

## Economic cost of malaria in four countries in sub-Saharan Africa: A comparative analysis

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### Abstract

**Background:** Malaria remains a major cause of burden of illness in sub-Saharan Africa. The objectives of this study were to measure the costs of a malaria case in terms of costs borne by households affected and healthcare systems (either ambulatory or hospitalized) comprehensively in a number of countries in Sub-Saharan Africa, collecting data prospectively and retrospectively using a common protocol, which included data on lost productivity and unpaid time of caregivers.

**Methods:** We conducted community-based and health care facility-based studies on disease burden and cost of malaria disease in four sub-Sahara Africa (SSA), namely: Burkina-Faso, Ghana, Nigeria and Uganda. These were both prospective and retrospective studies that used a common protocol. The study population included children under five years old with febrile illness that met the World Health Organization's clinical case definition for malaria. To standardize measurements of economic impact across countries and facilitate comparisons and interpretations, we expressed all direct and indirect costs in 2019. The study incorporated empirical values for most of the components of health services used, and most of their unit costs. Furthermore, it examined actual medical practices, rather than the more expensive setting of a formal prospective clinical study of laboratory confirmed malaria disease. We used the unit costs as they were in 2010 and 2011, when the field work was conducted, but then discounted them to the current year of 2019.

**Findings:** The total household costs were highest in Ghana and lowest in Uganda. Health systems costs are significantly higher in Nigeria. As opposed to the three other countries, indirect costs in Ghana are lower than direct costs. It was found that in general richer households tended to spend more on treating OPD and IPD cases in the four countries and a majority of Ghana respondents were insured (67%) while in the three other countries, out of pockets spending were high (from different sources), followed by subsidies from social institutions.

**Conclusion:** Malaria remains a major contributor the high economic burden of disease in SSA. The reasons that our estimates are higher than previous estimates could be the fact that we included as much as possible costs incurred by households before arriving at the facility where they were interviewed, comprising informal sector payment. Malaria endemic countries should not relent, but should rather redouble efforts to control and eliminate malaria as a major public health burden in SSA.

**Keywords:** Burden of malaria, Burkina Faso, Direct and indirect costs, Nigeria, Sub-Saharan Africa, Uganda

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## Introduction

In 2011, malaria caused 216 million cases, of which 81% were from the sub-Saharan African region [1]. It represents in many endemic countries the first reason for consultation, often translating into large shares of healthcare expenditures.

Cost of illness studies quantify the economic value of resources lost because of disease or consumed in its prevention, treatment and care [2]. Endemic and epidemic malaria imposed economic and social stress on health care systems, affected households and society at large. Previous cost studies have been focusing on one country and mainly on treatment costs, so did not address all these associated economic losses. Many studies to date have used weak data to calculate indirect costs, which fail to account for seasonal variations, and the ways households cope in response to illness episodes [3-4].

The objectives of this study were to measure the costs of a malaria case in terms of costs borne by households affected and healthcare systems (either ambulatory or hospitalized) comprehensively in a number of countries in Sub-Saharan Africa, collecting data prospectively and retrospectively using a common protocol, which included data on lost productivity and unpaid time of caregivers. The countries participating in this collaborative study represents more than 30% of Africa-wide reported malaria cases.

## Methods

### Study design

We conducted community-based and health care facility-based studies on disease burden and cost of malaria disease in four countries in Africa: Burkina-Faso, Ghana, Nigeria and Uganda. These were both

prospective and retrospective studies that used a common protocol under the supervision of a local coordinating institution. This protocol sought to document, not to change patterns of visits and hospital days. Investigators chose facilities based on malaria endemicity and access. Two sites enrolled patients from both public and private facilities. These countries and specific sites were selected based upon various criteria including the presence of malaria vaccine clinical trial, disease burden, country economic profile and malaria control context. The study population included children under five years old with febrile illness that met the World Health Organization (WHO) clinical case definition for malaria [5]. Malaria cases reported were confirmed or not according to countries practices. Patients were selected consecutively or systematically depending on interviewer capacity and patient volume. Given the age of patients, legal guardians were invited to participate, asked to sign an informed consent form, and then enrolled in the study. Recruitment periods varied by country, extending from July 2010 to July 2011.

### Study countries' context

In Uganda, the study was in Apac district, located in the northern region of the country about 500km from Kampala (the capital city). The site is covered with savannah grassland, woodland and thickets interrupted by extensive swamps and a few hills. This very high endemicity area is 60% swampy which creates favorable conditions for mosquito breeding, as reported in an entomology study conducted in 2006[6]. In Burkina Faso, the study area was the Nanoro district located in the central region of the country, about 85km from the capital city (Ouagadougou). It is a very hyper-endemic malaria area (50-60 bppa) with seasonal

transmission. In Nigeria, the study was conducted in the Enugu state, located in Southeast Nigeria where the two sites used for the study are both in the Oji River LGA. There are both hyper-endemic and all year around. In Ghana, this study was conducted in the two RTS, trial clinical site districts in Kintampo and Agogo where malaria transmission levels are high and follow seasonal transmission pattern.

### **Research procedures**

We developed, piloted and translated into French (for Burkina Faso), Twi (for Ghana) and Igbo (for Nigeria), a set of patient questionnaires for health facilities, health providers, and communities. These tools documented demographics and socio-economic information for patients' parents and other household members, characteristics of present illness episode and its effects on health status, use of informal and formal medical care, work absences for parents, hours of patient care provided by household members, household spending and household income lost. We abstracted medical records of hospitalized children to obtain clinical data, including length of hospital stay. In addition, we used a hospital cost form to collect each facility's operating expenses per case of malaria, number of beds, occupancy rates and number of emergency and outpatient visits. In household survey, we collected personal data and demographics of respondent, malaria status of children under five within the past one month, healthcare seeking pattern for malaria treatment as well as the economic cost of malaria suffered by the household. Information was also collected on the household food expenditure and assets to determine their socio-economic status.

### **Data collection and management.**

Parents of children included were interviewed by trained health interviewers using the relevant questionnaire. Supervisory visits were carried out two times a week so as to closely monitor the data collection process to ensure quality. A patient-level database was developed to record the quantities of each input used in the treatment of each patient. Each record in the database included information on individual patients, including demographics, type of facility and duration of stay. Data was also captured on each diagnostic test and medication used. To do this, a comprehensive list of all types of tests and medications (by dose and route) was developed, based on the information collected in the data abstraction forms. For each patient, the quantity of each item was recorded in the database.

### **Analytic framework.**

The unit of analysis is a malaria case, defined as a documented acute febrile illness with a clinical diagnosis of malaria, classified into simple or severe malaria. Malaria laboratory confirmation was not a condition for enrollment, so analyses were conducted on both groups of patients. Principal components analysis was undertaken to generate a socioeconomic status (SES) index and wealth quintiles based on per capita food expenditure and household asset ownership. We estimated the economic cost of a case by summing direct medical costs, direct non-medical costs and indirect costs borne by government and households during the malaria episode

Direct medical costs were estimated by summing the products of the quantity of services used (inpatient and outpatients) in the public sector, times their respective

average unit costs. In all countries, we used a micro-costing approach to estimate average unit costs of health services. Direct non-medical costs included patients' out-of-pocket payments for transportation, food, lodging, and miscellaneous expenses associated with seeking and obtaining medical care and/or household members visiting patients at the hospital. Indirect costs were the monetary values of 1) lost days of work for pay and 2) days lost by either the patient or any other household member who provided care to the patient during the illness episode. We didn't include the number of school days lost by children involved because in all 4 countries, first school entry age is about 5-6 years. Valuation of a day of work lost to the worker or employer [7] as the higher of the reported daily loss or the country-specific minimum daily wage [8-10], and then calculated the total economic costs of work days lost as the product of this average daily loss times the number of work days lost. To value time of unemployed parents, we used a country's daily minimum wage for household members 15 years of age or above. Household total days affected are the sum of work and other days lost. In a further analysis step, we will aggregate costs to provide national estimates based on unit costs of malaria per case.

### **Provider costs**

Provider costs were also collected using health personnel and medical resources used costs. Time spent by each category of health professional for each type of malaria case was costed using their salary rates and medical resources used was costed using local unit rates obtained from the health facilities or local pharmacies. Total costs per case for ambulatory and hospitalized cases of malaria were then calculated by adding up

household direct and indirect costs to health system costs in each country.

### **Standardization of costs across countries**

To standardize measurements of economic impact across countries and facilitate comparisons and interpretations, we expressed all direct and indirect costs in 2019 international dollars (I\$), which adjust for purchasing power parity (PPP), using the ratio of the gross domestic (GDP) per capita in I\$ to the GDP per capita in US dollars (US\$) at the market exchange rate (See table 2). Specifically, WHO describes I\$ as "the costs in local currency units converted to international dollars using PPP exchange rates. The PPP exchange rates is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as the US\$ would buy in the United States [11]. In addition, we expressed total cost in US\$ to facilitate within-country interpretation. To compare economic costs calculated for previous studies of malaria and other infectious diseases in low-and middle-income countries, we also expressed costs in days of GDP per capita (per capita GDP divided by 365).

### **Statistical analysis for cost per malaria case.**

We conducted separate analyses for each country by type of care –ambulatory (participants without any hospitalization) and hospitalized (participants with a hospital stay of at least one day). Data was analyzed using SPSS, STATA and Microsoft Excel, to calculate unweighted means and standard deviations for continuous variables, and cross tabulated categorical variables which provide a natural weighting for all participants. Frequency distribution was analyzed, and we examined relationship between variables. Chi square tests were

used. We treated each patient as an independent observation as to our knowledge no two patients came from the same household and no patient had repeat malaria episodes during the study period. Missing data were generally imputed from other items from the same household or same socio-economic category. Principal component analysis was undertaken to generate a socioeconomic status (SES) index and wealth quintiles based on per capita food expenditure and household asset ownership.

### **Aggregate national and regional malaria cost estimates.**

In order to help the reader quantify the magnitude of malaria costs; we calculated we average annual aggregate costs of malaria by country and region based on 2010 WMR. Specific malaria inputs include malaria cases, percentage of malaria cases by setting (ambulatory and hospitalized), cost of a malaria case by setting and GPD per capita.

### **Ethical considerations.**

The study protocol was approved by Institutional Review Board at PATH, participating universities' review boards, and national Ethics Committees in participating countries.

## **Results**

### **Demographic description of respondents.**

Across the four countries, most of the respondents were female middle-aged caretakers, although some of the study sites covered both urban and rural areas. Farming (agricultural subsistence farming) and small business are the most represented occupations in the four samples.

### **Types of healthcare facilities where patients sought treatment.**

Across the countries, free treatment policy exists for less than 5 years old children officially. However, it was found in our study that most parents incur out of pockets expenses for both simple and severe malaria episodes in their children.

### **Average household and provider treatment costs for outpatients and inpatients cases for the respondents**

Table 1 shows the household treatment costs and providers' costs. The total household costs were highest in Ghana and lowest in Uganda. Health systems costs are significantly higher in Nigeria.

**Table 2** shows the discounted costs of an episode of malaria based on the severity in the four countries. It was found that in general richer households tended to spend more on treating OPD and IPD cases in the four countries. The data shows that a majority of Ghana respondents were insured (67%) while in the three other countries, out of pockets spending were high (from different sources), and followed by subsidies from social institutions.

## **Discussion**

In all countries except Ghana, the direct costs consisted in a significant proportion of non-medical costs, probably due to transportation costs relatively high given the rural location of the study sites. Indirect costs of malaria treatments were greater than the direct medical and non-medical costs. This can be potentially because in most facilities in Uganda, Nigeria and Burkina-Faso, there was no consultation fees charged because of the free treatment policy for under five children [12-13]. However, this has not eliminated the out of stock syndrome where



facilities do not always have drugs available, and so parents ultimately have to pay for drugs which are supposed to be free, as well as for other fees like registrations card, other drugs. Despite all this, the indirect costs of treating malaria surpass the medical costs because adults give up activities like going to work, farm or business, in order to take care of the sick child [14]. These activities would further erode the earning of households with a greater impact on the poorest households. In Nigeria, these findings are comparable to those from previous studies [15]. Given the occupation of the majority of the respondents, (petty traders or farmer or so), a loss of income in any form together with out-of pocket expenses for treatment will impact more heavily on the poor. This is corroborated by previous studies with similar observations and in other countries [15-16-17-18]. As opposed to the three other countries, indirect costs in Ghana are lower than direct costs. This could be explained by the wide use of Rapid Diagnostic tests in Ghana for malaria diagnosis. A right diagnosis followed by the right treatment certainly limits the drug costs and shortens the time spent at hospital, away from daily occupations. This result is also corroborated by the findings from Akazili *et al* in Ghana [18-19].

Not surprisingly, in all four countries, hospitalized cases (inpatient cases) cost were more severe than ambulatory cases, as evidenced by higher duration of disease state and more days affected. Inpatient cases costs were significantly higher than outpatient treatment costs. This is explained by the costs of hospitalization, special services, co-morbidities (upper respiratory tract infections and diarrhea) and other systemic complications that could arise from severe malaria (anemia, hypoglycemia and

comatose). Within the 4 countries, the total costs of a hospitalized case were 2-3 times higher than ambulatory cases. The variations in cost among countries might reflect many factors, such as the case-mix of the study participants, the type of facility at which they were enrolled, the costs of health services, patterns of treatment, the country's wage rates, and cost of living. [20-21]

The results also showed that in Ghana, Nigeria and Burkina Faso, as oppose to Uganda, most hospitalized patients sought treatment from other places and incurred some costs before arriving at the health facility where they were interviewed. This health seeking pattern most likely contributed to increasing the cost of treating the disease, witnessing that they didn't receive proper diagnosis and/or treatment. This would reflect in an even greater impact on household impact, leading to high incidence of catastrophic health spending for malaria [21-23]. Health seeking behavior findings showed that a majority of respondents across countries used self-treatment and patent medicine dealers before going to health centre or hospital, as discussed by others in neighboring countries [23-24].

To face these significant costs, households used various mechanisms, including savings, borrowing money, selling assets and community assistance. Except in Ghana, the distribution across quintiles for all coping mechanisms does not reveal any discernible pattern. In Ghana, only health insurance was used consistently across the socio-economic groups. This suggests that households' use of specific mechanisms is not dependent on the household poverty level. This result compares partially to findings from Somi *et al* in Tanzania [25] and others [26-27].

**Table 1: Total costs of an episode of malaria according to severity in 2011 US\$**

Components	Household costs			Health System	Total
	Direct (SD)	Indirect (SD)	Total (USD) (SD)	Total (USD)	US \$
<b>GHANA</b>					
Uncomplicated malaria	20.17 (56.17)	13.01 (10.94)	27.94 (42.45)	5.30	<b>33.24</b>
Severe malaria	67.21 (21.54)	19.03 (13.82)	76.91 (32.96)	37.96	<b>114.87</b>
<b>UGANDA</b>					
Uncomplicated malaria	2.27 (3.60)	3.09 (6.34)	5.37 (8.96)	1.45	<b>6.82</b>
Severe malaria	5.61 (1.50)	9.1 (9.48)	15.57 (13.34)	9.52	<b>25.09</b>
<b>BURKINA FASO</b>					
Uncomplicated malaria	2.32 (1.30)	5.15 (3.79)	7.66 (4.69)	4.10	<b>11.76</b>
Severe malaria	30.18 (9.09)	33.98 (19.65)	64.17 (21.82)	34.94	<b>99.11</b>
<b>NIGERIA</b>					
Uncomplicated malaria	3.46 (3.05)	9.11 (6.91)	12.57 (9.90)	21.34	<b>47.53</b>
Severe malaria	7.32 (3.82)	12.88 (6.08)	23.2 (12.21)	36.75	<b>71.85</b>

**Table 2: Discounted costs for an episode of Malaria according to severity (n=5 years r=5%).**

Components	Household costs			Health System	Total
	Direct (SD)	Indirect (SD)	Total (USD) (SD)	Total (USD)	US \$
<b>GHANA</b>					
Uncomplicated malaria	15.80 (4.01)	10.19 (8.57)	21.89 (33.26)	5.3	<b>26.04</b>
Severe malaria	52.66 (16.88)	14.91(10.83)	60.26 (25.83)	37.96	<b>90</b>
<b>UGANDA</b>					
Uncomplicated malaria	1.78 (2.82)	2.42 (4.97)	4.21(7.02)	1.45	<b>5.34</b>
Severe malaria	4.40 (1.18)	7.13 (7.43)	12.20 (10.45)	9.52	<b>19.66</b>
<b>BURKINA FASO</b>					
Uncomplicated malaria	1.82 (1.02)	4.04 (2.97)	6.00 (3.67)	4.1	<b>9.21</b>
Severe malaria	23.65 (7.12)	26.62 (15.40)	50.28 (17.10)	34.94	<b>77.66</b>
<b>NIGERIA</b>					
Uncomplicated malaria	2.71 (2.39)	7.14 (5.41)	9.85 (7.76)	21.34	<b>37.24</b>
Severe malaria	5.74 (2.99)	10.09 (4.76)	18.18 (9.57)	36.75	<b>56.3</b>

Although a national health insurance scheme was launched in Ghana and Nigeria to reduce burden by individuals, it is only in Ghana that we found insured respondents.

Officially, two thirds of the countries are covered reportedly by Ghana Health Insurance [28], this is consistent with our findings in the study, 60% of household in each quintile used health insurance to cover their expenses, with the highest proportion (67%) recorded within the poorest quintile, suggesting that populations perceive health insurance as a safe haven offering protection against catastrophic expenditures. These are much higher figures than what is reported by independent evaluations from Oxfam, which reported inequalities in access to health insurance in Ghana, with a 20% coverage rate [29]. No insured respondent

was interviewed in Nigeria, and all respondent paid using other means. Burkina Faso and Uganda do not have any type of financial risk protection scheme, meaning that most families, particularly non-government workers, pay their healthcare costs with out-of-pocket. [27] Whatever the financial protection scheme is, socio-economic status analysis showed that relatively rich households appear to incur more costs to treat OPD and IPD in all four countries. However, this doesn't suggest that the economic burden is higher for rich families. Instead, it is highly possible that the proportion of poor households' income spent on treating the diseases far exceed that of rich households. In other words, relative burden is more concerning than absolute costs provided in the SES analysis. Various



reasons could explain these greater costs, such as prescriptive patterns of providers that may be influenced by the socio-economic status of the household, with providers tending to prescribe more drugs and tests and more expensive drugs for patients from richer families, or families using more expensive transportations means to facilities. Other found similar results in Burkina Faso and Ghana [3-30].

The absence of universal laboratory testing on all cases of suspected malaria cases reflected the standard practices the participating institutions and the local and national policies. A clinical diagnosis of malaria without laboratory confirmation is usual in ambulatory settings and in facilities where clinicians have extensive experience with malaria. The relationships between the confirmed and unconfirmed cases' costs were not uniform. Only in Ghana, were these costs significantly different.

Previous research on the economic impact of malaria has been limited to single-country studies and using less comprehensive costing methods [31]. Costs per case in these studies were lower due to less comprehensive analysis of government subsidies for public services and valuation of indirect costs and inflation. In Nigeria, our findings are similar to results reported by others in Nigeria [22]. In neighboring countries, figures found by Deressa *et al* in Ethiopia and Some in Kenya are lower but covered fewer comprehensive aspects of those costs [18].

Most studies have documented malaria impact to households, so little interest has been given to costs borne by health systems to treat malaria cases, especially in countries where there is a health insurance scheme. Costs borne by providers in each country are

variable across the four countries, with IPD cost about 5-7 times higher than OPD costs but were always lower than household costs. These findings are consistent with previous research, which found similar proportions of household costs compare to health systems costs [32].

Compared to other studies, our estimates could be perceived as too high. Many reasons could explain the numbers observed in our study. First, we included as much as possible costs incurred by households before arriving at the facility where they were interviewed, comprising informal sector payment. Second, we used the unit costs are they were in 2010 and 2011, when the field work was conducted. As expected, malaria policies have changed at both national and global levels with impact on unit costs, particularly drug costs, through the Global Fund AMFM Initiative. This last policy has divided the cost of ACT drug by almost 8, which would decrease our direct medical costs significantly.

There are a number of limitations to this study. First, the definition of a malaria episode, ideally, we would have had a follow-up interview within a household survey with parents interviewed at exit of health facilities, in order to assess treatment outcomes and costs. Second, the difficulty to recruit for severe malaria cases, limiting the sample sizes. Third, the studies were conducted in specific locations in the four countries, with poverty levels and health systems representativeness that could limit its generalizability.

Finally, although it may be premature to extrapolate these preliminary data, we appreciated the interest to generate aggregated estimates at the national level for each country. The validity of our estimates

relies on our assumption that the distributions of cost per case in our study are representative for the whole country.

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