Chapter 4.
Impact of malaria control

This chapter summarizes the global burden of malaria and provides assessments of the evidence that malaria control activities have had an impact on malaria disease burden in each WHO Region.

4.1 Global estimates of malaria cases and deaths in 2008

The global numbers of malaria cases and deaths in 2008 were estimated by one of the two methods described in the *World Malaria Report 2008 (1)* (Annex 1). In brief, the numbers of malaria cases were estimated: *i)* by adjusting the number of malaria cases for completeness of reporting, the extent of health service use and the likelihood that cases are parasite-positive; when the data permit, this is generally the preferred method and was used for countries outside Africa and for selected African countries; or *ii)* from an empirical relation between measures of malaria transmission risk and case incidence; this procedure was used for countries in Africa where a convincing estimate could not be made from reports.

The numbers of malaria deaths were estimated: *i)* by multiplying the estimated number of *P. falciparum* malaria cases by a fixed case fatality rate for each country, for countries where malaria accounts for a relatively small proportion of all deaths and where reasonably robust estimates of case incidence could be made, primarily outside Africa; or *ii)* from an empirical relation between measures of malaria transmission risk and malaria-specific mortality rates, primarily for countries in Africa where estimates of case incidence could not be made from routine reports.

4.1.1 Cases

In 2008, there were an estimated 243 million cases of malaria (5th–95th centiles, 190–311 million) worldwide (**Table 4.1**). The vast majority of cases (85%) were in the African Region, followed by the South-East Asia (10%) and Eastern Mediterranean Regions (4%). The totals are similar to those reported in the *World Malaria Report 2008 (1)* (for the year 2006), except that the number of cases in the Region of the Americas is lower because of updated information from household surveys and other information on the number of cases detected by surveillance systems. The number of cases in the South-East Asia Region is higher, owing to updated household survey information for Bangladesh and Indonesia on where patients seek treatment for fever. The estimates also reflect progress in reducing the number of cases in several countries, but because most reductions have been seen in smaller countries, they do not yet have much influence on the regional and global totals. The estimates are accompanied by large uncertainty intervals, which overlap those of previous estimates.

4.1.2. Deaths

Malaria accounted for an estimated 863 000 deaths (5th–95th centiles, 708–1003 million) in 2008, of which 89% were in the African Region, followed by the Eastern Mediterranean (6%) and the South-East Asia Regions (5%). The estimated numbers of deaths are similar to those reported in the *World Malaria Report 2008 (1)* (for the year 2006), but the number of deaths in Africa is lower by 34 000, primarily because of a reduction in the total number of deaths from all causes among children under 5 years of age *(2)*. The number of malaria deaths is assumed to follow this trend, although evidence on trends in malaria-specific mortality is not available for most of the countries in which a reduction in under-5 mortality is documented.

Table 4.1 Estimated numbers of malaria cases (in millions) and deaths (in thousands) by WHO Region, 2008

WHO REGION	CASES				DEATHS			
	Point	*Lower*	*Upper*	*P. falciparum* (%)	*Point*	*Lower*	*Upper*	Under 5 (%)
AFR	208	155	276	98	767	621	902	88
AMR	1	1	1	32	1	1	2	30
EMR	9	7	11	75	52	32	73	77
EUR	0	0	0	4	0	0	0	3
SEAR	24	20	29	56	40	27	55	34
WPR	2	1	2	79	3	2	5	41
Total	**243**	**190**	**311**	**93**	**863**	**708**	**1003**	**85**

The number of deaths due to malaria is also higher in the Eastern Mediterranean Region, owing to increases in envelops for mortality from all causes in children under 5 in Somalia and Sudan *(2)*, although specific evidence of a rise in malaria mortality is lacking. The number of deaths in the South-East Asia region is higher owing to the increased estimate of the number of cases that was due to better information on where fever cases seek treatment; there is no specific evidence of an upward trend in the number of malaria deaths. The estimates are accompanied by large uncertainty intervals, which overlap those of previous estimates.

4.2 Assessing the impact of malaria interventions

4.2.1 Investigating trends in the incidence of malaria

The reported numbers of malaria cases and deaths are used as core indicators for tracking the progress of malaria control programmes. The main sources of information on these indicators are the disease surveillance systems operated by ministries of health. Data from such systems have two strengths. First, case reports are recorded continuously over time and can thus reflect changes in the implementation of interventions or climate conditions. Secondly, routine case and death reports are often available for all geographical units of a country. Changes in the numbers of cases and deaths reported by countries do not, however, necessarily reflect changes in the incidence of disease in the general population, because: *i)* not all health facilities report each month, and so variations in case numbers may reflect fluctuations in the number of health facilities reporting rather than a change in underlying disease incidence; *ii)* routine reporting systems often do not include patients attending private clinics or morbidity treated at home, so disease trends in health facilities may not reflect trends in the entire community; and *iii)* not all malaria cases reported are confirmed by slide examination or RDT, so that cases reported as malaria may be other febrile illnesses *(3)*. When reviewing data supplied by ministries of health in malaria-endemic countries, we attempted to minimize the influence of these sources of error and bias by pursuing the following strategy:

- Focusing on confirmed cases (by microscopy or RDT) to ensure that malaria and not other febrile illnesses are tracked. For high-burden countries in the WHO African Region, where little case confirmation is undertaken, the number of inpatient malaria cases is reviewed because the predictive value of an inpatient diagnosis is considered to be higher than outpatient diagnoses based only on clinical signs and symptoms; in such cases, the analysis may be heavily influenced by trends in severe malaria rather than trends in all cases.
- Monitoring the number of laboratory tests undertaken. It is useful to measure the annual blood examination rate, which is the number of laboratory tests undertaken per 100 people at risk per year, to ensure that potential differences in diagnostic effort or completeness of reporting are taken into account. The annual blood examination rate should ideally remain constant or be increased if attempting to discern decreases in malaria incidence.[1] When reviewing the number of malaria admissions and deaths, the health facility reporting rate should remain constant and should be high, i.e. > 80%.
- Monitoring trends in the malaria (slide or RDT) positivity rate. This rate should be less severely distorted by variations in the annual blood examination rate than trends in the number of confirmed cases. For high-burden African countries, when the number of malaria inpatients is being reviewed, it is also informative to examine the percentage of admissions or deaths due to malaria, as this proportion is less sensitive to variation in reporting rates than the number of malaria inpatients or deaths.
- Monitoring the number of cases detected in the surveillance system in relation to the total number of cases estimated to occur in a country.[2] Trends derived from countries with high case detection rates are more likely to reflect trends in the broader community. When examining trends in the number of deaths, it is informative to compare the total number of deaths occurring in health facilities with the total number of deaths estimated to occur in a country.
- Examining the consistency of trends. Unusual variation in the number of cases or deaths that cannot be explained by climate or other factors or inconsistency between trends in cases and in deaths can suggest deficiencies in reporting systems.
- Monitoring changes in the proportion of cases due to *P. falciparum* or the proportion of cases occurring in children < 5. While decreases in the incidence of *P. falciparum* malaria may precede decreases in *P. vivax* malaria, and there may be a gradual shift in the proportion of cases occurring in children < 5, unusual fluctuations in these proportions may point to changes in health facilities reporting or to errors in recording.

The aim of these procedures is to rule out data-related factors, such as incomplete reporting or changes in diagnostic practice, as explanations for a change in the incidence of disease and to ensure that trends in health facility data reflect changes in the wider community. The conclusion that trends inferred from health facility data reflect changes in the community has more weight if: *i)* the changes in disease incidence are large, *ii)* coverage with public health services is high and *iii)* interventions promoting change, such as use of ITNs, are delivered throughout the community and not restricted to health facilities.

1. Some authorities recommend that the annual blood examination rate should exceed 10% to ensure that all febrile cases are examined; however, the observed rate depends partly on how the population at risk is estimated, and trends may still be valid if the rate is < 10%. Some authorities have noted that 10% may not be sufficient to detect all febrile cases. It is noteworthy that the annual blood examination rate in the Solomon Islands, a highly endemic country, exceeds 60%, with a slide positivity rate of 25%, solely by passive case detection.

2. The *World Malaria Report 2008* described methods for estimating the total number of malaria cases in a country based on the number of reported cases and taking into account variations in health facility reporting rates, care-seeking behaviour for fever as recorded in household surveys and the extent to which suspected cases are examined in laboratory tests.

4.2.2 Assessing coverage with malaria interventions

Data on the number of ITNs distributed by malaria programmes and populations covered by IRS are supplied annually by ministries of health to WHO as part of reporting for the *World Malaria Report*. Such information may contain inaccuracies or gaps, particularly for earlier years. Hence, if data for earlier years are missing, it might be inferred incorrectly that preventive activities have recently been intensified. Nevertheless, for many countries, data from ministries of health are the only source of information on preventive activities and are consistent over the years. Data from nationally representative household surveys are available for selected countries, but these surveys are usually not undertaken frequently enough to allow assessment of trends in intervention coverage or to provide contemporary information. Information on access to treatment is less complete than data on ITNs and IRS, as few countries supply information on the number of courses of antimalarial medicines distributed in relation to the number of cases treated in the public sector. Information on preventive activities or treatment provided by the private sector is almost completely absent. It is therefore not always possible to obtain a complete picture of the extent of control activities in a country. Similarly, information on other factors that can affect malaria incidence is often not available, such as climate variations, deforestation or improved living conditions.

4.2.3 Establishing a link between malaria disease trends and control activities

In establishing a causal link between malaria disease trends and control activities, one should consider what the disease trends would have been without application of the control activities and then assess whether the decrease in malaria observed is greater than that expected without control activities. A robust view of what would have happened without control activities (i.e. counterfactual) cannot be established from the data currently available; however, it can be expected that, without a change in control activities, the malaria incidence might fluctuate in response to short-term climate variations but would otherwise show little change, as improved living conditions, environmental degradation or long-term climate change have only gradual effects (although there may be local exceptions). Thus, a plausible link with control efforts can be established if the disease incidence decreases at the same time as control activities increase, if the magnitude of the decrease in malaria incidence is consistent with the magnitude of the increase in control activities (a 50% decrease in the number of cases is unlikely to occur if malaria control activities cover only 10% of the population at risk) and if the decreases in malaria incidence cannot readily be explained by other factors.

Countries for which there is evidence from good-quality surveillance data of a large, sustained decrease (> 50% or 25%) in the number of cases since 2000 are presented below by WHO region. Information on the scale of malaria control interventions is also summarized, to identify countries with preventive programmes that cover > 50% of the population at high risk and countries that undertake extensive case detection and treatment. Countries in which there is evidence of both a sustained decrease in cases since 2000 and extensive control activities are highlighted as providing evidence of an impact of malaria control activities. Selected high-burden countries in the African Region are discussed individually. For other regions, the results of the analysis are shown in a standard set of graphs, as described in **Box 4.1**.[3]

BOX 4.1

Explanation of graphs

Population at risk: the population at high risk for malaria is that living in areas where the incidence is 1 or more per 1000 per year (defined at the second or lower administrative level). The population at low risk for malaria is that living in areas with fewer than 1 case of malaria per 1000 per year (see Methods in Annex 1).

Percentage of cases due to *P. falciparum:* percentage of confirmed cases in which *P. falciparum* or a mixed infection was detected

Annual blood examination rate: number of slide examinations undertaken each year in relation to the population at risk for malaria, expressed as a percentage.

Confirmed cases reported as a percentage of total estimated: total number of confirmed cases in relation to the estimated number of malaria cases in a country. The estimated number of cases is calculated by taking into account: *i)* the completeness of reporting from health facilities, *ii)* the extent to which people with fever use public health facilities for treatment and *iii)* the extent to which public health facilities undertake case confirmation (see technical notes). The line in the centre of the bar represents the point estimate of the percentage of estimated cases captured by the surveillance system. The width of the bars reflects uncertainty around the estimate of the number of cases.

Change in number of reported cases: the number of confirmed malaria cases is shown on the vertical axis, with each country indexed at 100 in 2000 (or a later year if data were not available for 2000); i.e. a value of 200 in 2005 indicates that the number of cases in 2005 was twice that reported in 2000 and represents a 100% increase. Countries with evidence of a decrease are generally those in which there has been a consistent decrease in the number of cases and consistency in reporting of malaria cases (e.g. stable annual blood examination rate). Countries for which there is little evidence of a decrease are those that do not show a decrease in the number of cases or where there have been irregular variations in surveillance data (e.g. annual blood examination rate falling, or unexplained variations in the percentage of cases due to *P. falciparum*).

IRS and ITNs delivered. The vertical scale shows the percentage of the population at risk for malaria potentially covered by preventive programmes with IRS and ITNs. It is assumed that each bed net delivered can cover two people, that conventional nets are retreated regularly and that each net is not replaced for 3 years. IRS is assumed to target a different population from that receiving bed nets. The percentage of the population potentially covered is therefore the maximum possible covered by the interventions delivered. The denominator is the population living at high risk for malaria, as the number of malaria cases in areas of low risk is small. The scale of preventive efforts in any year is calculated as: 100 x (number of ITNs delivered in past 3 years + number of people protected by IRS in current year)/population at high risk. Note that this indicator can exceed 100% if interventions are also applied to populations at low risk.

3. Countries in the prevention of re-introduction phase with only sporadic cases are excluded from the analysis.

4.3 African Region

4.3.1 High burden countries

This section updates the trends in morbidity and mortality from malaria presented in the *World Malaria Report 2008*. As the quality of the information received from most of the 35 high-burden countries in the WHO African Region was poor, trends could be analysed for only four of these countries, Eritrea, Rwanda, Sao Tome and Principe, Zambia and for the Zanzibar area of the United Republic of Tanzania. The four countries were among the ten with the highest rates of ITN ownership, as estimated in Chapter 3, the percentage of households owning at least one ITN exceeding 60% in 2008. A household survey undertaken in Zanzibar at the end of 2007 showed that 72% of households owned at least one ITN.

Eritrea. Eritrea had a population of 3.8 million in 2001 and reported a total of 126 000 malaria cases in that year. More than 1.1 million nets were distributed between 2001 and 2008 (an average of 139 000 per year), with LLIN distribution starting in 2005. In 2004, 73% of households in areas of high transmission owned an ITN and 59% of children 0–5 years slept under a net *(4)*. A malaria indicator survey in 2008 showed that 71% of households owned at least one ITN, and 39% of children < 5 years slept under an ITN (Eritrea Ministry of Health, unpublished data). Annual rounds of IRS protected approximately 238 000 people per year between 2001 and 2006. An average of 28 000 courses of ACT were distributed annually between 2006–2008, which was sufficient to treat all cases of *P. falciparum* malaria in outpatients.

The number of malaria outpatients fell by more than 90% between 2001 and 2008 (**Fig. 4.1**). The number of patients admitted to hospital for any reason increased by 44% between 2001 and 2008, but the number of malaria inpatients decreased by 68%. There were 86% fewer deaths from malaria among inpatients in 2008 than in 2001. A review of the evidence suggested that the observed decreases in the numbers of cases and deaths were due to malaria control interventions and not solely to environmental or other factors *(4)*.

Rwanda. Two sources of information on trends in the numbers of malaria cases and deaths were available from Rwanda: the results of a study by the Ministry of Health and WHO on the impact of malaria control in 2001–2008 on the basis of information from 19 health facilities in all 10 provinces and nationwide case records from surveillance activities in 2001–2007[4], as reported to WHO.

Approximately 765,000 ITNs (not LLINs) were distributed between 2001 and 2005 for a population of 8–9 million; 185,000 LLINs were added in 2005. During a nationwide campaign targeting children < 5 years in 2006, 1.96 million LLINs were distributed, and a further 1.16 million LLINs were distributed in 2007, increasing the percentage of the population potentially covered by nets to 70%. ACTs were distributed nationwide between September and October 2006, at the same time as the mass distribution of LLINs. A malaria indicator survey in 2007 showed that 50% of households owned an ITN and 56% of children < 5 slept under an ITN. A demographic and health survey conducted in 2007–2008 showed that 56% of households owned an ITN and 56% of children < 5 slept under a net.

The numbers of malaria cases and deaths appeared to decrease rapidly after the distribution of LLINs and ACT in 2006 (**Fig. 4.2**). In the 19 health facilities visited for the impact study in 2009, the annual number of confirmed malaria cases (all ages) in 2008 was 53% lower than the average for 2001–2005 (data not available by age group). The number of malaria inpatients was 52% lower, and the number of malaria deaths was 41% lower in 2008 than in 2001–2005 among children < 5 years old (target age group of the ITN campaign).

A similar trend is seen in an aggregation of surveillance data nationwide for 2001–2007. The annual number of confirmed malaria cases (all ages) in 2007 was 31% lower than in 2001–2005, the number of admissions for malaria was 43% lower, and the number of malaria deaths was 66% lower among children < 5 years old.[4] The slide positivity rate fell from an average of 52% between 2001 and 2005 to 22% in 2007. The annual blood examination rate increased from 8% in 2001 to 16% in 2007. Health facility reporting rates were high throughout the period, averaging 92%, the lowest value being obtained in 2006.

In summary, mass distribution of ITNs to children < 5 and to pregnant women, distribution of ACTs to public-sector facilities and increased rates of household ITN ownership and use by children exceeding 50% were associated with approximately 50% decreases in the numbers of confirmed outpatient cases, inpatient cases and deaths due to malaria over 24 months.

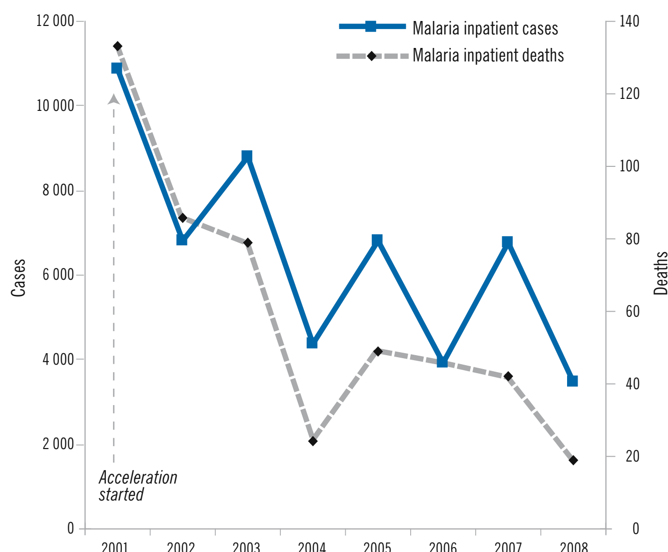
Sao Tome and Principe. The population of Sao Tome and Principe was 160 000 in 2008. IRS protected 140 000 people in 2005, 126 000 in 2006 and 117 000 in 2007. By 2007, nationwide ITN coverage was among the highest in Africa: 78% of households owned at least one ITN, and 54% of children < 5 years of age slept under an ITN. ACT was introduced for treatment of malaria in 2005, and the number of treatment courses distributed in 2005–2008 was enough to cover all reported cases.

The annual number of confirmed malaria cases in 2005–2008 was 84% lower than in 2000–2004, and the slide positivity rate fell from 47% between 2000 and 2004 to < 13% between 2005 and 2008 (**Fig. 4.3**). The number of admissions due to malaria was 87% lower in 2005–2008 than in 2000–2004, while the percentage of admissions for malaria fell from an average of 62% in 2000–2004 to 23% in 2005–2008. Similarly, the number of malaria inpatient deaths in 2005–2008 was 86% lower than in 2000–2004, and the percentage of deaths due to malaria in health facilities fell from 23% to 4%. The number of deaths from malaria among children < 5 fell by 89%, while the number of deaths from all causes among children < 5 decreased by 59%. By 2008, the numbers of inpatient malaria cases and deaths and outpatient malaria cases had decreased by > 90% in comparison with 2000–2004. All-cause inpatient deaths declined by 53%.

In Sao Tome and Principe, therefore, a strong association is seen between interventions and impact, albeit on a relatively small scale *(5)*.

4. As a new information system was introduced in 2008, it is difficult to compare data from the national health information system for 2008 with those for previous years.

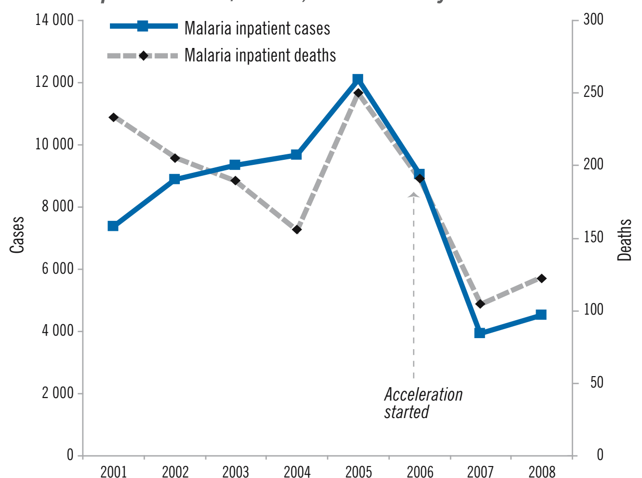
Figure 4.1 Malaria inpatient cases and deaths by year, all ages, 2001–2008, Eritrea



Source: Ministry of Health routine surveillance data

Figure 4.2 Malaria inpatient cases and deaths among children < 5 by year and outpatient all-cause and confirmed malaria cases in all ages, 19 health facilities, 2001–2008, Rwanda

a) *Malaria inpatient cases/deaths, children <5 years old*



* Mass distribution of ITN to children < 5 years old and pregnant women and distribution of ACT to public health facilities

b) *Outpatients: all-cause cases and malaria test positivity rate, all ages*

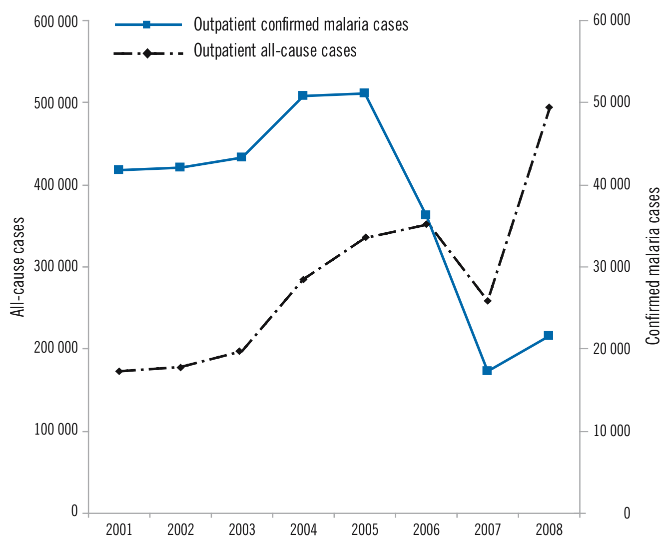
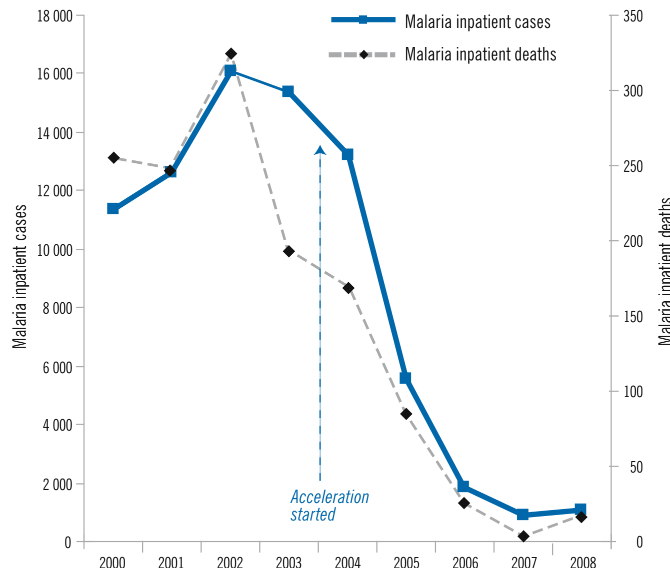
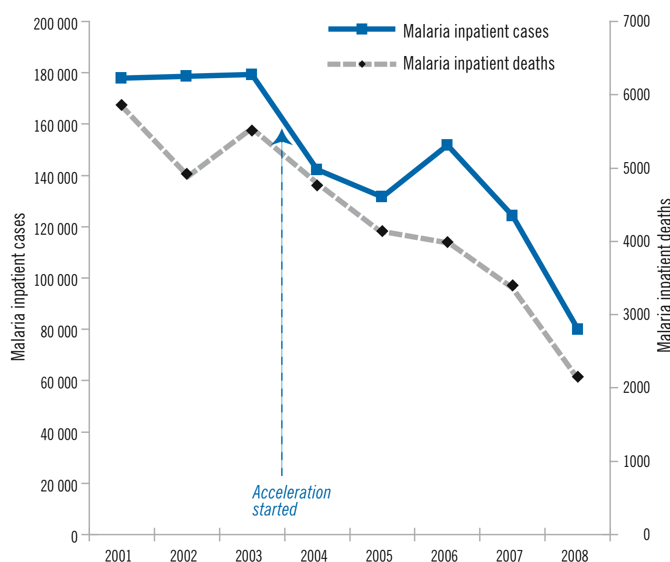


Figure 4.3 Malaria inpatient cases and deaths, all ages, by year, 2000–2008, Sao Tome and Principe



Source: Ministry of Health routine surveillance data

Figure 4.4 Malaria inpatient cases and deaths by year, all ages, first and second quarter each year, 2001–2008, Zambia



Source: Ministry of Health routine surveillance data

Zambia. Data on malaria trends in Zambia are more comprehensive than those for most countries, because: *i)* records from the health management information system were more or less complete between 2001 and the first half of 2008, and *ii)* two nationally representative household surveys that included testing for malaria parasites and anaemia were undertaken in 2006 and 2008.

Zambia had a population of 12.6 million in 2008. During 2002–2005, 1.26 million LLINs were distributed, enough to protect about 2.5 million people (assuming one net protects two people). An additional 4.8 million LLINs were distributed between 2006 and 2008 – enough to protect 9.6 million people, or 76% of the population. IRS covered an average of 0.9 million persons between 2003 and 2005, 2.4 million in 2006 (mostly in urban areas), 3.3 million in 2007 and 5.7 million in 2008. ACT was made available nationwide in 2004. The number of ACT treatment courses distributed increased from 1.2 million in 2004 to 3.1 million in 2008, coverage increasing from 29% of the malaria cases reported in public health facilities to 100%.

A nationally representative household survey in 2006 found that 44% of households owned an ITN, and 23% of children < 5 slept under an ITN. In 2008, these proportions had risen to 62% of households and 41% of children < 5. Approximately 47% of the population (mostly urban) were protected by IRS; 13% of children with fever in the previous 2 weeks had received ACTs, and 16% had received other antimalarial medicines.

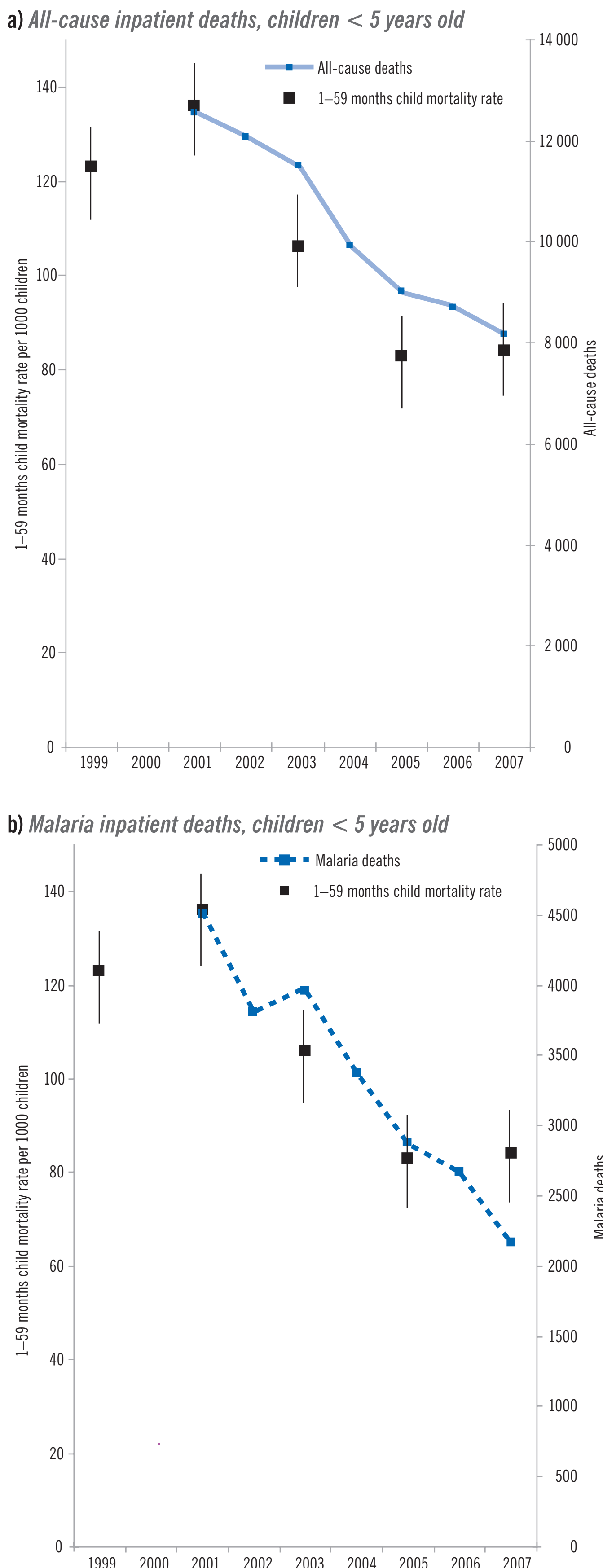
A switch to a new health management information system during the third and fourth quarters of 2008 resulted in some incompleteness of reporting for those quarters. Therefore, data for the first two quarters of each year (the peak malaria season in most years) are presented. These surveillance data show that the numbers of malaria inpatients and deaths were 55% and 60% lower, respectively, in 2008 than the average for 2001–2002 for all ages (**Fig. 4.4**). The numbers of admissions and deaths from diseases other than malaria or anaemia decreased by 0% and 6%, respectively.

The scale of change observed in health facility data on inpatient cases is consistent with that from household surveys. The parasite prevalence among children < 5 decreased by 53% between 2006 and 2008 (from 21.8% to 10.2%), and the percentage of children with severe anaemia (< 8 g/dl haemoglobin) decreased by 68% (from 13.3% to 4.3%). The numbers of inpatient malaria cases and deaths among children < 5 decreased by 57% and 62%, respectively, while the number of admissions for anaemia decreased by 47%.

The magnitude of the decrease in numbers of inpatient deaths from all causes among children < 5 was similar to that of the decrease in mortality among children aged 1–59 months observed in the 2007 demographic and health survey (**Fig. 4.5**). A possible reason for the similarity between inpatient and population trends might be the geographically homogeneous ITN coverage: the 2008 malaria indicator survey showed that ITN coverage in Zambia was similar for the poorest (63%) and richest quintiles (65%) and in urban (59%) and rural areas (64%).

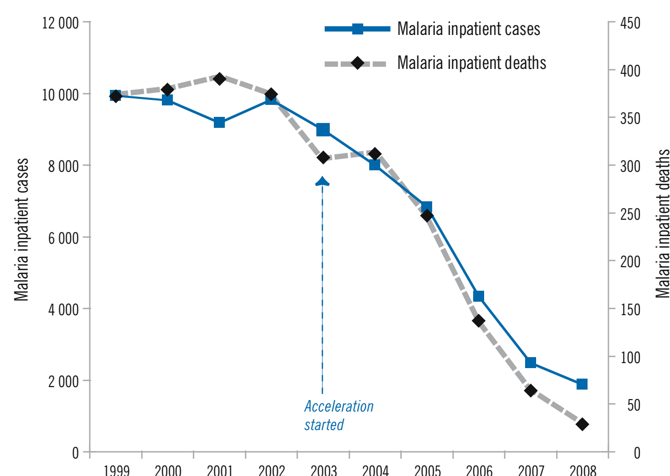
Zanzibar, United Republic of Tanzania. The islands of Zanzibar had a population of 1.2 million in 2008. ACT was made freely available in all public health facilities in September 2003. Approximately 245 000 LLINs were distributed in 2006, enough to cover 40% of the population, while a further 213 000 were distributed in 2007–2008. ITN household ownership was 72% and ITN use by children was 59%

Figure 4.5 Trends in 1–59-month child mortality rate from a demographic and health survey (DHS) compared with inpatient all-cause and malaria deaths from routine health information system, 1999–2007, Zambia. Mortality rates in children 1–59 months in 2-year intervals from DHS data are shown in black squares (95% confidence interval shown as line)



* Mortality rates from DHS data were calculated by Julie Rajaratnam, Linda N. Tran and Alison Levin-Rector at Institute for Health Metrics and Evaluation

Figure 4.6 Malaria inpatient cases and deaths, all ages, by year, 1999–2008, six of seven hospitals in Zanzibar, United Republic of Tanzania



Source: Ministry of Health routine surveillance data

at the end of 2007. One round of IRS was carried out in 2006, followed by a further two rounds in 2007 and a single round in 2008. Each round covered nearly all households.

The numbers of inpatient cases and deaths from malaria decreased substantially between 2003 and 2008, and in 2006–2008, the numbers of malaria admissions and deaths were 70% lower than the numbers recorded in 2001 and 2002 (**Fig. 4.6**). By 2008, the numbers of inpatient malaria cases and deaths were lower by 80% and 92%, respectively. In contrast the number of admissions for conditions other than malaria was 20% higher.

Before acceleration of malaria control activities in 2005, 52% of cases and 53% of deaths among all inpatients were diagnosed as malaria. The number of inpatient deaths from all causes among children decreased by 57% and that of cases by 48% in 2008 as compared with 1999–2003, before acceleration. While the decrease in the number of admissions for malaria is dramatic and its timing is associated with high coverage with antimalarial interventions, it is uncertain how much of the decrease is due to improved diagnosis of cases, as fewer cases were diagnosed symptomatically and consequently fewer non-malarial fevers were classified as malaria. (A total of 650,000 RDTs were distributed by the Zanzibar malaria control programme between 2005 and 2006.) Other evidence for an impact of malaria interventions comes from a detailed investigation in one district, where, among children < 5, there were substantial reductions in *P. falciparum* prevalence, malaria-related admissions, blood transfusions, crude mortality and malaria-attributed mortality after introduction of ACTs in 2003 *(6)*.

4.3.2 Low-transmission countries in the African Region

In Botswana, Cape Verde, Namibia, South Africa, Swaziland and Zimbabwe, malaria is highly seasonal, and transmission is of much lower intensity than in the rest of sub-Saharan Africa. The vast majority of cases are due to *P. falciparum* (**Fig. 4.7b**). Five countries (Botswana, Cape Verde, Namibia, South Africa and Swaziland) demonstrated decreases > 50% in the numbers of confirmed cases and deaths due to malaria between 2000 and 2008 (**Fig. 4.7e**), although the decrease in cases appears to have levelled off, the numbers of cases remaining at 10–25% of those in 2000. The reasons are not yet clear, but the few cases remaining may be more difficult to prevent, detect and treat. Four of these countries (Botswana, Namibia, South Africa and Swaziland) also reported large decreases in the number of deaths due to malaria (**Table 4.2**) while Cape Verde reported only 2 deaths in 2008. In Zimbabwe, an increase in the number of confirmed malaria cases from 16 990 in 2004 to 92 900 in 2008 was associated with a sixfold increase in the number of slides examined; in contrast, the total of all reported malaria cases, which includes unconfirmed cases, decreased from 1.8 million in 2004 to 1 million in 2008. The increase in the number of slides examined is a positive development but makes it difficult to assess trends in the number of cases.

The scale of IRS has remained fairly constant over the past 8 years; South Africa and Swaziland protect 80% and 100% of their population at risk per year, while Botswana, Namibia and Zimbabwe protected 91%, 26% and 20% of those populations between 2000 and 2008, respectively. Namibia delivered 630 000 LLINs between 2006 and 2008, enough to cover 92% of the population at high risk (a ratio of one LLIN per two persons at risk); Swaziland reached about 47% of the population at risk by delivering about 85 000 LLINs during the same period; and the number of ITNs delivered in Botswana was negligible. South Africa adopted ACTs for first-line treatment of malaria in 2001, and their introduction, with improved mosquito control (including spraying with DDT), has been associated with a decrease in malaria cases. Botswana, Namibia and Swaziland adopted ACTs after 2005. Zimbabwe adopted a policy of treating *P. falciparum* cases with ACTs in 2008, but the programme has not yet reported deployment to public health facilities. The malaria programme in Cape Verde focuses on case detection and treatment.

In summary, five of the six low-transmission countries in the African Region (Botswana, Cape Verde, Namibia, South Africa and Swaziland) showed > 50% decreases in the numbers of malaria cases and deaths between 2000 and 2008. Each of these countries implemented widescale malaria programmes, but a drought affecting Namibia, South Africa, Swaziland and Zimbabwe between 2001 and 2003 might also have contributed to an initial decrease. It is not possible to determine whether the number of cases in Zimbabwe is increasing, stable or decreasing, but preventive activities appeared to cover > 50% of the population at high risk in 2008.

Table 4.2 Reported numbers of deaths due to malaria in southern African low-transmission countries

COUNTRY	2000	2001	2002	2003	2004	2005	2006	2007	2008
Botswana		29	23	18	19	11	40	6	12
Namibia		1728	1504	1106	1185	1325	571	181	171
Swaziland		62	46	30	25	17	27	14	5
South Africa	458	119	96	142	89	64	87		
Zimbabwe			1844	1044	1809	1916	802	285	

Figure 4.7 WHO African Region, low transmission countries

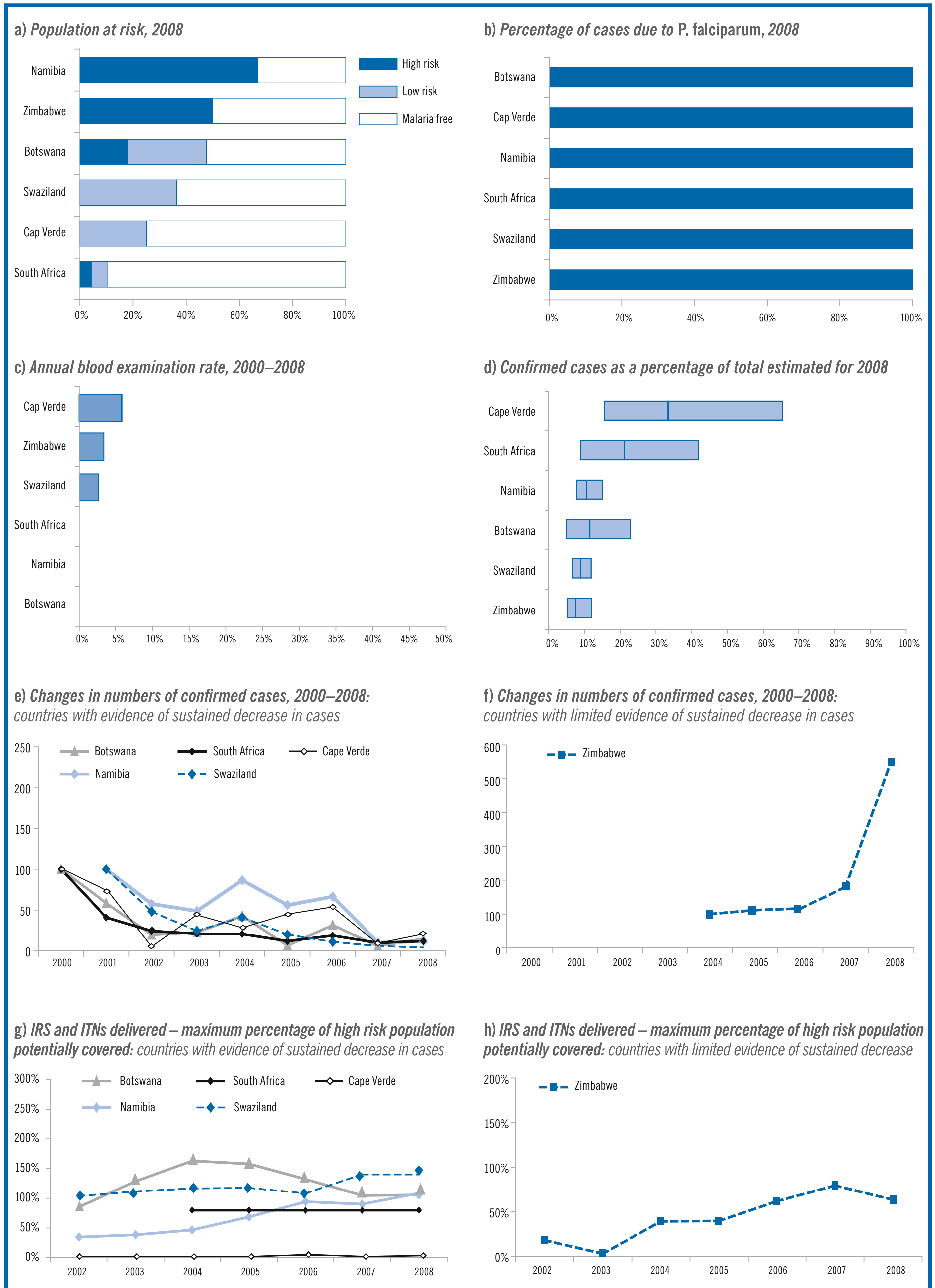
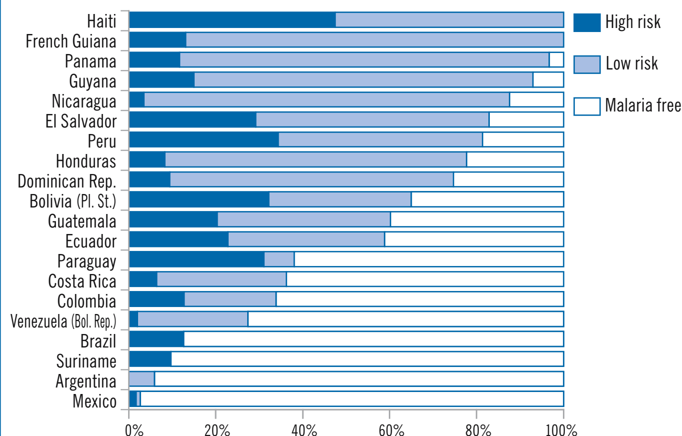
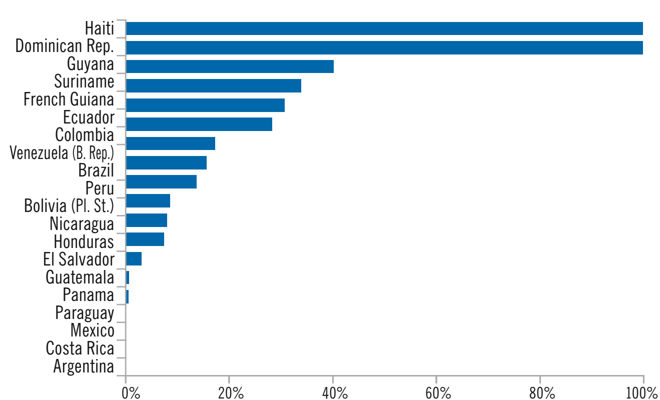


Figure 4.8 WHO Region of the Americas by IRS in 2006

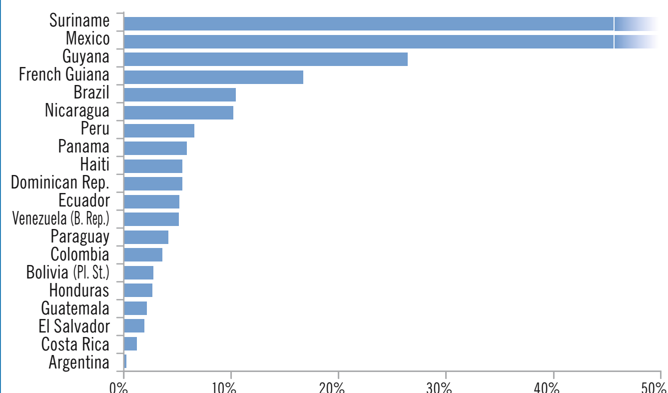
a) *Population at risk, 2008*



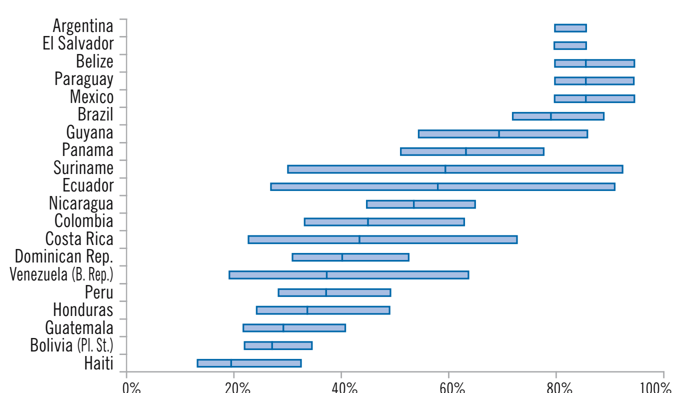
b) *Percentage of cases due to* P. falciparum, *2008*



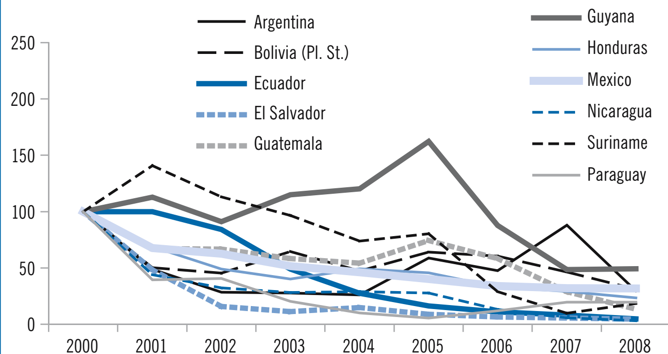
c) *Annual blood examination rate, 2000–2008*



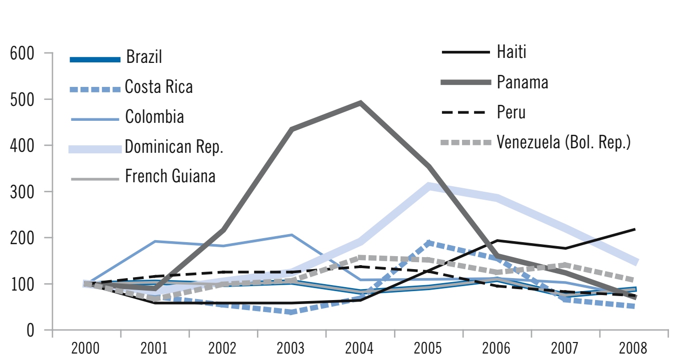
d) *Confirmed cases as a percentage of total estimated for 2008*



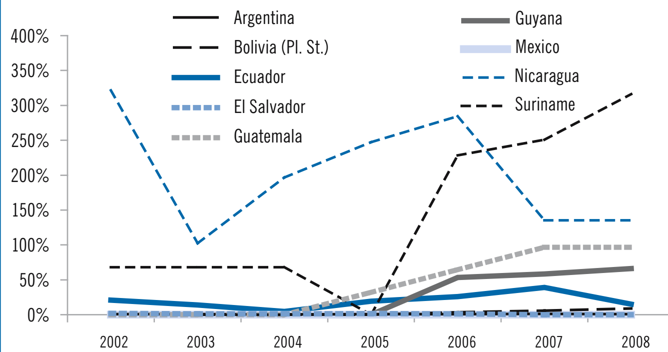
e) *Changes in numbers of confirmed cases, 2000–2008: countries with evidence of sustained decrease in cases*



f) *Changes in numbers of confirmed cases, 2000–2008: countries with limited evidence of sustained decrease in cases*



g) *IRS and ITNs delivered – maximum percentage of high risk population potentially covered: countries with evidence of sustained decrease in cases*



h) *IRS and ITNs delivered – maximum percentage of high risk population potentially covered: countries with limited evidence of sustained decrease*

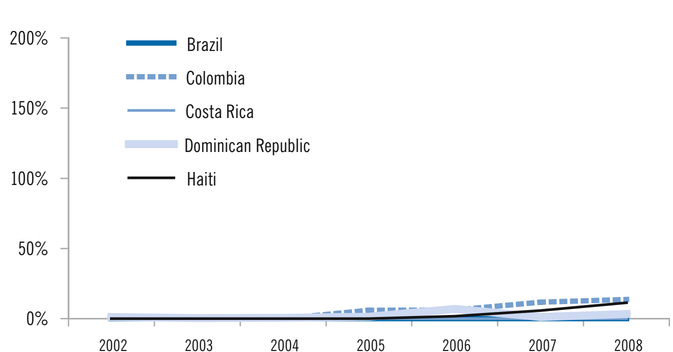


Figure 4.9 WHO South-East Asia Region

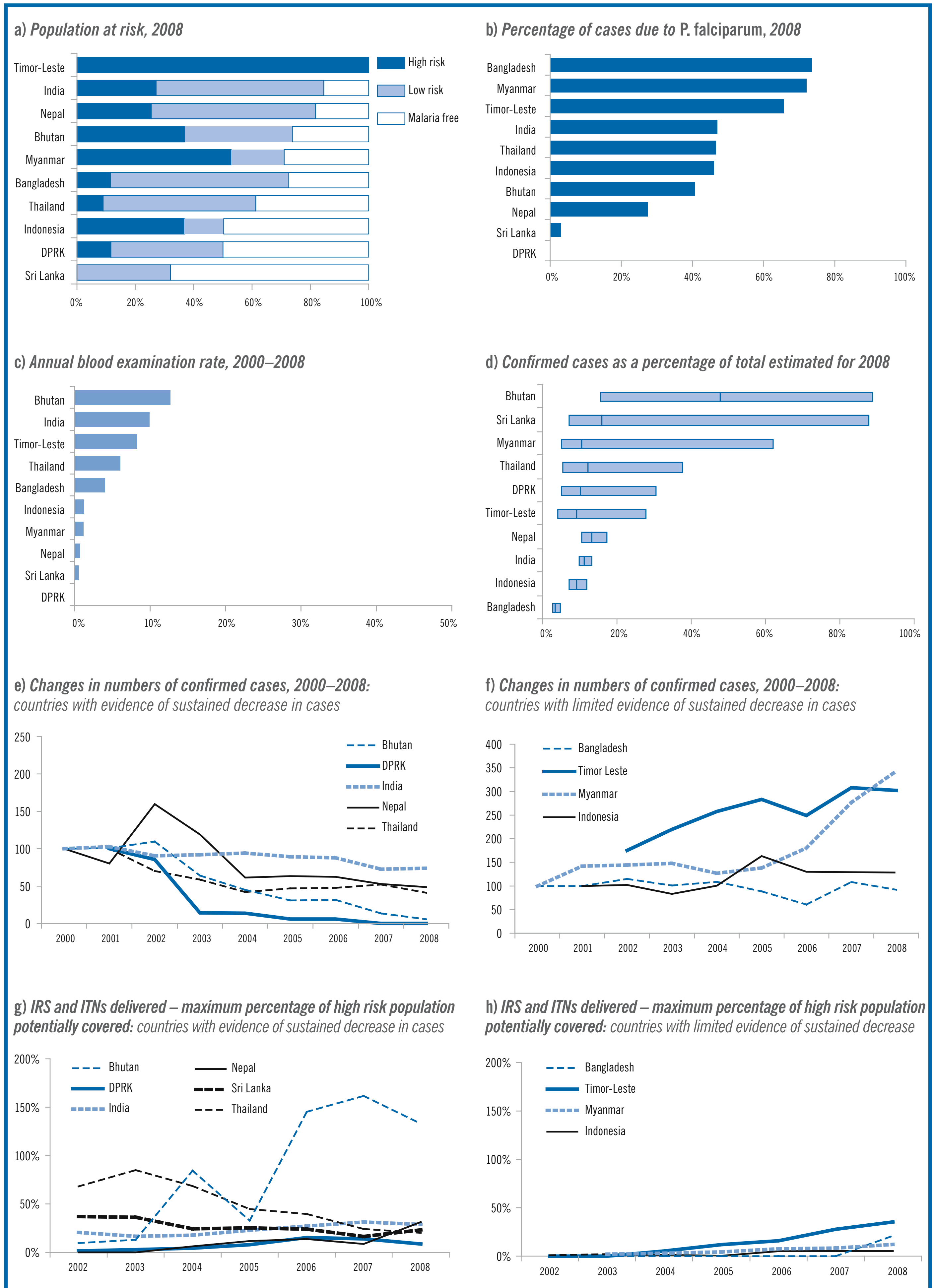
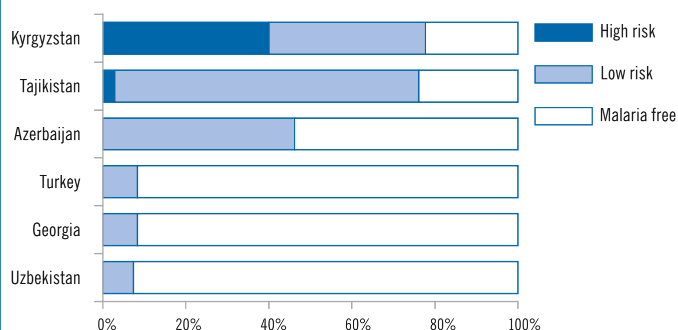
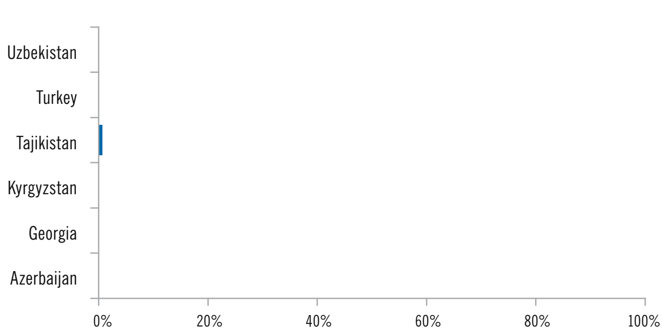


Figure 4.10 WHO European Region

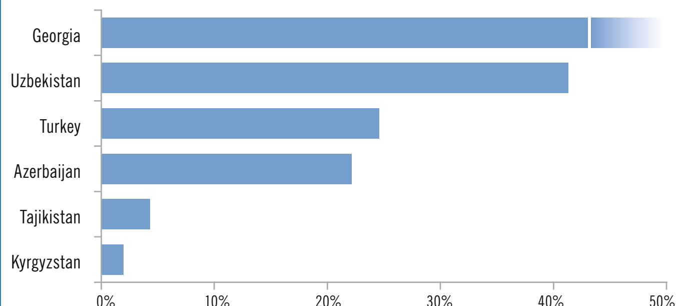
a) *Population at risk, 2008*



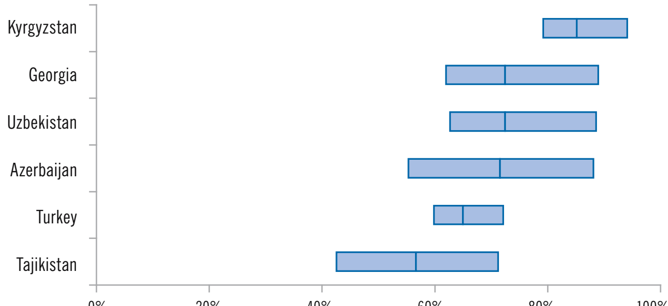
b) *Percentage of cases due to* P. falciparum, *2008*



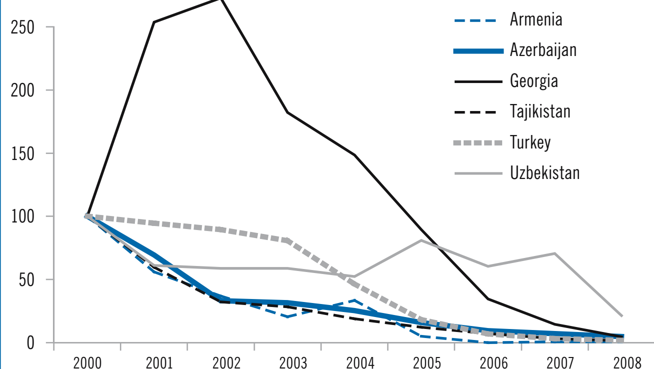
c) *Annual blood examination rate, 2000–2008*



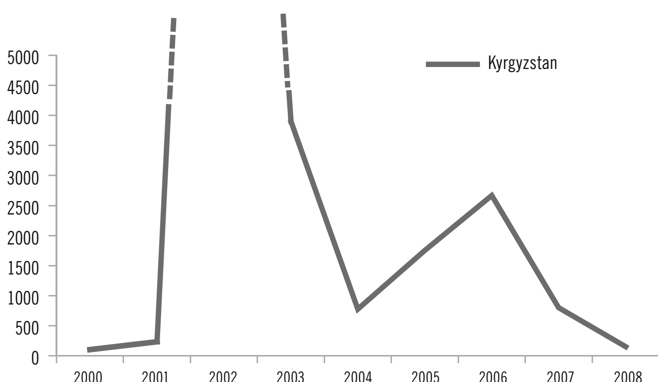
d) *Confirmed cases as a percentage of total estimated for 2008*



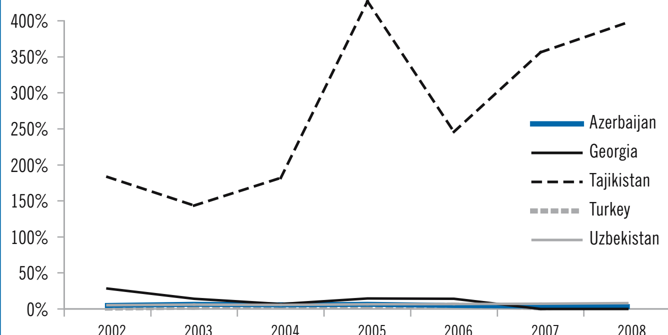
e) ***Changes in numbers of confirmed cases, 2000–2008:*** *countries with evidence of sustained decrease in cases*



f) ***Changes in numbers of confirmed cases, 2000–2008:*** *countries with limited evidence of sustained decrease in cases*



g) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** *countries with evidence of sustained decrease in cases*



h) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** *countries with limited evidence of sustained decrease*

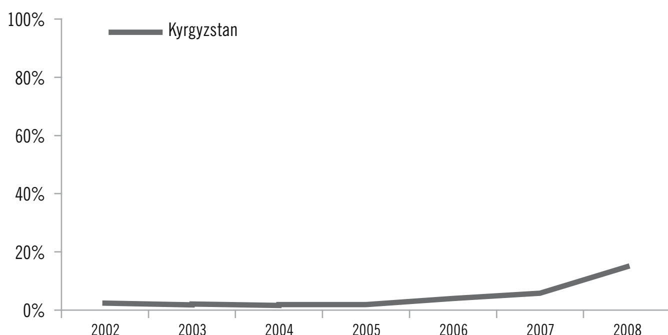
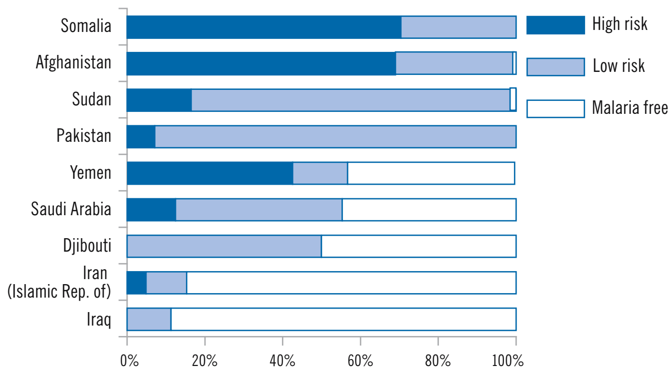
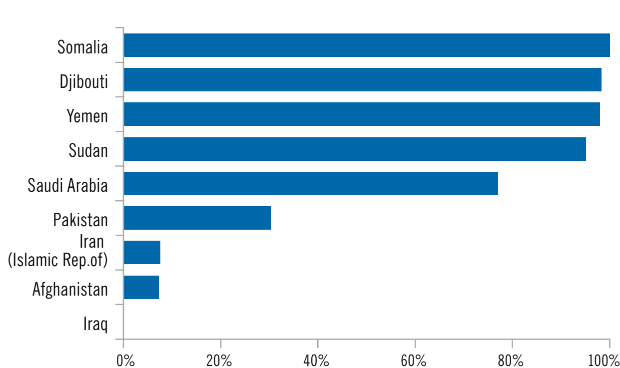


Figure 4.11 WHO Eastern Mediterranean Region

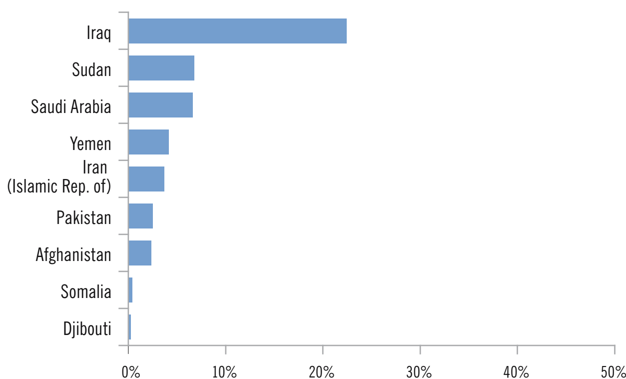
a) *Population at risk, 2008*



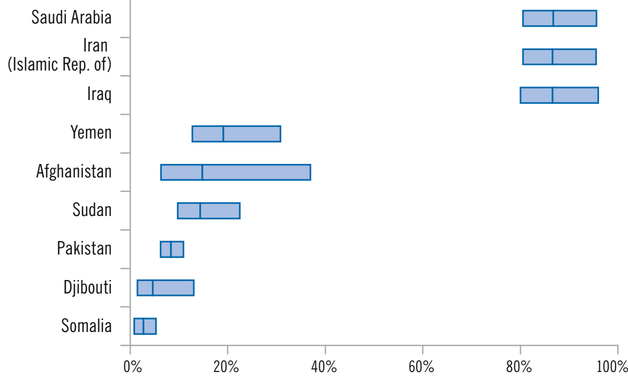
b) *Percentage of cases due to* P. falciparum, *2008*



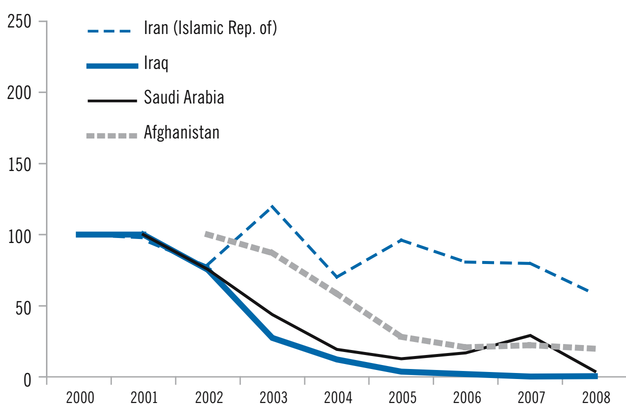
c) *Annual blood examination rate, 2000–2008*



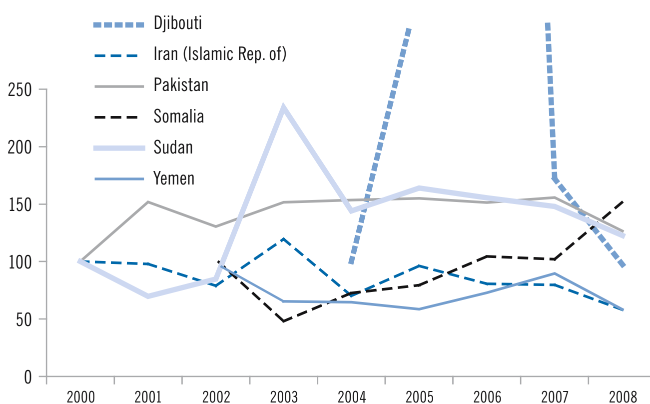
d) *Confirmed cases as a percentage of total estimated for 2008*



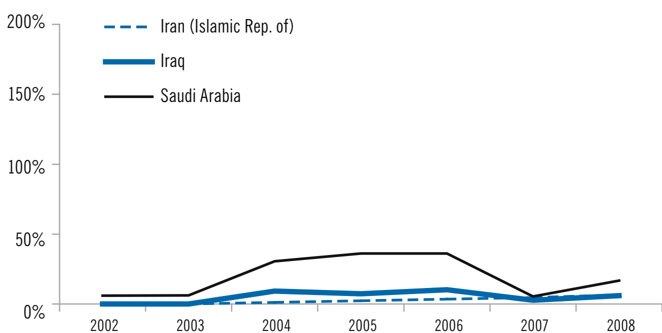
e) *Changes in numbers of confirmed cases, 2000–2008:* countries with evidence of sustained decrease in cases



f) *Changes in numbers of confirmed cases, 2000–2008:* countries with limited evidence of sustained decrease in cases



g) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** countries with evidence of sustained decrease in cases



h) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** countries with limited evidence of sustained decrease

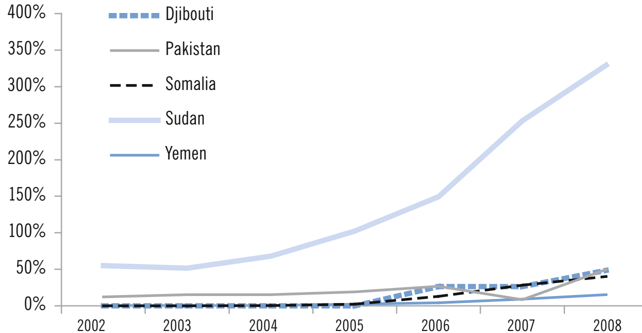
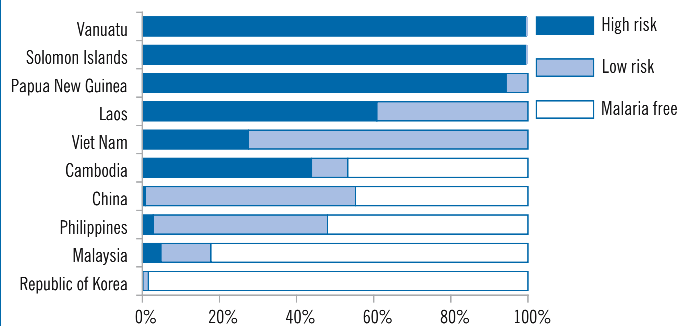
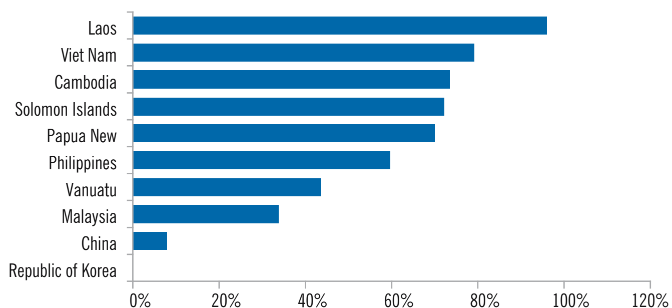


Figure 4.12 WHO Western Pacific Region

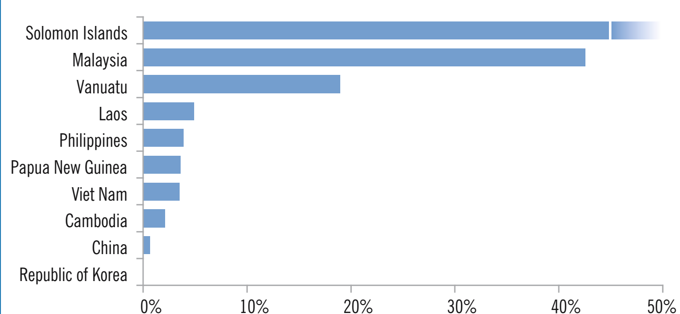
a) *Population at risk, 2008*



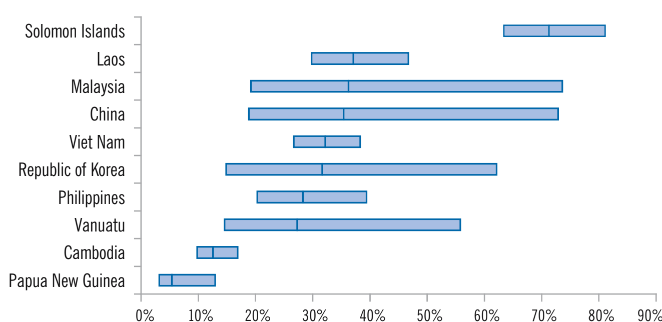
b) *Percentage of cases due to* P. falciparum*, 2008*



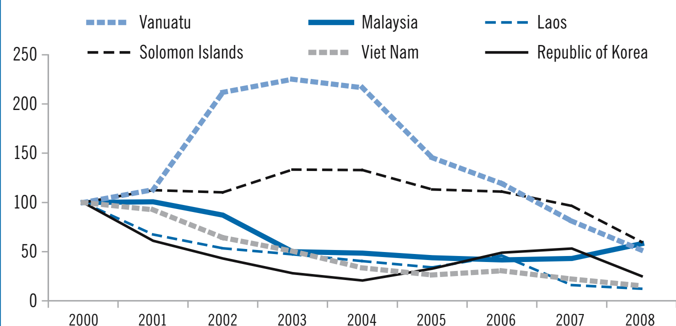
c) *Annual blood examination rate, 2000–2008*



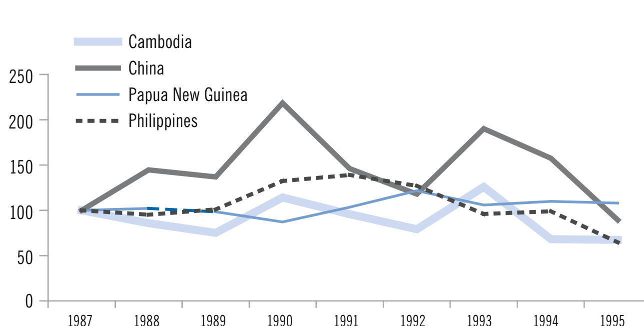
d) *Confirmed cases as a percentage of total estimated for 2008*



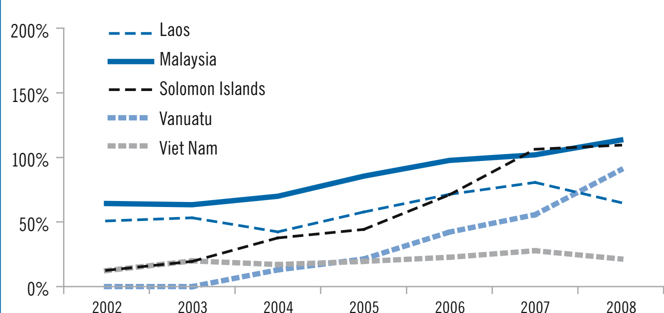
e) ***Changes in numbers of confirmed cases, 2000–2008:*** *countries with evidence of sustained decrease in cases*



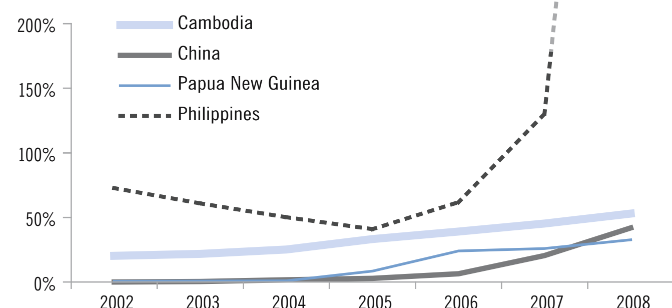
f) ***Changes in numbers of confirmed cases, 2000–2008:*** *countries with limited evidence of sustained decrease in cases*



g) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** *countries with evidence of sustained decrease in cases*



h) ***IRS and ITNs delivered – maximum percentage of high risk population potentially covered:*** *countries with limited evidence of sustained decrease*



4.4 Region of the Americas

Malaria transmission occurs in 21 countries of the Region, with almost 3 of every 10 persons at varying degrees of risk for malaria transmission. *P. vivax* accounted for 77% of all cases reported in 2008, but the percentage of cases due to *P. falciparum* was almost 100% in Haiti and the Dominican Republic (**Fig. 4.8b**). The number of cases reported in the Region decreased from 1.14 million in 2000 to 572 000 in 2008. Reductions of > 50% were reported in 12 countries (Argentina, Belize, Bolivia, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Paraguay and Suriname) (**Fig. 4.8e**). Four of the countries (Argentina, El Salvador, Mexico and Paraguay) are in the elimination or pre-elimination phase, with active follow up of suspected cases. In five others (Belize, Guyana, Guatemala, Nicaragua and Suriname), control activities are implemented extensively among populations at risk for malaria; three of these countries (Guyana, Nicaragua and Suriname) also have high rates of annual blood examinations, which indicate good access to malaria treatment. Five countries (Brazil, Colombia, Costa Rica, Panama and Peru) reported fluctuations in the number of cases between 2000 and 2008, which may be associated with reductions in recent years. Brazil has greatly extended the availability of diagnosis and treatment through a network of more than 40 000 health workers, who reach individual households. The number of confirmed cases in French Guiana showed little change between 2000 and 2008. Three countries (Dominican Republic, Haiti and Bolivarian Republic of Venezuela) reported increased numbers of cases between 2000 and 2008, although the increase in Haiti is associated with an increased rate of annual blood examinations.

Thus, nine countries – Argentina, Belize, El Salvador, Guatemala, Guyana, Mexico, Nicaragua, Paraguay and Suriname – experienced a > 50% decrease in the number of cases, associated with intense malaria programme activity.

4.5 South-East Asia Region

Ten of the 11 countries of the region are malaria-endemic; there has been no indigenous transmission of malaria in the Maldives since 1984. Approximately 8 of 10 people in the region live at some risk for malaria, of whom 3 of 10 live at high risk (areas with a reported incidence of > 1 case per 1000 population per year). In 2008, 2.4 million laboratory-confirmed malaria cases and 2408 deaths were reported, whereas the estimates were about 24 million cases and 40 000 deaths, respectively. Four countries accounted for 97% of the estimated cases in the region in 2008 (Bangladesh, 10%; India, 55%; Indonesia, 15% and Myanmar, 17%). Most cases in the region are due to *P. falciparum*, although the proportion varies by country; transmission is due almost entirely to *P. falciparum* in Myanmar and Timor-Leste but due exclusively to *P. vivax* in the Democratic People's Republic of Korea (**Fig. 4.9b**). Reductions of more than 50% in the number of reported cases between 2000 and 2008 were seen in five countries (Bhutan, the Democratic People's Republic of Korea, Nepal, Sri Lanka and Thailand; **Fig. 4.9e**). Reductions of > 25% but < 50% were seen in one country (India). There was evidence of widescale implementation of antimalarial interventions in two countries that showed decreases in the number of cases (Bhutan and Thailand), although the decrease in Thailand levelled off in 2006 as the number of persons potentially reached by malaria prevention programmes decreased. Two countries in the pre-elimination stage actively follow up all suspected cases (Democratic People's Republic of Korea and Sri Lanka). The scale of preventive interventions appears to be small in India and Nepal, with less than 50% of the population at high risk covered. The remaining malaria-endemic countries reported no change or an increase in the number of cases (Bangladesh, Indonesia, Myanmar and Timor-Leste), and the scale of control activities appeared to be small in relation to the total population at risk.

In summary, four countries (Bhutan, the Democratic People's Republic of Korea, Sri Lanka and Thailand) experienced a decrease in the number of malaria cases, which was associated with malaria programme activity, although the decrease in Thailand appears to have levelled off between 2006 and 2008.

4.6 European Region

Locally acquired malaria cases were reported in 6 of the 53 Member States of the region in 2008: Azerbaijan, Georgia, Kyrgyzstan, Tajikistan, Turkey and Uzbekistan. Transmission of *P. falciparum* is confined to Tajikistan, with only two cases reported in 2008; in other countries, transmission is due exclusively to *P. vivax*, although imported cases of *P. falciparum* may occur. In all affected countries, malaria transmission is seasonal, occurring between June and October, and shows a marked focal distribution. The number of reported cases of malaria in the Region has been reduced substantially, from 32,474 in 2000 to 660 in 2008, only Kyrgyzstan failing to register a decrease of > 50% in the number of cases since 2000. In Kyrgyzstan, the number of cases rose from 12 in 2000 to 2744 in 2002, before falling to 18 in 2008 (**Fig. 4.10e,f**). Tajikistan and Turkey accounted for 80% of the reported cases in the Region in 2008.

Intensive control activities are implemented throughout the Region. IRS is the primary means of vector control in all countries and is applied with strict total coverage of all residual and new foci of malaria, with a view to interrupting transmission over the target area as soon as possible and preventing its re-establishment. The intensity of activity is not evident from **Figure 10g**, as the denominator used is the total population at risk rather than that living in active foci. ITNs are also used for protection, particularly in Tajikistan. The use of larvivorous *Gambusia* fish is promoted by almost all affected countries in rice-growing areas.

Blood slides are taken from clinically suspected malaria cases for active and passive case detection. All cases detected are treated, and information on their origins is obtained to facilitate epidemiological classification of malaria foci. Particular attention is given to situations in which there is a risk for spread of malaria between neighbouring countries and regions. In 2005, all nine malaria-affected countries in the region endorsed the Tashkent Declaration *(7)*, the goal of which is to interrupt malaria transmission by 2015 and eliminate the disease within the region. Since 2008, national strategies on malaria have been revised to reflect the new elimination challenges.

In summary, all the malaria-endemic countries in the European Region have active malaria control programmes, and five of six

countries reported sustained decreases of > 50% in the number of cases. Kyrgyzstan was the only country that did not show a sustained decrease in the number of cases since 2000, but only 18 cases were reported in 2008.

4.7 Eastern Mediterranean Region

The region contains six countries with areas of high malaria transmission (Afghanistan, Djibouti, Pakistan, Somalia, Sudan and Yemen), and three countries with low, geographically limited malaria transmission and effective malaria programmes (Islamic Republic of Iran, Iraq and Saudi Arabia). *P. falciparum* is the dominant species of parasite in Djibouti, Saudi Arabia, Sudan and Yemen, but the majority of cases in Afghanistan and Pakistan and almost all cases in the Islamic Republic of Iran and Iraq are due to *P. vivax* (**Fig. 4.11b**). The Eastern Mediterranean region reported 890 000 confirmed cases in 2008, from an estimated regional total of 8.6 million cases. Four countries accounted for 90% of the estimated cases: Afghanistan, 7%; Pakistan, 18%; Somalia, 10% and Sudan, 62%. Four countries reported downward trends in malaria frequency (Afghanistan, Islamic Republic of Iran, Iraq and Saudi Arabia), and in the last three there is evidence of intense control activities, these countries having been classified as in the elimination or pre-elimination stage (**Fig. 4.11e**). Other countries in the region have not registered consistent decreases in the number of cases (Djibouti, Pakistan, Somalia, Sudan and Yemen), although Sudan has extended the coverage of malaria preventive activities to more than 50% of the population at risk for malaria and any change in cases may be masked by changes in reporting practices.

In summary, three countries (Islamic Republic of Iran, Iraq and Saudi Arabia) showed evidence of a sustained decrease in the number of cases associated with widescale implementation of malaria control activities.

4.8 Western Pacific Region

The epidemiology of malaria in the Western Pacific Region is highly heterogeneous. Transmission is intense and widespread in the Pacific countries of Papua New Guinea, Solomon Islands and, to a lesser extent, Vanuatu; however, malaria is highly focal in the countries and areas of the Greater Mekong subregion, such as Cambodia, Yunnan (China), the Lao People's Democratic Republic and Viet Nam, occurring in remote forested areas and disproportionately affecting ethnic minorities and migrants. Malaria is also restricted to particular geographical locations in Malaysia, the Philippines and the Republic of Korea. Most countries have both *P. falciparum* and *P. vivax*, but transmission is entirely due to *P. vivax* in the Republic of Korea and central areas of China (**Fig. 4.12b**). Approximately 240 000 confirmed cases were reported from the Western Pacific Region in 2008, while 1.75 million cases were estimated for the region in 2008. Two countries accounted for 82% of the estimated cases in 2008 (Papua New Guinea, 68%; and Cambodia, 15%). Three countries reported decreases in the numbers of confirmed cases of > 50% between 2000 and 2008 (the Lao People's Democratic Republic, the Republic of Korea and Viet Nam), and three countries reported decreases of 25–50% (Malaysia, Solomon Islands and Vanuatu) (**Fig. 4.12e**). In all six countries, there is evidence of widescale implementation of malaria control activities. No evidence for a sustained decrease in the number of cases was found in Cambodia, China, Papua New Guinea or the Philippines. Evidence of increased preventive or curative activities was seen in all these countries, particularly the Philippines, but this has either been too recent for effects to be apparent in the long term, or weaknesses in surveillance systems have meant that changes are not detected.

In summary, six countries in the Western Pacific Region showed evidence of a sustained decrease in the number of cases associated with widescale implementation of malaria control activities (Lao People's Democratic Republic, Malaysia, Republic of Korea, Solomon Islands, Vanuatu and Viet Nam).

4.9 Conclusions

4.9.1 WHO African Region

Reductions in the number of reported malaria cases and deaths of ≥ 50% have been observed in four high-burden countries of the WHO African Region (Eritrea, Rwanda, Sao Tome and Principe and Zambia) and one area (Zanzibar, United Republic of Tanzania). Reductions achieved in 2007 were maintained in 2008. Reductions of > 50% were also observed in five low transmission African countries (Botswana, Cape Verde, Namibia, South Africa and Swaziland). All the reductions were associated with intense malaria programme activity. The role of the climate and other factors in promoting change cannot be excluded; in particular, a drought in 2001–2003 may have contributed to an initial decrease in southern African countries. Nevertheless, decreases have been seen consistently for more than five years in seven countries or areas (Botswana, Eritrea, South Africa, Sao Tome and Principe, Swaziland, Zambia and Zanzibar, United Republic of Tanzania) and are unlikely to be due entirely to climate variation. In Rwanda, large decreases in the number of cases were observed soon after a rapid scale-up of malaria control activities, and these also are unlikely to be due to climate factors, although it would be valuable to test this hypothesis formally.

In Botswana, Cape Verde, Namibia, Sao Tome and Principe, South Africa and Swaziland, large initial decreases in the numbers of cases appear to have levelled off, the numbers of cases remaining at 10–25% of those seen in 2000. The reasons are not yet clear, but the few cases remaining may be more difficult to prevent, detect and treat, and it may be necessary to strengthen the programmes further.

When comparisons are possible, correspondence is seen between the trends in data from health facilities, household surveys and individual studies. The magnitude of the change seen in data from health facilities in the numbers of confirmed malaria cases, admissions for anaemia and overall numbers of childhood deaths is consistent with changes in parasite prevalence, prevalence of severe anaemia and mortality rates for children < 5 reported from household surveys. The magnitude of the decreases seen in the numbers of cases and deaths in health facilities is also consistent with the impact expected from controlled trials of the interventions. These observations suggest that surveillance data can be used to monitor the impact of interventions.

It is important, however, to ensure completeness of reporting and to choose indicators for monitoring trends that are highly specific for malaria (i.e. confirmed malaria cases or malaria admissions).

All 10 countries in the African Region that were reviewed had > 50% coverage with vector control activities. Some evidence of changes in the malaria burden in other countries with high coverage rates has been published, but the studies – in Equatorial Guinea *(8)*, the Gambia *(9)* and Kenya *(10)* – were confined to limited geographical areas, and the generalizability of the results is uncertain. More studies are needed to measure the impact of high coverage in the countries identified in Chapter 3, particularly high-transmission areas in western and central Africa.

The main reason for the lack of additional evidence for a change in the malaria burden has been weak disease surveillance systems. Although many governments and partners have scaled-up malaria control interventions massively, their impact is not being measured consistently and continuously. The ability of malaria-endemic countries to monitor changes in the numbers of confirmed malaria cases, admissions for severe malaria and malaria-associated deaths must be strengthened. Inadequate monitoring can lead to poor adjustment of strategies, inefficient use of funds and inadequate "learning" for malaria programmes. Once malaria transmission has been reduced, national programmes must be able to detect malaria resurgence quickly and respond with appropriate resources. As experience suggests that malaria transmission decreases heterogeneously, robust surveillance systems are essential to identify residual transmission foci and target additional resources to those areas. Strengthening of surveillance systems will require investment in diagnostic services, reporting systems and capacity-building to manage systems and undertake appropriate data analysis and dissemination.

In countries where malaria control has been scaled-up, not only have the rates of malaria cases, hospitalizations and deaths dropped dramatically, but overall child mortality rates are also in steep decline. National disease surveillance data from Eritrea, Sao Tome and Principe, Rwanda, Zambia and Zanzibar, United Republic of Tanzania, showed a > 50% reduction in malaria cases and deaths in health facilities after the introduction of accelerated malaria control. In Sao Tome and Principe and Zanzibar, these gains were mirrored by a > 50% decrease in inpatient cases and deaths from all causes among children < 5 years of age. In Zambia, child mortality rates from all causes fell by 35%, as measured both by the number of deaths recorded in health facilities and by < 5 mortality rates derived from the Demographic and Health Survey of 2007. The magnitude of these decreases is similar to that found in a recent study on Bioko Island, Equatorial Guinea, in which population-based mortality among children < 5 had decreased by 66% in the fourth year after the start of intensive malaria control *(8)*. If this finding is confirmed by additional studies, intensive malaria control can be considered an important intervention for helping African countries to reach the MDG target of reducing child mortality by 2015.

4.9.2 Other WHO Regions

A > 50% decrease in the reported number of cases of malaria was found between 2000 and 2008 in 29 of the 56 malaria-endemic countries outside Africa (**Table 4.3**), and downward trends of 25–50% were seen in five other countries, most of which showed longer-term decreases of > 50%. The European Region has been the most successful, as almost all countries have reduced their case loads. Most small countries in the South-East Asia Region also reported substantial progress in reducing their malaria burden, while in other regions, large decreases in the number of malaria cases were observed in countries with strong political and financial support and well-developed health systems at central and peripheral levels.

Of the 34 countries that showed a decrease of > 25% in the number of cases, there was evidence of extensive control activities in 27 (in comparison with 4 of 22 for which there was limited evidence of a decrease). In 10 countries, the decrease in the number of cases was associated with an increase in preventive activities to > 50% of the population at high risk and strengthened case management (Guyana, Guatemala, Nicaragua and Suriname in the Region of the Americas; Bhutan and Thailand in the South-East Asia Region; and the Lao People's Democratic Republic, Malaysia, Solomon Islands and Vanuatu in the Western Pacific Region). In 15 countries, the decrease was associated mainly with intensive case detection and treatment, combined with rapid response to outbreaks (Argentina, El Salvador, Mexico and Paraguay in the Region of the Americas; Azerbaijan, Georgia, Tajikistan, Turkey and Uzbekistan in the European Region; the Islamic Republic of Iran, Iraq and Saudi Arabia in the Eastern Mediterranean Region; the Democratic People's Republic of Korea and Sri Lanka in the South-East Asia Region; and the Republic of Korea in the Western Pacific Region).

The magnitude and consistency of the changes observed in these countries are unlikely to be due to variations in case reporting, and, while factors such as climate variation, the environment or improved living conditions may have had some influence on the number of cases, they are unlikely to be entirely responsible for the change. It was not possible to link the scale and timing of interventions precisely with the changes in disease incidence in the analyses undertaken here; that would require disaggregation of the information on numbers of cases and control activities by month and subnationally. Until more detailed analyses can be undertaken, the association between implementation of control activities and changes in disease incidence is suggestive but not conclusive.

The size of the decrease observed in health facility data may not be seen in the wider community; however, with changes as large as those observed and with typically ≥ 40% of affected persons attending public health facilities, some impact can be expected in the wider community. The analytical approach used might result in an underestimate of the impact of control efforts in countries in which the effect is not noticeable at national level or in which the impact is more recent and cannot yet be distinguished from changes due to year-to-year climate variations or possible changes in reporting practices.

The countries that saw > 50% decreases in the numbers of cases comprised only 4% of the total estimated cases outside Africa in 2006 (850 000 cases out of 34 million estimated). The countries with the highest malaria burdens in each region (such as Bangladesh, Brazil, Cambodia, Colombia, Indonesia, Myanmar, Pakistan, Papua New Guinea and Sudan) were less successful in reducing the numbers of cases of malaria nationally. The scale of interventions in relation to populations at risk appears to be particularly small in the South-East Asia Region, presumably because of the additional challenges

of implementing programmes on a larger scale, requiring not only considerable financial resources but also time to build systems for, e.g. the distribution of commodities (ITNs, insecticide, diagnostic tools, medicines and equipment), training staff, mobilizing communities, quality control and supervision. Nevertheless, some of these countries have reported successful control in some parts of their territory, due either to targeted efforts in some communities or to phasing implementation over a wide scale. Further work is needed to determine if current levels of investment and programme implementation are likely to yield more positive results in the near future. Current evidence suggests, however, that, while smaller countries are making considerable progress towards reaching the MDGs and other malaria targets, more attention should be given to ensuring success in the countries that account for most malaria cases and deaths.

Table. 4.3 Summary of progress in reducing the number of malaria cases between 2000 and 2008

Decrease in cases > 50%	Decrease in cases > 25%	Limited evidence of decrease
African Region		
Botswana		Angola
Cape Verde		Benin
Eritrea		Burkina Faso
Namibia		Burundi
Rwanda		Cameroon
Sao Tome and Principe		Central African Republic
South Africa		Chad
Swaziland		Comoros
Zambia		Congo
		Côte d'Ivoire
		DR Congo
		Equatorial Guinea *
		Ethiopia**
		Gabon
		Gambia *
		Ghana
		Guinea
		Guinea-Bissau
		Kenya *
		Liberia
		Madagascar***
		Malawi
		Mali
		Mauritania
		Mozambique
		Niger
		Nigeria
		Senegal
		Sierra Leone
		Togo
		Uganda
		UR Tanzania*
		Zimbabwe

Decrease in cases > 50%	Decrease in cases > 25%	Limited evidence of decrease
Region of the Americas		
Argentina		**Brazil**
Belize		Colombia
Bolivia (Plurinational State of)		Costa Rica
Ecuador		Dominican Republic
El Salvador		French Guiana
Guatemala		Haiti
Guyana		Panama
Honduras		Peru
Mexico		Venezuela (Bolivarian Rep. of)
Nicaragua		
Paraguay		
Suriname		
South-East Asia Region		
Bhutan	India	Bangladesh
DPRK		Indonesia
Nepal		Myanmar
Sri Lanka		Timor-Leste
Thailand		
European Region		
Armenia		**Kyrgyzstan**
Azerbaijan		
Georgia		
Tajikistan		
Turkey		
Uzbekistan		
Eastern Mediterranean Region		
Afghanistan	**Islamic Rep. of Iran**	Pakistan*
Iraq		Somalia
Saudi Arabia		**Sudan***
		Yemen*
Western Pacific Region		
Lao People's Dem. Rep.	**Malaysia**	Cambodia
Rep. of Korea	**Solomon Islands**	China
Viet Nam	**Vanuatu**	Papua New Guinea
		Phillipines*

The assessment of whether a country has evidence of decreases in cases or widespread coverage of programmes was made according to the data available to WHO at the time of publication of this Report. It is possible that additional evidence of decreases in cases or widespread coverage of programmes is available at country level.

Countries in bold show evidence of wide scale implementation of malaria control activities to more than 50% of the population at high risk.

* The country reports some progress sub-nationally where interventions have been intensified.

** A ministry of health/WHO study, 2001–2007 previously reported a 50% decrease in cases and deaths, but national data as reported to WHO in 2008 are inconsistent; further investigation is required.

*** Data submitted in 2008 were different from data published in the *World Malaria Report 2008*. Therefore observed decreases of more than 50% in cases and deaths need further investigation.

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