



WORLD MALARIA REPORT 2012



Foreword



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The past five years have seen an impressive increase in international funding for malaria prevention, control and elimination. Following the call in 2008 by United Nations

Secretary-General, Ban Ki-moon for universal access to malaria interventions, we saw a rapid expansion in the distribution of life-saving commodities in sub-Saharan Africa, the continent with the highest burden of malaria. The concerted effort by endemic country governments, donors and global malaria partners has led to strengthened disease control and visible results on the ground. During the past decade, an estimated 1.1 million malaria deaths were averted, primarily as a result of a scale-up of malaria interventions.

However, the available funding still falls short of the resources required to reach the health-related Millennium Development Goals and other internationally-agreed global malaria targets. An estimated US\$ 5.1 billion is needed every year between 2011 and 2020 to achieve universal access to malaria interventions. At present, only US\$ 2.3 billion is available, less than half of what would be needed. There is an urgent need to identify new funding sources in order to further scale up and sustain malaria control efforts, and to protect the investments made in the last decade. We also need to examine new ways to make existing funds stretch further by increasing the value for money of malaria commodities and the efficiency of service delivery.

The *World Malaria Report 2012* brings together the latest available data from malaria-endemic countries and partners, and contains valuable analyses of progress and trends. Behind the statistics and graphs lies a great and needless tragedy: malaria – an entirely preventable and treatable disease – still takes the life of an African child every minute. The most vulnerable communities in the world continue to lack sufficient access to long-lasting insecticidal nets, indoor residual spraying, diagnostic testing, and artemisinin-based combination therapies. Unfortunately, only modest increases in access to these interventions were observed between 2010 and 2011 – the first such plateauing in the past 5 years. It is imperative that we act now to ensure that the recent momentum, and its results, are not diminished.

In addition, while our current tools remain remarkably effective in most settings, resistance to artemisinins – the key compounds in artemisinin-based combination therapies – has been detected in four countries of South-East Asia, while mosquito resistance to insecticides has been found in 64 countries around the world. While such resistance has not yet led to operational failure of malaria control programmes, urgent and intensified efforts are required to prevent a future public health disaster.

We are three years away from the target date set for the Millennium Development Goals. As the report demonstrates, 50 countries are on track to reduce their malaria case incidence rates by 75%, in line with the World Health Assembly and Roll Back Malaria targets for 2015. However, these 50 countries account for only 3% (or 7 million) of the total estimated malaria cases worldwide. International targets for malaria will not be attained unless considerable progress is made in the 14 highest burden countries, which account for an estimated 80% of malaria deaths.

Tracking progress is a major challenge in malaria control. Malaria surveillance systems detect only around 10% of the estimated global number of cases. Stronger malaria surveillance systems are urgently needed to enable a timely and effective malaria response in endemic regions, to prevent outbreaks and resurgences, to track progress, and to hold governments and the global malaria community accountable. In as many as 41 countries around the world, making a reliable assessment of malaria trends is currently not possible due to incompleteness or inconsistency of reporting.

On World Malaria Day this year, I travelled to Namibia to launch the *T3: Test. Treat. Track.* initiative, urging countries and partners to scale up diagnostic testing, quality-assured treatment and surveillance for malaria. WHO has also made available new global surveillance manuals for malaria control and elimination and published the Global Plan for Insecticide Resistance Management in malaria vectors. These practical documents will help countries update and refocus their national malaria strategies to achieve better results with the limited resources available. In addition, the newly constituted WHO Malaria Policy Advisory Committee recommended Seasonal Malaria Chemoprevention for the control of malaria in the Sahel sub-Region of Africa. This simple and inexpensive intervention has the potential to prevent more than 75% of uncomplicated and severe malaria among children younger than five years of age.

Defeating malaria will require a high level of political commitment, strengthened regional cooperation, and the engagement of a number of sectors outside of health, including finance, education, defence, environment, mining, industry and tourism. The fight against this disease needs to be integrated into the overall development agenda in all endemic countries. We cannot achieve further progress unless we work tirelessly to strengthen health systems and ensure that sustained and predictable financing is available. This report shows how far we have come in the struggle against malaria; we must act with urgency and determination to keep this tremendous progress from slipping out of our grasp.

A handwritten signature in black ink, which appears to read 'M. Chan'.

Summary and Key Points

The *World Malaria Report 2012* summarizes information received from 104 malaria-endemic countries and other sources, and updates the analyses presented in the 2011 report. It highlights the progress made towards the global malaria targets set for 2015 and describes current challenges for global malaria control and elimination.

The past decade has witnessed tremendous expansion in the financing and implementation of malaria control programmes. International disbursements for malaria control rose steeply from less than US\$ 100 million in 2000 to US\$ 1.71 billion in 2010 and were estimated to be US\$ 1.66 billion in 2011 and US\$ 1.84 billion in 2012. Analysis indicates that as funding has risen, international disbursements have been increasingly targeted to the African Region, to countries with the lowest gross national income (GNI) per capita, and to countries with the highest malaria mortality rates. Domestic government funding for malaria control programmes also increased through 2005–2011 and was estimated at US\$ 625 million in 2011.

While still falling short of the US\$ 5.1 billion required to achieve universal coverage of malaria interventions, the financing provided for malaria control has enabled endemic countries to greatly increase access to malaria preventive interventions as well as diagnostic and treatment services. The percentage of households owning at least one insecticide-treated net (ITN) in sub-Saharan Africa is estimated to have risen from 3% in 2000 to 53% in 2011, and remained at 53% in 2012. Household surveys indicate that approximately 90% of persons with access to an ITN within the household actually use it. The percentage protected by indoor residual spraying (IRS) in the African Region rose from less than 5% in 2005 to 11% in 2010 and remained at that level in 2011. For malaria diagnostic testing and treatment, the numbers of rapid diagnostic tests (RDTs) and artemisinin-based combination therapies (ACTs) procured is increasing, and the percentage of suspected cases that receive a parasitological test has also risen, from 68% globally in 2005 to 77% in 2011, with the largest increase in sub-Saharan Africa. But the increase in diagnostic testing rates between 2010 and 2011 was just 1%.

It appears that the rapid increase shown by these measures of programme performance up to 2010 has tended to level off recently in parallel with a leveling of funding, and that millions of people continue to lack access to preventive therapies, diagnostic testing and quality-assured treatment. Considerably more work is needed before the target of universal access to malaria preventive interventions, diagnostic testing and appropriate treatment will be attained. A further complication is that resistance to artemisinins – the key compounds in artemisinin-based combination therapies – has been detected in 4 countries of the South-East Asia Region, while mosquito resistance to insecticides has been found in 64 countries around the world.

Of 99 countries with ongoing malaria transmission in 2011, 58 submitted sufficiently complete and consistent data on malaria cases between 2000 and 2011 to enable an assessment of

trends to be made. Based on these reported data, 50 countries are on track to meet WHA and RBM targets: to reduce malaria case incidence by 75% by 2015, including 9 countries in the African Region. However, the 58 countries that submitted sufficiently complete and consistent data account for only 15% of estimated cases worldwide; surveillance systems are weakest where the malaria burden is highest. There is a critical need to strengthen malaria surveillance in the remaining 41 countries which account for 85% of estimated malaria cases, so that programmes can identify and direct resources to the populations most in need, respond to outbreaks of disease, and assess the impact of control measures.

Because countries with higher numbers of cases are less likely to submit sufficiently consistent data, it is necessary to draw inferences about trends in some countries using estimates of numbers of cases. The estimated numbers of malaria cases and deaths are accompanied by a large degree of uncertainty, but suggest that reductions in malaria case incidence and mortality have occurred faster in countries with lower initial numbers of cases and deaths. Nonetheless, greater numbers of cases and deaths are estimated to have been averted between 2001 and 2010 in countries which had the highest malaria burdens in 2000. If the malaria incidence and mortality rates in 2000 had remained unchanged over the decade, 274 million more cases and 1.1 million more deaths would have occurred between 2001 and 2010. The majority of cases averted (52%) and lives saved (58%) are in the 10 countries which had the highest estimated malaria burdens in 2000. Thus, malaria programmes have had their greatest impact where the burden is highest.

The enormous progress achieved appears to have slowed recently. International funding for malaria control has levelled off, and is projected to remain substantially below the US\$ 5.1 billion required to achieve universal coverage of malaria interventions. The number of ITNs procured in 2012 (66 million) is far lower than in 2011 (92 million) and 2010 (145 million). With the average useful life of ITNs estimated to be 2 to 3 years, ITN coverage is expected to decrease if ITNs are not replaced in 2013. There is an urgent need to identify new funding sources to maintain and expand coverage levels of interventions so that outbreaks of disease can be avoided and international targets for reducing malaria cases and deaths can be attained.

Policy development; updated policies, manuals and plans; and global targets for malaria control and elimination

In 2011, WHO completed a major re-design of its policy-setting process, resulting in the creation of the Malaria Policy Advisory Committee (MPAC), which held its inaugural and second meetings in 2012. Several new and updated malaria control policies, operational manuals, plans and initiatives were released in 2012. A

comprehensive set of indicators has been developed to track progress towards internationally-agreed malaria targets.

1. The MPAC came into operation in 2012, with a mandate to provide strategic advice and technical input to WHO on all aspects of malaria control and elimination. In accordance with the MPAC recommendations, WHO released a new policy on Seasonal Malaria Chemoprevention (SMC) and updated policies for Intermittent Preventive Treatment of malaria in pregnancy (IPTp) and for single-dose primaquine as a gametocytocide for treatment of *Plasmodium falciparum* malaria in selected settings.
2. Position statements were released on larviciding in sub-Saharan Africa and on the effectiveness of non-pharmaceutical forms of *Artemisia annua*. Surveillance manuals were published in April 2012 as part of the “T3: Test. Treat. Track.” initiative, urging endemic countries and stakeholders to scale up diagnostic testing, treatment, and surveillance for malaria. The *Global Plan for Insecticide Resistance Management in malaria vectors* was launched in May 2012, providing a global blueprint for managing insecticide resistance.

Financing malaria control

The total international and domestic funding committed to malaria control was estimated to be US\$ 2.3 billion in 2011, substantially less than the amount that will be needed to reach the global targets.

3. International disbursements to malaria-endemic countries increased every year from less than US\$ 100 million in 2000 to US\$ 1.71 billion in 2010 and were estimated to be US\$ 1.66 billion in 2011 and US\$ 1.84 billion in 2012. The leveling off in funds available for malaria control has been primarily due to lower levels of disbursements from the Global Fund. In 2011 the Global Fund also announced the cancellation of Round 11 of Grant Awards.
4. Reported data suggest that domestic financing for malaria has increased in all WHO Regions during 2005–2011 except the European Region. The Region of the Americas and the African Region report the greatest expenditure on malaria control. Total domestic spending in 2011 was estimated to be US\$ 625 million in 2011.
5. Global resource requirements for malaria control were estimated in the 2008 Global Malaria Action Plan (GMAP) to exceed US\$ 5.1 billion per year between 2011 and 2020. In Africa alone, the resource requirements estimated by GMAP were, on average, US\$ 2.3 billion per year during the same period. Combining both domestic and international funds, the resources available for malaria control globally were estimated to be US\$ 2.3 billion in 2011, leaving a gap of US\$ 2.8 billion. Projections of both domestic and international resources available between 2013 and 2015 indicate that total funding for malaria control will remain at less than US\$ 2.7 billion, substantially below the amount required to achieve universal access to malaria interventions.
6. Historical funding patterns indicate that international funding for malaria control has been targeted to countries with lower GNI per capita and higher mortality rates, particularly those in Africa. Domestic funding for malaria per person

at risk is highest in the European Region and the Region of the Americas and lowest in the South-East Asia Region. Countries in the highest quintile of GNI per capita invest much more money per capita in malaria control than countries from other quintiles. These wealthier countries have lower malaria burdens, accounting for just 1% of estimated cases in 2010 and 0.3% of deaths. The high expenditures are partly related to the drive towards elimination of malaria in some countries. Countries with larger populations at risk of malaria – and the highest malaria mortality rates – have lower levels of domestic malaria funding per capita than countries with lower malaria burdens.

Progress in vector control

During the past decade, coverage with vector control interventions increased substantially in sub-Saharan Africa, with household ownership of at least one ITN reaching an estimated 53% by 2011 and remained at 53% in 2012. However, due to fewer deliveries of ITNs and increasing mosquito resistance to insecticides, recent successes in malaria vector control may be jeopardized.

7. By 2011, 32 countries in the African Region and 78 other countries worldwide had adopted the WHO recommendation to provide ITNs to all persons at risk for malaria. A total of 89 countries, including 39 in Africa, distribute ITNs free of charge.
8. Every year, an estimated 150 million ITNs are needed to protect all populations at risk of malaria in sub-Saharan Africa. Between 2004 and 2010, the number of ITNs delivered annually by manufacturers to malaria-endemic countries in sub-Saharan Africa increased from 6 million to 145 million. However, in 2011 only 92 million ITNs were delivered by manufacturers, while 66 million are estimated to be delivered in 2012. The numbers delivered in 2011 and 2012 are below the number of ITNs required to protect all populations at risk, and they will not fully replace the ITNs delivered 3 years earlier, indicating that ITN coverage will decrease unless deliveries are massively increased in 2013.
9. The percentage of households owning at least one ITN in sub-Saharan Africa is estimated to have risen from 3% in 2000 to 53% in 2011, and remained at 53% in 2012. The proportion of the population sleeping under an ITN, representing the population directly protected, also increased from 2% in 2000 to 33% in 2011, and remained at 33% in 2012.
10. Analysis of household survey data indicates that a high percentage (approximately 90%) of the population with access to an ITN within the household actually uses it, suggesting that efforts to encourage ITN use have been successful, and that the main constraint to increasing the number of at-risk persons sleeping under an ITN is insufficient availability of nets. However, the population that uses available nets includes households in which nets are used beyond their assumed capacity of 2 persons per net as well as those in which nets are not used to full capacity, indicating that further work is needed to ensure that all available nets are fully utilized.

11. The proportion of the population sleeping under an ITN is higher in wealthier, urban areas, and lower among older children. Disparities in ITN access should diminish as programmes move towards universal coverage.

Indoor residual spraying

12. IRS remains a powerful vector control tool for reducing and interrupting malaria transmission. In 2011, 80 countries, including 38 in the African Region, recommended IRS for malaria control.

13. In 2011, 153 million people were protected by IRS worldwide, or 5% of the global population at risk. In the African Region, the proportion of the at-risk population that was protected rose from less than 5% in 2005 to 11% in 2010 and remained at that level in 2011, with 77 million people benefiting from the intervention.

Insecticide resistance

14. Mosquito resistance to at least one insecticide used for malaria control has been identified in 64 countries. In May 2012, WHO and RBM released the *Global Plan for Insecticide Resistance Management in malaria vectors*, a five-pillar strategy for managing the threat of insecticide resistance.

15. Monitoring insecticide resistance is a necessary element of the implementation of insecticide-based vector control interventions. In 2011, 77 countries reported that they had adopted the policy of insecticide resistance monitoring.

Progress on chemoprevention

Among 25 countries reporting this information to WHO, the percentage of pregnant women attending antenatal clinics who received 2 doses of Intermittent Preventive Treatment during pregnancy ranged from 30% to 57% in 2011. Recent WHO recommendations on Intermittent Preventive Treatment for infants and Seasonal Malaria Chemoprevention for children await adoption and implementation by endemic countries.

16. Intermittent preventive treatment (IPT) is recommended for population groups in areas of high transmission who are particularly vulnerable to *Plasmodium* infection and its consequences, particularly pregnant women and infants. In sub-Saharan Africa, an estimated 32 million pregnant women and a large portion of the estimated 28 million infants born each year would benefit from IPT. In addition, about 25 million children in the Sahel subregion of Africa could be protected from malaria through seasonal malaria chemoprevention (SMC).

17. A total of 36 of 45 sub-Saharan African countries had adopted IPT for pregnant women (IPTp) as national policy by the end of 2011. This policy was also adopted by Papua New Guinea (Western Pacific Region) in 2009.

18. Among 25 of the 36 high-burden countries in the African Region which have adopted IPTp as national policy – and for which data are available – 44% (range 30%–57%) of pregnant women attending antenatal clinics received 2 doses of IPTp in 2011, in line with the WHO recommendation at that

time. Since October 2012, WHO recommends IPTp at each scheduled antenatal visit after the first trimester.

19. In 16 countries in the African Region for which household survey data were available for 2009–2011, the weighted average of all pregnant women who received 2 doses of IPTp during pregnancy was low, at 22% (range 5%–69%), primarily due to low coverage in Nigeria and the Democratic Republic of the Congo.

20. All infants at risk of *P. falciparum* infection in sub-Saharan African countries with moderate-to-high malaria transmission and low levels of parasite resistance to the recommended agent sulfadoxine-pyrimethamine should receive preventive malaria treatment through immunization services at defined intervals corresponding to routine vaccination schedules. Only one country, Burkina Faso, has adopted a national policy of IPT for infants (IPTi) since the WHO recommendation was issued in 2009.

21. In March 2012, WHO issued a recommendation on seasonal malaria chemoprevention for children aged 3–59 months. No endemic country has yet adopted SMC, but several countries involved in evaluating the policy have indicated that they plan to expand SMC coverage beyond their study populations. The release of implementation guidance, *Seasonal Malaria Chemoprevention with Sulfadoxine-pyrimethamine plus Amodiaquine in Children: a Field Guide*, by WHO in December 2012 should facilitate rapid scale-up of this important intervention.

Progress in diagnostic testing and malaria treatment

The numbers of procured rapid diagnostic tests (RDTs) and artemisinin-based combination therapies (ACTs) are increasing, and the reported rate of diagnostic testing in the public sector in the African Region has increased from 20% in 2005 to 47% in 2011. However, many fever cases are still treated presumptively with antimalarials without parasitological diagnosis, and not all confirmed malaria cases receive appropriate treatment with a quality-assured anti-malarial.

Diagnostic testing

22. Implementation of universal diagnostic testing in the public and private sectors would substantially reduce the global requirements for antimalarial treatment. In 2011, 41 of 44 countries with ongoing malaria transmission in the African Region and 46 of 55 countries in other WHO Regions reported having adopted a policy of providing parasitological diagnosis for all age groups. This represents an increase of 4 countries in the African Region since 2010.

23. Malaria diagnostic testing is provided free of charge in the public sector in 84 countries around the world. The proportion of suspected malaria cases receiving a diagnostic test in the public sector increased from 20% in 2005 to 47% in 2011 in the African Region and from 68% to 77% globally. Most of the increase in testing in the African Region is attributable to an increase in the use of RDTs, which accounted for 40% of all cases tested in the Region in 2011.

24. The number of patients tested by microscopic examination increased to a peak of 171 million in 2011, with India accounting for over 108 million blood slide examinations. The number of RDTs supplied by manufacturers increased from 88 million in 2010 to 155 million in 2011. This included increased sales for both *P. falciparum*-specific tests and combination tests that can detect more than one parasite species.
25. A total of 49 countries reported deployment of RDTs at the community level and 12 million patients were reported as having been tested through such programmes in 2011. Data from a limited number of countries suggest that diagnostic testing is less available in the private sector than in the public sector.

Treatment

26. ACTs are recommended as the first-line treatment for malaria caused by *P. falciparum*, the most dangerous of the *Plasmodium* parasites that infect humans. By 2011, 79 countries and territories had adopted ACTs as first-line treatment for *P. falciparum* malaria. *P. vivax* malaria should be treated with chloroquine where it is effective, or an appropriate ACT in areas where *P. vivax* is resistant to chloroquine. Treatment of *P. vivax* should be combined with a 14-day course of primaquine to prevent relapse.
27. From reports of manufacturers and the Affordable Medicines Facility-malaria (AMFm) initiative, the number of ACT treatment courses delivered to the public and private sectors globally increased from 11 million in 2005 to 76 million in 2006, and reached 278 million in 2011. The increases in ACT procurement in 2011 occurred in large part as a result of the AMFm initiative, managed by the Global Fund. Although the AMFm accounted for a substantial portion of public sector sales, the total amount of ACTs procured for the public sector showed a year-on-year decrease between 2010 and 2011.
28. It has been difficult to track the extent to which patients with confirmed malaria received antimalarial medicines because information linking diagnostic testing and treatment has been limited in both household surveys and routine health information systems. An estimate of the proportion of patients in the public sector potentially treated with ACTs (and not a less effective antimalarial) can be made by comparing the number of ACT treatments distributed by national programmes with the number of presumed (treated without testing) and confirmed (by microscopy or RDT) *P. falciparum* malaria cases reported (or estimated cases if reported data are lacking). This proportion varies by WHO Region, reaching 52% in the African Region in 2011.
29. In 12 countries in the African Region with household surveys during 2010–2011, the proportion of febrile children given antimalarial treatment who received ACTs was greater among children treated in the public sector and in the formal private sector than in the informal private sector or in the community. In some countries the proportion of all febrile children given antimalarials who receive ACTs remains low, which implies that a proportion of patients with malaria do not receive appropriate treatment.
30. In the African Region in 2011, the total number of tests (both microscopy and RDTs) was less than half the number of ACTs distributed by national malaria control programmes, indicating that ACTs are given to many patients without confirmatory diagnostic testing.

Antimalarial drug resistance

31. WHO recommends that oral artemisinin-based monotherapies should be progressively withdrawn from the market and replaced with ACTs, a policy endorsed by the World Health Assembly in 2007. The number of countries which still allow the marketing of these products has decreased from 55 countries in 2008 to 16 countries as of November 2012, of which 9 are in the African Region. The number of pharmaceutical companies marketing these products has dropped from 38 in 2010 to 28 in 2011. Most of the countries that allow marketing of these medicines are in the African Region, while most of the manufacturers are in India.
32. Therapeutic efficacy studies remain the gold standard for guiding drug policy and should be undertaken every 2 years. In 2010 and 2011, studies of first- or second-line antimalarial treatments were completed in 47 of 71 countries where *P. falciparum* efficacy studies were possible, an increase from 31 countries during 2008–2009. (In 28 countries with ongoing malaria transmission, efficacy studies are impracticable because of low malaria incidence, or because they are endemic for *P. vivax* only.) Studies were planned in 49 countries during 2012, including 29 countries in Africa.
33. Parasite resistance to artemisinins has now been detected in 4 countries of the Greater Mekong subregion: Cambodia, Myanmar, Thailand and Viet Nam. Despite the observed changes in parasite sensitivity to artemisinins, ACTs continue to cure patients provided that the partner drug is still efficacious. In Cambodia's Pailin province, resistance has been found to both components of multiple ACTs, and special provisions for directly observed therapy using a non-artemisinin-based combination (atovaquone-proguanil) have been put in place.

Malaria surveillance

Malaria surveillance systems currently detect only 10% of cases estimated to occur annually. Case detection rates are lowest in countries with the highest numbers of malaria cases.

34. The proportion of malaria cases seeking treatment in public sector health facilities, tested and reported (the "case detection rate"), is less than 20% in 39 of the 99 countries with ongoing malaria transmission. These 30 countries account for 185 million cases of malaria or 78% of the estimated global total. Impediments in case detection vary by WHO Region: in the African and Western Pacific Regions, the main constraint is the small proportion of patients attending public facilities who receive a diagnostic test for malaria, whereas in the South-East Asia Region, the most important issue is the high proportion of patients who seek treatment in the private sector.

35. For countries in the phase of malaria control (as opposed to elimination), surveillance systems do not need to detect all cases in order to achieve their objectives which are primarily to assess trends over time and identify geographic differences in malaria incidence. However, in 41 countries around the world which account for 85% of estimated cases, it is not possible to make a reliable assessment of malaria trends due to incompleteness or inconsistency of reporting over time. Thus, surveillance systems appear to be weakest where the malaria burden is greatest; urgent action is needed to improve malaria surveillance in these settings.

Changes in malaria incidence and mortality

Approximately half of countries with ongoing malaria transmission are on track to meet the World Health Assembly (WHA) and RBM target: to achieve a 75% reduction in malaria cases by 2015, compared to levels in 2000. While 50 countries are on track to reach the target, progress in more than a third of countries cannot be assessed due to limitations in their reported data. Further progress towards international malaria targets depends on achieving substantial gains in the highest burden countries.

36. Of 99 countries with ongoing malaria transmission, 58 submitted sufficiently complete and consistent data on malaria cases between 2000 and 2011 to enable an assessment of trends to be made. Based on these reported data, 50 countries, including 9 countries in the African Region, are on track to meet the WHA and RBM target to reduce malaria case incidence by 75% by 2015. A further 4 countries are projected to achieve reductions of between 50% and 75%. Malaria case incidence increased in 3 countries of the Region of the Americas.

37. Of the 99 countries with ongoing transmission in 2011, 76 countries are classified as being in the malaria control phase, 11 are in the pre-elimination phase, 10 are in elimination phase, and 5 are classified in the prevention of introduction phase.

38. Estimates of the number of malaria cases and deaths can provide insight into the distribution of malaria cases across countries and trends over time, in particular for those countries which do not submit sufficiently consistent data, although these estimates are accompanied by a large degree of uncertainty. Country-level malaria estimates available for 2010 show that more than 80% of estimated malaria deaths occur in just 14 countries and approximately 80% of estimated cases occur in 17 countries. Together, the Democratic Republic of the Congo and Nigeria account for over 40% of the estimated total of malaria deaths globally. The Democratic Republic of the Congo, India and Nigeria account for 40% of estimated malaria cases.

39. Malaria is strongly associated with poverty. Estimated malaria mortality rates are highest in countries with a lower GNI per capita. Countries with higher proportions of their population living in poverty (less than US\$ 1.25 per person per day) have higher mortality rates from malaria. Within

countries, parasite prevalence rates in children are highest among poorer populations and in rural areas.

40. Progress in reducing malaria case incidence and mortality rates has been faster in countries with lower numbers of cases and deaths. Nonetheless, greater numbers of cases and deaths are estimated to have been averted between 2001 and 2010 in countries which had the highest malaria burdens in 2000. If the malaria incidence and mortality rates estimated for 2000 had remained unchanged over the decade, 274 million more cases and 1.1 million more deaths would have occurred between 2001 and 2010. The majority of cases averted (52%) and lives saved (58%) are in the 10 countries which had the highest estimated malaria burdens in 2000. Such estimations indicate that malaria programmes are having their greatest impact where the burden is highest.

41. There are many inherent uncertainties in any approach to producing estimates of malaria case incidence and mortality, and in analyses based on these estimates. The global malaria community needs to increase its efforts to support malaria-endemic countries in improving diagnostic testing, surveillance, vital registration, and routine health information systems, so that accurate information on malaria morbidity and mortality can be obtained.