

**Evaluating the Impact of Malaria Control Interventions in Sub-Saharan Africa**  
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**Article Summaries**

**I. Framework for Evaluating the Health Impact of the Scale-up of Malaria Control Interventions on All-cause Child Mortality in Sub-Saharan Africa**

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**Why was this study done?**

- This study was conducted to review and update the Roll Back Malaria Monitoring and Evaluation Reference Group (RBM MERG)'s longstanding framework and methodology used to generate evidence of the impact of the scale-up of malaria control interventions on malaria morbidity and mortality.

**What did the researchers do?**

This expanded framework includes new features, such as:

- Examining sub-populations most likely to demonstrate improvement from intervention scale-up
- Using a national platform framework
- Analyzing complete birth histories from national household surveys

**What do these findings mean?**

- Despite challenges, it is possible to combine multiple data sources and analytical techniques, to generate evidence of the impact of the scale-up of malaria control interventions on malaria morbidity and mortality.

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## II. Implementing Impact Evaluations of Malaria Control Interventions: Process, Lessons Learned, and Recommendations

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### Why was this study done?

- The process for carrying out impact evaluations and lessons learned from conducting such evaluation in 13 countries were compiled to provide recommendations to inform future evaluations.

### What did the researchers do?

- Lessons learned were collected from the teams conducting the malaria impact evaluations following the RBM MERG-recommended methodology:
  - National malaria control programs (NMCPs) have a central role in such evaluations. It is best practice for NMCPs to lead these evaluations.
  - Stakeholder engagement was critical throughout the evaluation process. The platforms for such engagement include: steering committees, broad stakeholder groups, and core evaluation teams.
  - When designing an evaluation, epidemiological context, intervention coverage levels, time since intervention scale-up began, time since intervention coverage levels reached sufficient levels, and time since last evaluation should be considered.
  - The evaluation results should be presented in multiple formats (e.g. full scientific report, key findings report, journal article, and/or policy brief) in order to be useful to a broad range of stakeholders.
  - The evaluation results can be used by NMCPs and their partners to identify and address gaps in their programs, including data collection systems and to address those gaps.

### What do these findings mean?

- Assessing impact of national level programs in operational settings often require a large investment in financial and human resources.
- The quality of available data can have a large effect on whether robust conclusions can be drawn related to the impact on malaria burden.
- The experiences and resulting recommendations can be used by malaria programs and other health programs to improve the quality and efficiency of planning and implementing impact evaluations, and potentially reduce their cost.

### **III. Using Rainfall and Temperature Data in the Evaluation of National Malaria Control Programs in Africa**

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#### **Why was this study done?**

- Climate (rainfall and temperature) impact on malaria transmission can increase during unusually wet and warm years.
- Variations in the climate before and after interventions may undermine the assessment of those interventions, resulting in over/under estimation of their impact.
- Improving the accuracy of assessing the impact of malaria interventions can improve the targeting of resources, increase confidence in results, and assure governments that resources are being used effectively.

#### **What did the researchers do and find?**

- The researchers evaluated the likely effect of climate on assessing the impact of malaria interventions in 10 priority countries/regions in eastern, western and southern Africa for the U.S. President's Malaria Initiative.
- They used global climate products and high-resolution national climate data sets, using a new tool to assess relative changes in rainfall between baseline and intervention years.

#### **What do these findings mean?**

- The study demonstrated that climate information is a potentially valuable resource for improving the quality of malaria impact assessment.
  - Three countries/regions (Tanzania, Zanzibar, Uganda) where climatic factors may have led to these evaluations overestimating the impact of interventions.
  - Three countries (Mali, Senegal and Ethiopia) where impact evaluations may have underestimated the impact of interventions because of climatic factors.
  - Four countries (Rwanda, Malawi, Mozambique and Angola) where there was no strong difference in climate suitability for malaria in the pre- and post-intervention period.

#### **IV. Methodological considerations for use of routine health information system (HMIS) data to evaluate malaria program impact in an era of declining malaria transmission**

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##### **Why was this study done?**

- Evaluating the impact of health interventions typically takes the form of randomized controlled trials, where outcomes are compared between areas that receive or do not receive interventions.
- Malaria interventions such as insecticide-treated mosquito nets have been scaled up by national malaria control programs to provide access to all populations at risk of malaria, meaning that control areas are not available.
- While some countries have used malaria data from large-scale surveys such as the Demographic and Health Survey (DHS) to evaluate the impact of interventions, these surveys have limited ability to detect changes in settings with low malaria transmission.
- Routine data reported by health facilities is a potentially valuable source of information about changing malaria trends, but these data tend not to be analyzed due to concerns that the data are biased.

##### **What did the researchers do?**

- Authors presented a variety of analysis methods used for impact evaluations with malaria data from routine HMIS. For each method, advantages and disadvantages are discussed and include examples from the literature to provide guidance for control program staff on potential approaches for analysis of HMIS data.
- Authors also discuss in detail techniques to minimize bias in HMIS data used for impact evaluations.
- Interrupted time series analysis and dose-response analyses are recommended as the strongest methods to analyze the impact of interventions using HMIS data, when interventions have been introduced throughout the study area and control areas are not available.

##### **What do these findings mean?**

- Routine HMIS data can be used to evaluate the impact of interventions against malaria; this approach is particularly valuable in settings with declining or low malaria transmission.
- Using a plausibility approach, meaningful information about the impact of interventions can be gained from even relatively simple analyses of routine HMIS data.

**V. Assessing the contribution of malaria control interventions in reducing all-cause under-5 mortality in Zambia, 1990–2010**

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**Why was this study done?**

- Under-five mortality in Zambia has declined since 1990, with reductions accelerating after 2000.
- This study was conducted to systematically evaluate the impact of malaria control interventions as well as other child and maternal health interventions on under-five mortality in Zambia. Scale-up of malaria control interventions in Zambia has been viewed as the driver of these gains.

**What did the researchers do?**

- Authors first quantified the relationship between malaria control interventions, as well as other priority health interventions and socioeconomic indicators, with district-level under-five mortality trends from 1990 to 2010.
- Secondly, authors attempted to estimate under-five mortality in the absence of scaling up malaria control interventions.
- During the evaluation period, malaria control intervention scale-up coincided with scaling up three other interventions: the pentavalent vaccine, exclusive breast-feeding, and prevention of mother-to-child transmission of HIV services.
- This simultaneous scale-up of interventions made isolating intervention-specific impact infeasible.

**What do these findings mean?**

- In combination, these interventions jointly accelerated declines in under-five mortality by 11% between 2000 and 2010.
- Zambia's scale-up of multiple interventions is notable, yet our findings highlight challenges in quantifying program-specific impact without better health data and information systems.
- As countries aim to further improve health outcomes there is even greater need – and opportunity – to strengthen routine data systems, and to develop more rigorous evaluation strategies.

**VI. Impact of insecticide-treated net (ITN) ownership on all-cause under-five mortality in Malawi, 2006–2010**

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**Why was this study done?**

- Many resources have been leveraged to increase insecticide treated net (ITN) coverage in malaria endemic countries such as Malawi, with an aim to reduce malaria morbidity and mortality.
- Unique availability of nationally representative survey data powered at the district level in Malawi permitted impact analysis using a district platform approach.

**What did the researchers do?**

- Two distinct analytic approaches were applied to estimate the impact of increasing ITN ownership on all-cause under-five mortality in Malawi between 2006 and 2010.
- Both approaches showed significant associations between high levels of ITN ownership and reductions in child mortality when controlling for potential household, and child and maternal health confounders.

**What do these findings mean?**

- Publicly available, nationally representative data from household surveys can be used to examine the impact of malaria control interventions under routine conditions.
- The expansion of ITN coverage in Malawi contributed to declines in child mortality.

## **VII. Malaria control interventions protect against malaria parasitemia, severe anemia and all-cause mortality in children less than five years of age in Malawi, 2000–2010**

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### **Why was this study done?**

- Given the increased investments in malaria control, the National Malaria Control Program in Malawi and its partners were interested in determining if there was an impact on malaria morbidity and all-cause mortality in children under five years of age.
- This study assessed the impact of the malaria interventions under programmatic conditions.

### **What did the researchers do and find?**

- A before-and-after assessment was used to look at the magnitude and timing of changes in the coverage of malaria control interventions and parallel trends in malaria morbidity and all-cause, under-five mortality in the context of changes in other socio-economic, child and maternal health interventions.
- According to nationally representative household survey data, insecticide-treated net ownership and intermittent preventive treatment during pregnancy increased significantly during the evaluation period, with 107% and 95% relative increases, respectively.
- Failing antimalarial drugs (chloroquine and sulfadoxine-pyrimethamine) were replaced with highly efficacious artemisinin-based combination therapies (ACTs) for first-line treatment of uncomplicated malaria.
- Malaria parasite prevalence decreased significantly from 61% in 2001 to 20% in 2009 and all-cause mortality in children under five declined 41% between 2000 and 2010.
- Using data from subnational anemia and parasitemia surveys, insecticide-treated net ownership was found to be protective against malaria parasitemia (odds ratio = 0.81 [0.72-0.92]) and severe anemia (odds ratio = 0.82 [0.72-0.94]) in multivariable logistic models controlling for household wealth, age, rainfall, temperature, year and region.

### **What do these findings mean?**

- Intervention coverage improved, malaria morbidity declined and all-cause under-five mortality declined between 2000 and 2010.
- Coverage with other health interventions also increased between 2000 and 2010; however, none of these improvements can fully explain the decline in all-cause mortality. Therefore, it is plausible that the malaria control interventions contributed to the decline in all-cause mortality in Malawi between 2000 and 2010.
- These conclusions are supported by the declines in all-cause under-five mortality that were greater in higher malaria risk areas. Declines were observed in malaria parasite levels and severe anemia, which are along the causal pathway between malaria control intervention increases and reductions in malaria, and therefore, all-cause mortality.

## VIII. Declines in malaria burden following scale up of control interventions in Senegal, 2005–2010

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### Why was this study done?

- Since 2005, interventions to prevent and treat malaria have been scaled-up in Senegal, particularly the distribution of insecticide treated nets (ITNs) to every household, prevention of malaria during pregnancy, and rapid diagnosis and treatment of people with malaria with artemisinin-based combination therapy (ACT).
- At the same time, all-cause mortality among children under five years of age decreased 40% from 2005 to 2010, the period when these malaria prevention and treatment interventions were scaled up.
- While there is solid evidence to show that the proportion of children under five years of age with malaria parasites in their blood decreased during this time frame, this assessment sought to determine whether this increase in malaria prevention and treatment contributed to the decline in parasite prevalence and in all-cause mortality.

### What did the researchers do and find?

- Authors used data sets from four nationally representative household cross-sectional surveys, data collected from all publicly supported health facilities on malaria cases and deaths, and rainfall data from 2005 to 2010 to determine if malaria prevention and treatment intervention coverage had increased, and if the decrease in malaria morbidity and in all-cause child mortality can plausibly be attributed to this increase.
- Authors found that household ownership of ITNs increased from 20% to 63%, and that the proportion of people sleeping under an ITN increased from 6% to 29%, while malaria parasite prevalence decreased from 6% to 3%.
- While some other health indicators for children improved somewhat, none improved to this magnitude, and some, such as nutritional status, actually deteriorated. Rainfall was atypically high during this five-year period, particularly during the last two years of the assessment period.
- Malaria parasite prevalence and all-cause childhood mortality decreased most in the regions and in the socio-economic groups with the greatest increase in ownership and use of ITNs.

### What do these findings mean?

- Coverage of malaria prevention and treatment interventions increased substantially in Senegal, with the greatest increases in these interventions coinciding with the greatest decreases in parasite prevalence and all-cause childhood mortality.
- No other contextual factors satisfactorily explained this decrease, suggesting that the scale-up of malaria control interventions contributed substantially to the 40% decrease in all-cause childhood mortality.

## **IX. Impact Evaluation of Malaria Control Interventions on Morbidity and All-Cause Under Five Mortality — Rwanda, 2000–2010**

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### **Why was this study done?**

- There has been a concerted effort between the Government of Rwanda and its global health partners to improve malaria control interventions in Rwanda to reduce malaria morbidity and mortality.

### **What did the researchers do?**

- Bivariate analysis was used to examine associations between malaria control interventions and malaria morbidity and all-cause child mortality.
- A decomposition model was used to explore which malaria control interventions and contextual factors contributed to the declines in all-cause child mortality, seen across the evaluation period.
- Decomposition models of under-five mortality showed that the observed increase in household bed net ownership, from 8% to 94%, could have explained as much as 50% of the modeled decline in ACCM between 2000 and 2010 and as much as 35% of the observed decline in ACCM, equivalent to a reduction of 42 deaths per 1,000 live births per year, in the absence of other changes.

### **What Do These Findings Mean?**

- Publicly available nationally representative data from household surveys can be used to examine impact of malaria control interventions under routine conditions.
- The expansion of ITN coverage in Rwanda contributed to declines in child mortality.

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