Malaria

in the Greater Mekong Subregion:

Regional and Country Profiles

World Health Organization
South-East Asia Region Western Pacific Region

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Abbreviations

ADB	Asian Development Bank
AL	Arthemeter-lumefantrine
AFRIMS	Armed Forces Research Institute of Medical Sciences
AQ	amodiaquine
ARC	American Refugee Committee
ART	artemisinin
ASU	artesunate
BMGF	Bill & Melinda Gates Foundation
CDC	U.S. Centers for Disease Control and Prevention
CQ	chloroquine
DHA	dihydroartemisinine
FHI	Family Health International
GFATM	The Global Fund to fight AIDS, TB and Malaria
GMS	Greater Mekong Subregion
HU	Health Unlimited
IOM	International Organization for Migration
JICA	Japanese International Cooperation Agency
IRS	indoor residual spraying
ITM	Institute of Tropical Medicine
ITNs	insecticide-treated nets
LLINs	long-lasting insecticidal nets
MEF	mefloquine
MMV	Medicines for Malaria Venture
MORU	Mahidol-Oxford-Wellcome-Trust Tropical Medicine Research Unit
MSF	Médecins Sans Frontières
MSH/RPM Plus	Management Sciences for Health, Rational Pharmaceutical Management Plus
PFD	Partners for Development
PIP	piperaquine
PSI	Population Services International
PYR	pyronaridine
RACHA	Reproductive and Child Health Alliance
SEAMEO TROPMED	Southeast Asian Ministers of Education Organization Tropical Medicine and Public Health
SP	sulfadoxine-pyrimethamine
TDR	Tropical Diseases Research
TRI	trimethoprime
TUC	Thailand Ministry of Public Health – U.S. Centers for Disease Control and Prevention Collaboration
URC	University Research Co., LLC
USAID	United States Agency for International Development
USAID-RDM	United States Agency for International Development, Regional Development Mission/Asia
USP DQI	United States Pharmacopeia, Drug Quality and Information
WHO	World Health Organization
WHO SEARO	WHO Regional Office for the South-East Asia
WHO WPRO	WHO Regional Office for the Western Pacific
WFP	World Food Programme
WRO	WHO Representative Office

Regional Profile of Malaria in the Greater Mekong Subregion

1. Background and epidemiology

In 1999, the Mekong Roll Back Malaria Initiative was launched in Ho Chi Minh City, Viet Nam, bringing together programmes and partners from six countries (Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, Viet Nam and China).

It aimed to consolidate efforts in reducing malaria morbidity and mortality throughout the Greater Mekong Subregion (GMS). During this meeting, the GMS Member States committed to achieve the following goals by 2010:[1]

1) Reduce deaths due to malaria to less than 50% of the 1998 level.
2) Substantially reduce malaria morbidity.
3) Contain the spread of multidrug resistance.

This section reports on the progress made in malaria morbidity and mortality in the GMS since 1998, using country-level data aggregated for the Greater Mekong Subregion. The epidemiological data in this report were provided by the six National Malaria Control Programmes in the region, which produce annual estimates of malaria deaths and malaria cases at national and subnational levels.

It should be noted that these estimates do not accurately reflect the disease burden of malaria due to limitations in the coverage of health services as well as in the diagnosis and reporting of malaria cases. As the estimates of malaria cases are largely based on passive detection in government health facilities, they are likely to underestimate the true morbidity of malaria in each country.

Moreover, comparisons between countries in the number of cases and deaths do not account for differences in reporting methods. For instance, the number of malaria cases is estimated on the basis of various combinations of active and passive case detection. Therefore, any interpretation of the data presented in this report should take into account these caveats.

[1] Roll Back Malaria. *Implementation of Roll Back Malaria in the six Mekong countries: report on the planning meeting, 2-4 March 1999*.

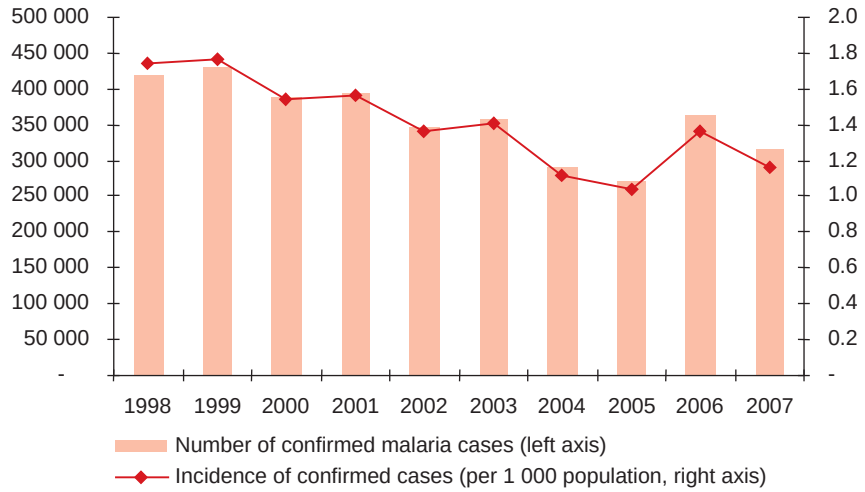
National estimates of malaria morbidity and mortality reveal that, to date the Mekong Subregion has made considerable progress with regard to the goals set out during the launch of the Mekong Roll Back Malaria Initiative (now known as the WHO Mekong Malaria Programme). With a 60% drop in annual malaria deaths between 1998 and 2007, the Subregion overall has already met its objective on malaria mortality (Figure 2).

In terms of morbidity, the number of confirmed malaria cases across the Subregion has declined by approximately 25% from 1998 to 2007 (Figure 1).[2,3]

The rise in the number of confirmed malaria cases in 2006, depicted in Figure 1, is due to a range of country-specific factors, which are explained in each of the country profiles.

Multiple factors have contributed to the Region's achievements in alleviating the burden of malaria. Governments and partners have played a role in improving the malaria situation by increasing investments in malaria control interventions, strengthening political will, integrating malaria control into national health systems, and intensifying cross-border collaboration in malaria control. At the broader level, environmental changes such as deforestation, economic developments (including urbanization), demographic stabilization, greater political stability and the improved coverage of general health services have also contributed to reducing malaria morbidity and mortality in the GMS. Nonetheless, despite these significant improvements in the epidemiological situation, malaria continues to be a major public health problem in the Mekong Subregion.

Figure 1: Malaria morbidity in the reater Mekong Subregion, 1998–2007

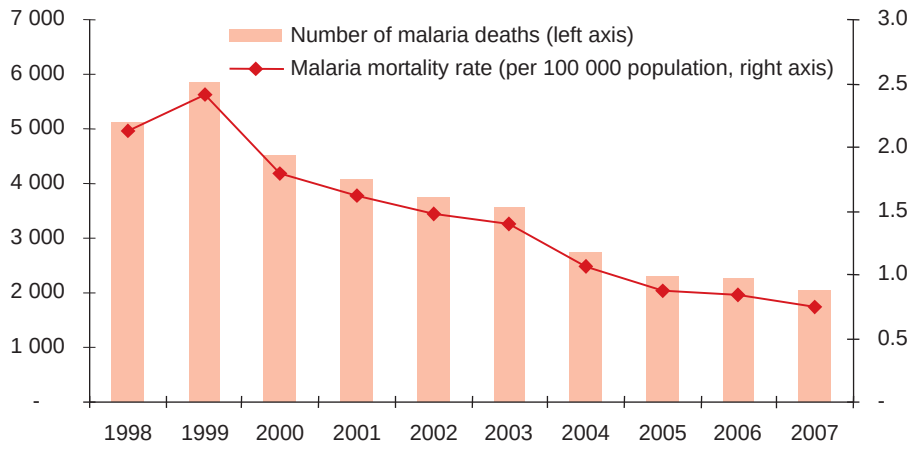


Source: National malaria control programmes

[2] Unless otherwise specified, all data on malaria cases and deaths are official estimates from National Malaria Control Programmes, obtained through WHO's Western Pacific and South-East Asia Regional Offices. Comparisons between countries do not account for differences in reporting methods.

[3] At the time this report was written, estimates of cases and deaths for Myanmar were not available for 2007; therefore 2006 data were used for Myanmar.

Figure 2: Malaria mortality in the Greater Mekong Subregion, 1998–2007



Source: National Malaria Control Programmes

Progress in malaria control has varied across Mekong countries, and the current malaria situation is highly uneven. As indicated in Table 1, the incidence of malaria in 2007 ranged from 0.13 confirmed cases per 1000 population in Yunnan province of China to 3.55 confirmed cases per 1000 population in Myanmar. The malaria mortality rate for 2007 was lowest in both Viet Nam and Yunnan province, at 0.02 deaths per 100 000 population, and highest in Myanmar, at 2.91 deaths per 100 000.

Table 1: **Population, malaria cases and malaria deaths in the Greater Mekong Subregion, 1998 and 2007**

Country	1998				2007			
	Total population (1000s)	Number of confirmed malaria cases	Incidence of confirmed malaria cases (per 1000 pop.)	Malaria mortality rate (per 100 000 pop.)	Total Population (1000s)	Number of confirmed malaria cases	Incidence of confirmed malaria cases (per 1000 pop.)	Malaria mortality rate (per 100 000 pop.)
Cambodia	11 422	58 874	5.15	5.44	14 364	42 518	2.96	1.68
China-Yunnan	40 091	12 988	0.32	0.04	45 763	6 085	0.13	0.02
Lao PDR	4 967	39 031	7.86	8.60	5 842	19 037	3.26	0.24
Myanmar*	47 349	104 753	1.83	6.72	56 603	200 679	3.55	2.91
Thailand	60 252	131 055	2.18	1.14	62 851	33 178	0.53	0.15
Viet Nam	76 108	72 091	0.95	0.24	85 701	14 581	0.17	0.02
Total	240 190	418 792	1.67	2.13	263 296	316 078	1.17	0.75

Source: National Malaria Control Programmes
*2006 data are reported instead of 2007

Viet Nam, Thailand and Yunnan Province in China have made great strides in reducing the burden of malaria. Particularly striking is Viet Nam's trajectory from 1991 onwards, wherein increased national and external investment in malaria control played a key role in dramatically lowering the annual number of malaria cases and deaths.

Cambodia and Lao PDR have also experienced notable improvements in the malaria situation due to increased effort by the governments and substantial support from the international community. However, the malaria situation remains serious in these two countries. As Table 1 indicates, there were 2.96 and 3.26 confirmed malaria cases per 1000 persons reported in 2007 in Cambodia and Lao PDR, respectively.

In the Mekong Subregion, Myanmar is the only country where the incidence of confirmed cases has increased since 1998 (see Table 1). Although Myanmar accounts for approximately onefifth of the area's population, more than half of the malaria cases and approximately three quarters of the malaria deaths in the GMS in 2007 occurred in this country (see Figures 3 and 4).

The malaria epidemiology is closely linked with the physical environment of the Subregion. The most prevalent malaria vectors are *Anopheles dirus,* which breeds predominantly in forested areas, and *Anopheles minimus*, which is widespread in the forest fringe areas. Most of the population in this Subregion lives in rice-growing areas and the plains, which are generally free of malaria transmission. The at-risk population are those who live in remote villages in or close to forested areas, which are not only where malaria vectors thrive but also where accessibility to health services is poorest.

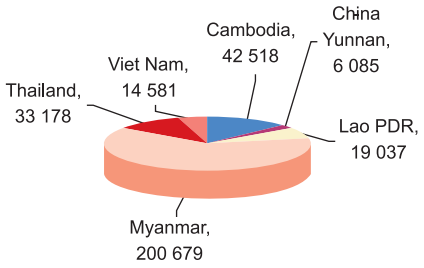
Another factor affecting the malaria situation is the distribution of parasite species within the Region. The type of malaria parasite has implications on the severity of illness, risk of death and the optimal drug therapy. Therefore, identifying the parasite during diagnosis has important benefits for case management.[4]

Drawing from results of microscopy tests, Table 2 presents the proportion of total confirmed cases per country that are *Plasmodium falciparum.* This table shows that in the Subregion as a whole, the majority of confirmed malaria cases are *P. falciparum.* Yunnan province is the only part of the GMS where *Plasmodium vivax* is predominant.

However, these national figures mask the highly varied distribution of parasite species within countries. In Thailand, for instance, although half of the confirmed cases nationwide were *P. falciparum* in 2007, this proportion was considerably smaller in the Thai provinces bordering Cambodia, where the number of *P. vivax* cases was more than double the number of *P. falciparum* cases.

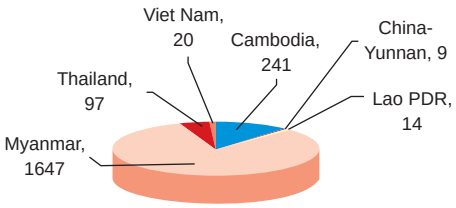
[4] P. Singhasivanon et al. Mekong Malaria II: Update of malaria, multidrug resistance and economic development in the Mekong region of South-East Asia. *The Southeast Asian Journal of Tropical Medicine and Public Health,* Volume 34 (supplement) 2003.

Figure 3: Distribution of malaria cases in the GMS, 2007



Source: National Malaria Control Programmes

Figure 4: Distribution of malaria deaths in the GMS, 2007



Source: National Malaria Control Programmes

Table 2: **Proportion of confirmed malaria cases that are *P. falciparum*, 2007**

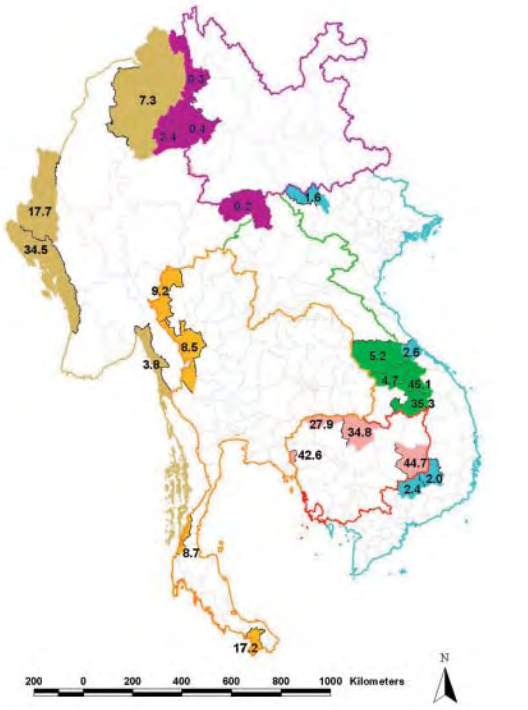
Country	Proportion of falciparum cases
Cambodia	86.9%
China (Yunnan)	22.3%
Lao PDR	98.6%
Myanmar*	74.0%
Thailand	49.9%
Viet Nam	76.0%

Source: National Malaria Control Programmes
*2006 data

Within each country, the four subnational areas with the highest incidence of confirmed malaria cases are highlighted in Map 1.[5] Given the differences in national reporting methods, the incidence rates should not be compared across countries. Nonetheless, the distribution of each country's highest malaria incidence rates does indicate that malaria is concentrated in border areas across the Subregion. Many of these border areas are characterized by forest and forest fringe areas with high malaria transmission, poor geographical accessibility, high population mobility, and low population density. The prevalence of malaria in the GMS along international borders underscores the importance of addressing malaria control from a regional standpoint.

Map 1: ***Distribution of the highest malaria incidence rates within each country in the GMS, 2007****

(Confirmed malaria cases per 1000 population)



*2006 data for Myanmar

[5] The subnational areas are provinces (for Cambodia, Lao PDR, Thailand and Viet Nam), states and divisions (for Myanmar) and prefectures (for Yunnan province).

2. National Malaria Control Programmes

The key malaria control strategies and policies of these countries are summarized in Table 3.

Table 3: **Key national strategies and policies in malaria control**

	Cambodia	China	Lao PDR	Myanmar	Thailand	Viet Nam
Treatment and Diagnosis Guidelines	✓	NA	✓	✓	✓	✓
Published/updated in:			2005	2008	2007	2003
Monitoring antimalarial drug resistance	✓	✓	✓	✓	✓	✓
Number of sites currently active:	8	4	3	4	8	5
Community-based approaches (e.g. village health workers or volunteers)	✓	✓	✓	✓	✓	✓
Vector control using IRS in targeted areas	✓	✓	✓	✓	✓	✓
Vector control using ITNs/LLINs (personal protection)	✓	✓	✓	✓	✓	✓
Monitoring insecticide resistance	✓	NA	✓	✓	✓	✓
Number of sites currently active:	4		10	1	2	>10
Epidemic preparedness	-	✓	✓	✓	✓	✓

Source: Adapted and updated from *World Malaria Report 2005* (Roll Back Malaria/WHO/UNICEF), Table A.1

Diagnosis and treatment

Early diagnosis—through quality microscopy and rapid diagnostic tests (RDTs)—and effective treatment are critical elements for controlling malaria in the Mekong Subregion. The use of artemisinin-derived combination therapies (ACTs) for *P. falciparum* malaria is now part of national drug policies across the Subregion. Where good quality microscopy is unavailable, RDTs have been increasingly used by National Malaria Control Programmes because of their simplicity and accuracy.[6] In parts of the Subregion where there is high prevalence of *P. vivax* and microscopy is not available, pan-specific tests are most appropriate. However, these tests have problems of low sensitivity (in particular, the sensitivity to *P. vivax* is less than 80%, as these tests do not detect infections with parasite densities below 200/µl) and the correct storage and use of these tests may be a challenge. Overall, ensuring quality diagnosis and treatment is difficult in the remote areas of the GMS, which are often where

[6] http://www.wpro.who.int/sites/rdt

these interventions are needed most. In these areas, road access is often poor (especially during the rainy season), it is difficult to keep commodities at controlled temperatures, and supervision at the village level is limited.

Vector control

The distribution of insecticide-treated nets (ITNs) and regular indoor residual spraying (IRS) are measures employed by all six countries. Currently, the GMS countries are progressing towards greater use of long-lasting insecticidal nets (LLINs), which do not require re-treatment during their expected lifespan of four to five years.[7]

As with the provision of quality diagnosis and drugs, ensuring an adequate coverage of vector control measures is particularly challenging in isolated, forested areas (such as on the Thai–Myanmar border and the Thai–Cambodian border, where many ethnic minorities and migrant workers live).

Moreover, ITNs are not always appropriate, for example in forest settings where *A. dirus* bites early in the evening. This highlights the need for operational research to develop and use relevant vector control measures that are adjusted to transmission settings, malaria vectors and characteristics of the targeted population groups.

[7] K. Thimasarn, Mekong Roll Back Malaria. A Strategic Framework for Rolling Back Malaria in the Mekong Region, February 2003.

3. Key challenges facing malaria control in the Region

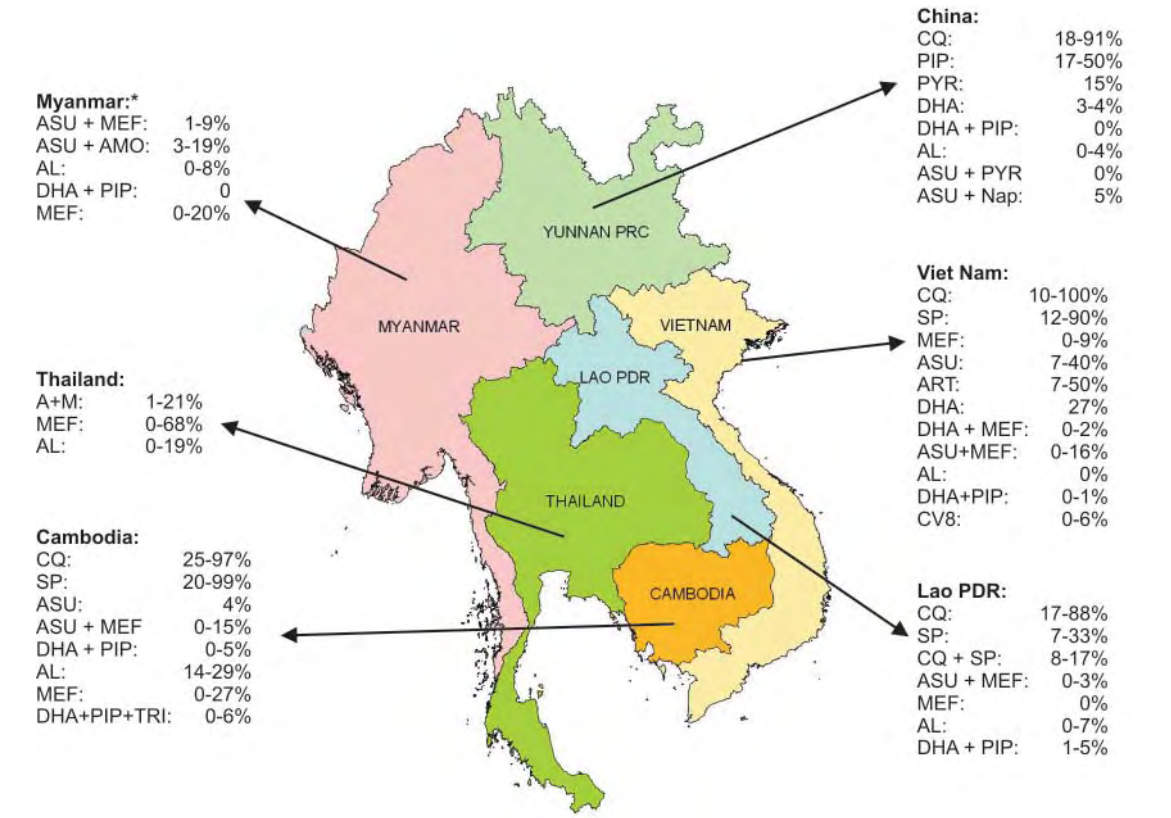
The National Malaria Control Programmes of the GMS grapple with important challenges that characterize the Region. Key issues that undermine malaria control in the Region are: (1) multidrug resistance; (2) the prevalence of counterfeit and substandard antimalarial drugs and irrational drug use; (3) widespread population mobility; and (4) inadequate coverage of health services among ethnic minorities. Several of these factors are interrelated. For instance, the potential for antimalarial drug resistance in the Region is fuelled by extensive population movements, irrational drug use and the proliferation of counterfeit drugs.

Multidrug resistance

Resistance to antimalarial drugs has been a long standing problem in the Greater Mekong Subregion. A network of 32 sentinel sites is active in the six countries to monitor antimalarial drug resistance (see Map 2 for a summary of results of drug efficacy studies). While studies have reported varying degrees of drug resistance throughout the GMS, resistance has been most pronounced on the Thai–Cambodian border. Since the 1970s, the Cambodia–Thailand border has been the global epicentre of emerging resistance to antimalarial drugs. It is in this area that parasite resistance to chloroquine first developed, followed by resistance to sulfadoxine-pyrimethamine, then to mefloquine.[8]

[8] WHO Western Pacific Region. *Review of the Malaria Drug Efficacy Situation in 10 countries*

Map 2: *Results of drug efficacy studies in the Mekong (Treatment failure rates %)*



In response, Cambodia and Thailand have adapted their national drug policies accordingly and now use artemisinin-based combination therapies (ACTs) to treat uncomplicated falciparum malaria.

Currently, all WHO-recommended treatment regimens for falciparum malaria are based on artemisinin derivatives combined with an effective partner drug. Recently, though, results from surveillance sites on the Thai–Cambodian border have shown an increasing failure rate of *P. falciparum* to artemisinin-combination therapies.[9] In particular, slow parasite clearance times have been detected on the third day of treatment in Pailin, in western Cambodia.[10] These rates give cause for concern, particularly since a possible driving factor for increasing failure could be the local emergence of falciparum resistance to artemisinin derivatives.

Further investigation is being undertaken to examine the underlying causes of decreased sensitivity of *P. falciparum* to artemisinin in the Subregion, in order

[9] World Health Organization. *Containment of malaria multidrug resistance on the Cambodia-Thailand border, Report of an informal consultation, Phnom Penh, 29-30 January 2007*. SEA-MAL-246.

[10] C. Wongsrichanalai and S.R. Meshnick. *Declining Artesunate-Mefloquine efficacy against falciparum malaria on the Cambodia-Thailand border.* Emerging Infectious Diseases, Vol. 14, No. 5, May 2008.

to determine whether resistance to artemisinin is in fact arising or whether other causes for treatment failure are in play.

A laboratory network has been established to strengthen *in vitro* research on malaria parasites in Cambodia and Thailand.[11] Activities of the network include standardizing methodologies for clinical testing across laboratories in the Region so that *in vitro* results on drug efficacy are comparable. It is intended to eventually expand this network to cover the Mekong Subregion.

Counterfeit/substandard drugs and irrational drug use

A growing problem throughout the GMS has been the proliferation of counterfeit antimalarial drugs on the market. The inadvertent use of fake drugs has caused deaths from malaria that would otherwise have been avoidable. Further consequences of using counterfeit antimalarials are the negative impact on livelihood and the loss of confidence in malaria treatment and health systems. As these drugs are often sold for less than the standard price of antimalarials, the poor are particularly affected.

Substandard drugs, which are genuine drugs with insufficient quantities of the active ingredient, are also a possible contributor to antimalarial drug resistance in GMS because sub-therapeutic doses of a drug may allow the parasite to survive and develop resistant strains.

In the Mekong Subregion, counterfeit and substandard medicines are sold primarily in the informal sector, along international border areas. The parts of the Subregion with long borders and many unofficial ports of entry are most difficult to control and are, therefore, vulnerable to the trafficking of fake drugs. Cross-country collaboration, though essential to halting the counterfeit drug trade, is a sensitive issue because many sources of counterfeit antimalarials are from neighbouring countries.

Although no precise estimate is available on the proportion of counterfeit antimalarial drugs present throughout the GMS, several studies have been conducted in localized areas. In terms of multicountry studies, a survey conducted in sites in Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam in 1999-2000 (using convenience sampling) found that 38% of 104 samples marked as oral artesunate were fake and contained no active ingredient.[12] A similar survey conducted in 2002-2003 found that 53% of the 188 artesunate blister packs collected were counterfeits.[13]

The misuse of drugs is also an impediment to malaria control in the

[11] World Health Organization. *Containment of malaria multidrug resistance on the Cambodia-Thailand border, Report of an informal consultation, Phnom Penh, 29-30 January 2007*. SEA-MAL-246.

[12] Newton PN et al. Fake artesunate in Southeast Asia. *Lancet* 2001; 357: 1948-50.

[13] Dondrop et al. Fake antimalarials in Southeast Asia are a major impediment to malaria control: multinational cross-sectional survey on the prevalence of fake antimalarials. *Tropical Medicine and International Health,* December 2004, Vol. 9 No. 12: 1241-1246.

GMS. Over- or under-medication can lead to treatment failure and can allow the parasite to develop resistance. Drug-use surveys have reported a high degree of self-medication in parts of the GMS (for instance, results from a Lao PDR survey showed that about 53% of respondents self-medicated for malaria[14]), which imposes difficulties in ensuring proper drug use. The problem of irrational drug use has increased with the expanding role of the private sector in malaria diagnosis and treatment. In Cambodia, it is estimated that the private sector has been the first point of contact for over 70% of people seeking malaria treatment.[15]

To combat the distribution of counterfeit and substandard drugs, a drug quality monitoring network has been in place for the Mekong Subregion since 2002 involving WHO and in collaboration with US Pharmacopeia, the German Pharma Health Fund and the Thai Bureau of Drug and Narcotics. Through this network, antimalarial drugs are sampled in selected provinces of all six countries over two or three rounds per year. The Western Pacific Region of WHO also has a rapid alert system for countries to quickly share information on counterfeit drugs.[16] Other measures in place include increasing public awareness on the existence of fake drugs through village malaria workers (for example, in Cambodia and Viet Nam) and social marketing of ACTs and RDTs in the private sector in Cambodia.

In 2006–2007, an international multidisciplinary group consisting of WHO officials, physicians, pharmacists, scientists and INTERPOL officers conducted a joint investigation on counterfeit artesunate in the Mekong countries. From a sample of 391 artesunate collected between 1999 and May 2006 in Viet Nam, Cambodia, Lao PDR, Myanmar and the Thai–Myanmar border (mostly using convenience sampling), a wide variety of fake artesunate was identified, including 14 different fake holograms and numerous chemical compositions.[17]

Studies on the pharmaceutical ingredients in the counterfeits suggested that the manufacturing sites came from two groups in southern China. The evidence was presented by INTERPOL to the Chinese authorities, who in turn carried out a criminal investigation and arrested two persons in Yunnan and Guangdong provinces who had allegedly traded 240 000 blister packs of counterfeit artesunate. This investigation provides a successful model of collaboration between the health sector, INTERPOL and national authorities in combating the trafficking of counterfeit drugs in the Mekong Subregion.

[14] Lao PDR National Health Survey, 2001.

[15] World Health Organization. Containment of malaria multidrug resistance on the Cambodia-Thailand border, Report of an informal consultation, Phnom Penh, 29-30 January 2007. SEA-MAL-246.

[16] http://218.111.249.28/ras/default.asp

[17] Newton PN et al. A collaborative epidemiological investigation into the criminal fake artesunate trade in South East Asia. *PLoS Medicine,* February 2008, Volume 5, Issue 2.

Population mobility

Whether for seeking economic opportunities or to escape political conflict, substantial population mobility takes place in the GMS, both internally and internationally. Large-scale population movement from highly endemic areas to low endemic zones has contributed significantly to the spread of *P. falciparum* within and beyond the Subregion. The transmission of malaria across borders complicates surveillance and follow-up for National Malaria Control Programmes.

A well-known example of extensive migration leading to the spread of malaria is the movement of gem miners from Borai district, Trat province of Thailand, into Pailin Province of Cambodia. During the "Ruby Rush" of 1988 to 1992, a large influx of non-immune people entered Cambodia's Pailin province on the Thai–Cambodian border, which is the epicentre of drug-resistant malaria. During this period, it is estimated that 100 000 to 200 000 people crossed the border from Thailand to Cambodia, many of whom being from the western Thai provinces bordering Myanmar. When the gem miners returned to their provinces, mefloquine-resistant *P. falciparum* spread westward. Estimates from clinics in Mae Sot district in Tak province in western Thailand on the Thai-Myanmar border were that 80% of malaria infections were acquired in eastern Thailand on the Thai–Cambodian border.

Currently, the Thai–Myanmar border and the southern border of Yunnan, China, are two main areas where frequent cross-border movement has exacerbated the malaria situation.

1) Thailand is the primary destination for migrant labour from neighbouring countries *(see Map 3)*.[18] Much of the population movement in and out of Thailand occur on the Thai–Myanmar border, which extends for about 2000 kilometres. Along this border malaria is the leading infectious disease, of which most cases and deaths are related to cross-border movements. The Mae Tao clinic in Mae Sot district, Tak province, which provides free health care for refugees and migrant workers, treated more than 8000 cases of malaria in 2006, of which 75% were from Myanmar.[19] The clinic reported 30 deaths from malaria the same year.

   Thailand's Round 7 of the Global Fund is focused on improving the malaria situation among migrants and people living in conflict zones in the southern provinces by strengthening and expanding community-based malaria services for these two target population groups.

[18] Asian Migration Centre, *Migration in the Greater Mekong Subregion (second edition)*, November 2005.

[19] Mae Tao Clinic, Annual Report 2006.

Map 3: *Migration in Thailand*

Migration to Thailand*
From Myanmar: 921 492
From Cambodia: 179 887
From Lao PDR: 179 887

Source: Migration in the Greater Mekong Subregion (second edition), Asian Migrant Centre, November 2005.
*refers to registered migrants only, as of July 2004.

2) Malaria cases in Yunnan province are also concentrated around the international border areas. Yunnan shares a border of 4000 kilometres with Myanmar, Lao PDR and Viet Nam. As shown in Map 4, migration between Yunnan and the neighbouring countries occurs in both directions.

Many of these migrants are seasonal workers from China who travel across the border to work in activities such as logging or mining. Non-immune migrants who work in holoendemic areas are especially at risk. On the China-Myanmar border, the coverage of malaria services is low, particularly for transient workers.

The Global Fund to fight AIDS, TB and Malaria (GFATM) is currently financing a project to strengthen malaria prevention and treatment for mobile workers in the Yunnan border areas. A key component of this project is to improve surveillance and reporting systems for cross-border malaria cases, in order to better detect the reintroduction of cases, local transmission and outbreaks.[20]

Map 4: *Migration in Yunnan province, China*

Source: Migration in the Greater Mekong Subregion (second edition), Asian Migrant Centre, November 2005.

[20] GFATM, China Round 6 proposal.

Ethnic minorities and hard-to-reach populations[21]

Malaria continues to undermine the health conditions of ethnic minorities in the Mekong Subregion. While well-managed, effective malaria control measures have drastically reduced mortality in the overall population, the malaria burden remains high among hill tribes or ethnic minorities.

About one third of the ethnic minority population in the Mekong Region (which amounts to approximately 7 million people) live in remote, often hilly and forested areas where malaria transmission is high. The majority of them are very poor, have little education, and reside in isolated villages with little or no access to basic health services. Although the malaria situation in this area has improved over the past several years, it is widely recognized that ethnic minorities, migrants and forest workers remain the most at risk for malaria.

Malaria control programmes face difficulties in reaching ethnic minorities in hilly, forested regions (such as on the Thai–Cambodian border or the Thai–Myanmar border) because of the difficult terrain and bad road conditions, which impede the provision of commodities, service delivery and the supervision of activities, especially during the rainy season. Moreover, interventions that are implemented nationally are not always effective for ethnic minority groups due to differences in cultural beliefs, behaviour, language and customs.

To improve malaria control among vulnerable ethnic minorities in the GMS, the Asian Development Bank (ADB) undertook a project in collaboration with WHO, titled *Strengthening Malaria Control for Ethnic Minorities in the Greater Mekong Subregion*, from October 2005 to December 2007. The objective of the project was to pilot and document specific and locally adjusted malaria control strategies in poor ethnic minority groups. The population in the targeted communities were from the following ethnic minority groups: Kreung in Cambodia, Wa in China-Yunnan, Brau-Lave in Lao PDR, Shan in Myanmar, Karen in Thailand and Raglai in Viet Nam.

As part of the project, village volunteers and local health staff were trained in malaria control and prevention services; bednets were distributed to increase coverage among households and forest-goers in the targeted villages; and RDTs and ACTs were distributed to the volunteers and health staff.

These activities were monitored regularly through regular village meetings and supervision visits. Although health staff reported difficulties reaching the target villages during the rainy season, findings indicate that the malaria situation nonetheless improved significantly since the project's inception.

Between mid-2006 and mid-2007, the RDT positivity rate in fever cases decreased from 49% to 20% in the

[21] Summarized from: World Health Organization Regional Office for the Western Pacific, *Final project report: Strengthening malaria control for ethnic minorities in the Greater Mekong Subregion* 2008.

Cambodia site, and the slide positivity rate from parasitological surveys decreased from 15% to 7% in the Lao PDR site and from 72% to 46% in the China site, while remaining at less than 1% in the Viet Nam site. The percentage of people sleeping under an ITN increased by at least 14% in all project sites.

4. International partners in malaria control in the GMS

GFATM provides the majority of international funding for malaria control in the Greater Mekong Subregion. Table 4 provides an overview of the funding status regarding the GFATM for each of the six countries. The areas of support are outlined for each proposal in Annex 1.

Other key international partners and donors in malaria control in the Mekong Subregion are listed below:

- ACTMalaria Foundation: *http://www.actmalaria.net*
- Armed Forces Research Institute of Medical Sciences (AFRIMS): *http://www.afrims.org*
- American Refugee Committee (ARC): *www.arcrelief.org*
- Asian Development Bank (ADB): *www.adb.org/*
- Bill & Melinda Gates Foundation (BMGF): *www.gatesfoundation.org*
- Cesvi: *www.cesvi.eu*

Table 4: **GFATM Funding for malaria control (US$)**

Country	Round	Total amount requested	Approved funding		Total amount disbursed
			Phase 1	Phase 2	
Cambodia	2	9 998 371	5 013 262	4 717 083	9 371 433
	4	9 857 891	5 221 242	4 636 649	6 734 646
	6	31 113 759	13 105 131	0	6 765 594
	Rolling Continuation Channel (RCC)	44 489 661	Final amount to be determined	Final amount to be determined	-
Lao PDR	1	12 709 087	3 155 152	9 553 935	12 709 087
	4	14 502 222	3 289 689	11 212 533	8 539 238
	6	4 098 992	1 726 701	0	1 146 846
	7	24 628 024	6 740 783	0	3 801 109
Myanmar	3	27 050 046	3 091 409	0	3 091 409
Thailand	2	5 282 000	2 280 000	3 002 000	5 282 000
	7	24 689 670	11 939 346	0	5 170 981
Viet Nam	3	22 787 909	13 388 402	9 399 507	19 952 246
	7	29 977 899	-	-	-
China	1	6 406 659	3 523 662	2 882 997	6 347 448
	5	39 410 395	20 096 149	0	20 052 630
	6	16 808 186	7 047 932	0	5 079 557
Total GMS		323 810 771	99 618 860	36 014 597	114 044 224

Source: The Global Fund to fight AIDS, TB and Malaria (www.theglobalfund.org), as of 12 September 2008.

- Family Health International (FHI): *www.fhi.org*
- Health Unlimited (HU): *www.healthunlimited.org/*
- Institut Pasteur Cambodia: *www.pasteur-kh.org*
- Institute of Tropical Medicine (ITM), Antwerp, Belgium: *www.itg.be/itg/*
- International Organization for Migration (IOM): *http://www.iom.int*
- INTERPOL: *http://www.interpol.int*
- Japanese International Cooperation Agency (JICA): *www.jica.go.jp*
- Japanese Ministry of Health, Labour and Welfare: *www.mhlw.go.jp*
- Kenan Institute Asia (Kenan): *http://www.kiasia.org*
- Mahidol-Oxford-Wellcome-Trust Tropical Medicine Research Unit (MORU): *http://www.tm.mahidol.ac.th/research/dept/moru.htm*
- Malaria Consortium: *www.malariaconsortium.org*
- Malteser International: *www.malteser.de/*
- Management Sciences for Health, Rational Pharmaceutical Management Plus (MSH/RPM Plus): *www.msh.org/projects/rpmplus*
- MEASURE / Evaluation: *www.cpc.unc.edu/measure*
- Médecins Sans Frontières (MSF): *www.msf.org*
- Medicines for Malaria Venture (MMV): *www.mmv.org*
- Partners for Development (PFD): *www.pfd.org*
- Population Services International (PSI): *www.psi.org*
- Reproductive and Child Health Alliance (RACHA): *http://rc.racha.org.kh*
- Southeast Asian Ministers of Education Organization Tropical Medicine and Public Health (SEAMEO TROPMED) network: *http://www.seameotropmednetwork.org*
- Thailand Ministry of Public Health – U.S. Centers for Disease Control and Prevention (TUC) collaboration: *http://www.cdc.gov/ieip/thailand.html*
- Three Diseases Fund for HIV/AIDS, TB and Malaria: *www.3dfund.org/*
- Tropical Diseases Research (TDR): *www.who.int/tdr*
- UNICEF: *www.unicef.org*
- University Research Co., LLC (URC): *http://www.urc-chs.com*
- US Pharmacopeia, Drug Quality and Information (USP DQI): *http://www.usp.org/worldwide/dqi/*
- USAID-Regional Development Mission (RDM)-Asia: *www.usaid.gov*

- U.S. Centers for Disease Control and Prevention (CDC): *www.cdc.gov*
- World Food Programme (WFP): *www.wfp.org*
- WHO Collaborating Centre for Malaria, Schistosomiasis and Filariasis, Chinese Center for Diseases Control and Prevention (China CDC), Shanghai, China.
- WHO Collaborating Centre for Malaria Training and Research, Department of Medical Research (Lower Myanmar), Ministry of Health, Yangon, Myanmar.
- WHO Collaborating Centre for Reference and Research on Biological Characterization of Malaria Parasites, Chulalongkorn University, Bangkok, Thailand.
- WHO Collaborating Centre for Clinical Management of Malaria, Mahidol University, Bangkok, Thailand.

Country Profiles

Cambodia

1. Epidemiological profile

Malaria remains a serious public health concern in Cambodia. It is estimated that 2.1 million people (15% of the population) in Cambodia are at risk of malaria, of which approximately 500 000 people live in forest and forest fringe areas with high malaria transmission.[22] *Anopheles dirus* and *Anopheles minimus* are the main vectors in Cambodia's forests and jungles, which cover around 59% of the country's landmass.[23]

The burden of morbidity and mortality due to malaria is aggravated by the poor nutritional status, including anaemia, of women and children. Early childhood mortality rates for Cambodia are the highest in South-East Asia, with an infant mortality rate of 98 per 1000 live births and an under-five mortality rate of 143 per 1000 live births in 2005.[24]

According to official estimates, the malaria incidence rate in Cambodia was 3.0 confirmed cases per 1000 population in 2007, and 5.6 confirmed cases in 2006 (Figure 1).[25] Cambodia's malaria mortality rate of 1.7 deaths per 100 000 population in 2007 (Figure 2) is ranked second highest in the Subregion, after that of Myanmar. It should be noted that these official estimates for Cambodia do not include data from the private sector and, therefore, are likely to underestimate the malaria burden, since over 70% of malaria patients in Cambodia seek treatment in the private sector.[26]

After peaking in the early 1990s, the annual number of malaria cases has steadily declined to 42 518 cases in 2007. Malaria mortality also decreased over the same time period, from a high

[22] WHO Regional Office for the Western Pacific. *Malaria Situation in the WHO Western Pacific Region 1992-2000.* 2002 (Draft).

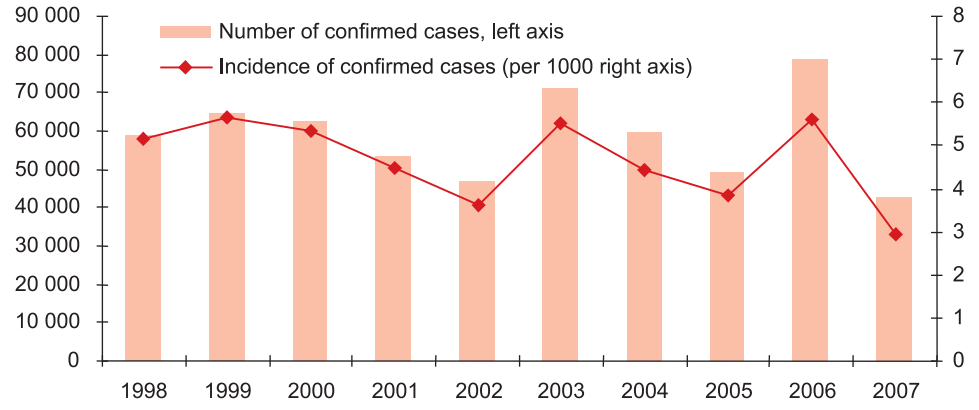
[23] TWG Forestry & Environment, Forest cover changes in Cambodia 2002-2006.

[24] UNDP, *Human Development Report,* 2007/2008.

[25] Unless stated otherwise, all data on malaria cases and deaths in this chapter are from the National Centre for Parasitology, Entomology and Malaria Control, Cambodia.

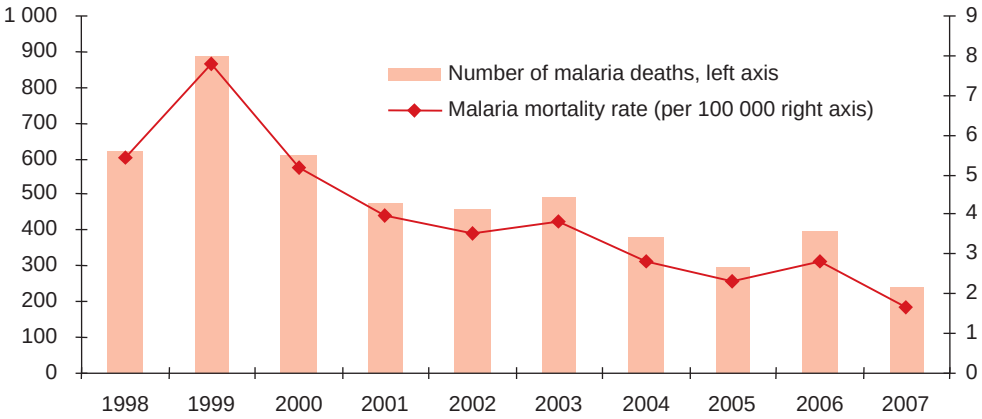
[26] World Health Organization. *Containment of malaria multidrug resistance on the Cambodia-Thailand border, Report of an informal consultation, Phnom Penh, 29-30 January 2007*. SEA-MAL-246.

Figure 1: Malaria morbidity in Cambodia, 1998–2007



Source: National Centre for Parasitology, Entomology and Malaria Control, Cambodia.

Figure 2: Malaria mortality in Cambodia, 1998–2007



Source: National Centre for Parasitology, Entomology and Malaria Control, Cambodia.

of 1408 deaths in 1992 to 241 deaths in 2007. Reductions in morbidity and mortality since the early 1990s are due to multiple factors, some of which are environmental changes (such as the reduction of primary forest cover), the scale-up of effective interventions including the expansion of mosquito net coverage in accessible areas (mostly in north-eastern Cambodia), and the end of conflict in 1998. As the political situation has stabilized after the late 1990s, widespread population movements have decreased and Cambodia's malaria control programme has improved its ability to implement curative and preventive measures.

Figures 1 and 2 show that the number of malaria cases and deaths spiked in 2003, and the number of malaria cases jumped again in 2006. The increase in 2003 is due in part to greater access to public health facilities (including an improved referral system in remote areas) and better reporting of malaria cases and deaths.[27] Factors that contributed to the rise in malaria

[27] http://www.wpro.who.int/sites/mvp/epidemiology/ malaria/cam_profile.htm

cases in 2006 over the previous year include: (i) the increased movement of mobile populations from low Malaria Risk areas to high Malaria Risk areas in 2006; (ii) the establishment of many new villages in malaria endemic areas without malaria protection measures in place, and (iii) early rainfall, which may have increased the mosquito density that year.

As Table 1 indicates, the incidence of malaria is most pronounced in Mondulkiri in eastern Cambodia, which is the country's largest and most sparsely populated province. The provinces of Pailin and Preah Vihear in the western part of Cambodia, along the Thai border, also had very high incidence rates in 2007. Large parts of these provinces are forested, with high malaria transmission and little access to public health services.

The highest malaria mortality rate in 2007 was recorded in the small western province of Oddar Mean Chey, with 11.7 deaths attributed to malaria per 100 000 population. Following Oddar Mean Chey, the provinces with the highest mortality rates are all located in the East: Sung Treng, Rattanakiri, Kratie, and Mondulkiri, with 10.9, 7.8 and 6.8 malaria deaths per 100 000 population, respectively.

In 2005 and 2006, the incidence rate of confirmed malaria cases was dramatically higher in Pailin than in any other province in the GMS (348 and 238 cases per 1000 population, respectively).

Table 1: **Confirmed malaria cases for selected provinces**

15 of 24 provinces	2002	2003	2004	2005	2006	2007	% of total confirmed cases, 2007	Incidence rate (cases per 1000 population), 2007
Preah Vihear	5 270	6 865	4 960	4 228	8 230	5 591	13	34.8
Battambang	5 221	10 227	6 873	5 997	8 996	4 105	10	4.0
Pursat	4 748	7 032	5 949	4 492	6 268	3 800	9	8.6
Kratie	2 311	2 340	2 675	2 086	4 706	3 750	9	10.7
Siem Reap	3 701	6 256	3 691	3 363	9 279	3 338	8	3.7
Oddar Mean Chey	2 391	4 029	2 671	1 505	3 778	2 871	7	27.9
Rattanakiri	3 011	2 793	2 726	3 967	5 503	2 839	7	22.2
Kampong Speu	3 321	7 898	4 251	3 285	4 326	2 618	6	3.4
Mondulkiri	1 320	1 807	2 861	2 072	3 325	2 009	5	44.7
Kampong Cham	3 119	2 956	1 689	1 117	2696	1 994	5	1.0
Kampot	2 624	4 640	2 956	2 231	3 143	1 981	5	3.2
Kampong Thom	1 930	3 435	2 322	1 669	4 439	1 879	4	2.7
Pailin	2 432	3 762	8 915	8 971	8 088	1 501	4	42.6
Stung Treng	2 179	2 935	2 770	1 354	2 189	1 292	3	11.8
Kampong Chhnang	690	1 181	1 161	1 097	1 200	956	2	1.8

Source: Nationtal Centre for Parasitology, Entomology and Malaria Control, Cambodia.

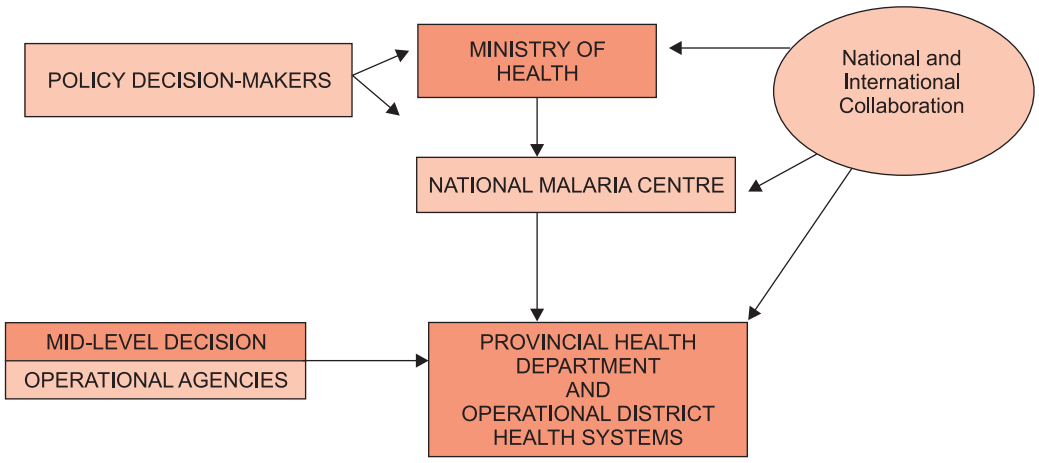
Several factors have contributed to the malaria situation in Pailin, most notably multidrug resistance, heavy forestation, geographical isolation, inadequate coverage of health services and the availability of fake drugs.

Specific high-risk groups in the Pailin area include soldiers, forestry workers and gem-miners. The surge in reported cases in this province from 2003 to 2004 is partially attributed to better case detection at the community level resulting from the implementation of early diagnosis and treatment by Médecins Sans Frontières, which has been operating in Pailin since 2004.

the central level, it is decentralized administratively, with provincial and district health departments bearing responsibility for planning and implementing malaria control activities.

Specific strategies of the programme are to: (i) strengthen the institutional capacity of the National Malaria Control Programme at the central and peripheral levels; (ii) improve malaria case management for all segments of the population; (iii) improve preventive measures to protect at-risk groups; and (iv) increase the coverage and effectiveness of information, education and communication (IEC) initiative for populations residing in areas at risk.[28]

Figure 3: Structure of the NMCP



Source: Ministry of Health, National Centre for Parasitology, Entomology and Malaria Control, 2005.

2. Overview of malaria control activities

Malaria control activities in Cambodia are coordinated by the National Centre for Parasitology, Entomology and Malaria Control, formerly called the National Malaria Centre (CNM), which is a specialized institution of the Ministry of Health. While the National Malaria Control Programme (NMCP) is led at

Traditional inhabitants of the forest, forest workers and new forest settlers are particular risk groups that are targeted with specific vector control approaches according to their behavioural and epidemiological characteristics. For instance, impregnated hammock nets are

[28] www.cnm.gov.kh

distributed to forest workers for personal protection.

Diagnosis and treatment

Access to quality diagnosis and treatment for malaria is a problem in Cambodia's endemic provinces, particularly in remote areas. The widespread use of the unregulated private sector for health services also presents a challenge for the NMCP.

Regarding National Treatment Guidelines, in 2000 the Ministry of Health adopted a single national treatment policy for falciparum malaria. Currently, the first-line treatment for uncomplicated malaria in adults is artesunate 600 mg over three days and mefloquine 1000mg over two days. Artesunate and mefloquine are packaged in combined blister packs for distribution in both public and private sectors.

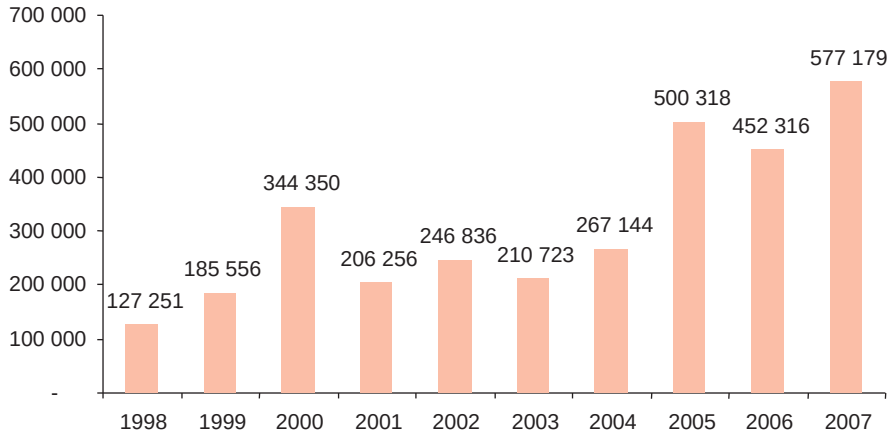
Vector control

- A large-scale survey conducted in 2004 found that 85% of people living in high-risk areas slept under some kind of net (usage levels are high for nets overall, but lower and inadequate for ITNs). Recent surveys indicate that ITN coverage is low despite retreatment efforts, as approximately only 20% of

Table 2: **Antimalarial drug policy in Cambodia**

P. falciparum						*P. vivax*
Uncomplicated		Treatment failure	Severe malaria	Pregnancy treatment	Pregnancy prevention	Treatment
Unconfirmed	Lab-confirmed					
ASU(3d) + MEF(2d)	ASU(3d) +MEF(2d)	QN(7d)+T(7d)	AM/AS injection followed by AM+MEF; AS suppository pre-referral	1st trimester: QN(7d) 2nd/3rd trimester: AS+MEF		CQ(3d) (PQ (14d) only if G6PD deficiency is ruled out)

Figure 3: Number of nets treated per year, 1998–2007



Source: National Centre for Parasitology, Entomology and Malaria Control, Cambodia.

people who work in the forest are covered by ITNs.[29]

- The distribution of LLINs began in 2007. By 2007, the coverage of ITNs and LLINs was 54.2% in areas at risk of malaria (3296 villages across 20 provinces).[30]

Monitoring antimalarial drug efficacy

Since 1991, drug efficacy monitoring has been carried out in several sentinel sites. Cambodia has been using the WHO standard 28-day protocol for drug-resistance monitoring since 2001. Table 3 presents the results of drug-efficacy studies conducted in Cambodia from 2002 to 2005.

Of particular concern in Cambodia is the high level of multidrug resistance in affected areas. Since the 1980s, there has been a considerably higher level of resistance to chloroquine and sulfadoxine-pyrimethamine (SP) in western Cambodia compared to the rest of the country and the Mekong Subregion. More recently, there has been evidence of increasing failure of *P. falciparum* to artemisinin-combination therapies in western Cambodian provinces.[31]

A significant contributing factor to drug resistance in this region has been the extensive population movement among gem-miners, soldiers, refugees and plantation workers in this part of the country. Another related issue is the widespread availability of fake antimalarial drugs. Moreover, the NMCP has little control over how the private sector manages the high number of malaria cases diagnosed and treated in its facilities.[32]

[29] Cambodia RCC proposal to the GFATM, 2008.

[30] ACTMalaria country profile, Cambodia, 2008. www.actmalaria.net

[31] World Health Organization. *Containment of malaria multidrug resistance on the Cambodia-Thailand border, Report of an informal consultation, Phnom Penh, 29-30 January 2007*. SEA-MAL-246.

[32] Ibid.

Table 3: **Efficacy of artesunate (ASU) plus Mefloquine (MEF) to *P. falciparum*, 2001–2007**

Study site	Year	Dose	Modifications	Quality control	N	ACPR (%)
Ratanakiri Northeast, on Lao and Viet Nam border	2002	12 mg/kg 20 mg/kg	28-day	Raw data	71	71 (100%)
	2004	12 mg/kg 25 mg/kg	28- and 42-day follow-up/ PCR	slide validation; drug manufacturer cited	80	28-day: 80 (100%) 42-day: 78 (100%)
	2006	12 mg/kg 25 mg/kg	28- and 42-day follow-up/ PCR	Data PCR corrected	80	28-day: 80 (100%)

Snoul Southeast, on Viet Nam border	2001	ASU +MEF blister 12 mg/kg 20 mg/kg	28-day	Raw data	50	50 (100%) S/RI
	2003	12 mg/kg 22.5 mg/kg		Data PCR corrected	63	63 (100%)
	2006	12 mg/kg 25 mg/kg	28- and 42-day follow-up/PCR	Data PCR corrected	82	28-day: 80 (97.6%)
Preah Vihear North	2002	ASU +MEF blister 12 mg/kg 20 mg/kg	28-day	Raw data	29	28 (96.6%)
	2004	12 mg/kg 25 mg/kg	28- and 42-day follow-up/PCR 28- and 42-day follow-up/PCR	slide validation; drug manufacturer cited Data PCR corrected	85	28-day: 85 (100%) 42-day: 83 (100%)
	2006	12 mg/kg 25 mg/kg			80	28-day: 80 (100%)
Pursat Northwest	2007	12 mg/kg 25 mg/kg	28- and 42-day follow-up/PCR	Data PCR corrected	65	55 (85%), PCR 90% at 28 days: 51 (80%), PCR 91% at 42 days
Battambang Northwest	2002	ASU +MEF blister 12 mg/kg 20 mg/kg	28-day	Raw data	50	48 (96%) S/RI
	2003	12 mg/kg 22.5 mg/kg	28-day (study done in parallel with Coartem)	Data PCR corrected	52	48 (92.3%)
	2005	12 mg/kg ASU over 3 days + 25 mg/kg MEF split dose Day 0	28- and 42-day follow-up/PCR	slide validation; drug manufacturer cited Data PCR corrected	54	28-day: 51 (94%) 42-day+PCR: 48/51 (94%)
	2007	12 mg/kg 25 mg/kg	28- and 42-day follow-up/PCR		44	28-day+PCR: 43 (98%) 42-day+PCR: 42 (96%)

Pailin West, on Thailand border	2002	ASU +MEF blister 12 mg/kg 20 mg/kg	28-day	Raw data PCR	70	60 (85.7%)
	2004	12 mg/kg 25 mg/kg	28- and 42-day follow-up/ PCR	slide validation; drug manufacturer cited	81	28-day: 73/81 (90%) 42-day: 46/58 (79.4%)
Veal Veng, West, on Thailand border	2002	ASU +MEF blister 12 mg/kg 20 mg/kg	28-day	Raw data PCR	67	63 (94.4%)
	2004	12 mg/kg 25 mg/kg	28- and 42-day follow-up/PCR	slide validation; drug manufacturer cited	81	28-day: 75 (92.6%)
	2005	12 mg/kg ASU over 3 days + 25 mg/kg MEF split dose Day 0	28- and 42-day follow-up/PCR	slide validation; drug manufacturer cited	83	75 (90%) 42-day+PCR: 75 (90%)
Oral	2003	12 mg/kg 22.5 mg/kg		Data PCR corrected	91	88 (96.7%)
Anlong Veng	2003	12 mg/kg 22.5 mg/kg		Data PCR corrected	90	99 (97.8%)
	2003	4 mg/kg ASU daily x 3 days+ 25 mg/kg MEF split in 2 doses 8 hrs apart on 1st day	63-day	Drug manufacturer cited, PCR, slide validation, supervised Tx	176	158/176 (90%): 172/176 (97.7%) PCR corrected

Source: WHO Western Pacific Regional Office.

China–Yunnan province

1. Epidemiological profile

While the malaria burden in Yunnan province is low when compared to the rest of the Mekong Subregion, it is the most endemic province in China, along with Hainan province. In 2005, Yunnan province accounted for 38% of malaria cases and nearly 80% of malaria deaths nationwide.[33]

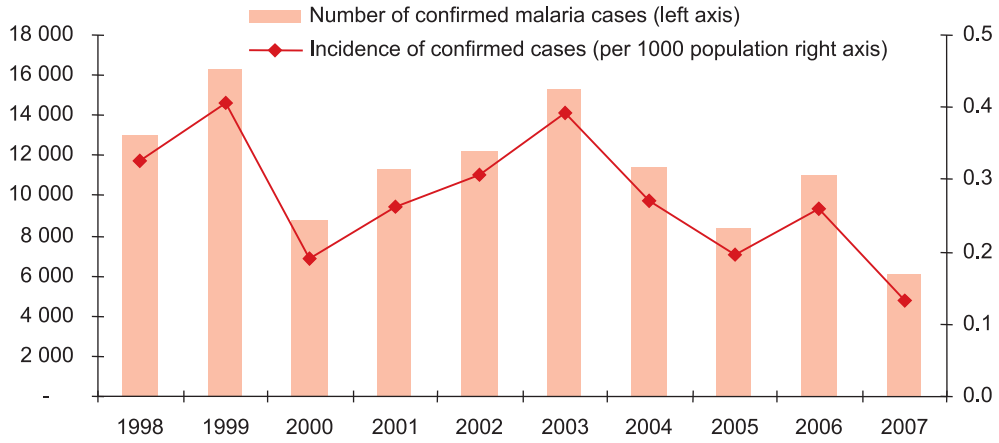
Yunnan province shares a border of 4000 kilometres with Myanmar, Lao PDR and Viet Nam. Within Yunnan, malaria occurs mainly on these border areas and in the drainage areas of the Yuanjiang river. Ethnic minority groups living in forests and on forest fringes are at risk, as are mobile workers who cross the border frequently for economic purposes such as logging, mining, farming, and have little access to routine health services on both sides of the border. International population movements occur on a large scale in the Yunnan border areas, with substantial implications for the malaria burden in the province. It is estimated that between 2001 and 2005, 25.6% of the total confirmed cases in Yunnan (64 943) were infected in neighbouring countries, mostly in Myanmar.[34] To mitigate the impact of population mobility on the malaria situation in Yunnan, China's Round 6 project of the Global Fund to fight AIDS, TB and Malaria is aimed at strengthening cross-border collaboration in malaria control, targeting the highly mobile workers in the China–Myanmar border area.

As shown in Figures 1 and 2, the malaria situation in Yunnan province has improved since 1999. However, progress has not been steady, with the number of cases and deaths increasing from 2001 to 2003, and the number of cases rising again from 2005 to 2006. In 2007, both the malaria cases and deaths dropped substantially: there were 6085 confirmed cases for malaria and nine malaria deaths throughout the province, down from 11064 cases and 32 deaths in 2006. However, the incidence of malaria is markedly uneven across Yunnan province. The prefectures listed in Table 1 recorded the highest number of malaria cases in 2007; all are located on international borders.

[33] Unless otherwise stated, all data on malaria cases and deaths are official estimates from the national malaria programme, Ministry of Health, China.

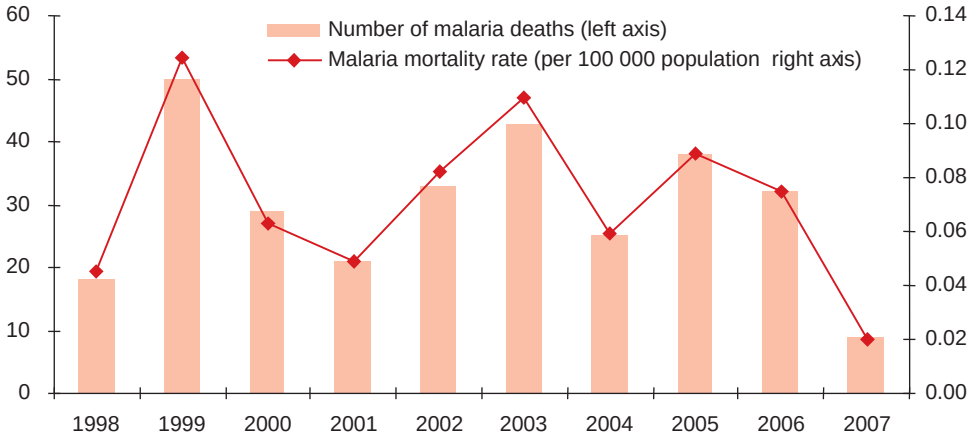
[34] GFATM proposal Round 6, China.

Figure 1: Malaria morbidity in Yunnan, China, 1998–2007



Source: Ministry of Health, China.

Figure 2: Malaria mortality in Yunnan, China, 1998–2007



Source: Ministry of Health, China

Within Yunnan province, Dehong prefecture has by far the highest malaria burden. Located in western Yunnan along the Myanmar border, Dehong accounted for over 40% of the total confirmed cases in Yunnan in 2007. The proportion of *falciparum* cases is higher in Linchang prefecture than in the rest of the province, where malaria parasites are predominantly *P. vivax*. In 2007, for example, 31.3% of confirmed malaria cases in Linchang were *falciparum*, compared to an average of 22.3% of confirmed cases throughout Yunnan province (the corresponding rate for Dehong province was 27.1%).

Annual data since 2002 indicate that the highest number of malaria epidemics was recorded in 2004, with a total of eight epidemics in Yunnan province, seven of which occurred in Lijiang prefecture (in northwestern Yunnan).[35]

[35] National Malaria Control Programme, Ministry of Health, China.

Table 1: **Distribution of malaria cases and deaths in selected prefectures**

7 of 16 prefectures	2002	2003	2004	2005	2006	2007	% of total confirmed cases, 2007	Incidence rate (cases per 1000 population), 2007
Dehong	3 335	4 894	3 131	4 225	4 508	2575	42	2.36
Baoshan	2 021	2 832	2 719	NA	3 693	1 746	29	0.35
Linchang	1 119	1 448	836	806	749	403	7	0.18
Simao	1 275	1 367	1 184	794	532	396	7	0.16
Sishuangbanna	1 543	2 128	1 375	783	451	214	4	0.22
Shaotong	529	266	334	324	173	202	3	0.04
Honghe	929	1 097	1 013	606	389	154	3	0.04

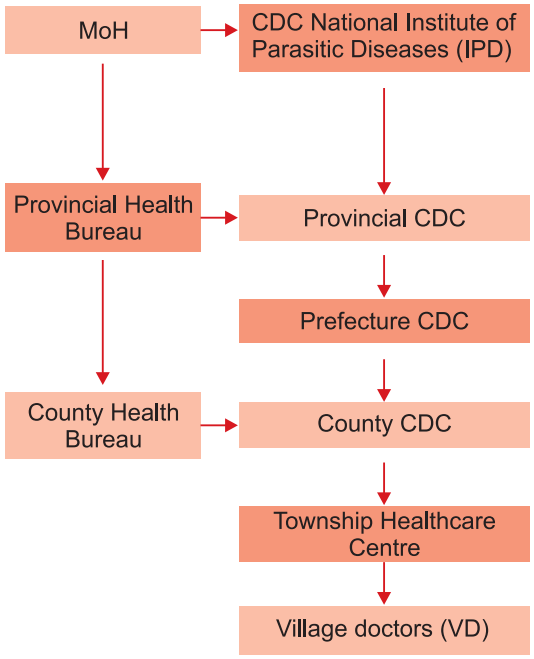
Source: Ministry of Health, China.

2. Overview of malaria control activities

The Bureau of Disease Control at the Ministry of Health of the People's Republic of China is primarily responsible for malaria control in China. Technical support is provided at the national level by the National Institute of Parasitic Diseases, Chinese Centre for Disease Control and Prevention (CDC), based in Shanghai. Strategies of the National Malaria Programme, which are laid out in its 2006-2015 plan, include greater access to diagnosis and treatment in remote areas, free distribution of LLINs, strengthening malaria surveillance and epidemic preparedness, and increasing the awareness of malaria issues.

The Centres for Disease Control and Prevention (CDC) are responsible for malaria prevention and control at province, prefecture and county levels while the other part is responsible for medical care services.

Figure 3: Structure of the public health system in China



Diagnosis and treatment

Malaria diagnosis and treatment are managed by one to two doctors in township hospitals at the township level and by one part-time doctor at the village level. The increasing role of the private

Table 2: **Antimalarial drug policy in China**

P. falciparum						*P.vivax*
Uncomplicated		Treatment failure	Severe malaria	Pregnancy treatment	Pregnancy prevention	Treatment
Unconfirmed	Lab-confirmed					
	PR(3d)/AM(7d)/ AS (7d)/ DHA(7d)+PQ(2d); DHA+PIP(2d)/ AS+AQ(3d)/ AS(3d)+SP(1d)+ PQ(2d) (22.5mg/ day)		PR (3d) injected/ AM (7d) injected/ AS(7d) injected	QN(7d) / CQ		CQ3/ PIP (3d)+ PQ(8d) at 22.5 mg/day - relapse tx: PM2+PQ4/ PQ8

sector in providing malaria treatment in Yunnan poses challenges to maintaining good quality services for malaria control. For instance, diagnostic skills are often weak among private providers in this province and delayed or inaccurate reporting of malaria cases is high.[36] Malaria cases are also underreported at the village level due to the lack of incentives provided for village doctors.

Vector control

- According to national malaria data from the Ministry of Health, a total of 2 972 497 persons were protected by house spraying in 2007.

[36] GFATM Round 6 proposal, China.

Monitoring antimalarial drug efficacy

Table 3: **Efficacy of antimalarial drugs to *P. falciparum* in Yunnan province: Summary of results, 2002–2003**

Study site	Year	Drug	Dose	Modifications	N	ACPR (%)
Yunnan	2002-2003	Group A. ASU 300 mg + Naphthoquinone 600 mg	Group A. ASU 300 mg + Naphthoquinone 600 mg	28-day follow-up	78	74 (95%)
	2002-2003	Group B. Artesunate 300 mg	Group B. Artesunate 300 mg	”	30	15 (50%)
	2002-2003	Group C. Napthoquinone 600 mg	Group C. Napthoquinone 600 mg	”	45	42 (93%)

Source: WHO Western Pacific Regional Office

Lao PDR

1. Epidemiological profile

Malaria continues to affect a significant proportion of the population in Lao PDR, particularly in the remote parts of the country. However, the number of malaria cases has declined notably since 2000 (Figure 1), and the number of malaria deaths has had an even more impressive downward trend (Figure 2). In 2007, the incidence of confirmed malaria cases per 1000 population stood at 3.3, while the mortality rate declined sharply between 2005 and 2007, from 1.4 to 0.2 deaths per 100 000 population (77 and 14 deaths in total in 2005 and 2007, respectively).[37] Support of the GFATM through Rounds 1 and 4 has contributed towards improvements in the malaria situation in recent years.

It should be noted that these morbidity and mortality figures, which are based on hospital records, may underestimate the actual number of cases and deaths in the country, as a large proportion of the population does not seek health care in government facilities. The most at-risk groups are miners, forest and agricultural workers, pregnant women and children under five years of age.[38]

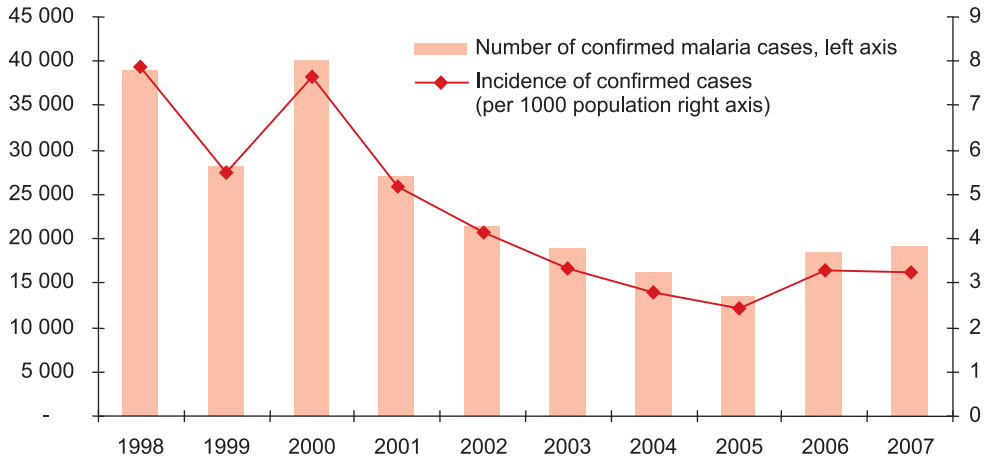
Province-level data provided in Table 1 reveal that malaria morbidity has declined tremendously in the northern part of the country (such as Luangnamtha, Luang Prabang) but the prevalence of malaria remains high in the southeastern provinces bordering Viet Nam. The incidence rates of confirmed malaria show that malaria cases are concentrated in the southern provinces of Attapeu, Sekong, Savannakhet, Champasack and Saravane. The provinces of Champasack and Savannakhet also accounted for most of the 14 malaria deaths recorded in 2007, with five malaria deaths each.

In 2006, nine provinces recorded a rise in the number of confirmed malaria cases. Among these provinces, the southeastern provinces of Savannakhet, Attapeu and Sekong (which accounted for 75% of Lao PDR's confirmed malaria cases) recorded a combined increase of 69% in the number of cases from 2005

[37] All data in this section on malaria cases and deaths are from the Centre for Malaria, Parasitology and Entomology (CMPE), Lao PDR.

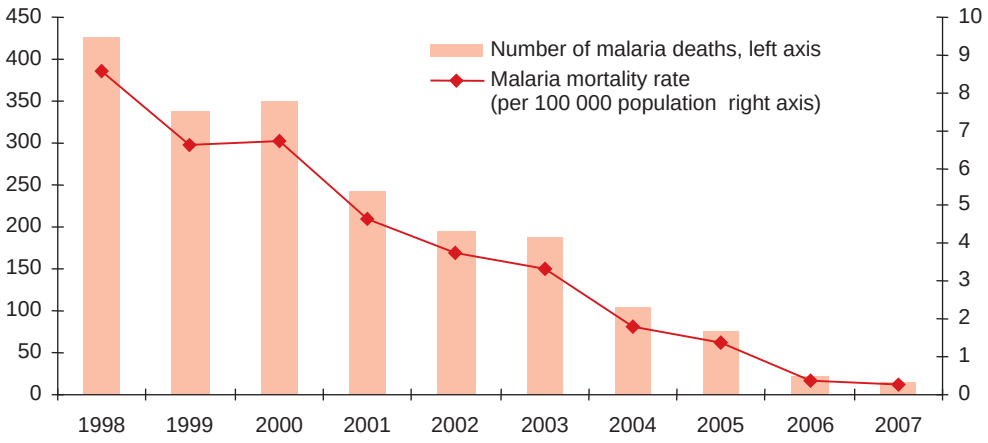
[38] WHO Regional Office for the Western Pacific. *Malaria Situation in the WHO Western Pacific Region 1992-2000.* 2002 (Draft).

Figure 1: Malaria moridity in Lao PDR, 1998–2007



Source: Centre for Malaria, Parasitology and Entomology (CMPE), Lao PDR.

Figure 2: Malaria mortality in Lao PDR, 1998–2007



Source: Centre for Malaria, Parasitology and Entomology (CMPE), Lao PDR.

to 2006 (Table 1). The main reasons for these increases were the scale-up of Early Diagnosis and Treatment (EDAT) coverage, which resulted in increased case detection using RDTs, as well as improvements in reporting from peripheral sites.[39] Over the same period, most northern provinces reported either a slight increase or a fall in the number of malaria cases.

2. Overview of malaria control activities

Malaria activities are coordinated by the Ministry of Health's Centre for Malaria, Parasitology and Entomology (CMPE).

Diagnosis and treatment

Indicators from Round 4 of the GFATM show that 89% of patients with uncomplicated malaria received diagnosis (using RDTs or microscopy) and adequate treatment in the public and private sectors in 2007. The project's target for 2010 is 85%.

[39] The Global Fund to fight AIDS, Tuberculosis and Malaria, Lao PDR malaria proposal, Round 7, 2007.

Table 1: **Confirmed malaria cases for selected provinces**

10 of 18 provinces	2002	2003	2004	2005	2006	2007	% of total confirmed cases, 2007	Incidence rate (cases per 1000 population), 2007
Savannakhet	6 070	7 111	6 905	5 034	6 270	4 533	24	5.2
Attapeu	3 292	1 615	1 442	1 249	3 850	4 157	22	35.3
Sekong	930	1 252	595	887	2 020	3 678	19	41.1
Champasack	3 305	2 596	2 467	1 002	1 561	2 551	13	4.0
Saravane	3 805	3 434	1 819	1 169	1 764	1 608	8	4.7
Khammuane	1 451	943	550	536	785	1 413	7	4.0
Luang Prabang	561	759	378	547	738	333	2	0.8
Luangnamtha	112	82	1 100	2 332	470	248	1	1.6
Oudomxay	518	527	185	223	356	225	1	0.8
Xayabury	847	303	252	224	186	91	1	0.3

Source: Centre for Malaria, Parasitology and Entomology (CMPE), Lao PDR.

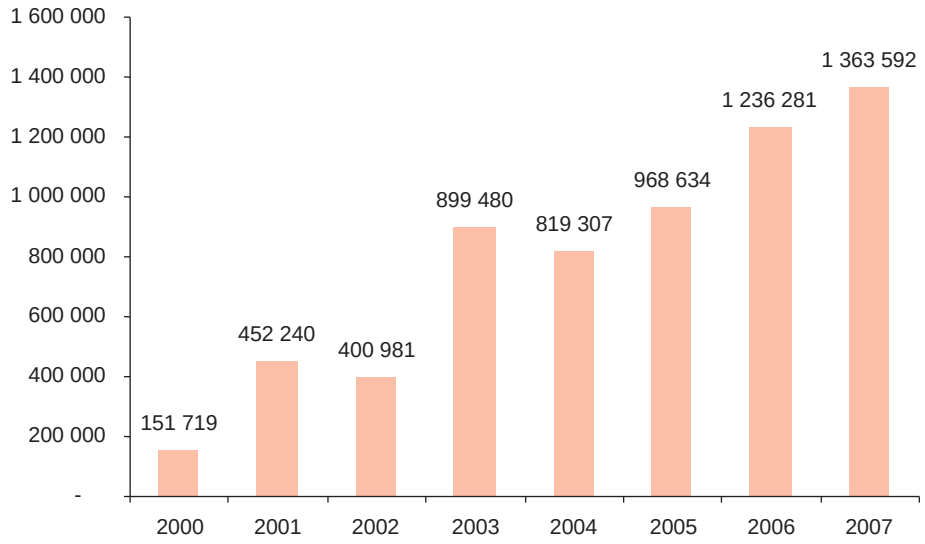
Table 2: **Antimalarial drug policy in Lao PDR**

P. falciparum						*P. vivax*
Uncomplicated		Treatment failure	Severe malaria	Pregnancy treatment	Pregnancy prevention	Treatment
Unconfirmed	Lab-confirmed					
CQ(3d)	A+L(3d)	QN(7d)+D(7d)	ASU (injected) followed by A+L; ASU suppository pre-referral			CQ(3d)

The National Malaria Policy implements coartem® (artesunate + lumefantrine) as the first-line treatment for uncomplicated malaria. This drug is distributed by the NMCP through provincial and district hospitals, health centres and targeted villages. The provision of ACTs is currently being expanded to all 17 provinces and 72 target districts.

The widespread availability of substandard and counterfeit drugs has become a serious problem for malaria control in Lao PDR. From the many studies carried out on antimalarial drug quality in Laos using various methodologies and sampling procedures, estimates of counterfeit prevalence in Lao PDR vary widely. To provide one example, in 2002 the EU Malaria Project tested 170 samples of chloroquine, quinine, Fansidar and arthemeter, and found that 32% were substandard and 6% were

Figure 3: Number of nets treated per year, 2000–2007



Source: Centre for Malaria, Parasitology and Entomology (CMPE), Lao PDR.

counterfeit.[40] That same year, a drug quality survey conducted in 12 provinces (FDD/FDQCC/Wellcome Project) on a sample of 1450 antimalarials and antibiotics found that 89% of the sampled oral artesunate were counterfeit.[41]

The problem of counterfeit drugs available on the market is compounded by irrational use of medicines and a high degree of self-treatment. The Lao PDR National Health Survey, conducted in 2001, estimated that 53% of people self-medicated when they had health problems. Round 6 of the Global Fund is currently addressing these challenges for Lao PDR by focusing on strengthening quality and regulatory mechanisms for antimalarial drugs.

Vector control

In 2007, over 1.3 million nets were treated (see Figure 3). The NMCP has begun a phased replacement of ITNs with long-lasting insecticidal nets.

Monitoring antimalarial drug efficacy

There is ongoing sentinel drug resistance monitoring in three sites, in northern, central and southern Lao PDR. Therapeutic efficacy results from 2003 onwards are displayed in Table 3.

[40] GFATM Lao PDR proposal, Round 4.

[41] Ibid.

Table 3: **Efficacy of antimalarial drugs to *P. falciparum*: Summary of results, 2001-2007**

Study site	Drug	Year	Dose	Modifications	Quality control	N	ACPR (%)
Phuvong district, Attapeu province (south, bordering Cambodia and Viet Nam)	Artemether+lumefantrine (Coartem®)	2007	1 dose every 12 hrs x 3 days (4 tabs/ dose adult dose)	28 days follow-up	Drug manufacturer cited	24	24 (100%)
	Artemether+lumefantrine (Coartem®)	2005	”	”	”	43	43 (100%)
Nghommalat district, Khammouane province (central, bordering Thailand and Viet Nam)	Artemether+lumefantrine (Coartem®)	2007	1 dose every 12 hrs x 3 days (4 tabs/ dose adult dose)	28 days follow-up	Drug manufacturer cited	18	17 (94.4%)
	Artemether+lumefantrine (Coartem®)	2005/6	”	”	”	42	42 (100%)
Nan, Luang Prabang province (North, bordering Viet Nam)	Artemether+lumefantrine (Coartem®)	2007	1 dose every 12 hrs x 3 days (4 tabs/ dose adult dose)	28 days follow-up	Drug manufacturer cited	5	5 (100%)
Phalanxay District Clinic, Savannakhet province (south, bordering Thailand and Viet Nam)	Artesunate+mefloquine	2004	ASU 4 mg/ kg/day x 3days + Mef 15 mg/kg on D1 then 10 mg/kg on D2	28 and 42 days follow-up/ intent to treat analysis and per protocol analysis	Drug manufacturer cited; Slides double checked; Supervised Treatment: drug levels assayed	108	INTENT TO TREAT 28-day: 97% 42-day: 96% PER PROTOCOL 28-day: 99%
	Dihydroartemisinin-piperaquine (Artekin®)	2004	2.1 mg DHA/16.8 PIP mg/kg single daily dose for 3 days	”	”	106	INTENT TO TREAT 28-day: 95% 42-day: 95% PER PROTOCOL 28-day: 99%
Luang Namtha Provincial Hospital and 7 villages, Luang Namtha province (North, bordering Myanmar and Yunnan)	Artesunate+mefloquine	2003	ASU 4 mg/ kg/day x 3days + Mef 15 mg/kg on D1 then 10 mg/kg on D2	42 days follow-up	Drug manufacturer cited Slides double checked; Supervised Treatment	53	100%
	Artemether+lumefantrine (Coartem®)	2003	1 dose every 12 hrs x 3 days (4 tabs/ dose adult dose)	”	”	47	93.6%

Source: WHO Western Pacific Regional Office.1. Epidemiological profile

Myanmar

1. Epidemiological profile

As one of the leading causes of morbidity and mortality, malaria is a major public health problem in Myanmar. The majority of malaria cases and deaths in the GMS occur in this country, which accounts for approximately one-fifth of the Subregion's population. In 2006, Myanmar had 200 679 confirmed cases and 1647 deaths due to malaria.[42]

Historically, malaria morbidity and mortality in Myanmar peaked between 1988 and 1991 as a result of epidemics, widespread population mobility and drug resistance, particularly along the border with Thailand. From 1992 onwards, efforts to improve the coverage of health services by installing more hospitals, rural health centres and sub-rural health centres led to an improvement in the overall malaria situation.[43] Myanmar continued to suffer from outbreaks, having experienced a total of 56 malaria outbreaks between 1991 and 2000, most of which were sparked by migration.[44] Since 2000, the frequency of malaria outbreaks has decreased.

More recently, as shown in Figures 1 and 2, the number of confirmed cases has risen between 1998 and 2006, while the annual number of deaths attributed to malaria was almost halved over the same period, from 3182 to 1647 deaths. The drop in malaria mortality may be partially attributed to greater private sector provision of artemisinin derivatives. As of 2006, the estimated malaria mortality rate in Myanmar was 2.9 deaths per 100 000 population (down from 6.7 in 1998), while the incidence of confirmed malaria was 3.6 cases per 1000 population (compared to 1.8 in 1998). Possible explanations for the increase in the number of malaria cases are improvements in case finding and reporting systems, as well as the greater movement of migrant workers.[45]

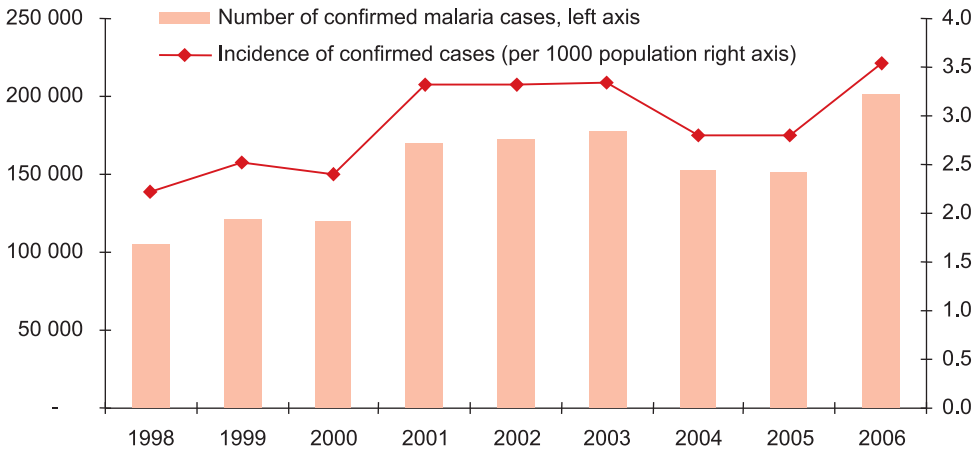
[42] Unless otherwise specified, all data on malaria cases and deaths in this chapter are from the Ministry of Health, Myanmar.

[43] ACTMalaria country profile, Myanmar 2007. www.actmalaria.net

[44] WHO Roll Back Malaria. *Myanmar country profile.* 2005.

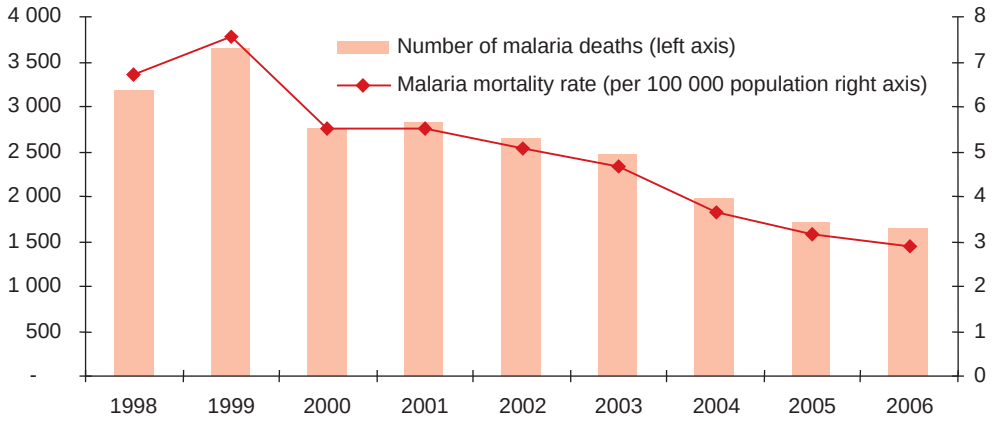
[45] ACTMalaria country profile, Myanmar. www.actmalaria.net

Figure 1: Malaria morbidity in Myanmar, 1998–2006



Source: National Malaria Control Programme, Myanmar.

Figure 2: Malaria mortality in Myanmar, 1998–2006



Source: National Malaria Control Programme, Myanmar.

Malaria is endemic in 284 out of 324 townships.[46] About 60% of the total malaria cases occur in forest or forest fringe areas where the main vectors are *A. dirus* and *A. minimus*. Population groups at high risk of malaria are internal migrants, people who resettle in malaria endemic areas, subsistence farmers in forests and on the forest fringes, and forest workers (loggers, gem-miners etc.), particularly non-immune migrants working in forested areas.[47]

Within the country, the malaria burden is particularly high in the border areas. As shown in the table above, the highest morbidity rates were recorded in 2006 in Rakhine state on the west coast (54.6 clinical suspected malaria cases per 1000 population). The other provinces that also recorded a high rate of malaria

[46] WHO and Ministry of Health. *Communication and Social Mobilization for Malaria Prevention and Control in Myanmar*. June 2007 (Draft).

[47] WHO Roll Back Malaria. *Myanmar country profile.* 2005.

Table 1: Suspected malaria cases for selected states and divisions

11 of 17 states and divisions	2002	2003	2004	2005	2006	% of total suspected malaria cases, 2006	Incidence rate (cases per 1000 population), 2006
Rakhine state	192 937	228 369	189 030	117 793	172 495	32	54.6
Sagaing	99 891	79 238	71 391	72 588	56 953	11	9.3
Northern Shan state	42 764	37 792	33 683	35 209	35 748	7	14.5
Kachin state	43 835	47 118	34 597	38 007	32 088	6	21.7
Taninthayi division	30 915	31 103	32 609	25 426	29 377	5	18.5
Magway	50 480	40 632	30 970	29 779	28 289	5	5.3
Mandalay	44 382	34 201	30 422	24 847	23 480	4	3.0
Chin state	31 161	27 256	23 787	24 720	23 112	4	43.2
Southern Shan state	24 602	26 612	22 555	22 359	21 435	4	10.0
Kayin	20 302	16 963	15 623	21 507	21 071	4	12.3
Ayeyarwaddy	30 726	30 943	27 662	26 353	20 864	4	2.7

Source: National Malaria Control Programme, Myanmar.

cases per 1000 persons are Chin state which borders Bangladesh, Kachin and Northern Shan states on the border with PR China, and Tanintharyi Division which borders Thailand. Rakhine and Shan states, which accounted for the highest number of suspected malaria cases in 2006, also had the most epidemics between 1991 and 2006 (nine and ten epidemics respectively)[48]. The highest mortality rates were recorded in Kayah (on the Thai border) and Kachin states, with 9.4 and 7.8 deaths respectively per 1000 population in 2005.

Factors contributing to high morbidity and mortality in the border areas are the topography and climate conditions that facilitate malaria transmission, compounded by difficult communication in these remote areas, low literacy rates of ethnic minorities, difficult access to health services, high population mobility and the prevalence of multidrug-resistant P. *falciparum*. The malaria burden may be even greater than these figures suggest, as only approximately 25% to 40% of fever cases utilize public health facilities, and self-treatment or treatment by the private sector are not reported.[49]

2. Overview of malaria control activities

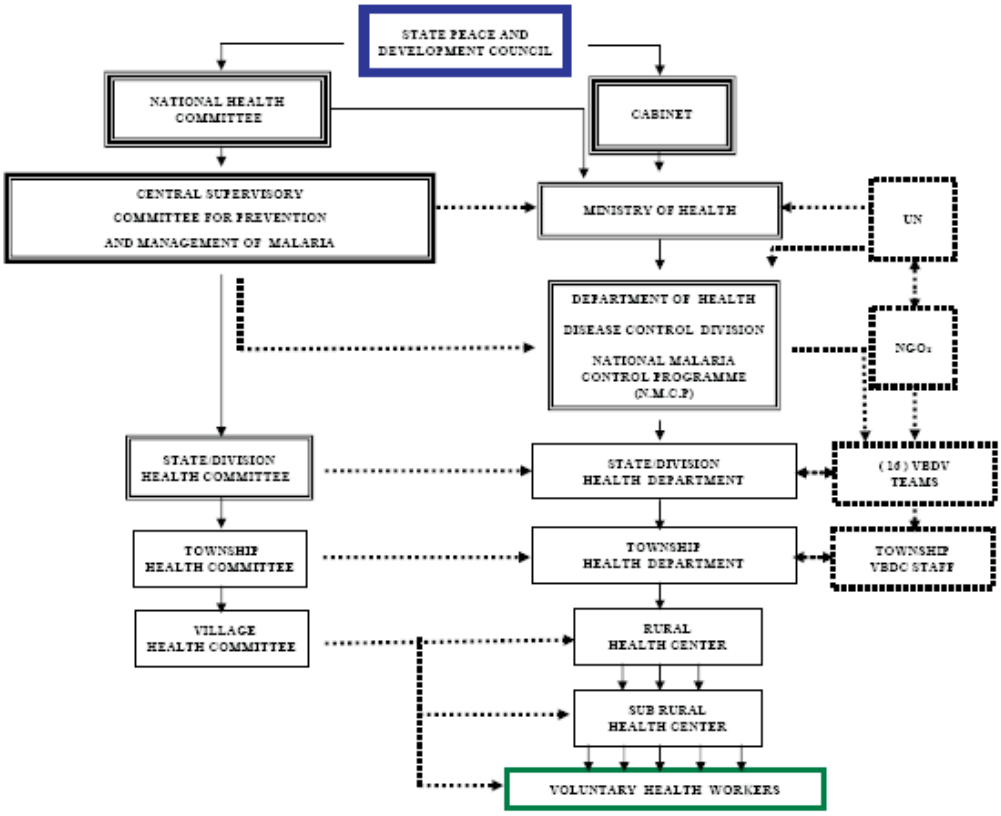
Malaria control in Myanmar has been integrated with basic health services since 1978, and is currently under the responsibility of the Vector Borne Disease Control Programme. National funding for malaria control was US$ 23 million in 2003.[50] A National Strategic Plan

[48] ACTMalaria country profile, Myanmar, 2008. www.actmalaria.net

[49] ACTMalaria country profile, Myanmar, 2007. www.actmalaria.net

[50] WHO Roll Back Malaria. *Myanmar country*

Figure 3: Structure of the National Malaria Control Programme



2006-2010 has been drafted for malaria control in Myanmar. The plan adopts a multi-pronged approach by combining the following key interventions:

- Case management for early diagnosis and treatment.
- Prevention by insecticide-treated mosquito nets and other vector control methods.
- Malaria surveillance and information systems.
- Information, education and communication (IEC) and social mobilization.

Other important components of the National Malaria Control Programme are capacity-building of health staff, both pre- and in-service; partnership-building within the Ministry of Health as well as with external partners; community participation, involvement and empowerment; and basic and applied research.

Diagnosis and treatment

A key challenge to effective case management is the lack of laboratory services and proper health facilities in remote, isolated and inaccessible areas. Early diagnosis and treatment is being promoted by expanding diagnostic facilities and providing RDTs and other diagnostic tools to rural health centres

profile. 2005.

Table 2: **Antimalarial drug policy in Lao PDR**

P. falciparum						*P. vivax*
Uncomplicated		Treatment failure	Severe malaria	Pregnancy treatment	Pregnancy prevention	Treatment
Unconfirmed	Lab-confirmed					
CQ(3d)	ASU(3d) + MEF(2d) or AL(3d)	QN(7d) + D(7d)	QN(7d) + D(7d) or ASU(7d) + D(7d)	QN(1st trim.) + C/D, ASU + C/D (2nd &3rd trim.)		CQ + PQ(14d)

and sub-centres in remote areas.[51] In 2006, 700 microscopes were distributed to rural health centres in priority areas.[52] Regarding treatment, artemisinin-based combination therapy has been implemented to treat *P. falciparum* cases since late 2002.

Vector control

The focus of vector control in Myanmar is on the distribution of ITNs, while IRS is generally limited to the control of epidemics and to development project areas. Target groups for ITN distribution include marginalized communities in remote areas, and pregnant women and children in moderate to high-risk areas.

Approximately 50% of households own mosquito nets, with an average of two nets per household.[53] Mass treatment of nets is scheduled to be carried out at least once per year. In 2007, it was estimated that 17.4 million persons in Myanmar were covered by treated or untreated mosquito nets, which amounts to 58% of the population at moderate and high risk of malaria.[54]

Monitoring antimalarial drug efficacy

P. falciparum resistance to chloroquine and SP is now widespread in Myanmar, while resistance to mefloquine and quinine is on the rise, particularly on the Myanmar—Thai border.

In this part of the country, the spread of multidrug resistance has been amplified by uncontrolled population movement. The indiscriminate use of antimalarial drugs by private practitioners has also contributed to drug resistance.

[51] WHO and Ministry of Health. *Communication and Social Mobilization for Malaria Prevention and Control in Myanmar*. June 2007 (Draft).

[52] Ibid.

[53] ACTMalaria country profile, Myanmar, 2007. www.actmalaria.net

[54] www.searo.who.int. These figures are preliminary, and are based on the following definitions for population at risk: API>10 (high risk), API>1 (moderate risk), and API<1 (low risk).

Table 3: **Efficacy of antimalarial drugs to *P. falciparum*: Summary of results, 2006**

Study site	Drug	Year	Dose	Modifications	Quality control	N	ACPR (%)
Kawthaung, Thanintharyi Division (south, on Thai border)	ASU+MEF	2006	ASU 100 mg tab BID x 3 days: Mef 750 mg total single dose: No of tabs based on age group/weight	28 day follow-up	ASU from Mekophar, Viet Nam: MEF from Mepha, Switzerland: Slide validation	34	91.3%
	AL (Coartem®)	2006	20mg Artemether+120 mg lumefantrine (4 tabs BID in adults)	”	AL from Novartis: slide v`alidation	36	91.7%
	ASU+AMO	2006	ASU 2 tabs bid x 3 days + AMO 4 tabs a day for 2 days and 2 tabs on the 3rd day	”	ASU from Mekophar, Viet Nam: AMO from Markers Lab Ltd, India	26	80.8%
Myit Kyinar, Kachin state (north, on Yunnan border)	AL (Coartem®)	2006	20mg Artemether+120 mg lumefantrine (4 tabs BID in adults)	28 day follow-up	AL from Novartis: slide validation	54	96.1%
Chaung Gyi, Mandalay Division (central)	AL (Coartem®)	2006	20mg Artemether+120 mg lumefantrine (4 tabs BID in adults)	28 day follow-up	AL from Novartis: slide validation	55	96.3%
	ASU+AMO	2006	ASU 2 tabs bid x 3 days + AMO 4 tabs a day for 2 days and 2 tabs on the 3rd day	”	ASU from Mekophar, Viet Nam: AMO from Markers Lab Ltd, India	60	96.6%
Pathein Gyi, Ayeyarwady Division (coastal)	ASU+MEF	2006	ASU 100 mg tab BID x 3 days: Mef 750 mg total single dose: No of tabs based on age group/weight	28 day follow-up	ASU from Mekophar, Viet Nam: MEF from Mepha, Switzerland: Slide validation	47	95.7%
	AL (Coartem®)	2006	20mg Artemether+120 mg lumefantrine (4 tabs BID in adults)	”	AL from Novartis: slide validation	52	96.1%

Study site	Drug	Year	Dose	Modifications	Quality control	N	ACPR (%)
	DHA+ Piperaq uine (Artekin®	2005-2006	DHA 40mg+PIP 320mg : total 360 mg = 8 tabs (2 tabs at 0, 8, 24 and 32 hr)	28 day follow-up	Artekin® from Holleykin Pharmaceuticaal Co, Ltd, Guangzhou, China	30	30(100%)
Clinical Research Unit, Defence Services General Hospital, Mingaladon, Yangoon	ASU + Mefloquine (Artequin®	2005-2006	ASU 600mg+ Mef 1500 mg (combi pack): 1+2 tablets on Days 1, 2, 3	”	Mepha, Switzerland	9	9 (100%)
	DHA+ Piperaquine (Artekin®	2006	DHA 40mg+PIP 320mg : total 360 mg = 8 tabs (2 tabs at 0, 8, 24 and 32 hr)	”	Artekin® from Holleykin Pharmaceuticaal Co, Ltd, Guangzhou, China	30	30(100%)
	ASU + Amodiaquine (Larimal®)	2006	ASU 200mg + AMO 600 mg	”		26	26(100%)

Source: WHO.

Thailand

1. Epidemiological profile

The malaria situation in Thailand has greatly improved since the National Malaria Control Programme was first established over six decades ago. Between 1996 and 1999, the southern provinces experienced a re-emergence of malaria through several outbreaks. However, after the last epidemics occurred in 1999, malaria morbidity and mortality have declined substantially (see Figures 1 and 2).

For 2007, Thailand reported 33 178 confirmed malaria cases and 97 deaths due to malaria, demonstrating a significant improvement from the 125 359 cases and 740 deaths in 1999.[55] Nonetheless, malaria remains an important health problem along the borders, which are largely forested areas with substantial population movements. Moreover, as Figure 1 indicates, confirmed malaria cases have risen since 2004. A factor that has contributed to the recent increase in morbidity is the ongoing serious conflict in the southern provinces of Thailand.

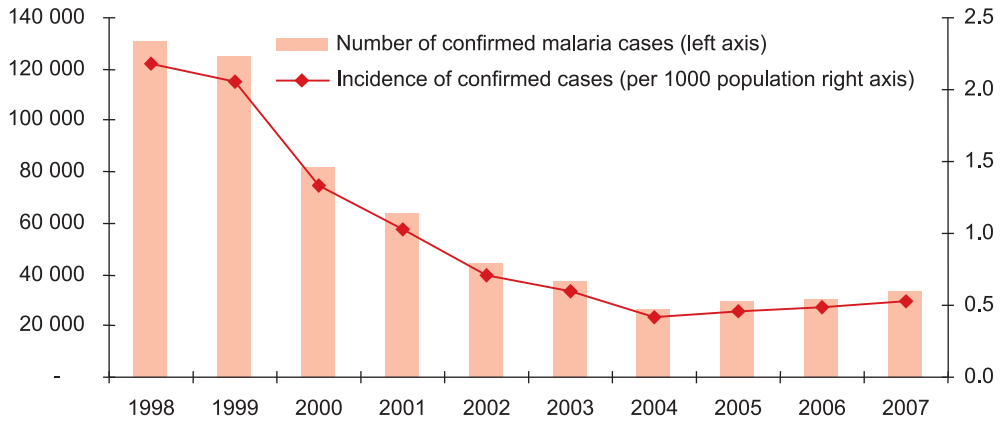
On account of the reporting system in Thailand, the graphs here depict only Thai cases. However, non-Thais bear a disproportionately high proportion of the malaria burden. In 2005 and 2006, there were more cases among non-Thais (mainly consisting of migrants who have been in the country for less than six months) than among Thais. For instance, in the fiscal year 2006, 36 313 malaria cases were reported from non-Thais, compared to 30 338 cases among Thais.[56] Migrants are particularly vulnerable to malaria because they are often barred from accessing the formal health system due to barriers such as language and cultural differences, discrimination, and risks of arrest or deportation.

Of the Thai cases reported in 2007, over 80% were found in the 10 provinces presented in Table 1. There is a concentration of malaria cases in southern Thailand, particularly in Yala, Songkla and Narathiwat provinces, which accounted for more than 40%

[55] Unless stated otherwise, all data on malaria cases and deaths in this section are from the Department of Disease Control, Ministry of Public Health, Thailand.

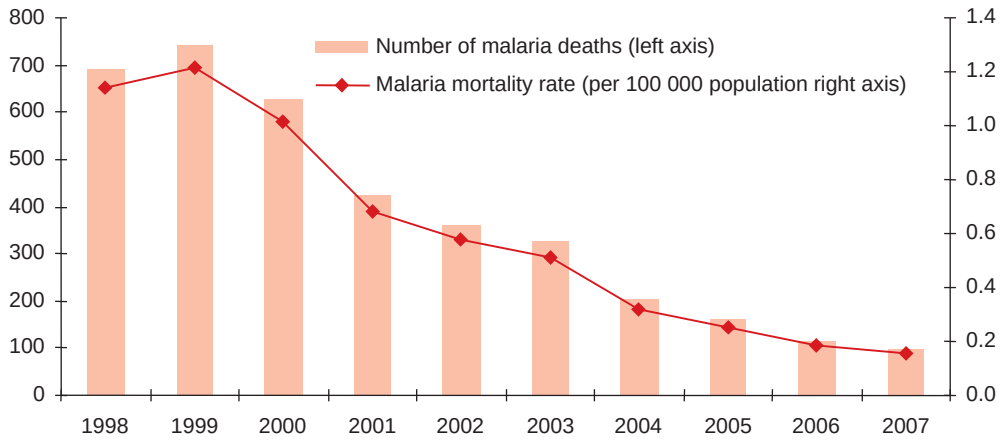
[56] Department of Disease Control, Ministry of Public Health. Presentation on the Malaria Situation in Thailand, March 2008.

Figure 1: Malaria morbidity in Thailand, 1998–2007



Source: Department of Disease Control, Ministry of Public Health, Thailand.

Figure 2: Malaria mortality in Thailand, 1998–2007



Source: Department of Disease Control, Ministry of Public Health, Thailand.

of confirmed malaria cases in 2007, and where civil conflict escalated from 2004. The unstable political situation and high degree of violence have severely disrupted access to health services in these three provinces, and it is believed that these are the causes of a massive increase in the number of malaria cases observed. From 2006 to 2007, the number of cases in these three provinces more than doubled, causing the overall incidence of malaria in Thailand to rise.

Many of Thailand's malaria cases occur on the Thai–Myanmar border (e.g. Tak, Mae Hong Son, Ranong, Chumporn, Prachup Kiri Khan, Kanchanaburi), largely due to the continuous influx of migrants from Myanmar in this area. A large proportion of Thailand's malaria cases were reported in Tak province, which has one of the main crossing points on the Thai–Myanmar border.

From January to April 2007, 12 784 malaria patients were admitted to hospitals in Tak, constituting the worst malaria outbreak since 1999, when over 80 000 cases were reported.[57]

[57] Bangkok Post, 15 June 2007.

Table 1: **Confirmed malaria cases for selected provinces**

10 of 24 provinces	2002	2003	2004	2005	2006	2007	% of total confirmed cases in 2007	Incidence rate (cases per 1000 population), 2007
Yala	4 708	2,352	1 740	4 159	3 554	7 824	24	17.2
Tak	10 359	10 635	5 532	6 730	7 935	4 423	13	8.5
Songkla	223	437	252	659	1 432	3 880	12	3.1
Chumporn	2 058	1 051	1 511	1 603	1 217	2 062	6	3.9
Mae Hong son	2 442	1 982	1 545	1 778	2 477	1 873	6	9.2
Narathiwat	154	151	350	1 706	1 600	1 785	5	2.6
Ranong	855	684	684	1 052	1 156	1 538	5	8.7
Prachuap Khiri Khan	1 929	1 389	1 660	1 656	1 114	1 377	4	2.9
Kanchanaburi	2 521	2 542	2 225	1 414	1 165	1 178	4	1.2
Chanthaburi	2 512	2 371	1 134	627	1 428	866	3	1.7

Source: Department of Disease Control, Ministry of Public Health, Thailand.

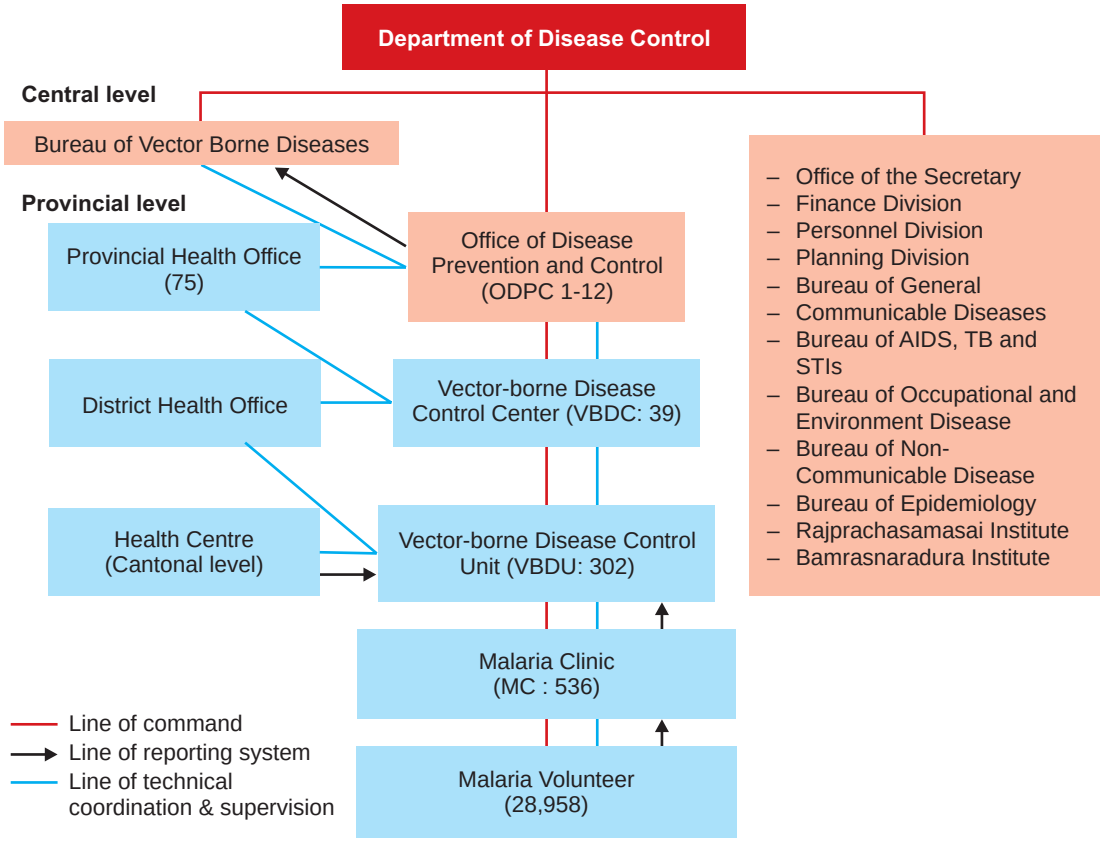
Of these patients, 9497 (about 75%) were migrant workers from Myanmar. In response, surveillance units have been set up in remote villages (where most of these cases occurred) and health workers have stepped up the distribution of long-lasting insecticidal nets (LLINs). Thailand's Round 7 of the Global Fund is focused on improving the malaria situation among migrants and people living in conflict zones in the southern provinces by strengthening and expanding community-based malaria services for these two target population groups.

While mortality attributed to malaria has declined steadily since 1999, it remains most pronounced on the Thai–Myanmar border. Nearly half of the 97 malaria deaths nationwide in 2007 occurred in the provinces bordering Myanmar: Chiang Mai (10 deaths), Tak (7), Kanchanaburi (6), Phetchaburi (6), Prachuap Kiri Khan (5), Chumphon (5), Mae Hong Son (3) and Ranong (2). Chanthaburi, on the Thai-Cambodian border, accounted for five of the country's malaria deaths in 2007.

2. Overview of malaria control activities

The National Malaria Control Programme (NMCP) is a division of the Department of Disease Control in the Ministry of Public Health. Its organizational structure is depicted in Figure 3. As part of the NMCP's strategy, the programme is currently being further decentralized to strengthen the role of local organizations in malaria prevention and control. In view of the decreasing burden of malaria in Thailand, the amount of national financial and human resources available for malaria control have shrunk drastically. In 2006, national funding for the malaria control programme amounted to US$ 14

Figure 3: Structure of the NMCP



million, a sharp reduction compared to the US$ 24 million available in 2003.[58]

The NMCP divide Thailand into four categories, which are determined by the level of malaria endemicity combined with the degree of integration of malaria control into the health system. These categories are:

- Control areas with perennial transmission (A1: where transmission takes place for at least six months in a year) and areas with periodic transmission (A2: where transmission takes place for fewer than six months in a year).
- Control areas without transmission, separated into high-risk areas (B1: where transmission was not reported during the last three years but primary or secondary vectors have been found) and low-risk areas (B2: where transmission was not reported during the last three years and both primary and secondary vectors have not been found).
- Pre-integration areas (defined as having been low risk for three years and where local health services are able to perform case detection, treatment and case investigation).

[58] GFATM Thailand proposal, Round 7. 2007.

Table 2: **Antimalarial drug policy in Thailand**

P.falciparum						*P.vivax*
Uncomplicated		Treatment failure	Severe malaria	Pregnancy treatment	Pregnancy prevention	Treatment
Unconfirmed	Lab-confirmed					
	ASU(3d) +MEF(2d)	QN(7d)+T(7d)	AS or QN(7d)	QN(7d)		CQ(3d)+ PQ(14d)

- Integration areas (defined as areas that have been pre-integration for at least three years, where the Provincial Health Office manages malaria control activities).

Due to recent successes in malaria control, the number of villages classified as A1 and A2 has declined from covering a population of 3.1 million in 2005 to 2.7 million in 2006.[59]

Diagnosis and treatment

Early diagnosis and prompt effective treatment is a key strategy of the NMCP. Over 60% of the country's malaria clinics are located in the 30 border provinces.[60] As stipulated in the strategy, RDTs are used for malaria diagnosis in remote areas.

The high proportion of multidrug-resistant *P. falciparum* on the Thai–Cambodian and Thai–Myanmar borders presents a key concern for Thailand's malaria control programme. Throughout the country, there is *P. falciparum* resistance to chloroquine, SP, and reduced sensitivity to quinine. Resistance to mefloquine is present on the Myanmar and Cambodia borders. In Trat province, on the Cambodian border, a 10% failure rate was recorded for a two-day course of artesunate (600mg) in combination with one-day mefloquine (25mg) and a single dose of primaquine, which comprised the first-line treatment for malaria nationwide.

In 2008, the national programme revised its national antimalarial treatment policy to shift from a two-day regimen to a three-day artesunate and two-day mefloquine regimen (Table 2).

Vector control [61]

- In 2007, 884 913 insecticide-treated mosquito nets were distributed in Thailand.
- In total, approximately 8 million people in Thailand were covered by mosquito nets in 2007, including low-risk populations. Of the population at moderate and high risk of malaria, it is estimated that approximately 40% were covered by mosquito nets.

[59] GFATM Thailand proposal, Round 7. 2007.

[60] S. Nutsathapana, Bureau of Vector-Borne Diseases, Department of Disease Control, Ministry of Public Health, Thailand. *Intercountry Workshop on Revised Malaria Control Strategy, 20 January-2 February 2006: Country report, Thailand.* 2006.

[61] www.searo.who.int. These figures are based on the following definitions for population at risk: API>10 (high risk), API>1 (moderate risk), and API<1 (low risk).

Monitoring antimalarial drug efficacy

Therapeutic efficacy studies have been conducted in eight surveillance sites located in the border areas of Thailand. Recent results of these studies are provided in the table 3.

Table 3: **Efficacy of ASU + MEF to *P. falciparum*, 2003-2007**

Study site	Year	Dose	Modifications	N	ACPR (%)
Mae Hong Son (Thai–Myanmar border)	2004	25mg/kg + 12mg/kg for 2 days		111	93.7%
	2006	Mef 25mg/kg + Art 12 mg/kg for 2 days	28 day test	191	94.8%
Tak (Thai–Myanmar border)	2003	25mg/kg + 12mg/kg for 2 days	28 day test	83	95%
	2004	”		47	87.2%
	2005	”		26	65.3%
	2006	”	28 day test	46	89.1%
Kanchanaburi (Thai–Myanmar border)	2004	25mg/kg + 12mg/kg for 2 days	28 day test	71	97.1%
	2005	”		30	96.7%
Ratchaburi (Thai–Myanmar border)	2005	25mg/kg + 12mg/kg for 2 days		83	94%
	2006	”	28 day test	54	92.5%
Ranong (Thai–Myanmar border)	2003	25mg/kg + 12mg/kg for 2 days	28 day test	33	93.9%
	2004	”		40	87.5%
	2006	”	28 day test	19	89.5%
Trat (Thai–Cambodia border)	2003	25mg/kg + 12mg/kg for 2 days		42	78.6%
	2004	”	28 day test	15	93.3%
	2005	”	”	22	81.8%
	2005	”	42 day test with PCR	42	81.8%
	2006	”	28 day test	29	86.2%
	2007	“	”	30	90%
Chanthaburi (Thai–Cambodia border)	2003	25mg/kg + 12mg/kg for 2 days		47	97.8%
	2004	”	28 day test	5	100%
Ubon Ratchathani (Thai–Cambodia border)	2005	15mg/kg + 12mg/kg			

Source: WHO.

Viet Nam

1. Epidemiological profile

Between the late 1970s and early 1990s, Viet Nam faced serious outbreaks of malaria throughout the country, on account of limited resources, weaknesses in the health system in mountainous areas, and post-war population movements. From 1991 onwards, improvements in socioeconomic conditions coupled with increased government investment in malaria control significantly lowered Viet Nam's malaria burden.

The annual number of confirmed malaria cases plunged from 187 994 cases to 14 581 cases between 1991 and 2007 (Figure 1).[62] In 2007, the incidence of confirmed malaria cases was 0.17 per 1000 persons. The reduction in mortality was even more dramatic: in 2007 there were only 20 deaths from malaria nationwide, compared to 4646 deaths in 1991 (Figure 2). At 0.02 deaths per 100 000 population in 2007, Viet Nam has the lowest mortality rate in the Greater Mekong Subregion, together with Yunnan province.

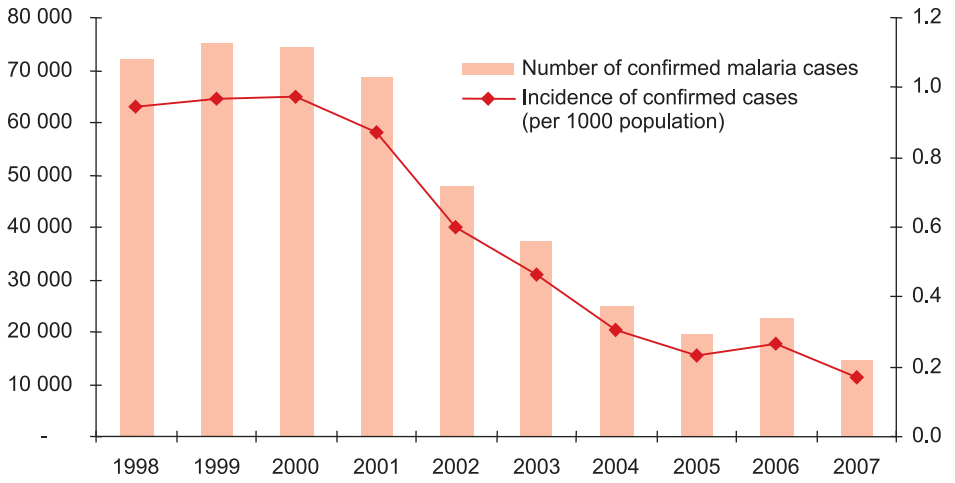
Most of the malaria cases occur in the mountainous forested areas of Viet Nam. Among the nine provinces with the highest number of cases (Table 1), many border Lao PDR or Cambodia, and are located in the central or southwestern part of the country. The central provinces of Binh Phuoc, Quang Tri, Gia Lai, Dak Lak and Dak Nong all recorded increased cases from 2005 to 2006, which caused the spike in the number of cases nationwide in 2006 (Figure 1).

The number of malaria deaths also rose in 2006, most notably in Dak Lak (7 deaths). One reason for the rise in annual cases and deaths in 2006 was the new health system structure that was introduced in Viet Nam (dividing the health sector at the district level into three sectors), which affected the performance of malaria prevention measures. Case detection also increased in 2006 as more RDTs were used to confirm *P. falciparum.* cases.

At the same time, there were ongoing limitations to malaria control in the central provinces, such as the lack of effective measures in place for forest-goers and migrants, and the limited capacity of community health staff and village health

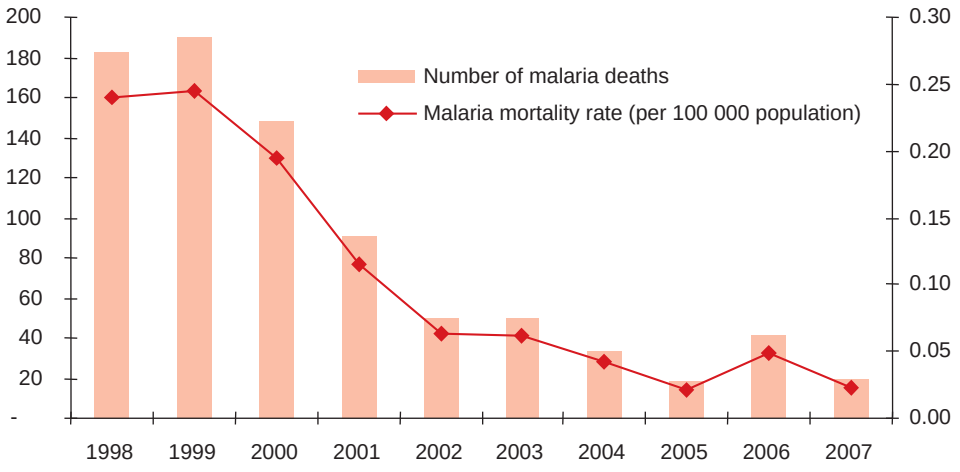
[62] Unless otherwise specified, all data on malaria cases and deaths in this chapter are from the National Institute for Malariology, Parasitology and Entomology (NIMPE), Viet Nam.

Figure 1: Malaria morbidity in Viet Nam, 1998–2007



Source: National Institute for Malariology, Parasitology and Entomology (NIMPE), Viet Nam.

Figure 2: Malaria mortality in Viet Nam, 1998–2007



Source: National Institute for Malariology, Parasitology and Entomology (NIMPE), Viet Nam.

workers in remote areas. However, the number of malaria cases has since come down, particularly in Gia Lai and Dak Lak.

2. Overview of malaria control activities

National Malaria Control Programme

Malaria control in Viet Nam is often hailed as a success story due to the drastic reductions in the malaria burden achieved since 1991, when the government first recognized malaria as a national priority. In 1991, the government changed its strategy from malaria eradication to malaria control, and prioritized interventions such as distributing antimalarial drugs and mosquito nets, carrying out intensive indoor residual spraying twice a year, and providing health education.[63] The government increased financing for malaria control and received funding from external

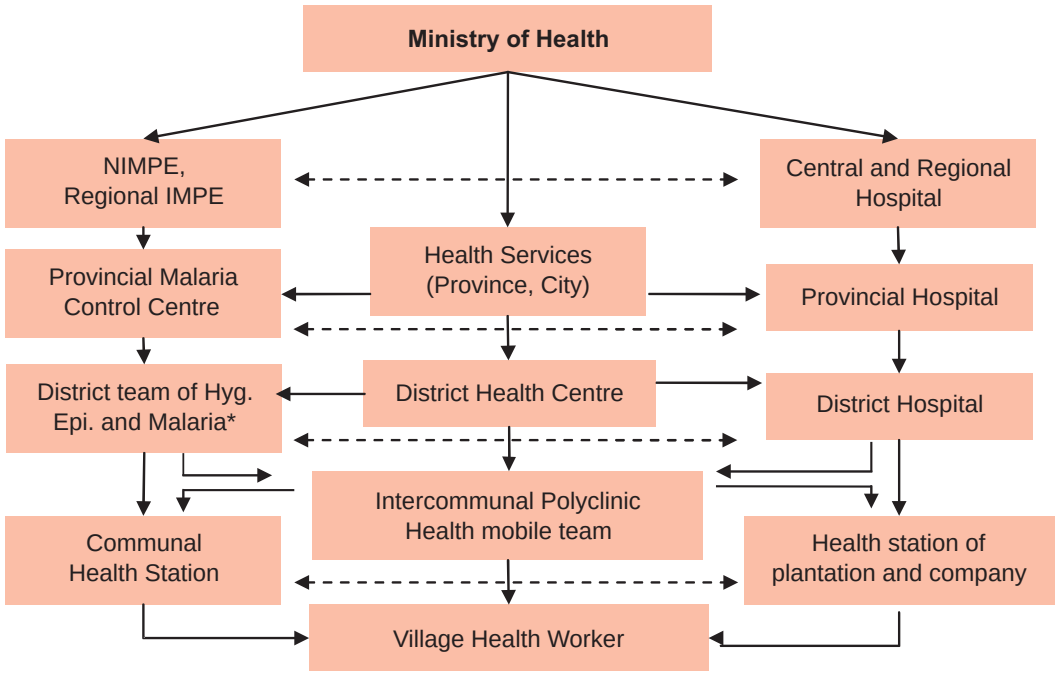
[63] ACTMalaria country profile, Viet Nam, www.actmalaria.net

Table 1: **Confirmed malaria cases for selected provinces**

9 of 64 provinces	2002	2003	2004	2005	2006	2007	% of total confirmed cases, 2007	Incidence rate (cases per 1,000 population), 2007
Binh Phuoc	5 278	3 953	2 156	1 226	2 580	2 178	15	2.4
Quang Tri	1 793	1 672	1 602	1 269	1 517	1 685	12	2.6
Gia Lai	5 526	4 770	2 774	2 649	4 282	1 465	10	1.3
Quang Nam	2 898	2 633	2 598	3 978	1 790	1 111	8	0.7
Khanh Hoa	2 952	2 179	1 411	1 467	1 099	940	6	0.8
Dak Lak	8 008**	6 127**	2 261	979	2 150	925	6	0.5
Dak Nong*	NA	NA	1 184	600	1 163	829	5	2.0
Quang Binh	1 148	1 108	851	470	671	719	5	0.8
Ninh Thuan	2 319	1 571	1 973	1 019	756	693	5	1.2

Source: National Institute for Malariology, Parasitology and Entomology (NIMPE), Viet Nam.
* New province; separated from Dak Lak since 2004.
**Includes Dak Nong.

Figure 3: Number of nets treated per year, 2002–2007



Source: National Institute for Malariology, Parasitology and Entomology (NIMPE), Viet Nam.

partners such as AusAID, WHO, EC and the Belgian government.[64] Consequently, from 1992 to 1996, morbidity and morality declined dramatically, by 20%–30% and 50% respectively.[65]

In terms of its organizational structure, the National Malaria Control Programme (National Institute for Malariology, Parasitology and Entomology, NIMPE) is integrated into the overall national health system and is decentralized at the local level (see chart below). Government funding for the programme has been around $5 million per year.

Diagnosis and treatment

The majority of early treatment (about 80% of cases) is provided at the commune and village levels (by village health workers), while approximately 10% of cases are treated by mobile teams and only 10%–15% in hospitals.[66] Diagnosis and treatment of malaria are based on microscopy, clinical site symptoms and RDTs. Village workers provide the first line treatment with chloroquine, and therefore play an important role in malaria surveillance and detection.

Vector control

As with case management, strategies for ITN distribution and IRS are based on the country's malaria control stratification. For instance, mosquito net impregnation is implemented on a wide scale in all malaria endemic provinces (namely, those that record more than 10 cases per 1000 population per year), while house spraying is carried out in hyper-endemic areas where ITNs are not available or are not used. Approximately 4 to 5 million nets are treated per year in Viet Nam (Figure 3).

Monitoring antimalarial drug efficacy

Recent results from the invivo tests carried out in Viet Nam's five surveillance sites (Table 3) demonstrate that the antimalarial drugs in use are still effective.

[64] WHO Regional Office for the Western Pacific. *Malaria Situation in the WHO Western Pacific Region 1992-2000.* 2002 (Draft).

[65] ACTMalaria country profile, Viet Nam, *www.actmalaria.net*

[66] Ibid.

Table 2: **Antimalarial drug policy in Viet Nam**

P.falciparum			*P.vivax*
	Pregnancy treatment	Pregnancy prevention	Treatment
DHA+PIP (used at all levels for falciparum malaria)	QN(7d) / ASU in 2&3 trimesters	CQ	CQ+PQ (10d)

Table 3: Efficacy of antimalaial drugs to *P. falciparum*, 2003–2007

Study site	Drug	Year	Dose	Modifications	Quality control	N	ACPR (%)
Thanh commune, Huong Hoa district, Quang Tri province (Central Viet Nam, on Lao PDR border)	Chloroquine	2005	25 mg/ kg for 3 days	28-day follow-up		70	77.1 %
Bu Gia Map commune, Phuoc Long district, Binh Phuoc province (South Viet Nam, on Cambodia border)	Artesunate	2004/5	16 mg/ kg for 7 days	28-day follow-up		82	92.7%
Ninh Thuan province (South Viet Nam)	Artesunate	2005	16 mg/ kg over 7 days	28-day follow-up		42	95.2%
	”	2005	”	”		42	88.1%
	”	2003	”	”		122	92.6%
Binh Thuan province (South East Viet Nam)	CV-8	2005	oral for 3 days	28-day follow-up		42	97.6%
Ninh Thuan and Binh Thuan provinces	Artemisinin	2005	80 mg/ kg x 7 days	28-day follow-up		23	NA
Dak Roong, Ninhai district, Ninh Thuan province	CV8	2006		28-day follow-up		36	100%
	”	2006		”		40	97.5%
Quang Tri and Ninh Thuan provinces	Dihydroartemisinin+ piperaquine	2006/2007	oral for 3 days	28-day follow-up	Pharmaceutical Company No. 1 Viet Nam	147	100%
	Dihydroartemisinin+ piperaquine	2004	”	t”		98	100%
Dak Nong province (Central Viet Nam)	Dihydroartemisinin+ piperaquine	2006-2007	oral for 3 days	28-day follow-up		43	100%
Quang Tri and Dak Nong provinces	Dihydroartemisinin+ piperaquine	2003	oral for 3 days	28-day follow-up	Pharmaceutical Company OPC Viet Nam	94	100%
Phuoc chien, Ninh Thuan province	Artemisinin + piperaquine (Artequick™)	2006	oral for 3 days	28-day follow-up		42	100%
	”	2006	”	”		14	100%
	DHA+PIP (Artekin™	2004	”	”		51	100%
	Artemisinin + piperaquine (Artequick™)	2004	”	”		52	100%

Source: WHO Western Pacific Regional Office.

Annex - I: Approved GFATM Malaria Proposals for the Greater Mekong Subregion

Country	Round	Main areas of support
Cambodia	2	⊙ Procurement of drugs and commodities such as mosquito nets, insecticide and diagnostic dipsticks, laboratory reagents. ⊙ Key control operations including IEC activities, monitoring and evaluation, training and capacity-building as part of Health Sector Support Project.
	4	⊙ Scaling up BCC interventions replacing conventional ITNs with LLINs in most inaccessible and hyperendemic villages. ⊙ Social marketing of LLINs and ITKs in other areas and TA to partners.
	6	⊙ Strengthening coordination and management of malaria control in the periphery and at the grass roots level. ⊙ Procurement of LLINs, RDTs and drugs.
Lao PDR	1	⊙ Procurement of ACTs and RDTs, and related training and supervision activities. ⊙ Social marketing to expand net retreatment programmes.
	4	⊙ Scaling up coverage of ITNs, ACTs and RDTs, particularly in remote areas. ⊙ Engaging village workers and the private sector to expand health service delivery.
	6	⊙ Strengthening the capability and capacity for inspection, testing and enhancement of regulatory mechanisms of antimalarial drugs, particularly in the private sector.
	7	⊙ Scaling up EDAT and VC measures for the population at risk. ⊙ Establishing village-based IEC interventions in endemic ethnic communities that are underserved.
Myanmar	3	⊙ Procurement of artemisinin-mefloquine blister packs and chloroquine. ⊙ Hiring and training voluntary health workers in malaria prevention and control. ⊙ Mass treatment of ITNs and provision of LLINs in hard-to-reach endemic areas. ⊙ Expanding microscopy services and the use of RDTs, particularly in remote areas.
Thailand	2	⊙ Procurement of ITNs, IEC materials and RDT kits. ⊙ Hiring and training community health workers, establishment of malaria diagnosis and treatment posts. ⊙ M&E.
	7	⊙ Improving access to EDAT and effective prevention measures among migrants and communities in conflict zones.
Viet Nam	3	⊙ Distribution of bednets to poor households in malarious areas, re-dipping and IRS campaigns in high-risk areas, and community mobilization and IEC activities for malaria prevention. ⊙ Strengthening human resources in EDAT, including training of village health workers and increased supportive supervision.

Country	Round	Main areas of support
China	1	• Training government and private health staff on prevention, diagnosis and treatment of malaria. • Health education for mobile populations. • Distribution of bednets, establishing microscopy stations. • Improvement of the malaria surveillance system.
	5	• Social marketing of LLINs and re-treatment of ITNs. • Strengthening management capacity within the National Malaria Control Programme. • Strengthening microscopy; provision of ACTs in Hainan and Yunnan; RDTs in remote areas; training of public and private providers; monitoring drug quality and resistance. • IEC/BCC. • Strengthening malaria surveillance and epidemic preparedness.
	6	• Hiring and training health workers to provide comprehensive malaria prevention and care services for Chinese migrant workers and local residents on the Myanmar border. • Establishment of border-crossing malaria surveillance system, information exchange and collaboration mechanisms.

Source: GFATM proposals, *www.theglobalfund.org*.

This report provides an overview of the epidemiological patterns of malaria in the Greater Mekong Subregion (GMS) from 1998 to 2007, and highlights critical challenges facing National Malaria Control Programmes and partners as they move towards malaria elimination as a programmatic goal.

Epidemiological data provided by malaria programmes show a drastic decline in malaria deaths and confirmed malaria cases over the last 10 years in the GMS. More than half of confirmed malaria cases and deaths in the GMS occur in Myanmar. However, reporting methods and data management are not comparable between countries despite the effort made by WHO to harmonize data collection, analysis and reporting among Member States.

Malaria is concentrated in forested/forest-fringe areas of the Region, mainly along international borders. This providing a strong rationale to develop harmonized cross-border elimination programmes in conjunction with national efforts. Across the Mekong Region, the declining efficacy of recommended first-line antimalarials, e.g. artemisinin-based combination therapies (ACTs) against falciparum malaria on the Cambodia-Thailand border; the prevalence of counterfeit and substandard antimalarial drugs; the lack of health services in general and malaria services in particular in remote settings; and the lack of information and services targeting migrants and mobile population present important barriers to reach or maintain malaria elimination programmatic goals.

Strengthening the networking between research institutions, nongovernmental organizations and national malaria programmes, perhaps through a supranational body like the ASEAN, will facilitate knowledge-based decision and action.

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