Maintaining the Gains in Malaria Control

COUNTRY BRIEFS
Ethiopia | Rwanda | Senegal | Tanzania (Mainland and Zanzibar)

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Maintaining the Gains in Malaria Control

EXECUTIVE SUMMARY

Key messages

• Aggressive campaigns to scale up malaria control have led to large reductions in the malaria burden in many African countries.
• These gains are impressive, but are fragile: if malaria control activities are reduced while the potential for transmission remains, the disease will rapidly resurge and the gains will be wiped out.
• In four countries alone—Ethiopia, Rwanda, Zambia, and Zanzibar—sustained control could avert about 151 million malaria cases over the next five years, similar in impact to childhood vaccination campaigns.
• Sustained control could avert costs to the public health system and household of treating resurgent malaria and could prevent school and worker absenteeism.
• Sustained control is a “best buy” in global health, costing only about $5–8 per case averted, similar in cost effectiveness to childhood vaccination.

Over the last decade, thanks to a large increase in international funding for malaria control, many countries have aggressively scaled up control tools such as insecticide-treated nets (ITNs) and indoor residual spraying (IRS). The 2010 World Malaria Report found that in eleven of these countries, malaria cases or deaths have fallen by over 50%. In other countries, if the upward trend in coverage with control tools can be maintained, it is likely that the burden of malaria will also be greatly reduced in the next few years.

Success is fragile

These gains are impressive, but they are fragile. If these successful countries were to reduce or cease their malaria control activities while the potential for malaria transmission remains, all of the gains they have made will be lost because malaria will rapidly resurge. A decade of progress will have been in vain.

Donors may be tempted to believe that the job is done in these successful countries, that investments in their malaria programs can now be reduced, and that resources can be shifted to other countries or other priorities. But if this happens, the results would be catastrophic. Although control tools such as ITNs and IRS effectively suppress malaria, they do not alter a country’s intrinsic potential for transmission—therefore malaria will quickly resurge to baseline levels if these suppressive measures are removed.

History shows that when malaria-endemic countries halted their control activities because the burden had fallen, the disease rapidly returned. Even short-term reductions in coverage with control tools can cause resurgence. In Rwanda, for example, a country that has dramatically reduced its malaria burden, a delay in procurement of ITNs in 2009 led to nationwide ITN stock-outs—which led to malaria resurgence (Figure 1).

Sustained control could avert millions of cases

If successful countries can find secure financing to sustain their control programs and maintain high coverage with control tools, they could avert millions of cases year after year.

We have conducted a new analysis of the public health impact of sustaining malaria control in four countries over the next five years (Ethiopia, Rwanda, Zambia, and Zanzibar). Figure 2 on page 4 shows the results for two of these countries.

If these four countries can secure sufficient financing to sustain their control programs from 2011 to 2015, about 151 million cases of malaria could be averted.

FIGURE 1. Rebound in malaria cases in Rwanda, 2009
Sustained malaria control could bring economic benefits

By averting malaria cases, sustained malaria control could avert economic costs to many different sectors.

Sustained malaria control prevents the “counterfactual scenario,” the orange dashed line in Figure 2. Without funding for sustained control, malaria resurgence would increase costs to many sectors: the public health system, which would incur the costs of treating resurgent malaria cases; households, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income); and industry, which would experience reduced productivity due to worker absenteeism.

In Ethiopia, for example, if the malaria control program can be sustained over the next five years:

- the public health system could avert about $39 million in the costs of diagnosing and treating malaria;
- households could avert about $427 million in direct and indirect costs, equivalent to about 8% of household income; and
- the direct and indirect costs of malaria to Ethiopia’s coffee farmers could fall by about 67% (coffee is Ethiopia’s most important export).

A sustained malaria control program is likely to be highly cost-effective, costing Ethiopia only about $41 per disability-adjusted life year (DALY) averted and about $5 per case averted, making it a “best buy” in global health.

Countries need sustained, predictable financing

To reap the health and economic benefits of sustained malaria control, countries need reliable, long-term malaria financing, free of the volatility that commonly disrupts health programs.

The Clinton Health Access Initiative (CHAI) and the African Leaders Malaria Alliance (ALMA) have worked closely with the governments of Rwanda, Tanzania (Mainland and Zanzibar), Ethiopia, and Senegal to develop financial sustainability plans for malaria. These plans include a mix of innovative mechanisms to increase domestic financing for malaria, such as tourist taxes, community health insurance schemes, health trust funds, and more predictable donor support.

Conclusion

When it comes to donor decisions about which countries to support, successful countries should be prioritized equally to countries that are still scaling up. Equal priority makes sense, as it emphasizes the number of cases that there would be without control. Governments in these successful countries should prioritize the maintenance of strong malaria control despite the competing health priorities that they face.

By ensuring the viability of their malaria control programs, these countries will be able to sustain high coverage of malaria control tools, continue to avert malaria cases and deaths, and generate far-reaching economic benefits into the future.
Summary

In 2005, Ethiopia instituted an aggressive malaria control program, massively scaling up control tools such as insecticide-treated nets (ITNs). By 2010, the annual incidence of malaria had fallen to the lowest rate in over two decades, lower than typical epidemic patterns would predict.

Although the malaria burden has been reduced, it will be crucial for Ethiopia to sustain its control activities. If coverage of control tools falls while the potential for malaria transmission remains, malaria will rapidly resurge, lives will be lost, and the gains of the last five years will be erased.

If Ethiopia can maintain its malaria program, it could reap impressive public health and economic benefits. Over the next five years, a sustained control program could avert an estimated:

- 50 million malaria cases;
- $39 million in the cost of treating malaria in the public health system; and
- $427 million in household costs (out-of-pocket treatment costs and lost income from illness), equivalent to about 8% of household income.

Sustaining its control program to keep the malaria burden low is estimated to be highly cost-effective, costing the country only about $41 per disability-adjusted life year (DALY) averted and about $5 per case averted, making it a “best buy” in global health.

By finding new ways to ensure the financial viability of its malaria control program, including increased domestic financing, Ethiopia will be able to sustain high coverage of malaria control tools, continue to avert malaria cases, and generate economic benefits into the future.

Malaria in Ethiopia—At a glance

Population in 2010: 80 million,1 living in 11 regions

Malaria transmission
- Endemic malaria in about 75% of the country
- 30–40% of cases due to *P. vivax* and 60–70% of cases due to *P. falciparum* (Figure 1)
- Five major strata of transmission—the highest stratum is stable, year-round transmission in the western lowlands and river basin areas, and the lowest is the malaria-free highland areas >2,500 meters2

Seasonality
- Variable, depending on geographic area; most transmission is September–December, after the main rainy season
- A second minor transmission period occurs in certain areas April–May, following a short rainy season3
- Epidemics occur every 5–8 years2

![Figure 1. *P. falciparum* malaria prevalence in 20074](image)
Ethiopia has aggressively scaled up malaria control tools
Through a combination of committed leadership, increased donor support, and strong partnerships, Ethiopia has achieved remarkable results in scaling up malaria control tools in a very short period of time (Figure 2). Through a combination of committed leadership, increased donor support, and strong partnerships, Ethiopia has achieved remarkable results in scaling up malaria control tools in a very short period of time (Figure 2).

• From 2005–2007, Ethiopia purchased and delivered about 20 million ITNs. There was a 10-fold rise in ITN ownership to about 66% of households in endemic areas (Figure 2).

• Over the same time period, indoor residual spraying (IRS) was also scaled up, reaching about 4.2 million households.

Since scale-up began, the malaria parasite prevalence has fallen, from 4.1% in 2006 to 1.0% in 2007. There has also been a fall in the reported number of malaria cases each year, as shown in Figure 2, and in annual hospitalizations and deaths due to malaria.

Malaria epidemics have historically occurred in Ethiopia every 5–8 years, and the most recent epidemic occurred between 2003 and 2005, just before major scale up of control tools began. Thus the falling burden may in part be explained by the end of the last epidemic. Nevertheless, the scale-up in control tools has resulted in declines greater than those observed in recent history, producing the lowest incidence rate since 1986.

Success is fragile
The increase in coverage with control tools and the falling malaria burden are impressive gains, but they are fragile. Unless Ethiopia can sustain its aggressive program, the gains will be wiped out because malaria will rapidly resurge.

Dozens of countries have brought the malaria burden down to low levels, after which they reduced or ceased their malaria control activities. As a result, malaria quickly resurfaced, since conditions suitable for transmission remained. Zanzibar, for example, reduced its malaria burden twice in the past—in the 1960s and the 1980s—but in both cases withdrawal of donor funding led to resurgence of malaria, erasing the gains. Similarly in the 1950s and 1960s, malaria was brought under control in Sri Lanka, Mauritius, Pakistan and the Kenya-Tanzania border region, but the cessation of malaria control activities such as IRS caused rapid resurgence (Figure 3).

These historical examples should serve as a warning to other countries, including Ethiopia. If donor and domestic investments in malaria control in Ethiopia are reduced while strong potential for malaria transmission remains, cases will resurge, lives will be lost, and the achievements since 2005 will be erased.

Sustaining malaria control could avert 50 million cases from 2011–2015
If current malaria control activities can be sustained, and if the malaria incidence continues to decline, Ethiopia will reap massive public health benefits.

Figure 4 summarizes the results of our analysis of the health impact of sustaining malaria control in Ethiopia up until 2015–16. These estimates include cases reported through the public health system as well as those that may have been self-treated or were not reported. The analysis compares the likely impact of sustained control (the light blue dashed line, called “Forecast if post-2005 trend is maintained”) with a “counterfactual” scenario in which control activities had not been scaled up at all (the orange, dashed line, called “Trend if scale-up had not occurred”). The shaded area shows cases averted by sustained malaria control.

Over the next five years, if Ethiopia is able to sustain its malaria control program, we estimate that it could avert about 50 million cases of malaria.
Sustained malaria control could have economic benefits to many sectors

By averting malaria cases, sustained malaria control could bring economic benefits to several different sectors in Ethiopia, which in turn could help to promote economic growth.14

Once the malaria burden has been reduced by scaling up control tools, sustained malaria control prevents the “counterfactual scenario,” the orange dashed line in Figure 4. Without funding for sustained control, malaria resurgence would increase costs to many sectors:

- the public health system, which would incur the costs of treating resurgent malaria cases;
- households, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income from the illness); and
- industry (including Ethiopia’s agricultural sector), which would experience reduced productivity due to worker absenteeism.

Public Health System

By averting malaria cases year after year (Figure 4), sustained malaria control is likely to eliminate a large proportion of the costs to the public health system of treating malaria. We conducted an economic analysis in which we estimated these cost savings to the public health system.15

Over the next five years, if Ethiopia can sustain its malaria control program, we estimate that the public health system could avert about $39 million in out-patient and in-patient malaria treatment costs.

Most of these cost savings are “virtual”—that is, they allow health sector resources (e.g., health workers’ time, hospital beds) to be devoted to other diseases. Nevertheless, some of the resources could be invested into strengthening and expanding malaria prevention and surveillance activities to maintain a reduced malaria burden.

Households

Malaria places a heavy economic burden on households in Ethiopia. One study conducted in the Tigray Region found that malaria costs households between 4% and 13% of their annual household income.16 Continuing to avert cases through sustained control could reduce this economic burden. We estimated the impact of sustained control on the direct and indirect household costs of malaria.

Over the next five years, if Ethiopia can sustain its malaria control program, we estimate that it could avert about $427 million in household costs: $76 million in direct costs and $351 million in indirect costs.17 This is the equivalent of about 8% of household income, a very large savings for a typical household.
Agricultural Sector
Coffee is Ethiopia’s main export crop, over half of which is produced in the Oromia region. The Oromia Coffee Farmers Cooperative Union, one of many coffee cooperatives, supports about 194,000 farmer members. These small scale farmers are highly dependent on coffee production and face many risks to their livelihood. One of the major risks is illness, particularly malaria, which prevents the farmers or their family members from working in the fields.

We estimate that over the next five years, sustained malaria control could reduce the direct and indirect costs of malaria to these farmers by 67%.

Sustained malaria control is likely to be highly cost-effective
We estimated the cost-effectiveness of a sustained malaria control program in Ethiopia, lasting from 2011–12 to 2015–16, using best estimates of future annual expenditures on control activities ($143 million annually; see below). We compared net expenditures on control (i.e., expenditures minus savings to the public health system and to households) against two health outcomes, DALYs averted and cases averted. Our estimates suggest that a sustained control program would be highly cost-effective, costing only about $41 per DALY averted and about $5 per case averted. This would make sustained control similar in cost effectiveness to childhood vaccination programs.

Donor and domestic financing is needed
In order to reap the health and economic benefits of sustained malaria control, Ethiopia will need long-term sustained financing for its control program, from both domestic and external sources.

The Federal Ministry of Health (FMOH) recognizes that long-term, sustainable health financing is a crucial pillar for building a viable health system and ensuring universal access to care. Over the past decade, FMOH has pursued a vision of improving financing for the health sector, with a focus on under-financed programs such as malaria. To ensure long-term funding for malaria even when it has become less visible, the Government of Ethiopia has developed a national Financial Sustainability Plan for malaria.

A number of innovative financing schemes have been approved by the Government and are now underway in the health sector (they are at the design or piloting stage), such as health insurance, performance-based financing, and a pooled fund for the Millennium Development Goals.

In addition to these schemes, FMOH is currently weighing five possible new mechanisms to address the specific funding limitations facing the national malaria control program, which will require an estimated $143 million per year through 2020:

1. Airport Surcharge: Ethiopia could generate considerable revenue by levying a small tax on international passengers travelling through the Ethiopia International Bole airport. Such a levy could generate enough revenue to cover about 20% of the annual program costs for malaria control. It would be easy to implement, its collection costs would be minimal, and it need not affect competition between air carriers.

2. Tax on cigarettes and alcohol: Given the relatively low price sensitivity, a marginal tax on these consumables could be a predictable and sustainable source of income for FMOH. The tax could finance around 2% or more of annual malaria costs.

3. Prize-Linked Savings (PLS): This savings scheme differs from a standard savings account in that depositors periodically receive a chance to win a lottery-like prize—its size is a func-

FIGURE 4. Health impact of sustained malaria control

![Graph showing the health impact of sustained malaria control.](image)
tion of the total deposited amounts. PLS could be established by the Government of Ethiopia and managed by a non-governmental financial institution. The interest generated on these savings would be used to cover payout for depositors and could cover about 2% of annual malaria program costs.

4. Trust Fund for Malaria: With initial capital secured through a bilateral arrangement, a functional trust fund could be established to generate an estimated 4.5% payout, directed to the national malaria control program. One approach could be a combined investment portfolio of stocks and bonds. The trust fund could cover an estimated 20–25% of annual malaria costs.

5. Pooled Commodity Procurement: The Government of Ethiopia is considering a pooled procurement mechanism to procure all essential malaria control commodities (e.g., ITNs, malaria drugs, and rapid diagnostic tests) at the lowest prices possible. Cost savings could then be re-directed to other core malaria interventions. Re-directed cost savings from participation in such pooled procurement could generate an estimated 5–7% of the annual malaria program costs.

The combination of these five mechanisms could mean an increase in the proportion of direct domestic contribution to the control program, from the current annual average of 15% to an estimated 30%. This increase could potentially address the anticipated funding gap for the national malaria program through 2020. To complement this increase in domestic support, the Government of Ethiopia anticipates continued bilateral support for malaria through 2020.

Conclusion

By finding new ways to ensure the viability of the malaria control program, Ethiopia will be able to sustain high coverage of malaria control tools, continue to avert malaria cases and deaths, and generate far-reaching economic benefits into the future.
For the analysis, we used the adjusted incidence rate from the country-level analysis and population data from the World Bank Development Indicators. The assumed

to estimate averted household costs of treating malaria, we compared the estimated household costs (direct and indirect) of treating malaria up until 2015–16 under the


Our analysis uses “adjusted” cases, which refer to Ethiopia’s Federal Ministry of Health case data that have been adjusted to estimate total malaria incidence data inside and outside the health system. To make these estimates, we used the following assumptions: population at risk defined as population <2000m (2005 GRUMP population data and USGS GTOPO30 digital elevation data) (57% of the population in 2005); risk threshold source: Lindsay SW, Martens WJM. Malaria in the African highlands: past, present and future. Bull World Health Organ 1998; 76(1): 33–45; fevers: 20.3% of children with fever in the past two weeks from Ethiopia Demographic and Health Survey (DHS) 2005; 8.3% of fevers are malaria (national estimate for Ethiopia) from Getting PW, et al. Estimating the number of paediatric fevers associated with malaria infection presenting to Africa’s public health sector in 2007. PLoS Med 2010; 7(7): e1000301; 0.98 weight adjustment for distribution of population at risk due to cluster sampling in Ethiopia, 2005 DHS.

The health impact of a sustained interruption of the epidemic cycle can be measured in “cases averted,” or the number of cases that never occurred but would have been expected without the 2005 scale-up. In Figure 4, averted incidence through 2015–16 is shown as the difference between what could have occurred if the pre-2005 epidemic cycle trend had continued, and what is happening with control (i.e., the extension of the current trend since the 2005 scale-up).

http://www.rollbackmalaria.org/gmap/2–5.html

To estimate averted costs of treating malaria cases in the public health sector (in-patients and out-patients), we compared the estimated costs of treating malaria up until 2015–16 under the two different forecasts shown in Figure 4. For these estimates, we used the following assumptions, based on published data (including the World Malaria Report 2010; Ethiopia profile; Ethiopia Ministry of Health Survey, 2005; Deressa W, et al. Economic costs of epidemic malaria to households in rural Ethiopia, Trop Med Int Health 2007; 12:1148–1156; 15.07% of malaria cases are seen as out-patients in public health facilities; average cost of diagnosis: $1.77; average cost of treatment for P. falciparum: $1.50; average cost of treatment for P. vivax: $0.14; 2.28% of cases are hospitalized; average daily cost of in-patient treatment: $23.82; average length of stay: 5.5 days. All costs were adjusted to 2011 prices.


To estimate averted household costs of treating malaria, we compared the estimated household costs (direct and indirect) of treating malaria up until 2015–16 under the two different forecasts shown in Figure 4. Data on costs were derived from: Ethiopia DHS 2005; Deressa W, et al, 2007; Cropper ML, et al, 2000. For the direct costs, we used data on the proportion of all malaria cases who seek help in each of the different settings where they pay out-of-pocket treatment costs, and on the costs of treatment in each of these settings. For the indirect costs, we used data on the average indirect costs per malaria episode for all adults of productive age with malaria plus their companion (the person who accompanies them to the clinic/hospital).

For the analysis, we used the adjusted incidence rate from the country-level analysis and population data from the World Bank Development Indicators. The assumed average revenue that families receive per year from coffee is $60 (http://www.goldencoffeebox.nl/PDF/ecafe.pdf). Background information from: Meskela T, Status of Coffee Farmers in Jimma Zone, Ethiopia. East African Medical Journal 1967; 44(11): 469–474.

We estimated the incremental cost-effectiveness ratio (ICER) of sustained control. We estimated ICER by dividing the net costs of the intervention (expenditures minus cost savings to the public health sector and to households) by the total number of incremental DALYs and cases averted by the intervention. Case fatality rate of 0.5% for calculating DALYs from Roca-Feltrer A, et al. Estimates of the burden of malaria morbidity in Africa in children under the age of 5 years. Trop Med Int Health 2008; 13(6): 771–783.

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Summary

In 2006, Rwanda launched an aggressive nationwide campaign to scale up malaria control tools, such as long-lasting insecticidal nets (LLINs) and artemisinin-based combination therapies (ACTs), which led to a large fall in the burden of malaria. The challenge it now faces is to maintain these gains.

As malaria rates continue to fall, it will be tempting to think that the job is done and that malaria control activities can be reduced. But if this happens, the disease will resurge and the recent gains will quickly be erased.

If Rwanda can sustain its successful malaria program, preventing resurgent cases, it will reap huge health and economic benefits. Over the next five years, a sustained control program could avert an estimated:

- 38 million malaria cases
- $267 million in costs to the public health system of diagnosing and treating out-patient and in-patient malaria
- $547 million in the household costs of malaria (out-of-pocket treatment costs and lost income from the illness), equivalent to about 7% of household income.

Rwanda faces an “out of sight, out of mind” paradox. The more successful the program is, the more invisible the disease becomes, increasing the risk that funding for it will be withdrawn and redirected to other diseases. But if this happens, it will cause resurgence. By finding new ways to ensure the financial viability of its malaria control program, including new sources of domestic financing, Rwanda will be able to sustain high coverage of malaria control tools, continue to avert malaria cases, and generate far-reaching economic benefits into the future.

Malaria in Rwanda—At a glance

Projected population in 2011
10.7 million,\(^1\) in four provinces and the city of Kigali

Malaria transmission
- Rwanda is divided into four malaria ecologic-zones based on altitude, climate, level of transmission, and vector prevalence.\(^2\)
- In the past decade, malaria has been evident in high altitudes and other areas where not previously a public health problem.\(^3\)

Seasonality
Year round transmission with two peaks (April–May, November–December) following rainy seasons.\(^3\)

FIGURE 1. *P. falciparum* malaria prevalence in 2007\(^4\)
Rwanda has aggressively scaled up malaria control tools

In 2006, Rwanda launched an aggressive nationwide campaign to scale up malaria control, supported by a very large rise in international funding, with impressive results (Figure 2).

- Between 2005 and 2010, household ownership of at least one LLIN increased from 15% to 82%, LLIN use in children under 5 increased from 13% to 70%, and LLIN use in pregnant women increased from 17% to 72%.
- ACTs have been made widely available in public health and faith-based facilities, and in the community via community health workers (CHWs) and private pharmacies.
- By 2007, coverage with indoor residual spraying (IRS) reached 97.7% of households in five high risk districts (295,000 households were sprayed).

In the decade prior to scale-up, malaria transmission was increasing—probably due to factors such as resistance to drugs (chloroquine, amodiaquine, and SP), increased population movements, and land use—but the increase in coverage with control tools led to a fall in transmission. In 2006, malaria was the leading cause of illness and death, responsible for 29% of outpatient consultations and 25.3% of hospital deaths. By 2010, the proportion of outpatient consultations attributed to malaria had fallen to 6% and deaths to 7%.

These gains are impressive, but they are very fragile as long as the potential for transmission remains. Sustained high coverage with control tools is essential for maintaining a low burden, as shown by the resurgence of malaria in 2009.

**Malaria resurged due to shortages of LLINs**

In 2009, a delay in LLIN procurement from both the Global Fund (which procures 85% of LLINs) and the US President’s Malaria Initiative (PMI) led to prolonged nationwide stock-outs of LLINs. Very few LLINs were available for distribution in integrated health campaigns or at health facilities.

We examined the impact of these shortages upon the adjusted malaria incidence (Figure 3), which shows that malaria resurged in 2009. The adjusted incidence takes the annual number of cases reported by Rwanda’s Ministry of Health (those shown in Figure 2), and then adjusts them upwards to account for unreported cases (e.g., cases that were self treated).

Starting with those districts that suffered the largest increase in malaria, Rwanda’s national malaria control program responded to the resurgence with mass distributions of LLINs, funded by the Global Fund, PMI and UNICEF. By 2010 the adjusted incidence had fallen again (Figure 3).

The 2009 resurgence shows the crucial importance of sustained, uninterrupted financing for malaria control activities. Although control tools such as LLINs and ACTs effectively suppress malaria, they do not alter a country’s intrinsic potential for transmission—so if control activities are reduced, malaria will rapidly resurge. In order for Rwanda to maintain the gains of the last five years, high coverage of control tools must be maintained.

**Sustained malaria control could avert 38 million cases from 2011–2015**

If malaria control activities can be sustained, Rwanda could reap massive public health benefits.

Figure 4 shows the results of our analysis of the number of cases that could be averted in Rwanda if the country can maintain an aggressive control program, with high coverage of control tools. The estimates in Figure 4 show the adjusted incidence
Sustained malaria control could bring economic benefits

By averting malaria cases, sustained malaria control could bring economic benefits to several different sectors in Rwanda, which in turn could help to promote economic growth.\(^{13}\)

Once the malaria burden has been reduced by scaling up control tools, sustained malaria control prevents the "counterfactual scenario," the orange dashed line in Figure 4. Without funding for sustained control, malaria resurgence would increase costs to many sectors:

- the public health system, which would incur the costs of treating resurgent malaria cases;
- households, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income from the illness); and
- industry, which would experience reduced productivity due to worker absenteeism.

We have estimated the likely economic impact of sustained malaria control upon two of these sectors: the public health system and households.

**Public Health System**

Prior to scale-up of malaria control, treating malaria cases was costly to the public health system—an estimated 19% of the recurrent budget of the Ministry of Health was directed to malaria.\(^{14}\) By preventing the counterfactual scenario, sustained control averts public health system costs. We conducted an economic analysis in which we estimated these cost savings to the public health system.\(^{15}\)

By preventing resurgence, sustained control over the next five years (2011–2015) could save the public health system an estimated $267 million in the costs of diagnosing and treating out-patient and in-patient malaria.

Most of these cost savings are "virtual"—that is, they allow health sector resources (e.g., health workers' time, hospital beds) to be devoted to other diseases. Nevertheless, some of the resources could be invested into strengthening and expanding prevention and surveillance activities to maintain a reduced burden of malaria.

**Households**

Malaria places a heavy economic burden on households in sub-Saharan Africa, falling most heavily on the poorest households. Prior to scale-up, one study estimated that the annual national household cost of malaria in Rwanda (direct plus indirect costs) was $3.81, equivalent to 3.5 days of individual production.\(^{14}\) Averting cases through sustained control will avert household costs of malaria. We conducted an economic analysis in which we estimated these household savings.\(^{16}\)

By preventing resurgence, sustained control over the next five years (2011–2015) could avert an estimated $547 million in household costs—$37 million in direct costs and US$510 million in indirect costs. This is equivalent to about 7% in household income, a significant saving for a typical household.

**Sustained malaria control is likely to be highly cost-effective**

We estimate that annual expenditures on malaria control will be about $53 million over the next five years,\(^{17}\) a total of about $265 million. Since our modeling suggests that the averted costs to the public health system of sustained control are about $267 million, the savings are greater than the expenditures, making sustained control a highly cost-effective program.

**Sustained donor and domestic financing is needed**

Over 90% of Rwanda’s malaria control expenditures are currently financed by the Global Fund and PMI, but such fund-
Given the risk of resurgence from reduced financing for control activities (Figure 3), Rwanda’s Ministry of Health is therefore developing a financial sustainability plan (FSP) for long-term malaria control based on more diverse revenue streams. A sustained control program in Rwanda would cost about $53 million annually from 2011–2015.

The National Malaria Control Program (NMCP) is evaluating several possible mechanisms for generating new revenues. The initial FSP focuses on whether these mechanisms can support three priorities:

- **Sustained control in endemic districts.** The plan prioritizes control activities in the 19 districts (out of 30 in total) where malaria is endemic.
- **Protecting high risk groups.** The plan prioritizes services for pregnant women and children under 5.
- **A “stop-gap” fund.** This fund will be used in an emergency to address shortfalls in donor funding, ensuring that the shortfalls do not disrupt essential LLIN distribution, ACT distribution, and malaria testing services.

The NMCP is considering three innovative financing mechanisms:

- **Partnerships with business.** A business would select one of a variety of malaria control plans developed by the NMCP (e.g., LLIN distribution) and would provide 50% of the funding, with the other 50% funded by the NMCP. The company would choose the scale, location, and timeline of the effort, and would have its name attached to the project, helping it to achieve its corporate social responsibility goals.
- **A “net purchase sweepstakes.”** When LLINs are distributed to households, each household would either accept the nets for free or contribute a small, fixed sum of cash—the contribution enters them into a sweepstakes to win a large cash prize.
- **Prize-linked savings accounts.** These would be similar to conventional savings accounts, except that the account owner agrees to forgo the standard monthly interest in exchange for a chance to win a major cash prize. The collective interest earned on the principal would then be divided into three, covering the bank’s operational costs, the prize pool, and a malaria fund that goes to the NMCP.

The NMCP is also considering expanding and strengthening two existing mechanisms:

- **Community health insurance scheme.** Currently under Rwanda’s scheme (called Mutuelle), hospitals and health centers are reimbursed by the scheme for treating patients, but CHWs are not. If the scheme was extended to also reimburse CHWs, the reimbursements for malaria consultations could be directed to the Malaria Unit in the Ministry of Health, representing a new source of income for malaria control.
- **Malaria commodities purchase scheme.** Malaria commodities (medicines, LLINs) are procured using external financing and are stored in a central warehouse. District pharmacies and health facilities then purchase them from the warehouse at subsidized prices, partially replenishing the central funds for further procurement. However, through weaknesses in the scheme’s oversight and management, a proportion of pharmacies and facilities end up under-paying or paying nothing for the commodities. Addressing these weaknesses could help recover more funds for malaria commodity procurement.

Through the mechanisms described above, Rwanda anticipates being able to increase its domestic contribution to malaria control expenditures.

**Conclusion**

By finding new ways to ensure the viability of the malaria control program, Rwanda will be able to sustain high coverage of malaria control tools, continue to avert malaria cases, and generate far-reaching economic benefits into the future.
References

6. Data provided by Rwanda’s Ministry of Health.
7. Figure 2 shows reported, parasitologically confirmed case data from Rwanda’s Ministry of Health. LLIN coverage data from 2005 DHS; 2007–08 DHS; 2010 DHS (Preliminary Report). Original expenditure data collected from the Ministry and partners.
12. The health impact of sustained control can be measured in ‘cases averted’, or the number of cases that never occurred but would have been expected without the 2006 scale-up. In Figure 4, averted incidence through 2015 is shown as the difference between what could have occurred if the pre-2006 trend had continued, and what is happening with control—the extension of the current trend since the 2006 scale-up. Our analysis uses the adjusted incidence.
15. To estimate averted costs of treating malaria cases in the public health sector (in-patients and out-patients), we compared the estimated costs of treating malaria up until 2015 under the two different scenarios shown in Figure 4 (i.e., sustained control versus a counterfactual in which there is no scale-up of control interventions). For these estimates, we used the following assumptions, based on published and unpublished data and personal communications with technical staff working closely with the Ministry of Health in Rwanda [data sources included: Twagirumukiza M, et al. Evaluation of medication adherence methods in the treatment of malaria in Rwandan infants. *Malar J* 2010;9:206; Rwanda 2005 DHS; Rwanda DHS 2007–08 DHS]: 28% of malaria cases are treated in government facilities as outpatients; 10% of cases are hospitalized; average cost of outpatient diagnosis is $14.19 and treatment is $1.95; average cost of in-patient treatment is $46.07, average in-patient stay is 3 days. All costs were adjusted to 2011 prices.
16. To estimate averted household costs of treating malaria, we compared the estimated direct and indirect household costs of treating malaria up until 2015 under the two different scenarios shown in Figure 4. Data on costs were derived from the sources listed in reference 15 above.
17. This estimate is based on Rwandan inflation rates; using US inflation rates, the estimate would be about $46 million per year (a total of about $230 million over five years).
Summary
Over the last six years, Senegal has aggressively scaled up coverage of malaria control tools, such as insecticide-treated nets (ITNs), rapid diagnostic tests (RDTs), and artemisinin-based combination treatments (ACTs). Scale-up has been associated with a large reduction in the malaria burden. The challenge the country now faces is to sustain these gains.

As the burden of malaria continues to fall, it will be tempting to think that the job is done and that malaria control activities can be reduced. But if this happens, the disease will resurge and the gains of the last six years will quickly be erased.

If Senegal can sustain its intensive control program, it is likely to reap very large public health benefits—potentially averting hundreds of thousands of resurgent cases every year. And by preventing such resurgence, it could also reap economic benefits, averting millions of dollars in malaria treatment costs incurred by the public health system and by households.

In order to reap these health and economic benefits, Senegal will need long-term, reliable financing for its sustained control program. In its plans for financial sustainability, the country is aiming to finance malaria diagnostics and medicines through increased domestic financing, including from new sources such as cigarette taxes and private sector contributions. It also hopes to pursue new bilateral partnerships to diversify its overall financing profile.

Malaria in Senegal—At a glance
Population in 2010:
13 million,\(^1\) living in 14 regions

Malaria transmission
• Endemic throughout the country
• More than 90% caused by \(P.\) falciparum (Figure 1)
• 2 epidemiological zones: Sahelian, with seasonal transmission, and tropical, with year-round transmission\(^2\)

Seasonality
Peak from June to November\(^1\)
Senegal has aggressively scaled up malaria control tools

In 2005, Senegal’s National Malaria Control Program (the PNLP) underwent a major reorganization, strengthening its managerial and programmatic capacities, which in turn attracted increased donor funding. In 2004, total donor funding was only about $1 million. By 2008, the sharp rise in donor funding meant that Senegal’s annual malaria control expenditures had reached $40 million, allowing the country to aggressively scale up coverage with malaria control tools (Figure 2).

- By the end of 2010, almost 6 million ITNs had been distributed, leading to a dramatic rise in household ITN ownership (from 20% in 2005 to 82% in 2009) and in children using ITNs (from 7% in 2005 to 45% in 2009).
- The proportion of pregnant women receiving one dose of intermittent preventive treatment (IPT) increased from 69% in 2006 to 76% in 2008/9 (52% of pregnant women received two or more doses in 2008/9).
- By the end of 2010, one million RDTs and 1.5 million ACTs had been distributed and made free of charge at public health facilities; by 2009, 86% of patients presenting with a malaria-like fever were screened with an RDT.
- Three districts were targeted for indoor residual spraying (IRS): 330,000 rooms were sprayed in these districts between 2007 and 2009.

This increased coverage with control tools, together with a change in the case definition of malaria, led to a fall in the annual number of reported malaria cases. The case definition changed in 2007, the same year that RDTs were scaled up, changing from reliance on just fever and clinical findings to requiring parasitological confirmation. The change in definition alone led to an expected fall in reported cases, since only confirmed cases were reported rather than suspected cases. But the continuing fall since then, from 242,000 reported cases in 2008 to 166,000 in 2009, is explained by the rising coverage of preventive control tools such as ITNs (Figure 2).

Success is fragile

The increase in coverage with control tools and the falling malaria burden are impressive gains, but they are fragile. Unless Senegal can sustain its aggressive program, the gains will be wiped out because malaria will rapidly resurge.

Dozens of countries have brought their malaria burden down to low levels, leading them to ease up on or abandon their control programs. As a result, malaria quickly resurged, since conditions suitable for transmission were still present. Zanzibar, for example, reduced its malaria burden twice in the past—in the 1960s and 1980s—but in both cases withdrawal of donor funding led to resurgence of malaria, erasing the gains.

Similarly, in the 1950s and 1960s, malaria was brought under control in Sri Lanka, Mauritius, Pakistan, and the Kenya-Tanzania border region, but the cessation or relaxation of malaria control activities such as IRS caused rapid resurgence (Figure 3).

These historical examples should serve as a warning to other countries, including Senegal. If donor and domestic investments in malaria control in Senegal are reduced while the potential for transmission remains, cases will resurge, lives will be lost, and the gains made in recent years will be erased.

Sustained malaria control could have huge public health benefits

If Senegal can find the financial resources to sustain its control program, it is likely to reap huge public health benefits through averting malaria cases and deaths year after year.

While it would be valuable to have an estimate of the annual number of cases nationwide being averted every year in Senegal by preventive control tools, such an analysis is difficult for two reasons. First, the fall in cases due to the change in case definition and national roll-out of RDTs in 2007 makes it hard to assess the specific contribution of preventive tools to the decline in the malaria burden. Second, mass national ITN
distribution campaigns only started in 2008 and it is still too early to observe the impact of such a recent scale-up. However, we have been able to estimate the cases averted each year by control tools in a specific district.

In several districts of Senegal, preventive control tools were scaled up much earlier than the national scale-up campaigns (e.g., district-level scale-up often began around 2002/3). We conducted an analysis of the public health impact of sustaining a control campaign in one of these districts, to estimate the number of malaria cases that could be averted if control activities can be sustained over the long term (Figure 4). Our study population includes about 7,600 people in the village of Mlomp in the Oussouye district in southwestern Senegal (see Box on page 19). Scale-up of bed nets in Mlomp began in about 2003.

Our analysis compares the likely impact of sustained control (light blue dashed line, called “forecast if post-2003 trend continues”) with a “counterfactual” scenario in which control activities had not been scaled up at all (orange dashed line, called “trend without scale-up”). The shaded area shows the cases averted.

Over the next five years (2011–2015), if control activities can be sustained in Mlomp, we estimate that 4,400 malaria cases could be averted.
Malaria control in Mlomp, Senegal

Mlomp Dispensary is a government peripheral health center serving a population of about 7,600 in the Oussouye district in southwestern Senegal. In this area, malaria occurs year-round with a seasonal peak during the rainy season (roughly July–December). Our modeling used clinical registry data from 1996–2010, which show a falling malaria burden over this time period (a 32-fold decrease in the calculated risk of malaria) and an increase in the age at which malaria cases occur. Malaria control interventions were introduced earlier in Mlomp than the nationwide introduction of control tools. For example, a clinical trial in 1999 introduced ACTs for children under 10 years, and ACTs were eventually expanded to the rest of the population. Nets were introduced in 2003.

Sustained malaria control could bring economic benefits to many sectors

By averting malaria cases, sustained malaria control could bring economic benefits to several different sectors in Senegal, which in turn could help to promote economic growth.

Once the malaria burden has been reduced by scaling up control tools, sustained malaria control prevents the “counterfactual scenario,” the orange dashed line in Figure 4. Without funding for sustained control, malaria resurgence would increase costs to many sectors:

- **the public health system**, which would incur the costs of treating resurgent malaria cases;
- **households**, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income from the illness); and
- **industry**, which would experience reduced productivity due to worker absenteeism.

We have modeled the likely cost savings to the local public health system and to households from sustained malaria control activities in Mlomp.

Over the next five years, if control activities can be sustained in Mlomp, we estimate that:

- the public health system could avert about $12,600 in diagnosing and treating out-patient and in-patient malaria
- households could avert about $1,900 in the direct costs of treating malaria.

Given that sustained control is likely to avert hundreds of thousands of cases nationwide each year, it would also bring very large economic benefits to the health system and households nationwide—in the order of millions of dollars in cost savings annually. The cost savings to the health system would free up health sector resources (e.g., hospital beds, health workers’ time) to be devoted to other diseases, although some of these resources could also be invested into strengthening malaria prevention and surveillance activities.

**Donor and domestic financing is needed**

In order to reap the health and economic benefits of sustained malaria control, Senegal will need long-term, reliable financing for its control program, from both domestic and external sources.

Senegal’s malaria control program has been relatively well-funded in recent years (Figure 2), although it has experienced volatility in financing. This volatility was due to the delayed arrival of planned and approved funding (notably from the Global Fund), rather than a failure to identify resources.

Over the long run, in order to sustain the benefits of its malaria control program, our analysis suggests that Senegal will need to spend an average of $53.5 million annually. In its plans for financial sustainability, Senegal has prioritized secure funding for malaria commodities—particularly diagnostics and drug treatments—and is keen to finance these domestically. It is currently considering three options to increase domestic financing for malaria control:

- **The PNLP will advocate for increased outright budget support in the form of budget lines for ACTs and RDTs.** The malaria caseload in Senegal has fallen to a point where the government could feasibly finance these needs. Creating an explicit allocation for these two needs will ensure that PNLP-directed funds are not consumed by competing priorities.
- **The mandate of the National Health Solidarity Fund, initially established as an umbrella fund to finance those health products and services that are meant to be provided free of charge to Senegalese citizens, will be amended to include ACTs and RDTs.** The fund will be financed by various sources, including **taxes on activities potentially harmful to health** (e.g., cigarettes, reckless driving), **community health insurance schemes**, and **private sector contributions**. Including malaria commodities in the Solidarity Fund’s mandate would not replace an outright budget allocation for ACTs and RDTs—instead, the PNLP would be able to access the Fund in response to urgent short-term gaps that arise.
- **Several modifications to Senegal’s tax code** may incentivize private donations both to the Solidarity Fund and potentially to the PNLP. In its upcoming tax code overhaul, the tax directorate will call to expand tax-deductible contributions in size and scope; the proposal is to raise the deductibility ceiling to 0.5% of a company’s revenue, and to expand the list of organizations eligible for these contributions.
(currently, only six organizations are eligible beneficiaries). Adding the Solidarity Fund to the list of beneficiary organizations and raising the deductibility ceiling may expand this financing stream.

Through these mechanisms, we estimate that Senegal could increase its domestic contribution to financing malaria control from 1.11% to 4.26% over the next five years. The PNLP also hopes to pursue new bilateral partnerships to diversify its overall financing profile and to reduce its dependence on the Global Fund and the US President’s Malaria Initiative.

Conclusion

By finding new ways to ensure the viability of its malaria control program, Senegal will be able to sustain high coverage of malaria control tools, continue to avert malaria cases and deaths, and generate far-reaching economic benefits into the future.

References

13. The health impact of sustained control can be measured in "cases averted," or the number of cases that never occurred but would have been expected. In Figure 4, averted incidence through 2015 is shown as the difference between what could have occurred (incidence pre-2003), and what is happening with control—the extension of the current trend since scale-up of interventions began.
14. This estimate is based on extrapolating the findings from Mlomp (4,400 cases averted over a 5-year period in a population of 7,600 people) to a population of 13 million people in Senegal.
17. To estimate averted costs of treating malaria cases in the public health sector (in-patients and out-patients), we compared the estimated costs of diagnosing and treating malaria under the two different forecasts shown in Figure 4 (i.e., sustained control versus a “counterfactual” forecast in which control activities had not been scaled up at all). For these estimates, we used the following assumptions, based on published data and personal communications with technical staff working closely with the Ministry of Health in Senegal (data included: Getting, PiW et al. Estimating the number of paediatric fevers associated with malaria infection presenting to Africa’s public health sector in 2007. PLoS Med 2010; 7(7): e1000301; Senegal DHS 2005; Franckel A, Lalou R. Health seeking behavior for childhood malaria: household dynamics in rural Senegal. J Biosoc Sci 2009;41:1–19; Thiam S, et al. Major reduction in anti-malarial drug consumption in Senegal after nation-wide introduction of malaria rapid diagnostic tests. PLoS ONE 2011; 6(4):e18419; Bichmann W, Diallo I. The Senegal experience, at http://whqlibdoc.who.int/pha/WHO_PHA_5_(chp4).pdf; Agence Nationale de la Statistique et de la Démographie. Situation économique et sociale de la région de Ziguinchor—Année 2006, 2007, 2009. Dakar, Sénégal. Available at http://www.ansd.sn/publications_SES_region.html; Ly AB, et al. Use of HRP-2-based rapid diagnostic test for Plasmodium falciparum malaria: assessing accuracy and cost-effectiveness in the villages of Dielmo and Ndop, Senegal. Malar J 2010; 9:153): 30.5% of fevers are due to malaria; 42% of malaria cases are seen as out-patients in public health facilities; average cost of an in-patient treatment: $117.69 (assumes an average length of stay of 3.5 days). All costs were adjusted to 2011 prices.
18. To estimate averted direct household costs of treating malaria, we compared these costs under the two different forecasts shown in Figure 4. Data on costs were derived from the data sources included in reference 17.
Summary
In 2009, thanks to a large increase in donor support for malaria control, Mainland Tanzania launched an aggressive national campaign to scale up insecticide-treated bed nets (ITNs). If ownership and use of ITNs can reach 80%, as is projected by the National Malaria Control Program (NMCP), the prevalence of malaria is expected to fall to a national average below 5%, down from around 18% in 2007.

If this forecast is correct, in the next few years malaria will diminish as a public health problem in Mainland Tanzania. It would then be tempting to reduce or cease malaria control activities and redirect malaria funds to other public health problems—but if that happens, malaria will rapidly resurge to its original levels, wiping out recent gains.

In contrast, if Tanzania can sustain high coverage levels with control tools, it will reap huge public health benefits. We estimate that after Mainland Tanzania has reduced its malaria burden, it could avert tens of millions of malaria cases every year from sustaining its national control program. And by averting cases, the country could avert millions of dollars annually in the costs to the public health system and households of treating malaria.

By starting to plan now for long-term, sustainable malaria financing—even before scale-up has been completed—Tanzania can ensure that its future success in reducing the malaria burden will be maintained. Through sustaining its control activities after the burden has fallen, the country will avert malaria cases and deaths year after year, and generate far-reaching economic benefits into the future.

Malaria in Tanzania—At a glance

Population in 2009
41.2 million in 21 regions

Malaria transmission
• Three epidemiological strata: 1) unstable seasonal malaria; 2) stable malaria with seasonal variations; 3) perennial malaria.
• Most cases due to *P. falciparum* (Figure 1)

Seasonality
Peak transmission during and immediately after the “short” rains in October–December and the “long” rains in March–May

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*FIGURE 1. P. falciparum malaria prevalence in 2007*
Mainland Tanzania is aggressively scaling up malaria control tools

In 2009, thanks to a large increase in donor support for malaria control, Mainland Tanzania launched an aggressive national campaign to scale up ITNs (Figure 2). It is also scaling up indoor residual spraying with insecticide (IRS), intermittent preventive treatment for pregnant women (IPTp), and artemisinin-based combination therapies (ACTs).

The Under Five Coverage Campaign distributed 9 million free long-lasting insecticidal nets (LLINs) over 2009 and 2010, and the recently launched Universal Coverage Campaign will distribute an additional 18.5 million LLINs by the end of 2011.3–5 These two campaigns supplement the Tanzania National Voucher Scheme, started in 2004, which distributes vouchers to pregnant women and mothers of infants—the vouchers can be redeemed for reduced-price ITNs at participating retailers.

Although Mainland Tanzania is still in the midst of its mass ITN distribution phase, there are already indications of progress in increasing ITN coverage:

- ITN ownership increased from 38% percent of households in 2007 to 63% after the first net distribution in 2010.
- ITN use in children under five increased from 26% in 2007 to 64% in 2010.6

Given that the mass free ITN distributions only began in 2009, a national fall in malaria cases has not yet been seen in reported malaria statistics. However, there are reports of sharp declines in the malaria burden at district level (see below).

FIGURE 2. Malaria control expenditures, ITN coverage, and ITN use, 2006–107

In addition, modeling suggests that as national rates of ITN ownership rise, malaria parasite prevalence will fall (Figure 3).8 If ownership and use of ITNs both reach 80% in the next few years, as expected by the NMCP, our model forecasts that the malaria prevalence will be reduced below 5%, down from around 18% in 2007.6,8 And if these ITN coverage rates can be maintained beyond 2012, the prevalence will continue to fall.

Malaria control must be sustained to avert resurgence

If the forecast shown in Figure 3 is correct, in the next few years malaria will diminish as a public health problem in Mainland Tanzania. It would then be tempting to reduce or cease malaria control activities and redirect malaria funds to other public health problems. But if that were to happen, if the potential for transmission still remains, then malaria will rapidly resurge to its original levels, wiping out recent gains.

Such resurgence has happened at least twice before in Tanzania, after control activities were halted (Figure 4). In the late 1960s, the Global Malaria Eradication Program (GMEP) succeeded in bringing malaria in Zanzibar down to very low levels. The prevalence of childhood malaria fell from 84.3% in 1957 to 7.8% in 1967 on Unguja (Zanzibar Island).9 By June 1968, malaria was described in Zanzibar as a “minor health problem” and no longer viewed as a health priority.9 Funding for the GMEP dried up,10 and in 1970 control interventions were abandoned.11 Within a few years, malaria had resurfaced—childhood prevalence rates in Unguja increased again to 54.0% by 1973.9 And an IRS campaign in the 1950s in the Kenya-Tanzania border region, lasting three and a half years, led to a fall in malaria prevalence—but when the spraying stopped, malaria returned.12

In order not to repeat these mistakes of the past, high coverage levels of control tools must be maintained in Tanzania while the potential for transmission remains, even if the malaria burden has been reduced to very low levels. The country should begin to plan now for long-term, sustained control in order to keep the gains permanent.
Sustained malaria control could have huge public health benefits

Once Mainland Tanzania has reduced the burden of malaria, it could continue to reap huge public health benefits by sustaining its control program, averting cases and deaths year after year.

Districts that have aggressively scaled up control tools have already brought the malaria burden down to low levels. We conducted an analysis in one of these districts, the Korogwe district in northeastern Tanzania (Box 1), to estimate the number of malaria cases that could be averted if control activities can be sustained from 2011–2015. Our study population includes about 4,000 people in two villages—Mkokola (lowland) and Kwamasimba (highland).

Our analysis compares the likely impact of sustained control with a “counterfactual” scenario in which control activities had not been scaled up at all.13

Between 2011 and 2015, if control activities can be sustained in Mkokola and Kwamasimba, we estimate that about 7,000 malaria cases could be averted.

Extrapolating from this analysis and a similar analysis of sustained control in Zanzibar,14 we estimate that after Mainland Tanzania has reduced its malaria burden it could avert tens of millions of malaria cases every year from sustaining its national control program.

Sustained malaria control could benefit the economy

By averting malaria cases year after year, a sustained control program is likely to bring major economic benefits to several different sectors, which in turn could help to promote economic growth.17

Once the malaria burden has been reduced by scaling up control tools, sustained malaria control will prevent resurgent cases. Resurgence would place a heavy economic burden on several different sectors, including:

• the public health system, which would incur the costs of treating these resurgent malaria cases;
• households, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income from the illness); and
• industry, which would experience reduced productivity due to worker absenteeism (Box 2).

We have estimated the likely averted costs to the local public health system and to households from sustained malaria control activities in the villages of Mkokola and Kwamasimba.19,20

Between 2011 and 2015, if control activities can be sustained in Mkokola and Kwamasimba, we estimate that:

• the public health system could avert about $39,500 in diagnosing and treating out-patient and in-patient malaria
• households could avert about $1,200 in the direct costs of treating malaria.

Box 1: Malaria control activities in the Korogwe district

Since 2003, the prevalence of malaria has been closely monitored in a sample of lowland and highland villages in the Korogwe district of Tanga region in northeastern Tanzania. There has been a dramatic fall in the prevalence: parasitemia in the lowland village (Mkokola) fell from 78% in 2003 to 13% in 2008.15 During this period, there was steady socio-economic development in the district, as in the rest of Mainland Tanzania, but there was also a very sharp rise in use of ITNs, from 19% in 2003 to 65% in 2008, and increased access to malaria drugs.14 The rise in ITNs is likely to have been due to roll-out in the district of the Tanzania National Voucher Scheme and a distribution by World Vision in 2005.15,16
If these savings were extrapolated to the rest of Mainland Tanzania, sustained control could clearly bring very large economic benefits to the health system and households nationwide—in the order of tens or even hundreds of millions of dollars in averted costs to the health system and households.

Most of the averted cost savings to the health system are “virtual”—that is, they allow health sector resources (e.g., health workers’ time, hospital beds) to be devoted to other diseases. Nevertheless, some of the resources could be invested into strengthening and expanding malaria prevention and surveillance activities to maintain a reduced malaria burden.

Sustained domestic and donor financing is needed

Mainland Tanzania is currently in the midst of an intensive national scale-up phase. If reliable long-term malaria financing can be secured for sustained control, Tanzania could avert cases and deaths year after year, with enormous economic benefits.

The country is aiming for universal ITN coverage. A rise in spending on nets has been the most important driver of malaria spending—from 2006–2010, ITN distribution was responsible for 39% of malaria expenditures. Following the mass distribution campaigns described earlier in this brief, Tanzania is using a continuous distribution system—school-based distribution plus subsidized nets for vulnerable groups—to achieve and maintain high levels of coverage (80%) while optimizing the delivery costs per free net distributed.

However, resources must be found to maintain this “keep-up” strategy. Without such a strategy, ITN coverage will fall, which will only increase the costs of “catching up” this coverage gap in the future. The high projected costs of maintaining LLIN coverage (about US$ 45 million/year) mean that donor financing will continue to play a significant role over the foreseeable future. The U.K. Department for International Development has announced its support to help sustain Tanzania’s net “keep-up” efforts over the next two years until additional funds from other sources become available.

Over the long run, our analysis suggests that Mainland Tanzania will need to spend $85–$90 million a year between 2011 and 2015 on malaria control in order to achieve the level of prevention and treatment coverage necessary to successfully reduce the malaria burden. Its financial sustainability goals are focused on generating additional resources to continue scaling up for impact, while improving predictability and increasing its domestic contribution:

- **Improving predictability**: Tanzania has suffered in the past from volatile malaria financing. For example, in 2009 the public sector experienced ACT stock-outs due to a delay in receiving funds from the Global Fund, highlighting the importance of a reliable and predictable revenue stream.

- **Domestic contributions**: Only 7% of malaria expenditures currently come from domestic financing.

Tanzania is adopting two approaches towards increasing domestic financing for malaria:

- **Health financing reform**, currently underway, aims to increase coverage of health insurance for the unemployed poor, whose enrolment fees will be subsidized by the government as well as by wealthier workers in the formal sector. The proposed expansion of social health insurance schemes will introduce new streams of funding into the health system as more households pay to enroll for insurance coverage. These reforms are also expected to increase uptake of preventive services, minimizing the financial burden to the health system of treating largely preventable illnesses. To reduce the high costs of malaria treatment and hospitalization borne by the Ministry of Health and by insurance schemes, Tanzania is considering allocating a portion of revenue from the expanded national health insurance schemes to finance malaria prevention activities at the district level.

- **Strong economic growth** in several industrial sectors (mining, banking, agriculture, and communications) provides an opportunity to align malaria financing needs with the corporate social responsibility aspirations of companies operating in Tanzania. The creation of a Malaria, Maternal and Child
Health Commodities Fund is expected to provide a coordinated platform for partnership between government and Tanzania’s private sector. An amendment to Tanzania’s Income Tax Act is currently under consideration and would guarantee a tax deduction worth the value of a donation to the Fund.

With these approaches, Tanzania expects to be able to increase its domestic financing to cover 20% of malaria expenditures.

Conclusion

By finding new ways to ensure the viability of the malaria control program, Mainland Tanzania will be able to transition from its current scale-up phase to sustained control. By sustaining its control activities, the country could avert malaria cases and deaths year after year, and generate far-reaching economic benefits into the future.

References

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6. Tanzania HIV and Malaria Indicator Survey (THMIS) 2007–08, Tanzania Demographic and Health Survey (DHS) 2010.
7. Figure 2 uses ITN coverage and use data from: DHS 2004–05, THMIS 2007–08, Bonner et al. 2011, DHS 2010. Original expenditure data were collected from the Ministry and partners.
13. The health impact of sustained control can be measured in “cases averted,” or the number of cases that never occurred but would have been expected without the Tanzania National Voucher Scheme, launched in 2004, and further scale-up activities. Averted incidence through 2015 is estimated as the difference between what could have occurred (the “counterfactual”); we used the median incidence pre-2004) and what is happening with control—the extension of the current trend since scale-up of interventions began. Incidence data were estimated from Minjand et al, 2010 (see reference 15) and Lusing JPA, et al. Malaria morbidity and immunity among residents of villages with different Plasmodium falciparum transmission intensity in North-Eastern Tanzania. Malaria J 2004; 3:26.
14. This estimate is based on two extrapolations: (a) extrapolating the findings from Mekoka and Kwamasimba (7,146 cases averted over a 5-year period in a population of 4,000 people) to a national mainland population of 41.2 million; and (b) extrapolating the findings from an analysis of sustained malaria control in Zanzibar (about 747,000 cases averted over a 5-year period in a population of 1.3 million) [Clinton Health Access Initiative, Evidence to Policy initiative, and the African Leaders Malaria Alliance: Maintaining the gains in malaria control. Country brief: Zanzibar, 2011].
19. To estimate averted costs of diagnosing and treating malaria cases in the public health sector (in-patients and out-patients) in Mekoka and Kwamasimba, we compared the estimated costs from 2011–2015 under the two different scenarios discussed in reference 13 (i.e. sustained control versus a counterfactual in which there is no scale-up of control interventions). For these estimates, we used the following assumptions, based on published/unpublished data on Mainland Tanzania and Zanzibar, and on personal communications with technical staff working closely with the Ministry of Health in Tanzania (data sources included: district- and region-level Health Management Information System (HMIS) reports; Tanzania DHS 2004–5 and 2010; Bijlmakers L, et al, 2007. Review of the essential health care package in Zanzibar. Report presented to the MOSHW, Zanzibar; Krishnan N. Evaluating malaria treatment in developing countries: analyzing household costs in Tanzania. Dissertation for degree of Master of Philosophy in Public Health, University of Cambridge, 2009; Lubell, Y et al. Cost-effectiveness of parenteral artesunate for treating children with severe malaria in sub-Saharan Africa. Bull World Health Organ 2011;89:504–512) for the Tanga region, 81% of malaria cases are treated in government facilities as out-patients; 8% of cases are hospitalised; average cost of out-patient diagnosis with a rapid test is $0.72, average costs of out-patient treatment (all ages) is $1.42; average cost of in-patient treatment (all ages) is $69.50 (assumes average length of stay of 3 days). All prices adjusted to 2011.
20. To estimate averted household costs of treating malaria, we compared the estimated direct household costs of treating malaria up until 2015 under the two different scenarios discussed in reference 13. Reference 19 above shows data sources for costs. For our analysis, we assumed that: 19% of malaria cases seek care in the private sector; half of whom go to drug shops and half to private clinics; cost of drug treatment is $1.15 in private clinics, $0.99 at drug stores. We are likely to have under-estimated the true costs, as we did not include costs of transportation. We had insufficient data to model the indirect costs.
Summary
Zanzibar has brought its malaria burden down to very low levels, thanks in large part to an aggressive campaign launched in 2004 to scale up malaria control. The challenge now facing the country is to maintain the gains it has made over the last six years.

It is tempting to think that the job is done, and that malaria control activities can now be reduced. But as Zanzibar’s past history shows, if funding for these activities is withdrawn, the disease will rapidly resurge, lives will be lost, and the recent gains will be erased.

On the other hand, if Zanzibar can find the financial resources to maintain its malaria control program, and therefore prevent resurgence, it will reap impressive public health and economic benefits. We estimate that over the next five years (2011-2015), sustained malaria control in Zanzibar could avert:

- about 747,000 malaria cases and 13,000 malaria deaths;
- about $3.2 million in the cost of diagnosing and treating malaria in the public health system;
- about $100,000 in out-of-pocket costs of malaria treatment.

Sustaining Zanzibar’s control program for the next five years is likely to be highly cost-effective, costing only about $49 per disability-adjusted life year (DALY) averted and about $8 per case averted, similar in cost effectiveness to childhood vaccination programs.

By finding new ways to ensure the financial viability of its malaria control program, including new sources of domestic financing, Zanzibar will be able to sustain high coverage of malaria control tools, continue to avert malaria cases, and generate far-reaching economic benefits into the future.

Malaria in Zanzibar—At a glance
Population in 2009
1.3 million on two main islands, Unguja and Pemba, and several smaller islands

Malaria transmission
- Stable perennial transmission
- Most cases due to *P. falciparum* (Figure 1)

Seasonality
Peak transmission during and immediately after the “short” rains in October–December and the “long” rains in March–May

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FIGURE 1. *P. falciparum* prevalence in Zanzibar in 2007

- No malaria
- 0–15%
- 16–30%
- 31–45%
Zanzibar has brought malaria under control

In 2004, Zanzibar launched an aggressive campaign to scale up malaria control, supported by a large rise in international funding (Figure 2). The results have been impressive.3–5

- By 2007, 94% of households were covered by indoor residual spraying with insecticide (IRS).
- Household ownership of insecticide-treated nets (ITNs) almost tripled between 2005 and 2010 (from 28% to 76%) and ITN use in children under 5 more than doubled (from 22% to 55%).
- The proportion of pregnant women who received at least two doses of intermittent preventive therapy increased from 14% in 2005 to 47% in 2010.
- Artemisinin-based combination therapies (ACTs) have been made widely available, free of charge, in public health facilities.

Although the burden of malaria was falling slowly prior to scale-up, the decline was accelerated by scale-up. The malaria parasite prevalence, as well as the annual number of malaria cases and deaths, have all fallen dramatically. For example, one study of children under 5 found that malaria-related hospital admissions fell by 77%, and malaria-attributed deaths fell by 75%, between 2002 and 2005.5 Zanzibar has now reached a state of “controlled low-endemic malaria.”6

Success is fragile

The increase in coverage with control tools and the huge fall in the malaria burden are impressive gains, but they are fragile as long as the potential for transmission remains. As Zanzibar’s past history of malaria control shows, unless the country can sustain its aggressive control program, malaria will rapidly resurge and the gains of the last decade will be wiped out.

In the late 1960s, Zanzibar brought malaria under control, only to see it resurge again after the control program was abandoned. The Global Malaria Eradication Program (1958–1968) succeeded in bringing malaria down to very low levels; the prevalence of childhood malaria fell from 84.3% in 1957 to 7.8% in 1967 on Unguja (Zanzibar Island; Figure 3).8 By June 1968, malaria was described in Zanzibar as a “minor health problem” and no longer viewed as a health priority.8 Funding for malaria control was withdrawn,9 and in 1970 control interventions were abandoned.10 Within a few years, malaria resurged.8

Sustained malaria control saves lives

If malaria control activities can be sustained, Zanzibar could reap massive public health benefits.

Figure 4 shows the results of our analysis of the number of cases and deaths that could be averted each year in Zanzibar if the country is able to sustain its malaria control program.11 These estimates include cases and deaths reported through the public health system as well as those that may have self-treated or were not reported.12 The analysis compares the likely impact of sustained control (turquoise dotted line, called “forecast if post-2004 trend continues”) with a “counterfactual” scenario in which control activities had not been scaled up at all (orange dotted line, called “trend without scale-up”).

Over the next five years (2011–2015), if Zanzibar is able to sustain its malaria control program, we estimate that it could:

- avert about 747,000 cases of malaria, and
- save about 13,000 lives that would have otherwise been lost to malaria.
Sustained malaria control could bring economic benefits

By averting malaria cases, sustained malaria control could bring economic benefits to several different sectors in Zanzibar, which in turn could help to promote economic growth.13

Sustained malaria control will prevent the “counterfactual scenario,” the orange dashed line in Figure 4. Without funding for sustained control, malaria resurgence would increase costs to many sectors:

• the public health system, which would incur the costs of treating resurgent malaria cases;
• households, which would incur direct out-of-pocket costs to treat malaria and indirect costs (lost income from the illness), as well as increased school absenteeism (see box on page 29); and
• industry, which would experience reduced productivity due to worker absenteeism.

We have estimated the likely cost savings to the public health system and to households from sustained malaria control in Zanzibar.

Public Health System

By averting malaria cases year after year (Figure 4), sustained malaria control will avert malaria treatment costs incurred by the public health system. We conducted an economic analysis in which we estimated these cost savings to the public health system.14

Over the next five years (2011–2015), if Zanzibar can sustain its malaria control program, we estimate that the public health system could avert about $3.2 million in the costs of diagnosing and treating out-patient and in-patient malaria.

Most of these cost savings are “virtual”—that is, they allow health sector resources (e.g., health workers’ time, hospital beds) to be devoted to other diseases. Nevertheless, some of these resources could be invested into strengthening and expanding prevention and surveillance activities to maintain a reduced burden of malaria.

Households

Out-of-pocket malaria treatment costs place a heavy burden on households in sub-Saharan Africa, falling most heavily on the poorest households.15 Averting cases through sustained control will reduce this economic burden.

We estimated the impact of sustained control on direct household costs, i.e. out-of-pocket expenditures on malaria treatment (we had insufficient data to model the indirect costs).16

Over the next five years, if Zanzibar can sustain its malaria control program, we estimate that it could avert about $100,000 in direct household costs of malaria. This is the equivalent of about 1% of household income (household savings would be even greater if the averted indirect costs were also included).

Sustained malaria control is likely to be highly cost-effective

We estimated the cost-effectiveness of a sustained malaria control program in Zanzibar, lasting from 2011 to 2015, using best estimates of future annual expenditures on control activities (about $3.9 million per year; see below).17 We compared net expenditures on control (i.e., expenditures minus savings to the public health system and to households) against two health outcomes, DALYs averted and cases averted.18

Our estimates suggest that a sustained control program is likely to be highly cost-effective, costing only about $49 per DALY averted and about $8 per case averted. Thus sustained control would be one of the “best buys” in global public health, similar in cost-effectiveness to childhood vaccine campaigns.
Donor and domestic financing is needed

Given the risk of resurgence from halting control activities (Figure 3), the Ministry of Health has prioritized a financial sustainability plan (FSP) for malaria control:

- The short term strategy is to **maintain current financing levels** to consolidate and sustain the gains in malaria control achieved to date; we estimate that sustained control expenditures would amount to about $3.9 million per year from 2011 to 2015.
- The longer term strategy is to **mobilize support and resources for elimination**, which is estimated to cost at least 20–30% more than sustained control.24

The two aims of the FSP are to secure funding for these strategies and to diversify the sources of malaria financing in order to become less reliant on external donors. Almost all current malaria funding (97%) comes from just two external donors—the President’s Malaria Initiative and the Global Fund—with the Government of Zanzibar contributing less than 1%. This reliance on external donors makes long-term planning difficult.

The FSP for malaria in Zanzibar is occurring within the context of a larger effort to reform health sector financing and increase domestic contributions to this sector. As part of this effort, the Ministry of Health has proposed four malaria financing mechanisms to help achieve the FSP’s aims. These mechanisms are all still under discussion:

- A **tourist tax** dedicated to malaria could finance 10–20% of the annual operating costs of Zanzibar’s malaria control program. Given the rise in tourism, and the likelihood that tourists’ spending decisions will not be affected by levying a fee of $5–10 per capita, a marginal tax charged on all international arrivals could be a predictable, sustainable source of income. Such a tax would be justifiable, given that tourists themselves reap the benefits of reduced malaria risk.
- In-country stakeholders could advocate for **increased budget support for malaria**, through the annual appropriations of the government budget cycle and through a new Basket Fund for pooling donor support for the health sector.
- Zanzibar is introducing **community health insurance schemes**, which will allow enrolled community groups to receive free access to primary health care services. The revenue generated from these schemes will be managed at district levels, and will contribute towards health system costs, curative care, and some preventive care. A contribution from these revenues could be directed towards preventive malaria control efforts at district level. Keeping malaria under control could save money both for insurance schemes as well as households.
- An **Endowment Fund**, initially funded by the Government and donors, could be established to generate interest income that could be directed at malaria control. Due to the unpredictable nature of investment income year-to-year, the Fund could be set up to allow withdrawal of funds from the endowment principal in emergencies (e.g., to fund an epidemic response).

These four mechanisms could potentially increase the proportion of domestic funding for malaria control from the current 1% to **at least 40% by 2020**. Nevertheless, Zanzibar expects bilateral support to continue as an important source of funding.

Impact of malaria control on education in Zanzibar

By preventing absenteeism among students and teachers, sustained malaria control is likely to have positive impacts on childhood education—which in turn could help to boost future earnings and productivity.19,20

In our interviews with schoolteachers in Zanzibar’s Central District, teachers reported that schoolchildren typically miss 2–3 days of school when they have a malarial illness. Before the launch of Zanzibar’s successful malaria control program, children experienced about 5–6 episodes of malaria per year;21 translating into about 10–18 days of school missed each year—equivalent to about 5–8% of the school year. Teachers in the Central District, which has seen sustained reductions in malaria transmission, report that the control program has had a noticeable impact on absenteeism, particularly among children aged 6–11 years, as well as upon attention and motivation. For example, one teacher said:

*When I first began to teach, my students often missed school due to malaria, but in the last twelve years, not one of my students has missed a day of school due to malaria; the malaria control project is very significant to us and has greatly improved attendance of our students.*

The Head of Primary Education for Zanzibar, and the Head of the Parents’ Society, also report that they have seen positive educational impacts of malaria control. While these reports are anecdotal, they are in line with empirical studies that have shown that preventing malaria can improve cognitive and educational outcomes.22,23

**Conclusion**

If Zanzibar can sustain its control program, from 2011–2015 it could save about 13,000 lives and 747,000 malaria cases, at a cost of only about $8 per case averted. Sustained control in Zanzibar is one of the “best buys” in global public health.
References


6. Controlled low-endemic malaria has been defined as: “A state in which interventions have reduced endemic malaria transmission to such low levels that it does not constitute a major public health burden, but at which transmission would continue to occur even in the absence of importation” (Cohen JM, et al. How absolute is zero? An evaluation of historical and current definitions of malaria elimination. *Malar J* 2010; 9:213).

7. Figure 2 uses confirmed malaria case data from the 2010 World Malaria Report. ITN coverage data from DHS 2004–05, THMIS 2007–08, DHS 2010. Original expenditure data collected from the Ministry and partners. The large fall in reported cases from 2006 to 2007 was probably due to the introduction of ACTs and confirmation of cases with rapid diagnostic tests.


11. The health impact of sustained control can be measured in “cases averted,” or the number of cases that never occurred but would have been expected without the 2004 scale-up. In Figure 4, averted incidence through 2015 is shown as the difference between what could have occurred if the pre-2004 trend had continued, and what is happening with control—the extension of the current trend since the 2004 scale-up.

12. Our analysis uses “adjusted” cases and deaths. To estimate such adjusted cases and deaths, our starting point was the number of cases and deaths reported in the 2010 World Malaria Report. To make these estimates, we used the following sources and assumptions. Population at risk: UN Population Division (courtesy of WHO); % of children with fever in the past two weeks from Tanzania 2004–05 DHS (Zanzibar only) (33%) and Tanzania 2010 DHS (Zanzibar only) (18%); % of fevers that are malaria (Zanzibar-specific): 2.2%, from Zanzibar Malaria Control Program; Zanzibar Malaria Early Epidemic Detection System Biannual Report, Year-End 2009; 1(2), 2010; under-5 mortality rates (deaths/1000 live births): 109 (2002–2004, average of Tanzania 2004–05 DHS [Zanzibar only] and Tanzania 2010 DHS [Zanzibar only]); 81 (2008–2009, Tanzania 2010 DHS [Zanzibar only]); crude birth rates (live births/1000 population): 38 (2002–2004, Tanzania 2004–05 DHS [Zanzibar only]); 35.9 (2008–2009, Tanzania 2010 DHS [Zanzibar only]).


14. To estimate averted costs of diagnosing and treating malaria cases in the public health sector (in-patients and out-patients), we compared the estimated costs from 2011–2015 under the two different scenarios shown in Figure 4 (i.e. sustained control versus a counterfactual in which there is no scale-up of control interventions). For these estimates, we used the following assumptions, based on published and unpublished data and personal communications with technical staff working closely with the Ministry of Health in Zanzibar (data sources included: Bijlmakers L, et al. 2007. Review of the essential health care package in Zanzibar. Report presented to the MOSHW, Zanzibar; Krishnhan N. Evaluating malaria treatment in developing countries: analyzing household costs in Tanzania. Dissertation for degree of Master of Philosophy in Public Health, University of Cambridge, 2009). 59.0% of malaria cases are treated in government facilities as out-patients; 15.6% of cases are hospitalized; average cost of out-patient diagnosis with a rapid test is $0.72; out-patient treatment for an adult is $2.08 and for a child is $0.76; average cost of in-patient treatment for an adult is $33.32 and for a child is $16.64 (assumes average in-patient stay of five days, and daily cost of $6.66 and $3.33, respectively). All prices adjusted to 2011.


16. To estimate averted household costs of treating malaria, we compared the estimated direct and indirect household costs of treating malaria up until 2015 under the two different scenarios shown in Figure 4. Data on costs were derived from: Krishnhan N. Evaluating malaria treatment in developing countries: analyzing household costs in Tanzania. Dissertation for degree of Master of Philosophy in Public Health, University of Cambridge, 2009.

17. We estimated the incremental cost-effectiveness ratio (ICER) of sustained control. We estimated ICER by dividing the net costs of the intervention (expenditures minus cost savings to the public health sector and to households) by the total number of incremental DALYs and cases averted by the intervention. Case fatality rate of 0.5% for calculating DALYs from: Roca-Feltrer A, et al. Estimates of the burden of malaria morbidity in Africa in children under the age of 5 years. *Trop Med Int Health* 2008; 13(6): 771–783.

18. Disability-adjusted life years (DALYs) are a measure of the overall burden of a disease (in this case malaria). A DALY combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health (www.who.int/healthinfo/global_burden_disease/en/index.html).


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