

## SECTION II: MALARIA CONTROL, BY REGION

### I. AFRICA

- Parasitological species of malaria cases: *P. falciparum* 93%, *P. vivax* or *P. falciparum/P. vivax* mixed 7%
- Principal malaria vectors: *A. gambiae*, *A. funestus*
- Estimated proportion of population at risk of malaria: 66% (21)
- Estimated contribution to the global burden of clinical malaria cases: 59% (2)
- Estimated contribution to the global burden of clinical falciparum malaria cases: 74% (2)
- Estimated contribution to the global malaria mortality burden: 89% (1)
- Main control strategies: **prompt and effective treatment including home management of malaria, ITNs, IPT, IRS, epidemic preparedness**

#### 1. Disease burden

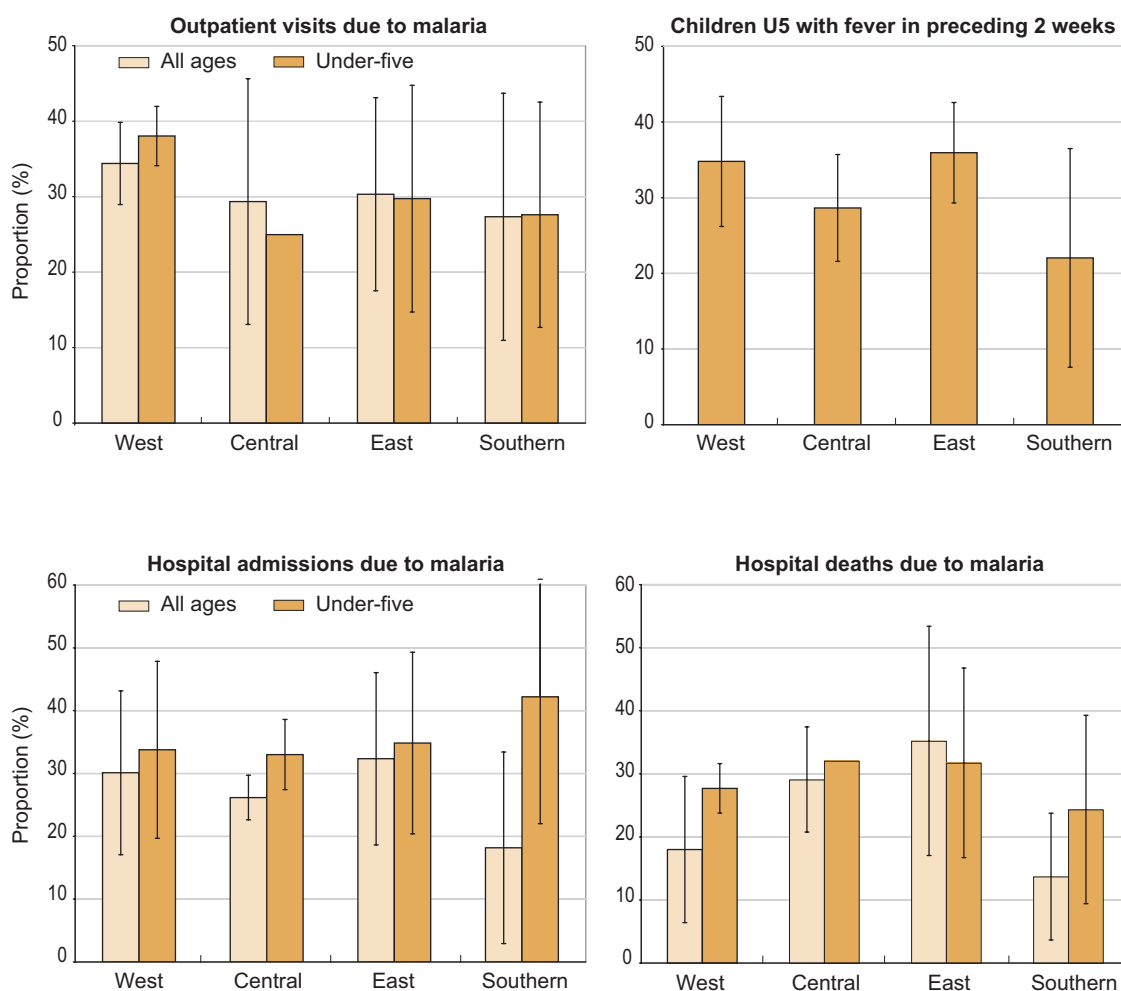
Africa remains the region that has the greatest burden of malaria cases and deaths in the world. In 2000, malaria was the principal cause of around 18%— 803 000 (uncertainty range 710 000–896 000)—of deaths of children under 5 years of age in Africa south of the Sahara (19). During the 1980s and the early 1990s, malaria mortality in rural Africa increased considerably, probably as a result of increasing resistance to chloroquine (18, 19). Malaria is also a significant indirect cause of death: malaria-related maternal anaemia in pregnancy, low birth weight and premature delivery are estimated to cause 75 000–200 000 infant deaths per year in Africa south of the Sahara (28). Malaria epidemics result in an estimated up to 12 million malaria episodes and up to 310 000 deaths per year in Africa (29).

In contrast to the endemic countries in Africa south of the Sahara, Egypt and Morocco have only residual malaria transmission and occasional imported cases. Their goal in controlling malaria is to eliminate the few remaining foci of transmission by 2006 (30). The remainder of this section focuses on countries in Africa south of the Sahara.

**Burden on health systems**

In Africa south of the Sahara, the case rates reported through national HIS represent only a minor fraction of the actual burden of malaria (31). Access to clinical care is poor, especially in the most rural areas where malaria transmission is most intense. Furthermore, reporting from facilities to districts and from districts to health ministries is incomplete, and completeness and timeliness vary between and within countries. Finally, in clinics most cases of malaria are diagnosed on the basis of clinical symptoms rather than on laboratory confirmation, which is rarely available at first-line health facilities.

**Figure 2.** Burden of malaria on health systems in Africa south of the Sahara, by subregion, 1999–2004



Proportion of outpatient visits, hospital admissions and hospital deaths due to malaria from national HIS data averaged from 2001 to 2003 or the 3 most recent years with available data since 1999 from countries in Africa south of the Sahara; proportion of children under 5 years of age with fever in the preceding 2 weeks from national DHS (11) and MICS (10) between 1999 and 2004 (median survey year 2000). Error bars indicate the standard deviation.

Given the incompleteness of case and death reporting from health facilities, the *proportions* of reported cases and deaths caused by malaria relative to the total number of cases and deaths from all causes are more informative indicators than *absolute* numbers of reported malaria cases and deaths. Across endemic countries, an average of 25–35% of all outpatient clinic visits are for (clinically diagnosed) malaria, both in children under 5 years of age and in other age groups. In these same countries, between 20% and 45% of all hospital admissions are caused by malaria. With high case-fatality rates due to late presentation, inadequate clinical management and unavailability or stock-outs of effective drugs, malaria is also a major contributor to deaths of hospital inpatients. The proportional malaria burden is somewhat lower in the Southern Africa subregion than in the Central, East and West Africa subregions (Fig. 2).

Especially among children under 5 years of age, malaria is an important contributor to demand for health care because of the high prevalence of fever in this age group. Throughout Central, East and West Africa, about 30–35% of children under 5 years of age report a fever in the 2 weeks preceding a survey (Fig. 2). The Integrated Management of Childhood Illness recommends, along with RBM, that in areas of high malaria endemicity all acute fevers in children under 5 years of age be treated presumptively with an antimalarial (32). Thus, although not all childhood fevers are in fact caused by malaria, these fevers do determine the demand for antimalarial treatments.

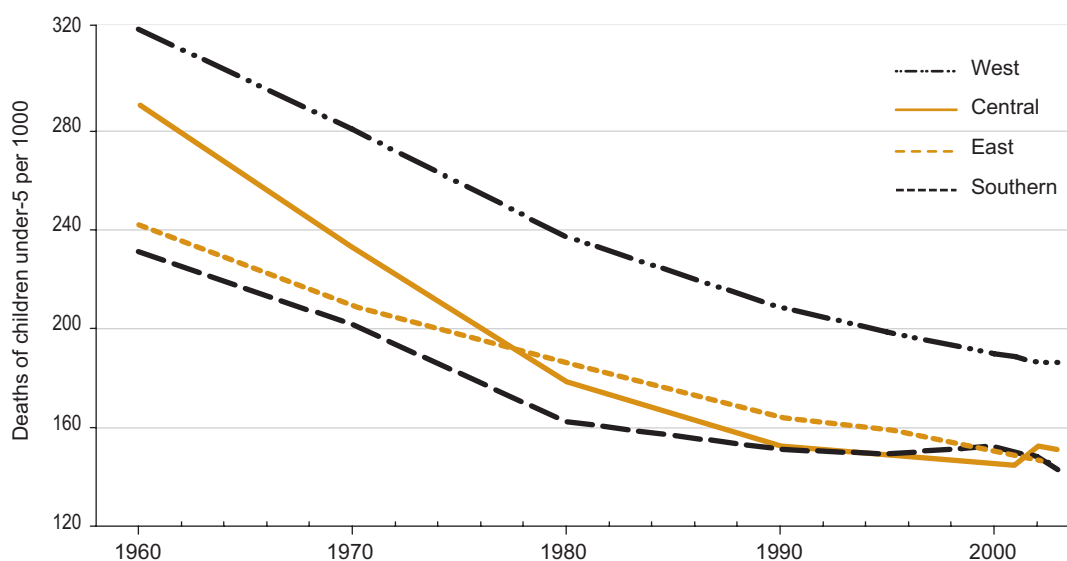
Although these data provide an indication of the continuing high burden of malaria on African health systems, annual reporting from countries to WHO is not complete enough to allow an evaluation of recent time trends.

### ***All-cause under-5 mortality***

In Africa south of the Sahara, all-cause under-5 mortality is an important indicator of the burden of malaria. Children in this age group are those most likely to develop severe disease and to be at risk of dying from malaria. In addition to the around 18% of all-cause deaths in African children under 5 years of age that are directly attributable to malaria (19), an even greater proportion of child deaths is probably indirectly related to malaria: repeated malaria infections contribute to the development of severe anaemia and make young children more susceptible to severe outcomes of other common childhood illnesses such as diarrhoea and respiratory diseases (33). In addition, malaria in pregnant women contributes to low birth weight, a major risk factor for infant mortality (34). Further demonstration of the importance of malaria as a contributor to deaths among young children is the series of community-randomized ITN trials that demonstrated a reduction in all-cause under-5 mortality by up to 25% (35). National household surveys provide more comprehensive data on all-cause under-5 mortality than is available for malaria-specific mortality, which is difficult to define and measure at a population-level with adequate specificity and sensitivity (19).

Throughout Africa south of the Sahara, the decrease in all-cause under-5 mortality that was apparent during the 1970s and 1980s levelled off in the 1990s (36) (Fig. 3). Besides HIV/AIDS, increased mortality caused by malaria in the 1990s compared with earlier decades is probably among the explanations for this trend (18).

**Figure 3.** Trend in all-cause under-5 mortality in countries in Africa south of the Sahara, by subregion, 1960–2002 (36)



## 2. Control efforts and progress towards Abuja coverage targets

At the African Summit on Roll Back Malaria in Abuja, Nigeria, in 2000, African heads of state committed themselves to halving the burden of malaria by 2010, by achieving a 60% coverage of all at-risk populations with suitable curative and preventive measures by 2005 (Box 1). However, few countries are likely to reach the 60% target for coverage of access to prompt and effective treatment for ITNs and IPT for protection of pregnant women by 2005 because, until very recently, control efforts remained too fragmented and major international investment materialized too late (37).

Around US\$ 2 billion per year—of which US\$ 1 billion is needed for ACTs—is estimated as needed to effectively combat malaria in Africa (38). Currently only about one quarter of this amount is available. However, financial support for programmes to prevent and treat malaria has increased rapidly over the past few years. Complemented by increased capacity development at all health system levels, through technical support to national control programmes and other avenues, progress is now likely to accelerate.

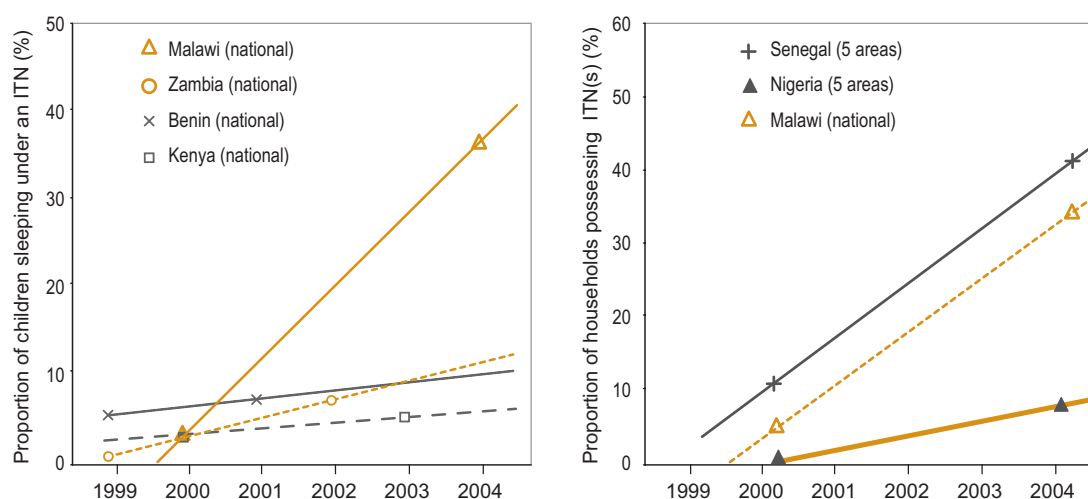
## 3. Coverage of mosquito nets and insecticide-treated nets

Increased national and international funds have boosted the deployment of ITNs. About half of the African countries have waived taxes and tariffs on nets, netting materials and insecticides. Since 2002, several countries started scaling up free of charge or highly subsidized provision of ITNs for children under 5 years of age and pregnant women (Table 6).

As a result, there has been a substantial increase in ITN coverage in several of these countries, according to household surveys conducted over time that measured either ITN usage by children under 5 years of age or household ownership of ITNs (Fig. 4).

**Table 6.** Initiatives to scale up ITN coverage started between 2001 and 2004

|  |  |
|--|--|
| Togo, Zambia   | Free distribution to children under 5 years of age during broader health campaigns including measles immunization (Box 4)  |
| Malawi   | Social marketing and distribution of highly subsidized ITNs through mother and child health clinics (Box 5)  |
| United Republic of Tanzania  | Subsidies in the form of discount vouchers delivered to pregnant women through antenatal clinics, in collaboration with the commercial sector  |
| Benin, Eritrea, Ghana, Mali, Nigeria, Senegal                                | Distribution of free and highly subsidized ITNs through routine antenatal clinics and routine child-immunization (Expanded Programme on Immunization) clinics (Box 6); free mass (re-)treatment campaigns in Eritrea |
| Ghana, Malawi, Uganda, Zambia  | National Child Health Days for distribution of ITNs and (re-)treatment, along with vitamin A and/or deworming medication   |
| Benin, Kenya, Madagascar, Mali, Nigeria, Rwanda, United Republic of Tanzania | Social marketing   |

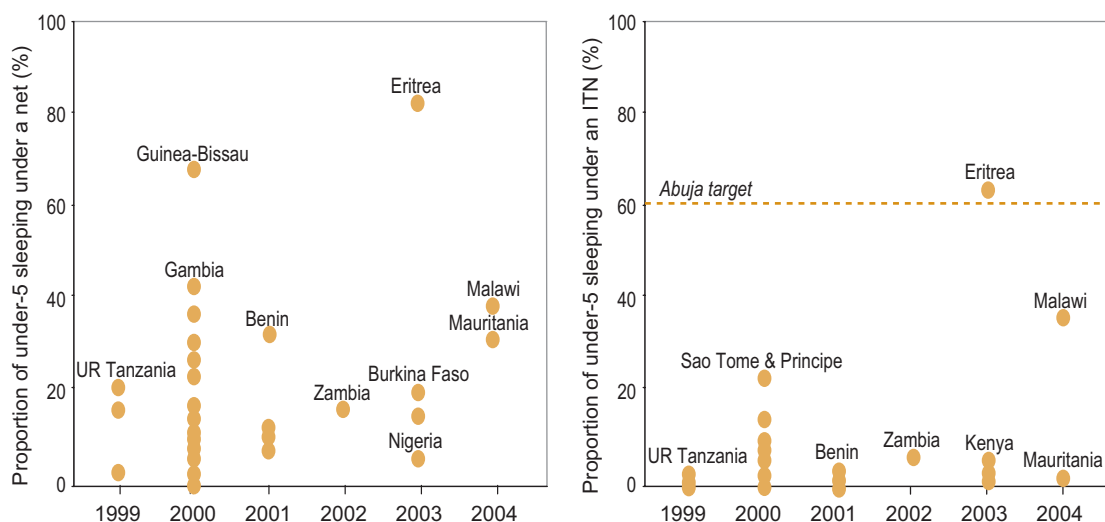
**Figure 4.** Time trends in ITN coverage in selected African countries with multiple data points, 1999–2004

Data for Benin, Kenya and Zambia from national DHS or MICS (10, 11); data for Nigeria and Senegal from Netmark surveys in selected areas with malaria (12); data for Malawi from DHS in 2000 (11) and a nationally representative survey by the MoH in 2004. Symbols indicate survey data; lines indicate estimated linear time trends based on the survey data.

On an Africa-wide scale, it is more difficult to precisely describe the current level of ITN coverage or the progress in increasing ITN coverage. Of the 45 African countries where ITNs form part of the national malaria control strategy, 36 had a representative household survey that measured child usage of nets and/or ITNs at some point between 1999 and 2004, but most of these surveys were conducted in 2000–2001. According to available surveys, only Eritrea, in 2003, reached the Abuja target of 60% ITN usage (Fig. 5). For many other countries that started scaling up ITN distribution in 2001, no data point later than 2000 is available (Table 6). It should be noted that the data presented in figure 5 and Box 3 represent national-level outcomes, except for Eritrea. In countries where malaria risk is not universal, ITN usage in those areas at actual malaria risk might be higher than the national average. There is a need for additional high-quality household surveys to measure

time trends in ITN coverage. Around 2007, more information will be available after another approximately 30 MICS and DHS planned in malaria-endemic African countries for 2005–2006 (10, 11).

**Figure 5.** Proportion of children under 5 years of age sleeping under mosquito nets and ITNs in African countries, by year of survey, 1999–2004



Data from national household surveys, except for Eritrea, which had a representative household sample survey in the three zobas with risk of malaria (39). For each country, the most recent national datapoint is presented.

Available surveys do indicate that coverage with any net is generally much higher (up to 10-fold) than coverage with ITNs: across all countries with data—taking the most recent survey point in each country—a median of only 11% of nets used by children under 5 years of age (range: 0–93%, 34 surveys) and a median of just 18% of nets owned by households (range: 1–79%, 10 surveys) were ITNs. Countries where ITN distribution was recently successfully scaled up include Eritrea, Malawi and Rwanda, where over half of nets used by young children were ITNs. A much larger number of untreated nets, compared to ITNs, are already available for at-risk populations, especially in West and Central Africa. This indicates that the provision of (re-)treatment of nets as a free public service is an important complement to the distribution of ITNs.

### BOX 3. ESTIMATED AFRICA-WIDE INSECTICIDE-TREATED NET USAGE BY CHILDREN UNDER 5 YEARS OF AGE

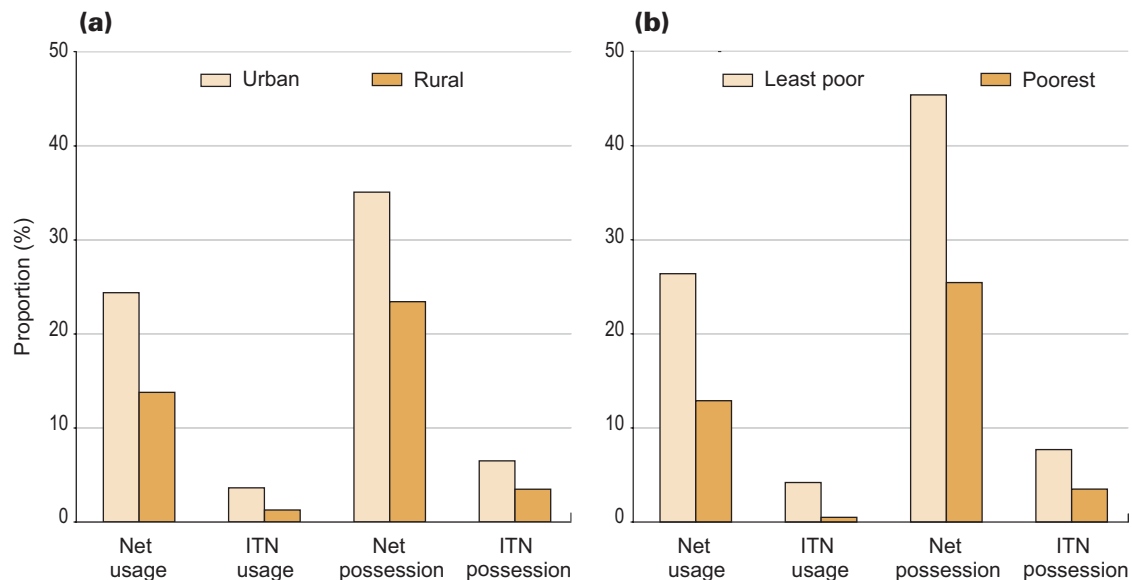
Considering the most recent available national survey for each country—with the exception of the most recent survey that covered all areas at risk of malaria in Eritrea—the population-weighted coverage of ITN usage in African children under 5 years of age was 3%. This is from 34 surveys conducted in a median survey year of 2001.

For comparison, the population-weighted coverage of ITN usage in African children under 5 years of age reported in *The Africa Malaria Report 2003* for the median year 2000 was 2% from 29 surveys (31). The difference is explained by new survey values for Burkina Faso, Eritrea, Ghana, Kenya, Mauritania and Nigeria.

### Countering inequities in ITN coverage

The cost of an ITN is a major barrier to ownership and usage for a large proportion of Africans who are among the poorest of the poor and also the most highly affected by malaria. Although the malaria burden is highest in rural areas and among the poorest people, ITN coverage tends to be generally higher in urban areas and in wealthier households. This is evident from the data from national surveys. Net and ITN possession and usage by children under 5 years of age are twofold to threefold lower in rural areas compared with urban areas. Net and ITN possession and usage are between twofold and eightfold lower in the poorest households compared with the least poor households (Fig. 6).

**Figure 6.** Median net and ITN possession (as % of households) or usage (as % of children under 5 years of age that slept under a net or ITN the night before a survey) in selected African countries by urban and rural division (a) and among the 20% poorest and 20% least poor households (b)

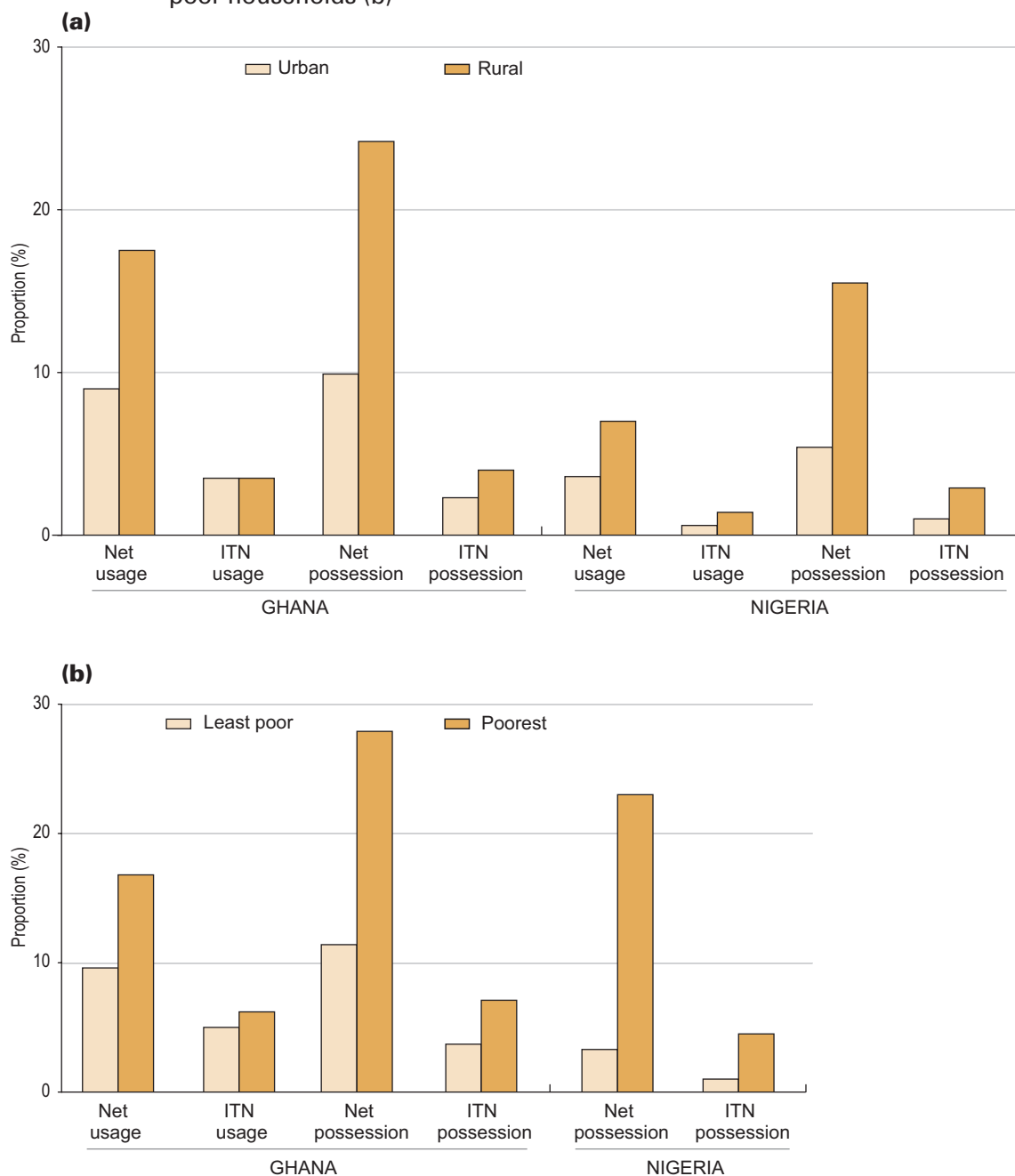


Data from national household surveys conducted between 1999 and 2004: urban/rural: net usage from 36 surveys, ITN usage from 34 surveys, net possession from 17 surveys, ITN possession from 8 surveys; poorest/least poor households: net usage from 25 surveys, ITN usage from 25 surveys, net possession from 6 surveys, ITN possession from 4 surveys.

Social marketing and subsidized or free of charge distribution of ITNs for target groups can effectively reduce this inequity, as was recently illustrated in Ghana, Nigeria and Togo (Box 4). Since 2002, in deprived areas of Ghana and Nigeria, UNICEF-supported programmes have supplied highly subsidized ITNs to pregnant women and children under 5 years of age through routine public health services. A year after the programmes began, usage of ITNs by children under 5 years of age and pregnant women in rural areas was similar to or higher than that in urban areas. Net possession in Nigeria and net possession as well as usage in Ghana were equally high or higher in the poorest households compared with the least poor households (Fig. 7). Although no ITN coverage data from earlier years are available for Ghana and Nigeria, the contrast with less favourable coverage distribution patterns in neighbouring countries that lacked subsidized distribution programmes is clear (Fig. 6).

In contrast to these inequities between urban and rural areas and between poorest and least poor households, no gender inequities are evident: in available survey data, net and ITN usage were generally similar for boys and for girls.

**Figure 7.** Median net and ITN possession (as % of households) or usage (as % of children under 5 years of age) in Ghana and Nigeria in 2003 after programmes of intensified distribution of free and subsidized nets in deprived areas, by urban and rural division (a) and among the 20% poorest and the 20% least poor households (b)



Data from national DHS surveys conducted in 2003 (11).



#### BOX 4. INTEGRATING INSECTICIDE-TREATED NET DISTRIBUTION WITH SCALED-UP IMMUNIZATION CAMPAIGNS IN ZAMBIA AND TOGO

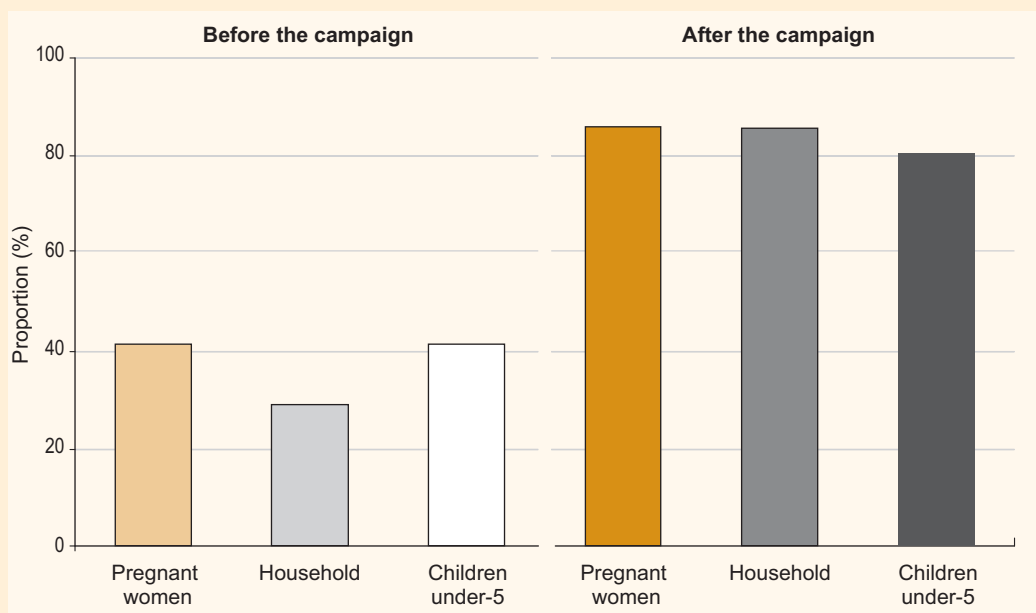
National campaigns of ITN distribution in combination with measles immunization conducted in Zambia in 2003 and in Togo in 2004 demonstrated an unprecedented successful approach of scaling up ITN coverage within only a few days.

#### Zambia

In 2003, the Zambian MoH, with support from UNICEF, the Canadian Red Cross and the Canadian International Development Agency, conducted a campaign integrating measles vaccination, ITN distribution, vitamin A supplementation and mebendazole treatment for intestinal worms in five underserved districts of Zambia. All households with children under 5 years of age were given an ITN. The Zambian Red Cross provided social mobilization and community education.

According to a survey conducted after the campaign, this resulted in greater than 80% coverage for all interventions in the five districts, which had 89 000 children under 5 years of age (Fig. 8). As part of the high and universal coverage, ITN usage was scaled up in a rapid and equitable way, reaching the poorest and most vulnerable segments of the population. Under the platform of the national measles campaign, the delivery cost per ITN was only US\$ 0.36 (and the production cost US\$ 4.41 per ITN).

**Figure 8.** Abuja target of 60% ITN usage was surpassed in 6 days in all five targeted districts of Zambia



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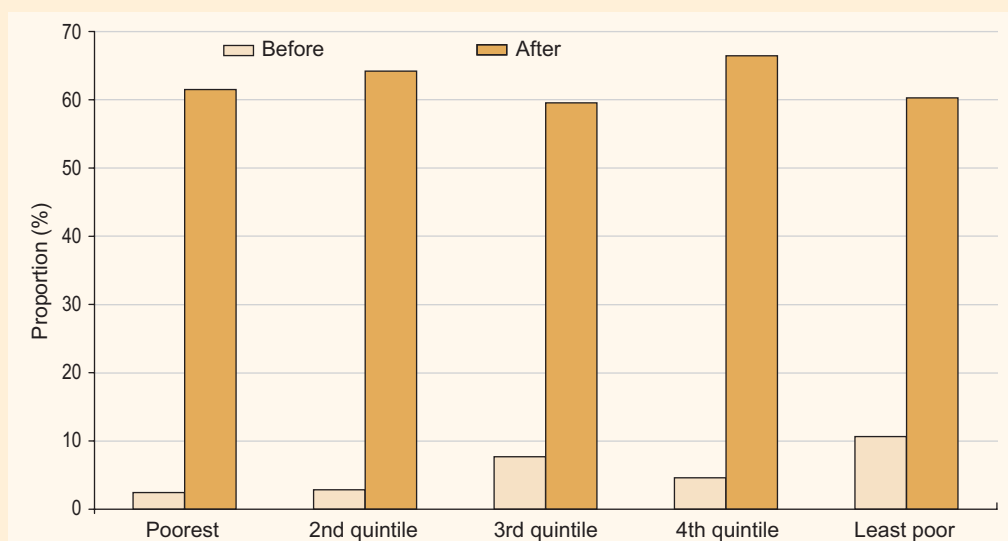
## Togo

A national campaign of ITN distribution, measles and polio vaccination and deworming treatment was conducted in Togo in December 2004. About 920 000 ITNs were distributed, or one per child under 5 years of age. Preceding the campaign, volunteers from the Togolese Red Cross Society conducted door-to-door and community social mobilization campaigns informing people about the importance of protecting their children and about the location of the vaccination and distribution centres. Through monthly home visits, Red Cross volunteers advise families on the proper use of the mosquito nets, and provide additional vaccinations and free ITNs to others at risk including pregnant women, neonates and immigrant children.

In January–February 2005, staff from the Togolese MoH, the Togolese Red Cross Society and the Division of Parasitic Diseases at the United States Centers for Disease Control and Prevention, Atlanta, conducted a household survey to assess the increase in ITN coverage resulting from the campaign. Trained personal data assistants with geopositioning capacity mapped relevant sampling units. Across 12 sampled districts, covering all 6 country regions, around 2254 households with 2259 children under 5 years of age were interviewed. Preliminary results indicate that, on a weighted basis, the campaign increased possession of ITNs from 6% to 62% averaged over all households. An estimated 98% of households with a child under 5 years of age now have at least one ITN, of which approximately 95% were obtained from the distribution campaign. The campaign had the effect of equalizing ITN ownership rates between groups of different socioeconomic status, although all groups benefited greatly (Fig. 9). Under the innovative mechanism of delivering ITNs using the platform of measles immunization, the incremental cost of delivery was less than US\$ 0.50 per ITN.

Campaigns combining immunization with other life-saving interventions such as ITN distribution are expected to become a major contribution towards achieving the Millennium Development Goal for reducing child mortality and the Abuja target of 60% ITN usage in Africa. In 2005–2006, similar campaigns are planned for areas of southern Chad, Equatorial Guinea and Niger at risk of malaria.

**Figure 9.** ITN ownership by households, before and after the integrated distribution campaign in Togo



**BOX 5. SCALING UP NET DISTRIBUTION IN MALAWI**

In 2002, the Government of Malawi scaled up the distribution of ITNs. With support from UNICEF, the MoH formed a National Malaria Policy Advisory Committee including RBM partners WHO, the United States Centers for Disease Control and Prevention, Atlanta, Malaria Alert Centre, Population Services International, Management Sciences for Health and the College of Medicine of Malawi. The resulting National Malaria Control Policy confirmed the use of ITNs as an important strategy for controlling malaria. Guidelines were developed outlining the responsibilities of key partners and addressing: (i) pricing, cost recovery and use of revenue; (ii) procurement and logistics; and (iii) monitoring and evaluation activities.

Three types of distribution channels were launched to ensure widespread equitable access:

- facility-based distribution targeting child health and antenatal services in hospitals and health centres in all districts with heavily subsidized ITNs;
- community-based distribution using trained village health committees and local NGOs supplied with ITN starter kits;
- private sector distribution, mainly in urban centres where people can afford to pay more for ITNs, of which the sales are used to subsidize ITN distribution elsewhere.

ITNs are procured and donated by UNICEF, with funding from the United Kingdom Department for International Development. Population Services International manages the delivery, storage and distribution system and promotes ITN usage and demand from the private sector through social marketing. The MoH through the NMCP coordinates annual, week-long, national insecticide (re-)treatment campaigns to ensure that nets maintain their effectiveness.

Malawi now has one of the largest ITN distribution programmes in Africa. Distribution rose from 750 000 in 2002 to more than 3 million by the end of 2004. A national survey of 10 000 households conducted in March 2004 revealed that 43% of households own at least one net, compared with only 5% in 2000. More significantly, 35% of children under 5 years of age and 31% of pregnant women sleep under an ITN, and 4 districts out of 27 have already achieved the Abuja target of 60% of children and pregnant women sleeping under ITNs. The programme demonstrates that ITNs can be scaled up on a national level and that programme cost-effectiveness improves dramatically with increasing scale.

**BOX 6. INSECTICIDE-TREATED NET COVERAGE INCREASES  
IN MALI AND SENEGAL UNDER UNICEF'S ACCELERATED  
CHILD SURVIVAL AND DEVELOPMENT INITIATIVE**

In response to unacceptably high numbers of preventable childhood deaths in West and Central Africa, UNICEF selected a package of cost-effective interventions that could be rapidly scaled up, aiming at substantially reducing child deaths. With support from the Canadian Government and in coordination with national governments and MoHs, UNICEF began implementation of the Accelerated Child Survival and Development initiative in 11 countries in West and Central Africa in 2002.

A strengthened outreach system for the Expanded Programme on Immunization and antenatal care provides the backbone of the Accelerated Child Survival and Development programme. These far-reaching systems are then also used to provide young children and pregnant women with other life-saving interventions such as free or highly subsidized ITNs. Pregnant women and young children receive an ITN at the time of antenatal visits and routine immunizations—3 doses of the DTP vaccine—or measles vaccination.

Benin, Ghana, Mali and Senegal implemented the full package of interventions, including the Integrated Management of Childhood Illness (32), while Burkina Faso, Cameroon, Chad, Gambia, Guinea, Guinea-Bissau and Niger carried out intensified Expanded Programme on Immunization activities, ITN distribution and (re-)treatment of mosquito nets. The selection of the 11 Accelerated Child Survival and Development countries was based on high under-5 mortality rates, sound national health policies, reasonable health infrastructure, experience with health-sector reform and a commitment to poverty reduction, community participation and health empowerment. Poverty indicators and higher than national average under-5 mortality rates then determined the districts that were to receive Accelerated Child Survival and Development interventions.

By 2002, 97 districts had been selected and 16.2 million people targeted of which 2.8 million were children under 5 years of age. From 2002 to 2004, over 4 million ITNs were distributed to pregnant women and young children, and insecticide (re-)treatment campaigns took place on a regular basis.

After more than 18 months of Accelerated Child Survival and Development interventions, large-scale household coverage surveys carried out in 2003 showed significant increases in ITN use. ITN coverage among children and pregnant women rose from 1% to 46% in implementation districts in Senegal. In Mali's implementation districts, ITN coverage rose from 6% to 71% among young children and pregnant women. In both countries, the routine immunization coverage and the proportion of pregnant women attending three or more antenatal visits has doubled. Similar increases were also seen in other Accelerated Child Survival and Development countries.

#### 4. Coverage of antimalarial treatment

About two-thirds of malaria-endemic African countries have changed their antimalarial treatment policy since 1998 in response to the emergence of drug-resistant falciparum malaria; of these, 65% have done so since the Abuja Declaration of 2000. By the end of 2004, 23 countries had adopted ACTs in their antimalarial treatment policies (Box 7), while 22 countries had adopted home management of malaria in their national malaria control strategies, of which 11 are scaling up home management and 11 are piloting the strategy (Table 7).

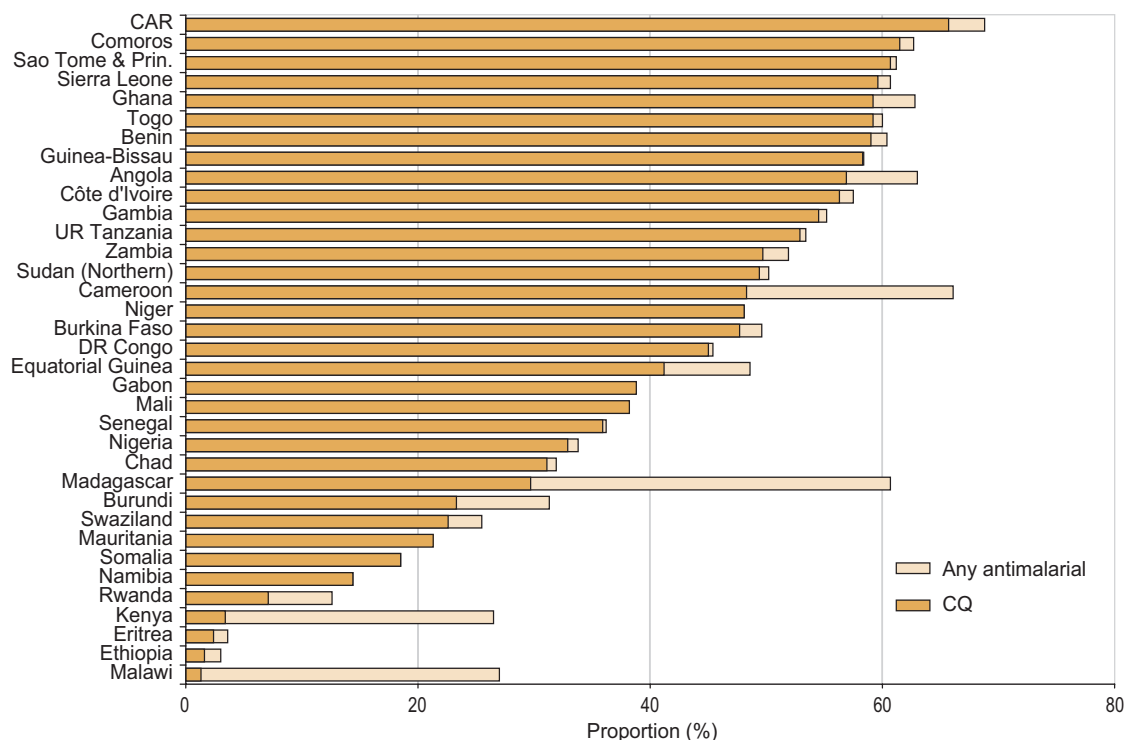
**Table 7.** Countries that adopted and implemented the strategy of home management of malaria in Africa, by the end of 2004

|   |   |
|---|---|
| Policy being implemented and scaled up  | Benin, Eritrea, Ethiopia, Gambia, Ghana, Madagascar, Nigeria, Senegal, Uganda, Zambia, Zimbabwe               |
| Policy being implemented in pilot areas | Burkina Faso, Cameroon, Guinea Bissau, Kenya, Mali, Niger, Togo, Rwanda, Malawi, Sao Tome and Principe, Sudan |

In Africa, where the vast majority of malaria cases and deaths occur in young children, WHO recommends that all acute childhood fevers in areas of high malaria endemicity be treated presumptively with an antimalarial (32). Therefore, the proportion of young children with fever who received an antimalarial drug represents a relevant survey-based indicator of the coverage of antimalarial treatment among all malaria patients with prompt and effective treatment. Between 1998 and 2004, across 35 national surveys, the median proportion of children under 5 years of age that were treated with an antimalarial drug was 49.6% (range 3.0–68.8%) (Fig. 10). However, most of these antimalarial treatments could not be considered effective since: (i) 95% were with chloroquine, against which there is a high rate of falciparum malaria resistance (Fig. 10); (ii) a significant proportion were not started within 24 hours of the onset of fever, so not all treatments were necessarily given in sufficient time to prevent a possible progression into severe life-threatening malaria (Fig. 11); and (iii) the dosages typically taken might not always have been adequate for full parasitological cure, although dosaging was not measured in national surveys. For these reasons, the coverage with prompt and effective antimalarial treatment was probably much lower than survey data indicate. However, it is likely that the proportion of fevers treated with effective antimalarial regimens is now increasing in those countries that have recently implemented a change in drug policy to combination treatment. There are as yet no wide-scale survey data available to document this, but national DHS and MICS scheduled for 2005–2006 will include detailed, standardized questions on antimalarial drug treatments.

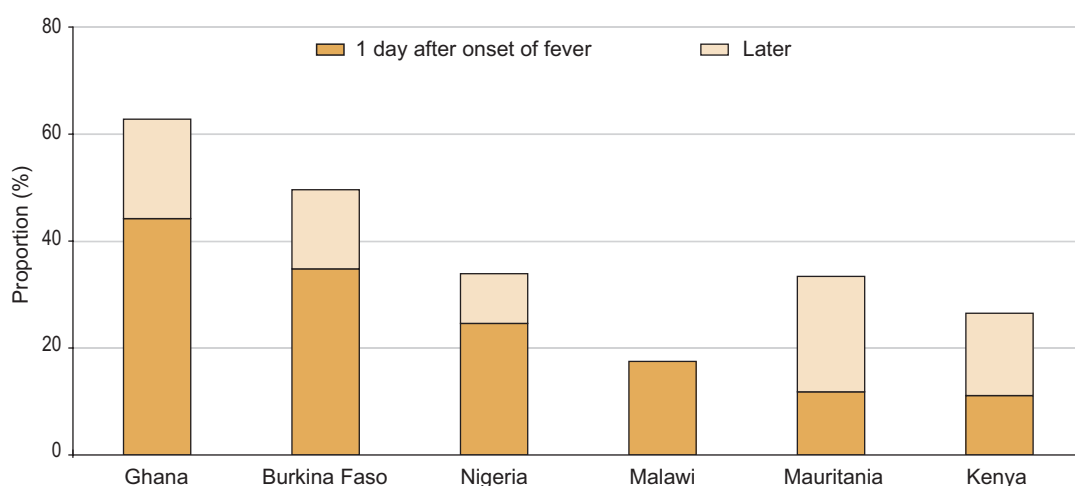
Strengthening of primary care for children under the strategy of Integrated Management of Childhood Illness is also expected to help improve the coverage of prompt and effective antimalarial treatment among children in Africa. As part of the strategy, prompt referral of sick children with defined danger signs from primary health facilities to the next level of the health-care system should improve the coverage of life-saving treatment for severe malaria (32). As of 2004, 38 countries in Africa south of the Sahara were implementing Integrated Management of Childhood Illness, of which 36% were in the early implementation phase and 58% in the expansion phase; among countries in the expansion phase, about one quarter had more than half of their districts implementing the strategy (37).

**Figure 10.** Proportion of children under 5 years of age with fever treated with any antimalarial or with chloroquine in countries in Africa south of the Sahara, 1999–2004



Data from most recent national household survey either DHS (11) or MICS (11). Median survey year is 2001.

**Figure 11.** Proportion of children under 5 years of age in selected African countries treated with an antimalarial starting within 1 day after onset of fever or later, 2003–2004



Data from most recent national household survey, either DHS (11) conducted in 2003 or 2004, and a survey by the MoH in 2004 for Malawi. In the Malawi survey, the coverage of antimalarial treatment starting more than one day after onset of fever was not measured.

### **BOX 7. BURUNDI: TREATMENT POLICY CHANGE IN THE MIDST OF A COMPLEX EMERGENCY**

In September 2000, the north-eastern part of Burundi experienced one of the deadliest malaria epidemics in recent times in Africa, affecting more than half the country's population and resulting in an estimated 10 000 deaths. As the death toll mounted, speculation rose about the effectiveness of the two drugs used to treat malaria—chloroquine and sulfadoxine–pyrimethamine. With support from UNICEF and other partners, the government of Burundi assessed the efficacy of chloroquine and sulfadoxine–pyrimethamine in four sites across the country in 2001. Treatment failure rates ranged from 51% to 74% for chloroquine and from 9% to 49% for sulfadoxine–pyrimethamine. The MoH therefore removed chloroquine from its antimalarial treatment guidelines.

Subsequent studies demonstrated the safety and effectiveness of two alternative therapies: the ACTs artesunate+amodiaquine and artemether–lumefantrine (Coartem®) (50). Based on cost and simplicity to administer, artesunate+amodiaquine was chosen to replace sulfadoxine–pyrimethamine as the first-line national treatment policy. Because no co-formulated (i.e. multiple components combined in a single pill) or co-packaged artesunate+amodiaquine combination was available from a prequalified supplier, interim guidelines were established to ensure that available medicines met WHO's manufacturing and quality standards. A national commission, including officials from the MoH, Doctors Without Borders, WHO and UNICEF, was established to guide and monitor implementation of the new policy.

Initially, the cost of the combination therapy, which at US\$ 2.80 per adult treatment course was higher than estimated during the planning stage, created a problem. Subsequently, the European Commission's Humanitarian Aid Office and the USAID Office of Foreign Disaster Assistance committed funding for an initial supply. To cover procurements for an initial 6 months, La Coopération Belge and the USAID Regional Economic Development Services Office for East and Southern Africa bridged the remaining gap.

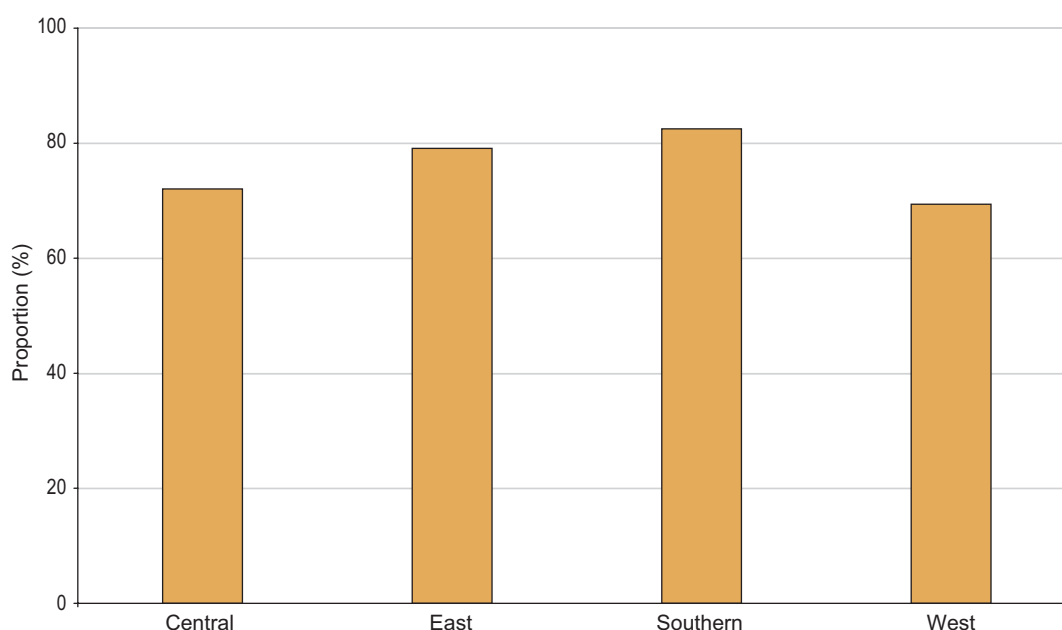
A national drug stock was created, stored and managed by UNICEF. All provincial health centres were provided with an initial 2-month supply of drugs. Before the launch, clinicians, nurses, and community health workers in the public sector and those working for NGOs in all provinces were trained in the use of the new treatment. To ensure equitable access at health facilities, the government developed a scaled pricing scheme, including free distribution to the very poor. Finally, the Health Promotion Service of the MoH launched a national communication strategy several months before the new drug was introduced to inform the population and practitioners about the new protocol.

The new treatment policy was successfully launched in November 2003. A rapid initial evaluation in six provinces suggested that the incidence of malaria had decreased over the first 9 months of 2004. A US\$ 13 million grant from the GFATM—half of which was earmarked for the purchase of ACT, the cost of which had dropped to US\$ 1.24 as of November 2004—will ensure the continued supply of drugs through 2006.

## 5. Malaria prevention and treatment in pregnant women

In all subregions of Africa, well-timed antenatal clinic attendance is key for delivering the malaria prevention package to pregnant women, since surveys have consistently shown that at least two thirds of pregnant women in malaria-endemic countries use antenatal care, and most of them attend antenatal clinics at least twice (Fig. 12). Since approximately 40% of these women present for the first time to an antenatal clinic in the second trimester of pregnancy, the first dose of IPT could be given in time to most pregnant women.

**Figure 12.** Proportion of pregnant women in Africa who receive antenatal care at least twice, based on national surveys, by subregion, 1995–2004



Data are from the most recent DHS ( $n = 29$  surveys); median survey year is 2000.

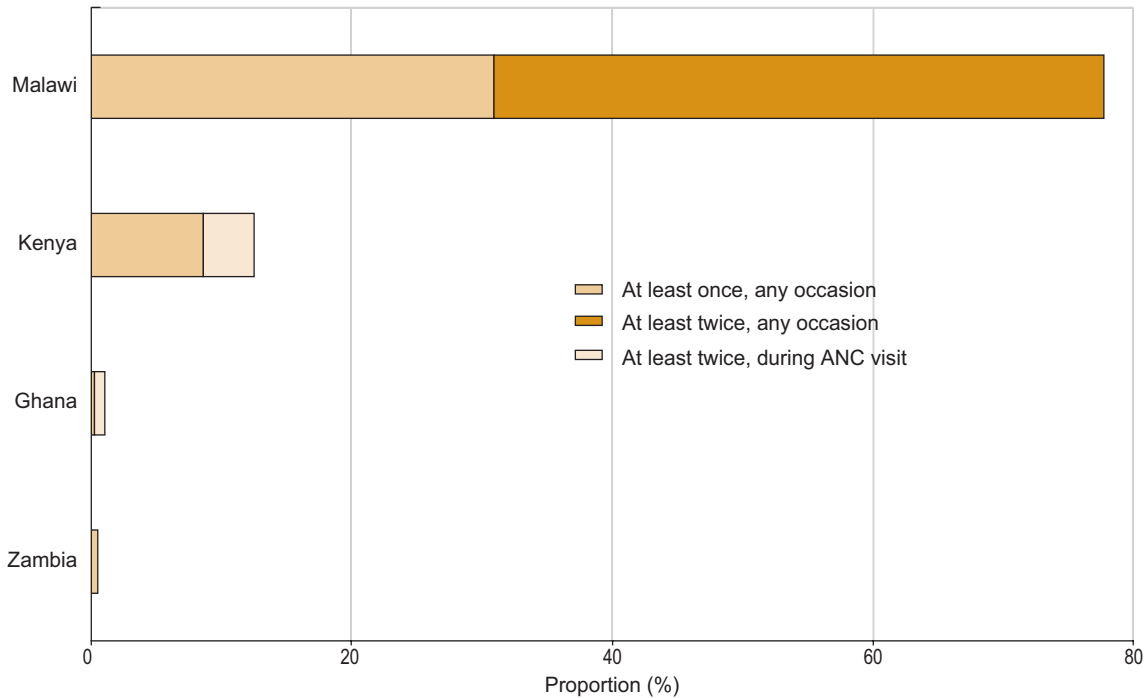
While initially few countries were using antenatal care services for IPT, the integration of IPT into these services became part of the national malaria control strategy in 21 countries by the end of 2004. However, only 11 of these countries are at some stage of actually implementing IPT. In Kenya, Malawi, Uganda, United Republic of Tanzania and Zambia, implementation covers the whole country or scaling up towards countrywide coverage is on track.

Coverage of pregnant women with IPT using sulfadoxine–pyrimethamine, according to national surveys in Ghana, Kenya and Zambia, generally remains below 10% (Fig. 13). An exception is 47% coverage in Malawi, the first country to adopt IPT in its national malaria control policy. The interpretation of these data is complicated because some surveys measured the receipt of sulfadoxine–pyrimethamine specifically during antenatal clinic visits, while other surveys measured any usage during pregnancy regardless of the occasion or source; the latter would include both preventive and curative treatments and thus overestimate IPT programme coverage. Moreover, for both outcomes some surveys reported use of sulfadoxine–



pyrimethamine regardless of the number of doses, while others reported coverage only for those women who received at least 2 doses during the pregnancy, which is the WHO-recommended frequency for IPT policy. Recent progress in standardizing assessment of IPT coverage in household surveys will address these inconsistencies.

**Figure 13.** Proportion of pregnant women receiving sulfadoxine–pyrimethamine based on national surveys conducted in African countries, 2002–2004



Median survey year is 2003 and includes countries where IPT implementation is currently underway or planned for the whole country. Surveys reflect DHS 2002 (Zambia), DHS 2003 (Ghana, Kenya) and MoH 2004 (Malawi). IPT was adopted in Ghana in 2004 and implementation began at the end of the year.

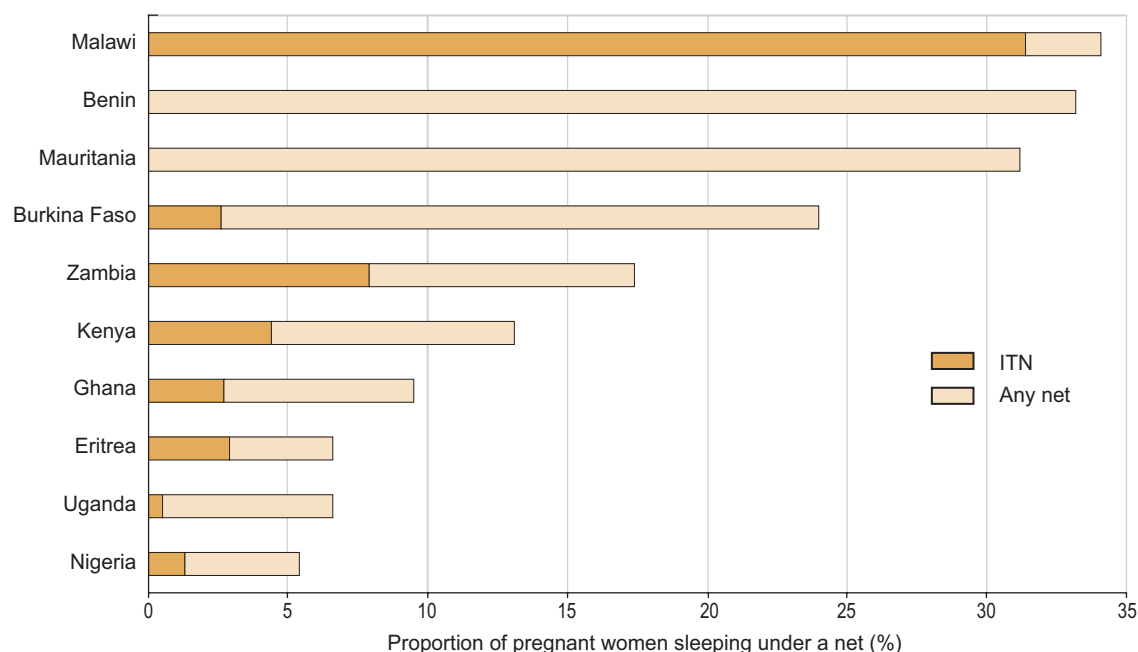
IPT coverage was fairly equally distributed between urban and rural areas and between less poor and poorer women, reflecting that antenatal clinic services are widely used among all socioeconomic levels of African populations and thus providing a major opportunity for delivery of IPT.

National-level surveys indicate that use of mosquito nets among pregnant women in malaria-endemic countries remains unacceptably low (Fig. 14). The proportion of pregnant women sleeping under a net (irrespective of the net's treatment status) was a median of 15% (range 5.4–34.1%) across 10 surveyed countries. Coverage with ITNs was a median of 2.8% (range 0.5–31.4%) across 8 national surveys.

## 6. Coverage of indoor residual spraying

About half of the endemic countries, mainly in Southern and East Africa, include targeted IRS in their NMCP strategy. An increasing number of African countries use IRS for mosquito control, and the reported number of households or units sprayed rose from around 2.7 million in 1999 to over 4 million in 2003.

**Figure 14.** Proportion of pregnant women sleeping under a mosquito net and ITNs in countries in Africa south of the Sahara, based on national surveys, 2001–2004



Median survey year is 2003.

## 7. Coverage of epidemic detection and control

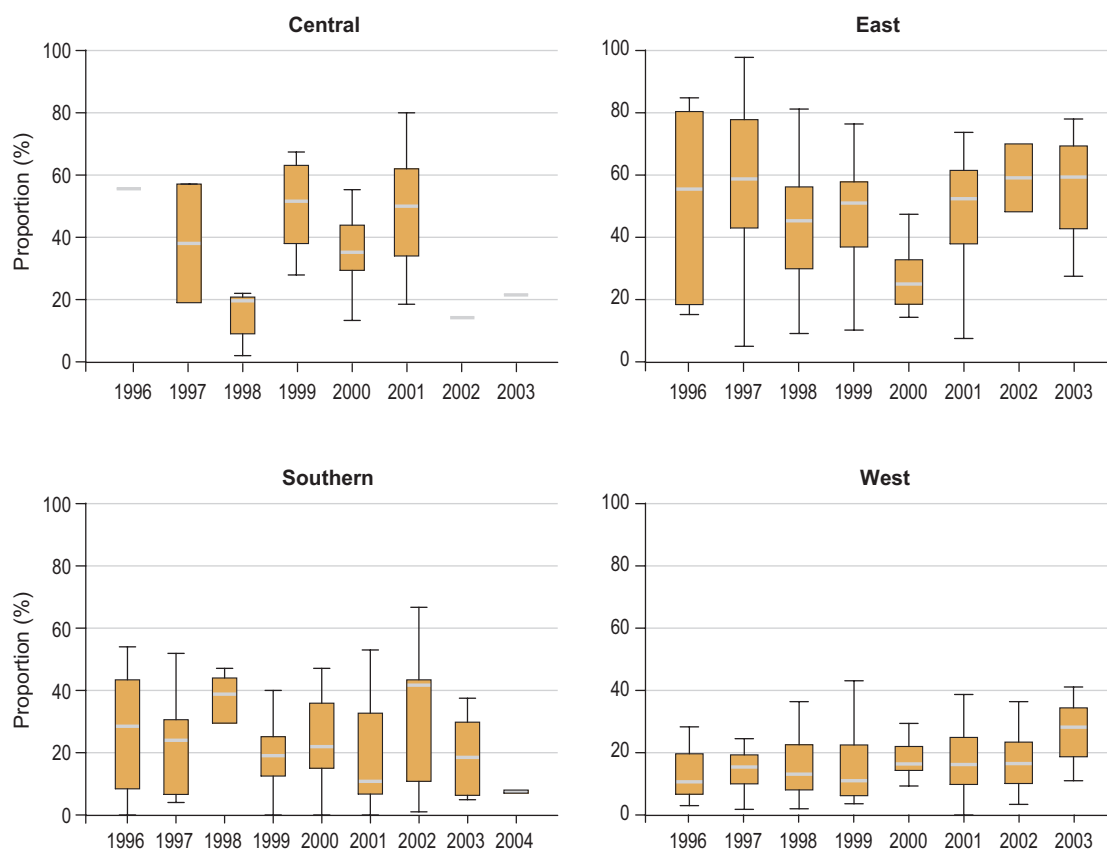
Of 17 countries that reported at least one malaria epidemic between 1999 and 2004 (totalling 119 epidemics), 9 report using a weekly surveillance system that allowed them to detect ongoing epidemics and, subsequently, to respond within 2 weeks (37).

## 8. Drug efficacy

Chloroquine failure rates were between 50% and 60% in East and Central Africa in recent years, respectively. In West and Southern Africa, typically between 10% and 30% of treatments with chloroquine fail (Fig. 15). These failure rates are similar to those in the 1990s, confirming that chloroquine resistance had already spread widely throughout Africa more than a decade ago. The fluctuation in median failure rates from 1994 to 2004 reflects that sites sampled for efficacy testing varied over the years: not every site was repeatedly sampled to track the actual local time trend (Fig. 15).

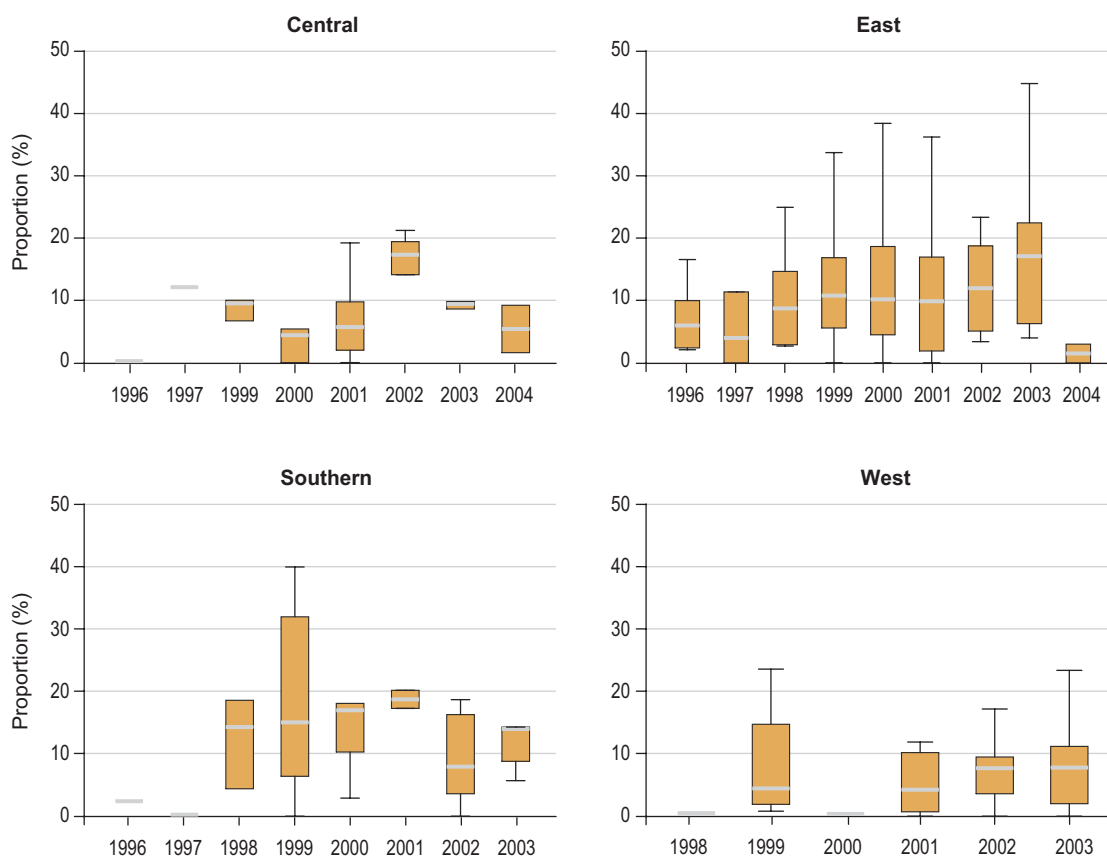
Resistance of *P. falciparum* against the most affordable alternative drug, sulfadoxine–pyrimethamine, is typically 10–20% in East and Southern Africa and around 10% in Central and West Africa (Fig. 16). The few available studies of chloroquine combined with sulfadoxine–pyrimethamine from just 6 countries show failure rates ranging from 3% in Comoros to 13% in Rwanda (Fig. 17). Amodiaquine resistance is found at low levels in East and Central Africa.

**Figure 15.** Treatment failure of chloroquine for falciparum malaria in Africa, by subregion, 1996–2004



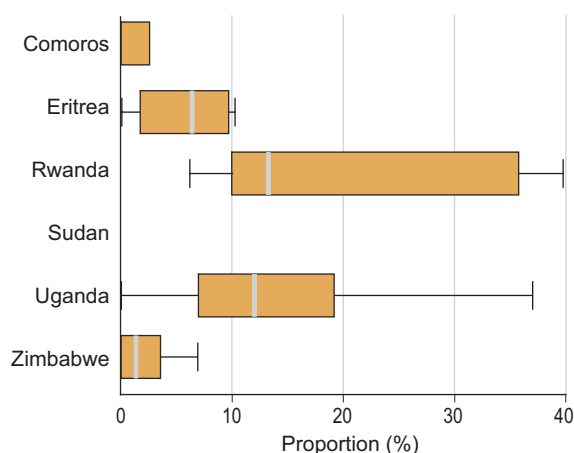
Drug efficacy expressed as clinical treatment failure with 14-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median. Excludes years with fewer than five studies.

**Figure 16.** Treatment failure of sulfadoxine-pyrimethamine in Africa by subregion, 1996–2004



Drug efficacy expressed as clinical treatment failure with 14-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median. Excludes years with fewer than five studies.

**Figure 17.** Treatment failure of chloroquine+sulfadoxine-pyrimethamine in Africa south of the Sahara, by country, averaged over 1996–2004



Drug efficacy expressed as clinical treatment failure with 14-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median. Excludes years with fewer than five studies.

## 9. Malaria and HIV/AIDS

Malaria and HIV/AIDS mutually reinforce each other and contribute synergistically to morbidity, mortality and burden on health systems. Especially in Southern Africa, where HIV is highly prevalent and malaria is unstable and therefore affects a relatively large proportion of adults, HIV infection has probably contributed to observed increases in malaria cases during the 1990s (40, 41).

In Central Africa, where large areas of countries have malaria transmission at high intensity, malaria is likely to be an important contributor to morbidity and mortality in HIV/AIDS patients.

In areas of unstable malaria transmission, HIV infection augments the risk of developing severe and fatal malaria (42, 43). In areas of stable endemicity, HIV infection among adult men and non-pregnant women increases the incidence of clinical malaria and its severity and case fatality (44). These effects are most pronounced in HIV/AIDS patients with advanced immunosuppression. Pregnant women who have high rates of both HIV and malaria infection are a particularly vulnerable group. Coinfected pregnant women are at very high risk of anaemia and malarial infection of the placenta, which contributes to poor birth outcomes (28).

Conversely, there is some evidence that malaria may exacerbate HIV infection. Acute malaria episodes temporarily increase viral replication and hence HIV viral load, which may accelerate disease progression and contribute to heterosexual HIV transmission (45). In addition, as an important cause of anaemia, malaria frequently leads to blood transfusions, which is a potential risk factor for HIV infection.

The increased disease burden resulting from coinfection with HIV and malaria highlights the need for better integration of health services for both diseases. HIV-infected adults should be targeted for free or subsidized distribution of ITNs (46). The recurrent non-malarial fevers in HIV/AIDS patients could cause considerable overuse of antimalarial drugs under the policy of presumptive antimalarial treatment of all acute fevers (47). To reduce costs and the risk of drug resistance, capacity for laboratory diagnosis of febrile disease should be increased in countries with high HIV prevalence and high malaria incidence. Prompt and effective combination treatment is particularly important for HIV-infected individuals who might be prone to treatment failure with conventional antimalarial drugs (48, 49). By preventing acute increases in viral load, good coverage of antimalarial treatment could contribute to limiting HIV disease progression and transmission (45).

## II. ASIA

- Parasitological species of recorded malaria cases: *P. falciparum* 35%, *P. vivax*
- Principal malaria vectors: *A. culicifacies*, *A. minimus*, *A. annularis*, *A. dirus*, *A. fluviatilis*, *A. maculipennis*, *A. sacharovi*, *A. superpictus*, *A. farauti*
- Estimated proportion of population at risk of malaria: 49% (21)
- Estimated contribution to the global burden of clinical malaria cases: 38% (2)
- Estimated contribution to the global burden of clinical falciparum malaria cases: 25% (2)
- Estimated contribution to the global malaria mortality burden: 10% (1)
- Main control strategies: prompt and effective treatment, (focal) IRS, larviciding, epidemic preparedness, ITNs

### 1. Disease burden and control efforts in:

#### • Eastern Mediterranean

In major parts of the Eastern Mediterranean, the malaria situation had deteriorated over the 30 years before the inception of RBM (30). A chronic shortage of resources for the health sector and complex emergencies had nearly stopped malaria control in some of the affected countries, and resistance to commonly used insecticides—except pyrethroids—and antimalarial drugs had emerged.

As of 2004, over 40% of the population in this subregion is at risk of malaria. The malaria problem is most serious in Afghanistan, a complex emergency situation (51), and Yemen, where up to 60% of the population might be at risk of falciparum malaria (21) and where internal resources for malaria control are limited (Table 8).

**Table 8.** Malaria control targets in the Eastern Mediterranean

| Countries  | Type of malaria situation  | Target   |
|--|----------------------------|--|
| Afghanistan, Yemen   | Severe malaria             | Halve malaria incidence, severity and mortality by 2010          |
| Iraq, Islamic Republic of Iran, Pakistan, Saudi Arabia, Turkey | Low-to-moderate endemicity | Prevent malaria deaths and halve malaria incidence by 2010       |
| Oman, Syrian Arab Republic                                     | Small foci of transmission | Eliminate the few remaining foci of malaria transmission by 2006 |
| Other countries  | Malaria-free               | Prevent (re-)introduction of malaria                             |

Source: (30).

Countries with low-to-moderate endemicity include the Islamic Republic of Iran and Saudi Arabia, which have functional health systems and relatively well-established control programmes. In the complex emergency situations of Afghanistan and Iraq, the malaria problem is aggravated by the displacement of populations caused by civil strife resulting in an increased risk of epidemics, and by the destruction of health facilities and shortages of supplies and trained staff.

Oman and Syrian Arab Republic have only residual malaria transmission and imported cases (30). High rates of population movements complicate the control of malaria in border areas of affected countries such as between Iraq, Syrian Arab Republic and Turkey, between Saudi Arabia and Yemen, and between Afghanistan, Islamic Republic of Iran and Pakistan. These countries have therefore started coordinating their control activities in border areas.

Between 1998–1999 and 2002–2003, total expenditure on malaria increased from less than US\$ 3 million to over US\$ 8 million. The governments of Afghanistan (51), Pakistan and Yemen (Box 8) revitalized their malaria control programmes since the inception of RBM, with support from United Nations agencies, bilateral agencies and recently from the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM). All countries in which malaria is still transmitted have national-level multi-year strategic plans. Control strategies in all countries include diagnosis and prompt and effective antimalarial treatment, IRS, epidemic preparedness and strengthening surveillance systems. Afghanistan, Pakistan, Saudi Arabia and Yemen have national strategies for ITNs. In 2003, Pakistan introduced a malaria early warning system, based on weekly reporting of cases in epidemic-prone districts.

The reported case rates pooled across countries remained fairly stable between 1990 and 2003 (Fig. 19). Actual case rates are likely to be much higher—e.g. up to an estimated 20-fold in Yemen—since many of the cases are treated outside the public health system, which in most countries remains the main or only source of health statistics. However, in certain high-risk areas targeted for the most intense malaria control such as in Saudi Arabia and Yemen, malaria case rates have started to fall in recent years. The proportion of cases reported to be caused by falciparum malaria infection was reasonably constant over time within each country, but varied from 12% in Afghanistan to 97% in Yemen. In Turkey, the reported case rate has continued to fall gradually since its peak in 1994; control activities carried out since 2002–2003 include capacity building, disease management and prevention, drug-efficacy monitoring, malaria surveillance, health education and community participation.

Some of the challenges for the Eastern Mediterranean countries include expanding successful programmes begun in specific high-risk areas to other areas, improving monitoring and surveillance systems, and ensuring continued financial support needed to fund effective antimalarials and their availability from local providers (30). There is a need for cross-border coordination between Iraq, Syrian Arab Republic and Turkey to reduce malaria (re)introduction from highly endemic southern Turkey.

### BOX 8. VECTOR CONTROL AND STRENGTHENED SURVEILLANCE IN SOCOTRA ISLAND, YEMEN

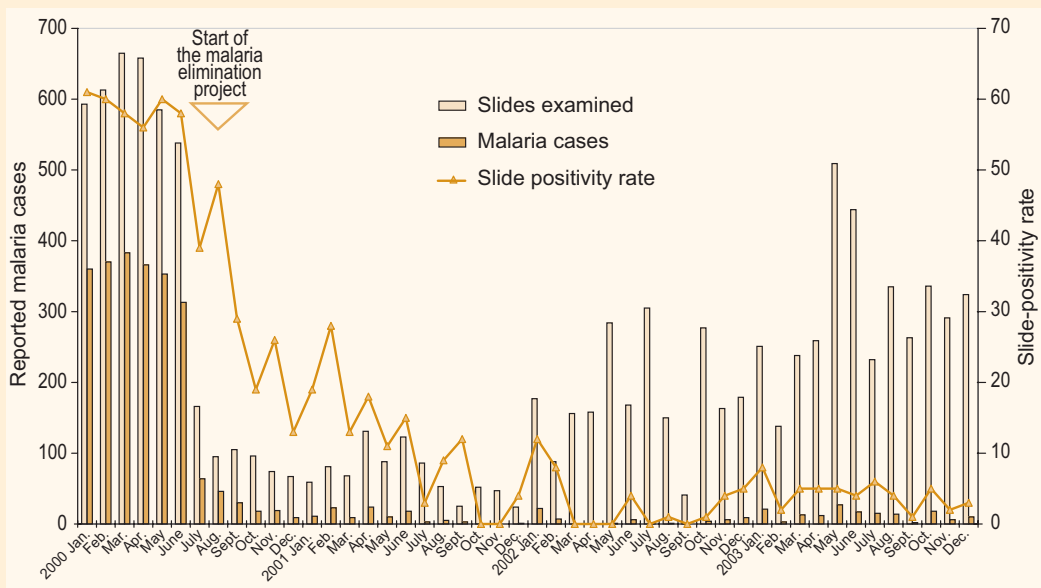
In Yemen, the reported malaria case rate rose from 1 per 1000 person per year in 1990 to a high of 160 per 1000 person per year in 1999. Social unrest during the 1990s brought about an almost full halt to antimalarial activities, and heavy rainfalls contributed to malaria epidemics in 1996 and 1998.

In October 2000, the NMCP reinstated malaria control with assistance from WHO, GFATM and various NGOs. A community-wide effort identified high-risk areas suitable for vector control by weekly larviciding and biannual IRS. In the high-risk area of Socotra Island, control measures also included increased surveillance and improved training and health education campaigns.

Active community participation in these efforts was essential. Key community leaders, United Nations agencies and other interested partners provided guidance through public health education campaigns and coordinated the control efforts. Trained community members, who were offered a daily rate for increased incentive, carried out vector control campaigns. The NMCP and responsible agencies provided intensified supervision of activities.

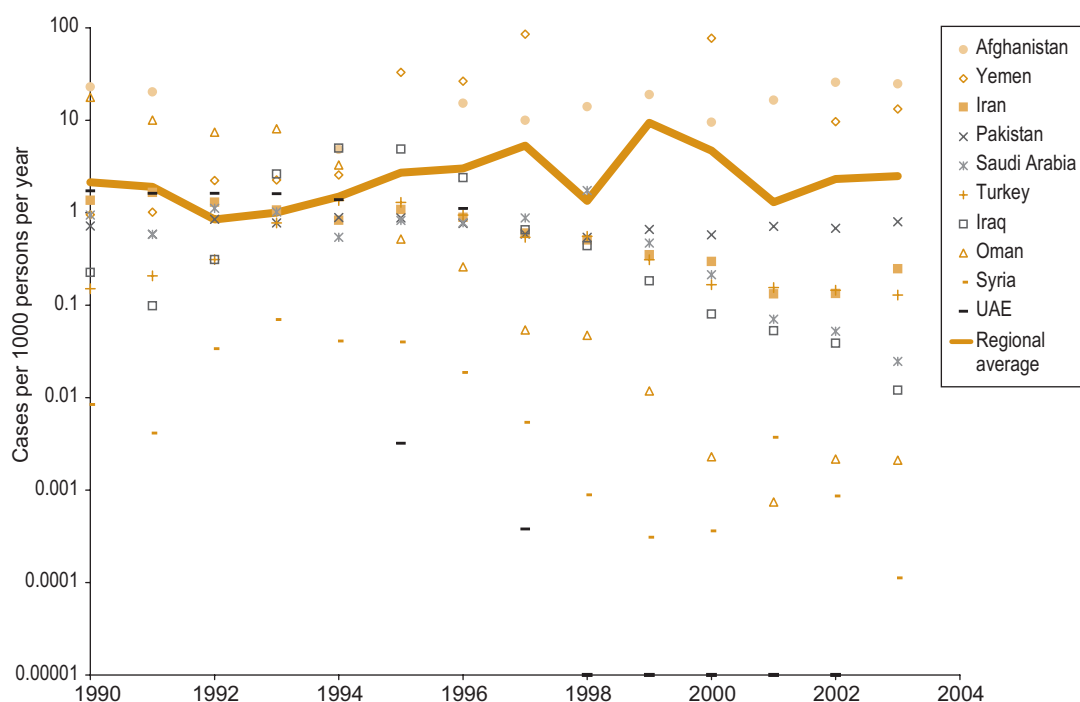
The reported burden of malaria in Socotra Island has remained low in the subsequent three malaria seasons (Fig. 18), despite intensified efforts to identify cases through active case detection and microscopy.

**Figure 18.** Reported slide-confirmed malaria cases and slide-positivity rates from Socotra Island, Yemen, 2000–2003



Source: Yemen NMCP.



**Figure 19.** Standardized reported case rates in malaria-endemic countries in the Eastern Mediterranean, by calendar year, 1990–2003

Numerators are based on confirmed autochthonous cases. Country-specific rates are shown for countries that reported a non-zero number of cases or deaths; the regional average is based on these countries weighted by population size (52).

### • Central Asia and Transcaucasia

Central Asia and Transcaucasia have long been subject to seasonal malaria transmission, which even the historic malaria eradication campaign of the 1960s never completely interrupted. Since the early 1990s, the incidence of malaria, which is mostly caused by *P. vivax*, has risen. The residual reservoir of malaria infection, aggravated by political and socioeconomic situations, mass population migration, extensive development projects and a nearly complete discontinuation in activities for malaria prevention and control, created conditions favourable for malaria transmission. As a result, epidemics of relatively large scale for this region occurred in Azerbaijan and Tajikistan, while Armenia, Georgia, Kyrgyzstan and Turkmenistan faced smaller-scale epidemics. In recent years, endemic falciparum malaria has returned to Tajikistan and is now well established in the southern part of the country, although still focal and primarily affecting the most remote rural areas. In 2004, the first autochthonous cases of falciparum malaria were reported in the southern part of Kyrgyzstan bordering Uzbekistan. Sporadic cases of autochthonous malaria are reported every year in Kazakhstan, Uzbekistan and some parts of the Russian Federation, and these countries remain vulnerable to a resumption of malaria transmission.

A scaling up of RBM interventions in Central Asia followed the epidemic that occurred in Kyrgyzstan in 2002. The emphasis has been on Kyrgyzstan, Tajikistan and Uzbekistan. In 2003–2004, these countries, as well as Kazakhstan and Turkmenistan, reaffirmed their commitment towards implementing malaria control based on well-defined national and regional priorities. Key elements of national

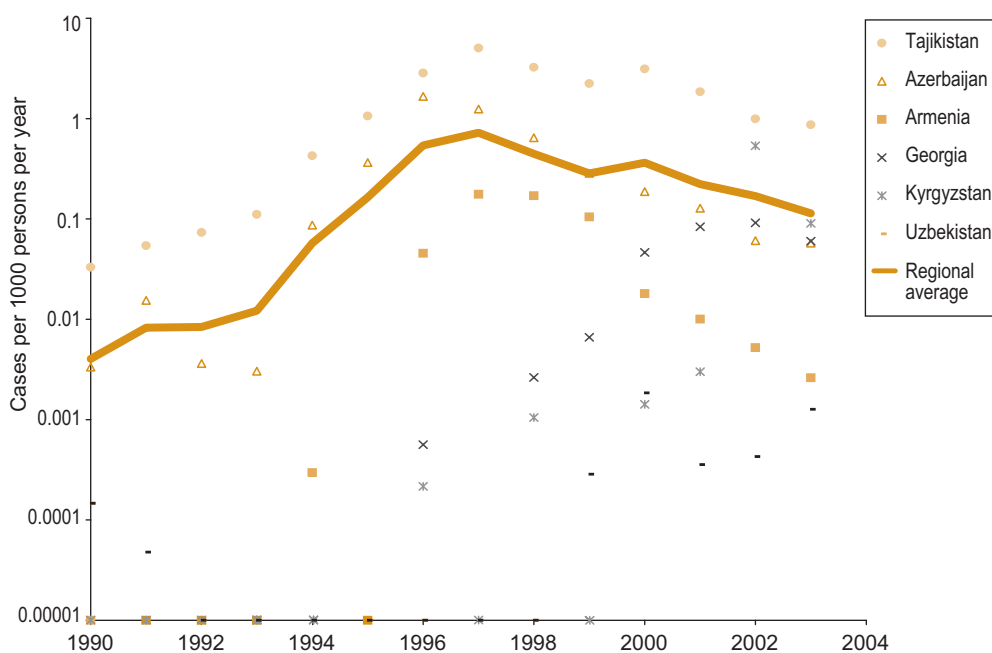
control policies are vector control by IRS and epidemic preparedness, as well as ITN use in Armenia, Azerbaijan, Kyrgyzstan and Tajikistan.

Grants from the GFATM will help strengthen malaria control in Uzbekistan (more than US\$ 2.5 million over 5 years) and Georgia (more than US\$ 800 000 over 3 years), where the reported case rate rose steeply until 2002. In contrast, Armenia and Azerbaijan still have insufficient resources available to manage the malaria problem.

In response to the 2002 epidemic, Kyrgyzstan reinforced surveillance, targeted IRS and improved disease management on a large scale in malaria-affected areas. In 2003, the number of reported malaria cases decreased substantially (Fig. 20).

Averaged over the region, after a peak incidence of around 0.45–0.72 annual reported cases per 1000 between 1996 and 1998—reflecting peaks in Armenia, Azerbaijan and Tajikistan—the rate of reported cases steadily declined to around 0.11 per 1000 in 2003. This is around 10-fold higher than the level recorded in 1991–1992, but completeness of reporting is likely to have varied during the decade due to socioeconomic and political changes (Fig. 20).

**Figure 20.** Standardized reported case rates in malaria-endemic countries in Central Asia and Transcaucasia, by calendar year, 1990–2003



Numerators are based on confirmed, autochthonous cases. Country-specific rates are shown for countries that reported a non-zero number of autochthonous cases or deaths; the regional average is based on these countries weighted by population size (52).

## • South-East Asia

In the 1960s and early 1970s, the Global Eradication Programme reduced malaria incidence to low levels by extensive IRS and large-scale use of antimalarial drugs, but transmission never completely ceased. The disease re-emerged in the 1980s and 1990s, when vector control became less intensive and resistance to most of the commonly used conventional drugs (chloroquine, sulfadoxine–pyrimethamine) and insecticides (DDT, malathion) spread rapidly. Epidemics occurred along the Thai–Cambodian border between 1979 and 1983 coinciding with population movements during the civil war in Cambodia in 1987 and in Sri Lanka in 1990–1992. In India, urban malaria has emerged as a serious health problem in several states. Rapid urban growth and labour migration led to some of the epidemics that have occurred with increasing frequency since 1995. Labour-related movement of non-immune migrants into forests has contributed to epidemics in Myanmar and Thailand, and adult men are the main group at risk in such areas. Currently, Bangladesh, Bhutan, India, Indonesia, Myanmar, Nepal, Sri Lanka, Thailand and Timor-Leste have endemic falciparum malaria, and transmission of vivax malaria reappeared in the Democratic People’s Republic of Korea in the 1990s.

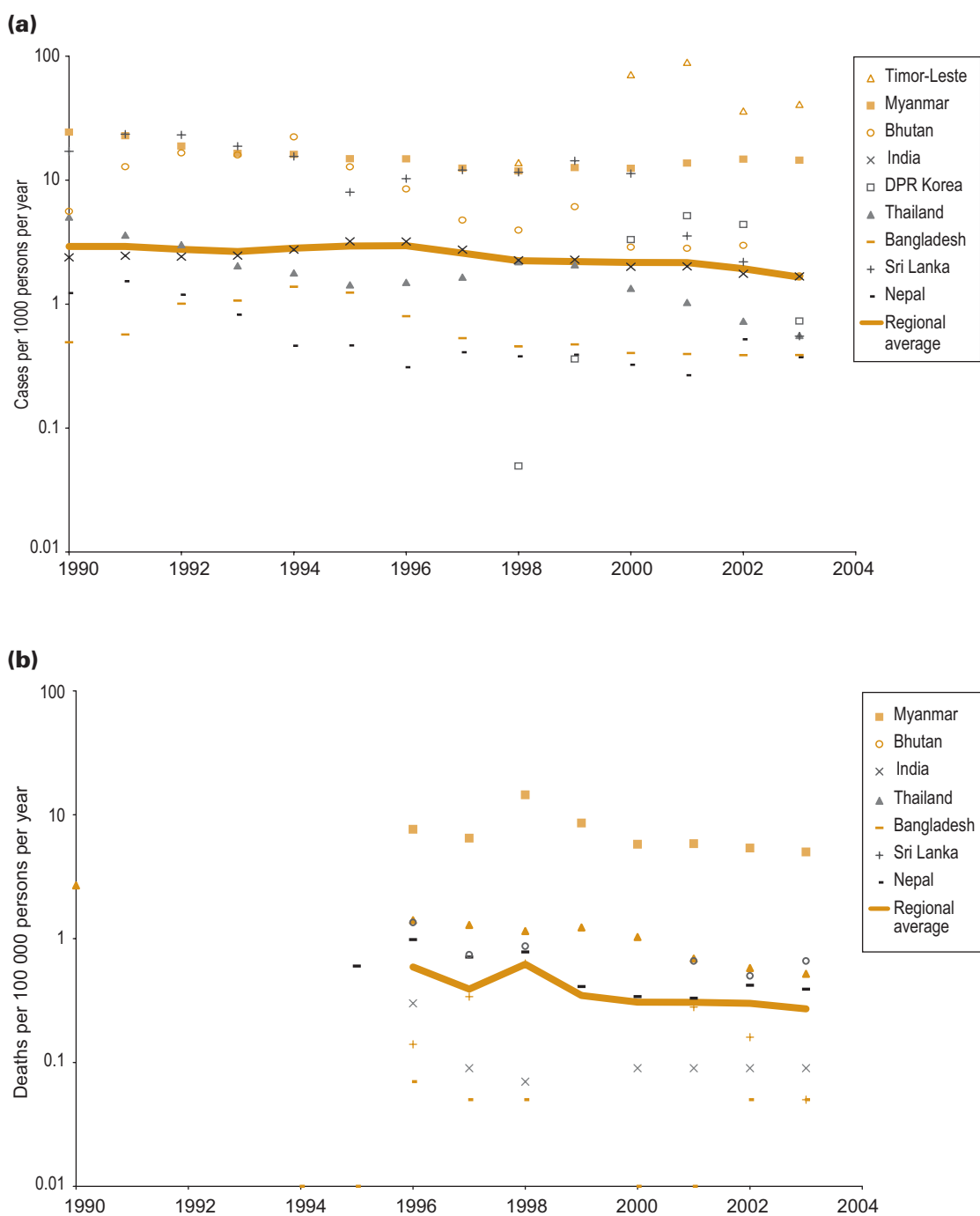
Malaria control was resumed or reintensified in Thailand in the early 1980s, in Maharashtra State in India in 1995, in the Democratic People’s Republic of Korea in 1999, in Bangladesh in 1998, on central Java in Indonesia in 2001 (53) (Box 9) and in Sri Lanka in 2003 (Box 10). The total budget, from national funds and other sources, increased from US\$ 66 million across 6 countries reporting such data in 1998 to US\$ 122 million across 9 countries reporting data. As of 2004, 5 countries have received support from the GFATM for malaria control.

South-East Asia has the highest rates of drug and insecticide resistance in the world. Multidrug resistance emerged earliest in this part of the world and is particularly prevalent near international borders. All countries monitor drug resistance in surveillance sites. In light of drug resistance, Bangladesh, Bhutan, Indonesia, Myanmar and Thailand have now adopted ACT as the national policy for first-line treatment of uncomplicated falciparum malaria. Drug policies for the public health sector alone are not enough; a large proportion of patients obtain treatment in private health facilities or from pharmacies or local shops, where the sale of counterfeit and substandard drugs is common. Timely revisions and effective implementation of treatment guidelines, coupled with improved access through specialized malaria clinics, have been crucial for reducing malaria mortality and clinical incidence in Thailand over the past two decades. Under RBM, rapid diagnostic tests were introduced for malaria diagnosis in remote areas in Nepal and Thailand.

Vector control through IRS for selected areas and epidemic preparedness and surveillance are key control strategies in all affected countries. In addition, larvivorous fish are used for vector control in some areas of India, Myanmar and Sri Lanka. Over the past 7 years, Bhutan, Indonesia, Myanmar and Thailand switched from using DDT and/or organophosphates to using pyrethroids; Sri Lanka decreased the use of DDT, while increasing the use of pyrethroids.

ITN distribution has begun in all endemic countries except Nepal. Since 1999, at least 3.6 million nets were distributed and over 4.3 million existing nets were (re-) treated. An ITN distribution programme in the Khagrachari Hill District of Bangladesh halved the number of reported clinical cases within 3 years of scaling up ITN coverage.

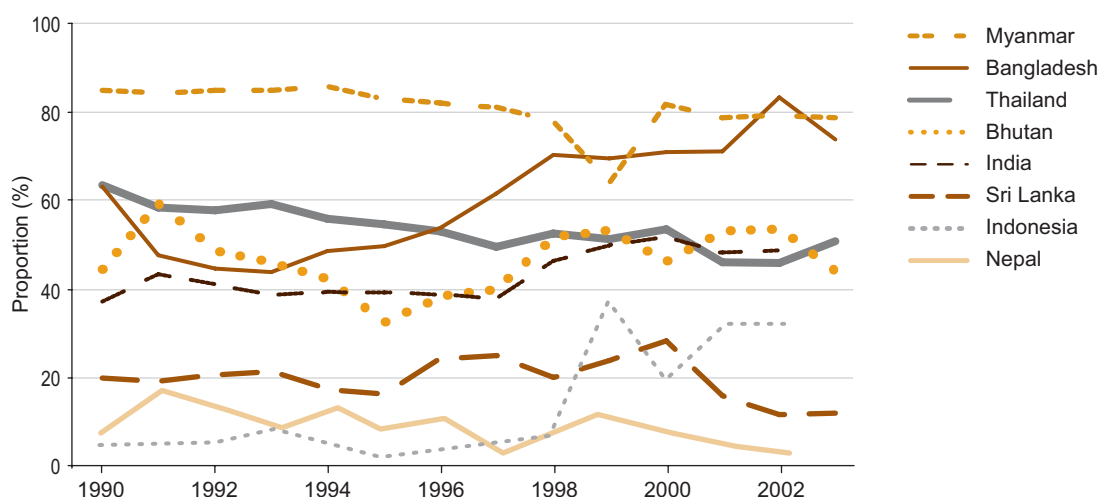
**Figure 21.** Standardized rates of reported malaria cases (a) and deaths (b) in malaria-endemic countries in South-East Asia, by calendar year, 1990–2003



Numerators are based on confirmed, autochthonous cases. Country-specific case rates are shown for malaria-endemic countries that provided feedback during the preparation of this report and that reported a non-zero number of cases; country-specific deaths rates are shown for all countries with a rate of > 0.1 per 100 000 persons per year in at least one year. Regional averages are based on all countries including those not providing feedback to WHO, weighted by population size (52). No data are available for the period 1990–1994.

In India, the national reported malaria case rate had by 2003 fallen to below the 1990 level, after a peak in 1995–1996, when many malaria outbreaks occurred. Across most other countries, the case reporting rate has slightly fallen since 1990–1991. For Bhutan, India and Thailand, this decline was paralleled by a decrease in the death reporting rate between 1995 and 2003 (Fig. 21). The proportion of cases caused by falciparum infection remained reasonably constant between 1990 and 2003 in Bhutan, Myanmar, Nepal and Sri Lanka, slightly decreased in Thailand, but tended to increase in Bangladesh, India and Indonesia (Fig. 22).

**Figure 22.** Percentage of cases reported as *P. falciparum* or as mixed infection with *P. falciparum* and another *Plasmodium* species, for selected countries in South-East Asia, 1990–2003



A major challenge for malaria control programmes in South-East Asia is to ensure access to high-quality-assured drugs according to updated national drug policies through all types of providers. Furthermore, rapid diagnostic tests or microscopy and pre-packaged ACT are to be provided through public health systems, including in remote rural villages.

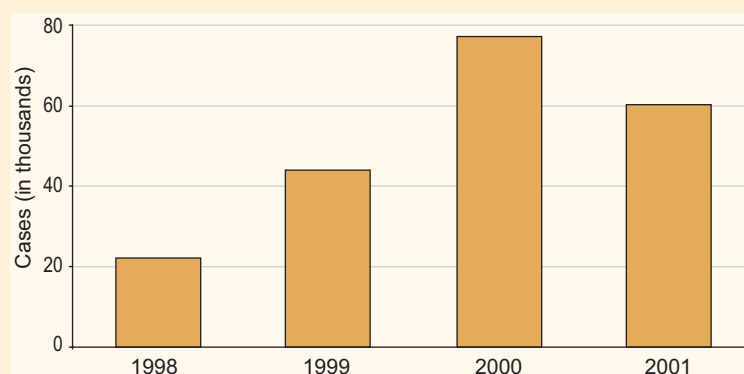
The tsunami of 26 December 2004 raised concern about an increased risk of epidemics in some coastal areas of India, Indonesia, Myanmar and Sri Lanka. Accumulations of mixed salt and fresh water might encourage breeding of *A. sundaicus*, an important vector in many affected coastal areas. The fact that survivors of the tsunami are living under crowded and makeshift conditions is likely to increase exposure to these malaria vectors (54). Initial actions of larviciding appear to have prevented immediate outbreaks and, as of March 2005, there is no evidence of an increase in malaria cases. Active surveillance is ongoing to assess the longer-term impact of the tsunami on malaria transmission and disease burden.

### BOX 9. INDONESIA CONFRONTS MALARIA EPIDEMICS THROUGH OUTREACH IN POOR RURAL AREAS

The 1997 economic crisis in Indonesia brought increased poverty, a reduction in health spending, the breakdown of malaria control efforts—in particular a dramatic cutback in IRS—and the re-emergence of malaria in areas where the disease was previously under control. There was also a decrease in surveillance and monitoring, leading to insufficient knowledge about malaria transmission and failure to diagnose the disease early. Many village health clinics lacked sufficient supplies of drugs and skilled staff to administer them and monitor their use. The districts of Kulonprogo, Magelang and Purworejo in the Menoreh Hills area on the island of Java were the most affected by the epidemic (53).

The Menoreh Hills Malaria Control Project was carried out between May and December 2001, with support from WHO and USAID. Communities were mobilized, local people were trained as malaria workers and community members were educated on how to manage epidemics. Village health workers played an important role in early diagnosis and treatment of the disease among poor rural populations. Health workers also introduced IRS and the new habit of sleeping under ITNs, which were distributed free of charge. Village elders and local teachers were engaged in information campaigns to promote the use of ITNs. In 2001, close to 4500 ITNs were distributed by district administrations and 8000 houses were sprayed.

By the end of 2001, the malaria epidemic in the Menoreh Hills had been halted and reversed (Fig. 23). Commitment on the part of the district authorities was crucial for supporting action at community level and for negotiating adequate domestic and external funds. Indonesia's decentralization programme, initiated in 2001, gave more responsibility and autonomy to the districts. But investment in health—both from domestic and external sources—is low, thus many district governments rely on user fees from public health facilities as a source of local revenue, without exempting even the poor or the most basic services.



**Figure 23.** Malaria cases decrease in the Menoreh Hills, Indonesia

A crucial factor in controlling the epidemic was establishing monitoring and surveillance systems. Mass blood surveys were carried out in Kulonprogo and Purworejo during September and October of 2001. Mass fever surveys were conducted in all three districts from October 2001 to April 2002, with treatment for those fever cases subsequently found infected on blood slides.

District authorities from the sectors of agriculture and public works helped to ensure that the rapid opening of land plantations did not aggravate the spread of malaria, by enforcing good agricultural practices and adherence by farmers to planting schedules. Intervillage cooperation involved notifying residents working in other villages to be careful not to spread malaria. Neighbouring villages were given IRS concurrently to maximize the impact on mosquito populations.

### BOX 10. FOCUSED INDOOR RESIDUAL SPRAYING CONTROLS MALARIA IN SRI LANKA

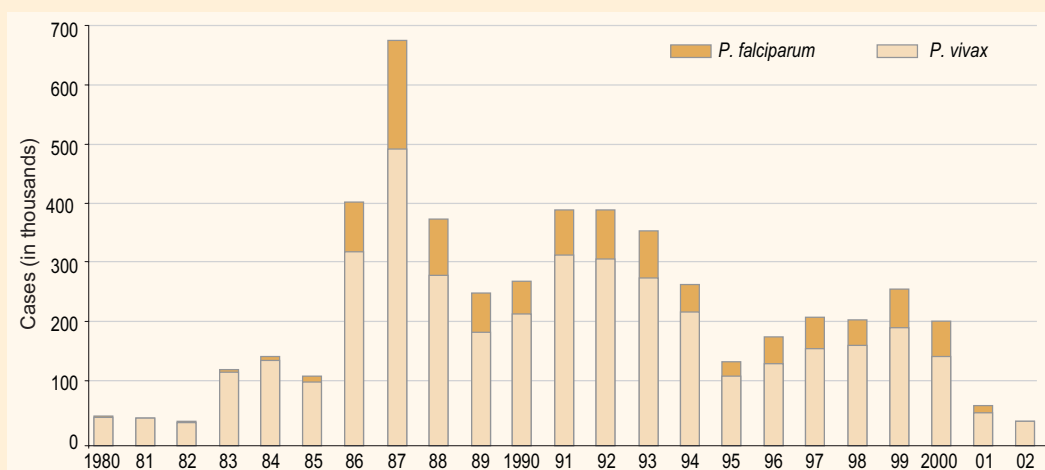
During the 1970s and the 1980s, malaria caused very high morbidity levels and regularly broke out in epidemic form in Sri Lanka. In 1992, the NMCP drastically revised its control strategy, in keeping with the New Global Malaria Control Strategy introduced that year.

As during the eradication programme in the 1960s and 1970s, IRS was a major activity of the new control programme. But instead of aiming for universal and frequent IRS coverage, which during the eradication programme had failed to stop transmission and met community resistance in some areas, vector control was targeted to carefully stratified malaria-risk areas. Varying frequencies of IRS were implemented according to malariogenic potential, i.e. year-round, seasonal or exclusively at times of observed transmission. This resulted in better acceptability in the communities and higher cost-effectiveness.

To further reduce the number of villages where IRS was needed, the use of larvivorous fish was introduced and, under a project funded by the International Development Association/World Bank between 1997 and 2002, ITNs were provided to villages with a very high risk of malaria. Entomological activities were reoriented with a view to helping predict and prevent epidemics. Furthermore, early detection and prompt treatment through outreach-type Mobile Malaria Clinics was implemented. Chloroquine resistance of falciparum malaria, which was prevalent in some areas and foci, was managed well by temporarily changing to sulfadoxine–pyrimethamine as the first-line drug treatment in these areas.

In 2003, recorded malaria incidence fell to the lowest level observed since 1967 (Fig. 24). Another remarkable achievement is that epidemics have been averted since the last epidemic of 1990–1992.

**Figure 24.** Microscopically confirmed malaria cases detected by surveillance in Sri Lanka, 1980–2003



## • Western Pacific

Malaria control was revitalized in the 1980s in China and in the 1990s in most other Western Pacific countries, following resurgence in the 1980s and early 1990s (Box 11). The resurgence was related to a general economic decline and reduced budget for malaria control, resulting in deterioration of health care in general—such as in Viet Nam—and breakdowns in drug supplies and the arrest of vector control in rural areas—such as in Papua New Guinea. Large-scale population movements and emergence of drug resistance contributed as well. With transmission of vivax malaria reappearing in the Republic of Korea in the 1990s, the region now includes 10 endemic countries.

Parts of Papua New Guinea and Vanuatu (55) continue to suffer from hyperendemic falciparum malaria. As in tropical Africa, the primary risk groups are young children and pregnant women. Elsewhere, forest workers, miners, farmers and migrants of all ages form special risk groups.

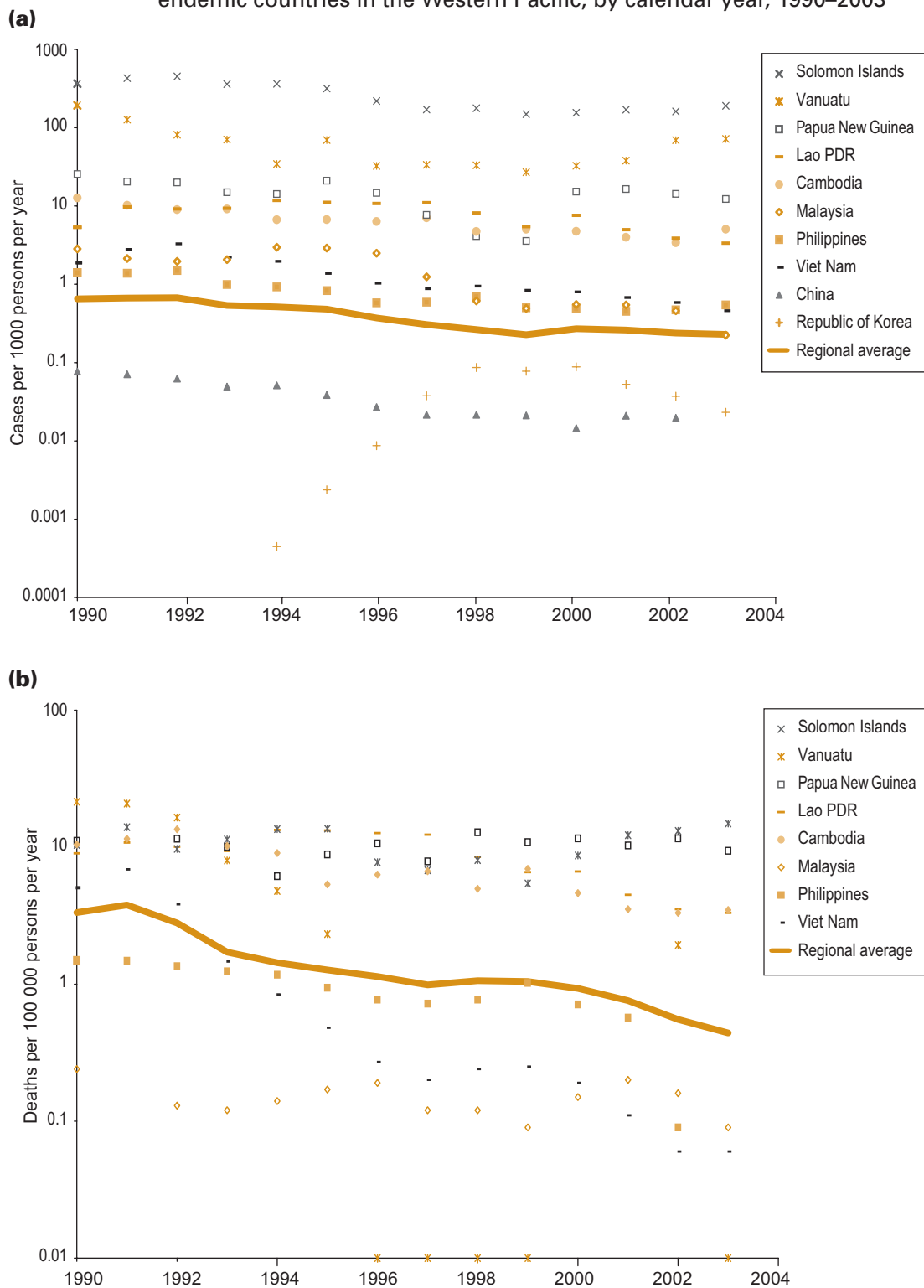
National control policies in all countries include vector control with ITNs, targeted IRS and improvement of diagnosis, and prompt and effective treatment. In the mid-1990s, China, Malaysia, the Philippines and Viet Nam replaced DDT and organophosphates with other insecticides. Since 1999, at least 1 million ITNs have been distributed and 6.4 million existing nets have been (re-)treated with insecticide.

Cambodia, China and Viet Nam were among the first countries to suffer from high-level parasite resistance to antimalarial drugs. Multidrug resistance was recorded as early as the 1980s, with the highest prevalence in border areas. These countries now use ACTs for first-line treatment. In Viet Nam, wide availability of artemisinin derivatives and later ACTs for first-line treatment contributed to a low and falling level of mortality caused by malaria since 1995–1996 (Fig. 25) (56). Under RBM, and with support from the GFATM, all countries with falciparum malaria are using rapid diagnostic tests to reduce overusage of costly antimalarials and the risk of development of resistance to the newest drugs. All countries perform drug efficacy monitoring in at least one sentinel site.

After a peak in 1991–1992, the overall case reporting rate across 10 countries fell gradually until 2003 (Fig. 25). In individual countries, year-to-year fluctuations in reported case rates are apparent, which however often reflect changes in the completeness of surveillance or reporting rather than actual epidemiological trends. For example, reporting completeness decreased in Papua New Guinea between 1995 and 1998, but it improved during the early 1990s in Lao People's Democratic Republic; in the Philippines, a varying intensity of active case detection resulted in variations in case reporting rates. In Papua New Guinea, the Solomon Islands and Vanuatu, programme success fell and morbidity rose again caused by civil unrest and human and financial constraints since 2000 (Fig. 25). However, increased funding including from the GFATM is expected to help reverse this trend.

Challenges for malaria control in the coming decade include: (i) ensuring the quality and effectiveness of available antimalarial drugs in both the public and private sectors; (ii) increasing the coverage of rapid diagnostic tests or microscopic diagnosis; and (iii) access to diagnosis and treatment in remote, high-risk rural areas. In addition, the scaling up of ITN distribution and (re-)treatment of ITNs and the distribution of LLINs require increased efforts.



**Figure 25.** Standardized rates of reported malaria cases (a) and deaths (b) in malaria-endemic countries in the Western Pacific, by calendar year, 1990–2003

Numerators are based on confirmed autochthonous cases. Country-specific case rates are shown for all countries; country-specific death rates are shown for all countries with a rate of > 0.1 per 100 000 persons in at least one year. Regional averages are weighted by population size (52).

### BOX 11. SUCCESSFUL MALARIA CONTROL IN SABAH, MALAYSIA

The Sabah area of Malaysia accounts for approximately 70% of malaria cases in the country. Recorded incidence in this area was very high in the early 1990s. Chloroquine resistance, an insufficient control budget and lack of personnel contributed to the problem. In this forested area, which is climatically highly suitable for malaria transmission and relatively inaccessible to control efforts, aboriginal groups, soldiers, plantation and forest workers, and illegal immigrant populations are especially vulnerable.

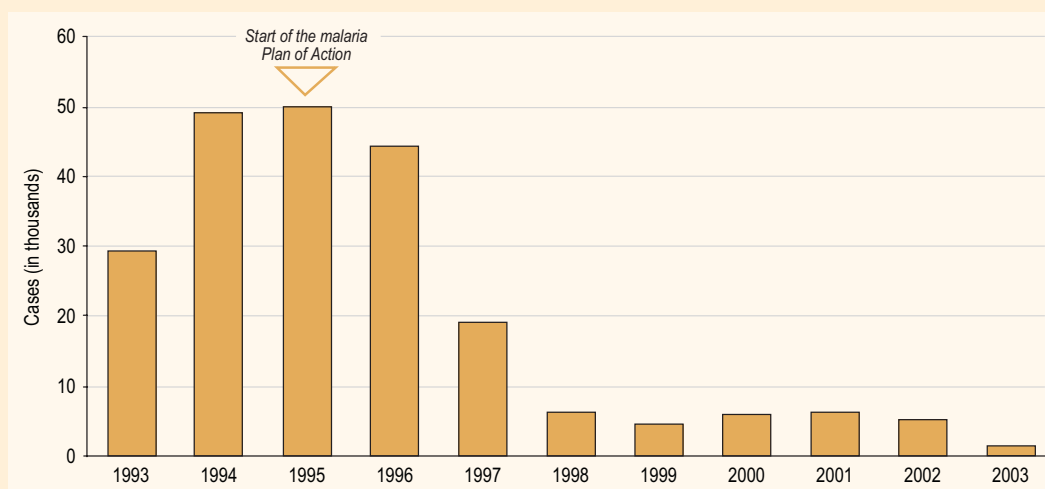
An intensified malaria control plan was launched in 1996. Districts were stratified into high, moderate and low risk, based on annual recorded malaria incidence rates. With increased budget and staff, ITNs were provided for more than 700 000 people and over 400 additional primary health-care volunteers were trained in diagnosing and treating malaria, and in improving awareness. In addition, IRS was scaled up. By 2003, all high-risk areas were reduced to moderate or low risk, and all moderate-risk areas had regressed to low risk.<sup>a</sup> The overall recorded annual number of cases fell from 49 863 in 1995 to 1770 in 2003 (Fig. 26).

Challenges ahead are to maintain the gains achieved through early recognition and control of epidemics, to prevent drug resistance and to reduce malaria transmission further in the inaccessible, hilly forested areas where transportation facilities are poor. In the longer term, infrastructural and socioeconomic developments are expected to consolidate the successful containment of malaria.

<sup>a</sup> Local definitions:

- high risk = recorded incidence >10 cases per 1000 population per year,
- moderate risk = recorded incidence 1–10 cases per 1000 population per year,
- low risk = recorded incidence <1 case per 1000 population per year.

**Figure 26.** Malaria report case rates in Sabah, Malaysia

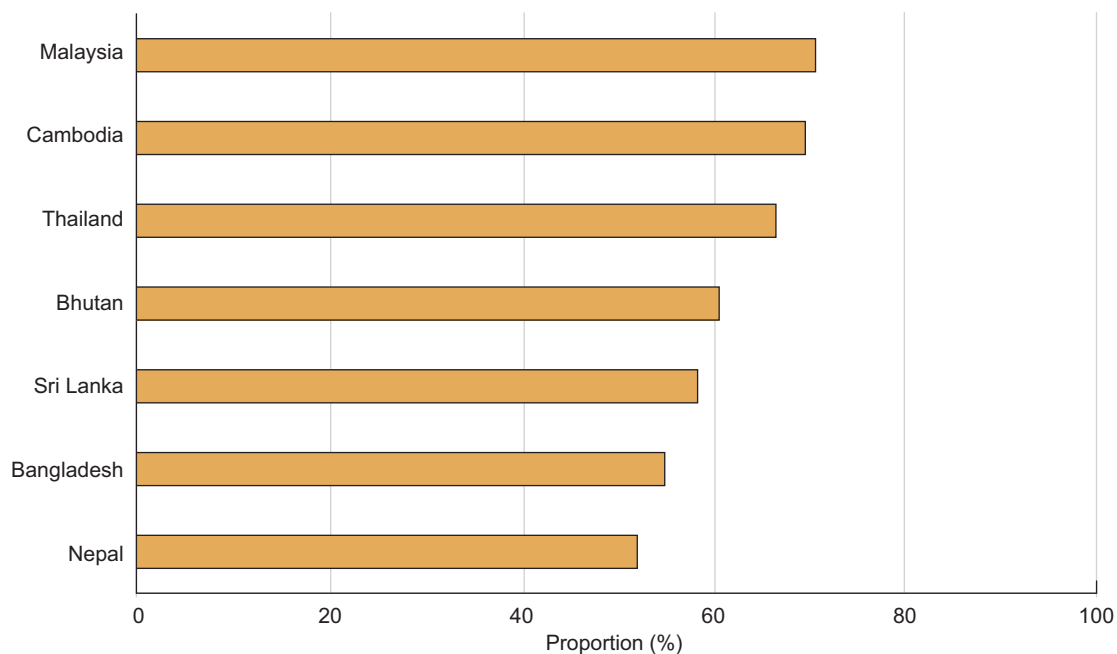


## 2. Age/sex distribution in reported cases

Few countries record the sex of reported cases. In 7 Asian countries that did, between 52% and 71% of reported cases were male (Fig. 27). The higher incidence in males compared with females in Cambodia, Malaysia and Thailand probably reflects the occupational exposure in parts of these countries, although gender differences in treatment-seeking behaviour might also be a contributing factor.

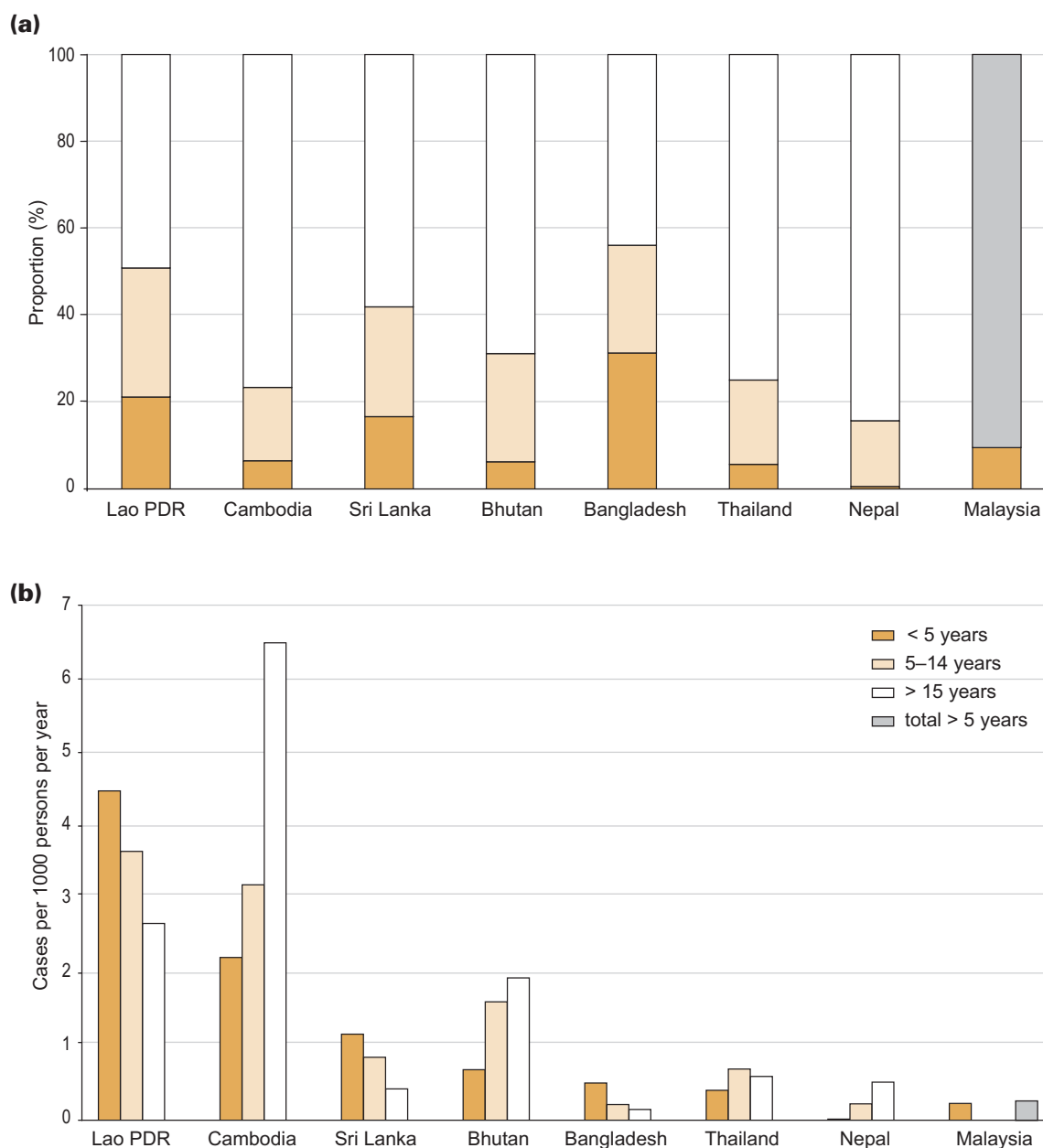
Reliable data on the age distribution in reported cases were available for 8 countries in South-East Asia. In most of these countries, adults over 15 years of age account for more than half of the total cases. However, the age pattern in reported case rates varied markedly between countries. In Bhutan, Cambodia and Nepal, the case rate increased with age, while in Bangladesh, the Lao People's Democratic Republic and Sri Lanka, children under 5 years of age had the highest case rate (Fig. 28).

**Figure 27.** Proportion of cases reported in males in Asia, 2003



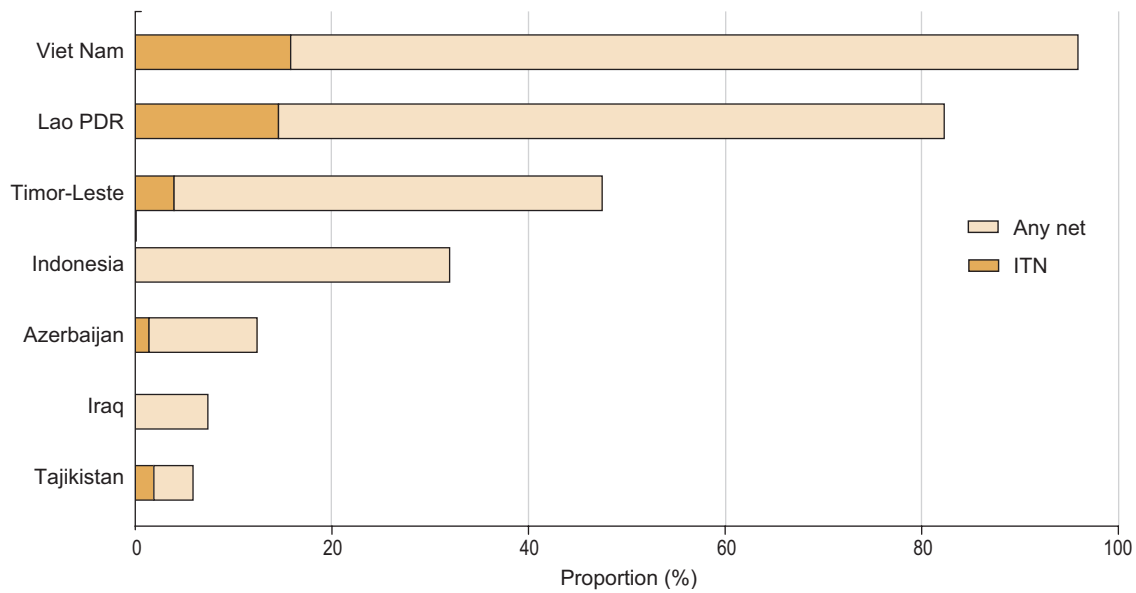
Data are from countries that reported numbers of cases for males and females separately in 2003 and for which the sum of reported cases in males and females was equal to the reported total.

**Figure 28.** Age distribution of reported cases in Asian countries, 2003; age distribution of cases (a) and age-specific case rates per 1000 persons per year (b)



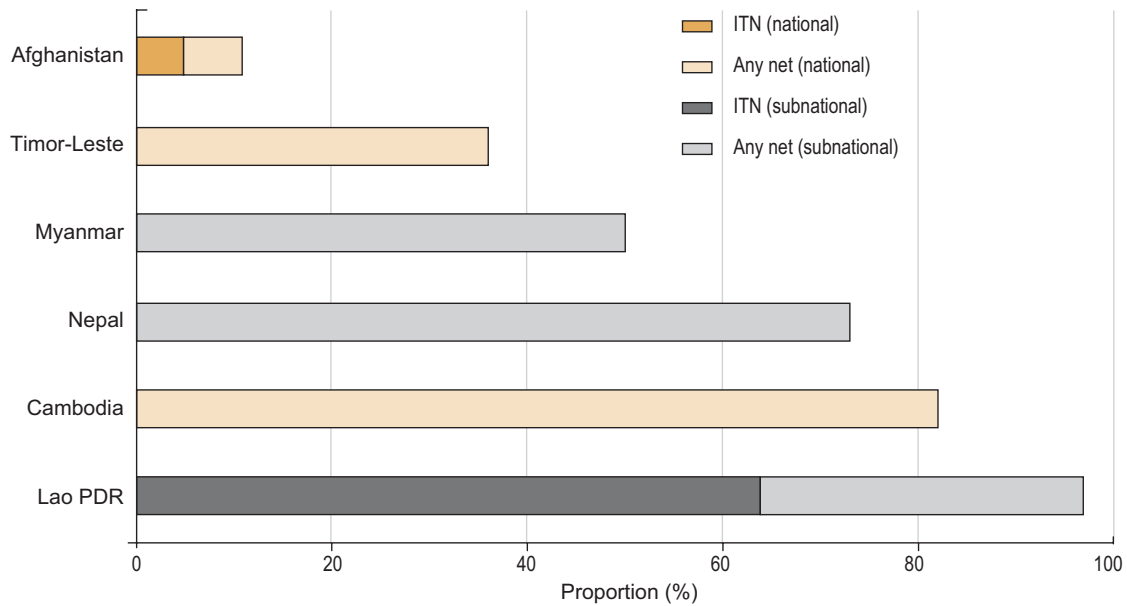
Data are from countries that reported numbers of cases by age group in 2003, and for which the sum of age-specific reported numbers of cases was equal to or smaller than the reported total.

**Figure 29.** Proportion of children under 5 years of age sleeping under mosquito nets or ITNs based on national surveys in Asian countries, 2000–2002



Median survey year is 2000.

**Figure 30.** Household possession of mosquito nets and ITNs in Asian countries



Median survey year is 2001. Results from subnational surveys are included for countries where malaria is focal and where the survey sampled selectively in areas with a relatively high burden of malaria.

### 3. Coverage of mosquito nets and insecticide-treated nets

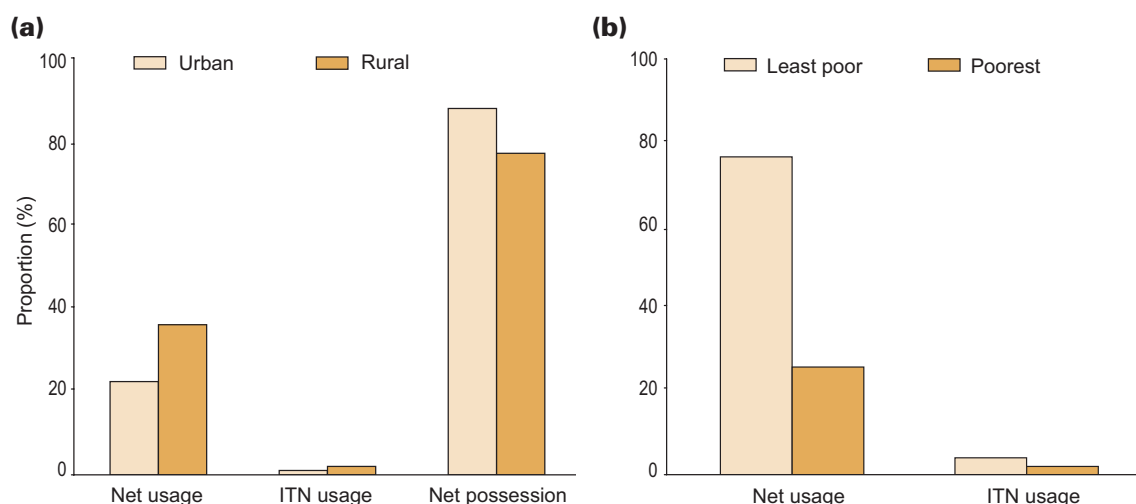
National surveys in 7 Asian countries measured a median net usage rate for children under 5 years of age of 32% (range 6–96%); for ITNs the median child usage rate was 1.9% (range 0–16%) (Fig. 29).

In many countries in Asia, given the relatively moderate transmission intensity, people of all ages are at risk and the proportion of households possessing one or more nets is a more relevant indicator than usage by young children. Surveys in Afghanistan, Cambodia, Timor-Leste and malarious areas of Lao People's Democratic Republic, Myanmar and Nepal measured household possession levels of between 11% and 97% for any nets, whether or not these had been treated with insecticide. In Afghanistan, 4.8% of households owned an ITN in 2002, and in Lao People's Democratic Republic 64% of households owned an ITN in 2001. In all surveyed countries, most available nets are not insecticide-treated (Fig. 30).

#### *Equity in net coverage*

In the few countries with detailed survey data available, net and ITN coverage was not consistently higher in urban or in rural areas. However, net usage and ITN usage by children were a median of threefold and twofold lower in the poorest households compared with the least poor households (Fig. 31).

**Figure 31.** Median net and ITN possession (as % of households) or usage (as % of children under 5 years of age) in Asian countries by urban and rural division (a) and for the 20% poorest and 20% least poor households (b), from national surveys conducted between 1999 and 2004



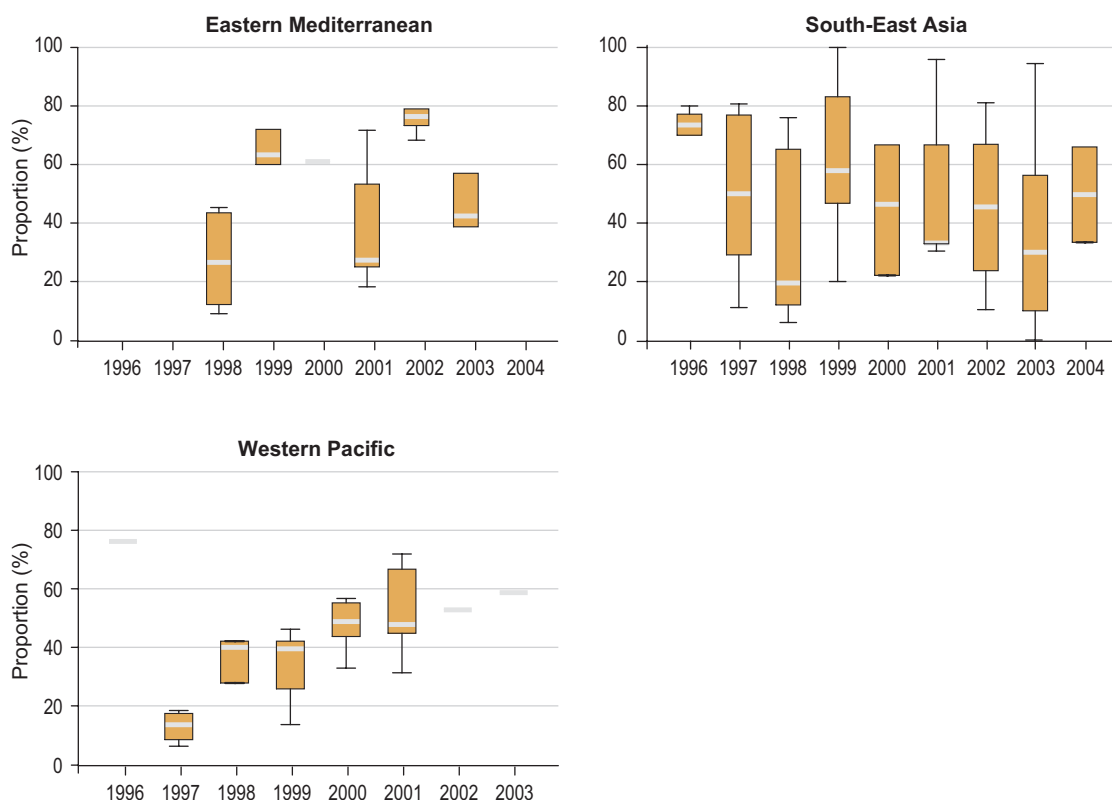
Sources: urban/rural data: net and ITN usage from seven surveys, net possession from one survey; poorest/least poor households data: net and ITN usage from five surveys, no surveys available on net or ITN possession. Countries surveyed: Azerbaijan, Indonesia, Iraq, Lao People's Democratic Republic, Tajikistan, Timor-Leste and Viet Nam.

#### 4. Drug efficacy

Resistance of *P. falciparum* against most common antimalarial drugs as well as multidrug resistance has been widely prevalent throughout Asia. Failure rates of chloroquine are generally above 40% in the Eastern Mediterranean and Western Pacific, and around 40% in South-East Asia (Fig. 32). For sulfadoxine-pyrimethamine, failure rates remain below 20% in the Eastern Mediterranean, around 20% in South-East Asia and 20–40% in the Western Pacific (Fig. 33). Trends over time are difficult to infer because of the scarcity of studies, and because studies in different sites were conducted in different years. Mefloquine treatment failure has increased to more than 20% in South-East Asia by 2004, and between 10% and 20% in the Western Pacific (Fig. 34).

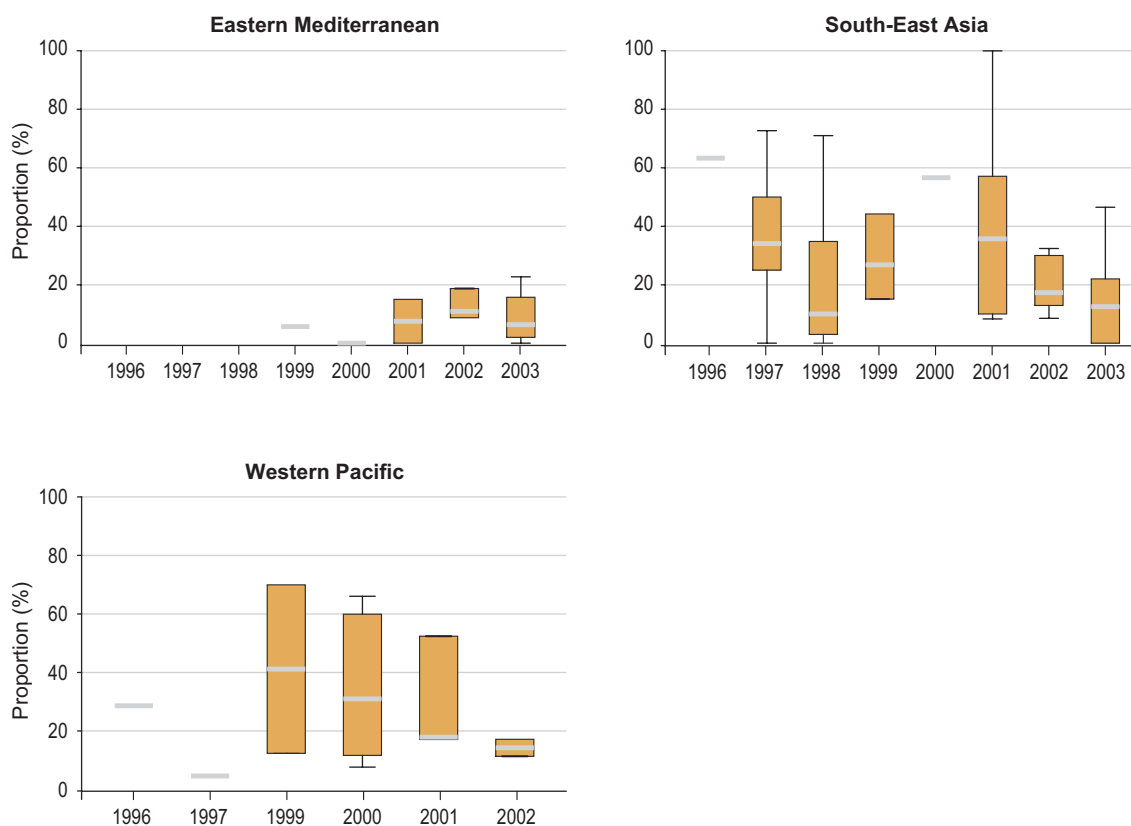
The description of drug resistance of *P. vivax* is more recent. In 1989, the first cases of chloroquine-resistant vivax malaria appeared in Papua New Guinea. *P. vivax* remains generally sensitive to the common antimalarial drugs, but chloroquine and/or pyrimethamine treatment failure has been documented in some focal areas of South-East Asia and Oceania including Irian Jaya and other Indonesian Islands.

**Figure 32.** Treatment failure of chloroquine to falciparum malaria in Asia by subregion, 1996–2004



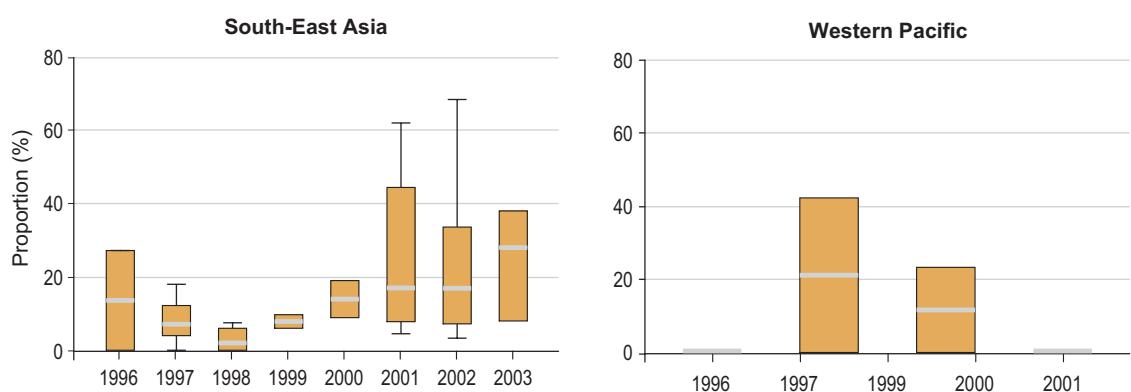
Drug efficacy is expressed as total treatment failure with 28-day follow up (9). BBoxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median.

**Figure 33.** Treatment failure of sulfadoxine–pyrimethamine against falciparum malaria in Asia, by subregion, 1996–2003



Drug efficacy is expressed as total treatment failure with 28-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median.

**Figure 34.** Treatment failure of mefloquine against falciparum malaria in South-East Asia, 1996–2003



Drug efficacy is expressed as total treatment failure with 28-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median.



### III. THE AMERICAS

- Parasitological species of malaria cases: *P. falciparum* 18%, *P. vivax* 72%, *P. malariae*
- Principal malaria vectors: *A. albimanus* (Central America), *A. darlingi* (Amazon Basin)
- Estimated proportion of population at malaria risk: 14% (21)
- Estimated contribution to the global burden of clinical malaria cases: 3% (2)
- Estimated contribution to the global burden of clinical falciparum malaria cases: 1% (2)
- Estimated contribution to the global malaria mortality burden: <1% (1)
- Main reported control strategies: **prompt and effective treatment, vector control especially IRS and space spraying, ITNs**

#### 1. Disease burden

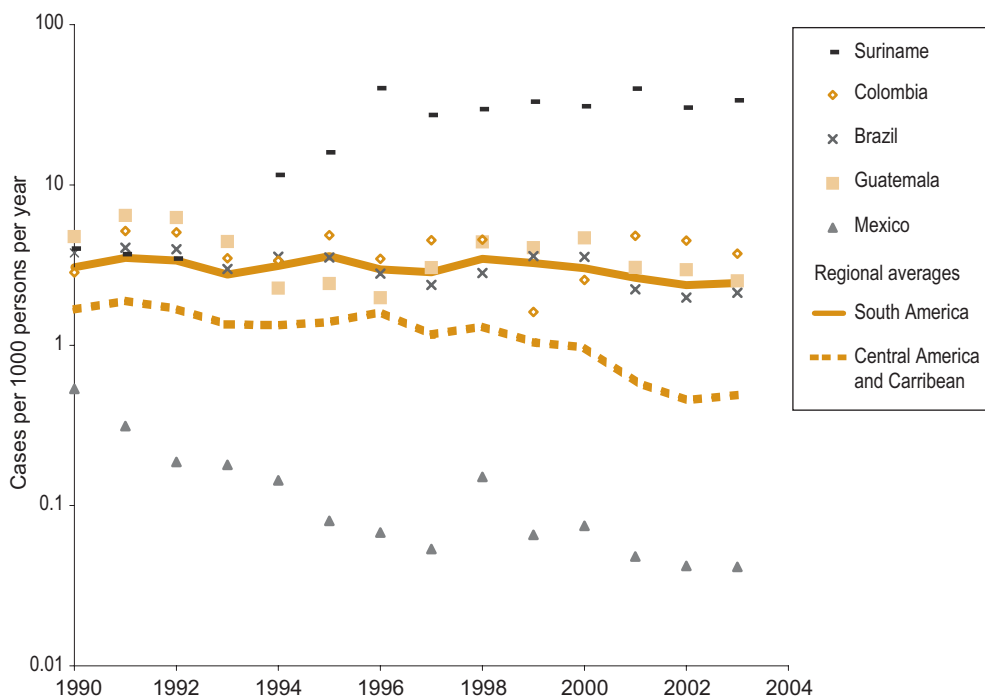
Malaria transmission occurs in 9 countries that share the Amazon rainforest in South America (Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela), 8 countries in Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Mexico) and in 2 countries that share the Caribbean island of Hispaniola (Haiti and the Dominican Republic). In addition, small numbers of cases are reported from Argentina and Paraguay in South America. Population movement accounts for part of the malaria problem, causing an epidemic in 2003 in Suriname in gold mining areas near the border with Brazil. In Brazil, urban and periurban malaria associated with population movement to the periphery of large cities is increasingly contributing to the disease burden.

The reported case rate pooled across all countries has remained fairly stable since 1990. A slight decrease in recent years mainly reflects a decrease in Mexico (Box 12) and other countries in Central America (Fig. 35).

Across countries in South America, around 25% of reported cases are caused by *P. falciparum*, the remainder are *P. vivax*. In Central America and the Caribbean, an average of around 10% of reported cases are caused by falciparum malaria infection. Between 1994 and 2003, the proportion of cases caused by falciparum infection decreased in Bolivia, Colombia, Ecuador and Peru, increased in Nicaragua and was stable or fluctuating in other countries.

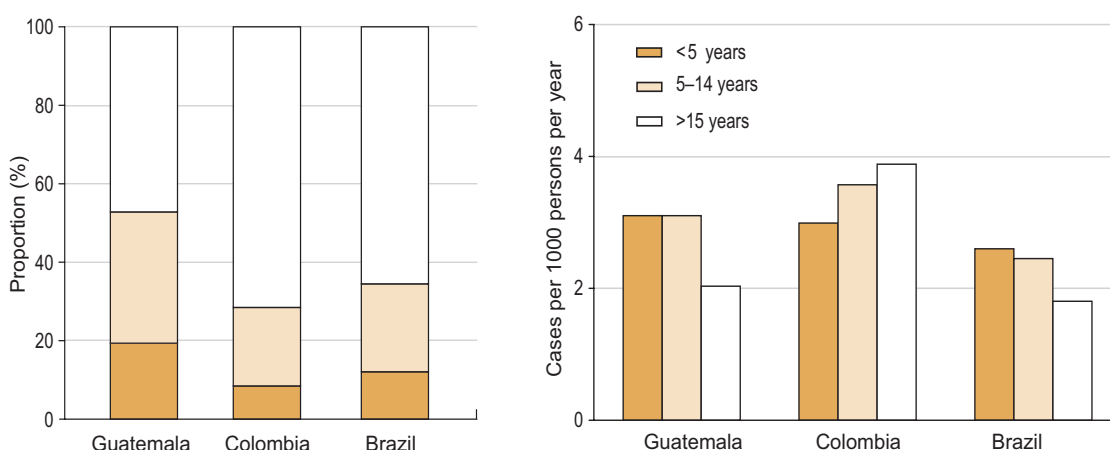
In Colombia and Guatemala, 64% and 53% of recorded cases respectively were male. Brazil, Colombia and Guatemala identified the age distribution of reported cases. Adults over 15 years of age accounted for more than half of the total number of cases in all 3 countries. The case reporting rate decreased with age in Brazil and Guatemala, but increased with age in Colombia (Fig. 36).

**Figure 35.** Standardized rates of malaria reported case rate in malaria-endemic countries in Central America and the Caribbean and in South America, by calendar year, 1990–2003



Numerators are based on confirmed, autochthonous cases. Regional averages, given for South America and for Central America and the Caribbean, are based on all countries including those not providing feedback to WHO, weighted by population size (52). Country-specific rates are shown for countries that provided feedback during the preparation of this report and for Mexico, the most populous country in Central America.

**Figure 36.** Age distribution of reported cases in the Americas, 2003; age distribution of cases (a) and age-specific case rates per 1000 persons per year (b)



Data are from countries that reported numbers of cases by age group in 2003, and for which the sum of age-specific numbers of cases was equal to or smaller than the reported total.

## 2. Control efforts

Nine countries employ ITNs as per the national malaria control strategy. Surveys in Colombia, Nicaragua and malarious areas of Bolivia measured household possession levels of 31%, 42% and 95% for any nets, respectively. In Colombia and selected areas of Bolivia, 2% and 13% of households had an ITN, respectively. The proportions of children under 5 years of age sleeping under a net according to national surveys were 24% in Colombia, 6% in Guatemala and 77% in Suriname; for ITNs, corresponding proportions ranged between 1% and 7%. The low coverage levels in some of these countries probably reflect the fact that ITN promotion, while part of the national malaria control policy, is not the highest priority intervention. It is also important to note that by 2004, coverage is likely to have increased compared with that measured in available surveys, which were conducted between 1999 and 2002.

In all countries with malaria, vector control by IRS and larviciding in focal areas form part of the national malaria control strategy. Argentina has an epidemic preparedness strategy. Most countries are striving to integrate and/or increase collaboration between the malaria control programme and the local health service in order to promote community participation in malaria control.

In addition to financial support provided by national governments, Bolivia, Guatemala, Guyana, Haiti, Honduras, Nicaragua and Suriname receive financial support for malaria control from the GFATM. Colombia, Ecuador, Peru and Venezuela are awaiting final approval from the GFATM for their jointly submitted grant proposal. Mexico and the Central American countries receive support from the Global Environmental Facility.

## 3. Drug efficacy

Recent drug efficacy studies in South America documented over 80% resistance of *P. falciparum* to chloroquine (Fig. 37), and close to 20% resistance to sulfadoxine–pyrimethamine (Fig. 38). Confirmed and/or suspected resistance of *P. falciparum* was also reported for primaquine, mefloquine and quinine. Based on these data, 8 of the 9 endemic Amazon countries (Bolivia, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela) have changed national drug policies and now use ACTs for the treatment of falciparum malaria. However, in several of these countries various other antimalarial drugs remain readily accessible through private pharmacies and/or informal suppliers.

In Central America north of the Panama Canal, the only case of chloroquine failure against falciparum malaria that has been documented so far was in Guatemala. Chloroquine continues to be used for prophylaxis for international travellers to the Dominican Republic and Haiti, (57) and for treatment during recent falciparum malaria epidemics in the Dominican Republic. The drug has generally retained its efficacy for the treatment of vivax malaria in the Americas, although chloroquine-resistant *P. vivax* has been reported in Brazil, Colombia, Guatemala, Guyana and Peru.

**BOX 12. IMPACT OF “FOCALIZED TREATMENT” STRATEGY IN MEXICO**

Climatic conditions such as temperature and humidity would seem to permit malaria transmission in much of Mexico, except for the mountainous and desert areas. The vast majority of cases (99% in 2003) are caused by *P. vivax*, which explains the absence of reported malaria-related deaths since 1982. Effective control measures have now restricted malaria transmission to foci that are in dispersed rural areas, in 15 of the country's 32 states. Thus, 99.8% of Mexico's population now live in areas where malaria is not a threat.

The unsuccessful eradication campaign, centred on IRS with DDT from 1956 to 1982, was followed by a transition phase during which malaria cases dramatically increased (Fig. 39). In 1989, a Plan of Intensive and Simultaneous Actions was instituted, consisting of massive drug administration and insecticide spraying in high-transmission areas. While this plan initially yielded good results, its activities were costly and malaria transmission resumed when the activities were interrupted or limited by budgetary constraints. This occurred in 1998, generating an epidemic affecting mainly Oaxaca State.

Since then, a new strategy, “focalized treatment”, was adopted consisting of:

- epidemiological surveillance and identification of “malaria reservoirs” for malaria patients and their families;
- repeated drug treatments—chloroquine and primaquine—for patients and their families over a 3-year period;
- focal, selective spraying with pyrethroid insecticides.

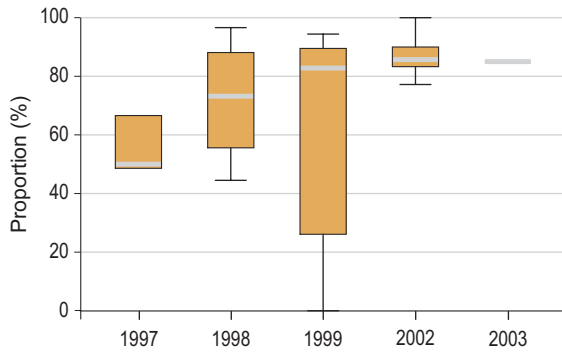
Intensive surveillance is a key activity because:

- climatically, many areas remain suitable to malaria transmission and epidemics could occur if cases are not treated promptly before the parasites spread further.
- population movements from countries south of Mexico with higher malaria endemicity represent a continuous risk of introduction of malaria parasites, including of chloroquine-resistant *P. falciparum*.

The rational use of insecticides has decreased the number of houses sprayed from 500 000 in 1997 to 100 000 in 2003. IRS is now only used in the southern border areas, which reduced the costs of the control programme.

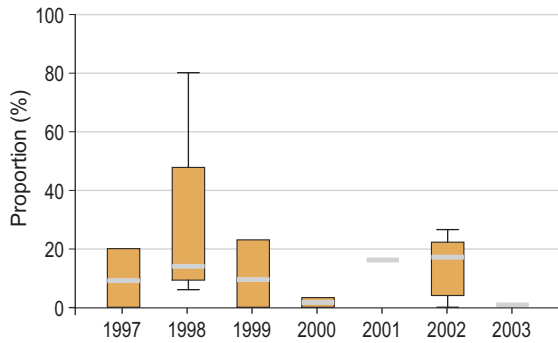
These activities have prevented epidemics and successfully interrupted transmission in 99% of the localities. Between 1985 and 2003, the numbers of reported cases decreased by 97%—3819 cases (Fig. 40). Most remaining cases occur in foci near the country's southern borders, and in four north-west states where difficult access hinders control activities. To date, no drug resistance has been reported. Eventual elimination of the disease does not appear to be an unrealistic goal; such an achievement would yield important health benefits for the country and its neighbours, as well as substantial economic dividends, particularly for Mexico's tourism industry.

**Figure 37.** Treatment failure of chloroquine against falciparum malaria in South America, 1997–2003



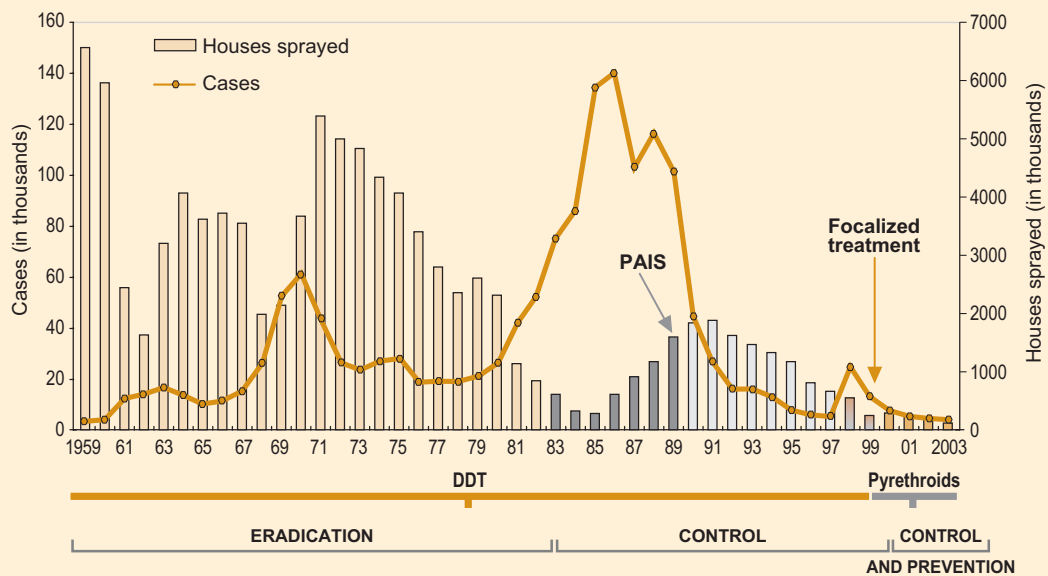
Drug efficacy expressed as total treatment failure with 28-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median.

**Figure 38.** Treatment failure of sulfadoxine–pyrimethamine against falciparum malaria in South America, 1997–2003



Drug efficacy expressed as total treatment failure with 28-day follow up (9). Boxes indicate the 25th and 75th percentile of failure rates observed across available studies, error bars indicate the upper and lower adjacent values and the grey line in each box indicates the median.

**Figure 39.** Malaria cases and insecticide sprayings in Mexico, 1959–2003



PAIS = Plan of Intensive and Simultaneous Actions – Source: Mexico Ministry of Health (Secretaría de Salud)