Maintaining the Gains in **Global Malaria Control**

The Health and Economic Benefits of Sustaining Control Measures

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Abbreviations

ACT	Artemisinin-Based Combination Therapy
ALMA	African Leaders Malaria Alliance
CHAI	Clinton Health Access Initiative
COD	Cash on Delivery
CQ	Chloroquine
DAH	Development Assistance for Health
DALY	Disability-Adjusted Life Year
DFID	United Kingdom Department for International Development
DHS	Demographic and Health Survey
E2Pi	Evidence to Policy Initiative
FSP	Financial Sustainability Plan
Global Fund, GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GMAP	Global Malaria Action Plan
GMEP	Global Malaria Eradication Programme
ICER	Incremental Cost-Effectiveness Ratio
IPTp	Intermittent Preventive Treatment for Pregnant Women
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
LLIN	Long-Lasting Insecticidal Net
MDG	Millennium Development Goal
MIS	Malaria Indicator Survey
NMCP	National Malaria Control Program
PMI	United States President's Malaria Initiative
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SP	Sulfadoxine-Pyrimethamine
USAID	United States Agency for International Development
WHO	World Health Organization

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EXECUTIVE SUMMARY

The past decade has seen an extraordinary turnaround in the global effort to control malaria. The launch of the Roll Back Malaria campaign in the late 1990s ushered in a new era of partnerships between endemic countries, donors, the private sector, nongovernmental organizations, and academic institutions. New control tools were introduced, including long-lasting insecticidal nets (LLINs) and artemisinin-based combination therapies (ACTs). The Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), the US President's Malaria Initiative (PMI), and the World Bank's Booster Program for Malaria Control in Africa mobilized a large increase in malaria financing, from just $300 million in 2003 to $1.94 billion in 2009.

This increased financing supported aggressive national scale-up of insecticide-treated nets (ITNs) and other tools. In eleven countries (Algeria, Botswana, Cape Verde, Eritrea, Madagascar, Namibia, Rwanda, São Tomé and Príncipe, South Africa, Swaziland, and Zambia) and one region (Zanzibar), scale-up has been associated with a decline in reported malaria cases or deaths by over 50% since 2000. In other countries, if the upward trend in coverage with control tools is maintained, the burden of malaria will also be greatly reduced in the next few years.

Such success is a cause for celebration, but it is fragile. If these successful countries were to reduce their malaria control activities while the potential for transmission still remains, all of the gains they have made will be lost because malaria will rapidly resurge. The global health community's continued focus on scale-up in high burden countries must therefore be matched by a new effort to **maintain the gains** that have been achieved to date in the successful countries.

Reducing control activities could have catastrophic results

Malaria control programs face an "out of sight, out of mind" paradox. The more successful the program is, the more invisible the disease becomes to policymakers, which increases the risk that financing for control tools such as ITNs and indoor residual spraying (IRS) will be withdrawn. While these tools effectively suppress malaria, they do not alter a country's intrinsic potential for malaria transmission. Therefore even after suppressing malaria, countries must sustain their control activities year after year or else malaria will rapidly resurge to its intrinsic baseline. Many countries that bring their malaria burden down remain at high risk of malaria resurgence.

The risk of resurgence is not just hypothetical. In the past, when malaria-endemic countries halted control activities because the burden had fallen, funding was withdrawn, or the malaria program was disrupted by a civil war or natural disaster, the disease quickly returned, often with devastating consequences.

Countries need reliable, long-term malaria financing

In 2010, donor funding for malaria control reached a plateau. The Global Fund is facing a severe financing crunch. While donor countries remain committed to malaria control, they are under intense pressure from the public to reduce their foreign aid budgets. Given these stark realities, the writing is on the wall: ensuring sustainable malaria financing in countries that have reduced their malaria burden will require identifying alternatives to donor financing. To avoid funding shortfalls and a potential resurgence, they must develop a plan to sustain financing for control that goes beyond donor support—they will need to look at novel domestic resources and new mechanisms to improve the predictability and quality of financial resources.

Over the course of 2010–2011, the governments of four countries—Senegal, Rwanda, Ethiopia, and Tanzania/Zanzibar—began to develop plans to sustain malaria control financing, which estimated the annual costs needed to maintain the gains and which explored novel solutions to provide these resources. These solutions include raising additional domestic revenues, such as through tourist taxes and community health insurance schemes, and mechanisms that improve the predictability and quality of malaria financing, such as trust funds. In addition, governments have also considered new ways to increase the diversity of funders and to broaden

the number of donors supporting malaria control. Lastly, mechanisms that improve the sustainability and predictability of external financing were examined more closely—a particularly promising approach is Cash on Delivery (COD) aid, in which donors reward countries by tying continued financing to the maintenance of low malaria prevalence.

There may also be scope for countries to reduce their overall malaria funding need through efficiencies in malaria programming. The most immediate gains could be garnered through reducing the prices of ITNs and insecticides through more effective procurement and negotiation. However, a range of potential efficiencies exist that require further study, such as defining the most cost-effective mix of interventions between surveillance and targeted prevention (ITNs and IRS).

Sustained malaria control is an excellent investment

If successful countries can maintain their control program through effective financing, they could reap enormous public health benefits, through averting cases and deaths year after year. Our estimates suggest that if four countries alone—Ethiopia, Rwanda, Zambia, and Zanzibar—can secure sufficient financing to sustain their current control programs over the next five years, about 151 million cases of malaria could be averted. Over this same time period, about 162,000 deaths could be averted in Zambia and Zanzibar alone by sustaining malaria control.

By averting malaria cases, sustained control would also bring economic benefits through averting costs to the public health system, households, and industry. If Ethiopia, Rwanda, Zambia, and Zanzibar can sustain their malaria programs over the next five years, they could avert an estimated $650 million in costs to the public health sector of diagnosing and treating malaria. Health sector resources, such as health workers' time and hospital beds, would be freed up to tackle other diseases. Sustaining control activities in these four countries could also avert about $1 billion in household costs, equivalent to about 7–8% of household income, making a real difference for a typical household.

The health and economic benefits clearly demonstrate that sustaining control is highly cost-effective. In Ethiopia and Zanzibar, a control program sustained for the next five years would cost only about $41–49 per disability-adjusted life year (DALY) averted and about $5–8 per case averted. This would make the program a "best buy" in global health, similar in cost-effectiveness to childhood vaccination programs.

Next steps

When it comes to donor decisions about which countries to support, donors should prioritize countries according to their malaria risk, rather than their current malaria burden. Countries with an equal risk should be prioritized equally, even if their current burden is unequal. Equal priority based on risk makes sense, because it emphasizes the number of cases that there would be without control, rather than the number of cases today. Governments in these successful countries should prioritize the maintenance of strong malaria control activities 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. Sustaining anti-malaria efforts will ensure that the gains of the last decade are maintained.

INTRODUCTION

The past decade has witnessed dramatic progress in the global effort to roll back malaria. Annual funding for malaria control increased from just $300 million in 2003 to $1.94 billion in 2009,[1,2] an increase attributable mostly to the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund) and its donors, the US President's Malaria Initiative (PMI), and the World Bank.[2] This funding increase has financed aggressive national campaigns to scale-up effective prevention and treatment tools, though the total funding still falls far short of the estimated $6 billion needed annually for comprehensive global control.[1–3]

In some countries, these aggressive campaigns have led to a dramatic reduction in the malaria burden over the past five years. Previously overflowing pediatric wards in countries such as Zanzibar now lie empty as annual malaria-related illnesses and deaths have fallen by more than half. These successful countries and their donors are now facing an important question: *should constrained international and domestic resources still be invested in the malaria program, or should they be shifted to controlling other infectious diseases, such as HIV or pneumonia, or to countries currently hit harder by malaria?*

Given these clear achievements and the lack of a visible burden of malaria in these countries, donors and the countries themselves may be tempted to believe that the job is done, and that financing for malaria can be withdrawn and diverted elsewhere. But if that happens, malaria will resurge, lives will be lost, and the gains of the last decade will be erased.

The global community and endemic country governments need to ensure that these impressive gains are not lost. A new strategy is needed to transition global control efforts from scale-up to the next phase: **maintaining the gains**. Maintaining these gains will require continued malaria control activities and the stable, predictable, and efficient financing necessary to deliver them over the long-term.

This report focuses on five successful countries (**BOX 1**). Ethiopia, Rwanda, Senegal, Zambia, and Zanzibar have significantly reduced their malaria burden in recent years, and in Mainland Tanzania, if the upward trend in coverage with control tools is maintained, the burden of malaria will also be greatly reduced in the next few years. All of these countries will need long-term, reliable financing for their control programs. Donors must continue to provide funding for malaria. And countries themselves will need to diversify their funding portfolios, increase their domestic contributions to malaria programs, establish mechanisms to counter financing volatility, and, where possible, find efficiencies in malaria programming to reduce the overall funding need.

The primary aim of our report is to convince both international and in-country policymakers that even when the malaria burden is reduced, malaria funding needs are not. Furthermore, malaria control is one of the best-buys in public health. The report also shows that current funding streams are volatile and that countries need long-term financial sustainability plans for malaria. These plans must specify how much it will cost each year to maintain the gains and how revenues from both domestic and external sources will be raised. In addition, countries need to begin considering how the needs of the malaria program can be reduced through more efficient use of existing funds and more targeted programming.

As we show in this report, by finding new ways to ensure the viability of their malaria control programs, successful 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.

BOX 1. Maintaining the Gains: focus countries

- Ethiopia
- Rwanda
- Senegal
- Tanzania (Mainland and Zanzibar)
- Zambia

CHAPTER 1: A DECADE OF SUCCESS

How scale-up of control tools has made an impact in many countries

KEY POINTS

- **Over the last decade, an increase in international financing for malaria supported aggressive national campaigns to scale up effective control tools**
- **In eleven countries and one region that scaled up such tools, reported malaria cases or deaths have fallen by over 50% since 2000**
- **Countries such as Ethiopia, Rwanda, Zambia, and Zanzibar have brought the burden of malaria down to low levels**
- **These successes are impressive but fragile: if these countries reduce their control activities while the potential for transmission remains, malaria will rapidly resurge, wiping out the recent gains**

Before 2000, national malaria control programs were typically underfunded. They rarely used indoor residual spraying (IRS), which was too expensive, and they only had access to untreated bed nets that required logistically complicated retreatment programs. Malaria-endemic countries also faced rising resistance to standard drug treatments, such as chloroquine (CQ) and sulfadoxine-pyrimethamine (SP). Malaria was rampant. No large-scale successes had been achieved since the Global Malaria Eradication Programme (GMEP) of the 1950s and 1960s, which brought about an important reduction in the geographical distribution of malaria.[4]

Fortunately, the past decade has seen an extraordinary turnaround in the global effort to control malaria. The launch of the Roll Back Malaria (RBM) campaign in the late 1990s ushered in a new era of partnerships between endemic countries, donors, the private sector, nongovernmental organizations, foundations, and academic institutions. New control tools were introduced, including long-lasting insecticidal nets (LLINs), which last around three years without requiring retreatment, and artemisinin-based combination therapies (ACTs), recommended by the WHO and in almost all settings more effective than the ubiquitous monotherapies (**BOX 2**).[5]

BOX 2. Evidence-based malaria control tools

Malaria is a preventable and treatable disease, yet it is still the fourth largest cause of death or disability in low income countries.[6] Children under 5 years and pregnant women are at highest risk. In addition to its health impacts, malaria has direct and indirect economic impacts on households, the health system, industry, and the economy as a whole. These health and economic impacts can be mitigated by scaling up proven control tools. The Roll Back Malaria campaign focuses on four of these tools.

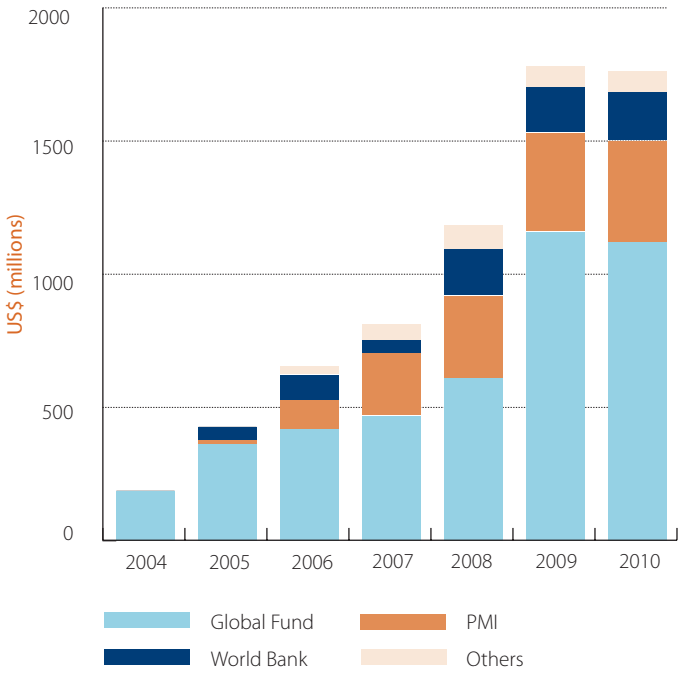
Prevention

- **Insecticide-treated nets (ITNs).** ITNs can reduce deaths in children by one fifth and can halve childhood malaria cases.[7] Long-lasting insecticidal nets (LLINs) have a lifespan of about three years.
- **Indoor residual spraying (IRS).** Impressive historical reductions in malaria have been achieved with IRS campaigns.[8,9] IRS involves spraying the walls of houses with insecticide, and it reduces malaria transmission in areas where the predominant mosquito species bite and rest indoors.
- **Intermittent preventive treatment in pregnancy (IPTp).** Giving antimalarial drugs on a regular basis to all pregnant women halves the risk of antenatal parasitaemia and reduces the risk of placental malaria by about two thirds.[10] For women in their first or second pregnancy, IPTp reduces perinatal deaths by about a quarter and low birth weight by about 40%.

Treatment

- **Artemisinin-based combination therapies (ACTs).** The WHO recommends ACTs for treating uncomplicated *falciparum* malaria; these drugs have treatment success rates of over 90%.[5] Older mono-therapies, such as CQ and SP, have become ineffective in many parts of the world due to drug resistance.

FIGURE 1. Malaria funding commitments of the Global Fund, PMI, the World Bank, and other agencies (figure adapted from the *World Malaria Report 2010*[2])



A huge increase in donor financing—mobilized by the Global Fund, PMI, and the World Bank's Booster Program for Malaria Control in Africa (**FIGURE 1**)—funded a massive scale-up of control tools (known as "Scaling Up for Impact").[2] Building upon this momentum, in 2008 the United Nations Secretary General appointed a Special Envoy for Malaria, tasked with mobilizing additional global support for action on malaria control.

This combination of increased donor funding for the scale-up of effective tools, global advocacy, and strong partnerships, together with committed national leadership, has led to tremendous progress across sub-Saharan Africa in scaling up malaria prevention and treatment (**BOX 3**).

In this chapter, we highlight the progress that has been made in our five focus countries, all of which have launched aggressive campaigns in the past few years to scale up malaria control interventions.

BOX 3. Progress in scaling up prevention, diagnosis, and treatment across sub-Saharan Africa

Progress in preventing malaria

- **ITNs:** From 2008 to 2010, enough nets were distributed to cover more than two thirds of the population at risk in sub-Saharan Africa.[2] By 2010, an estimated 42% of African households owned at least one ITN and 35% of children slept under an ITN (up from 2% in 2000).[2,11]
- **IRS:** The number of people in sub-Saharan Africa protected with IRS increased from 13 million in 2005 (about 1.7% of the population) to 75 million in 2009 (about 10% of the population).[2]
- **IPTp:** In 22 high-burden countries, a median of 55% of women attending antenatal care received two doses of IPTp.[2]

Progress in diagnosis and treatment

- **ACTs:** In 2005, only five African countries provided enough courses of ACTs to treat more than 50% of malaria patients in the public sector.[2] By the end of 2009, 11 countries were providing enough courses to cover 100% of patients treated in the public sector, and 8 additional countries delivered enough to treat more than 50% of patients.[2]
- **Diagnostic testing:** In early 2010, the WHO revised its guidelines to recommend diagnosis in all cases of suspected malaria prior to giving anti-malarial drugs—rather than the previous standard of presumptive treatment of all fevers in children under 5 years as malaria.[12] The proportion of reported cases in Africa confirmed with a diagnostic test increased from under 5% in 2000 to about 35% in 2009.[2] A small number of countries, such as Senegal, have rapidly scaled up malaria diagnostic testing on a national scale, resulting in a dramatic fall in presumptive use of ACTs.[2]

BOX 4. Scale-up of ITNs in our focus countries

- From 2005–2007, **Ethiopia** purchased and delivered about 20 million ITNs, leading to a 10-fold rise in ITN ownership to about 66% of households in endemic areas.[18,19]
- In **Rwanda**, between 2005 and 2010, household ownership of at least one ITN increased from 15% to 82%, ITN use in children under 5 increased from 13% to 70%, and ITN use in pregnant women increased from 17% to 72%.[20]
- By the end of 2010, almost 6 million ITNs had been distributed in **Senegal**, 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).[21,22]
- Although Mainland **Tanzania** is still in the midst of its mass ITN distribution phase, there are already indications of progress. For example, ITN ownership increased from 38% of households in 2007 to 63% after the first mass net distribution in 2010.[23]
- In **Zambia**, by 2010, 64% of households had at least one ITN, compared with 14% in 2001–02.[24]
- In **Zanzibar**, household ownership of 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%).[25–27]

Scaling up

The RBM partnership called for scaling up of effective control tools (BOX 2). Most countries adopted a strategy of free mass distributions of ITNs, which rapidly led to some major successes.

The 2010 *World Malaria Report* estimated that by the end of 2010, about 289 million ITNs had been delivered to sub-Saharan Africa, enough to cover three quarters of the 765 million people at risk of malaria. By mid-2010, around 4 in 10 African households owned at least one ITN and about a third of children slept under an ITN.[2]

In some countries, rates of ITN ownership rose dramatically. From coverage rates that were essentially zero before 2000, eleven countries reached household ITN ownership rates of over 50% by 2007–2009 (Equatorial Guinea, Ethiopia, Gabon, Mali, Rwanda, Senegal, São Tomé and Príncipe, Senegal, Sierra Leone, Togo, and Zambia).[2] Other countries, such as Chad, the Democratic Republic of Congo, Côte d'Ivoire, and Nigeria, have seen much slower progress, achieving only modest increases in coverage. There is a strong relationship between the amount of development assistance for health (DAH) targeted at malaria and the ITN coverage rates that have been achieved to date, which suggests that inadequate financing may be an important reason for lack of progress in certain countries.[13]

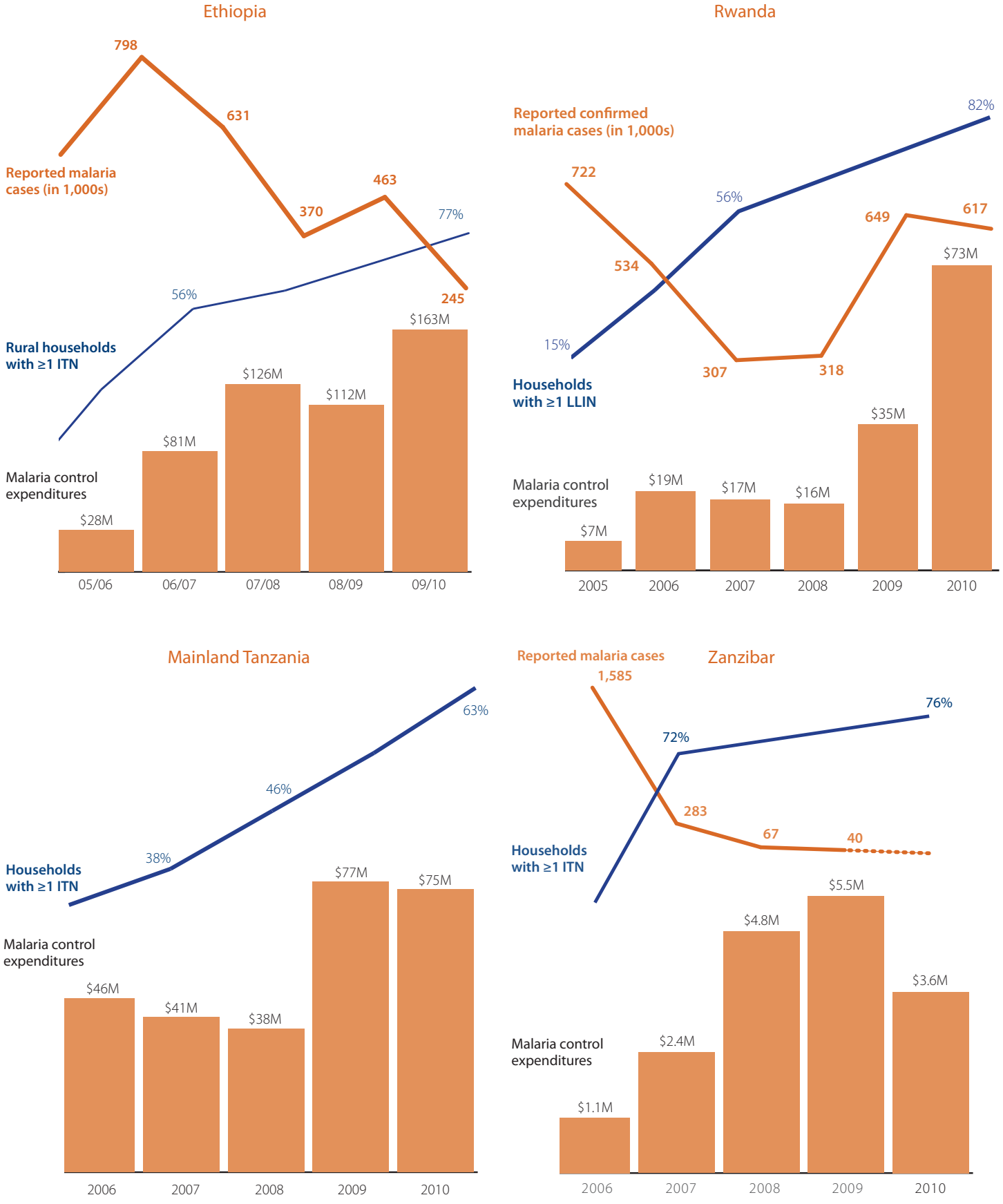
The focus countries in this report have all seen large increases in DAH targeted at malaria (**FIGURE 2**). They have leveraged this rise in financing to scale up ITN coverage through a variety of mechanisms, such as free mass distributions, vouchers for ITNs, and distribution of ITNs as part of routine antenatal care and immunization campaigns. All five countries have seen large increases in ITN coverage (**BOX 4**).

While ITNs seem to have been the major focus of scale-up efforts, some countries also launched campaigns to scale up IRS, IPTp, rapid diagnostic tests (RDTs), and ACTs. Many of our focus countries, in addition to increasing coverage of ITNs, have successfully scaled up these other tools (**BOX 5**).

BOX 5. Examples of scale-up of IRS, ACTs, IPTp, and RDTs in our focus countries

- Ethiopia has covered about 4.2 million households with **IRS**.[18]
- **ACTs** have been made widely available in Rwanda in public health and faith-based facilities, and in the community via community health workers and private pharmacies.[28] ACTs have also been made widely available, free of charge, in public health facilities in Senegal and Zanzibar.[21,25–27]
- In Zambia, 70% of pregnant women received two doses of **IPTp** in 2010, compared with 59% in 2006.[24]
- By the end of 2010, one million **RDTs** had been distributed and made free of charge in Senegal; by 2009, 86% of patients presenting with a malaria-like fever were screened with an RDT.[21]

FIGURE 2. Malaria control expenditures, ITN coverage, and reported malaria cases in Ethiopia,[14] Rwanda,[15] Mainland Tanzania,[16] and Zanzibar[17]



The trend in reported malaria cases in Mainland Tanzania is not shown, due to underlying weaknesses in the data.

Impact of scale-up

Scale-up of malaria control has been associated with a large fall in the malaria burden in many countries.

RBM estimates that in the past 10 years, scaling up malaria control tools has saved the lives of nearly three quarters of a million children in 34 malaria-endemic African countries.[29] From 2000–2009, malaria cases or deaths fell by over 50% in 11 African countries (Algeria, Botswana, Cape Verde, Eritrea, Madagascar, Namibia, Rwanda, São Tomé and Príncipe, South Africa, Swaziland, Zambia) and one region (Zanzibar).[2] Recent trends in the malaria burden in our five focus countries are summarized below.

In the decade prior to scale-up, malaria transmission in **Rwanda** was increasing due to a variety of factors, such as drug resistance, increased population movements, and land use.[30] When scale-up began in 2006, malaria was the leading cause of morbidity 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%.[31]

In **Zanzibar**, although the burden of malaria was falling slowly prior to scale-up, the decline was accelerated by scale-up. The malaria parasite prevalence and the annual number of malaria cases and deaths have fallen dramatically. For example, one study of children under five found that malaria-related hospital admissions fell by 77%, and malaria-attributed deaths fell by 75%, between 2002 and 2005.[27]

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.[32] Thus the falling burden is, in part, 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. If scale-up is continued and coverage maintained at very high levels in at-risk populations, further reductions can be expected and future epidemics may be avoided. Aggressive control will be especially important in the next few years, since historical trends indicate that another epidemic may be due.

Senegal changed the case definition for malaria in 2007, the same year that RDTs were scaled up, changing from reliance on just fever and clinical findings to requiring parasitological confirmation.[2] 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, can be explained by the rising coverage of preventive control tools.

In **Mainland Tanzania**, as national rates of ITN ownership rise, malaria parasite prevalence can be expected to fall.[33] If ownership and use of ITNs both reach 80% in the next few years, as expected by Tanzania's National Malaria Control Program, modeling suggests that the malaria prevalence will be reduced below 5%, down from around 18% in 2007.[23,33] And if these ITN coverage rates can be maintained beyond 2012, the prevalence will continue to fall.

Scale-up of control tools has been associated with a large fall in the burden of malaria in **Zambia**. For example, from 2003 (the year that scale-up began) to 2008, reported malaria admissions fell by about 50% and reported malaria deaths by about 60%.[2]

Malaria control can help to achieve the MDGs

Scaling-up for impact is likely to play an important role in achieving the child and maternal health Millennium Development Goals (MDGs 4 and 5).

A recent multi-country study by the Institute for Health Metrics and Evaluation found that ownership of at least one ITN was associated with a 23% reduction in mortality in children under the age of 5.[34] The large decreases in malaria cases and deaths in countries such as Zambia and Zanzibar have been accompanied by steep declines in all-cause mortality among children under 5, suggesting that malaria control could help countries achieve MDG 4.[35]

It is clear that donors who invested in scaling up malaria control have received a very good return on their investment. But now is not the time for them to withdraw their support.

These successes are fragile

The success stories described above are a cause for celebration. But this success is fragile. It is tempting to believe that the job is done in these countries and that investments in their malaria programs can now be reduced and resources shifted to other priorities. As we show in Chapter 2, if this happens while the potential for transmission still remains, malaria will resurge and the gains of the last decade will be wiped out.

Donors might be tempted to reallocate resources away from successful malaria control programs through their belief that a fall in malaria means that investment can be stopped. But if funding for control interventions in these successful countries is withdrawn while conditions suitable for malaria transmission still remain, the disease will rapidly resurge and the recent hard-won gains will be erased. Successful countries must secure long-term, sustainable financing to maintain their control activities: to sustain high levels of ITN coverage, replace aging nets, reapply IRS, and increase the availability and use of IPTp, RDTs, and ACTs for as long as the potential for transmission remains high.

Many African countries have experienced a "decade of success" in malaria control, reaping very large public health rewards from achieving high coverage of control tools. The challenge that these countries now face is to maintain their control programs so as to sustain the gains. At a minimum, maintaining current achievements will require securing sufficient resources to keep replacing LLINs every three years, conducting IRS regularly, and ensuring continued access to high quality diagnosis and treatment. While the successes of the past decade confirm that well-funded malaria programs can have an enormous impact, the malaria community's ambitious goals—including the goal of zero malaria deaths by 2015—will not be reached unless there is a huge increase in dedicated malaria financing.

CHAPTER 2: THE RISK OF RESURGENCE

How reducing malaria control activities will cause an increase in cases and deaths

KEY POINTS

- **Control tools such as ITNs and IRS effectively suppress malaria, but they do not alter a country's intrinsic potential for malaria transmission**
- **This potential is determined by factors such as socioeconomic and environmental conditions**
- **Even after suppressing malaria, countries must sustain their control activities or else malaria will rapidly resurge to its intrinsic baseline**
- **Throughout history, in places where the potential for malaria transmission remained, malaria resurged whenever control programs were weakened**
- **Successful countries must not repeat the mistakes of the past**

In 2010, the funding gap for achieving comprehensive malaria control was $4.4 billion: the Global Malaria Action Plan (GMAP), RBM's framework for concerted action on malaria control, estimated that $6.2 billion was needed, but only $1.8 billion was committed.[2] And for the first time in the past decade, annual malaria funding commitments actually *fell* from 2009 to 2010 (see **FIGURE 1**).

Given these resource constraints, and with so many highly endemic areas yet to fully scale up control tools, it would be tempting for donors to withdraw funding from those countries that have successfully reduced their malaria burden and invest the money in high burden countries instead. Similarly, successful countries themselves may be tempted to end their control programs and use the resources to control diseases that still have a high burden, such as HIV/AIDS, pneumonia, or diarrhea. But, as we argued in Chapter 1, if the potential for malaria transmission still remains in these successful countries, withdrawing financing for malaria control would be a terrible mistake because the disease would rapidly resurge.

Although control tools such as ITNs and IRS effectively suppress malaria, they do not alter a country's intrinsic potential for malaria transmission. Thus malaria will resurge to baseline levels—determined by factors such as climate, presence of mosquito vectors, and housing quality—once those suppressive measures are removed. These measures may be removed by withdrawal of financing, planned cessation of control activities, or by disruption of the control program due to a war or natural disaster.

In this chapter, we examine why it is essential to focus on the *potential* for malaria, and not just the current *burden*; we illustrate how removal of malaria control tools has already led to resurgence of malaria at many times and in many places; and we make the case that the global malaria community must ensure that the gains that have been achieved so far are maintained in successful countries.

The intrinsic potential for malaria

The burden of malaria is determined by environmental and social factors, but it can be reduced by sustained implementation of effective control measures.

Three sets of factors help to explain why some places have malaria and others do not:

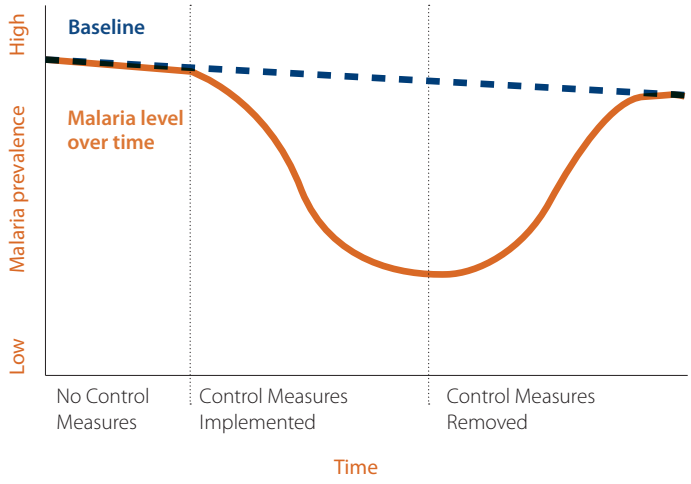
- **Environmental factors**. On a broad geographical scale, malaria transmission is significantly determined by climate.[36–38] At smaller scale, transmission requires environmental conditions suitable for the creation of vector breeding sites, such as the small, temporary sunlit pools favored by *Anopheles* mosquitoes, the primary malaria vectors of sub-Saharan Africa.
- **Mosquito-related factors.** The presence of different species of *Anopheles* mosquitoes influences the potential for transmission in a particular region—species differ in factors such as their tendency to feed on humans.[39]
- **Socioeconomic factors.** Malaria risk also depends on whether infected mosquitoes can actually come into contact with humans, which itself is determined by a variety of socioeconomic factors. For example, good quality housing with screened windows and doors and no open eaves will reduce the risk of its inhabitants being bitten at night, even if the house is in an area where mosquitoes breed. Land use may influence malaria risk—agricultural cultivation, for example, may encourage vector breeding by increasing the amount of standing water and the direct sunlight that it receives.[40]

Together, these factors determine a potential for malaria transmission that is intrinsic to a given region (a so-called "intrinsic baseline" of malaria). This intrinsic baseline is the malaria prevalence that occurs *in the absence of* malaria control measures.

The intrinsic potential for malaria in a particular place may change over time, but it usually does so slowly and through means that are unrelated to the malaria control program. Much of the United States and Europe—regions with an important burden of malaria only decades ago—probably now have minimal intrinsic potential, due to urbanization, draining of swamps, and improved housing, which permanently reduced the malaria risk.

The history of malaria control has clearly shown that malaria programs can reduce the number of malaria cases and deaths from the intrinsic baseline through active malaria suppression activities, such as IRS and ITNs. But reductions from the baseline achieved through implementation of malaria control do not represent permanent changes to the intrinsic potential for malaria. Thus removing malaria control will result in a return to baseline levels (**FIGURE 3**).[41]

FIGURE 3. Removal of control measures results in a return to the baseline prevalence



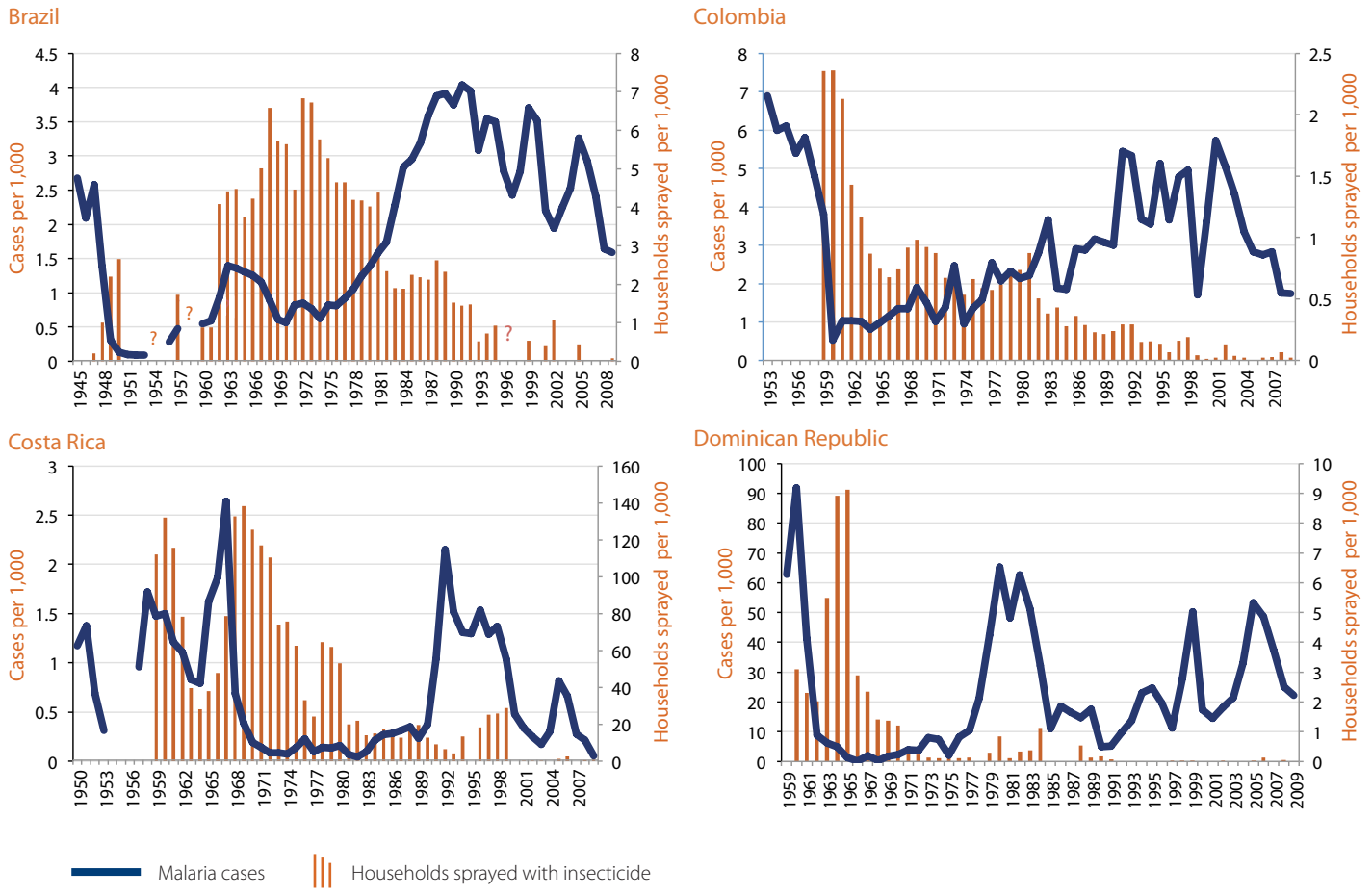
The history of malaria resurgence

Throughout history, in places where intrinsic potential for transmission remained, malaria returned whenever control programs were weakened.

The return of malaria following the removal of control measures is not just theoretical: it has been seen over and over again throughout the world, as we describe below. Many countries have succeeded in reducing malaria through active control measures, such as IRS, only to see the disease rapidly return once these measures were stopped. Resurgence occurred because the control interventions reduced the malaria burden without changing the potential for malaria transmission.

Such resurgence was particularly significant following the collapse of the GMEP in 1969. Enthusiasm for the program waned after it became obvious that global eradication would not be achieved. The alternative to elimination or eradication should have been the continued control of malaria to levels that did not represent a significant public health burden. But instead of sustaining control efforts, many countries disbanded their programs altogether. Given the high intrinsic potential for malaria in many of these regions, the results were predictably disastrous.

FIGURE 4. Malaria resurgence in the Americas after the waning of IRS campaigns



Resurgence in the Americas

Impressive reductions in malaria were achieved throughout Latin America in the 1950s and 1960s. Yet in many countries, malaria resurged (**FIGURE 4**). Although specific causes varied by country, in most cases resurgence was preceded by reductions in household coverage with the DDT spray campaigns that had so effectively brought malaria under control.[42]

- In **Brazil**, DDT spraying was interrupted in 1983, when the country managed to import only 60% of the insecticide that it needed. House sprayings in the endemic Amazonia region fell from 3.7 million in 1980 to 1.8 million in 1984,[43] and malaria returned.
- In **Colombia**, increasing civil strife and the rise of illicit drug activities stifled the malaria program's ability to reach malarious areas,[44] and a fall in IRS coverage accompanied an increase in incidence.
- In **Costa Rica**, malaria had been reduced to a minor public health problem in the 1970s. But the growth of banana plantations in the 1980s led to a mass movement of workers at the same time that household spraying was reduced to its lowest levels since the beginning of the campaign.[45] A sharp resurgence occurred in the 1990s.
- By the 1970s, the **Dominican Republic**'s surveillance and prevention activities were insufficient to manage a large increase in sugarcane workers from Haiti, and a surge in malaria began in 1977.[46]

Resurgence in Southeast Asia

In Asia, as in the Americas, "eradication" programs were extremely successful in reducing malaria to minor public health importance by the 1960s. In many cases, complacency then set in; previously strong programs were weakened since malaria had now lost its importance. As parts of the region became engulfed in political strife and war, these anti-malaria programs, which were already neglected, foundered and malaria resurged.

- In **India**, annual malaria incidence is alleged to have been 75 million cases in 1947 (over 200 cases per 1,000).[47] By 1961, the National Malaria Control Programme had suc-

ceeded in reducing malaria to only 50,000 cases.[48] In 1963, complacency set in: with malaria no longer a pressing problem, the Malaria Institute was collapsed into the more general National Institute of Communicable Diseases, and the *Indian Journal of Malariology* ceased publication.[49] In 1965, aid from the United States Agency for International Development (USAID) ended. India switched to purchasing most of the DDT that it needed under a long-term loan agreement, while intending to meet 30% of its needs through domestic production. Unfortunately, financial constraints limited actual importation and local manufacture never reached expected levels, leading to DDT shortfalls of 13–34% between 1965 and 1972 (**FIGURE 5**).[49] Resurgent malaria peaked at about 6.5 million reported cases in 1976.

- Malaria in the islands of Java and Bali in **Indonesia** declined from a prevalence of 24% in 1953 to less than 1% in 1958, when the "eradication" campaign began.[50] However, resurgence of varying magnitude has occurred twice since then. In 1965, eradication activities were halted following a period of political turmoil and malaria resurged. Malaria was suppressed again during the 1980s. But in the late 1990s there was severe economic and social strife, leading to a cut in health budgets (e.g., in the Purworejo district of Central Java, the total public health budget was cut from $150,000 in 1997 to just $20,000 in 1999[46]). Budget cuts were followed by a rise in malaria incidence.
- In 1967, for administrative, political, and financial reasons, **Pakistan** failed to continue full insecticide spraying, and surveillance activities were also weakened, after which malaria resurged.[51]
- **Sri Lanka**'s eradication program reduced malaria to only 17 cases in 1963, and, proud of its accomplishment, the country discontinued spraying. Resurgence was rapid—and prolonged by the fact that administrative and financial problems prevented the purchase of new insecticide.[51]

FIGURE 5. Malaria resurgence in Southeast Asia after deterioration or interruption of control activities

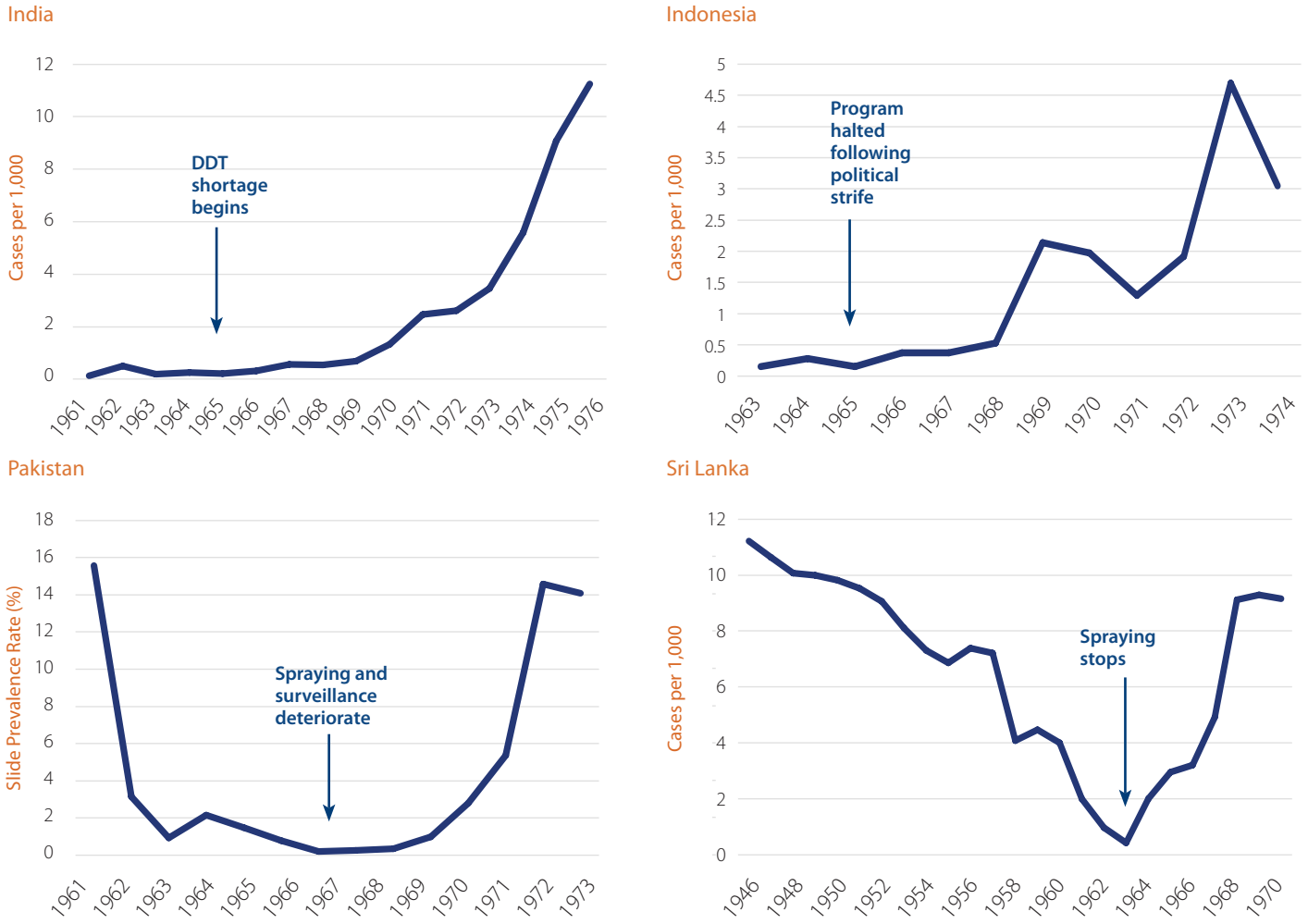
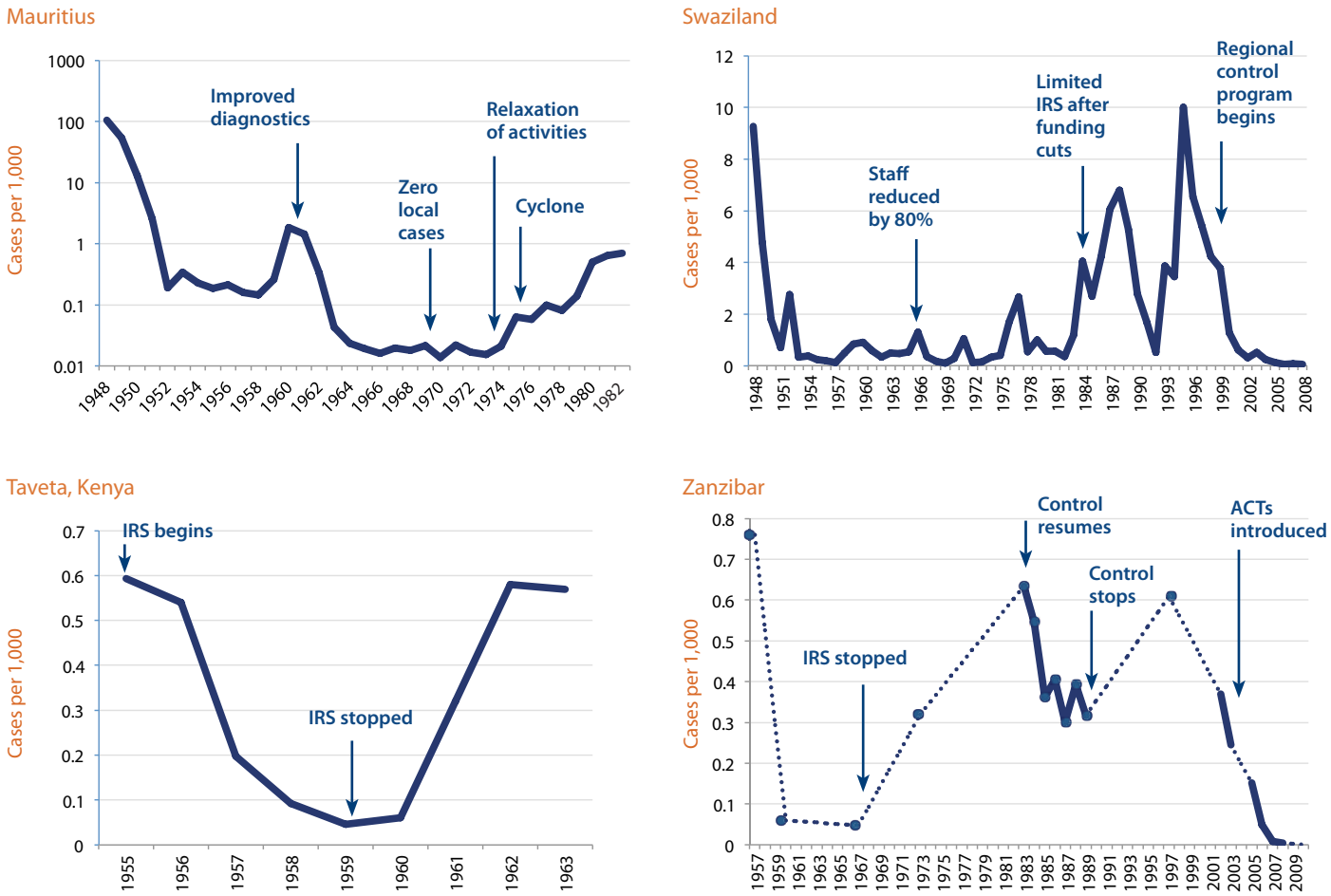


FIGURE 6. Malaria resurgence in Africa after deterioration or cessation of control activities



Resurgence in Africa

With a few exceptions, "eradication" programs were never attempted in Africa on the scale of the Americas or Asia. In some areas, pilot programs showed that malaria could indeed be suppressed even in areas of sub-Saharan Africa where the incidence was very high and a large proportion of the population was affected. But the cessation of these interventions led to rapid resurgence. Elsewhere, successful programs in countries like Mauritius, Swaziland, and Zanzibar were scaled back following the achievement of a low burden of disease, with predictable results.

- In **Mauritius**, successful certification of malaria elimination in 1973 led to increased complacency in the malaria program. The program was unable to deal with an increase in imported cases following a severe cyclone (**FIGURE 6**).
- In **Swaziland**, after achieving full IRS coverage in 1950, funding cuts led to weakening of malaria programmatic activities. The weakened program was unable to protect against resurgence as agricultural intensification led to an influx of workers from endemic areas to work at sugar plantations.[52]
- A spray campaign in the Pare-Taveta region on the **Kenya-Tanzania** border succeeded in reducing malaria, but the disease returned to its baseline level after spraying was stopped.[53]
- In **Zanzibar**, an elimination campaign began in 1955. However, the WHO team overseeing the campaign was expelled from the country in 1967 following a coup, and malaria prevalence rapidly returned to baseline levels. A subsequent USAID-funded program to control the disease resulted in modest successes that were immediately lost when the program ended in 1989.[41]

Learning from history

The gains of the past few years must be defended even as new ones are achieved.

In countries that have recently reduced the burden of malaria, the disease no longer seems like an urgent threat. Hospitals and clinics once filled with malaria cases can turn towards tackling other health issues. Policymakers may weigh their budgets against the few malaria cases remaining, consider the many other competing health needs, and choose to reallocate

malaria budgets to more obvious problems. But the historical examples of resurgence laid out in this chapter show that malaria resurgence is inevitable if control activities are halted in a place where intrinsic transmission potential remains.

Malaria programs face an "out of sight, out of mind" paradox: the more successful the program is, the less visible the disease becomes, and the greater the risk that its funding will be withdrawn. This paradox is not unique to malaria. Across public health, there is a paradox of success in which the more accomplished a program is in reducing the burden of disease, the harder it becomes to convince policymakers and the general population that the program needs to be continued:

- **Vaccine-preventable diseases** such as measles, rubella, pertussis, and diptheria are making a comeback in regions of the world such as the United States where high vaccination coverage had previously made them extremely rare. Increasing numbers of parents no longer perceive that these diseases are a threat to their children, and they choose not to have them vaccinated. Several large outbreaks have occurred as a result.[54]
- Control programs against **yaws**, a tropical skin infection, were remarkably successful in reducing the disease globally, beginning in 1952. With the skin lesions no longer widely visible, many of these programs were abandoned, only to see the disease resurge.[55]
- The mosquito *Aedes aegypti*, the vector for **dengue** and **yellow fever**, was eliminated in most Central and South American countries during the 1950s and 1960s. In the 1970s, the campaign was considered a success and resources were redirected to other diseases that still had a high burden, such as cancers. Since then, *A. aegypti* has returned to nearly everywhere it was eliminated, bringing back dengue and yellow fever throughout the Americas.[56]
- Mali was one of the first countries in sub-Saharan Africa to launch a national control program against the parasitic disease **schistosomiasis** ("snail fever"). Its national program started in 1982, with funding from the German development agency, GTZ. The program was very successful in reducing the prevalence of infection, and GTZ ended its support in 1992.[57] But the Malian government had insufficient domestic resources to continue the program, and a decade later, national prevalence of the disease had rebounded to pre-intervention levels.[57]

Conclusion

As today's malaria programs successfully reduce the burden of malaria, it is essential that they learn the lessons of the past. If malaria programs do their job right, malaria will be suppressed and the disease will become "out of sight," but we must not let it become "out of mind."

Over many decades, socio-economic development and health system strengthening may reduce the intrinsic potential of a region for malaria transmission. In this case, continued control interventions may no longer be necessary to maintain a low burden of malaria. However, until careful analysis shows that the potential for malaria no longer exists, malaria interventions will continue to be needed in order to avert malaria cases and deaths.

Malaria programs must therefore find ways to secure sustained, predictable financing in order to ensure prolonged, high coverage of control tools such as ITNs and IRS. As we show in Chapter 3, to achieve such financing, countries need to engage in a process of long-term, strategic financial planning.

CHAPTER 3: FINANCING SUSTAINED CONTROL

How countries can achieve long-term sustainable financing

KEY POINTS

- **Donor funding for malaria seems to have reached a plateau, which means that countries that have reduced malaria face a real risk that their funding will be cut**
- **These successful countries need to plan in advance how best to adapt to this changing financing environment—they will need to raise additional revenues for malaria control and use existing funds more efficiently**
- **Senegal, Rwanda, Ethiopia, and Tanzania/Zanzibar have developed financial sustainability plans (FSPs) for malaria, setting out new mechanisms by which their malaria control programs could be financed over the next ten years**
- **New sources of domestic financing include tourist taxes, community health insurance schemes, and health trust funds**
- **Cash on Delivery (COD) aid could be an innovative approach to addressing both the needs of the malaria program for sustainable, predictable donor financing and the desire of donors to see clear results**

Given the risk of resurgence described in the previous chapter, countries that have reduced their malaria burden, or are seeing the burden fall as they scale up control tools, need to plan in advance how best to sustain their malaria control programs. But they must do so in a very challenging economic climate.

A number of donors, including PMI and the United Kingdom Department for International Development (DFID), have expressed a strong commitment to continue funding malaria control. DFID's recent malaria strategy, for example, commits the agency to "sustain and expand gains into the future."[58] But other donors are clearly facing difficulties in maintaining their current levels of malaria funding. The Global Fund has announced that only $0.8 billion will be available for Round 11 proposals, rather than the initial projection of $1.6 billion, and these limited resources may not be available until the fourth quarter of 2013.[59] Efforts to fill the malaria funding gap are underway—but even if the gap can be filled, most donors are likely to continue focusing their DAH for malaria upon high-burden countries, rather than those that have reduced their malaria burden.

Even before the recent global economic downturn, when donor funding for malaria was on the rise, the total funding for malaria control still fell *very* far short of the amount required, as estimated by the GMAP.[2,3] Given the current economic downturn, donor countries—even those such as the UK that are committed to malaria control—are facing public pressure to cut their aid budgets. The Global Fund has already recognized this threat and is asking malaria-endemic countries to show that they are willing to contribute increased domestic resources towards the overall malaria financing needs, through its counterpart financing requirements.

In light of these stark realities, it is clear—particularly for countries that have successfully reduced their malaria burden—that endemic countries simply cannot rely on donor financing alone for malaria control. Local efforts and innovative approaches will be needed to maintain the gains.

In this chapter, we describe how successful countries can close the malaria financing gap and chart a path towards reliable, sustainable, and long-term malaria financing. There are two broad ways for countries to fill the gap between needs and resources. The first is to reduce the needs of the malaria program through more efficient use of existing funds and more targeted programming. The second is to raise additional revenues for the program (**FIGURE 7**).

FIGURE 7. Two approaches to filling the malaria financing gap

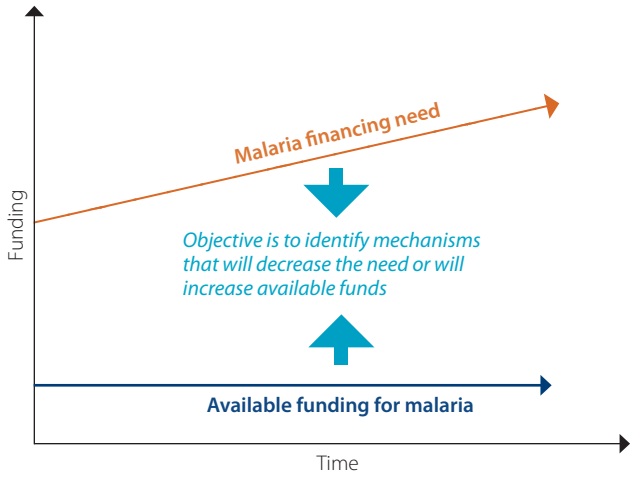
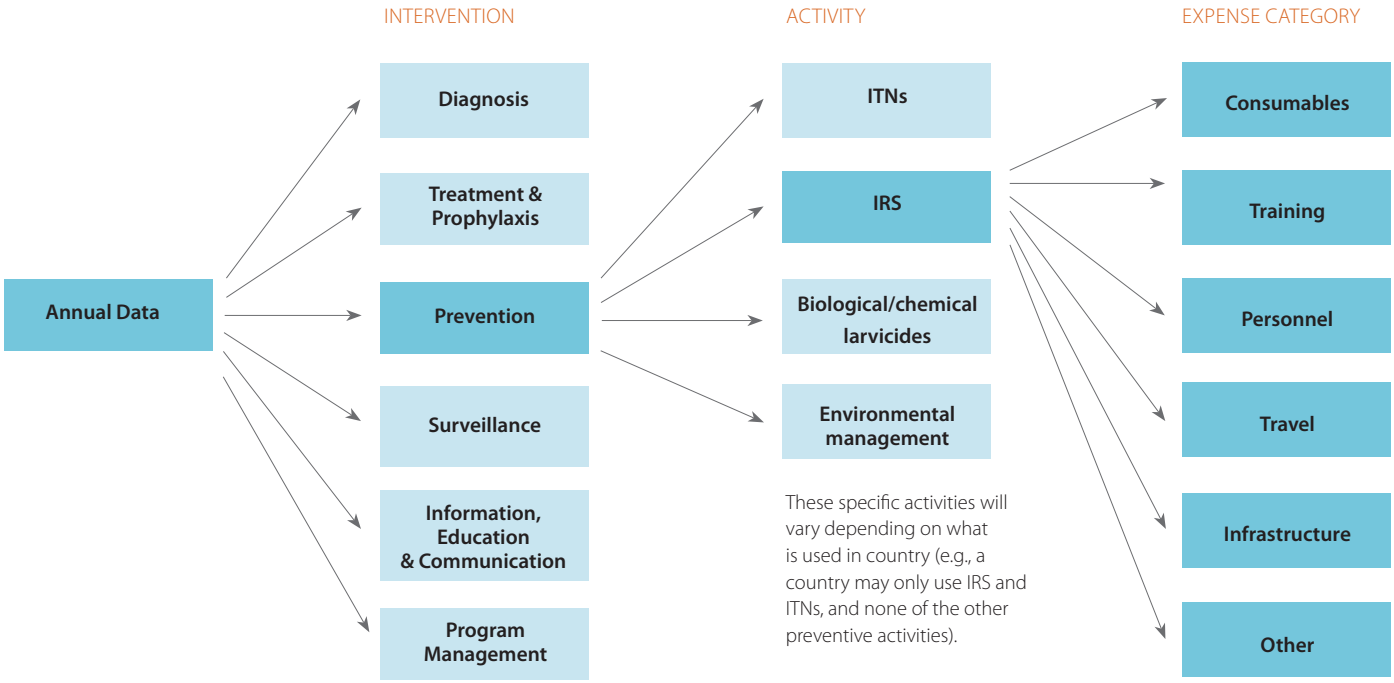


FIGURE 8. Assessing past malaria expenditures in order to estimate future needs



Each intervention has its own set of activities, and each activity has its own set of expense categories. The figure gives the example of prevention, with four preventive activities, and it shows expense categories for one of these activities (IRS).

Developing national financial sustainability plans

Rather than waiting until the funding situation is dire—with national malaria control programs facing financial shortages that result in resurgence—we encourage countries to have plans that ensure sustainable malaria financing.

Over the course of 2010–2011, the governments of four focus countries (Senegal, Rwanda, Ethiopia, and Tanzania/Zanzibar) started to develop FSPs for malaria that explore novel solutions to sustainably finance malaria control. These FSPs set out new mechanisms by which the malaria control program could be financed over the next ten years, mostly through raising additional revenues and proposing mechanisms to improve the quality and predictability of those resources. Initial work has also begun on scoping potential areas of efficiency in malaria programming.

Designing an FSP begins with identifying the needs: what does it cost to maintain the gains? The traditional ways to estimate future costs are to look at current malaria budgets and extrapolate based on the budgeted amounts or to create needs-based forecasts, but these methods have tended to over-estimate the actual requirements. Therefore, in collaboration with National Malaria Control Programs (NMCPs), we examined actual malaria spending in these countries (not budgets). Given that this level of annual spending has already achieved a reduced malaria burden, we assumed that a continuation of this spending would be the minimum amount needed to maintain the gains. Our projections therefore do not address more ambitious goals that some countries may have, such as moving towards malaria elimination (which would initially cost more than maintaining the gains). A comprehensive expenditure analysis was conducted to assess actual malaria expenditures over the past three to five years.

NMCPs in the four focus countries gathered expenditure data from the government and active partners in the malaria program (bilateral aid agencies, non-governmental organizations, development banks, and multilateral institutions). This costing effort was focused specifically on the malaria program. Thus the costing excluded health sector expenditures that supported the health system more generally, such as facility costs and health worker salaries (these systems costs would continue regardless of the malaria burden). As part of this data collection phase, cost data were tagged by intervention, activity, and, where possible, expense category (**FIGURE 8**). Finally, the data were reviewed by in-country partners and vetted to ensure that the analysis was representative and that there was no double counting. **TABLE 1** summarizes our estimates of the annual cost to four focus countries of maintaining the gains.

With existing donors such as the Global Fund facing acute financing crunches, it is unlikely that the full amount of funding needed by our focus countries shown in **TABLE 1** will be met by external donors in the coming years. Our costing analysis

FIGURE 9. Sources of funding for Zanzibar's malaria control program (RGoZ: Revolutionary Government of Zanzibar)

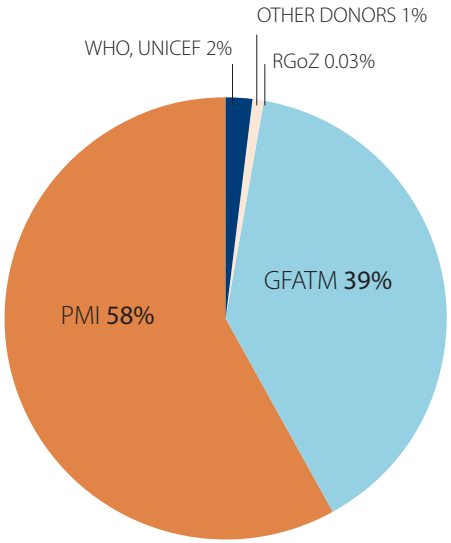
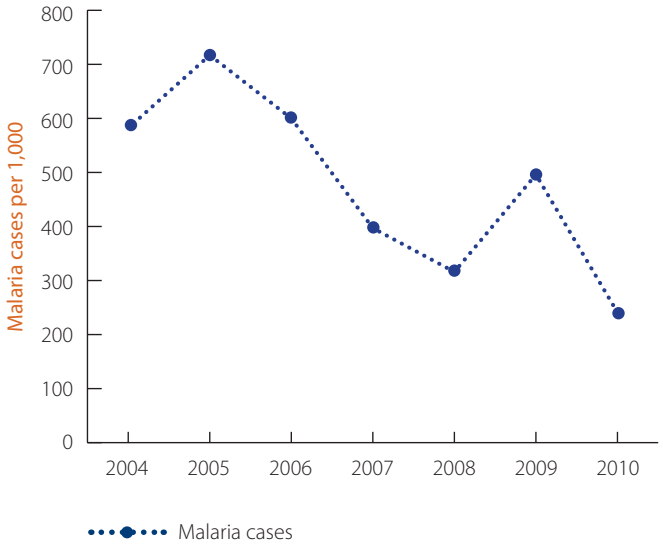


FIGURE 10. Consequences of a delayed procurement of LLINs in Rwanda in 2009



The figure shows the adjusted malaria incidence based on out-patient diagnoses (adjusted for under-reporting and treatment-seeking behavior). Details of the adjustment method are given in Chapter 4.

TABLE 1. Estimates of the annual cost to four focus countries of maintaining the gains

Focus country	Estimated annual cost of maintaining the gains
Ethiopia	$143 million
Rwanda	$53 million
Senegal	$53.5 million
Mainland Tanzania	$85–90 million
Zanzibar	$3.9 million

revealed that current malaria funding is highly dependent on just a few donors (with very little domestic contribution), it is volatile, and it targets too little money at malaria diagnosis compared with the suggested amount projected by the GMAP. We discuss each of these vulnerabilities in more detail below:

- **Malaria control programs lack diversity.** Most countries are dependent on just two key donors, the Global Fund and PMI. For example, 97% of Zanzibar's malaria funding comes from these two donors (**FIGURE 9**), as does over 90% of Rwanda's malaria financing.
- **Several countries suffer volatility in funding.** Such volatility can have serious public health consequences. Delays in disbursement, for example, have had significant programmatic impact. In Rwanda, a delay in procurement of LLINs from both the Global Fund (which procures 85% of LLINs in Rwanda) and PMI caused malaria cases to increase due to prolonged nationwide LLIN stock-outs (**FIGURE 10**).[2,28,60] Malaria declines were again achieved after new LLIN distribution.
- **Many countries have large treatment costs and are underspending on diagnosis.** As a proportion of all expenditures, many countries spend more on treatment and less on diagnosis than the suggested proportions projected by the GMAP.[3,61] In Ethiopia and Tanzania in particular, spending on diagnosis was much smaller than it should be (**FIGURE 11**), indicating the need to scale-up RDTs, which would also significantly reduce treatment costs.
- **In most countries, there is very little government spending on malaria.** For example, domestic contribution to malaria financing is just 1% in Zanzibar and 1.56% in Senegal. **FIGURE 12** shows the minimal contribution made by most governments.

How countries can overcome financing vulnerabilities

The malaria FSP proposed by each country's NMCP, with input from the Ministry of Finance and relevant in-country malaria stakeholders, focuses on domestic financing solutions. It delineates the next steps, roles, and responsibilities—as well as a clear timeline—to enable each solution to be implemented.

In developing these FSPs, it became clear that countries needed to increase their domestic contribution both to achieve the funding levels that would support sustained control (**TABLE 1**) and also to diversify their funding base. Countries proposed several new ideas to raise additional domestic revenues:

- A **tourist tax** devoted to malaria is expected to finance 10–20% of the annual operating costs of Zanzibar's malaria control program. Given the rise in tourism, and the rela-

FIGURE 11. Proportion of total malaria expenditures spent over 2008–2010 on diagnostics/treatment compared with suggested proportions projected by GMAP

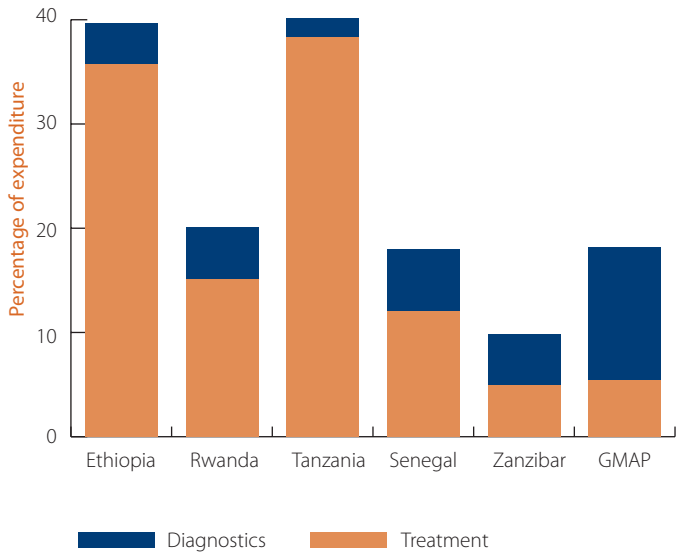
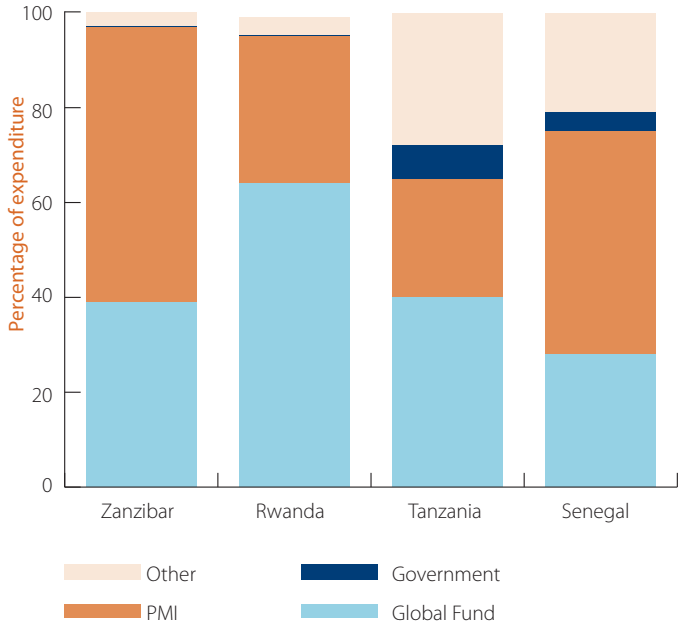


FIGURE 12. Sources of funding for malaria control programs in four focus countries



tively low price sensitivity of tourist travelers, a marginal tax charged on all international arrivals could be a predictable, sustainable source of income. Such a tax is justifiable, given that tourists themselves reap the benefits of reduced malaria risk.

- **Community health insurance schemes** 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 will be directed towards preventive malaria control efforts at district level. Keeping malaria under control can save money both for insurance schemes as well as households.
- **Prize-linked savings** is a savings scheme that differs from a standard savings account in that depositors periodically receive a chance to win a lottery-like prize—its size is a function of the total deposited amounts. The scheme could be established by the government and managed by a non-governmental financial institution. The interest generated on these savings would be used to cover both the payout for depositors and about 2% of annual malaria program costs.
- **Modifications to national tax codes** may incentivize private donations to support the malaria program.

New ways of managing funds are needed to overcome the problem of volatility in malaria financing. Countries proposed a number of solutions **to reduce such volatility:**

- An **endowment fund**, initially funded by the government and donors, could be established to generate interest income that will be directed at malaria control. Due to the unpredictable nature of investment returns year-to-year, the endowment would allow emergency withdrawal of funds (e.g., to cover a sudden, unexpected drop in aid). 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 potential approach could be a combined investment portfolio of stocks and bonds. The trust fund could cover an estimated 20–25% of annual malaria costs.
- In Senegal, a **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 the state, 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, Senegal's national malaria control program would be able to access the Fund in response to urgent short-term gaps that arise.

Finally, during the process of developing malaria FSPs, a number of ideas were proposed for how best to **increase the sustainability and predictability of external financing**. Even if countries increase their domestic contribution to malaria

BOX 6. Potential benefits of COD aid for malaria

COD aid for malaria could be an innovative approach to addressing both the needs of the malaria program for sustainable, predictable donor financing and the desire of donors to see clear results.

- **Visibility:** The greatest threat to sustained malaria control is the "out of sight, out of mind" phenomenon described in Chapter 2. In a "successful" country, malaria is largely invisible, so the government and donors are tempted to move resources away from malaria control to other diseases perceived to be of higher importance. COD aid addresses this challenge: since it bases payments on averting the "invisible" deaths and cases, it ensures that maintaining control interventions remains a priority locally and internationally.
- **Low risk:** The payment is only made if the results are achieved, i.e., funding is always associated with a health impact (there is little risk of wasted funds). The targeted countries have already shown that they can effectively use donor resources to deliver essential interventions, so there is a low risk of failure or inefficient use of resources.
- **Low transaction costs:** Instead of proposal writing, technical review panels, proposal clarification, and disbursement delays, COD aid is based on ***one outcome*** (e.g., malaria prevalence) and ***a single survey*** (or other method) to measure that outcome.
- **Country ownership and innovation:** COD aid does not require the recipient country to spend the funding on any specific input. The government and its local partners are free to shape the funding to any local approach that will sustain the targeted level of malaria, strengthening their ownership of program strategies. Countries are free to try innovative approaches and use flexibility in responding to local needs in ways that are often not possible with traditional funding.
- **Sustainable and predictable finance:** Donor funding is currently often unpredictable, with significant variations between years and delays in the timing of funding. This volatility is particularly difficult for a sustained malaria control program, which needs to maintain steady coverage for years to prevent resurgence. COD aid could be implemented as a multi-year agreement with predictable annual payout targets.

financing, they will still need donor support. For example, estimates suggest that Mainland Tanzania can eventually cover 20% of its malaria financing needs from new domestic sources, while Ethiopia could cover 30%; the rest will need to be covered by external funds.

The most promising of the ideas to improve external financing flows is **Cash on Delivery (COD) aid** (also called "pay for performance"), an idea originally developed by the Center for Global Development,[62] which could potentially increase the funds available for malaria control and also incentivize efficiencies in malaria programming. COD aid typically involves linking donor payments directly to the achievement of a specific outcome—for example, a donor payment is given for every extra child vaccinated or educated. For malaria control, we propose payment on the *avoidance of a result*—i.e., a country is paid if it *avoids resurgence*. Each year that the recipient country maintains its malaria prevalence below a specified level (e.g., below 1%), it would receive a reward payment of untied cash that could be spent at the discretion of the country. In contrast, if the prevalence rises above that specified level, payments are reduced. Such COD aid would have five major benefits (**BOX 6**).

Reducing financing needs by finding efficiencies

Addressing financial sustainability for malaria control will also require reducing resource needs by finding programmatic efficiencies. A new scoping study, called *Value for Money in Malaria Programming*, examined these potential efficiencies.[63] Although the study did not identify any dramatic opportunities for savings—aside from potential savings through more efficient ITN procurement—it did identify the potential for more effective targeting of interventions, especially in low prevalence settings with more heterogeneous distribution of malaria.

The focus countries in this report face a challenge. When driving down prevalence, malaria is becoming more heterogeneously distributed over both space and time, and yet the transmission risk often remains high even in those areas where malaria prevalence has been suppressed to low levels. In theory at least, targeting prevention tools (ITNs, IRS) to malaria hot spots could be a cost-effective way to carry out malaria control in these settings. However, a shift to targeting hotspots can only be done in the presence of a robust surveillance and response system that both provides information on where the

hotspots are and identifies and treats cases before they can cause onward transmission. Further research will help to define the most cost-effective mix of interventions between surveillance and targeted prevention (ITNs and IRS). Research will also be needed to find out whether prevention can be scaled back at all in areas of high transmission before the area and its larger surroundings are actually malaria-free.

Conclusion

Countries that have successfully reduced their malaria burden should develop plans for financial sustainability that are enacted over the coming decade. These countries need strong buy-in from all levels of government to increase their domestic contributions to malaria programs and to achieve more efficient spending. However, even with increased domestic spending, donors will need to continue to provide external financing.

Sustained financing for malaria control in successful countries is an excellent investment for both donors and endemic countries: in the next two chapters, we show how such financing would reap huge public health and economic benefits year after year.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CHAPTER 4: THE PUBLIC HEALTH IMPACT OF SUSTAINED CONTROL

How sustained control could avert millions of malaria cases and deaths

KEY POINTS

- **After a country reduces its malaria burden, if it can sustain its control program it will continue to avert malaria cases and deaths every year**
- **Investments in sustaining control measures over the long-term could have a huge public health payoff**
- **If four of our focus countries—Ethiopia, Rwanda, Zambia, and Zanzibar—can secure sufficient financing to sustain their control programs over the next five years (2011–2015), we estimate that they could avert about 151 million cases of malaria**
- **If two of our focus countries—Zambia and Zanzibar—can sustain their control programs from 2011 to 2015, they could avert an estimated 162,000 deaths**
- **Donors should consider this huge number of averted cases and deaths resulting from maintaining existing control programs when making their funding allocations**

Countries such as Ethiopia, Zambia, and Zanzibar, which have recently reduced their malaria burden, will continue to reap public health benefits from *sustaining* their control programs. Every year that they maintain their programs, they are averting cases and deaths that would be occurring in the absence of control. Donors should consider this large number of *averted* cases and deaths from sustaining control programs when making their funding allocations.

In this chapter, we examine the public health benefits of continued investment in malaria control programs in several of our focus countries. We specifically address the question: if these successful countries can find the financial resources to sustain their programs over the next five years (2011 to 2015), how many malaria cases and deaths could they avert?

Our analysis shows that in every focus country that we were able to study, sustaining control measures for the next five years could avert **millions of cases and thousands of deaths**. For example, if Zambia can sustain its control program from 2011–2015, it could avert about 62 million cases and save about 150,000 lives. In other words, investments in sustaining control measures over the long-term could have a huge public health payoff.

Modeling the health impact of sustaining control measures

In order to model the public health impact of sustaining control measures in successful countries, we examined the impact on two outcomes, the incidence of clinical malaria and of malaria-associated mortality, by analyzing the association between expenditures on malaria control (prevention, diagnosis, and treatment) and time series of these outcomes.

Our modeling involved five steps (**FIGURE 13**), briefly summarized below. Detailed methods and assumptions are in Annex A (online at www.MaintainTheGains.org).

FIGURE 13. Approach to estimating cases and deaths averted from sustained malaria control

Estimating the true malaria burden

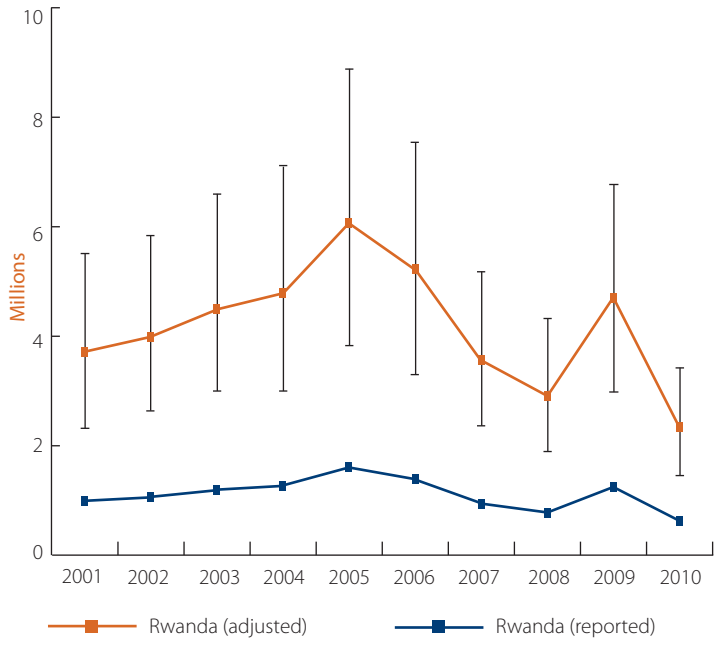
National malaria programs record the annual number of suspected and confirmed malaria cases and deaths. The data are reported both as cases and deaths in the whole population and as cases and deaths in children under 5 years.

These reported data are useful for discerning overall trends in incidence and mortality over time, but the cases and deaths are generally underreported for several reasons:

- not all individuals who develop clinical malaria will seek treatment in a health facility that reports data to the central authority (some may seek treatment in non-reporting facilities, others may self-treat, while many will seek no treatment at all);
- of those individuals who do seek treatment in a reporting facility, not all will be diagnosed appropriately; and
- data reported by facilities to the central authority may be incomplete or inaccurate.

In order to understand a country's *true* malaria burden, and thus analyze the costs and benefits of sustained malaria control, we therefore adjusted the reported health system data on cases and deaths to account for under-reporting and treatment-seeking behavior. The data were collected directly from the national malaria program in-country or taken from reports to the WHO, which publishes these data in the annual *World Malaria Report*.[2] Annex A explains how we made the adjustments. The adjustments allowed us to estimate actual cases and deaths occurring throughout the entire country, while preserving the valuable information about malaria trends over time in the annually reported data (**FIGURE 14**).

FIGURE 14. Reported and adjusted malaria clinical incidence data in Rwanda



Forecasting cases and deaths averted by malaria control

We used the adjusted data on cases and deaths to forecast the expected annual cases and deaths from 2011 to 2015 under two scenarios:

Sustained control scenario: In the first forecast, we projected future cases and deaths up to 2015, assuming that the trend in the number of cases and deaths since the country scaled up control tools continues.

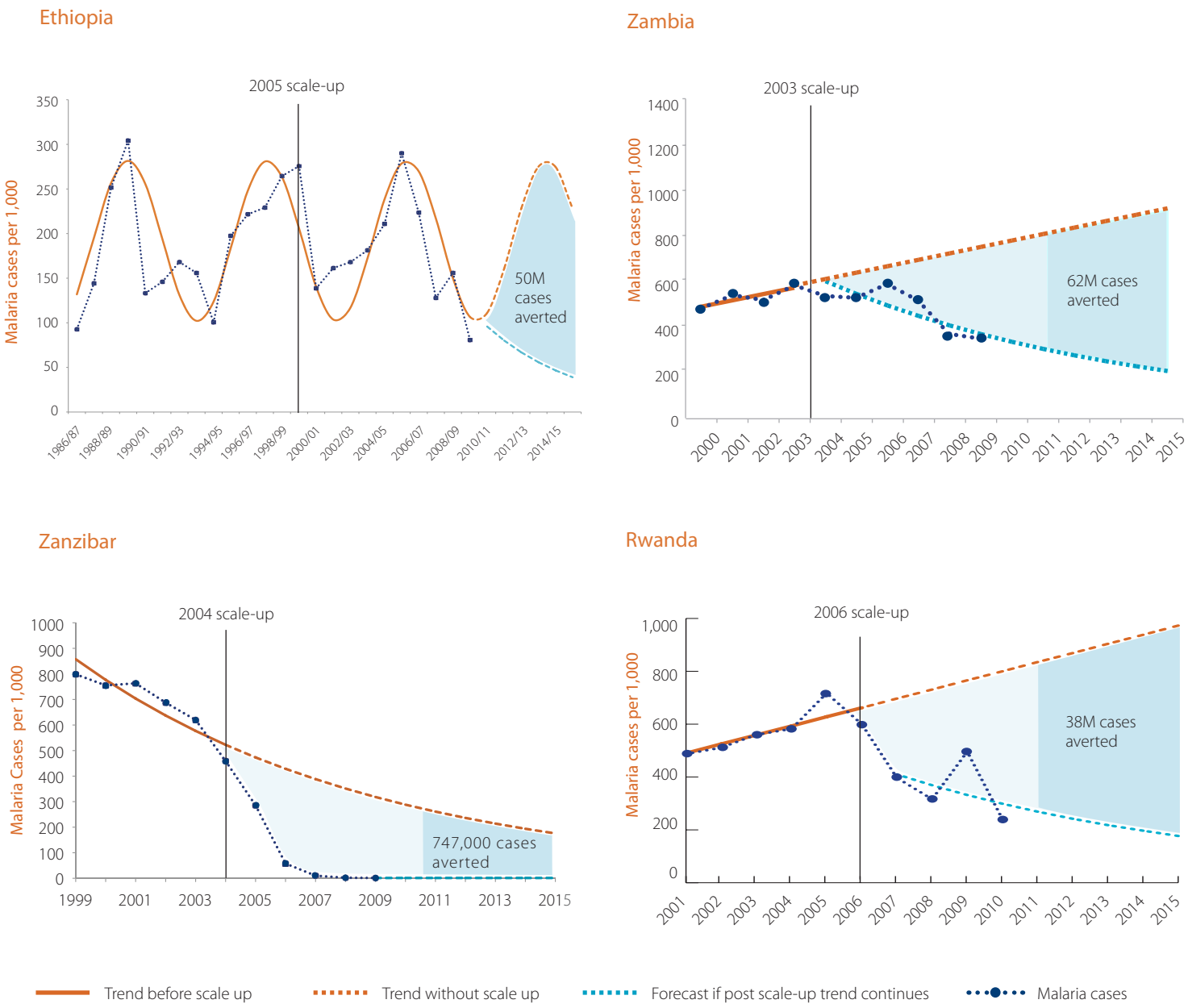
No control scenario: In the second forecast, we projected what would most likely have occurred had the scale-up never taken place (i.e., a "counterfactual" to the malaria control that was actually implemented). This projection assumed that the trends in cases and deaths seen *before* scale up would continue through 2015. For example, if malaria cases were rising before scale up, we expected them to continue following that rising trend under the "counterfactual" scenario.

The difference between the expected cases and deaths each year under the two scenarios represents the cases and deaths averted by sustaining control measures. By accounting for trends occurring in reported cases before scale up, this method at least partially accounts for other factors—such as socioeconomic change, urbanization, or health system strengthening—that might be changing in the background and that might otherwise confound observed declines in malaria.

Comparing our results against those derived from other methods

In the final step, we compared our estimates of averted cases and deaths with those derived from other methods, such as the Lives Saved Tool,[64] a model that allows researchers to evaluate the impact of scaling up evidence-based interventions on child mortality. The results of these comparisons are shown in Annex A. We also varied assumptions around factors such as the under-reporting of the true burden of malaria to get a realistic range of estimates.

FIGURE 15. Public health impact of malaria control: cases averted



Countries could reap massive public health benefits

Our modeling shows that sustained malaria control could avert millions of malaria cases and thousands of deaths.

FIGURES 15 AND 16 summarize the results of our analysis (the illustration for Ethiopia is cyclical rather than linear, due to the epidemic nature of malaria in Ethiopia). In each figure, the top line (orange dashed line, called "trend without scale up") represents the counterfactual scenario in which no control was implemented, and the bottom line (light blue dashed line, called "forecast if post scale-up trend continues") represents the scenario in which control measures are sustained over time. The shaded space represents cases averted (**FIGURE 15**) or deaths averted (**FIGURE 16**) by sustained malaria control activities. The figures show the dramatic public health impacts of sustained malaria control.

If four of our focus countries—Ethiopia, Rwanda, Zambia, and Zanzibar—can secure sufficient financing to sustain their control programs from 2011 to 2015, about 151 million cases of malaria could be averted (**TABLE 2**). In two of our focus countries, Mainland Tanzania and Senegal, scale-up of control tools has been very recent, and so we had insufficient data to conduct an analysis of cases averted at national level.

FIGURE 16. Public health impact of malaria control: deaths averted

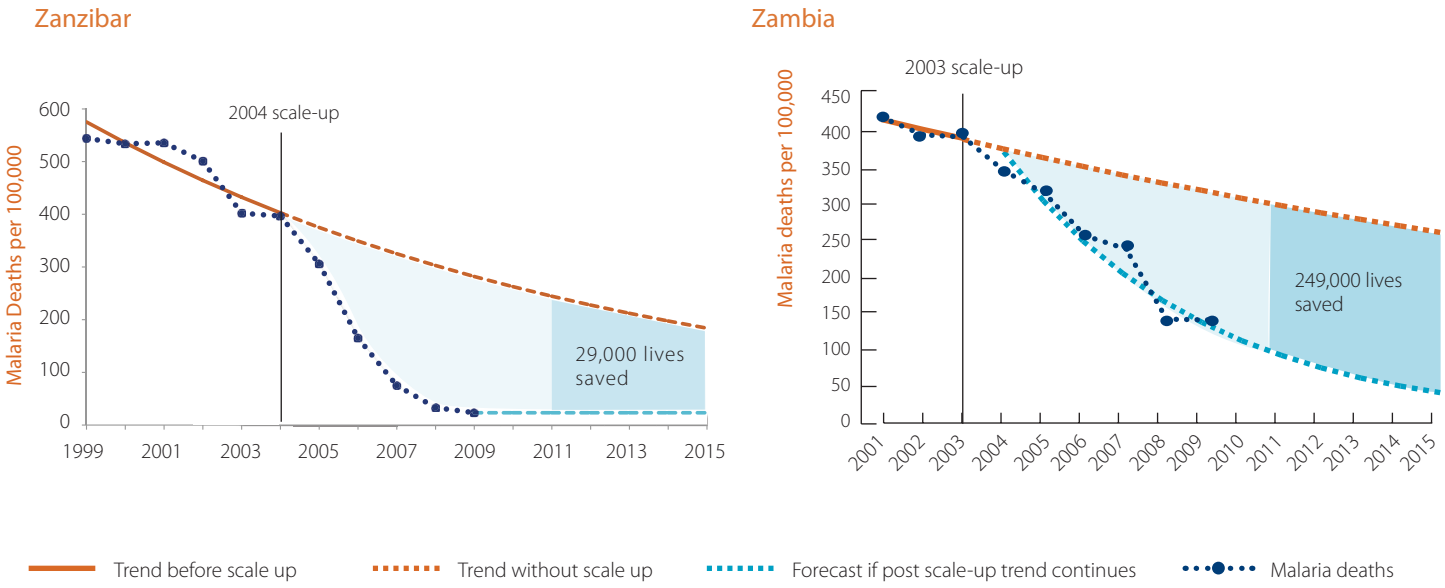


TABLE 2. Cases averted in four focus countries by maintaining malaria control from 2011–2015

	Cases averted
Zambia	62,000,000
Zanzibar	747,000
Ethiopia	50,000,000
Rwanda	38,000,000
TOTAL	**151,000,000**

TABLE 3. Deaths averted in two focus countries by maintaining malaria control from 2011–2015

	Deaths averted
Zambia	149,000
Zanzibar	13,000
TOTAL	**162,000**

In two of our focus countries, Zambia and Zanzibar, we had enough data to estimate the number of deaths averted by sustaining control. If these two countries can sustain their control programs from 2011 to 2015, they could avert about 162,000 deaths (**TABLE 3**).

Conclusion

Countries that have brought the malaria burden down to low levels will continue to reap impressive public health benefits from sustaining their malaria control programs year after year.

Our analyses have shown that in four countries alone, sustaining control activities could avert about 151 million cases of malaria from 2011-2015. In Chapter 5, we show that by averting cases, sustained control will bring large cost savings to the public health system, households, and industry. And in two countries alone, sustaining control could avert about 162,000 deaths. Given these massive public health benefits, maintaining high coverage levels of malaria control tools in successful controls should be a global public health imperative.


NAMNA YA KU
KUTUNZA CHANDARUA
Usingizi mnono bila malaria,
lala kwenye chandarua
chenye dawa kila siku
Net
rua Chenye dawa
muda mrefu
Miaka 5 na zaidi
A - Z
KIMETOLEWA KWENYE
ANDARUA BILA MALIPO KWA
YA MIAKA MITANO
The Global Fund

CHAPTER 5: THE ECONOMIC IMPACT OF SUSTAINED CONTROL

How sustained control could bring major economic benefits

KEY POINTS

- **By averting cases and deaths, continuing effective malaria control activities will bring economic benefits to many sectors of the country**
- **Sustained control will avert costs to the public health system of diagnosing and treating malaria**
- **It will also prevent direct and indirect household costs, as well as school and worker absenteeism**
- **Industry will also benefit, since fewer workers would be off sick, productivity is likely to be higher, and companies would spend less on treating malaria among their employees**
- **Sustaining control measures would be one of the "best buys" in global public health, similar in cost effectiveness to childhood vaccination programs**

In Chapter 4, we showed that if those countries that have reduced their malaria burden (or are seeing the burden fall as they scale up control) can sustain their control programs, they could reap enormous public health benefits. Averting malaria cases could in turn bring large economic benefits to several different sectors—such as the public health system, households, agriculture, and businesses.

TABLE 4. Averted malaria treatment costs in the public health system if countries can sustain malaria control from 2011-2015

Country	Estimated treatment costs averted (2011-2015)
Ethiopia	$39 million
Rwanda	$267 million
Zambia	$347 million
Zanzibar	$3.2 million
TOTAL	**$656.2 million**

In this chapter, we examine the likely economic benefits of sustaining malaria control programs in countries that have achieved, or will soon achieve, large reductions in their malaria burden. We include brief summaries of the methods that we used in our economic analyses; detailed methods are described in Annex B (online at www.MaintainTheGains.org).

BOX 7. Methods used to estimate costs averted to the public health system

To estimate these averted costs in four countries (**TABLE 4**), we compared the total costs of diagnosis and treatment under two scenarios: sustained malaria control from 2011 to 2015 versus a "counterfactual" of no control.

- Diagnostic costs: We began by estimating the annual number of malaria-like fevers.[68] We then obtained data, usually from the most recent national Demographic and Health Survey, on the proportion of all malaria-like fevers seeking treatment as out-patients in the public health sector. We assumed that everyone with fever diagnosed in the public health sector incurred a diagnostic cost. We multiplied the annual number of fevers seen in out-patients by the costs of diagnosis to estimate total annual diagnostic costs.
- Treatment costs: We estimated the annual number of malaria cases treated as out-patients based on the estimated true national malaria incidence (see Chapter 4 for how we estimated this incidence, adjusting for under-reporting and treatment-seeking behavior). We assumed that all those with confirmed malaria incurred a treatment cost. For ***out-patients***, we assumed that all patients with malaria received treatment at the first consultation and completed a full course of treatment with the first-line anti-malarial drug (usually an ACT). We multiplied the annual number of out-patient malaria cases by the treatment costs to estimate the annual out-patient treatment costs. For ***in-patients***, we used data on the proportion of patients in each country who were admitted to hospital and assumed that all admitted patients received a full course of treatment. We multiplied the average length of stay by the daily costs of in-patient treatment.
- Cost savings to the public health sector: We subtracted the total annual diagnostic and treatment costs under the sustained control scenario from the total costs under the no control scenario.

BOX 8. Methods used to estimate household costs averted

Direct treatment costs (out-of-pocket expenses): We obtained data on: (a) the proportion of patients with malaria seeking help in different sectors (e.g., public health sector, private clinics, pharmacies, etc.); and (b) the out-of-pocket treatment costs incurred in each sector. We multiplied the annual number of cases treated in these different settings by the cost of treatment in each setting to estimate the total direct household treatment costs per year.

Indirect costs (loss of income): We obtained data on the average indirect costs per malaria episode for all adults with malaria of productive age (the "economically active population") seeking any kind of care (e.g., out-patient or in-patient care in the public health sector, private clinics, pharmacies, etc). In each country, the official starting age of the economically active population varies (e.g., it is 14 years of age in Ethiopia, 10 years in Zambia). We multiplied the annual number of economically active cases treated in these different settings by the indirect cost per malaria episode in each setting to estimate the total indirect household costs per year.

TABLE 5. Selected studies on the total direct and indirect household costs of malaria[69-71]

Country	Study population	Household costs (as proportion of annual income)
Ethiopia	Households in the Tigray region	4–13%
Kenya	Rural agricultural households with small farms	9–18%
Malawi	National household survey	7.2%
Nigeria	Rural agricultural households with small farms	7–13%

Our estimates suggest that **the economic payoffs from sustained control could be enormous**. For example, if Rwanda can sustain its control program from 2011–2015, its public health system could avert about $267 million in the costs of diagnosing and treating malaria, while households could avert about $547 million in direct and indirect costs—equivalent to about 7% of household income, a huge saving for a typical household.

Economic benefits to the public health system

By averting malaria cases year after year, sustaining malaria control is likely to avert a large proportion of the costs to the public health system of treating malaria.

In heavily burdened countries, malaria accounts for up to 30–50% of hospital admissions and 60% of out-patient visits.[65] Ministries of health in high burden countries spend a large proportion of their budgets on malaria treatment. For example, in 1989, prior to Rwanda's aggressive scale-up of malaria control tools, its ministry of health spent an estimated 19% of its operating budget on treating malaria in public health facilities.[66] ALMA estimates that in sub-Saharan Africa, in the era prior to the recent scale-up of malaria control, up to 40% of healthcare spending in endemic countries was on malaria, costing the continent around $12 billion a year.[67]

Continuing control measures into the future is likely to reduce these costs by preventing malaria cases year after year. We estimated the likely impact of sustaining control measures on the costs of diagnosing and treating out-patient and in-patient cases of malaria in the public health sector (**BOX 7** briefly summarizes the methods). For four countries, we had sufficient data to model the averted treatment costs at a national level if the country is able to sustain its program over the next 5 years, from 2011–2015 (**TABLE 4**).

As **TABLE 4** shows, we found that sustained malaria control could have a very large impact in terms of reducing the costs to the public health system of diagnosing and treating malaria. We estimate that the total averted treatment costs in four countries—Ethiopia, Rwanda, Zambia, and Zanzibar—could be about $650 million.

Most of these cost savings represent opportunity costs—that is, they allow health sector resources (e.g., health workers' time, hospital beds) to be devoted to other diseases, as opposed to allowing actual additional monies to be placed into the ministry of health's coffers. Nevertheless, some of the resources could be invested into strengthening and expanding malaria prevention and surveillance activities to maintain a reduced malaria burden.

Economic benefits to households

By averting malaria cases year after year, sustaining malaria control is also likely to bring about very large cost savings to households.

Malaria is responsible for two types of household costs:

- **direct costs:** out-of-pocket expenditures on prevention and treatment
- **indirect costs:** loss of household income due to malaria morbidity.

In many malaria-endemic countries in sub-Saharan Africa, such as Ethiopia, most malaria treatment costs are paid for out-of-pocket rather than by the public health system. The evidence suggests that the combined direct and indirect costs of malaria to households are substantial (**TABLE 5**).[69–71] The burden falls most heavily on the poorest households. For example, a study in Malawi found that the average total annual household cost of malaria was $40.02, or 7.2% of annual household income; for very low income households, the total costs represented 32% of income.[71]

We modeled the likely impact of sustained control on these household costs (**BOX 8** briefly summarizes the methods). For four countries, we had sufficient data to estimate these averted household costs at a national level if the country is able to sustain its program over the next 5 years (**TABLE 6**). For two of these countries (Zambia and Zanzibar), we were only able to model the direct costs—we had insufficient data to model the indirect costs.

TABLE 6 shows that sustained malaria control could have a very large impact in terms of reducing household costs. We estimate that the total averted household costs in four countries—Ethiopia, Rwanda, Zambia, and Zanzibar—could be almost $1 billion (the household savings would be even greater if the averted indirect costs in Zambia and Zanzibar were also included). These averted direct and indirect costs are equivalent to about 7–8% of household income, representing very large savings for a typical household.

BOX 9. Methods used to estimate averted costs to coffee workers in Ethiopia

We conducted a household-level analysis using the members of the Oromia Farmers Cooperative Union (OFCU) as our study population. We projected the growth of this population from 2011 to 2015, based on Ethiopia's population growth rate. We used the adjusted malaria incidence rates in Ethiopia (see Chapter 4) to model the likely number of malaria cases among OFCU members under two scenarios, sustained malaria control up until 2015 versus a "counterfactual" of no control. Using the methods shown in Box 8, we estimated the total direct and indirect costs to these farmers of treating malaria under the two scenarios. The total cost for the years 2011-2015 in the counterfactual scenario was $2,874,208, and the total cost in the control scenario was $940,435, indicating a 67% reduction in costs.

TABLE 6. Averted household costs if countries can sustain malaria control from 2011-2015

Country	Estimated Direct Treatment Costs Averted (2011-2015)	Estimated Indirect Costs Averted (2011-2015)	Total Estimated Household Costs (Direct And Indirect) Averted (2011-2015)
Ethiopia	$76 million	$351 million	$427 million, equivalent to about 8% of household income
Rwanda	$37 million	$510 million	$547 million, equivalent to about 7% of household income
Zambia	$5.1 million	Unable to model these costs, due to insufficient data	$5.1 million (direct costs only)
Zanzibar	$0.1 million	Unable to model these costs, due to insufficient data	$0.1 million (direct costs only

BOX 10. Malaria is bad for business

- The CEO of Daimler-Chrysler explained in 2001 that the company rejected a plan to establish an automobile assembly plant in Zimbabwe because of the anticipated costs of malaria.[78]
- Prior to instituting malaria control interventions, the Mozal Aluminum Smelter in Mozambique reported very high rates of malaria among its workers: 7,000 cases of malaria and 13 malaria-related deaths of expatriate employees over two years. Malaria was responsible for the loss of 1% of the total person-hours of work. The firm lost an estimated $1.6 million due to malaria.[78]
- In Ghana, before the launch of its malaria control program, the gold mining company AngloGold Ashanti spent about $2.2 million a year in malaria treatment costs for its employees and their dependents.[76]

Economic benefits to the agricultural sector

Sustaining malaria control is likely to bring economic benefits to agricultural workers.

There has been very little research on the link between malaria and agricultural productivity.[72] One study in Côte d'Ivoire found that farmers who reported malaria-like symptoms for two or more days per month produced about half the yields and received half the incomes of those who reported symptoms for one or no days.[73] Another study, also in Côte d'Ivoire, found that malaria reduces the labor efficiency of cotton producers and consequently their income.[74]

By averting malaria cases in agricultural workers, sustained malaria control programs are likely to be economically beneficial to these workers. To estimate the impact of sustaining control measures on agricultural workers, we applied a household-level analysis to coffee workers in Ethiopia (i.e., we examined the impact of sustained control on their household costs). The methods are summarized in **BOX 9**.

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.[75] These small scale farmers are highly dependent on coffee production and face an array of risks to their livelihood, including malaria, which prevents the farmers or their family members from working in the fields.

Our estimates suggest that over the next five years, sustained malaria control could reduce the direct and indirect household costs of malaria to these farmers by about 67%.

Economic benefits to industry

Sustaining malaria control is likely to bring economic benefits to companies.

Malaria has a negative economic impact upon industry through at least three mechanisms.[76] First, the disease causes worker absenteeism: the WHO estimates that, on average, a malaria episode costs the equivalent of 10 days of lost labor.[65] Second, on returning to work after a malaria episode, workers report that they feel exhausted and less productive.[77] Third, malaria increases the health care costs of major companies, many of which provide health care services to their employees.[76] A 2006 survey found that about three quarters of companies in sub-Saharan Africa reported that malaria negatively affects their business (**BOX 10**).[73]

By averting malaria cases among its workers, sustained malaria control programs are likely to be economically beneficial to companies. For one country, Zambia, we modeled the impact of a sustained control program lasting from 2011–2015 upon the country's copper industry (**BOX 11**).[79] We estimated the averted costs to the industry and also conducted a cost-benefit analysis.

BOX 11: Methods used to estimate averted costs to the copper industry in Zambia

We began by modeling the impact of sustained control on a single copper mine, Konkola, which has invested in a malaria control program. We obtained published data on the company's annual malaria investments (ITNs, larvicides, and malaria drugs, covering workers and their families), and on the direct and indirect costs to the company of treating malaria.[79] We extrapolated these data to the 2011-2015 period. We modeled the direct and indirect costs under two scenarios: sustained malaria control from 2011-2015 versus a "counterfactual" of no control. We assumed that all sick workers were seen in the company's clinic and that 15% were hospitalized.[78] The averted costs to the company were estimated by subtracting the total direct and indirect costs under the sustained control scenario from the total costs under the no control scenario. We conducted a cost-benefit analysis by comparing investments against cost savings. Finally, we extrapolated our estimates to the whole copper industry, using World Bank data on the total number of copper industry workers in the whole sector.

BOX 12. Impact of malaria control on education in Zanzibar

In our interviews with schoolteachers in Zanzibar's Central District, teachers said 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,[83] translating into about 10-18 days of school each year or 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 attentiveness 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.[84,85]

TABLE 7. Cost-effectiveness of a sustained control program from 2011 to 2015

Country	Cost-effectiveness
Ethiopia	$41/DALY averted, $5/case averted: highly cost effective[88]
Rwanda	Estimated savings are greater than costs: • estimated savings to the public health sector are $267 million, estimated costs of control program are $265 million
Zambia	Estimated savings are greater than costs: • estimated savings to the public health sector are $347 million, estimated costs of control program are $134 million
Zanzibar	$49/DALY averted, $8/case averted: highly cost effective[88]

We found that over the next five years, a sustained malaria control program could save Zambia's copper industry an estimated $138 million in direct and indirect costs. Over the time period 2006–2015, our estimates suggest that the benefit-cost ratio (BCR) would be highly favorable to the industry (a BCR of about 40[80]).

Economic benefits to other sectors

Sustaining malaria control activities is likely to benefit other sectors:

- **Education:** Malaria is likely to have a significant negative economic impact through causing school absenteeism and intellectual impairment, which are important determinants of future earnings and productivity.[81] For example, one study estimated that primary schoolchildren in Kenya missed an average of 20 school days per year due to malaria, equivalent to 11% of the school year.[70] There is also anecdotal evidence that malaria may be responsible for high levels of teacher absenteeism, with further negative effects on educational outcomes.[82] By averting malaria cases, sustained malaria control programs are likely to have positive impacts upon education. For example, our interviews with schoolteachers in Zanzibar suggest that malaria control has been associated with reduced absenteeism (**BOX 12**).
- **Tourism:** There has been little research on the possible impact of malaria upon tourism, but there are anecdotal reports in the literature of tourists being deterred by malaria. For example, an article published in the *South African Medical Journal* argued that prior to scaling up malaria control tools, concerns about malaria deterred local and international tourists from visiting the border region between South Africa, Swaziland, and Mozambique.[86]And the Dominican Republic is reported to have lost an estimated $200 million in tourism due to an outbreak of malaria in 2004.[87]

Sustaining control measures from 2011–2015 is likely to be highly cost-effective

We estimated the cost-effectiveness (the incremental cost-effectiveness ratio, ICER) of a sustained malaria control program lasting 5 years, from 2011 to 2015, in several of our focus countries (**BOX 13** briefly summarizes the methods).

Our estimates suggest that a sustained control program from 2011 to 2015 is likely to be highly cost effective (**TABLE 7**), according to World Bank criteria,[88] making it one of the "best buys" in global public health. In Ethiopia and Zanzibar, it

BOX 13. Methods used to estimate cost-effectiveness of sustained malaria control

We compared malaria control expenditures versus the health benefits of control under two scenarios: sustained malaria control from 2011–2015 versus a "counterfactual" of no control. For our analysis, the ICER is the additional cost of one unit of outcome gained (i.e., one DALY or case averted) by sustained malaria control compared with a scenario of no control. The ICER is calculated by dividing the *net cost* of the intervention (expenditures minus cost savings) by the total number of incremental health outcomes (DALYs, cases) prevented by the intervention.

Expenditures: For each country, we used a best estimate of the likely annual expenditures on malaria control from 2011 to 2015, as shown in Table 1.

Cost savings: We took a "societal perspective" i.e., we included the savings to both the public health sector and the household (we wanted to capture the benefits of malaria control to *both* sectors). A useful parallel is free mass vaccination campaigns, which benefit both the public health sector and households.

Net costs: The net annual costs are given by: (annual public sector expenditures on malaria control) – (annual cost savings to the public health sector + cost savings to households)

Estimating DALYs averted: We calculated DALYs using a standard formula.[89]

would cost only about $41–49 per DALY averted and about $5-8 per case averted, similar in cost-effectiveness to childhood vaccination campaigns. In both Rwanda and Zambia, the savings would be greater than the program costs.

Sustaining control measures is likely to bring macroeconomic benefits

Although there were insufficient data for us to model the macroeconomic effects of sustaining control measures, it seems likely that continued suppression of the malaria burden in endemic countries would be beneficial to the economy as a whole.

Macroeconomic studies have examined the impact of malaria on the entire economy, and have shown a significant relationship between malaria burden and GDP growth:

- Gallup and Sachs found that GDP growth in countries heavily burdened by malaria was 1.3% per year lower than countries with little or no malaria.[90]
- McCarthy and colleagues also found a significant negative association between malaria and economic growth, although their study found a smaller impact than that found by Gallup and Sachs.[91]

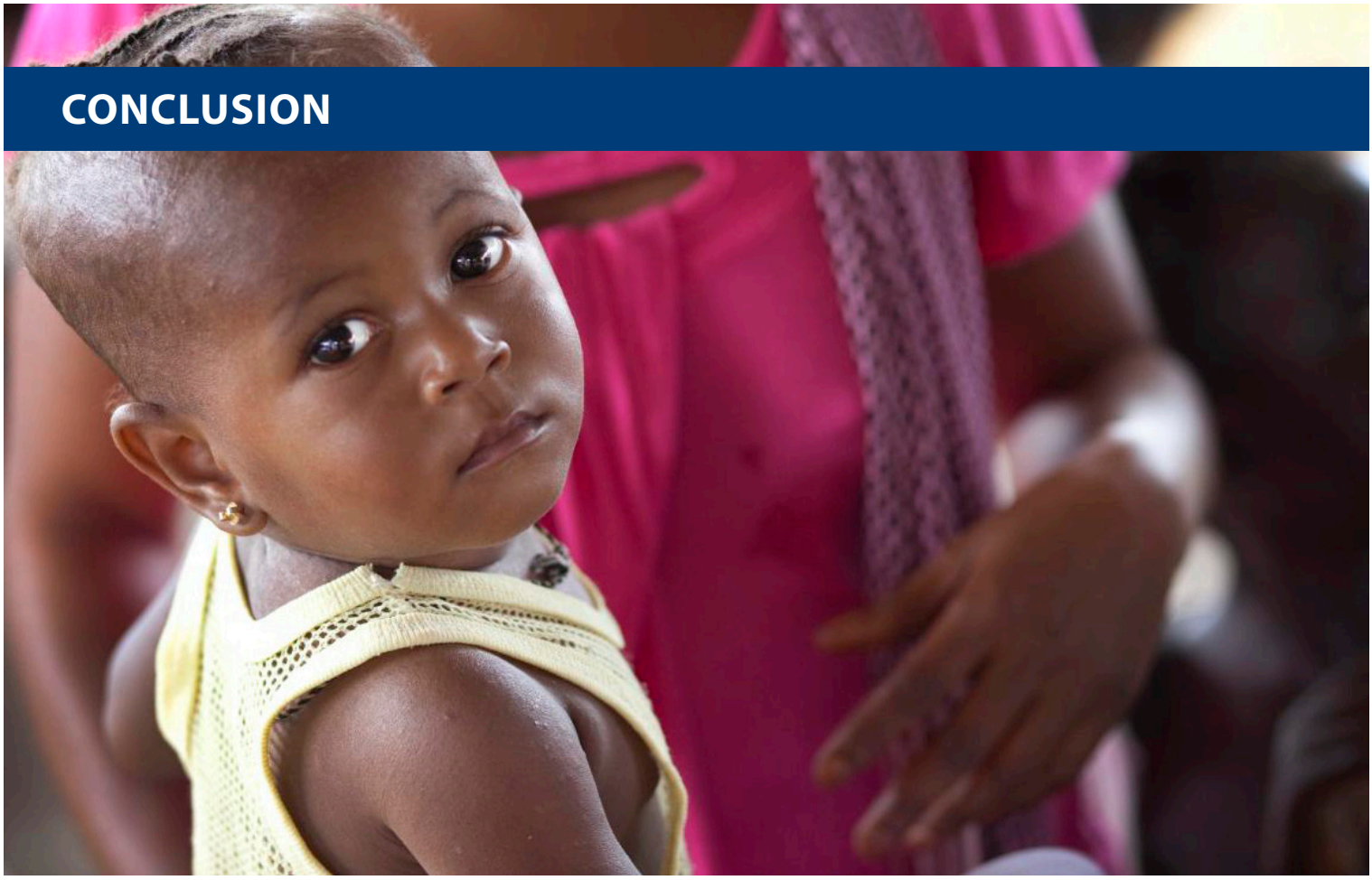
Given these impacts, malaria control is likely to have a positive impact on economic growth. For example, Gallup and Sachs found that a 10% fall in malaria is associated with a 0.3% higher GDP growth per year.[90] An analysis comparing the macroeconomic benefits versus the costs of malaria control found that the benefit-cost ratios were highly favorable, ranging from 1.9 to 4.7.[92] Based on this analysis, the Disease Control Priorities Project concluded that "in terms of economic growth alone, malaria control is extremely cost beneficial."[93]

Conclusion

If successful countries can find the financial resources to sustain their malaria control programs, our estimates suggest that they will reap large economic benefits.

Sustaining control activities could bring economic benefits to the health care system, by averting costs to the system of treating resurgent cases. It could benefit households, by preventing the direct and indirect household costs of resurgent malaria and by preventing school and worker absenteeism. And it could benefit the agricultural sector and industry, since fewer workers would be off sick with malaria, productivity would be higher, and companies would spend less on treating malaria among their employees. Our estimates also suggest that sustained control programs would be highly cost effective, making them one of the "best buys" in global public health.

CONCLUSION



Many countries are still scaling up malaria control tools, and have yet to see a reduction in their malaria burden. The malaria community must continue to support these crucial scale-up efforts. But at the same time, this focus on scale-up must be matched by a new effort to maintain the gains in countries that have successfully brought malaria down to low levels.

Maintaining the gains in global malaria control will require donors to prioritize countries according to their malaria risk, rather than their current malaria burden. Countries with an equal *risk* should be prioritized equally, even if their current *burden* is unequal. Equal priority makes sense, because it emphasizes the number of cases that there *would be* without control, rather than the number of cases that there are today.

Maintaining the gains will also require the malaria community to support successful countries in securing a more predictable and diversified stream of malaria funding, free of the volatility that commonly disrupts health programs. As described in this report, the governments of four focus countries have already started to develop financial sustainability plans for malaria that explore novel ways to create such a stream. These plans include ways to increase domestic funding through innovative mechanisms such as tourist taxes and community health insurance schemes, as well as mechanisms to overcome the problem of volatility in malaria financing, such as endowment funds. A number of ideas for increasing the sustainability and predictability of external financing are also being considered: Cash on Delivery aid shows particular promise. Future research will help to determine whether there are potential areas of efficiency in malaria programming, to reduce countries' overall financing needs.

Our report has clearly demonstrated that donors and endemic countries that choose to invest in sustained malaria control will reap enormous public health and economic benefits. Sustained control averts millions of cases and thousands of deaths, year after year, which in turn brings huge savings to the public health system, households, and businesses. Sustained malaria control in successful countries is highly cost effective and is one of the best buys in global public health.

Malaria control programs face an "out of sight, out of mind" paradox: the more successful the program is, the more invisible the disease becomes to policymakers, and the greater the risk its funding will be withdrawn. **We must avoid this fate, because if successful countries reduce or cease their malaria control activities, it would mean thousands of additional deaths every year and the reversal of a decade of significant investment and progress.**

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