Malaria Economic Research Guide

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Malaria Economic Research Community of Practice

The Malaria Economic Research Community of Practice (CoP), convened by the Health Finance and Governance project, facilitates communication and coordination among stakeholders of malaria economic research to enhance the targeting and efficiency of research efforts and the usability of results. Acknowledging the importance of involving all "users" and "producers" of malaria economic research in this collaboration, the CoP is comprised of implementers, program planners, policy makers, researchers, and funders of malaria programs and malaria economic research.

To learn more, visit http://malaria-econ-research-community-of-practice.org

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Introduction

Background

In November 2015, the President's Malaria Initiative (PMI) and the Health Finance and Governance Project (HFG) hosted a consultative session on the Economic Impact of Malaria Control at the 64th Annual Meeting of the American Society for Tropical Medicine and Hygiene (ASTMH) in Philadelphia. Attendees, including funders, researchers, and implementers, indicated that a mechanism to facilitate knowledge sharing and coordination on the economics of malaria among researchers and implementers would improve the targeting and efficiency of research efforts and the usability of results. Moreover, the group acknowledged the importance of involving implementers, programmers, and policymakers—the "users" of malaria economic research, or MER—in these discussions.

With the Roll Back Malaria (RBM) Partnership and its Advocacy and Resource Mobilization Partner Committee (ARMPC) still in the nascent stages of development, HFG was tasked with organizing existing MER and facilitating a community of practice (CoP) aimed at improving communication and collaboration among a broad range of MER users, including non-economists.

Early conversations among CoP members identified the need for a guide for malaria control planners and implementers to support and increase the usability of malaria program data. The CoP also developed two other key products to support decision making around program implementation and resource allocation:

(1)   A Malaria Economics Research Framework to help organize malaria economics research by useful categories (such as target audience and type of economic research);

(2)   A Malaria Economic Research (MER) Lit Scan Tool, an Excel-based tool that allows users to search a database of malaria economic research (MER) for articles related to a particular topic, filtering by criteria such as geographic focus, intervention type, or type of research. The tool also contains visualizations that allow users to analyze the MER database by selecting various criteria of interest.

These two deliverables supported the development of this guide.

Purpose of the Guide

This guide aims to:
- Provide guidance in determining the appropriate type(s) of malaria economic study/analysis that would be useful depending on the specific research question
- Describe the types of data sources and tools available for malaria economic research (MER)
- Document experiences on how MER have been used for decision making

Intended Audience and Uses of the Guide

Target audiences include but are not limited to: implementers of malaria programs (e.g., NMCPs); decision-makers (e.g., MOH, MOF); and donors (e.g., The Global Fund, the U.S. President's Malaria Initiative, The Bill and Melinda Gates Foundation, etc.). In particular, malaria control planners and implementers can use this guide to support and to increase the usability of program data for: (1) internal program refinement (monitor and improve efficiency) and; (2) resource allocation and policy decisions.

Overview of Malaria Economic Research

In this section, the different types of malaria economic research are described, and the types of questions that they may be used to answer are identified. The section intends to guide users to determine which type(s) of malaria economic research would be most useful to them.

Program Costs and Technical Efficiency Research

What is "program costs and technical efficiency research"?

Decision makers increasingly face the challenge of reconciling growing demand for health care services with available funds. Economists argue that the achievement of (greater) efficiency from scarce resources should be a major criterion for priority setting. Efficiency measures whether or not resources are used to get the best value for money.

Program Efficiency relates resource inputs (costs of labor, capital, equipment, etc.) to either intermediate outputs (i.e. numbers treated, number tested) or final health outcomes (i.e. lives saved, life years gained, quality adjusted life years). Cost is one key component of efficiency measurement because it translates all inputs used in a production process into the same unit: monetary currency.

The **cost of implementing a program**, conceptually, is the sum of the costs of the inputs used to implement the program. While the idea is simple, completing such an analysis requires making several assumptions and completing several sub-analyses along the way. Understanding program costs is important for planning and budgeting. Unit costs are the cost per unit of outcome obtained by the program.

There are several methodologies for estimating program costs, and they all have their usefulness in specific situations (Benjamin et al, 2003). The two main costing approaches used in costing (cost estimation) are the top-down method and the bottom-up method. There is no one single method appropriate for every situation and more often a combination of the two methods is used.

- The top-down approach starts with identifying every major shared cost at the program level (mostly overhead costs like utilities, rent, maintenance, etc.) and allocate them down to the different program outputs.
- The bottom-up approach (also called the "ingredients approach") tallies costs upward, starting at the bottom and accounting for each expected cost (price multiplied by quantity) for output production.

Technical Efficiency refers to the physical relation between resources (mainly capital and labor) and health outcome (Galactionova et al., 2013). Technical efficiency is achieved when the maximum possible improvement in outcome is obtained from a set of resource inputs. An intervention is technically inefficient if that intervention could produce the same (or greater) outcome with less of one (or several) type of inputs used. Technical efficiency ensures that a desired output is produced with the least cost combination of inputs. Ideally, we would want to measure the absolute technical efficiency of a production unit (in our case, an integration program), but it is rarely possible given that we ignore the underlying production and cost functions. In practice, efficiency measurement in health care usually measures relative efficiency – that is, efficiency relative to the best or some sample of best achievers among programs. The main methods used are Frontier Estimation Methods, which define an efficiency frontier from observed sample data, based upon best performance within the sample. Measurement of the deviation of individual production units from this frontier allows the calculation of relative efficiency scores, and the computation of potential efficiency gains if all units could achieve best performance levels. Two main variants of this approach are: (1) Data Envelopment Analysis (DEA), which is the most widely used form of frontier estimation, and (2) Stochastic Frontier Estimation (SFE).

What types of questions can program costs and technical efficiency research answer?

Target Audience→ Category ↓	Funders of Malaria Economic Research - *Local (e.g. NMCPs, MOH/F)* - *Int'l (e.g. GF/USAID/PMI/ CDC, Dev Banks)*	Funders of Malaria Programs - *Local (e.g. NMCPs, MOH/F)* - *Int'l (e.g. GF/PMI/CDC, Dev Banks)*	Malaria Planners/Implementers - *e.g. NMCPs, local and int'l NGOs*	Policymakers of Malaria-Endemic Countries -*e.g. NMCPs, MOH/MOF*	Private Sector - *private health sector & industry (GBCHealth, Chevron*
Program Costs and Technical Efficiency Understanding the inputs (both human and financial resources) required to maximize outputs (services delivered).	● How can we maximize coverage/scale-up of proven malaria interventions with limited resources? ● What are the differences in cost for donor- vs. locally-funded malaria programs? ● What are the costs associated with making progress towards elimination of malaria? What is the cost of eradication for countries that have reached near elimination? What are the differences in costs/benefits and technical efficiency associated with: • different ways of implementing malaria	What are the differences in costs/benefits and technical efficiency associated with: • different ways of implementing interventions (i.e. mass campaigns versus integrated or targeted interventions)? • different interventions themselves (i.e. IRS vs. ITNs)? • Packaging interventions, such as diagnostics + treatment or treatment + prevention Are there cost variances (total or per unit) within similar malaria programs I am funding/preparing to fund? Are there effective and cost-efficient ways to identify and ameliorate coverage of malaria interventions in areas with high implementation costs? What are the costs associated with:	● Do cost variances exist within the malaria program I run (and how do I manage that)? How does my program compare to other health programs or similar program in other countries? ● How can we maximize our programmatic outputs (services delivered, reduced number of cases, etc.) given limited resources (inputs)? ● How can we use economic data to support program proposals and/or budget development (improving an understanding of costs – total cost, cost drivers, efficiency, etc.)? ● What efficiency gains result from integrating malaria control interventions with other services (i.e. MNCH/immunization/ diarrhea)? ● What are the economic ads/disadvantages of iCCM (or other interventions) for malaria? What is the cost per confirmed case treated/cost per case treated? ● Who pays for iCCM health personnel? At the community level? Volunteers? How does this alter programmatic impact?	What are the differences in costs/benefits and technical efficiency associated with: • different ways of implementing interventions (i.e. mass campaigns versus integrated, vertically or integrated within health system)? • different interventions themselves (i.e. IRS vs. ITNs)? • Bundling interventions together, such as diagnostics and treatment See above.	Does increased productivity offset costs of malaria control for workers? E.g., is investment in malaria control more efficient than not investing? What is the role of the private health sector in the provision of interventions? How can we maximize outputs in public sector programs by leveraging the private sector? See above.

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	control interventions[1] (i.e. mass campaigns versus integrated)? • different interventions themselves (i.e. IRS vs. ITNs)? • Spending for malaria programs vs. other health programs?	• making progress towards elimination of malaria? • eradication for countries that have reached near elimination? • Development of new diagnostic tools or interventions?	● What is the cost of turnover/retraining of staff for malaria programs? ● What are program reorientation costs when shifting focus from control to elimination, or elimination to prevention of reintroduction (POR)? How do we implement re-orientation in a cost-effective way (e.g., manager trainings)? ● What are the costs associated with new diagnostic tools or new interventions? How can we cost effectively implement and scale-up? ● How can we collaborate with local industry (i.e. local pharmaceutical manufacturers) to support malaria programs? What are the pros/challenges? ● What opportunities exist to collaborate with the private sector? ● How can we/should we incentivize the appropriate use of preventative tools? Diagnostic tools? Treatments (such as completing medication doses)?		

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[1] Interventions could include vector control-related interventions such as ITNs/IRS/home repellant use or larviciding/fogging, pharmacological interventions (early diagnosis/treatment, IPTP, chemoprophylaxis, behavioral change efforts (health education/counselling), supervision/policy changes, or environmental (civil engineering efforts such as draining larval breeding sites) at the individual, community, district, or national levels (*Disease Control Priorities in Developing Countries*, 2nd edition).

How can program costs and technical efficiency research support evidence-based policy?

As noted in the above table, malaria programmers may be interested in the efficiency gains that result from integrating malaria control interventions with other health services. One example of a study that addressed this question considered an integrated HIV, malaria, and diarrhea prevention initiative in Kenya. The study estimated the cost savings (measured by medical care costs) per 1000 participants as $16,015, taking into account the cost of implementing the intervention, and the costs of medical care to participants who receive earlier HIV care as a result of the intervention's testing and counselling component. While other studies estimate the cost-effectiveness of interventions meant to prevent each of these three diseases individually, this study provides information for policymakers considering an integrated, community-level, multiple-disease prevention approach. The full article can be found here.

Allocative Efficiency and Effectiveness Research

What is "allocative efficiency and effectiveness research"?

Allocative efficiency is interested in the impact of a given intervention/program for the overall society. In recent years, the term allocative efficiency in health care has increasingly refer to the idea that society's health status should be maximized, through achieving the most cost-effective balance of programs and interventions. Allocative efficiency refers to the capacity to distribute (or redistribute) resources based on the effectiveness of interventions/programs following strategic objectives.

Cost-effectiveness Analysis (CEA) is the most common measure for allocative efficiency in the health sector. In the health sector, CEA is preferred to cost benefit analysis, which assigns a monetary value to the measure of effect, because such monetization can be inappropriate or very complex to do when we consider health effects.

CEA is a method for assessing the health outcomes relative to the costs of different health interventions. The basic calculation involves dividing the cost of an intervention in monetary units by the expected health gain measured in natural units such as lives saved, life years gained, quality adjusted life years, etc. The outcome measure used more often for health interventions is disability-adjusted life years (DALYs), representing a weighted combination of mortality and morbidity effects of an intervention. DALYs are useful for policy makers because they are a more comprehensive measure of population health than just counting deaths and because they allow comparisons among a wide range of health interventions. Some health interventions aim to reduce mortality, but many aim to reduce the severity of illness and improve the quality of life. With DALYs, we can compare these different interventions against a common standard.

CEA is not the only criterion for deciding how to allocate resources, but it is an important one, because it directly relates the financial and health implications of different interventions (Jamison et al., 2006).

What types of questions can allocative efficiency and effectiveness research answer?

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Allocative Efficiency and Effectiveness Prioritization of resources *specifically for malaria* (programs/ interventions) to maximize societal impact	• What interventions/ combinations of interventions are most cost effective at each stage of the malaria continuum (control, controlled low-endemic/pre-elimination, elimination, prevention of reintroduction)? • Is there a way to allocate resources/progr ams across sub-national units to maximize health impact?	• What interventions/ combinations of interventions are most cost effective at each stage of the malaria continuum? • Is there a way to allocate resources/programs across sub-national units to maximize health impact? • To what degree are allocated resources for malaria spent/underspent in X country? What budgetary systems are in place at the country level to facilitate budgeting and appropriate spending of resources for malaria activities?	• What interventions/ combinations of interventions are most cost effective at each stage of the malaria continuum? • Can resources/ programs be allocated across sub-national units to maximize health impact?	• What interventions/ combinations of interventions are most cost effective at each stage of the malaria continuum? • What are the differences in costs and efficiency associated with: o Malaria programs vs. other health programs? o Different ways of implementing malaria programs? (vertically/integratio n with the health system) • Can resources/ programs be allocated across sub-national units to maximize health impact? • To what degree are allocated resources for malaria spent/underspent?	• What interventions/ combinations of interventions are most cost effective at each stage of the malaria continuum? • Can resources/ programs be allocated across sub-national units to maximize health impact?

How can allocative efficiency and effectiveness research support evidence-based policy?

As noted in the table above, given limited resources available for malaria, one key question that policymakers and decision makers have is about the differences in costs/benefits and technical efficiency associated with different interventions. This information, combined with epidemiological and programmatic data, can help guide policymakers about which interventions to implement. In one study ([click here to view full-text](#)), the authors assess the cost-effectiveness of three different diagnostic and treatment strategies included in Ethiopia's national malaria diagnosis and treatment guidelines.

The analysis showed that the most cost-effective strategy (US$1.69 per correctly treated case) was the use of a species-specific rapid diagnostic test (RDT) plus treatment with artemether-lumefantrine (AL), chloroquine, or referral if diagnosed with *P. falciparum*, *P. vivax*, or no malaria, respectively. The cost of using a *P. falciparum*-specific RDT and treatment with AL for P. falciparum cases and chloroquine for the rest was US$4.66 per correctly treated case, while treatment with AL for all cases diagnosed presumptively as malaria cost US$11.08 per correctly treated case. The authors recommend that policymakers consider implementation of the most cost-effective treatment strategy, while ensuring sufficient provision of RDTs and adequate health worker training.

Economic Impact Research

What is "economic impact research"?

Economic impact of malaria refers to the consequences that malaria can have on a country's economy beyond the health sector. These effects can take different forms, but are ultimately negative.

Malaria is bad for business: it is responsible for a high percentage of employee absenteeism and decreases employee's productivity, which influences the bottom line of many companies in malaria endemic regions. In sub-Saharan Africa, 72% of companies reported a negative effect of malaria, with 39% identifying a serious effect (Roll back Malaria, 2011).

Children are at greater risk for malaria and in some areas, malaria accounts for 15% of health-related absenteeism from school (Leighton and Foster, 1993). Health expenditures related to Malaria can be a high burden on households, and on public health expenditures. Malaria discourages investments and tourism, affects land use patterns and crop selection resulting in sub-optimal agricultural production. To put the economic burden of malaria into perspective, leading economists estimate that malaria causes an "economic growth penalty" of up to 1.3% per year in malaria endemic African countries (World Health Organization, 2008).

Targeting interventions efficiently and equitably, and justifying current investments in research and control for the disease, requires Information on the economic burden of malaria. This type of research is growing in importance, as competition for resources is more explicit between malaria and other diseases.

At a basic level, economic impact analysis examines the economic effect of malaria has on the economy of a geographic area (country, group of countries, etc.) through modelling. The idea is to model two economies: one with malaria (and its negative effects), and another that avoids malaria and the associated negative effects. By comparing the two, we can assess the impact. There is no one defined method for such modelling, but most are based on an Input-Output model.

Input-output models are complex models designed to examine all industries in a local economy and estimate the ways that a change in one sector influences each of the other sectors. For example, what would be the effect, on the health sector, of a decrease in household health spending because of malaria elimination? What impact with the saved money have on the sector where it is used?

What types of questions can economic impact research answer?

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Economic Impact Questions related to economic impact of malaria interventions beyond health/malaria-specific areas	● What can malaria economic research tell us about the impact of malaria programs on broader outcomes (both within health and beyond health)? ● Have specific OOP expenditures decreased because of implementation/ scale-up of malaria interventions? ● What are the core economic indicators related to malaria we should be collecting at the HH level (e.g. OOP spending on fever)? What is the country-level capacity to collect such information? ● Which surveys should be prioritized in terms of advocating for inclusion of these questions? ● How can we quickly access HH data to compare how much/where money is being spent on malaria over time at household level?	● What is the economic impact of spending on malaria programs vs. other health programs? ● What country-level evidence is available on the impact of malaria control efforts? ● What are the macro/microeconomic effects of these efforts? What is the impact of inaction or lack of scale-up? ● What is the rate of return on investment of malaria programs? (compared to other health programs – in context of SDGs) What measurement/ indicators are used to measure this?	● To what extent are health resources freed up (if at all) if malaria service delivery is decentralized to lower levels of the health system? ● How can we use results on economic impact to support malaria control efforts? ● What is the impact of malaria control and other interventions (e.g. iCCM) on the macro/microeconomic outcomes? i.e. lost days of work due to traveling to health centers, etc.	● What evidence is available to support resources devoted to malaria? ● Where do synergies exist between malaria programs/efforts and other sectors? (education, agriculture, environment)	● What is the private sectors' contribution to financing of malaria control efforts? ● How does malaria impact the workforce and productivity? ● What is the calculus for private companies to invest or not invest in malaria control/elimination? How can they quantify benefits that speak to their bottom line? ● What is the economic impact of the malaria vaccine?

How can economic impact research support evidence-based policy?

Understanding and presenting the evidence on the impact of malaria control programs beyond the health sector can be a powerful tool to generate additional resources for malaria from non-health stakeholders such as the Ministry of Finance and private sector actors. With these stakeholders in mind, one study examined the cost of malaria to businesses in Ghana from 2012-2014—including expenses related to treatment and prevention, as well as worker absenteeism because of malaria. The findings indicated that malaria cost Ghanaian businesses about US$6.58 million in 2014. From 2012-2014, workers missed 3,913 days due to malaria. The study highlights the need to engage the private sector in malaria control; 93% of business leaders interviewed confirmed this need to invest in malaria control efforts.

Another article on this topic notes the common limitations that studies assessing the impact of malaria control have and suggest that future efforts should address the impact on the productive environment, and epidemiological and socio-economic geographical variation.

Sustainable Financing and Resource Mobilization Research

What is "sustainable financing and resource mobilization research"?

Malaria has historically benefited from donors funding through many big initiatives such as the PMI and the Global fund. With the current decreasing trend in donor funding, there is urgent need for countries to be able to use more sustainable financing for malaria control, essentially through domestic resources mobilization. Research on domestic resource mobilization (DRM) for achieving sustainable financing should assess (World Health Organization, 2017):

- Trends in domestic financing for malaria and the forms that this takes;
- The extent to which current spending approaches normative targets or estimated needs;
- The manner in which current spending for malaria is deployed or used to achieve stated priorities and finally;
- Potential options for domestic resource mobilization: achieve more efficiency gains that can be redistributed and/or raise more money locally

Sustainable financing and DRM come primarily from efficiency improvements and better use of current scarce resources. Accordingly, this topic draws heavily on some of the research previously described (program costs, efficiency, and economic impact).

The other part of DRM involves raising more money locally, and various countries are exploring different methods to accomplish this goal. One of those methods is **Fiscal Space Analysis,** which assesses the expected revenues from a new tax imposed to cover health expenditures (for example, sin taxes on tobacco, sweet beverages, etc.). Other analyses also look at the private sector as potential source of resources. Given the negative effect of malaria on business in endemic countries, many companies contribute to malaria control—for example, by supporting the mass distribution of bednets in the regions where they operate. Countries are currently both leveraging these existing partnerships as well as developing new ones.

What types of questions can sustainable financing and resource mobilization research answer?

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Sustainable Financing/ Resource Mobilization Domestically or in general	● What are the core economic indicators related to malaria we should be collecting at the HH level (e.g. OOP spending on fever)? What is the country-level capacity to collect such information? ●Which surveys should we prioritize for inclusion of these questions? ●How can we quickly access HH data to compare how much/where money is being spent on malaria over time at household level? ●Have specific OOP expenditures decreased as a result of implementation/ scale-up of malaria interventions? ●What is the quality/availability of local, country-level data for malaria economic research to support domestic resource mobilization (DRM)? ●What is the cost associated with increasing antimalarial drug resistance (i.e.	● How much do malaria programs cost (currently and over time)? ● How can we use or interpret measurement of ROI data to advocate for more funding for malaria? ● What is the quality/availability of local, country-level data for malaria economic research that supports domestic resource mobilization? ● What is the country-level capacity to collect information for malaria economic research? ● What is the cost associated with increasing antimalarial drug resistance (i.e. economic outcomes resulting from lower productivity – or economic impact of inaction)? How can this evidence serve to	● How can we best leverage malaria programmatic cost information (such as labor, infrastructure costs) beyond monitoring and evaluation to support improved decision making/resource mobilization/better outcomes? ● How feasible is the implementation of certain financing instruments or mechanisms (models (e.g. social impact bonds, pooled funding platforms and concessional loans) for malaria control and elimination efforts in particular settings, and what examples in health and/or development can we draw upon to improve their effectiveness? ● What is the cost associated with	●What costs of malaria programs/interventions are shared by health system more broadly? ● How can we best to integrate malaria control and treatment in efforts towards universal health coverage? ● What costs in the health system are included (or not) in malaria control efforts (e.g. education/ environ)? ● What financing mechanisms/models (e.g. social impact bonds, pooled funding platforms and concessional loans) are the most effective for malaria control and elimination? ● What is the cost associated with increasing antimalarial drug resistance? What is the economic impact of inaction? How can this evidence serve to	● How can we best leverage malaria programmatic cost information (such as labor, infrastructure costs) beyond monitoring and evaluation to support improved decision making/resource mobilization/better outcomes? ● How feasible is the implementation of certain financing instruments or mechanisms (models (e.g. social impact bonds, pooled funding platforms and concessional loans) for malaria control and elimination efforts in particular settings, and what examples in health and/or development can we draw upon to improve their effectiveness? ● What is the cost associated with

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	economic outcomes resulting from lower productivity – or economic impact of inaction)? ● How can the evidence on the impact of malaria control on other outcomes (around perhaps productivity/ education) serve to augment/support/ advocate for domestic resource mobilization? [What evidence is still missing? On what time horizon can needed evidence be produced?]	augment/support/advocate for DRM? ● What financing mechanisms/models (e.g. social impact bonds, pooled funding platforms and concessional loans) are the most effective to contribute to malaria control and elimination? ● What mix of national and local government funding is appropriate or efficient? ● For countries facing funding gaps from withdrawal of support, by how much should domestic financing increase? What is the country's readiness to transition out of aid?	increasing antimalarial drug resistance (i.e. economic outcomes resulting from lower productivity)? Relatedly, what is the economic impact of inaction? ● How can this evidence serve to augment/support/advocate for domestic resource mobilization? How can we use or interpret measurement of ROI data to advocate for more funding for malaria? ● What is the quality/availability of local, country-level data for malaria economic research that can support domestic resource mobilization?	augment/advocate for DRM? ● How can we use or interpret measurement of ROI data to advocate for more funding for malaria? ● What is the quality/availability of country-level data for malaria economic research to support DRM? ● What mix of national and local government funding is appropriate or efficient? ● For countries facing funding gaps, by how much should domestic financing increase? What is the country's readiness to transition out of aid?	increasing antimalarial drug resistance (i.e. economic outcomes resulting from lower productivity)? Relatedly, what is the economic impact of inaction? ● How can this evidence serve to augment/support/advocate for domestic resource mobilization? How can we use or interpret measurement of ROI data to advocate for more funding for malaria? ● What is the quality/availability of local, country-level data for malaria economic research that can support domestic resource mobilization?

How can sustainable financing and resource mobilization research support evidence-based policy?

Evidence to support the mobilization of additional resources for malaria is in high-demand, especially as many countries are required to supplement external funding sources with domestic resources. One study supporting sustainable financing for malaria determined the resources required to scale up malaria control from 2006-2015 and achieve the targets set forth by the Roll Back Malaria Partnership Global Strategic Plan 2005-2015 and United Nations Millennium Declaration. The analysis focused on the 81 most heavily affected malaria-endemic countries in the world, and generated the cost of scaling up a wide array of interventions (vector control, IPT, RDTs, ACTs, etc.) and included commodities and distribution costs as well as health systems strengthening components such as health worker and training. The authors then compared the resources required to each country's current level of health spending and funding for malaria.

Based on the study, across all 81 countries, between US$ 38 billion (optimistic scenario) to US$ 45 billion (pessimistic scenario) is needed from 2006 to 2015 to accomplish the goals and targets set—an average of US$ 3.8 to US$ 4.5 billion per year. The average annual costs for Africa are US$ 1.7 billion and US$ 2.2 billion in the optimistic and pessimistic scenarios, respectively; outside Africa, the corresponding costs are US$ 2.1 billion and US$ 2.4 billion. The analysis suggests that most countries are spending far less and have far less funding available than is required; less than 5% of the resources needed are available based on current levels of domestic resources. While the authors caution that the results should not dictate country level planning, the findings are still useful as standards to help assess resources planned.

Generating and Collecting Data for Malaria Economic Research

Generating and Collecting Country-Level Data

This following table provides guidance on relevant indicators/types of data for different types of research.

Type of Malaria Economic Research	Examples of Indicators		Data Type	Sources of Data
Program costs and technical efficiency	• Number of cases averted • Change in cost of illness • Change in cost savings • Change in cost of control • Change in cost of treatment • Incremental cost-effectiveness ratio (ICER) • Change in cost per capita • Change in cost per case • Change in disability-adjusted life years • Government spending • Household expenditure	• Willingness to pay • Change in infection averted ratio • Labor productivity • Morbidity rate • Mortality rate • Productivity loss • Survival rate • Opportunity cost • Antimalarial drug resistance • Changes in cost of Chloroquine • Changes in cost of indoor residual spraying	Primary and secondary	• Household survey • Demographic and Health Survey (DHS) • Drug prices • Malaria Indicator Survey (MIS) • Qualitative interviews • Focus groups and direct observations • Retrospective review of patient records • Cross-sectional survey • Quantitative and qualitative surveys • Case study
Allocative efficiency and effectiveness	• Benefit-cost ratio (BCR) • Number of cases averted • Changes in cost of illness • Changes in cost savings • Changes in cost of control • Changes in cost of treatment • ICER	• Morbidity rate • Mortality rate • Disability-adjusted life years(DALYs) • Opportunity cost • Productivity loss • Survival rate • Willingness to pay	Primary	• MIS/DHS; Household survey • Case study • Data collection • Health management information system • Interviews
Economic impact	• ACT coverage; proportion/number of people receiving ACTs • Changes in cost of illness • Drug coverage	• Household expenditure • Morbidity rate • Mortality rate • Willingness to pay	Primary and Secondary	• MIS/DHS • Household survey • Case study • Health management information system • Qualitative interviews
Sustainable financing/resource mobilization	• Number of ACTs available • Antimalarial drug resistance • Benefit-cost ratio (BCR) • ICER • Opportunity cost	• Willingness to pay • Morbidity rate • Mortality rate • Disability-adjusted life years (DALYs)	Primary and Secondary	• MIS/DHS • Household survey • Case study • Data collection • Health management information system

Type of Malaria Economic Research	Examples of Indicators	Data Type	Sources of Data
			• Interviews

Using Existing Sources of Data and tools for Malaria Economic Research

This section lists existing sources of data, including databases, such as the World Bank Health Nutrition and Population Statistics and World Development Indicators databases, WHO Global Health Observatory; Demographic and Health Survey Data, etc. and also identify available costing tools or epidemiologic models for malaria.

Existing Sources of Data for Malaria Economic Research

Data to support Malaria Economic Research can be obtained from different sources including from official country Health Management Information Systems (HMIS) and from international organizations or programs sites as described below. (Note: Most of the descriptions of the sources of data are extracted from the *Household Survey Indicators for Malaria Control manual* that was developed in 2013, by MEASURE, USAID, RBM, UNCEF and WHO. The manual discusses the different types of household surveys commonly used in monitoring and evaluation of malaria programs. [2])

Household Surveys: Nationally representative, population-based household surveys are a principal measurement tool to collect data for measuring outcome and impact indicators. These surveys complement routine data collection carried out by national governments and national malaria control programs (NMCP).

Three large survey efforts 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). For more information visit: https://www.measureevaluation.org/resources/publications/ms-13-78

A. **Demographic and Health Surveys (DHS):** Demographic and Health Surveys (DHS) are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. For Malaria, information is available on the following topics: ownership and use of mosquito nets, prevalence and treatment of fever, and indoor residual spraying for mosquitoes. For more information visit: https://dhsprogram.com/What-We-Do/Survey-Types/DHS.cfm and for more malaria specific information, visit: https://dhsprogram.com/topics/malaria/index.cfm.

B. **Malaria Indicator Surveys (MIS):** The Malaria Indicator Surveys (MIS) measure indicators related to the Roll Back Malaria (RBM) Global Malaria Action Plan, the Millennium Development Goals (MDG), and the President's Malaria Initiative (PMI) targets. Information is collected on the ownership and use of insecticide-treated mosquito nets (ITNs), indoor residual spraying (IRS) of insecticides, prompt and effective

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[2] Household Survey Indicators for Malaria Control:
https://www.measureevaluation.org/resources/publications/ms-13-78

treatment of fever in young children, and the prevention of malaria in pregnant women. Most MIS surveys also include biomarker tests for anemia and malaria. For more information visit: http://www.malariasurveys.org/

The survey gathers additional information on indoor residual spraying (IRS), and background data on the characteristics of household members and ownership of household assets such as electricity, bicycles, radios, and indoor plumbing. Almost all of the questions in the MIS instrument were derived from the DHS and the MICS. For more information, visit: http://www.malariasurveys.org/

C. **Multiple Indicator Cluster Survey (MICS):** MICS surveys are nationally representative, population-based household surveys developed by the United Nations Children's Fund (UNICEF) to support countries in filling critical data gaps for monitoring the situation of children and women. Initially designed to collect indicators marking progress towards the World Summit for Children goals, MICS surveys have been an important component of national data collection in many countries. MICS surveys are currently conducted in rounds approximately every three years, and since its inception 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. Published reports, questionnaires, and datasets related to the MICS surveys are available online at http://www.childinfo.org.

Strengths and Limitations of Surveys used in Malaria Economic Research

	Strengths	Limitations
Demographic and Health Surveys (DHS)	• Sampling design rigor and reliability over time and across countries • Comprehensive package of demographic and health data is collected during both of these surveys, which allows additional analyses to be conducted.	• Only implemented every three to five years • Typically conducted during the dry season and therefore outside of 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.
Malaria Indicator Surveys (MIS)	Conducted during peak transmission (during rainy or right after the rainy season). This is essential if the MIS includes biomarker testing for malaria.	• Only implemented every three to five years
Multiple Indicator Cluster Survey (MICS)	• Sampling design rigor; reliability over time across countries • Comprehensive package of demographic and health data is collected during both of these surveys, which allows additional analyses to be conducted.	• Only implemented every three to five years • Typically conducted during the dry season and therefore outside of 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.

D. **World Bank Health Nutrition and Population Statistics:** This database provides key health, nutrition and population statistics gathered from a variety of international and national sources. Themes include global surgery, health financing, HIV/AIDS, immunization, infectious diseases, medical resources and usage, non-communicable diseases, nutrition, population dynamics, reproductive health, universal health coverage, and water and sanitation. For more information, visit this site: https://datacatalog.worldbank.org/dataset/health-nutrition-and-population-statistics.

E. **World Development Indicators databases:** The primary World Bank collection of development indicators, compiled from officially-recognized international sources. It presents the most current and accurate global development data available, and includes national, regional, and global estimates. For more information visit: https://data.worldbank.org/products/wdi.

F. **WHO Global Health Observatory (GHO):** This is WHO's gateway to health-related statistics for its 194 Member States. The aim of the GHO portal is to provide easy access to:
• Country data and statistics with a focus on comparable estimates;

- WHO's analyses to monitor global, regional and country situation and trends.

GHO theme pages cover global health priorities such as the health-related Millennium Development Goals, mortality and burden of disease, health systems, environmental health, non-communicable diseases, infectious diseases, health equity, and violence and injuries. The GHO database provides access to an interactive repository of health statistics. Users are able to display data for selected indicators, health topics, countries and regions, and download the customized tables in Excel format. The GHO country data includes all country statistics and health profiles that are available within WHO. For more information visit: http://www.who.int/gho/about/en/.

Existing Tools for Malaria Economic Research

The table below show some examples of tools used for costing and budgeting for Malaria interventions. One of the tools is designed specifically for costing of malaria interventions (Malaria Costing Tool) and the remaining four include costing of malaria interventions among other services (Crowell et al, 2013).

Overview of Five Tools used for Costing and Budgeting for Malaria Interventions

Tools	Purpose	Developed by	Specific to Malaria
Malaria Costing Tool	Estimate resource requirements of scaling up malaria interventions over a period of time	WHO	Only malaria
OneHealth	Support planning, costing and budgeting of health sector priorities, including health system strengthening strategies	Futures Group and Inter-Agency Working Group on Costing	Includes malaria services
CORE Plus	Estimates costs of individual and packages of interventions	MSH/USAID	Includes malaria services
Integrated Community Case Management (iCCM)	Estimates service delivery costs at community level and support, supervision, and management costs at all levels of health system.	MSH/USAID	Includes malaria services
UNDP Integrated Health Model (UNDP)	Estimates resources required to meet health-related MDGs.	UNDP	Includes malaria services

A. The **Malaria Costing Tool** is used to estimate the resource requirements of scaling-up malaria interventions over a specified period. Its intended users are malaria program managers, consultants, and academics. The current version of the tool is from April 2006. Program managers in Zambia, Mozambique, and Angola have used the tool.

- Projections: The tool is designed to make national-level projections of total and incremental commodity and system costs by intervention and total and incremental commodity and system cost per capita. The user can make short to medium term projections of up to ten years.

- Data inputs: The tool provides default demographic and epidemiological data by country, coverage from the DHS or MICS, and median prices for commodities. The user can change these. Users input include coverage goals and unit costs.

- Costing methodology: The tool uses a bottom-up methodology to calculate financial costs. The user selects which interventions to include and can choose to calculate the costs by administrative level (e.g. national, province, district). The tool sums these to arrive at the total cost. The tool does not classify costs as recurrent or capital, and does not annualize or discount costs for capital items (such as vehicles).

- Measures of effectiveness: Total numbers of commodities purchased.

- Sensitivity analysis: The tool allows users to save and compare results of different scenarios. Currently, users cannot save scenario inputs, so are advised to save each scenario as a separate file.

- User-friendliness: Fairly user-friendly, with a helpful user manual. However, the tool makes calculations in hidden sheets, so they can be difficult to follow. Designed to harmonize with Global Fund grant applications, the tool automatically generates several graphs and tables for this purpose.

- Limitations:
  - The tool currently cannot attribute only the share of financial costs of additional support to a malaria control program when the support intervention also services other health programs.
  - The tool is not designed to determine if new health care workers will need to be employed or new health care facilities will need to be built. This analysis would need to be done prior to using the tool.

B. The **OneHealth Tool** was developed to provide a unified harmonized costing tool to facilitate comprehensive health system costing and budgeting, and to reduce confusion, workload, and transaction costs associated with multiple costing tools. The Futures Institute developed the tool in 2012 under the auspices of the Inter-Agency Working Group on Costing (IAWG-COSTING) established in 2008 (WHO, United Nations Children's Fund (UNICEF), World Bank (WB), United Nations Programme on HIV/AIDS (UNAIDS), United Nations Population Fund (UNFPA), United Nations Development Programme (UNDP). The tool is now being used in about 17 countries. The tool allows estimation of costs of malaria interventions—insecticide-treated nets, indoor residual spraying, intermittent preventive treatment, malaria diagnostics and

treatment—and custom interventions can be added in the whole population or in sub-groups.

- Projections: The tool is designed to make national-level projections of total and incremental costs by year and program. Subnational projections are also possible. The tool is intended for medium-term projections of three to seven years but the timeframe is user-defined. The financial gap analysis allows for analysis of alternative scenarios of private sector participation in the health system, user fee schemes, conditional and cash transfer schemes.

- Data inputs: The tool provides considerable default data, including demographic data, malaria case management protocols, and international drug prices. Personnel time required per case, bed days and number of outpatient visits are based on international norms. User inputs include baseline data and targets for coverage, staffing and facilities, and unit costs.

- Costing methodology: The tool uses a bottom-up methodology to calculate financial costs to the healthcare provider. The tool estimates total and incremental costs by year, program, and cost component; financial analysis (financial space), and costs presented by budget categories. A key feature of the OneHealth Tool is the ability to estimate shared resources for health systems within the health systems modules. There are also mechanisms within the tool for looking at activities that could be considered cross-cutting and for which integration could be strengthened, such as training programs that can be set up to deal with multiple conditions rather than single conditions. The tool uses a default exchange rate that users can modify. The tool currently presents costs only in constant prices, but a function to account for inflation will be programmed into the tool as an option. The tool does not annualize or discount capital costs.

- Measures of effectiveness: The tool produces some process, outputs and outcomes indicators. The output indicator is the number of services, while the outcome indicator is mortality reduction in children under five years of age, estimated using the Lives Saved Tool (LiST), which models changes in child survival in accordance with changes in coverage of different maternal and child health interventions ITN use is assumed to prevent 50% of malaria cases. Further information on default assumptions is available in the OneHealth Intervention Input Assumptions Manual: http://www.futuresinstitute.org/onehealth.aspx.

- Sensitivity analysis: Users can save different versions of the tool to simulate scenarios of cost and impact estimates for different scale up strategies. Users can open and view up to 10 projections simultaneously.

- User-friendliness: The tool is a Windows-based program with a user-friendly front end. Users can enter custom staff and facility types, program areas and

interventions. Tables can be copied between OneHealth and Excel but the tool's outputs are not designed to harmonize with any particular grant or report formats. Completion of the tool is time-consuming and requires some knowledge of costing principles. Hands-on trainings have been conducted in a number of regions.

- Limitations:
  - o Modelling of intervention impact. To date, only the impact of antimalarial interventions on child mortality is considered. The tool could report the impact on adults and on episodes averted, in addition to mortality.
  - o Give users the option to calculate economic costs

C. The **CORE Plus 2.0 tool** estimates the costs of individual interventions (services) and packages of interventions as part of integrated health care facilities. It also calculates the cost of scaling-up and reaching the MDGs. The tool is designed to be used by planners and managers of government, private and NGO primary health care. It includes ITN distribution, malaria case detection, and treatment services. The first version of the tool was developed in 2007.

- Projections: The tool is designed to make national- or lower-level projections of costs of specific and integrated interventions. The tool is designed for short-, medium- or long-term planning at the health facility level.

- Data inputs: The user needs to enter intervention resource prices and quantities for facility operating expenses, including drugs, services, overhead expenses and staffing, and fees. The user also is required to provide demographic information, epidemiological data (such as incidence and prevalence rates), coverage (catchment population for the facility), number of services, and a time period.

- Costing methodology: The tool uses a bottom-up methodology to calculate normative, variable, and fixed costs. It does not include capital costs although it is possible to include depreciation. The tool allocates fixed operating costs based on the proportion of variable costs and direct service staff costs.

- Measures of effectiveness: Process indicators are the number of services, disaggregated by curative, preventive and promotional. Output measures include total and per capita services.

- Sensitivity analysis: Can estimate with and without community health workers.

- User-friendliness: The reviewers in the 2008 Cost Review Pack found, the tool to be user-friendly. It requires three days of small group training. The tool does not generate automatic reports and is not designed to harmonize with grant proposals and other report formats. It does generate graphs and tables.

- Limitations: The tool definition of 'basic package' may be different from country's definition.

D. The **Integrated Community Case Management (iCCM) costing tool** estimates service delivery costs at the community level and support, supervision, and management costs at all levels of the health system. Its intended users are program planners and managers that want to rapidly assess costs and financing of iCCM introduction and expansion in developing country settings. It estimates the cost of providing malaria case detection and treatment. The tool is still being developed and has been piloted in three countries - Malawi, Rwanda and Senegal.

- Projections: The tool is used to estimate the costs of service delivery by community health workers (CHWs) during the baseline year and projects the costs over five years. It can be used at a national or sub-national level.

- Data inputs: The user is asked to enter data on the number of CHWs per administrative area, program coverage, equipment and medicines, trainings, management and supervision.

- Costing methodology: Recurrent, direct, and indirect costs are calculated.

- Measures of effectiveness: The main process indicator is the number of services. Outputs that are calculated are cost per service, cost per capita, and cost per CHW.

- Sensitivity analysis: Various scenarios can be compared – e.g. level of scaling-up.

- User-friendliness: The tool is designed to be user-friendly: 1) cells are color-coded; 2) it has drop down menus for protocols; 3) it has a worksheet for choosing a scenario; and 4) it has a dashboard with graphical representations of the results.

- Limitations:
  - Only one scenario of program with specific improvements can be estimated at a time.
  - Having a manual explaining the costing methodology and assumptions made would be helpful.

E. The **UNDP Integrated Health Model costing tool** estimates the resources required to meet the health-related MDGs. The intended users of the tools are health planners. The tool estimates the cost of malaria services. UNDP developed Version 2 in 2007.
- Projections: The tool has a medium-term time focus, i.e. up to ten years. The unit of analysis is national.

- Data inputs: Some default demographic and epidemiological data are in the tool, e.g. total population. This tool requires the user to provide demographic and epidemiological data, treatment protocols, and unit costs.

- Costing methodology: A unit cost approach is used to calculate both total and per capita costs, which includes recurrent/operating costs as well as capital costs. Intervention cost is the number of people receiving the intervention multiplied by the cost of intervention per case or person receiving the intervention.

- Measures of effectiveness: The main output is the number of people requiring services.

- Sensitivity analysis: None

- User-friendliness: This tool is an Excel workbook with multiple spreadsheets. This tool has a toolbar and a color scheme for cells to help the user navigate the tool. Several charts are easily prepared.

- Limitations: A more detailed user manual would be helpful.

The table below shows the type of malaria services included in the five tools, sources of epidemiological data, and measures of effectiveness. All five tools include diagnostics and treatment, and four out of five include ITN distribution. Only two tools include IRS, IPTp, and ITPi. Most of the tools get their epidemiological data either from surveys (DHS and MICS) or from LiST. Only one tool, OneHealth, generates outcome measures of effectiveness.

Tool	Malarial services	Epidemiological data/sources	Baseline incidence	Outputs measured	Assumptions for measurement of outcomes	Health outcomes measured
Malaria Costing Tool	ITNs, IRS, IPTp, ITPi, diagnostics, treatment (including through community-based providers), source reduction, refugees and internally-displaced persons	UN Population Division, coverage from DHS or MICS	1/3 of fevers reported in the DHS will not be measurable fevers; malarial fevers = 48% of all fevers: fevers in epidemic areas= fevers in endemic areas /4.5	# of commodities purchased	ITNs reduce incidence of malarial fevers by 50%	NA
OneHealth	ITNs, IRS, IPTp; diagnostics, treatment, can add custom interventions and delivery channels	UN Population Division, LiST, AIM, and FamPlan	Data on the percentage of children that live in malaria endemic areas and annual malaria incidence is sourced from a database in WHO's Child Health Cost Estimation Tool (CHCET) model; Information on adults suffering from malaria is taken from Kiswzewski et al (2007).	# of services	ITN prevents 50% cases; assumes 100% malarial cases seek treatment	Mortality reduction; use of LiST models for child survival
CORE Plus	ITN distribution, diagnostics, treatment	N/A	Input average number of episodes per person	# of services	NA	NA
iCCM	Diagnostics, treatment	DHS or MICS	Use data (e.g. DHS malaria prevalence) to calculate # episodes per year	# of services	NA	NA
UNDP IHM	ITNs, diagnostics, treatment	DHS or MICS	Country epidemiological data	# of services	NA	NA

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