

The Malaria Control Success Story

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Malaria is both preventable and treatable. Yet more than 220 million cases of malaria are estimated to occur each year, and approximately 785,000 people die from the disease annually. Half of the world's population—some 3.3 billion people living in 109 countries—are at risk of malaria (Roll Back Malaria 2008). Worldwide, malaria is the fifth-leading cause of death from infectious diseases (after respiratory infections, HIV/AIDS, diarrheal diseases, and tuberculosis). The disease is life threatening and needs early, accurate diagnosis and treatment, which can be difficult in remote areas that lack clinics, trained health care providers, technical assistance, or medicine.

Malaria is caused by *Plasmodium* parasites, which are spread to humans through infected *Anopheles* mosquitoes, called *malaria vectors*, which bite mainly between dusk and dawn.¹ Ninety percent of the world's malaria deaths occur in Sub-Saharan Africa, where the most severe form of the disease prevails, making malaria the second-leading cause of death in the region after HIV/AIDS (Roll Back Malaria 2008). The disease is one of the leading causes of death of children under the age of five in Sub-Saharan Africa and a major cause of complications, including maternal death and low birth weight, in pregnancy.

Malaria is not only a health problem in Africa; it is also a development problem. Death and disability (both short- and long-term) from malaria have enormous social and economic costs, costing African countries an estimated \$12 billion a year in lost productivity (Gallup and Sachs 2001).

Treatment of severe episodes, which can cost up to one-quarter of a household's monthly income, accounts for up to 40 percent of public sector health expenditures in the worst-affected countries (WHO 2007). Other direct costs include the costs of insecticide-treated nets and indoor residual house spraying to prevent malaria, antimalarial drugs, transportation to clinics, and hospital fees. Operating in a vicious cycle, malaria is both a cause and a consequence of poverty.

Malaria keeps countries as well as households in poverty: annual economic growth in countries with high malaria transmission has historically been lower than in countries without malaria. Economists have estimated that malaria is responsible for an "economic growth penalty" of up to 1.3 percent a year in malaria-endemic African countries (Gallup and Sachs 2001). The disease discourages local and foreign investment and tourism, affects land use patterns and crop selection (resulting in suboptimal agricultural production), and reduces labor productivity through lost work days and diminished on-the-job performance. It affects learning and academic achievement through frequent absenteeism of teachers and students. In children who suffer severe or frequent infections, it can cause cognitive impairment and in some cases permanent neurological damage. Other indirect costs include loss of income and work, including the unpaid work carried out largely by women who take care of the sick and support them at home or in the hospital.

Expenditures on malaria control drain already fragile economies through the deterrent effect on investment

(private businesses are reluctant to expand in areas where the disease is affecting the workforce and creating gaps in the production line). Economic and social decision making at all levels is affected. Travelers are hesitant to visit countries with a high incidence of malaria, reducing tourism revenues and leading to losses of job opportunities and income.

A global effort to help countries control the disease that was revitalized in 2005 is showing signs of success. In countries in which control measures have been intensified, there have been clear and positive results. Eleven countries and one territory in Africa show reductions of more than 50 percent in either confirmed malaria cases or malaria admissions and deaths in recent years (WHO 2010b). This progress is a direct result of the scaling up and acceleration of measures against the disease. Other positive outcomes include parallel declines in child mortality in some countries.

This chapter examines progress in Sub-Saharan African countries on key malaria indicators as well as in funding for the fight against malaria between 2005 and 2010. The first section examines the four main interventions for preventing and treating malaria (insecticide-treated nets, antimalarials, artemisinin-based combination therapy, indoor residual spraying). The second section looks at prevention among and treatment of pregnant women and children under five. The third section discusses partnership and coordination in the fight against malaria. The fourth section describes success stories in four African countries (Eritrea, Ethiopia, Rwanda, and Zambia). The last section identifies lessons learned and discusses the way forward.

INTERVENTIONS FOR PREVENTING AND TREATING MALARIA

Between 2000 and 2008 malaria control efforts in Africa were measured against targets set in the 2000 Abuja Declaration.² Since 2008 progress has been measured against the universal coverage targets set forth in the Roll Back Malaria Global Malaria Action Plan 2010. These targets include the following:

- Eighty percent of people at risk from malaria are using locally appropriate vector control methods, such as long-lasting insecticidal nets, indoor residual spraying, and, in some settings, other environmental and biological measures.
- Eighty percent of malaria patients are diagnosed and treated with effective antimalarial treatments; in areas of

high transmission, 100 percent of pregnant women receive intermittent preventive treatment.

- The global malaria burden is reduced by 50 percent from 2000 levels, to less than 175 million–250 million cases and 500,000 deaths annually.

This section looks at progress on key malaria indicators in Africa based on an analysis of nationally representative surveys in countries in which the data were available for a particular indicator. A subset of countries for which data were available is used to illustrate progress on key indicators.

Insecticide-treated nets

The promotion and distribution of insecticide-treated nets has long been recognized internationally as a key cost-effective intervention to control malaria (Statesmen's Forum 2010 (box 23.1). This intervention has been the primary focus for scale-up over the past few years. Beginning in 2008, some countries in Africa made a policy shift from providing insecticide-treated-net coverage only for populations at greatest risk (including children under five and pregnant women) to seeking coverage for the entire population at risk. This shift has largely been the result of a global effort to increase progress toward the Millennium Development Goals (MDGs) and a call for action from the UN Secretary General in 2008. Given that the policy changed fairly recently, the shift to implementation has not yet been seen on a large scale across the continent.

Figure 23.1 illustrates progress toward coverage with insecticide-treated nets across a number of countries in Africa. At first glance, the story appears discouraging, as many countries are well below the 80 percent coverage target for this key intervention. Many of the data used, however, come from representative surveys in countries conducted in 2006 and 2007—around the same time that malaria control efforts on the continent started ramping up. Among countries in which coverage is 50 percent or greater (Ethiopia, Madagascar, Rwanda, Senegal, Zambia, and Zanzibar), most surveys were conducted between 2007 and 2009. The most recent 2010 Malaria Indicator Survey in Zambia (not illustrated in the figure) shows an increase in the share of households with at least one insecticide-treated net rising to 64 percent.

Since 2006 coordinated efforts have supported the “catch-up, keep up” approach to bed net distribution in countries with low coverage. During the “catch-up” phase, bed nets are distributed through either stand-alone or integrated bed net campaigns to increase coverage

Box 23.1 Cost-Effective Tools in the Fight against Malaria

A variety of antimalarial tools are starting to produce results in Africa. They include artemisinin-based combination therapies (ACTs), long-lasting insecticidal-treated nets, indoor residual spraying, intermittent preventive treatment, and rapid diagnostic tests.

Artemisinin-based combination therapies

Artemisinin-based combination therapies are produced by combining compounds from the *Artemisia annua* plant with various antimalarial partner drugs. They are recognized by the World Health Organization (WHO) and the scientific community as the most effective therapy for treating *Plasmodium falciparum* malaria, the predominant form in Africa and the most deadly. ACTs are thought to delay the development of drug-resistant strains of the disease. They are also active against gametocytes, the sexual stage of the parasite cycle, effectively reducing disease transmission. For these reasons ACTs have become the first line of therapy for many countries struggling to control malaria infection and transmission. The treatment is fast acting and produces minimal side effects, making it possible for patients to return quickly to their daily routines. The challenge is to ensure that prompt and effective treatment with ACT is available as a critical intervention to complement prevention activities.

Long-lasting insecticidal nets

WHO policy recommends long-lasting insecticidal mosquito nets (a type of insecticide-treated net), which offer protection against malaria. If used by at least 80 percent, in an affected area, these nets can help break the malaria transmission cycle, thus reducing the risk for all who live nearby. Woven from insecticide-bound fibers, the nets kill the potential disease-carrying mosquitoes on contact and offer protection from bites. Unlike insecticide-treated nets that require redipping every few months, long-lasting insecticidal nets remain effective for at least three years. The nets provide protection at night, when individuals are most vulnerable. They are safe for children and simple to hang up.

Indoor residual spraying

Indoor residual spraying is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area to kill the adult vector mosquitoes that land and rest on these surfaces. Indoor residual spraying shortens the life span of vector mosquitoes so that they can no longer transmit malaria parasites from one person to another, and reduces the density of the vector mosquitoes.

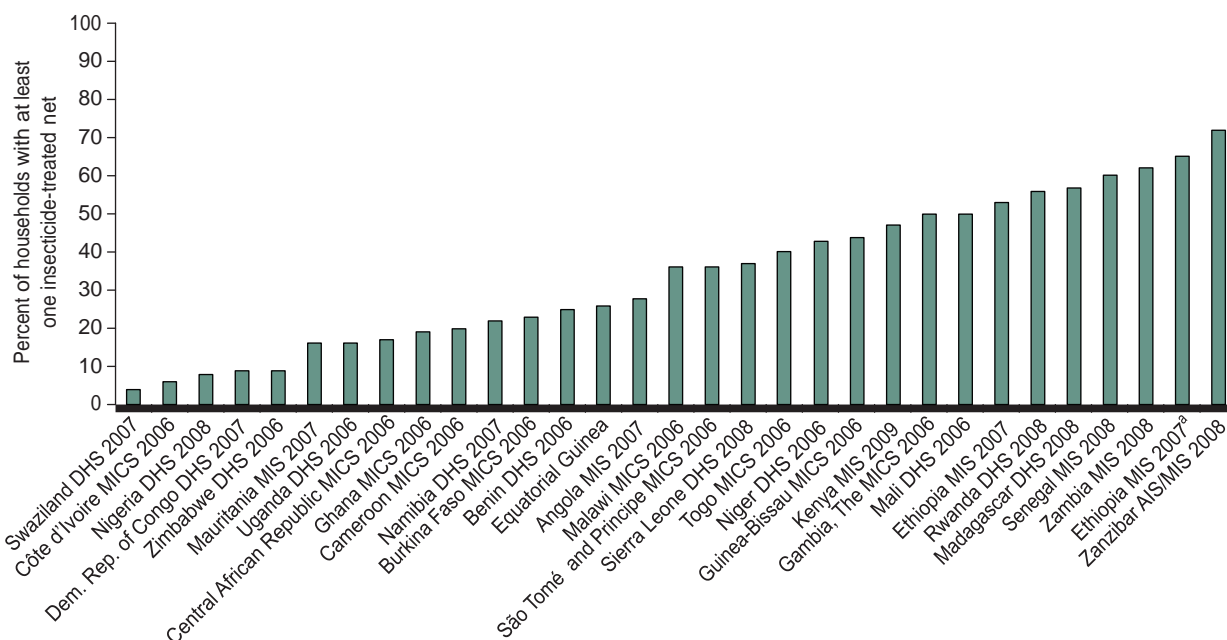
Intermittent preventive treatment

Intermittent preventive treatment given to pregnant women at routine antenatal care visits has been shown to promote healthier pregnancies and yield benefits for both mothers and developing fetuses. It can significantly reduce the proportion of low birthweight infants and maternal anemia. Intermittent preventive treatment in infants may also play a major role in malaria prevention at the public health level; however, additional research is needed to confirm this hypothesis.

Rapid diagnostic tests

Rapid diagnostic tests for malaria, also known as dipsticks or malaria rapid diagnostic devices, have the potential to greatly improve the quality of management of malaria infections when high-quality microscopy is not readily available. The tests detect specific antigens (proteins) produced by malaria parasites that are present in the blood of infected individuals. Some rapid diagnostic tests detect only one species (*P. falciparum*), others also detect other species of the parasite. Blood for the test is commonly obtained from a finger prick. WHO (2010) now recommends that all cases of suspected malaria be confirmed with a diagnostic test before treatment. As the incidence of malaria continues to decrease in Africa, the need to differentiate between malaria from nonmalarial fevers becomes more pressing, especially given the need to avoid drug resistance and increase efficiency of resources. Implementation of the WHO recommendations will require a more integrated approach to childhood illnesses (to address the question of what to do if the fever is not caused by malaria).

Figure 23.1 Coverage of Insecticide-Treated Nets in Africa, by Country



Source: WHO 2010b.

Note: DHS is Demographic Health Survey. MICS is Multiple Indicator Cluster Survey. MIS is Malaria Indicator Survey. AIS is AIDS Indicator Survey. Data for Equatorial Guinea are from a national survey.

a. Updated since original DHS.

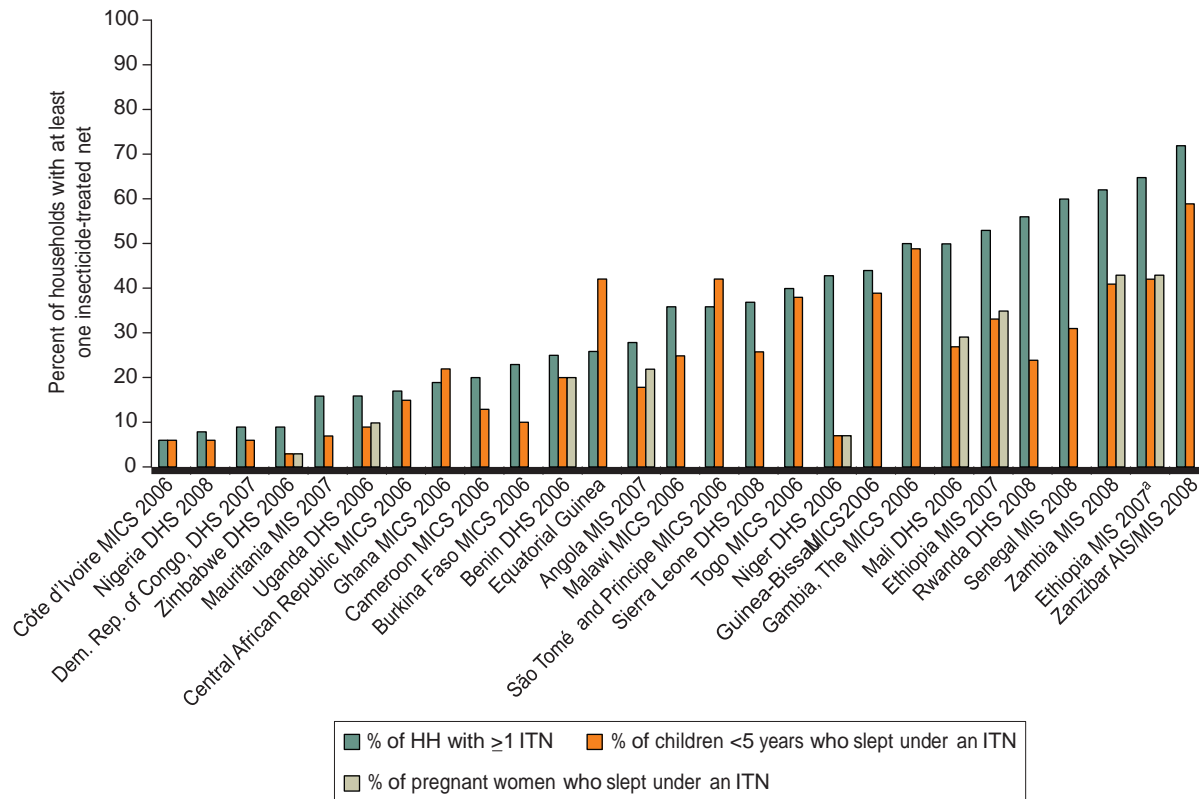
quickly. During the “keep-up” phase, bed nets are distributed through mechanisms such as routine antenatal care visits, child wellness weeks, routine immunization completion, and school health programs. This approach has been proven to work in countries such as Ethiopia, Zambia, and Zanzibar, where high coverage of bed nets is correlated with sharp declines in malaria prevalence. Other countries that are lagging behind, such as the Democratic Republic of Congo (where just 4 percent of the population has bed nets) and Nigeria (3 percent), have been focusing efforts on increasing coverage of bed nets. The Democratic Republic of Congo plans to launching a large-scale bed net campaign in 2011 to ramp up coverage rates. In Nigeria the government has been working with partners to implement a “catch-up, keep-up” approach to increasing bed net coverage. The catch-up phase has been under way since 2008, through a phased-in nationwide mass campaign whose ultimate goal is to distribute 70 million nets (providing every household with at least two long-lasting insecticidal nets) by the end of 2011. In Nigerian states in which the bed net campaigns have been completed, data from a Lot Quality Assurance Sampling (LQAS) survey conducted in 2010 show coverage of bed nets of more than 70 percent.³

USE OF INSECTICIDE-TREATED NETS AMONG VULNERABLE GROUPS

Two of the many vulnerable population groups in the malaria epidemic are pregnant women and children under age five. To help safeguard these populations, a number of countries in Africa made the strategic choice to focus key prevention and promotion activities on these two groups. Despite the recent policy shift to universal coverage, many countries are still targeting these groups, given constrained budget envelopes for health in general and for malaria in particular. Examining use of LLINs among pregnant women and children under five thus still provides a good indicator of progress on use of bed nets (figure 23.2). Among these groups, the rates of usage are more encouraging, with Equatorial Guinea, Ethiopia, The Gambia, São Tomé and Príncipe, Zambia, and Zanzibar reaching at least 40 percent usage.

Analysis of usage rates among pregnant women indicates that, despite some progress, there is much room for improvement. Figure 23.2 highlights two key issues in this context: the lack of data for this indicator and the relatively low level of use among pregnant women compared with children under five. Ethiopia and Zambia⁴ are the highest performers with 43 percent of pregnant women sleeping under an insecticide-treated net.

Figure 23.2 Use of Insecticide-Treated Nets in Africa by Children under Five and Pregnant Women, by Country



Source: WHO 2010b.

Note: DHS is Demographic Health Survey. MICS is Multiple Indicator Cluster Survey. MIS is Malaria Indicator Survey. AIS is AIDS Indicator Survey. Data for Equatorial Guinea are from a national survey.
a. Updated since original DHS.

Antimalarials

Fever is internationally recognized as one of the main indicators of malaria. Prompt access to treatment of malaria, especially among children under five, is one of the key indicators of effective malaria treatment.⁵ The percentage of children under five receiving any antimalarial treatment (including artemisinin-based combination therapy, or ACT) through public and private channels varies by country (figure 23.3), but across the board there is vast room for improvement. In several countries, access to antimalarial treatment is much higher in the public sector than in the private sector, although many seek treatment first in the private and informal sectors.

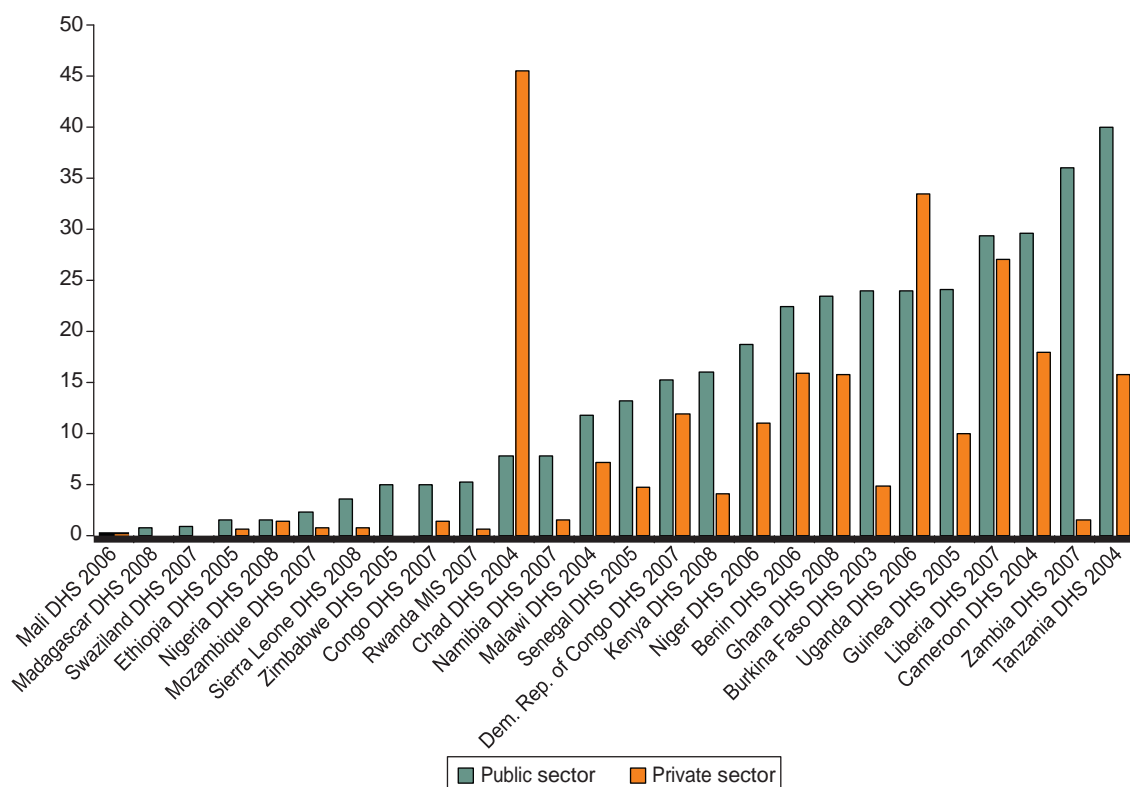
Artemisinin-based combination therapy

In response to increasing levels of antimalarial resistance, in 2001 WHO began recommending that countries experiencing resistance to conventional monotherapies, such as chloroquine, amodiaquine, or sulfadoxine-pyrimethamine,

use combination therapies, preferably those containing artemisinin derivatives for *p. falciparum* malaria. In 2006 it developed standard guidance on artemisinin-based combination therapy for countries to adopt into policy. As of 2010, 43 countries in Africa had adopted ACTs, several as first-line treatment and a few as second-line treatment. The rollout of this policy is being implemented in stages across Africa (table 23.1).

ACTs retail for \$6–\$10 a course in the private sector, making the drug prohibitively expensive; even the \$1 paid by the public and nonprofit is 10 times the price of chloroquine. In addition, a number of factors, including procurement and supply chain issues, theft, and counterfeiting have made the availability of quality-assured ACTs through public and private sectors challenging (figure 23.4). But innovative solutions to access to ACTs are being implemented at the global and country level. The Affordable Medicines Facility for Malaria mechanism aims to reduce the unit cost of ACTs (box 23.2). In Zambia, a supply chain intervention has dramatically increased the

Figure 23.3 Percentage of Children under Five with Fever Receiving Any Antimalarial Medication in the Public and Private Sector, by Country



Source: WHO 2010b.

Note: DHS is Demographic Health Survey. MIS is Malaria Indicator Survey. AIS is AIDS Indicator Survey.

Table 23.1 Adoption of Policies for Malaria Treatment in Africa

Policy	Number
Number of endemic countries and territories	43
Number of <i>P. falciparum</i> endemic countries and territories	42
Artemisinin-based combination therapy (ACT) used for treatment of <i>P. falciparum</i>	42
ACT provided free of charge in public sector for all age groups	24
ACT provided free of charge in public sector only for children under five	5
ACT delivered at community level	25
Pre-referral treatment with quinine/artemether IM	32
Artesunate suppositories	25

Source: WHO 2010.

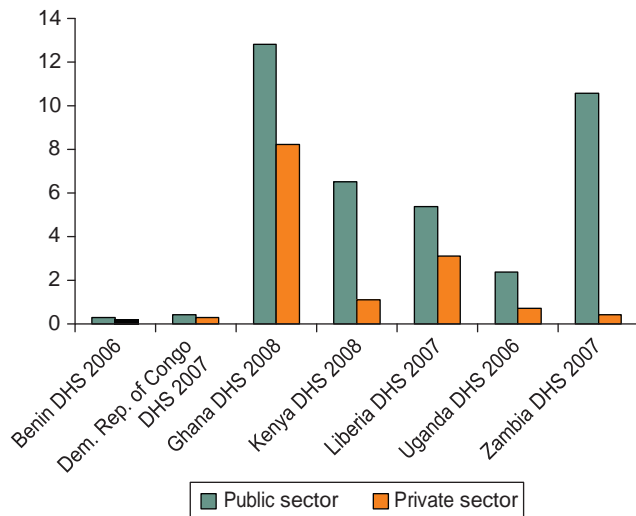
availability of ACTs and other essential drugs in health facilities (box 23.3).

Indoor residual spraying

Indoor residual spraying is recommended for control of malaria in 71 countries, 32 of them in Africa. It is the primary vector control intervention in Botswana, Mozambique, Namibia, South Africa, Swaziland, and Zimbabwe.

The number of people benefiting from indoor residual spraying rose from 10 million in 2005 to 73 million in 2009, or about 10 percent of the population at risk for malaria (WHO 2010b). In countries that have seen a rapid decline in malaria within the past five years, bed net distribution has been complemented with indoor residual spraying in the areas of the countries where it is epidemiologically justified.

Figure 23.4 Percentage of Children under Five with Fever Receiving Artemisinin-Based Combination Therapy in the Public and Private Sector, in Selected Countries



Source: WHO 2010b.
 Note: DHS is Demographic Health Survey.

Box 23.2 The Affordable Medicines Facility for Malaria

Most malaria cases are treated with an over-the-counter drug such as chloroquine. Resistance to this drug has increased, however, making it increasingly ineffective. As a result, in 2004 WHO recommended that all countries use ACTs as first-line treatment for malaria. ACTs are not widely available at private pharmacies and other medical distribution centers because of their high cost.

The Affordable Medicines Facility for Malaria (AMFM) is a financing mechanism, managed by the Global Fund to Fight AIDS, Tuberculosis and Malaria, designed to subsidize ACTs. The initiative negotiates a lower price with pharmaceutical producers. It aims to make ACTs even more affordable through a co-payment and subsidy system that will allow first-line buyers, including in-country private sector wholesalers, hospitals, and nongovernmental organizations, to pass on the benefit to patients, who will pay \$0.20–\$0.50 for ACTs—comparable to what they currently pay for less effective alternatives.

Source: Authors.

The data also point to deficiencies in the use of intermittent preventive treatment of pregnant women. In three countries (Malawi, Senegal, and Zambia), at least 70 percent of pregnant women reported having received SP/Fansidar during an antenatal care visit (figure 23.5).⁶ In contrast, less than 10 percent of pregnant women in Benin, Niger, and Nigeria and less than 20 percent of women in the Democratic Republic of Congo reported receiving intermittent preventive treatment during an antenatal care visit.

PARTNERSHIP AND COORDINATION FOR RESULTS

During the past decade governments, communities, donors, and individuals have been working under growing consensus and coordinated action. Since 2005 partners and malaria-endemic countries have placed greater emphasis on strengthening coordination of technical and human resources at global, regional, and country levels. This intense collaboration, under the umbrella of the Roll Back Malaria Partnership (box 23.4), has been a key component of the success on the ground in Africa. These partnerships have helped reduce duplication in efforts, increase resource mobilization, raise awareness of the problem at the global and regional level, and create a network of technical and implementation experts for countries to draw on as they implement strategies to control malaria.

Funding for malaria control has increased dramatically since 2005 (figure 23.6). Evidence-based advocacy efforts have led to a number of notable achievements, including increased funding from partners such as the President's Malaria Initiative, the World Bank, and the Global Fund to Fight AIDS, Tuberculosis and Malaria. As a direct result of these efforts, in 2008 the Global Fund increased its funding to malaria to the historic level of \$1.62 billion worldwide. In addition, the Roll Back Malaria Partnership formed the Harmonization Working Group, which seeks to harmonize donor resources to support countries with costed national malaria control plans. Partners also joined forces to develop the Global Malaria Action Plan, which provides a framework for current and future malaria control effort worldwide.

Aid harmonization for malaria has improved, and malaria disbursements rose to \$1.5 billion in 2009. But new commitments for malaria control plateaued in 2010 at \$1.8 billion. Government spending for health in high-burden countries remains low, with far less than 15 percent of budgets spent on the health sector in more than 90 percent of countries. The level of spending for malaria falls far short of the resources needed to control the disease, which the RBM

Box 23.3 Improving Access to ACTs in Zambia

Recognizing that access to proper treatment needed to be improved, the World Bank, the United Kingdom's Department for International Development, and the U.S. Agency for International Development (USAID) joined forces to try out new drug distribution methods in 16 districts in Zambia. The results from this pilot, evaluated through a rigorous impact evaluation, have been exceptionally encouraging. Simple but smart steps to grease the supply chain for lifesaving drugs—including hiring district-level planners to help manage orders and deliver them more efficiently—have proved very effective.

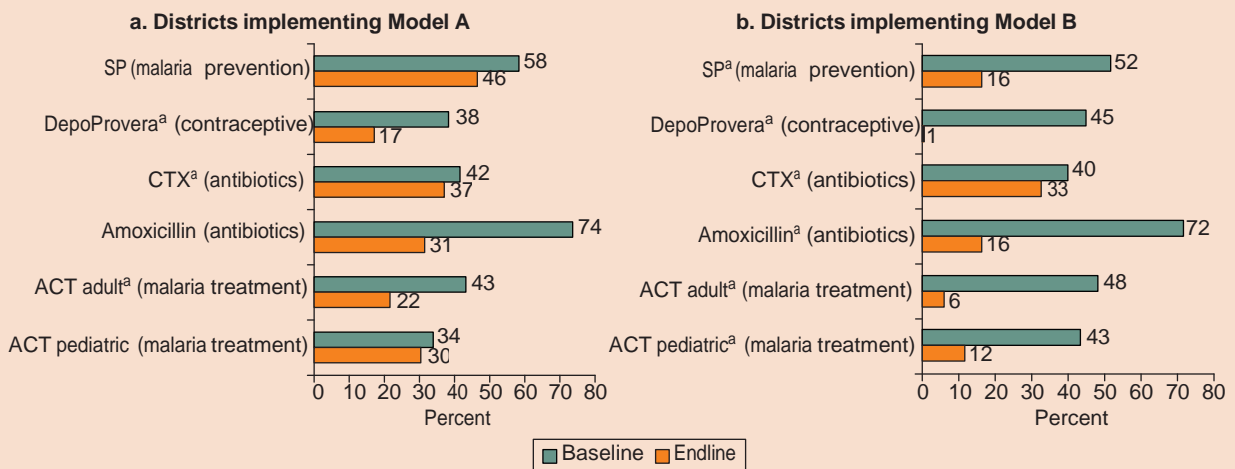
Two models were tested. Under Model A drug stock continues to be held at the district level. The new position of commodity planner (CP) at the district level, designed to enhance planning capacity, is responsible for coordinating orders from the health facilities and stock management at the district. The CP also ensures that requisitions requests are sent every month by each health facility to the district store and performs picking and packing operations at the district level to fulfill the order requisitions of health facilities under that district. The CP also estimates the overall requirements and places orders to Medical Stores Limited (MSL)¹ for the stock needed to maintain the desired inventory level at the district store. CPs were recruited to hold the logistics responsibilities in 12 of the intervention

districts, while the remaining 4 districts relied on pharmacy technologists.

Model B eliminates the intermediate storage of drugs at the district level. The district store is converted into a “cross-dock,” a point of transit that receives shipments from MSL that are pre-packed for individual health facilities. Under this option, the district does not carry any stock or perform any secondary picking and packing. This system has the potential to reduce the scope for pilferage and leakages because it enables better shipment tracking.² However, it hinges on the health facilities transmitting their order requisitions to MSL every month to allow for the assembling of packages to individual health facilities. As in Model A, a CP was added to the district store under this option to ensure the smooth flow of order information from the health facilities to MSL.

Remarkable improvement in access to essential drugs has occurred at the health facility level, particularly in districts in which Model B was implemented. In districts implementing Model A (panel a of figure B23.3), 38 percent of health facilities were out of stock of DepoProvera (a contraceptive) at baseline. At the end of the pilot program, the stock-out rate had fallen to 17 percent. Reductions in stock-out rates of the same magnitude are observed for amoxicillin and ACT for adults. Reductions in stock-out rates were even more dramatic in districts

Figure B23.3 Baseline and Endline Stock-Out Rates following Implementation of Pilot Program



Source: Authors.

Note: Figures show the percentage of health facilities that were out of stock of the drug indicated. The intervention had similar impacts on almost all essential drugs tracked.

a. Reduction in stock-out rate is statistically insignificant compared with observed change in control districts.

implementing Model B (panel b of figure B23.3), where decreases in stock-out rates exceeded 40 percentage points for SP, DepoProvera, amoxicillin, and ACT for adults.

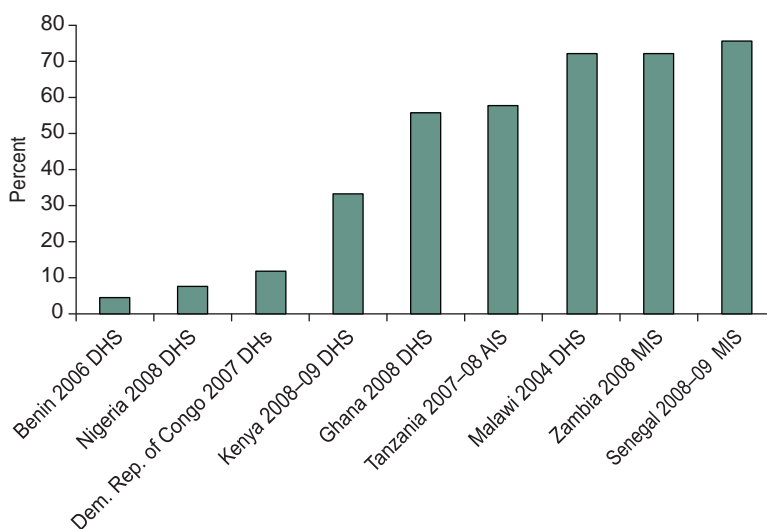
Zambia is in the process of scaling up Model B nationwide. A conservative estimate suggests that this effort could decrease under-five mortality by 21 percent

and over-five mortality by 25 percent. These reductions would avert 3,320 under-five deaths and 448 over-five deaths from malaria each year. In economic terms, the aggregate household income loss averted as a result of the national scale-up of Model B is estimated to exceed \$1.6 million a year.

Source: World Bank 2010.

1. The receipt, storage, and primary distribution of drugs and other health commodities from Lusaka to approximately 120 districts stores and hospitals are managed by a parastatal agency called Medical Stores Limited (MSL), currently under the management of Crown Agents. Improvements of MSL have been observed in recent years as a result of large capital investments and management reforms. Consequently, primary distribution is quite reliable and effective.
2. Zambia already had a very similar arrangement in place that has eliminated stock-outs of antiretrovirals at almost all antiretroviral therapy sites.

Figure 23.5 Treatment of Pregnant Women with SP/Fansidar during Antenatal Visit in Selected African Countries



Source: Authors' compilation based on data from national household surveys.

Note: DHS is Demographic Health Survey. MIS is Malaria Indicator Survey. AIS is AIDS Indicator Survey.

Global Malaria Action Plan estimates at about \$5 billion a year in 2010–15 and \$4.75 billion in 2020–25. The shortfall underscores the need for policy makers and development partners to continue to work collaboratively to ensure that adequate resources are mobilized to scale up and sustain control efforts over the long term.

SUCCESS STORIES

This section highlights four countries that are showing significant progress in their malaria control efforts. The profiles

show that with a combination of effective prevention and treatment tools, country leadership, and partner coordination, controlling malaria in Africa is possible.

Eritrea

In 1997 and 1998 Eritrea experienced a series of malaria epidemics that produced more than 424,000 cases; more than 500 inpatient malaria deaths were recorded in 1998 alone (RTI 2005). A 2002 Demographic Health Survey revealed

Box 23.4 The Roll Back Malaria Partnership

The Roll Back Malaria (RBM) Partnership is the global framework for implementing coordinated action against malaria. It mobilizes resources and forges consensus among more than 500 partners, including malaria-endemic countries, their bilateral and multilateral development partners, the private sector, nongovernmental and community-based organizations, foundations, and research and academic institutions.

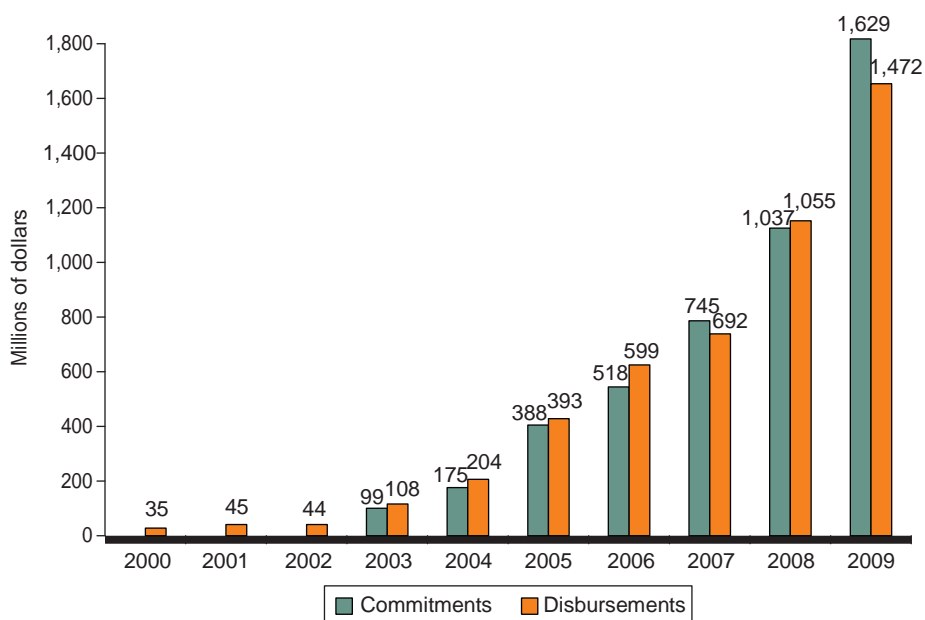
RBM's strength lies in its ability to form effective partnerships globally and nationally. Partners work together to scale up malaria control efforts at the country level, coordinating their activities to avoid duplication and fragmentation and to ensure optimal use of resources.

Source: Authors.

RBM's overall strategy aims to reduce malaria morbidity and mortality by reaching universal coverage and strengthening health systems. The Global Malaria Action Plan defines three stages of malaria control: scaling up for impact of preventive and therapeutic interventions, sustaining control over time, and elimination.

The RBM Partnership was launched in 1998 by WHO, UNICEF, the United Nations Development Programme, and the World Bank, in an effort to provide a coordinated global response to the disease. It is served by a secretariat, hosted by WHO in Geneva, that works to facilitate policy coordination at the global level.

Figure 23.6 Commitments and Disbursements for Antimalaria Activities in Malaria-Endemic Countries in Africa, 2000–09



Source: WHO 2010b.

that less than 20 percent of households had at least one mosquito net, just 7 percent of pregnant women slept under a mosquito net the night before the interview, and less than half of those used an insecticide-treated net. The report also indicated low use of antimalaria drugs by pregnant women, with just 5 percent of women who had given birth in the five years preceding the survey reporting having received

antimalarial treatment for the last birth. Twelve percent of children under five were reported as having slept under a mosquito net the night before the interview, and just a third of them used an insecticide-treated net; 30 percent had a fever in the two weeks preceding the survey, but only 4 percent were treated with antimalarial medication—mostly chloroquine (NSEO and ORC Macro 2003).

Efforts. The alarming condition in the country, coupled with the rise of HIV/AIDS in Africa, triggered the Eritrean Ministry of Health to establish a new strategy and program to control HIV/AIDS, malaria, sexually transmitted diseases, and tuberculosis in 2000. The program, dubbed HAMSET, supplemented the National Malaria Control Program (NMCP), established in 1998. The technical strategy of NMCP sought to reduce and better target indoor residual spraying to the highest-risk areas and scale up rapid diagnosis and effective treatment for fever cases, environmental management activities, and use of insecticide-treated nets. At the core of this strategy was the strengthening of disease surveillance and operational research activities, data from which would be used to select and refine the mix of strategies and geographically target control activities. During 1999–2005, the NMCP introduced a first-line antimalarial drug and implemented an integrated vector control program using insecticide-treated nets, indoor residual spraying in selected areas, and other interventions. In 2005 the Ministry of Health articulated a clear strategic plan, with the goal of “reducing malaria to such low levels that it is no longer a public health problem in the country” (Ministry of Health 2008).

Through support from the World Bank, the Global Fund, and other donors, Eritrea has been able to employ a comprehensive strategy against malaria through a centralized approach. This approach involves targeting the use of indoor residual spraying in the highest-risk areas, carrying out environmental management of malaria vector breeding sites, increasing distribution of insecticide-treated mosquito nets, and expanding diagnostic and treatment services.

Results. The fact that about 60 percent of Eritrea’s population of 3.5 million people live in malaria- endemic or epidemic-prone areas where disease is seasonal, highly focal, and unstable puts the country in a disadvantageous position in terms of malaria control. Despite these odds, through the support of the World Bank and other donors, in only a few years Eritrea has been able to introduce new first-line antimalarial drugs and implement an integrated vector control program using insecticide-treated nets, indoor residual spraying in selected areas, and other interventions. Through these efforts, Eritrea has reduced malaria mortality by more than 80 percent, malaria inpatient cases by 90 percent, and malaria outpatient cases by 68 percent (WHO 2009). It also met the target set at the Africa Summit on Roll Back Malaria in April 2000 of reducing the incidence of malaria by at least 60 percent before 2010.

As a result of the strong commitment of the government, Eritrea has come a long way in 10 years. Through

implementation of prevention activities, diligent environmental management of malaria vector breeding sites, and widespread diagnostic and treatment services, it has reduced overall malaria morbidity from about 100,000 cases in 2000 to about 8,000 in 2008 (Ministry of Health 2008). These achievements have led to an overall decrease in maternal and infant mortality and a healthier population.

Ethiopia

Malaria was responsible for the deaths of nearly 29,000 children—about 80 children a day—in Ethiopia in 2000 (WHO 2002). In 2003 Ethiopia had more than half a million reported malaria cases. According to a 2005 Demographic Health Survey, malaria was the primary cause of health problems, accounting for 17 percent of outpatient visits, 15 percent of hospital admissions, and 29 percent of in-patient deaths (Central Statistical Agency [Ethiopia], and ORC Macro 2006). During this period only 5.7 percent of households owned at least one bed net, and less than 4 percent had an insecticide-treated net. The situation for children under five years of age was dire, with only 2.3 percent sleeping under any net the night before the survey and less than 2 percent sleeping under an insecticide-treated net. During the two weeks preceding the survey, about 19 percent of children under five were reported as having had a fever, and only 3 percent of these received antimalarial drugs. Among pregnant women, only 1.6 percent slept under any bed net the night before the survey and only about 1 percent slept under an insecticide-treated net. Less than 5 percent took any antimalarial drug, and only 0.5 percent received any intermittent preventive treatment. Just one-tenth of all households reported occupying a dwelling that was ever sprayed with insecticide to prevent malaria.

Efforts. Ethiopia has been trying to control and eliminate malaria for more than 60 years. The Malaria Eradication Service was established in 1959, making Ethiopia one of the pioneering countries in Africa to embark on a malaria eradication effort. In 2000 the country became a cosignatory to the Abuja Declaration, committing itself to the declaration’s aims of increasing coverage of malaria interventions and reducing malaria mortality by half by 2010.

The Ethiopian government has implemented a centralized approach to bringing the disease under control, with significant success. In 2009, after analysis of the results of the 2007 Malaria Indicator Survey as well as the discussions and recommendations that followed a consultative meeting held in Ethiopia in 2009, Ethiopia developed a six-year

(2010–15) National Strategic Plan for Malaria Prevention, Control, and Elimination. In the new strategic plan, top priorities among malaria control strategies are given to community empowerment and social mobilization. These priorities were based on the results of the 2007 Malaria Indicator Survey, which showed substantial differences between the coverage and utilization of key malaria interventions by the population at risk of malaria. Malaria diagnosis, case management, disease surveillance, and epidemic control will all be geared to serve Ethiopia's goal of shrinking malaria-endemic areas by 2015 and eliminating the disease throughout the country by 2020 (USAID and PMI 2010).

Donors such as the World Bank, the Global Fund, the U.K. Department for International Development, UNICEF, and the Canadian International Development Agency have been providing coordinated support to the Ethiopian government in its fight against malaria by offering flexible and pragmatic funding to ensure that the country's efforts have been scaled up and sustained. Together they have contributed more than \$151 million—for malaria control efforts in the country. Partner resources have supported the procurement and free distribution of long-lasting insecticidal nets, antimalarial drugs, and indoor residual spraying as well as the strengthening of the supply chain. Other components have included capacity building for other functions, especially procurement and monitoring and evaluation.

Results. The effort by the Ethiopian government and its partners has resulted in remarkable improvements in malaria control and overall health in Ethiopia. Recent data suggest sharp declines in the number of malaria cases as well as declines in malaria outbreaks and deaths (Global Fund 2009). These efforts correlated with an overall decrease in under-five mortality by more than 20 percent between 1990 and 2008, and maternal mortality declined by nearly 60 percent, from 968 maternal deaths per 100,000 live births to 590.

Given the scope of the problem in Ethiopia—about 68 percent of the population of 73 million lives in areas at risk of malaria—the government has accomplished extraordinary results.

Rwanda

Rwanda has made remarkable progress in malaria control. In 2005, according to the Demographic Health Survey, only one-fifth of households reported having at least one once-treated mosquito net. Sixteen percent of children under five, 20 percent of pregnant women, and 13 percent of all women

reported having slept under any mosquito net the night before the survey. Only 5.8 percent of women reported having taken any antimalarial drug to prevent or treat malaria during an antenatal care visit during their last pregnancy, and just 0.3 percent of women reported having received intermittent preventive treatment during their last antenatal care visit.

Efforts. Acting on the recommendation of its ministry of health, the Rwandan government adopted two major strategies to reduce malaria: promoting the use of insecticide-treated nets for prevention, particularly among vulnerable groups, including pregnant women and children under five, and providing early diagnosis and timely treatment with combination therapy of amodiaquine and sulfadoxine/pyrimethamine (Concern Worldwide, International Rescue Committee, and World Relief 2004). The prevention component of malaria transmission was moving along steadily. In contrast, as a result of rapid widespread resistance to older first-line treatment antimalarial drugs, the country was no longer able to effectively combat the disease, forcing it to change its national treatment policy. In 2005 the Rwandan government made ACT the official first-line antimalarial drug (Friends of the Global Fight against AIDS, Tuberculosis, and Malaria 2008). To support the intense efforts of the Rwandan government to control malaria and strengthen health systems, development partners such as the World Bank, the Global Fund, the President's Malaria Initiative, the Roll Back Malaria Partnership, WHO, Malaria No More, the Bill & Melinda Gates Foundation, nongovernmental organizations, and others contributed grants and loans to step up funding of programs across the country.

In addition to providing assistance for prevention activities such as bed net distribution and indoor residual spraying and funding for antimalarial treatment, some donors have provided grants to finance the overall strengthening of Rwanda's health system. In 2005 the Global Fund approved a grant of \$33.9 million to finance health systems strengthening activities. The grant reduced the cost of health services, improved the quality of care offered at health centers, and financed training for more than 100 healthcare administrators in health financing and management for health information systems.

Results. Rwanda was once a country with extremely high malaria prevalence and large numbers of deaths from malaria, particularly among children. As a result of its efforts, the number of malaria illnesses attended at health facilities declined from 1.5 million people in 2005 to 800,000 in 2008, and the mortality rate from malaria

dropped from 41 percent in 2006 to 16 percent in 2008. In 2008 malaria was the third-leading cause of morbidity and mortality, after pneumonia and diarrhea. The 2008 interim Demographic Health Survey indicated a child mortality rate of 103 deaths per 1,000 live births, a 32 percent reduction from the 2005 rate of 152 (USAID and PMI 2009).

The percentage of households with at least one ever-treated net increased by nearly 40 percent, from 18.1 percent in 2005 to 57.2 percent in 2007–08. The percentage of children under five that slept under an ever-treated net the night before the Demographic Health Survey increased by 42 percentage points, from 15.7 percent in 2005 to 58.0 percent in 2007–08, and the share of children under five with fever in the two weeks preceding the survey decreased by nearly 5 percentage points, from 26.2 percent in 2005 to 21.4 percent in 2007–08. By 2008 the use of health centers had increased by 10.0 percent and the use of district hospitals had increased by 16.8 percent over 2005 (Malaria Free Future 2008).

Rwanda—a country whose entire population was once at risk of malaria—is now one of Africa’s frontrunners in the fight against the disease. With increasing use of bed nets, long-lasting insecticidal-treated mosquito nets, antimalarial drugs, and intermittent preventive treatment during pregnancy, Rwanda has significantly reduced the number of malaria transmissions, malaria cases being reported at health facilities, and deaths from malaria. These achievements have contributed to a decrease in infant and maternal mortality and a healthier Rwanda. The Rwandan National Malaria Control Program is continuing to pursue its very ambitious goals, which include universal coverage of long-lasting insecticidal-treated mosquito nets, expansion of indoor residual spraying, subsidization of ACTs nationwide, and better monitoring and evaluation to tackle epidemics (Malaria Free Future 2008).

Zambia

In 2001–02 Zambia had about 3.5 million cases and 50,000 deaths a year from malaria, making the disease the leading cause of morbidity and the second-highest cause of mortality. Disease prevalence was highest among pregnant women and children under five, making Zambia one of the countries with the highest malaria-related maternal mortality in Africa and one with an extremely high under-five mortality rate (168 deaths per 1,000 live births) (DHS 2002). During this time, only 14 percent of households in Zambia owned an insecticide-treated net, 7 percent of children under five slept under a mosquito net the night before the survey, and

43 percent of children under five suffered from fever or convulsions in the two weeks preceding the survey, among whom about half received antimalarial drugs for their symptoms. Among pregnant women, just 8 percent slept under an insecticide-treated net, and only 36 percent received antimalarial drugs during pregnancy (DHS 2002).

Efforts. To control and reverse the deteriorating situation, the Zambian Ministry of Health identified malaria control as one of its main public health priorities and included it in both the National Development Plan 2006–10 and the National Health Strategic Plan 2006–10. Through the National Malaria Control Centre, the Ministry of Health developed a detailed national malaria strategic plan, which aimed to drastically reduce the malaria burden—by scaling up malaria control interventions—with a vision of achieving a malaria-free Zambia. This plan was the backbone for support by the country and its partners.

The strategy adopted a two-pronged approach, aiming to bring malaria under control with key malaria control interventions while at the same time supporting broader improvements in health systems, including decentralizing budgeting and planning, building capacity throughout the supply chain for procurement and forecasting of commodities, and strengthening monitoring and evaluation and program management. As a result of these combined efforts, 3.6 million long-lasting insecticide-treated bed nets were distributed throughout the country between 2006 and 2008, raising the percentage of households with one long-lasting insecticidal-treated net from 48 to 72 percent. Indoor residual spraying coverage increased from 15 districts in 2006 to 36 districts in 2008.

Results. The impact of Zambia’s efforts has been felt countrywide. In just two years the number of malaria deaths declined 47 percent, and nationwide surveys showed a decline in parasite prevalence of 53 percent (from 21.8 percent in 2006 to 10.2 percent in 2008). The percentage of children with severe anemia declined 68 percent (from 13.3 percent in 2006 to 4.3 percent in 2008). The percentage of children under five with malaria parasite prevalence fell by half (from 22 percent in 2006 to 10.2 percent in 2008) and the percentage of children under five with severe anemia fell from 14 percent in 2006 to 4.3 percent in 2008 (MIS 2008). These successes reduced the overall under-five mortality from 168 in 2002 to 148 in 2008 (UNICEF 2008). The successful scale-up of Zambia’s malaria program contributed to a 29 percent drop in the overall mortality rate for children under five between 2002 and 2008, saving an estimated

75,000 lives over that period. The capacity of the malaria program as well as supporting critical health systems interventions was strengthened for better management.

Fragile progress. Zambia's success illustrates one of the most important issues associated with malaria control efforts. Delayed external financing slowed execution of all of the necessary malaria control interventions between June 2009 and December 2010, causing a significant decline in malaria outcomes in some provinces of the country. Data from the 2010 Zambia National Malaria Indicator Survey indicates a resurgence in malaria between 2008 and 2010. Most of this increase was in rural areas, among the poorest segments of the population. In three of the country's nine provinces, about half of the decrease in malaria cases between 2006 and 2008 was lost by 2010. In Luapula and the Northern Provinces, there were marked declines in ownership and use of mosquito nets between 2008 and 2010, which alone could explain the increase in malaria cases. Zambia's experience shows that once the disease is under control, efforts have to be sustained if gains are not to be reversed or even worsened, because malaria can have an even deadlier impact on a population that has lower immunity to the disease.

LESSONS LEARNED AND THE WAY FORWARD

Effective tools for malaria prevention and treatment exist. With concerted and collaborative efforts, implementation of these tools is starting to show results in Africa. Progress in the past few years has shown that success in Africa is possible. The results of WHO's 2010 *World Malaria Report* are very encouraging. Since 2000, 11 countries have shown decreases in malaria cases after widescale implementation of malaria control activities in the population at high risk. In Botswana, Cape Verde, Eritrea, Madagascar, Rwanda, Zambia, and other countries, the number of cases has fallen by more than half. By the end of 2010, about 289 million insecticide-treated nets were to have been delivered to Sub-Saharan Africa, enough to cover 76 percent of the 765 million people at risk of malaria there. Global malaria control efforts have resulted in a reduction in the estimated number of deaths from nearly 1 million in 2000 to 781,000 in 2009. The international community has played an important role in supporting government efforts to reduce the impact of malaria through substantial financial and technical support in the past decade.

These emerging successes notwithstanding, more remains to be done. Sustained support is needed to replace

nets and scale up other proven interventions (access to effective diagnosis and treatment, indoor residual spraying). Gaps in increased coverage and use of malaria control activities remain substantial in many countries. To continue and intensify the fight against malaria, increased funding is required for activities that prevent and treat malaria. In countries where there has been significant progress, resources must be sufficient to, at the very minimum, maintain efforts, so that the disease does not resurface.

It is critical that political will and financing be sustained. Failure to protect and expand on the fragile progress taking place in Africa will lead to a resurgence of malaria cases and deaths. Learning from early successes is critical to avoiding such a prospect. Several lessons emerge from African countries' experience:

- The high level of external funding, coupled with in-country ownership, has proven to be extremely successful in combating malaria. Government ownership and initiative to work with partners in support of established policy in the malaria control programs at the country level is essential.
- Bed net coverage has rapidly increased, but other key interventions are lagging, and the gaps are becoming increasingly more critical. There needs to be more focus on use of key interventions, monitoring of drug resistance, deployment of rapid diagnostic tests, and access to ACTs.
- At a minimum, maintaining current levels of funding in order to ensure prevention and treatment activities is essential in the short and medium term to protect the progress that has been achieved to date. To reach the Abuja targets of the Roll Back Malaria Partnership—coverage of 80 percent for insecticide-treated nets for people at risk, treatment with appropriate antimalarial drugs for people with probable or confirmed malaria, indoor residual spraying for households at risk, and intermittent treatment in pregnancy in high-transmission areas—funding needs to be about four times the current level. This estimate does not take into account the resource needs to reach the universal coverage target of the population at risk by the end of 2010 set by the Secretary-General of the United Nations and highlighted in the RBM Global Malaria Action Plan.
- Without continued and additional resources in the short and medium term, countries may risk a resurgence of malaria cases in the coming years. Zambia highlights this issue by showing that significant progress is possible but that it is fragile and needs a sustained effort.

- To achieve long-term financial sustainability in national health systems, national malaria control funding as well as the national health budget of countries will need to increase. In the long run, malaria control efforts will need to be covered more substantially by those sources. Both governments and partners need to address financial sustainability.
- Financing should focus on supporting countries that have not yet scaled up their prevention and treatment efforts while maintaining support to those that have.
- Support needs to be provided to countries ready to move toward eliminating malaria. In this context, more attention will have to be placed on cross-border and regional activities.
- Strengthening health system aspects such as supply chains and human resources as well the interface between health systems and disease control will be needed to sustain gains.

NOTES

1. There are four types of human malaria: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, and *Plasmodium ovale*. *Plasmodium falciparum* and *Plasmodium vivax* are the most common. *Plasmodium falciparum*, the most deadly form of the disease, is the predominant type of malaria in Sub-Saharan Africa.

2. The original Abuja targets were set and agreed to by 53 African heads of state in the Abuja Declaration on Roll Back Malaria in Africa on April 25, 2000. They included the following targets: at least 60 percent of those suffering from malaria have prompt access to and are able to use correct, affordable, and appropriate treatment within eight hours of the onset of symptoms; at least 60 percent of those at risk of malaria, particularly pregnant women and children under five years of age, benefit from the most suitable combination of personal and community protective measures, such as insecticide-treated mosquito nets and other materials to prevent infection and suffering; at least 60 percent of all pregnant women who are at risk of malaria, especially those in their first pregnancies, have access to chemoprophylaxis or presumptive intermittent treatment.

3. Lot Quality Assurance Sampling (LQAS) was developed in the 1920s as a quality control technique for goods produced on a factory assembly line. It was used to examine a small number of units randomly selected from each lot. If the number of defective items in that small sample exceeded a predetermined number, the lot was examined more closely and either repaired or discarded; otherwise the lot was accepted. The number of units tested and the maximum allowable number of defects were determined to ensure

that there was a high probability that the lots accepted contained no more than a specified proportion of defective goods and that the lots rejected contained a relatively high proportion of defective goods. Since the 1980s, use of LQAS in health assessment has increased. In 1991 WHO identified LQAS as one of the more practical rapid assessment methods and encouraged further study. (For examples of LQAS application in the health field, see Robertson 1997.) LQAS has been employed for a range of purposes, including monitoring immunization program performance in Southeast Asia, Peru, and the United States and assessing immunization coverage. To monitor immunization, supervisors sample records to assess compliance with immunization protocols. The number of “defective” or incorrect procedures allowed per lot is set to determine whether a facility (or lot) is accepted or rejected. LQAS can also be used to assess compliance with a policy, such as patient screening practices or immunization administration; identify areas of high incidence of specific diseases; or assess program impact.

4. According to the Zambia MIS carried out in 2010, the percentage of women sleeping under an insecticide-treated net rose from 43 percent to 46 percent.

5. Once a diagnosis of malaria is established, effective treatment should be started within 24 hours of the onset of symptoms, to avoid progression to severe malaria, for which the case fatality rate is high.

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