

Systematic Review Protocol: Non-health outcomes of malaria control interventions

Joe Brew

joe.brew@isglobal.org

Laia Cirera Crivillé

laia.cirera@isglobal.org

Elisa Sicuri

elisa.sicuri@isglobal.org

Institut de Salut Global de Barcelona

Summary

The literature regarding the non-health effects of malaria control and prevention interventions on those targeted is scant, varies in terms of units and metrics, and stems from a diversity of times and locales. These factors make the comparison of different interventions difficult. By carrying out a systematic review of the available literature pertaining to the direct non-health impact of malaria control and prevention activities, we will aggregate information to generate standardized measurements of interventions' effects, informing both the scientific discussion on malaria as well as public health practice.

Background

The issue

The non-health outcomes of infection with malaria is poorly understood, but describing and quantifying the full spectrum of consequences of malaria control interventions is crucial, particularly in light of the fact that malaria disproportionately impacts low-income countries. Though macro-level analyses suggest that a reduction in malaria's burden could be causally associated with increased economic growth [Sachs and Malaney, 2002], the direct impact on worker productivity, income, and expenditure, along with education attainment, is unclear.

Public health authorities are interested in quantifying the overall effect of malaria control on worker health, as measured in DALY's, QALY's, and other metrics of morbidity and mortality. But quantifying the short-term and direct impact of malaria infection (or, inversely, prevention) on a worker's productivity or a student's absenteeism is a more useful and actionable metric for those who finance malaria control activities outside of the public sector, especially private firms. Much of the available literature on the topic of malaria's economic burden is either exclusively macroeconomic (overly general) [Bloom et al., 2004] or narrowly understands costs to be only the value of work-time lost, as translated to worker wages (overly specific) [Chima et al., 2003]. A critical and systematic review of available evidence on the totality of direct costs and non-health outcomes related to malaria and its control is sorely needed, and would serve not only to further the scientific discussion regarding the economics of malaria, but could inform the advisability and sustainability of interventions carried out by both the private and public sectors.

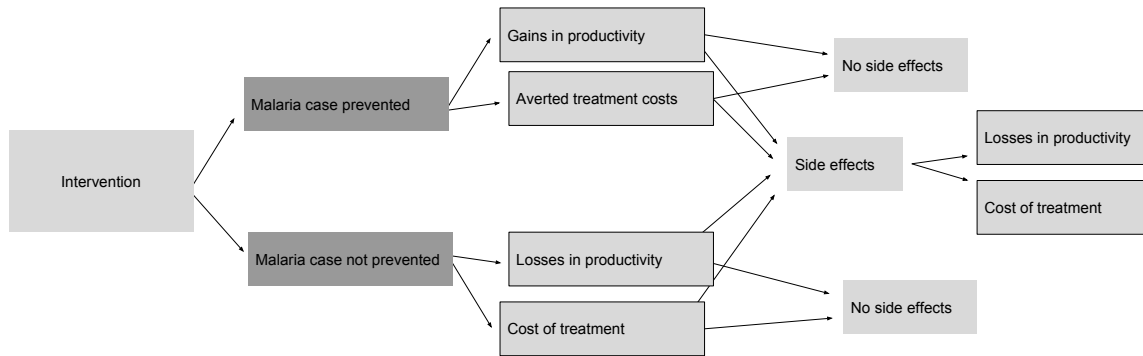
The interventions

Malaria control is constituted by many interventions: the distribution of insecticide-treated bed nets (ITNs), indoor residual spraying (IRS) of buildings, mass drug administration (MDA), larval control (LC), biological control (BC), area spraying (AS), pre-exposure prophylaxis (PEP) and, more recently, the malaria vaccine (MV). These interventions have been evaluated in multiple instances and areas both in terms of their implementation costs, as well as their benefits in human health and disease prevention. However, analyses focusing on the *economic* benefits are scattered, use different currencies and times, do not follow a standardized approach to defining "productivity", and do not reach consensus in regards to the prospective time-frame for which the effect of a disease (or its prevention) should be counted.

How we assess interventions

A clear comparison between different interventions in regard to their effects on the economic well-being of those targeted necessitates both (a) a clear understanding and delineation of what those effects are (both in terms of kind and time), and (b) a standardization of the pricing units used to measure those effects.

In regards to the delineation of what constitutes an effect, we follow the below flow chart.



In the flow chart, the calculation of prevalence/incidence occurs at the dark grey boxes, whereas the costing of economic effects occurs at boxes with black borders. In all cases, we limit the effect timeframe to exactly one year following the intervention, and adjust for age, pregnancy status, and overall population malaria prevalence whenever possible. For all costs, we use 2015 United States dollars. Costs are standardized to a per-person basis, and converted to direct return on investment.

This standardized approach allows us to compare the economic effect of malaria control and prevention interventions across time and space.

Why it is important to do the review

A systematic review of the literature on the direct economic impact of malaria control and prevention is sorely needed. Particularly in light of the current push for eradication, standardized comparisons of interventions is important to researchers, policy-makers, and public health practitioners.

Much of the current literature on the economic impact of malaria control and prevention focuses on indirect costs and benefits [Gallup and Sachs, 1998], is only quasi-scientific [Malaria, 2011], is exclusively macroeconomic [Hsiao and Emdin, 2015] [Zafar, 2007] [Carstensen, 2006], and overwhelmingly restricted to outcomes in health alone. Studies which estimate the direct economic effect of those targeted by interventions are both difficult to find and vary in regards to quality, interventions assessed, outcomes measured, time, geography, and units used. A systematic review is needed not only to identify which studies are of utility for those seeking to answer questions regarding the economic effect of malaria control, but also to standardize measurements and make comparisons in a way that is useful and actionable.

We anticipate that the results of this review will have notable application on the science, policy, and practice of malaria control and prevention. In particular, we believe that the direct comparisons and quantification of return on investment made possible by our review will be of great interest to business investors seeking to reduce absenteeism and increase productivity of workers in malaria-endemic regions as well as governments and health institutions in low-income countries which are keen on economic development.

Objectives

This review has one **primary** objective:

- Describe the existing evidence on non-health outcomes of malaria control and prevention interventions

Secondary objectives include:

- Standardize, quantify and compare the direct economic impact of malaria control and prevention interventions on those targetted.
- Provide an explanation for differing results over time and space
- Translate all findings into “return on investment”, so as to be of more interest to those in the private sector
- Create and document a framework for the replication of this review over time and for other diseases
- Augment the review through the inclusion of the estimation of side-effects and direct treatment costs taking from the general economic and biomedical literature

Methodology

Criteria for including studies in the review

- *Interventions* We count as a “malaria control intervention” any systematic, organized, planned and documented campaign involving distribution of insecticide-treated bed nets (ITNs), indoor residual spraying (IRS) of buildings, mass drug administration (MDA), larval control (LC), biological control (BC) in any of its forms, area spraying (AS), pre-exposure prophylaxis (PEP) and, more recently, the malaria vaccine (MV).
- *Geography* We include studies which took place in areas which were estimated to be holoendemic, hyperendemic, mesoendemic and hypoendemic at the time of intervention/study, as measured by spleen rate parasite prevalence and defined by [Hay et al., 2008].
- *Study design* Studies included in the review can be experimental, quasi-experimental, or observational (with the latter category constituting the greatest majority, given the nature of population-level interventions). “Control” conditions/groups are understood as the health status (and corresponding economic characteristics) of comparable populations who were not targeted by the intervention, or the intervened populations in the period immediately prior to the intervention.
- *Timeframe* We include any study that took place since 1990.
- *Measures* We include studies which report measures of either (a) likelihood and severity/duration of illness as a function of intervention, (b) absenteeism of students, (c) absenteeism of workers, and (d) productivity of workers. In the case of only (a) we average the economic effect of other studies so as to estimate the economic effect as a function of illness likelihood, severity and duration.

- *Duration of follow-up* We include studies which follow the target population for a period of at least one “season” (in the case of seasonal malaria) or one year (in the case of year-round transmission).
- *Exclusion criteria* We include no qualitative studies, no “grey literature”, no meta-analyses or systematic reviews, and no non-peer reviewed papers.

Search Strategy

Database For the purposes of simplicity and reproducibility, we will exclusively use the PubMed and IDEA databases.

Title keywords The title of any included work must contain the word “malaria”.

Abstract keywords The abstract of any included work must contain either the word “intervention” or “campaign”, or one of the specific descriptors for an intervention:

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> "insecticide-treated bed net" OR "bednet" OR "ITN" OR  
+ "INDOOR RESIDUAL SPRAYING" OR "IRS" OR "MASS DRUG ADMINISTRATION" OR  
+ "MDA" OR "larval control" OR "larvicide" OR "biological control" OR  
+ "genetic modification" OR "area spraying" OR "fumigation" OR  
+ "prophylaxis" OR "vaccine"
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Additionally, the abstract must contain at least one word pertaining to educational or economic (non-health) outcomes:

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> "productivity" OR "output" OR "grades" OR "absenteeism" OR  
+ "wages" OR "education" OR "attainment" OR "achievement" OR  
+ "literacy" OR "expenses" or "expenditure" "earnings"
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Filtering After having retrieved all articles with the above search strategy, manual filtering will be applied to keep only those articles with health outcomes (as measured in likelihood [attack rate, incidence, etc.] and severity/duration of disease, for later translation to economic outcomes), education outcomes (as measured in absenteeism and performance), or direct economic outcomes (as measured in productivity, earnings, or absenteeism).

Details of study coding categories

All studies will be “coded” according to (a) geographic location, (b) time frame, (c) target population (infant, child, adult, pregnant women), (d) intervention type, and (e) study type. In any case in which the coding may have been subjective or was not explicitly indicated by the study authors, a study will be flagged as “coding potentially subjective”.

Sources of Support

This systematic review will be undertaken in the context of the doctoral research of Joe Brew, who is enrolled in the Transdisciplinary Global Health programme, an Erasmus Mundus doctorate funded by the European Commission.

Declarations of interest

The authors declare no potential conflicts of interest.

Review authors

Lead review author

Name: Joe Brew
Title: Pre-doctoral fellow
Affiliation: Institut de Salut Global de Barcelona
Address: c/ Rosselló, 132
City, State, Province or County: Barcelona
Postal Code: 08036
Country: Spain
Phone: +34 666 66 80 86
Email: joe.brew@isglobal.org
Role: Retrieval and statistical expertise

Co-authors

Name: Laia Cirera Crivillé
Title: Researcher
Affiliation: Institut de Salut Global de Barcelona
Address: c/ Rosselló, 132
City, State, Province or County: Barcelona
Postal Code: 08036
Country: Spain
Email: laia.cierera@isglobal.org
Role: Content expertise

Name: Elisa Sicuri
Title: Professor of Economics
Affiliation: Institut de Salut Global de Barcelona
Address: c/ Rosselló, 132
City, State, Province or County: Barcelona
Postal Code: 08036
Country: Spain
Email: elisa.sicuri@isglobal.org
Role: Methodological expertise

Preliminary timeframe

- April-May 2016: protocol redaction and approval

- May-June 2016: systematic retrieval and designation of articles for review
- July-August 2016: review of articles
- September-October 2016: analysis and synthesis, preparation of manuscript for publication
- November 2016: Submission for publication

Plans for updating the review

The review will be updated, using identical methods, every two years, beginning in November 2018 (two years after initial submission for publication). Joe Brew will be responsible for coordinating updates.

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