REDUCING DIRECT COSTS OF PREVENTING AND TREATING MALARIA IN SUB-SAHARAN AFRICA

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Abstract

Malaria is a devastating parasitic infection in humans and is the primary focus for new initiatives in sub-Saharan Africa. Greater financial resources will improve prevention and treatment of the disease. Until these resources are available, new approaches to saving costs are being considered. New anti-malarial combination therapies can help stop drug resistance, however their costs are often beyond the means of the peoples in sub-Saharan Africa. Insecticide treated nets, indoor residual spraying and chemophylaxis are all effective, yet costly, ways of preventing infection by mosquitoes. Areas where prevention and treatment costs can be reduced need to be examined. Affordable prevention and treatment for sub-Saharan humans will not only improve compliance, but inevitably reduce the number of new malaria cases.

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Introduction

According to data compiled by the INDEPTH network, malaria kills 2,000 children daily and between 1 and 2 million humans annually, with 75 to 90% of cases occurring in sub-Saharan Africa.(1,22)

Malaria accounts for 40% of Africa's public health expenditure, 30 to 50% of inpatient admissions and up to 50% of outpatient visits. Malaria is estimated to cost Africa more than $12 billion every year in lost gross domestic product (GDP). The great tragedy is that this disease can be controlled with minimal expense.(1)

The goal of this article was to identify situations where reducing expenditures was both successful and effective in fighting future costs associated with malaria.

Overview

According to World Health Organization (WHO) data, direct costs of malaria include personal and public expenditures on prevention and treatment.

Personal expenditures include costs of insecticide-treated mosquito nets, health-care fees, anti-malarial drugs, transport to health facilities, and general living expenses for the patient. Public expenditures include government spending on health-care facilities and health-care infrastructure, publicly-managed vector control, education and research.(1)

A major challenge in the fight against malaria in Africa is drug resistance. Chloroquine, the cheapest and most used anti-malarial drug in Africa, is increasingly ineffective because of drug resistance. Alternative, higher priced anti-malarial drugs are being considered to fight drug resistance; however, these are not always affordable in sub-Saharan countries.(1)

Costs of Diagnosing Malaria

In sub-Saharan Africa, malaria is frequently diagnosed on symptoms, and not laboratory tests. This can lead to mis-diagnosis, under-diagnosis and eventually drug resistance.(2)

The most effective and affordable tool for diagnosing malaria is microscopy, which has an estimated accuracy of 70 to 75% and an estimated cost of around $0.53 per test.(3,5) Rapid dipstick tests can determine the infecting parasite species; these tests are twice the cost of microscopy.(4,5)

A study reported from Kenya showed evidence that microscopy can be more cost effective than other diagnostic tools if training was given to ensure proper use and future interventions were looked at to improve accuracy in clinical practice.(2)

A recent observation study in Kenya showed the benefits of microscopy with correct clinical practice. (2,3,23) The study found the costs of artemther-lumefantrine antibiotics and malaria microscopy decreased from $2,154 to $1,254.

Costs of Treating Malaria

About 60% of all diagnosed patients in sub-Saharan Africa are first treated by private providers, some of whom may not administer the complete course of antimalarials.(6) This helps patients who lack the funds to buy a full supply, but is disastrous medically because incomplete anti-malarial therapy causes drug resistance.(7)

In sub-Saharan Africa most clinics and hospitals keep only chloroquine as the first line drug for treatment.(8) Documented clinical failure rates with chloroquine as first-line drug during the 1990s reached 48% in Zambia and 50% in Malawi. Also in

Malawi, 74% of children attending a clinic were given chloroquine, but only 17% took the correct dose.(9) To improve treatment outcomes, recent changes from chloroquine as a first-line therapy to sulfadoxine-pyrimethamine have been incorporated, as well as introducing second- and third-line drugs into treatment.(10)

A sub-Saharan modeling study reported showing a range of $0.70 to $3.11 costs per disability adjusted life years (DALY) averted with sulfadoxine-pyrimethamine and quinine as second- and third-line drugs instead of chloroquine alone.(11) A full course of chloroquine costs under $150 with up to 69% parasitological resistance.(11)

In Kenya and Malawi, sulfadoxine-pyrimethamine were compared as the first-line drug against sulfadoxine-pyrimethamine-artesunate over 10 years. The cost-effectiveness range fell below $150 per DALY prevented when growth of resistance was reduced over 14%, and below $25 per DALY prevented when growth of resistance was reduced by more than 58%.(12)

Distributing and Packaging Anti-malarials

The packaging and distribution of anti-malarial drugs may also play a role in saving costs. In Burkina Faso, pre-packaged plastic bags of chloroquine were distributed by local village health workers and mothers were educated on basic health information and shown how to administer the chloroquine.

This led to more children taking the correct doses of chloroquine: from 3% to 49%, and more children staying on the chloroquine for the whole treatment course, from 21% to 72%.(13) The total costs for each plastic bag and their labels were $0.015; an additional $0.07 was added for training village health workers and packaging. The packaging of a course of chloroquine in standard blister packs adds $0.84 to the total cost of treatment.(14)

Assuming an intervention similar to Burkina Faso, the modeling study estimated that the cost per DALY would improve compliance with a full treatment dose between 10% and 30%. By improving compliance, $2 to $8 per DALY is avoided in high transmission areas.(11)

Preventing Malaria through Vector Control

Insecticide Treated Nets (ITNs)

Sub-Saharan Africa hosts the 3 most effective vectors, making control difficult.(15,20)

Insecticide treated nets can reduce or eliminate the burden of malaria cost-effectively, with an estimated cost per DALY prevented of under $50.(11) Evidence that preventive spending directed at insecticide treated nets may reduce the annual cost of clinic visits by diagnosed children from $49 to $38.(16)

A cost-effectiveness study in Malawi reported that as awareness of insecticide treated nets increased over 5 years, costs per net distributed and treated decreased from $5.04 to $1.92.(11) A human in the Kou Valley sleeping without mosquito protection is estimated to receive 158 bites by Anopheles gambiae per night, 35,000 per year. According to a 2006 review of insecticide treated nets, a small percentage of African children in malaria endemic areas sleep under an insecticide treated net, and perhaps fewer than 1 in 4 sleep under any kind of net.(17,20)

The estimates from the sub-Saharan Africa modeling study are based on annual public treatment of nets with a pyrethroid insecticide. Like the Burkina Faso intervention, 2 scenarios were tested. First, nets were distributed by the public program, so calculated costs included the annualized cost. Second, the intervention costs were limited to the retreatment of existing mosquito nets. The cost-effectiveness range for insecticide treatment of existing nets is $4 to $10 per DALY prevented, but if nets must be supplied and re-treatment required, it rises to $19 to $85. If 2 insecticide treatments are required per year, the cost-effectiveness range increases to $9 to $23 for insecticide retreatment of existing nets and $25 to $96 for the supply of nets and insecticide treatment.(11)

Indoor Residual Spraying (IRS)

Indoor residual spraying protects humans against bites of infected Anopheles gambia mosquitoes. This spraying repels mosquitoes from entering homes and by killing female mosquitoes resting inside.(18) In southern Africa, over 13 million inhabitants in 7 countries have access to spraying, however virtually none of these programs operate in the other endemic countries of sub-Saharan Africa. Indoor residual spraying requires programs run by governments and financial support, which are not available in many of these countries.(19)

Cost-effectiveness analysis of residual spraying in the sub-Saharan study investigated government-controlled residual spraying. The cost per DALY prevented by spraying once per year is $16 to $19 and $32 to $58 if spraying is done twice. The cost-effectiveness ratios for the residual spraying and insecticide treated nets overlapped, however residual spraying costs more.(11)

Chemophylaxis

In the sub-Saharan Africa modeling study the cost-effectiveness of chemoprophylaxis was observed from the distribution of pyrimethamine and dapsone to children aged 6 to 59 months by village health workers.(11) This was done by first assuming the village health workers were already working and second, by including costs of training and setting up

village health workers. The results found a cost effectiveness ratio of $3 to $12 per DALY if existing village health workers were already working, and $8 to $41 if village health workers had to be arranged, making chemophylaxis in children cost-effective.(11) In 2000, a study published in the Lancet found a 40% reduction in under-5 child mortality after mothers in Ethiopia were given supplies of chloroquine for treatment at home.(25) However, drug resistance to chloroquine, has since made this method not as effective in some areas of sub-Saharan Africa. It is questionable if more demanding drugs like artemether-lumefantrine, which are taken in 2 daily doses with a fatty meal, will be as effective as chloriquine alone. Unless patients take the full course of artemether-lumefantrine, they can develop further resistance.

In a 2006 study in Uganda, mothers were given home-based artemether-lumefantrine treatment and did not develop drug resistance.(25) Another study reported that families are willing to pay for artemether-lumefantrine when they live in areas such as Uganda where drug resistance to chloriquine is prominent. However, the extra costs they will pay are nowhere near the real costs. Only with financial support will artemisinin-based combination therapies have any reasonable impact.(26)

An analysis done by Ramanan Laxminarayan determined the effects of combination therapy such as artemether-lumefantrine. A morbidity cost of $1.50 per infected patient per day was assumed based on the average costs per day incurred with the disease. The cost of a dose of sulfadoxine-pyrimethamine was assumed to be $0.12 and artemether-lumefantrines were assumed to be $1.00. Including the cost of treatment favors introducing artemether-lumefantrines immediately since the cost of the drug may not add considerable costs associated with the disease.(27)

Malaria and Economic Growth

Malaria is a contributing factor to economic growth and poverty; additionally, geography, history, and policy all affect income. However, GDP is lower in countries affected by malaria.(1,20)

The average purchasing-power parity GDP per capita for malarial countries in 1995 was $1,526, while the average income was $8,268.(20) Cross-country regressions from 1965 through 1990 confirm the relationship between malaria and economic growth. Malarial countries grew 1.3% less per person per year. Documented growth of income per capita over the same 25 year period for countries with severe malaria was 0.4% per year, whereas average growth for other countries was 2.3%.(20)

In Nigeria, 132 billion naira is spent yearly on costs of treatment, transportation to facilities, hospital costs, loss of man-hours, and productivity loss due to morbidity and premature mortality.(20,24)

Conclusions

Eliminating malaria will both substantially increase Africa's GDP, and improve productivity in areas riddled by malaria. An example of this was seen when malaria was eradicated in Mymensingh, Bangladesh. Crop yields increased 15%, presumably because farmers had more time and energy for cultivation.

According to the World Bank, the near-eradication of malaria in Sri Lanka between 1947 and 1977 raised its national income by an estimated 9%. A study reported from the Harvard University Center for International Development and the London School of Hygiene and Tropical Medicine estimates that, if malaria had been eradicated in 1965, Africa's GDP would have been 32% higher in 2000.

Through the sub-Saharan modeling study it is evident there are various effective avenues of cost reduction through prevention and treatment.(21)

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Abbreviations

DALY	disability adjusted life years
ITN	insecticide treated nets
GDP	gross domestic product