rates, it is possible to examine all-cause childhood mortality trends over a clearly defined time interval and, for the same time interval, observe changes in malaria intervention coverage, the prevalence of other factors influencing malaria and non-malaria childhood mortality (vaccination coverage, malnutrition, etc.), and morbidity indicators (anemia and parasite prevalence). If statistically significant reductions in mortality and morbidity are found *and* malaria intervention coverage has increased to high levels *and* other factors influencing all-cause childhood mortality have not changed substantially, then it is a plausible conclusion that malaria control activities caused or contributed to reductions in malaria-associated mortality. A more detailed description of this evaluation method has been described in a separate RBM MERG document and in the American Journal of Tropical Medicine and Hygiene [27, 28].

Details on the strengths and limitations of all impact indicators are listed in Table 8.

Table 8: Strengths and Limitations of Impact Indicators

Strengths	<ul style="list-style-type: none">▪ They are representative of large populations of interest.▪ Data are comparable across countries given that appropriate and consistent sampling procedures are followed.
Limitations	<ul style="list-style-type: none">▪ Due to cost and other resource limitations, large nationally representative surveys are usually conducted on three-year or five-year cycles, and data may not be available at the optimal intervals for evaluation.▪ The survey recall period for all-cause under-five mortality may not coincide exactly with the scale-up period of interventions, causing their impact to be underestimated.▪ Prevalence estimates for anemia and malaria parasitemia may be biased by the seasonality of survey data collection, because survey fieldwork for DHS and MICS is sometimes done during the dry season when prevalence is likely at its lowest.

Indicator 12. Parasite Prevalence: Proportion of Children Aged 6-59 Months with Malaria Infection

- **Numerator:** Number of children aged 6-59 months with malaria infection detected by rapid diagnostic test or microscopy
- **Denominator:** Total number of children aged 6-59 months tested for malaria parasites by rapid diagnostic test or microscopy

Purpose/Rationale

The parasite prevalence among children aged 6-59 months is an indicator of malaria burden within populations and provides a guide to the level of malaria transmission.

Method of Measurement

Parasitemia testing should be included in surveys that are conducted during the high transmission season for malaria. In some cases where transmission is perennial (occurs all year), seasonal peaks may still influence the parasite prevalence, and seasonality should be taken into account when planning a survey. Ideally the MIS should be conducted when rains become intermittent and in the four to six weeks after the rains end. This timeframe is associated with peak transmission and is therefore suitable for measuring parasite prevalence. Large-scale household surveys, such as the DHS and MICS, are typically not suitable for inclusion of parasitemia measurement because these surveys are not usually conducted during the high transmission season and because of the length of fieldwork, which would cover different periods of seasonal transmission.

Parasitemia testing should target children aged 6-59 months. This is the same age range that is targeted for anemia testing in both DHS and MIS surveys. Depending on a number of conditions in the survey setting, parasite prevalence should be based on either a high-quality RDT or microscopy. RDT testing is always necessary to provide treatment to infected individuals, because microscopy test results are not immediately available. Further, in circumstances in which quality-assured malaria microscopy cannot be met, the use of quality-assured malaria RDTs may function as a first-line diagnostic test for detection of malaria infection in population-based surveys [29]. More detail on the appropriate use of each of these tests is provided below.

Rapid Diagnostic Tests

Parasite prevalence should be based on the results of a high-quality RDT in settings where there is reasonable evidence (from household surveys, routine data, or special studies) that both of the following conditions prevail:

- *P. falciparum* accounts for nearly all infections (≥ 90 percent).
- Low-level infections (<200 parasites/ μ l) are uncommon.

Following consultation with the RBM constituency, in situations in which requirements for high-quality malaria microscopy cannot be met, the RBM MERG endorses the use of quality-assured malaria RDTs as the first-line diagnostic test for detection of malaria infection in population-based surveys. RDTs produce reliable, sensitive, and specific results within 15–20 minutes and at low cost, with limited technical skill requirements. For these reasons, they are a more practical choice for the collection of field data on a larger scale. For the few areas in sub-Saharan Africa with identified presence of *P. falciparum* HRP2 deletions greater than 5 percent, it is important to obtain expert advice from the WHO's Global Malaria Programme and the RDT Evaluation Program on the type of RDTs to be deployed for malaria prevalence surveys [30, 31]. At the time of publication of this manual, the latest results were available at: <http://www.who.int/malaria/publications/atoz/978924151268/en/>.

Microscopy

Prevalence should be based on microscopically examined blood films prepared in the field and read in a quality-controlled laboratory by well-trained microscopists in settings where there is reasonable evidence (from household surveys, routine data, or special studies) that either of the following conditions prevail:

- Non-*falciparum* malaria or mixed infections account for more than 10 percent of infections.
- Parasite density is expected to be below 200 parasites/ μl in a substantial proportion of cases.

In settings where the determination of species is necessary, thick blood films should be used to determine parasite prevalence, and thin films should be examined to estimate levels of infection with *P. falciparum*, *P. vivax*, or other species. Rapid diagnostic testing with tests that can detect all species present should also be included for field surveys so that all respondents with malaria can be treated or referred, according to national policy. Where both RDTs and microscopy are used for parasitemia testing, results of both should be reported.

It is important to recognize the distinction between diagnosis in clinical settings and identification of infected individuals for prevalence studies. Microscopy presents special issues for survey efforts. Field teams must be adequately trained to collect specimens on slides. The storage and transportation of slides is also difficult in the field and requires logistical planning. Supervision of these efforts is also important.

Considerations

Some studies of malaria interventions showing mortality reductions have found large decreases in parasite prevalence [32, 33]; however, other studies have found that despite reductions in mortality, parasite prevalence changes little [5].

As measurement of parasite prevalence requires finger stick blood, some caretakers may not consent to parasitemia testing of their child.

Microscopy results are often delayed due to factors involving slide transportation, laboratory access, and availability of a trained slide reader; RDTs, however, produce reliable, sensitive, and specific results within 15–20 minutes and at low cost, with limited technical skill requirements. For these reasons, they are a more practical choice for the collection of field data on a larger scale. There is no requirement from WHO to use microscopy for prevalence measurement if RDTs are of high quality; however, microscopy may help identify the need for potential HRP2 deletion surveillance.

Parasite prevalence can fluctuate dramatically throughout the course of a year with the seasonality of malaria, and thus values of the indicator may be influenced by the timing of a survey in relation to peak transmission. Accordingly, parasite prevalence should not be used for tracking the short-term impact of scaling up prevention efforts, because the prevalence rates may merely reflect differences in the timing of surveys in relation to within-year variation in parasite prevalence. Parasite prevalence is better suited to measuring changes in malaria burden over a longer term during which changes in parasite prevalence are expected to be much greater and outweigh within-year variation. To demonstrate a reliable trend, no more than four data points within a 10-year span are generally needed.

Interpretation

This indicator provides a direct measure of parasite prevalence among children aged 6-59 months at the national level.

Parasite prevalence is difficult to interpret and can fluctuate dramatically throughout the course of a year; therefore, it is not suitable for the detection of program impact over short periods.

Although malaria RDTs are a suitable alternative to microscopy for estimating prevalence in certain circumstances, the method of measuring parasite prevalence should be considered (microscopy or RDT) when interpreting this indicator. This is especially important when interpreting trends over time, because parasite prevalence before the advent of RDTs was measured primarily using microscopy. Microscopy detects parasites present in the blood at the time of the survey and therefore provides point *parasite prevalence*. In contrast, HRP2-based RDTs detect antigens to malaria parasites, which may endure for some weeks after treatment. This difference can result in very different estimates of malaria prevalence and should always be taken into consideration when interpreting results for these indicators.

Details on the strengths and limitations of using RDTs and microscopy for population-based surveys are listed in Table 9.

Table 9: Strengths and Limitations of Using RDTs and Microscopy for Population-based Surveys

Test Type	Strengths	Limitations
RDTs	<ul style="list-style-type: none"> ▪ RDTs require less training than microscopy because they do not require staining, mounting and reading of slides. ▪ Results are rapid (within 15 minutes), thus facilitating timely treatment of infected individuals. ▪ In survey settings, costs are lower than those of microscopy (materials, transport, and labor). ▪ Currently available RDTs have sensitivity and specificity comparable to routine microscopy. 	<ul style="list-style-type: none"> ▪ Some children previously treated for malaria may test positive by RDT within 14 days after treatment, because antigens often persist after treatment. ▪ Variation may exist between brands and types of RDTs, such as which antigens are detected. This could affect the comparability of survey results across time and countries. ▪ RDTs may have limited determination of species. Some tests detect only one <i>Plasmodium</i> species, usually <i>P. falciparum</i>; others detect any species but do not identify which is present. ▪ Quantification of parasites is not possible. ▪ Sensitivity is low for low parasite densities. ▪ HRP2-based RDTs have difficulty detecting <i>P. falciparum</i> parasites that lack the PfHRP2 gene and do not produce HRP2, but this is uncommon in sub-Saharan Africa [34].
Microscopy	<ul style="list-style-type: none"> ▪ It is historically considered the gold standard for malaria diagnosis. ▪ Microscopy permits determination of species and quantification of parasites. ▪ Historical comparisons are possible assuming comparable skill of microscopists due to consistency of diagnostic methods over time. ▪ Slides can be stored and reexamined. 	<ul style="list-style-type: none"> ▪ There are practical difficulties in preparing blood films in the field. ▪ Slides must be transported and stored. ▪ Sufficiently trained microscopists (especially in settings where determination of species is required) are not always available, and there are often inconsistencies in reading slides. ▪ Variation is likely to occur between microscopists. ▪ It increases survey costs. ▪ Sensitivity is low for low parasite densities. ▪ It increases the time necessary before data can become available.

Parasite Prevalence among All Ages

It is not recommended that parasite prevalence be estimated for all ages on a regular basis. In some cases, however, the inclusion of all ages for testing may be warranted. These include special studies in settings where a clear age pattern of malaria infection is not apparent, surveys that will provide for modeling of incidence of malaria, or surveys carried out where prevalence is very low or unstable.

Recruiting and testing an older, less accessible population through large-scale household surveys involves a number of challenges to gather estimates of parasite prevalence among all ages. These include the following:

Practical Challenges

- The time and cost associated with conducting a survey will increase significantly if parasite testing is extended to all age groups. When testing is conducted for children aged 6-59 months only, approximately 15 percent of the total sample population is tested. In contrast, up to 100 percent of that population will be tested to get an estimate for all age groups.
- School children and adults who work outside the home are generally not present at home during the time of day that survey fieldwork is often conducted, and those who are home are more likely to be sick. To reduce the bias caused by this absence, survey teams can carry out fieldwork during school holidays or late in the afternoon, or they can conduct repeat visits to households during times when school children and working adults are more likely to be at home.

Epidemiological Challenges

- During pregnancy, malaria parasites can sequester themselves in the placenta. Routine light microscopy and RDTs cannot detect all infections in peripheral blood, which serves as the sample for parasite testing in MIS [35, 36, 37].
- In most low-risk countries where national prevalence is 2 percent or less, it is probable that all age parasite prevalence estimates will be imprecise, especially subnationally.

Case Management Challenges

There are difficulties related to testing and treating pregnant women, especially early pregnancies, which are more difficult to detect, because treatment protocols are different for pregnant and non-pregnant women. The following should be considered when testing and treating pregnant women:

- First, survey implementers must establish whether a woman is pregnant to be able to provide the correct treatment. Household surveys do not conduct pregnancy tests, so pregnancy status would have to be based on women's reports on whether they are pregnant. Self-reported pregnancy status is considered unreliable because many women either do not know they are pregnant or do not want to divulge this information during early pregnancy. There also may be some bias if any reluctance to discuss pregnancy is associated with first births, adolescence, or other demographic factors.
- If it is established that a woman who tests positive for malaria is pregnant, the trimester of her pregnancy must be determined to follow the appropriate treatment protocol. In past surveys in some countries, a qualified nurse or equivalent was required to be present in the survey team to conduct a pregnancy history and determine the trimester so that appropriate treatment could be provided [38, 39].
- In some settings, the first-line treatment for malaria is also used for malaria during pregnancy. In many settings, however, national treatment guidelines depend on the trimester of pregnancy. This may require that the survey implementers procure more than one type of antimalarial drug to treat pregnant women.
- Some recommended treatments are given over a period of days and thus cannot be administered by survey personnel. Individuals can be referred to nearby health centers for treatment, but some health centers may be far from survey households or may not have the appropriate antimalarial drugs.

In sum, one should proceed cautiously when considering extending this indicator to respondents of all ages, but under some circumstances special studies may be deemed appropriate, and an additional indicator should then be calculated.

Indicator 13. Moderate-to-Severe Anemia Prevalence

Proportion of Children Aged 6-59 Months with a Hemoglobin Measurement of <8 g/dL

- **Numerator:** Number of children aged 6-59 months with a hemoglobin measurement of <8 g/dL
- **Denominator:** Total number of children aged 6-59 months who had hemoglobin measurements obtained during the household survey

Purpose/Rationale

Anemia, defined by a hemoglobin (Hb) concentration below established cut-off levels, is a widespread public health problem. Although anemia is not specific to malaria, it can be useful to follow trends in anemia prevalence, because they can reflect the impact of malaria interventions [24, 25]. Malaria interventions have been associated with a 60 percent reduction in the risk of moderate-to-severe anemia (Hb<8.0 g/dL) [26].

Method of Measurement

Monitoring anemia through household surveys has become a more viable option due to the development of the HemoCue® test of finger stick blood, which is used to measure Hb distributions in large-scale household surveys. Anemia should be measured in children aged 6-59 months. Surveys should record Hb measurements to the 0.1 g/dL precision level using a HemoCue® instrument on capillary blood sampled while the child is sitting [25].

An Hb concentration cut-off of less than 7.0 g/dL has been widely used to classify severe nutritional anemia [40, 41], but a different cut-off, 8.0 g/dL, is used to classify malaria-related anemia, because intervention trials have shown that malaria control reduces the prevalence of moderate-to-severe anemia (below 8.0 g/dL) more so than it reduces the prevalence of any anemia (below 11.0 g/dL) [24].

Data on altitude should be used to adjust anemia prevalence estimates in countries that have any enumeration areas above 1,000 meters, because normal Hb distributions vary with altitude. To supply a sufficient amount of oxygen to the tissues, individuals living at higher altitudes must produce more red blood cells to compensate for lower oxygen partial pressure and decreased oxygen saturation of blood. The recommended adjustment factors, described by the Centers for Disease Control and Prevention, are available at:

<http://www.cdc.gov/mmwr/pdf/rr/rr4703.pdf> [42]. If altitude data are not used to adjust results in areas of high altitude, underestimates of anemia are likely to occur.

Considerations

A potential drawback to this indicator is the seasonal variation in malaria-related anemia, which makes survey outcomes sensitive to the season of measurement.

Measurement of anemia requires finger stick blood, and some caretakers may not consent to anemia testing of their child. In addition, survey personnel will require extra training to carry out HemoCue® testing.

Interpretation

This indicator provides a proxy measure of the prevalence of malaria-related anemia among children aged 6-59 months at the national level.

Anemia measurement has become a standard component of the DHS and some other household surveys. It should be noted that DHS surveys include anemia measurements in the nutrition chapter, using the cut-off value of less than 7.0 g/dL rather than 8.0 g/dL, necessitating that caution be taken when interpreting and comparing results.

Use of anemia as a malaria indicator will be compromised by a lack of specificity, particularly in areas with low malaria transmission, given other anemia determinants such as pediatric HIV/AIDS, malnutrition, and helminth

infections. Even in areas of intense malaria transmission, moderate-to-severe anemia in young children may depend more on undernutrition than on malaria, and separating malnutrition from malaria as the cause of anemia is not possible, because the proportions will vary from population to population and cannot be known. Consequently, data must be interpreted cautiously, with consideration of the many other causes of anemia present in the survey area.

Additional Analysis

Survey reports should tabulate both the prevalence of Hb <8.0 g/dL and the mean Hb level, preferably with its standard deviation so that the user can derive anemia prevalences with alternative cut-offs by applying a normal approximation [25]. In survey reports that include sections on both nutrition and malaria, the prevalence of Hb <7.0 g/dL and the prevalence of Hb <8.0 g/dL should be reported in the appropriate chapters. Consequently, analyses using both Hb cut-offs will need to be conducted. It should be clearly stated in the text that the prevalence of Hb <7.0 g/dL measures severe anemia to assess nutritional deficiencies, and the prevalence of Hb <8.0 g/dL measures moderate-to-severe anemia, to assess the impact of interventions on malaria-related anemia.

Indicator 14. All-Cause Under-Five Mortality Rate

Purpose/Rationale

In areas of stable endemicity, the major burden of malaria occurs in very young children who, because they have not yet developed adequate clinical immunity, are at the highest risk of severe illness and death; globally, malaria accounts for approximately 7 percent of all child deaths [43]. Thus, in areas of stable transmission, malaria control interventions should have an impact on all-cause under-five mortality trends.

Method of Measurement

The U5MR can be derived from household survey data using direct or indirect methods. The direct method is used in DHS surveys and requires a birth history that includes information on all children ever born, their survival status, and the age of death for non-surviving children, to calculate the probability of dying before age five for children exposed to mortality during the five-year period before the survey. More specifically, the DHS employs the synthetic cohort life table approach, in which mortality probabilities for small age segments based on real cohort mortality experience are combined into larger age segments that correspond to the age group of interest.

In the majority of MICS surveys, the U5MR is calculated based on an indirect estimation technique known as the Brass method. This technique converts the proportion of children who have died among women in a certain age group into the probability of dying by an exact childhood age. By using model life tables and strong assumptions as to age patterns and time trends, the mortality rate estimates are indirectly derived, as well as the date to which they apply. Some MICS surveys, however, use birth histories to calculate direct estimates of U5MR.

The MIS was conceptualized to provide national-level estimates of malaria infection. MIS surveys are topic specific and most of the malaria indicators of interest do not require a large sample size to measure reliably, so these surveys are typically much smaller in scale than DHS or MICS. MIS surveys are not designed to collect estimates of child mortality. Standard MIS questionnaires do not include the questions necessary for calculating mortality rates. Birth history information is collected for children born in the six years immediately preceding the survey for the main purpose of defining denominators for other indicators. In countries that lack reliable vital registration systems, accurate estimates of child mortality rates are best obtained through DHS or MICS surveys.

Considerations

U5MR has the benefit of capturing both direct and indirect effects of malaria interventions on under-five mortality (i.e., the effects on malaria mortality and on mortality from other causes that are influenced by malaria). Changes in U5MR may, however, be influenced by a variety of factors other than malaria control.

The indicator can be measured reliably and is not affected by limitations of methods to identify malaria-specific deaths. Under reporting of deaths, however, is always a possibility in household surveys.

Household surveys calculate mortality rates over a five-year period to ensure that there are enough cases to produce reliable results. Therefore, on average, surveys measure under-five mortality with a 2.5-year lag. In addition, point estimates of U5MR will be centered at a different time from indicators of intervention coverage estimated from the same survey.

In areas of moderate to high malaria transmission, malaria may account for as much as 30 percent of under-five mortality due to all causes. In these settings, if malaria-specific mortality decreases by 50 percent, a 15–19 percent reduction in all-cause under-five mortality is generally expected. At the usual sample size, DHS surveys have the statistical power to confirm under-five mortality reductions between two successive surveys if the true mortality reduction is 15 percent or larger. Consequently, the ability to detect a reduction in all-cause mortality resulting from fairly small reductions in malaria deaths may be difficult when relying on this data source.

Estimation methods currently do not account for selection bias that may arise due to high HIV prevalence.

Interpretation

This indicator provides a measure of all-cause under-five mortality at the national level.

Malaria-Specific Mortality

Measuring malaria-specific mortality at the population level is challenging due to incomplete data from civil registration and vital statistics systems in most malaria endemic countries. Malaria is also difficult to confirm as a cause of death since its symptoms are similar to other infectious diseases and comorbidities are common. Furthermore, most malaria deaths occur outside of the formal health system. Due to these challenges, U5MR is recommended as an impact indicator for malaria interventions.

Estimates of malaria deaths are usually computed using disease modeling techniques. Information may be triangulated from civil registration and vital statistics systems, HMIS, and verbal autopsy.

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Annex 1: Previously Recommended Indicators

The following indicators were previously recommended by the Roll Back Malaria Monitoring & Evaluation Reference Group but are no longer recommended.

Proportion of Children under Five Years Old with Fever in the Last Two Weeks Who Received Any Antimalarial Treatment

- **Numerator:** Number of children under five years old with fever in the previous two weeks who received any antimalarial treatment
- **Denominator:** Total number of children under five years old with fever in the previous two weeks

Proportion of Children under 5 Years Old with Fever in Last 2 Weeks Who Received Antimalarial Treatment according to National Policy within 24 Hours from Onset of Fever

- **Numerator:** Number of children under five years old with fever in the previous two weeks who received recommended antimalarial treatment according to national policy within 24 hours from onset of fever
- **Denominator:** Total number of children under five years old with fever in the previous two weeks

Purpose/Rationale

The intention of the indicators was to capture the use of antimalarial treatment to children under five years old with fever. The indicators have become problematic as diagnostic testing has scaled up; they do not take into account the fact that some febrile children will be given a diagnostic test and those who test negative should not be given an antimalarial medicine. As a result, countries or areas with more accessible health services and diagnostic testing can produce lower values of the indicator than those with weaker health services. In addition, for those children who are not tested, the indicators do not provide a good guide to the appropriateness of treatment because in most epidemiological settings the proportion of fever cases with evidence of malaria parasitemia is low (less than 30 percent) [25].

Proportion of Households that Received Spraying through an IRS Campaign in the Last 12 Months

- **Numerator:** Number of households that were sprayed with a residual insecticide during an IRS campaign in the last 12 months
- **Denominator:** Total number of households surveyed

Purpose/Rationale

The purpose of this indicator was to measure IRS coverage at the national level. The intent was to obtain information on overall coverage with IRS, rather than information on the quality of spraying activities. In countries where sizeable IRS operations are underway, it may be advantageous to report IRS coverage at the national level. In some countries, relatively small areas or “target zones” are specifically targeted for spraying, so presenting nationally representative results may misrepresent the extent to which IRS targets have been achieved, because low nationwide coverage is not necessarily an indication of a poorly performing IRS program. The decision was thus made to remove IRS questions from household surveys, because they are not the best tool to capture meaningful data on IRS.

Annex 2: Sample Stata Code for Calculating the Intermediate Variable for Indicator 3

Proportion of Population with Access to an Insecticide-Treated Net (ITN) in Their Household

The calculation of Indicator 3—Proportion of Population with Access to an ITN in Their Household—needs an intermediate variable, which is “potential users.” This variable can be calculated by multiplying the number of ITNs in each household by two. The product of this calculation may be greater than the number of individuals who spent the previous night in a household if a household has more than one ITN for every two people. In this case, the “potential users” variable in that household should be modified to reflect the number of individuals who spent the previous night in the household, because the number of potential users in a household cannot exceed the number of individuals who spent the previous night in that household.

The indicator can then be calculated by dividing the sum of all potential ITN users in the sample by the total number of individuals who spent the previous night in surveyed households. The following link provides an in-depth video explanation of this indicator: <https://www.youtube.com/watch?v=YfTXcc13GOI>. An example of the Stata code used to calculate this indicator follows.

Sample Stata Version 12 Code

```
* create access variable in individuals file (household roster)
* variable "numitnhh" is the number of ITNs per household from the household file
* variable "sleep" is the de-facto residency (slept in the household the night before) yes=1, no=0
* variable "hhid" is the unique identifier for the household

gen potuse= numitnhh *2

label var potuse "potential ITN users in hh"

bysort hhid: gen access=potuse/sleep>1

svy: mean access if sleep==1
```