

The Economics Of Malaria And Its Control

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Catherine Goodman, Kara Hanson, Anne Mills, Virginia Wiseman, and Eve Worrall

Health Economics and Financing Programme, London School of Hygiene and Tropical Medicine, Keppel Street, London, United Kingdom

Introduction

Since a review of the economics of malaria conducted in the early 1990s [24], there has been some growth in the literature, although still very little relative to the need for understanding of the economic aspects of malaria and its control. The aim of this paper is to provide a brief review of current knowledge on economics of malaria, and to identify key knowledge and research capacity needs. The paper is structured according to the main categories of economic analysis, namely:

- Socioeconomic determinants of malaria transmission;
- Resource costs of malaria;
- Characteristics of demand for prevention and treatment of malaria;
- Characteristics of supply of prevention and treatment of malaria;
- Economic evaluation;
- Evaluation at the whole system level.

Socioeconomic determinants of malaria transmission¹

Malaria is frequently referred to as a disease of the poor. At a macro level, there is clear evidence that the burden of malaria is greatest among the poorest countries of the world, especially those in sub-Saharan Africa. At a micro level, a recent review has shown that evidence on the distribution of malaria and incidence of malaria in poor and less-poor population groups is mixed and contradictory [32]. Most studies using assets as a proxy for socioeconomic status (SES) have failed to establish a clear relationship between asset ownership and the incidence of febrile episodes (as a proxy for malaria). The most extensive study [11], using Demographic Health Survey (DHS) data, found no difference at the household level in incidence of fever between the poor and less-poor, but significant differences were seen at more aggregate levels².

Evidence concerning malaria incidence and occupation is also mixed, although stronger than that obtained from asset-based indicators of SES. Unemployment and migration of labourers for agricultural work have been shown to be risk factors for malaria infection. Similarly, although the work done is limited, aggregate-level data suggest that ethnic group might be significantly related to the incidence of malaria.

Where studies have found differences in incidence of malaria by various socioeconomic proxies, these differences often did not survive multivariate statistical analysis. Lack of clear findings is likely to be at least partly due to flawed methodologies and the inherent difficulties involved in measuring SES in

¹ This section is based on Worrall, Basu & Hanson, 2003; readers should refer to this paper for detailed references.

² These findings have been questioned by malaria epidemiologists, as differences in transmission patterns across the large number of countries examined may confound the consistency of the SES–incidence relationship, or lack thereof (L. Barat, 2002, personal communication,)

developing countries. Furthermore, although there is a great deal of literature on equity and health more generally, limited research has been undertaken that looks at these relationships specifically for malaria. Where studies contain variables that allow the relationship between SES and malaria to be investigated, this was rarely the main topic of the research, a factor that helps to explain the weaknesses in the measurement of SES.

Nonetheless, the lack of consistent socioeconomic differentials regarding malaria incidence is not necessarily unexpected, given the epidemiology of malaria transmission, particularly its environmental aspects, and may be testament to the high degree of exposure to the mosquito vector regardless of SES, particularly in areas and periods of high transmission. Susceptibility to malaria should, however, be distinguished from impact of malaria by socioeconomic group — this is considered in the next section.

Recommendations for future research:

1. A common methodology for measuring SES and poverty (including broader quantitative and qualitative aspects of poverty) is needed to develop a consistent body of evidence on the relationship between incidence of malaria and poverty, especially at the household and community level.
2. Existing datasets (e.g. DHS data) could be re-analysed to provide further evidence on this relationship, at relatively low cost.

Further exploration is required on vulnerability to malaria by socioeconomic group in different settings.

Economic Burden³

Information on the economic burden of malaria can help to target interventions efficiently and equitably, and to justify investment in research and control. Such data can inform our understanding of the financial and time burdens of illness episodes, the determinants of treatment-seeking behaviour, and the differential economic impact on population subgroups. Studies are conventionally categorized as macroeconomic or microeconomic studies.

Macroeconomic studies are concerned with impact at the level of the whole economy. Apart from Barlow's seminal work published in 1967 [6], this area of research has been neglected until very recently, when two studies have used malaria as an explanatory variable in economic growth models using cross-country regression analysis, and have demonstrated a significant relationship between growth in gross domestic product (GDP) per capita and the burden of malaria [12,21].

Microeconomic studies are concerned with impact at the level of a productive unit, such as the household or firm. A common method of estimation employed in many studies has been to sum the direct costs of expenditure on prevention and treatment, and the indirect costs of productive labour time lost. Evidence on direct costs suggests that households can spend quite substantial sums on prevention and especially treatment, and also that direct costs to governments are substantial. However the overall evidence on the microeconomic impact of malaria is patchy and weak [7,29], and there are many problems in using such data to reflect the burden to society or the potential benefits from control. Studies have generally focused on febrile illness, overestimating the burden of uncomplicated malaria, but underestimating the costs of severe illness, other debilitating

³ This section draws extensively on Chima et al., 2003

manifestations (especially neurological sequelae, anaemia and cognitive development), and mortality. Many studies use inadequate data to calculate indirect costs, failing to account for seasonal variations, the difference between the average and marginal product of labour, and the ways households and firms “cope” in response to illness episodes. An alternative approach has been to estimate the net impact on output by looking directly at the statistical association between malaria and agricultural output through a production function. Again, findings have been contradictory, at least in part because of weaknesses in data and methodology.

The evidence on the extent to which the burden falls more heavily on lower socioeconomic groups is reasonably consistent [32]. Studies examining SES using assets, education, and occupation all yield data that suggest an inverse relationship between the impact of malaria and SES. There exists some evidence that in the case of agricultural labourers, the relationship between occupation and incidence is dampened — if not reversed — by the generation of community-level wealth [32]. This evidence, taken with that from Filmer [11], implies that community-level data might provide a stronger indication of the link between malaria and poverty than does household data.

Indeed, a key problem with all microeconomic studies is their inherent failure to capture the impact of coping strategies in response to the risk of disease, as opposed to the experience of actual illness. The impact of these anticipatory coping strategies (e.g. fertility decisions, choice of crop, investment decisions) cannot be captured by comparing households or firms exposed to the same degree of risk because they reduce the average productivity of all households and firms, not just those experiencing illness during the study period. The contrast between the major impact of malaria found by macroeconomic studies and the weak evidence from microeconomic studies reinforces concerns on the value of past microeconomic work, and further highlights the need to develop a detailed understanding of the mechanisms by which malaria affects households and economies.

Recommendations for future research:

3. The scope of morbidity and mortality outcomes included in the disease burden need to be expanded, especially to include neurological sequelae and cognitive development.
4. Studies of microeconomic impact must be rooted in a sound understanding of the nature of economic activities in the specific setting, and must confront the possible pervasive effect of malaria on the productive environment and the production possibilities and incentives of households and firms.
5. A systematic approach to geographical variation is urgently required. Both economic and epidemiological factors vary greatly in different settings across Africa, but the haphazard set of country data available is of little use in making generalizations that are of value to policy-makers.
6. Studies are especially required on the impact of malaria on economic sectors, such as mining and quarrying, manufacturing, building and construction, commercial large-scale agriculture, tourism, and general commercial services.
7. Studies must be designed in order to inform policy action and not just to document total burden. This requires:

greater attention to economic burden by socioeconomic group, and especially impact on the poorest; and

emphasis on documenting the benefits of control and not just the costs of lack of control, and identifying interventions which that would make the largest contribution to reducing the economic burden.

Characteristics of demand for malaria prevention and treatment of malaria

The main purpose of most demand for health-care studies has been to understand the influences on household demand in order to predict likely trends and the impact of policy change. In a developing-country context, particular attention has been paid to the price elasticity of demand for curative care and, in turn, to the likely impact of user fees on use [3,4,9,18].

Few studies have been attempted that estimate the relative influence of the various determinants of treatment-seeking for malaria and febrile illness [5,8,9,23]. Those in the area of malaria have tended to focus on explaining patients' choice of "provider" or "outlet". For example, Asenso Okyere et al. [5] found that the choice of provider of malaria care is influenced by facility price, travel time, waiting time for treatment, a range of demographic factors (including education, age and sex) and, finally, the quality of care measured in terms of drug availability. They also reported that as income rises, individuals lean more towards self-medication when they get malaria. Bartolome and Vosti [9] found that private treatment was highly price-sensitive and, to a lesser extent, wealth-sensitive. Their results also stress the importance of transportation costs — that these may deter rural individuals from buying private treatment. Mensah [23] found that a patient's age, total expenditure, ethnicity, treatment costs and participation in a local credit scheme significantly affected the choice of treatment.

Households must also make choices between different types of product, the quantity of product and the timing of treatment. Relatively little is known about these determinants in the context of malaria. One exception is a recent econometric study of the demand for a malaria vaccine [8]. Cropper et al. report that the number of (hypothetical) vaccines that a respondent agrees to purchase was shown to increase with income, education, susceptibility to the disease and being married. In contrast, demand was shown to decrease with price, age of respondent and higher altitude. Holding household size constant, the demand for a vaccine was also shown to be lower the larger the number of children in the household.

The determinants of the demand for treatment for malaria are evidently varied. Other factors reported to influence demand include the incidence of malaria in the area, family members' susceptibilities to malaria, household size, the perceived quality of care/service, current health status and travel and treatment time [8,9]. To date, few attempts have been made to explore the way nationality, ethnicity, religion and tribal affiliation influence demand. "Regional" dummy variables are typically used as a proxy for these cultural differences [10].

Finally, a particular concern recently has been demand and use of services by the poorest population groups. Studies consistently find socioeconomic gradients in ownership of insecticide-treated nets (ITNs), indicating that the poor have less access [1,16,17,19,26]. There is also evidence that those of lower SES are more vulnerable to the consequences of malaria infection, possibly as a result of less access to effective treatment once infected. Evidence on use of treatment shows that the poor seek different, possibly inferior, types of care than the less-poor. Moreover, there is evidence that antenatal clinics in Africa are under-used by the poor and therefore there are likely to be socioeconomic inequalities in access to intermittent treatment/malaria prophylaxis during pregnancy.

Recommendations for future research:

8. Econometric analyses of large-scale household surveys are required to predict the effect of economic, social and cultural factors on different health-care choices and to measure the responsiveness of demand to these determinants.
9. Combined quantitative and qualitative studies should investigate: (i) the type of malaria-related health care that households would choose to purchase but fail to for lack of income/access/availability; and (ii) the changes that would make public sources of treatment more attractive to patients and their families, and especially to the poorest.
10. Evaluations should be done of interventions designed to increase demand for appropriate prevention and treatment, especially amongst poorer groups, and to increase adherence to treatment.
11. Evaluation of interventions to increase adherence to treatment are required.

Characteristics of supply of prevention and treatment for malaria ⁴

In the last 10 years, considerable knowledge has been gained about the supply of malaria control [[15](#)]. There is abundant evidence that in many places, public health services are of poor quality, with long waiting times, inaccurate diagnosis, inappropriate prescription and advice, frequent occasions when drug stocks run out, and continued use of ineffective drugs. Patients often resort to the unregulated private commercial sector where treatment may be inappropriate, although access costs may be lower. Inefficiency in public service delivery is also a problem: staff productivity is often low, especially when drugs are unavailable; polypharmacy raises drug costs unnecessarily; and excessive use of injectables increases costs. It is generally believed that church service providers are more efficient than government providers, but evidence is patchy. Evidence is even more scarce on the efficiency of the private commercial sector.

With respect to prevention, there is patchy and much disputed evidence on the relative performance of public and private sectors in distributing ITNs, and such performance is likely to vary considerably across contexts depending on, *inter alia*, the capacity and accessibility of the public sector and the existence and degree of competitiveness of the commercial sector. Most ITN delivery strategies have been implemented on a very small scale, providing little basis on which to infer the costs and likely performance of a substantially scaled-up intervention. Furthermore, achieving the Abuja targets of 60% coverage of children aged less than five years is likely to require a number of complementary interventions involving public and private distribution systems. Relatively little is known about the interactions among different distribution modes, and how they can be designed to encourage synergies and discourage negative interactions, such as crowding-out of commercial players.

The behaviour of providers is likely to be influenced by their knowledge, financial incentives, competition, perceptions of patient preferences, and any legal or regulatory sanctions for inappropriate behaviour, though studies in this area are very scarce. Many of the problems of service provision are linked to broader problems of health services, including inadequate resources for public sector services, poorly trained staff, and inappropriate incentives for health workers in both public and private sectors. Indeed, as Integrated Management of Childhood Illness (IMCI) is increasingly introduced, improving treatment for malaria must be addressed as a "horizontal" issue, along with improving other treatment services. However, there is little good evidence on how current problems can be addressed [[25](#)].

⁴ This section draws on Hanson et al., 2003.

Recommendations for future research:

12. There should be more analyses of relative performance (in terms of quality, equitable access, efficiency) of different types of service provider.
13. Evaluations of equity, efficiency, coverage and sustainability of different approaches to large-scale ITN distribution are urgently needed; in particular, more specifically, consistent methodologies and sufficient resources are needed to evaluate the large-scale approaches, such as voucher schemes, currently being supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria.
14. There needs to be greater evaluation of the success of approaches to increasing accessibility of treatment (e.g. community agents, retail outlets, home-based care)

Economic Evaluation⁵

National and international policy-makers require information on which strategies are best for prevention, how treatment should be improved, and whether malaria control is a good investment compared with other health-care interventions. Methods for economic evaluation, and in particular cost-effectiveness analysis, can provide important information for identifying the interventions that represent the best value for money.

Unfortunately, the number of cost-effectiveness analyses on malaria control is very limited — globally we know of only 14 different studies that report cost-effectiveness using generic health outcome measures, such as deaths averted or disability-adjusted life years (DALYs) [[14](#),[17](#)]. Most are based on data collected during trials, or use models to synthesize data from many different sources. Evaluations of routine service delivery are very rare. Country coverage is haphazard — and heavily related to the location of the main research institutions!

These few studies provide some guidance to decision-makers, and indicate that many of our current control measures can be highly cost-effective relative to many other health-care interventions. However, the potential of these studies to inform policy debates is limited by the lack of evidence on the costs and effects of packages of measures, and the problems in generalizing or comparing studies that relate to specific settings, and use different methodologies and measures of outcome.

While more studies are needed, in particular, focusing on new interventions and delivery modes in operational settings, this takes time and it will never be possible to perform studies in every possible situation. This argues for further development of modelling approaches, which can provide a systematic analysis of variation in cost-effectiveness across different epidemiological and economic zones. It is also essential that new studies are based on international best practice in cost-effectiveness analysis, and report results in line with standardized cost-effectiveness guidelines to enhance comparability between studies [[13](#)].

Recommendations for future research:

15. Ensure that any evaluation of new tools for the control of malaria includes an economic component.
16. Increase evaluation of the cost-effectiveness of packages of control measures, including increasing the number of evaluations of malaria control in routine settings.

⁵ This section draws on Goodman & Mills, 1999.

17. Expand efforts in application of modelling approaches to assessing cost-effectiveness.

Evaluation at the whole-system level

There are many systems-level questions that have been barely touched on in the literature on malaria, although the general health economics literature does include relevant publications. These questions include:

What is the appropriate role of government in malaria control and how can it be strengthened?

What are the efficiency and equity implications of different ways of carrying out the government's role?

What regulatory approaches are appropriate and effective in influencing access to and provision of prevention and treatment for malaria?

What is the appropriate balance between public and private sectors for both financing and provision?

Hanson [[15](#)] examines economic thinking on the role of government and its relevance to malaria control, emphasizing that although market failure provides a justification for public intervention in a number of malaria control interventions, this conventional welfare economics approach does not provide guidance about how governments should best intervene. Nor does it recognize that policy-makers are likely to pursue a broader range of objectives than simple welfare maximization, including health maximization and poverty alleviation. This implies that an expanded set of information is needed to make resource allocation decisions, including information on costs and cost-effectiveness of interventions, the nature of demand for interventions (including price and income elasticities), and the existence and performance (quality, accessibility) of substitutes for public provision. The complexity of the interactions among these dimensions means that it is not possible to arrive at simple, universally applicable guidelines on how governments should be involved malaria control.

Issues of government performance in malaria control have received virtually no attention since the failure of eradication. Yet there are major issues — examined in general terms in the development economics literature — concerning the organization of public services (for example, degrees of decentralization) and influences on the performance of public sector workers. In countries heavily affected by HIV, there may need to be a radical reappraisal of what the public sector can feasibly do.

Regulation has been examined particularly in the drugs literature, and is now becoming an increasingly important issue given concerns over drug use and quality. We know that antimalarial drugs are very widely available in the private sector, but only a few studies have explored issues of drug quality [[28,31](#)] and prescribing. [[20,27](#)] and greater understanding is required of intervention points and possible public policy action.

The balance of public and private action has been discussed primarily in relation to ITNs. Key policy questions are the optimal degree of subsidy; the role of the private sector in production, distribution, and sales; and the extent to which markets can be segmented through targeted approaches, enabling public funds to be concentrated on those least able to pay. There has recently been a considerable increase in research on this topic, but a much greater number of country studies are needed before clear conclusions can be reached. As argued earlier, evidence is particularly required about the effectiveness of alternative approaches when operated at a sufficiently large scale.

Recommendations for future research:

18. Effectiveness of alternative ways of carrying out the government role in malaria control.
19. Success of various ways of strengthening regulatory functions, especially relating to drugs.
20. With respect to both prevention and treatment: costs, effectiveness and feasibility of alternative nationwide approaches to targeting subsidies to vulnerable populations; costs and effectiveness of measures to encourage commercial sector expansion; impact of interaction of public and private delivery systems.

Research capacity building

Lack of availability of economists is a major barrier to greatly increasing the number of economic analyses of malaria. Of all the disciplines required for high quality research on malaria, economists are probably most in short supply. Moreover, economists attracted into health are more likely to work on broad health service issues rather than on specific diseases such as malaria; and malaria research groups often experience difficulties in recruiting economists to join them. Young economists can generally find relatively well-paid work outside health research, and remuneration for health economics research is not competitive with alternative options open to good young masters graduates.

McIntyre [22] argued that the following issues need urgently to be addressed if capacity is to be increased:

Expansion of soft-funded research institutions that are not dependent on the very limited government funding available.

Introduction of programme funding, which includes adequate support for institutional costs.

Greater opportunities for "on the job" experience in malaria research.

Adequate funding for capacity development within research projects.

Strengthened postgraduate training in health economics and disease-specific applications.

Support for networks that can link isolated researchers, and for conference attendance.

Conclusions

The above discussions make it clear that there is still a very large research agenda needing to be addressed, and prioritization is clearly called for. We would emphasize the following key priorities:

Evaluation of measures to improve access to malaria prevention and treatment. In general terms, we know what the problems are and what might be the potential solutions; what we do not know is how well different approaches might work in particular country settings. Far more real-life experimentation is called for, and on a large scale: small-scale research projects are not often very helpful in informing national policy.

Evaluation of measures to strengthen the performance of prevention and treatment services. Limited knowledge has gradually been gained on how the performance of private providers can be improved, but much more work is needed in this area; moreover the vital issue of improving public sector performance, and especially staff performance, requires much greater attention.

Systematically addressing how best to reach the poorest groups with preventive and treatment measures. An equity lens has been notably absent in most research to date; information relevant to equity should be collected in all evaluative research.

In all these areas, greater attention must be given to increased methodological rigour, and to standardization of methods in key areas, such as measurement of SES, to enable findings to be compared across settings.

All these research priorities will require close collaboration between research and control communities, and large-scale testing of approaches.

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