Report of the Cambodia National Malaria Baseline Survey 2004

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National Institute of Public Health, Cambodia (NIPH)
Malaria Consortium

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Authors:

National Institute of Public Health, Cambodia (NIPH)
Dr. Vohith Khol
Dr. Bunsoth Mao
Dr. Vonthanak Saphonn
Dr. Ung Sam An

Malaria Consortium
Ms. Jane Bruce
Dr. Sylvia Meek
Dr. Jo Lines, London School of Hygiene & Tropical Medicine (LSHTM) for the Malaria Consortium,
Dr. Jonathan Cox, LSHTM for the Malaria Consortium

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Acronyms

A+M	Artesunate + Mefloquine
AES	Average Enlarged Spleen
AFRIMS	US Armed Forces Research Institute of Medical Sciences
AVHRR	Advanced Very High Resolution Radiometer?
CCC	Country Coordinating Committee
C1……C6	Core Indicator
CMAA	Cambodia Mine Action Authority
CMBS	Cambodian Malaria Baseline Survey
CNM	National Centre for Parasitology, Entomology and Malaria Control
EDAT	Early Diagnosis and Treatment
EVI	Enhanced Vegetation Index
FRA	Forest Resource Assessment
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GFRA	Global Forest Resource Assessment
GIS	Geographic Information System
GPS	Global Positioning System
HU	Health Unlimited
IMCI	Integrated Management of Childhood Illness
ITN	Insecticide treated net
JICA	Japanese International Cooperation Agency
KABP	Knowledge, Attitude, Behaviour and Practice
IMCI	Integrated Management of Childhood Illnesses
MDG	Millennium Development Goals
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental Organisation
NIPH	National Institute of Public Health
NMCP	National Malaria Control Programme
OD	Operational District
PCR	Polymerase Chain Reaction
PFD	Partners for Development
PHD	Provincial Health Department
PSI	Population Services International
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
RS	Remote Sensing
S1……S11	Supplementary Indicator
SES	Socioeconomic status
SPOT	Système pour l'Observation de la Terre
VCF	Vegetation Continuous Fields
WHO	World Health Organization

Executive Summary

The Cambodia Malaria Baseline Survey was undertaken in November to December 2004 under the supervision of the CMBS Task Force and with technical inputs from the National Institute of Public Health, the Malaria Consortium and the Armed Forces Institute of Medical Science. It provides baseline data on agreed indicators to measure progress of the national malaria control programme with inputs from Round 2 of the Global Fund to fight AIDS, Tuberculosis and Malaria.

Overall slide positivity rate in sampled clusters, which focused on higher risk regions, was 2.7%, rapid diagnostic test positivity rates in nearby clusters was 3.9% and spleen rate 2.9%. Positivity rates were higher nearer to forest with little difference between 0 to 250 metres compared with 251 m to 1 kilometre but a sharp decline in the zone from 1 to 2 kilometres from forest. This suggests that preventive measures should be targeted mainly to populations up to 1 kilometre of forest, which is a greater geographical range than the current strategy.

Status of Core Indicators

Indicator	Result at baseline survey 2004
C1 % of people seeking treatment from trained providers within 48 hours of developing a fever	40.8% including pharmacist/ drug shop, 27.8% without shops
C2 % of target population who can explain how malaria is transmitted and prevented	93.1% know how malaria is transmitted (mosquito bite or visit to / stay in forest. 92.0% know mosquito bites cause malaria. 92.0 % know mosquito nets prevent malaria, 33.6% know nets and one other correct measure, but only 10.2% mentioned ITNs
C3 % of families living in endemic areas that have sufficient treated bed nets	7.0% households have sufficient ITNs and 37.2% "sufficient" nets*.
C4 % of population at risk sleeping under insecticide treated nets the previous night, measured during peak malaria transmission season	19.6% of whole population, 19.8% of children under five and 13.1% of pregnant women slept under an ITN the previous night. Note that net coverage (as opposed to ITN coverage) was very high.
C5 % of patients with malaria in public health facilities prescribed correctly according to national guidelines	88% have recent treatment guidelines. Most treatments were with correct drugs. 42% had latest diagnosis guidelines. Outpatient observations were inadequate to measure this indicator, and full documentation of routine supervision data is recommended
C6 % of public health facilities which maintain stocks of antimalarials and rapid tests with no out-of-date stocks	Percentage facilities maintaining stocks: 42% first line drugs, 25% second line antimalarials, 42% RDTs. Facilities with out-of-date stocks: 2% firstline, 8% second line, 0% RDTs

* Note that this definition of "sufficient" may be excessively demanding: although only 37% of households have "sufficient" nets by this definition, there is already almost complete coverage of children:with nets: 87% of under-fives already sleep under a net.

Status of Supplementary Indicators

Indicator	**Result at baseline survey 2004**
S1 % mothers and care takers able to recognize signs and symptoms of danger of a febrile illness in a child <5 years.	91.9% mentioned at least one general danger sign and 90.3% at least one malaria danger sign
S2 % seeking treatment from trained provider/total cases of febrile illness	69.6% sought treatment from a trained provider if pharmacist/ drug shop is excluded and 97.6% if they are included, but it is known that many drug shopkeepers are not trained.
S3 % of families using IBNs correctly *(this indicator has not been used, as there is no definition of "correctly". It is partly covered by C3 and C4)*	-
S4 % of families that have sufficient treated bed nets *(this indicator duplicates C3)*	-
S5 % of children under-5 sleeping under treated bed nets that have sufficient treated bed nets the previous night	19.8% children under five slept under an ITN the previous night
S6 % of public health facilities able to confirm malaria diagnosis according to national guidelines	60.9% offered a laboratory service, but only 25% had the most recent guidelines
S7 % availability of antimalarial regimens other than A+M and Malarine in the market	100%
S8 % awareness of Malarine among the targeted populations	46.1% were aware of Malarine or A+M (it was not possible to find out about Malarine separately)
S9 % of target groups who know where to obtain testing and treatment for malaria	92.6% of people know where to obtain testing and treatment. 69% cited public sector sources and 25% private sector for testing, and 65% and 32% cited public and private sector for advice or treatment. Actual practice was quite different.
S10 % of target groups who know that Malarine treatment is effective only if entire course is taken	41% said they would get sick again if they took fewer days than recommended.
S11 % of public health facilities reporting no disruption of stock of antimalarials for more than 1 week during the previous 3 months	0% for first-line A+M

Key recommendations for the programme

1. Rather than distribute more mosquito nets or ITNs the programme could achieve most impact for its resources by treating and retreating existing nets, given that net coverage is very high (>85% of target groups), but very few of these nets are recently treated.

2. There are already high levels of awareness of how malaria is transmitted and how this can be prevented, but awareness of ITNs is very low, and this should be the main message about prevention communicated in health education campaigns.

3. Treatment and retreatment of existing nets (and distribution of long lasting insecticidal nets as they become available) should be targeted with priority to CMBS risk zones 1 and 2 (0 to 1 km from forest), as these have higher malaria risk and lower economic status than CMBS risk zone 3. This is a wider target than the current target up to 200m from forest. Access to ITNs can also be facilitated beyond 1 kilometre from forest, particularly with a view to protecting people at occupational risk of malaria.

4. Further geographical analysis is needed to determine the most cost-effective and accurate ways of obtaining rapid estimates of village-level risk. This would explore newly available forest cover datasets.

5. Intense efforts are needed to reduce ruptures of antimalarial drug stocks in public sector health facilities/

6. Promotion of Malarine in the private sector needs to be handled carefully to avoid excessive unnecessary use of antimalarials by people currently using non-antimalarials for fever. The most promising approach would be to promote vigorously the use of parasitological diagnosis to determine the need for treatment. Strategies for increasing access to reliable diagnosis are needed.

7. The higher prevalence in pregnant than in non-pregnant women warrants further investigation, as it may reflect poorer utilisation of insecticide-treated nets, which is indeed what the survey found, and points to the need for more targeted education.

8. There is considerable evidence of malaria transmission in the zone from 1 to 2 km from the nearest forest. The risk is less than for those closer to the forest, but indicates the need for the control programme to include this zone in its control strategies.

9. Certain remote sensing – based approaches appear to have good potential for risk mapping and should be further explored.

10. Malaria slide positivity is strongly associated with the poorest parts of the population. Poverty reduction strategies should include malaria control measures.

11. The health centre survey was not the best way to obtain data for the facility level treatment indicators. In order to obtain the type and amount of data needed to track progress of these indicators, it is recommended that systematic routine data collection through supervision visits and monthly reports would be more appropriate. Health facility surveys of the type used in some countries to assess Integrated Management of Childhood Illness (IMCI) could be valuable, but would need considerably more resources in terms of time and personnel than were available for the present survey. If other health facility surveys are planned by the Ministry of Health, it is recommended that the CNM explores the possibility of adding questions. An important lesson learnt from the health centre survey was the need to notify health centres in advance, since staff were often too busy to spend adequate time with the interviewers, and were sometimes not available for consultation observation.

12. For the most part the process of undertaking the survey worked well. The full engagement of the multiagency taskforce was crucial to the success of the survey;

although it is costly in staff time, it should be maintained as an essential component of follow-up surveys.

Recommendations for future surveys

1. The questions on A+M and Malarine should be separated.

2. Pharmacists and shopkeepers should be defined more carefully and perhaps broken into three classifications: formally trained pharmacists, shopkeepers with on-the-job training and untrained shopkeepers.

3. The definition of "sufficient" nets may be excessively demanding: and should be reconsidered.

4. Collection of more useful health facility data will require a more extensive health facility survey, which would cost more, and systematic collection of routine supervision data.

1 Background

The Cambodian malaria component proposal was approved by the Global Fund in the Second Round for an initial period of two years (total budget of US $5,013,262 including a 5.9% contribution to the Principal Recipient office). The total budget needed for five years of implementation of the programme has been estimated to be US $9,998,371. The National Malaria Control Programme (NMCP) in Cambodia gives critical importance to the conduct of a baseline survey, since the improvement of monitoring and evaluation (M&E) systems based on a rigorously conducted Baseline Survey could be of particular relevance in view of results-based disbursement of future GFATM tranches. For this purpose, the four GFATM sub recipients (CNM, Health Unlimited, Partners for Development and Population Services International) have requested the services of the UK based Malaria Consortium through WHO to provide overall technical assistance in carrying out the baseline study, and have selected The National Institute of Public Health to manage data collection and assist with data analysis and report writing. The US Armed Forces Research Institute of Medical Science (AFRIMS), Thailand provided technical support for the parasite prevalence survey. Detailed Terms of Reference for the baseline survey are in Annex 1.

2 Purpose of the Survey

The Cambodia Malaria Baseline Survey (CMBS) studied a sample of individuals in high-risk areas of Cambodia in order to measure their Knowledge, Attitude, Behaviour and Practice (KABP) towards malaria and obtain a baseline prevalence estimate. In addition, health facilities and providers were surveyed to obtain a measure of coverage of both public and private distribution of antimalarial drugs and mosquito nets. Baseline surveys study the characteristics of a target area before beginning a project. These indicators will be measured again in two to three years to measure achievement of project objectives.

The data gathered through the baseline survey will have several important uses:

- To document the characteristics of the target areas of the malaria programme as a baseline for malaria situation analysis in Cambodia
- To track changes in key knowledge, attitude, behaviour and practice indicators in order to evaluate programme impact
- To use findings to improve delivery of malaria control interventions (training, supervision, communications), review current NMCP policies, strategies and programmatic priorities and make mid-course corrections if required

Specific Indicators on which baseline data are required:

The 4 implementing partners included the following prioritized coverage indicators in their revised Monitoring and Evaluation Plan submitted to the Global Fund on 8th April 2004.

C1 % of people seeking treatment from trained providers within 48 hours of developing a fever

C2 % of target population who can explain how malaria is transmitted and prevented

C3 % of families living in endemic areas that have sufficient treated bed nets

C4 % of population at risk sleeping under insecticide treated nets the previous night, measured during peak malaria transmission season

C5 % of patients with malaria in public health facilities prescribed correctly according to national guidelines
C6 % of public health facilities which maintain stocks of antimalarials and rapid tests with no out-of-date stocks

The four implementing partners had earlier included the following coverage indicators in their integrated proposal submitted to the Global Fund in September 2002.

S1 % mothers and care takers able to recognize signs and symptoms of danger of a febrile illness in a child <5 years.
S2 % seeking treatment from trained provider/total cases of febrile illness
S3 % of families using IBNs correctly *(this indicator has not been used, as there is no definition of "correctly". It is partly covered by C3 and C4)*
S4 % of families that have sufficient treated bed nets *(this indicator duplicates C3)*
S5 % of children under-5 sleeping under treated bed nets that have sufficient treated bed nets the previous night
S6 % of public health facilities able to confirm malaria diagnosis according to national guidelines
S7 % availability of antimalarial regimens other than A+M and Malarine in the market
S8 % awareness of Malarine among the targeted populations
S9 % of target groups who know where to obtain testing and treatment for malaria
S10 % of target groups who know that Malarine treatment is effective only if entire course is taken
S11 % of public health facilities reporting no disruption of stock of antimalarials for more than 1 week during the previous 3 months

It was also stated that it would be advantageous if the baseline study could provide information on other RBM and MDG Goals as they apply to Cambodia.

3 Methods

Overview

Given the range of required indicators the survey included several components, as shown in Figure 3.1. In addition, filter paper samples were collected at the time of taking blood samples for microscopic diagnosis for PCR and ELISA analysis, which will be performed at a later date.

The data collection was undertaken in October to November 2004 towards the end of rainy season, as this is the time of peak malaria transmission. The questionnaires used for the surveys are in Annex 2.

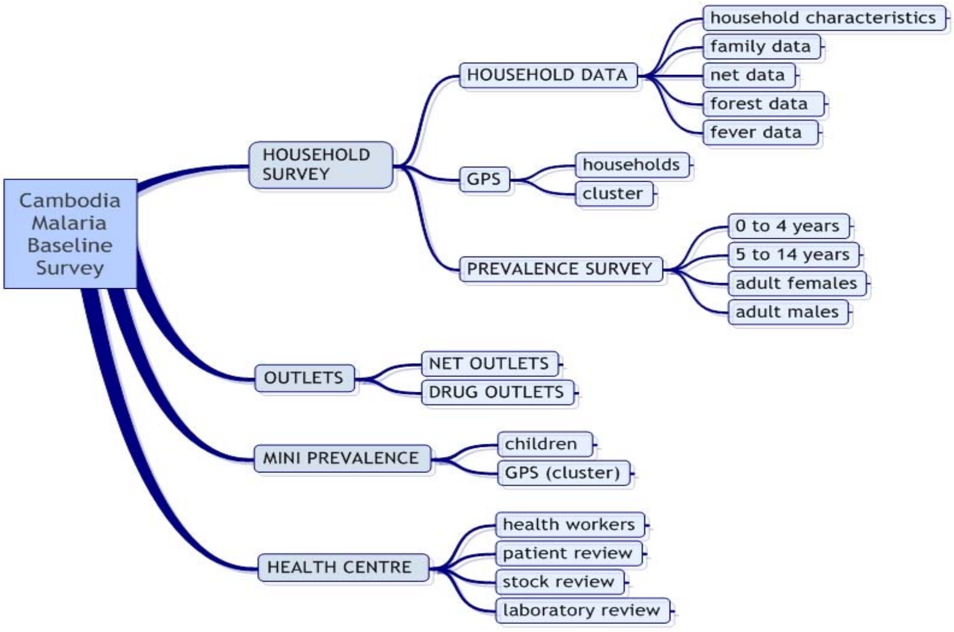


Figure 3.1 Components of the Cambodia Malaria Baseline Survey (CMBS)

Defining risk zones and sampling domains for baseline survey

Defining the sampling universe for the baseline survey involved combining GIS maps of village positions with maps of malaria risk zones and defined sampling domains. At the outset of the survey it was agreed that these malaria risk zones should be re-defined at the national level on the basis of the most up-to-date forest maps available. On this basis Cambodia Reconnaissance Survey Digital Database was used. The dataset was produced in 2003 (and released 2004) by the Ministry of Public Works and Transportation with support from JICA. It includes forest cover maps derived from remote sensing (using satellite data for 1995-6 (Phase 1 coverage) and 1998-2001 (Phase 2 coverage).

The land use dataset used in this exercise includes 11 main types of forest cover, together with a number of agricultural land use types that involve some sort of tree cover (orchards, rubber plantations etc.). Based on expert opinion, we selected 5 of these to represent forest cover of epidemiological significance:

LU_CODE	CATEGORY NAME
7	Orchard
8	Plantation (Rubber plantation)
22	Evergreen broad leafed forest
28	Bamboo and Secondary forests
32	Forest plantation

This selection represents 26% of Cambodia's total area.

Villages per risk zone

We used the current village list available from CMAA (including 13,634 village positions) to calculate the number of villages falling into each risk zone. Using the current definition of forest, the number of villages within 1 km of forest is 1689. This is broadly consistent with existing estimates.

Redefined Risk Zones

Currently the CNM uses four risk zones or categories (called CNM risk zones here) for determining its malaria control strategy. They all lie within one kilometre of the forest (Figure 3.2 and Table 3.1).

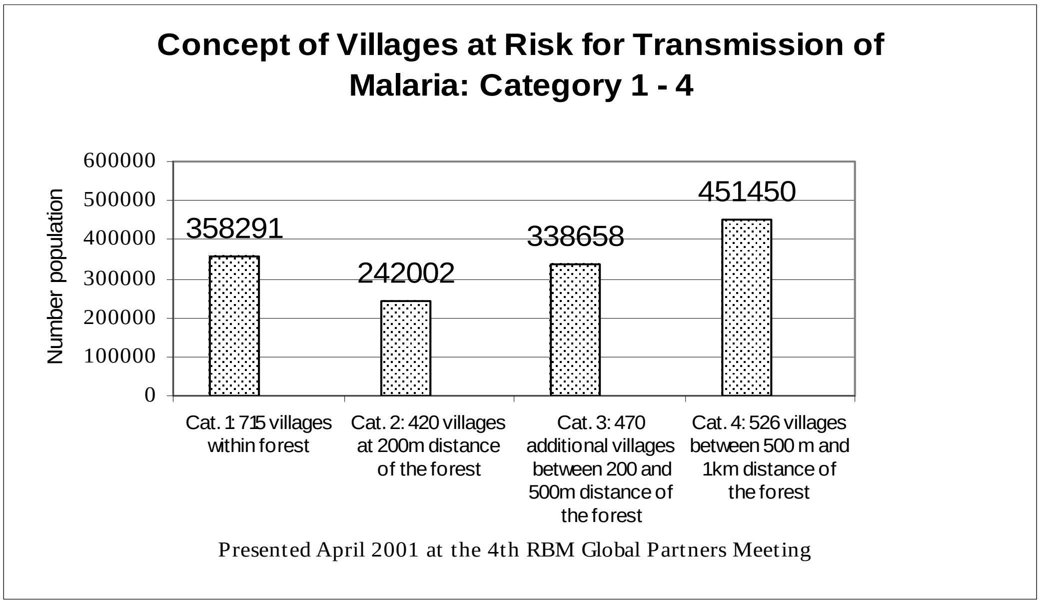


Figure 3.2 CNM risk zones (source: Sonnenburg. F. 2004. Full report of WHO short-term consultancy in Cambodia, 3rd to 27th March 2004)

The villages within each zone were listed by CNM in 2001 based on expert opinion and updated in 2005 to account for change in forest cover. ITN distribution programmes have been targeted at CNM zones 1 and 2, and villages in these zones were also selected to pilot the Village Malaria Worker (VMW) scheme. In order that the survey could ascertain if indeed the risk of malaria transmission is almost completely confined to within one kilometre of forest, sampling included a new risk zone of one to two kilometres from the forest for comparison with villages within one kilometre of forest. Since intervention strategy is not different in current zone 1 from zone 2 and current zone 3 from zone 4 the CMBS combined current zones 1 and 2 to a new zone 1 and current zones 3 and 4 to a new zone 2. The spatial analysis in Section 4.2 presents prevalence data for all the CNM risk zones.

Table 3.1 Risk zone definitions

CNM Risk Zones	CMBS Risk Zones
1. In forest 2. Less than 200m from forest	1. In forest and up to 250 m from forest
3. 200-500 m from forest 4. 500 m- 1 km from forest	2. 250m – 1 km from forest
(5. Greater than 1 km)	3. 1-2 km from forest

Geographical domains

It is not feasible in this Baseline Survey to gain precise estimates for each Province. Nevertheless it is useful to have some idea of environmental, geographical and cultural variations in coverage/epidemiology. Sampling areas were therefore defined by combining provinces to form three domains as shown in Table 3.2 and Figure 3.3. The selection of provinces for each domain was made by reviewing maps of predominant land use and particularly forest type by geographical location. The rationale for this is the dependence of the main malaria vectors on being near to or in particular types of forest.

Table 3.2 Distribution of Provinces by Domain

1. Northeast + Koh Kong	2. North West and Central	3. South East
Koh Kong	Banteay Meanchey	Kampong Cham
MondulKiri	Battambang	Kampong Chhnang
Ottar Meanchey	Kampong Thom	Kampong Speu
Preah Vihear	Kratie	Kampot
Rattanakiri	Pailin	Kandal
Stung Treng	Pursat	Kep
	Siemreap	Prey Veng *
		Sihanoukville
		Svay Rieng
		Takeo

Although Prey Veng was included in the sampling frame, it did not have any clusters selected.

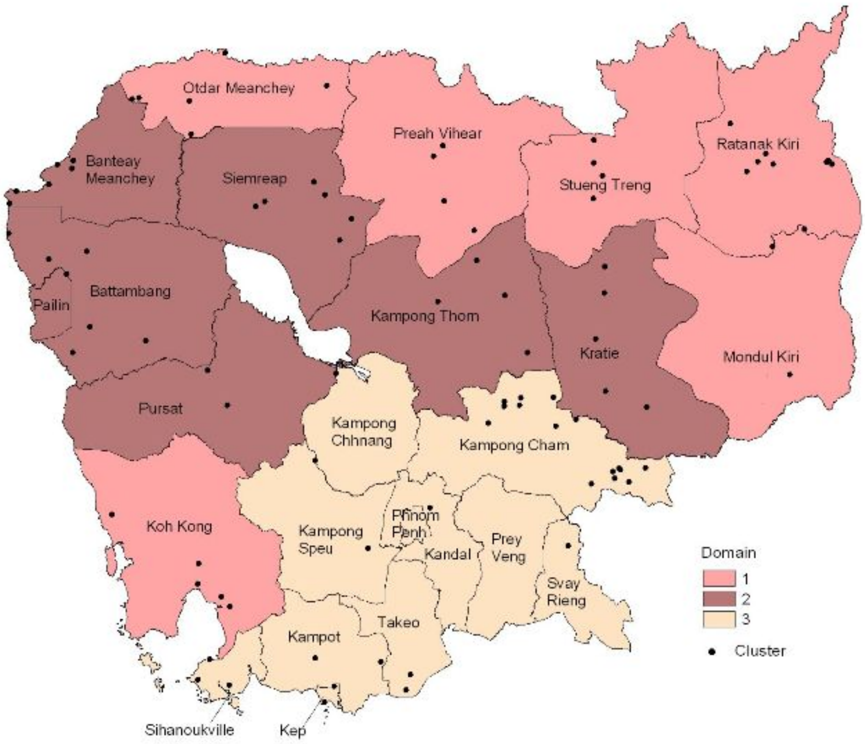


Figure 3.3 Selected Clusters by Domain

In each domain, sampling was restricted to villages within 2 km of a forest. About 11% of villages within Cambodia are within 2 km of forest (2001-2 data). Figure 3.4 shows distribution of selected clusters in relation to forest cover.

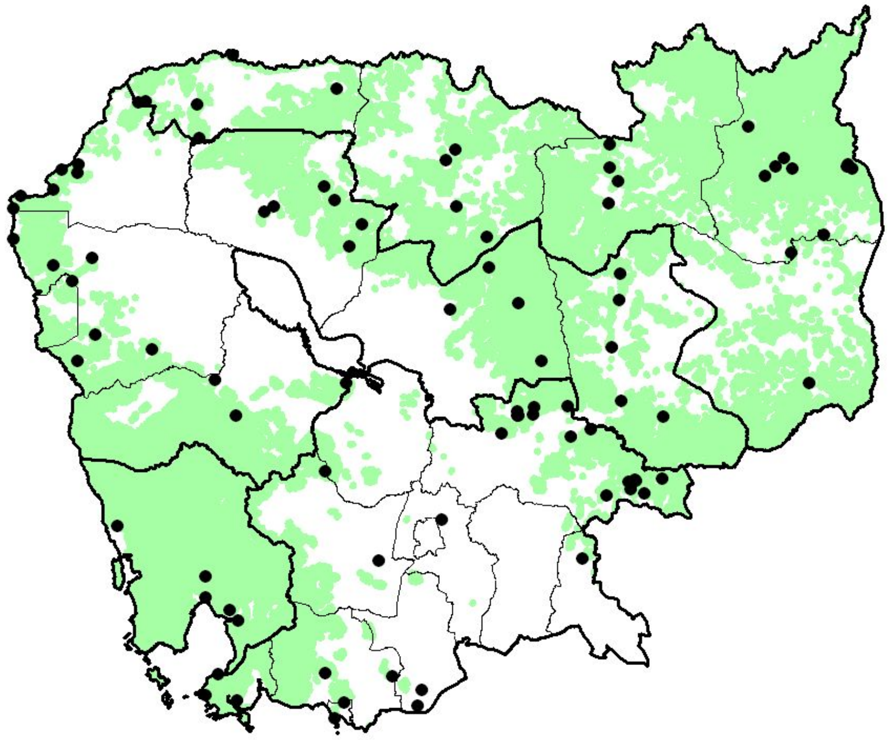


Figure 3.4 Selected clusters by forest cover

Main household survey

The household survey design is multi-stage, sampling clusters at the first stage, households within each cluster at the second stage, and then individuals within households. The proposed sample size was 1200 households per domain (for details of the calculations of the sample size and assumptions made see Annex 3). The most desirable design to obtain this was to take 30 clusters of 40 households in each of the 3 domains. As most villages have at least 40 households it was possible for each cluster to consist of a single village. Figure 3.5 summarises the selected sample.

The 30 clusters selected for each domain were distributed among the risk zones so that almost half were in the highest risk zone, i.e., within 250 m of the forest. Taking 14 from zone 1, and 8 each from zones 2 and 3 respectively. Table 3.3 summarises measure of size for all clusters by CMBS risk zone and domain.

Table 3.3 Village size by CMBS risk zone and domain

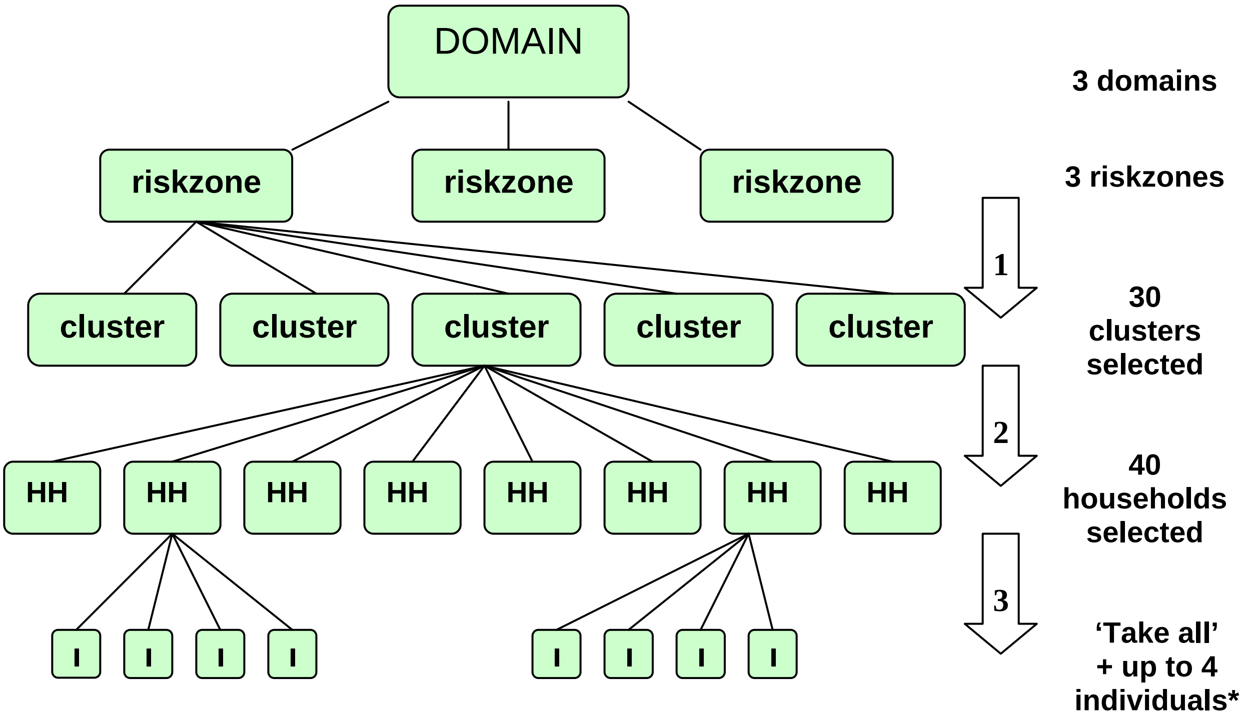
	Number of villages	Minimum village size	Maximum village size	Median
Domain 1				
Risk zone 1	14	26	274	95
Risk zone 2	8	53	166	94
Risk zone 3	8	41	339	95
Domain 2				
Risk zone 1	14	47	354	131
Risk zone 2	8	61	416	149
Risk zone 3	8	111	215	171
Domain 3				
Risk zone 1	14	72	668	246
Risk zone 2	8	231	585	437
Risk zone 3	8	35	893	200

Within each cluster households to be sampled were selected from a list of all households. This list was obtained from the village chief on arrival in the cluster.

A questionnaire was administered in each selected household. The person interviewed was the head female where possible. A finger prick blood sample was taken from a sub-sample of four individuals in the household, one from each of the following groups: one aged 0 to 4 years, one aged 5-14 years, one adult female and one adult male (except where not all occur). This selection was made to compare malaria risk in these classes. If there was more than 1 person in any of these groups one was sampled randomly from all individuals falling in that group. The individuals for whom blood samples were taken were recorded in the household schedule in the household questionnaire. A household survey blood sample sheet was used to record samples taken (and finally results). If there is no-one in any group (i.e. a blood sample cannot be taken) NONE was noted in the blood sample sheet for that group. Blood slides and one filter-paper containing 4 bloodspots was prepared from the blood samples. If there was a pregnant woman in the house who was not included in the blood taking sample for adult woman her blood was also taken. If there were any persons in the household who appeared to be symptomatic for malaria those persons were given a rapid diagnostic test (RDT) and those with a positive result given the appropriate treatment.

Microscopic examination of giemsa stained blood smears was performed in order to determine the presence of malaria parasites in survey participants. An extensive training and quality assurance program was implemented in order to best insure accuracy of prevalence data. Blood takers were trained in smear preparation and smear staining procedures and microscopists required to pass a blinded practical qualifying examination before reading smears obtained from the survey. All smears judged positive by these readers were re-read by a second, senior microscopist who was blinded to the results of the first reader. Additionally, 10% of all smears judged negative by the first microscopist were overread by a senior microscopist. In both cases, the senior microscopist reading was used in the event of non-concordance with the first reader.

The sample design for the household survey is non self weighting, and analysis was therefore adjusted using the appropriate weights for households and individuals respectively. The results presented in this report are weighted estimates, the corresponding frequencies given are the true number of observations sampled.



* 'take all' refers to questionnaire about behaviour of all individuals in the household; up to 4 individuals had a blood sample taken and the pregnant women who were not automatically included.

Figure 3.5 Cambodia Malaria Baseline Survey Sample Design

Mini prevalence survey

There was an additional 'mini-prevalence' survey conducted in parallel to the main household survey. For each household cluster (30 clusters per domain, 90 clusters total), two nearby cluster were identified for the 'mini-prevalence' survey. These were sampled from clusters in the surrounding area to the main survey cluster. Where possible 2 clusters were selected from within a 2 km radius. If there were not enough clusters this was increased to a 5 km radius, then 10 km radius and for a few main clusters a 20 km radius. If there were clusters within a specified radius from different communes sampling was restricted to clusters within the same commune where possible.

For these 'mini-prevalence' surveys, the selected villages were visited and the first twenty children to present themselves were recruited. Finger-prick samples for RDTs and spleen measures were taken from each child. Children with a positive RDT were treated. The RDT used was Paracheck F®, which detects *Plasmodium falciparum* but not other species. It is an HRP-II based test, and thus can remain positive for a few days after treatment.

Provider and Outlet Survey

During the household survey, there was a provider (of health care) and outlet (for mosquito nets and anti-malarial drugs) survey with a limited number of questions at three levels of treatment provider. The proposed number of facilities / providers is shown below:

Provider	Number per Domain	Total Number
1. Public Health Facility	8	24
2. Markets	15	45
3. Village outlets	30	90

For selected villages in the market, the field staff walked around the market to find mosquito net and anti malarial drug outlets. They assessed which was the largest outlet for both mosquito nets and anti malarial drugs and where possible noted any brands in other smaller outlets that were not available in the surveyed outlet.

Fieldwork process

This section describes how the fieldwork was organised based on the study design.
The sample is 30 clusters in 3 domains = 90 clusters.
90 clusters x 40 households / cluster = 3600 households
Normally a team visited each cluster for one day and one night to avoid excessive bias from missing people absent in the day time. Each team could do four clusters per week (Monday to Thursday days and nights) with Friday for planning, reporting and resupplying.
90 clusters @ 4 clusters per week = approximately 23 team weeks
There were five teams and field work took five weeks. There was a need for additional days for travel in remote areas so these five weeks were spread over 7 weeks. There was a week at the beginning for training, planning, notifying and preparing, then a week at the end (for some team members) for reporting and finalising.

Team composition was 14 people consisting of:

1 x survey superviser	4 x household interviewers
1 supervisory technician	5 x bloodtakers
1 x outlet/ facility interviewer	2 x drivers

With 5 teams that is 70 fieldworkers.

The 6 household interviewers interviewed 6-7 households per day (total 40 households), and the outlet/ facility interviewer visited one village outlet, one mosquito net and one drug outlet in the nearest market in alternate clusters and one health centre for 1 in 4 clusters.

The bloodtakers covered:

1) household prevalence survey in the village where the household questionnaire survey took place (blood slide and filterpaper samples on one aged 0 to 4 years, one aged 5-14 years, one adult female and one adult male.

an epidemiological survey (RDT and spleen survey). In each of the satellite villages, 20 children were examined for spleen and tested with an RDT. The team also took GPS readings for a central point in the village and 4 readings for the edge of the nearest forest.

4 Results and Interpretation

The sources of information for each indicator are shown in Annex 4.

Results are presented as weighted estimates, while the corresponding frequencies are the true number of observations sampled. This explains why percentages are not directly derived from the numbers presented.

4.1 Malaria and Fever Prevalence and Spleen Rates

Overall malaria point prevalence from the blood slide survey was 2.7% (see table 4.1.1), but it must be borne in mind that this does not measure overall malaria burden in Cambodia, since the survey sampled preferentially in higher risk areas. Rapid diagnostic test positive rate in the satellite clusters was 3.9%, spleen rate was 2.9% and Average Enlarged Spleen (AES)[1] in the satellite clusters was 1.8.

Table 4.1.1 Summary of parasitological survey results, fever prevalence and spleen rate

Source of results	P. falciparum	P.vivax	Pf + Pv	Other	% (number) positive	% (number) negative
Microscopy results in main clusters	1.8 (178)	0.8 (75)	0.1 (6)	0.04 (7)	2.7 (266)	97.3 (8,159)
Rapid diagnostic tests in satellite clusters					3.9 (141)	96.1 (3,459)
Spleen survey in satellite clusters					2.9 (104)	3,496
Reported fever in last two weeks					11.4 (2,026)	88.6 (15,729)

<u>Interpretation</u>: On the basis of the classification of malaria endemicity described by WHO in 1963 in its monograph on “Terminology of Malaria and of Malaria Eradication” a spleen rate of 2.9% in children aged 2-9 years indicates hypoendemic malaria (0-10%).

Table 4.1.2 shows the distribution by CMBS risk zone of slide positivity rates for each age, sex and pregnancy category. Detailed information on the geographical distribution of malaria is given in section 4.2

[1] AES is a malariometric index calculated from the frequency distribution of various classes of spleen size by multiplying the number of individuals in each class of enlarged spleen by the class of spleen and dividing this figure by the total number of individuals with enlarged spleens. It is used to compare endemicity in different areas or changes in endemicity at different times.

Table 4.1.2 Distribution of slide positivity by CMBS risk zone and age

	Percentage (number) with positive slide						
CMBS Risk zone	**0-4 yrs**	**5-14 yrs**	**15+ yrs male**	**15+ yrs female**	**Preg-nant**	**Total positive**	**Total slides**
< 250 m	3.9 (23)	5.2 (49)	3.3 (44)	1.9 (34)	3.2 (7)	3.4 (150)	3,868
250 m to <1km	4.1 (10)	3.5 (16)	5.7 (35)	1.7 (15)	6.4 (3)	3.6 (76)	2,288
1km to < 2km	0.6 (2)	1.5 (10)	2.5 (18)	0.8 (10)	1.6 (2)	1.4 (40)	2,269
All zones	3.0 (35)	3.2 (75)	4.0 (97)	1.4 (59)	3.7 (12)	2.7 (266)	8,425

Interpretation: There was remarkably little difference in slide positivity rate among different age groups overall, although the rate was a little lower in non-pregnant women. In the past adult men were considered the highest risk group for infection, but the difference seen here is not very large. It would be interesting to know if this reflects a change in occupation or relates to the fact that the sampling did not cover areas of low risk of local transmission, where infection may be predominantly in adult males who travel to the forest at night. Although slide positivity rates are lower in CMBS risk zone 3 (1 to 2 km from forest) than in the zones closer to the forest, there is still some risk even in children under five suggesting some transmission in this zone. At present the national programme has focused only on access to ITNs in villages up to 1 kilometre from the forest, and these results suggest that would not cover everyone at risk of transmission at home. Section 4.2 provides a more in-depth analysis of risk in relation to proximity to forest, which is a complex factor to measure and interpret. The parasite rates in children are consistent with hypoendemic malaria in all the risk zones (defined as parasite rate in children-9 years old being as a rule less than 10%, though may be higher at some times of the year). Slide positivity was somewhat higher in men aged 15 to 49 years (4.4%, 86/1,806) compared to men aged 50 or more years (3.0%, 11/463) reflecting the greater likelihood that the younger men go to the forest.

The higher prevalence in pregnant than in non-pregnant women warrants further investigation, as it may reflect poorer utilisation of insecticide-treated nets, which is indeed what the survey found (Table 4.3.8), and points to the need for more targeted education.

4.1.1 Fever

Respondents in the household survey were asked whether each household member had had a fever in the past two weeks (q52). Fever was reported in 1,653 (48.2%) of the 3,363 households and 2,031 (11.4%) of 17,755 individuals who stayed in the households. The age and sex breakdown (Tables 4.1.3 and 4.1.4) shows that children under five had the highest percentage of fevers.

Table 4.1.3 Percent and number of fevers in last two weeks in: children under five years, children 5-14 years, adult men, adult women

Age and sex	Percent with fever in past 2 weeks	Number with fever in past two weeks	Total number
Under five years	23.8	488	2,053
5 – 14 years	12.5	635	5,102
15+ years male	8.7	438	5,066
15+ years female	8.4	465	5,534
Total	11.4	2,026*	17,755

* In five cases age and sex details were not available.

Table 4.1.4 Distribution of recent fever by CMBS risk zone and age

	Percentage (number) with fever in the past two weeks					
CMBS Risk zone	**0-4 yrs**	**5-14 yrs**	**15+ yrs male**	**15+ yrs female**	**Total fever**	**Total number fever and non-fever**
< 250 m	25.8 (261)	13.3 (308)	7.7 (169)	9.1 (220)	12.0 (958)	7,973
250 m to <1km	21.9 (126)	12.0 (168)	9.5 (131)	8.1 (117)	11.3 (542)	4,791
1km to < 2km	21.6 (101)	11.5 (159)	9.3 (138)	7.7 (128)	10.5 (526)	4,991

Interpretation: Fever rates are high in children under five years old. No clear differences can be seen in fever rates among the three risk zones within any of the age groups
The percentage of different types of fevers and the percentage of named malaria fever (krun chanh) compared to other fevers by age and sex classes, by risk group and by domain and by slide result are shown in Tables 4.1.5 to 4.1.9 (q54).

Table 4.1.5 Percentage of fevers by type

Type of fever	Description	Percent with each type fever	Number with each type fever
Krun Chanh/Nheak	Malaria/ fever with chills	10.3	201
Krun Kdao /Kdao Kluan	Hot fever/ general fever (this does not specifiy malaria but could include it)	84.5	1,726
Krun Loap	48 hour intermittent fever	0.5	10
Krun Chhiem	Dengue	0.6	12
Krun yop	Night fever	1.0	24
Other		3.0	52

Interpretation: Most fevers are described by non-specific terms, but still 10% are specifically identified as malaria.

Table 4.1.6 Percentage fever types by age and sex

Age/sex groups	% Krun Chanh	% Krun Kdao	% other fever	Total number fevers
Under 5 yrs	3.2	93.2	5.6	487
5-14 yrs	8.4	85.0	6.6	633
15+ yrs male	21.9	74.4	3.7	436
15+ yrs female	8.6	85.1	6.3	464

Interpretation: Fever identified as malaria (krun chanh) is much commoner in adult males as we would expect if adult men had a higher risk of malaria, but the degree of difference is much greater than the actual difference in slide positivity rate (Table 4.1.2). This may suggest that people expect fevers in men to be malaria more than in other age groups.

Table 4.1.7 Percentage of fever types by CMBS risk zone and domain

Location	% Krun Chanh	% Krun Kdao	% other fever	Total number fevers
Risk zone				
< 250 m	10.3	84.7	5.0	956
250 m to <1km	11.5	83.4	5.1	542
1km to < 2km	9.1	85.6	5.3	527
Domain				
1	11.4	85.6	3.0	649
2	13.8	81.6	4.6	791
3	5.0	87.5	7.5	585

Interpretation: The percentage of krun chanh shows little difference from one risk zone to the next, but domain 3 (southeast Cambodia) is considerably lower.

Table 4.1.8 Percentage Krun Chanh by CMBS risk zone / domain and age/sex

Location	Under 5 yrs	5-14 yrs	15+ yrs male	15+ yrs female
Risk zone				
< 250 m	4.7	7.1	24.9	11.0
250 m to <1km	3.8	10.7	20.5	11.2
1km to < 2km	1.0	6.5	22.0	4.8
Domain				
1	4.5	10.2	24.5	9.4
2	4.1	13.0	11.5	13.9
3	0.6	1.8	14.8	4.9

Interpretation: In under five year olds fever identified specifically as krun chanh is commonest in CMBS risk zone 1 closest to the forest than further away. This pattern is less clear in other age groups, which may relate to short distance nighttime travel in the forest by adult men living 1 to 2 kilometres from the forest.

Table 4.1.9 Slide results for those *with fever* who were tested

Type of fever	Pf	Pv	Pf&Pv	Other	Positive	Negative
Krun Chanh/Nheak	7.8 (12)	2.1 (2)	0 (0)	0 (0)	9.9 (14)	90.1(107)
Krun Kdao/ Klao Kluan	3.9 (37)	1.4 (17)	0.02 (1)	0.2 (5)	5.4 (60)	94.6 (1057)
Krun Looa	0 (0)	0 (0)	0 (0)	0 (0)	0	100 (7)
Krun Chhiem	0 (0)	0 (0)	0 (0)	0 (0)	0	100 (8)
Krun Yop	2.3 (1)	0 (0)	0 (0)	0 (0)	2.3 (1)	97.8 (15)
Other	0 (0)	0 (0)	0 (0)	0 (0)	0	100 (28)
Total	4.1 (50)	1.4 (19)	0.02 (1)	0.2 (5)	5.7 (75)	94.4 (1222)

Interpretation: The higher percentage of positive slide results for people reporting krun chanh/ nheak than krun kdao/ klao kluan shows that the terminology does have some value, but a large proportion of krun chanh / nheak were still negative. These data would need further analysis to interpret fully, as some people may already have taken treatment.

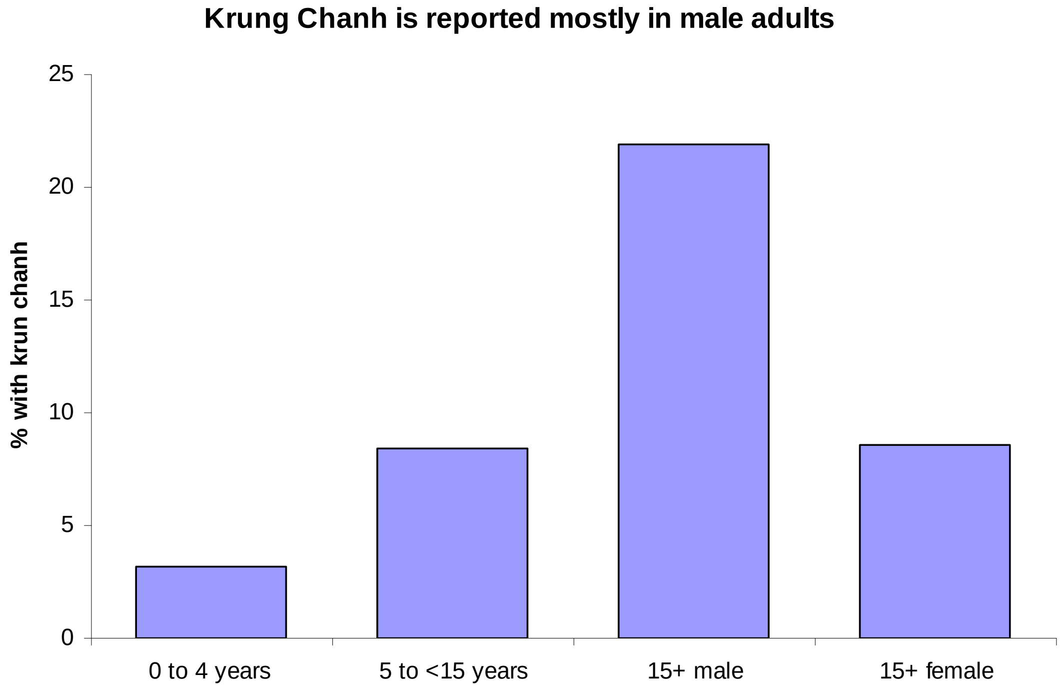


Figure 4.1 Percentage of Krun Chanh by age and sex

Interpretation: The commonest Cambodian word for malaria is krun chanh. While it only accounts for 10% of all fevers reported in the survey, it is commoner in adult men, who have usually been the highest risk group. While there is little difference in the percentage krun chanh among the three risk zones, there is a higher proportion in domains 1 and 2 than domain 3. This could reflect the higher prevalence of malaria in these domains or relate to people's familiarity with krun chanh before rates declined especially in the northwest (domain 2). Table 4.1.7 which shows slide results for people reporting different types of fever suggests a slight increase in probability of finding a positive slide in cases reporting krun chanh compared to other fevers. There are still many negative slides among those reporting krun chanh; some may have been treated. Table 4.1.8 shows that there is a higher proportion of krun chanh in children under 5 years in risk zones and domains 1 and 2 than in risk zone and domain 3, whereas there is little difference in percentage krun chanh in adult males among different risk zones and domains. This may reflect transmission in children close to forest and in more forested domains, while adult males are more mobile.

4.1.2 Spleen Rate and Rapid Diagnostic Test Positivity Rate

A spleen survey was conducted on the children sampled in the miniprevalence survey, and results are shown in Table 4.1.10 together with RDT results by risk zone and domain.

Table 4.1.10 Spleen rates and RDT positive rates by CMBS risk zone and domain

Location	% enlarged spleens	Number	% RDT positives	Number RDT positives
Risk zone				
< 250 m	3.7	62	5.4	90
250 m to <1km	3.5	34	4.6	44
1km to < 2km	0.8	8	0.7	7
Domain				
1	5.9	71	9.2	110
2	1.3	15	1.6	19
3	1.5	18	1.0	12
Total	2.9	104	3.9	141

Interpretation: Spleen rates and RDT positive rates show a similar pattern of sharp decline in risk zone 3 (1 to 2 km from forest) compared to risk zones 1 and 2. There are, however, a few positive cases suggesting slight risk of transmission. This pattern is very similar to the slide results in children in the main clusters (Table 4.1.2). A strong correlation between RDT positivity rate and spleen rate was reported previously in Cambodia [2]. Risk related to proximity to forest is discussed in greater detail in section 4.2.

[2] Hewitt, S 2004. Technical support to assist the National Malaria Centre in scaling-up village based diagnosis and treatment for malaria in remote hyperendemic hotspots in Cambodia. Final Report for GTZ

4.2 Spatial Patterns of Malaria

4.2.1 Spatial patterns of malaria at national level

Results from the cluster and mini-prevalence surveys are shown in Figures 4.2.1A and 4.2.1B. These indicate that malaria prevalence is generally highest in clusters located in Rattanakiri, Stung Traeng, Preah Vihear and northern areas of Kampong Thom and Kratie. This is reflected in prevalence calculations by domain, which show that mean prevalence in domains 1, 2 and 3 were 6.9%, 2.8% and 0.2% respectively. Corresponding figures for prevalence by domain at mini-prevalence sites were 9.2%, 1.6% and 1.0%. Table 4.2.1 shows the prevalence of different species of malaria parasite by domain.

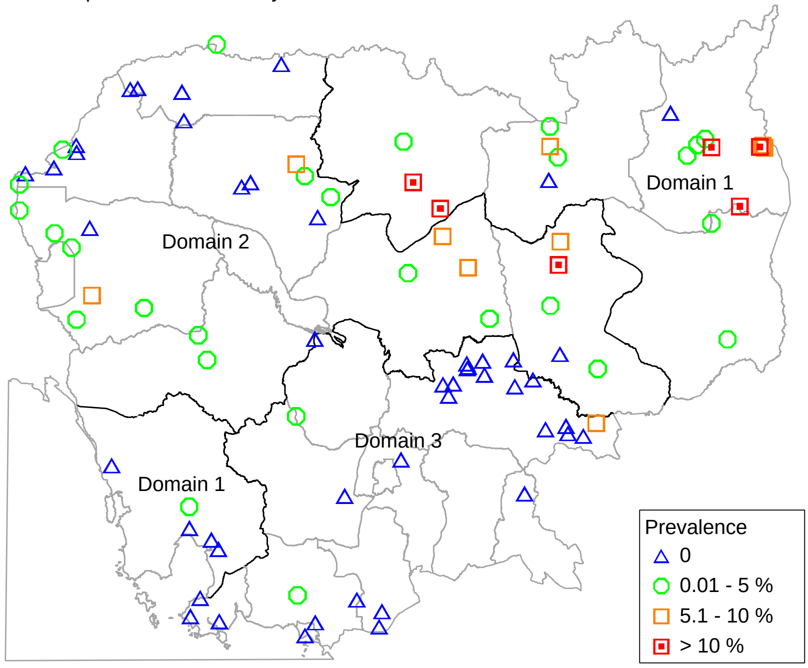
Table 4.2.1 Parasite prevalence by domain from cross-sectional blood slide survey during household survey

Domain	*P. falciparum*	*P.vivax*	Pf + Pv	Other *	Total positive	Negative
1	5.4 (128)	1.2 (31)	0.2 (4)	0.1 (4)	6.9 (167)	93.1 (2718)
2	1.3 (45)	1.4 (39)	0.04 (2)	0.03 (1)	2.8 (87)	97.2 (2723)
3	0.1 (5)	0.1 (5)	0 (0)	0.02 (1)	0.2 (11)	99.8 (2729)
Total	1.8 (178)	0.8 (75)	0.1 (6)	0.04 (7)	2.7 (266)	97.3 (8159)

*Other species = 7 (*P. malariae* = 6, mixed Pm+Pv = 1)

As expected the ratio of *Plasmodium falciparum* to *P. vivax* is much higher in domain 1 which has the highest prevalence.

A. Malaria prevalence for survey clusters



B. Malaria prevalence for mini-prevalence sites

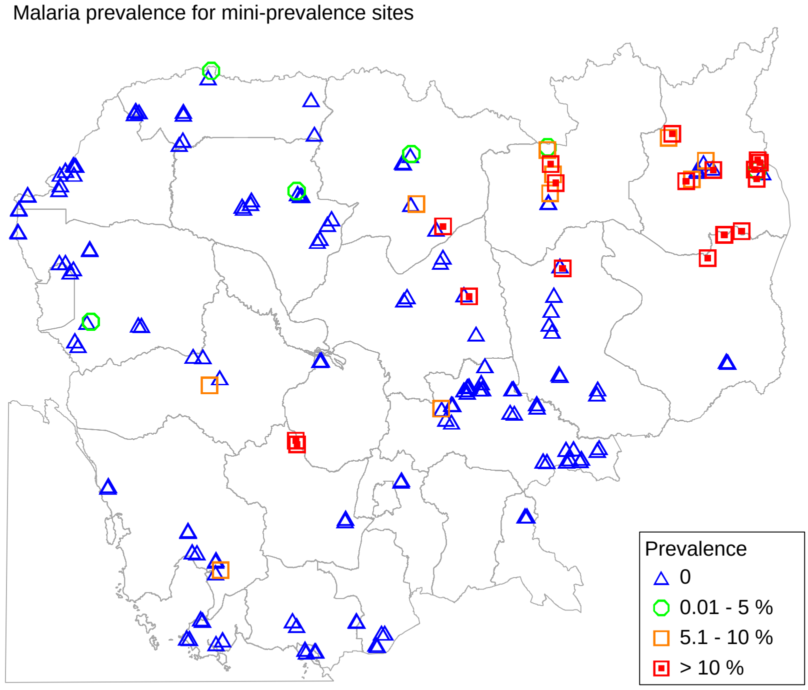


Figure 4.2.1. Maps of malaria prevalence by cluster (A) and mini-prevalence site (B).

4.2.2 Relationship between malaria prevalence and distance from forest

As set out in Section 3, cluster and mini-prevalence surveys were stratified on the basis of distance to forest, as indicated by the forest maps within the Cambodia Reconnaissance Survey Digital Database. The same GIS data were used subsequently to explore relationships between malaria prevalence (aggregated at cluster or mini-prevalence survey level) and distance to individual types of forest cover.

After a process of checking and cleaning, GPS records for individual household positions (for the cluster survey) and for survey locations (for the mini-prevalence survey) were first imported into a GIS as two sets of points. These point coverages were then overlayed with available forest maps to determine shortest euclidian (straight-line) distances between each point and forest of a particular type (Figure 4.2.2 and 4.2.3). Points lying within areas of forest were assigned a distance of zero. For each cluster, distances of households to each forest type were then averaged to provide an aggregate estimate of exposure at village level.

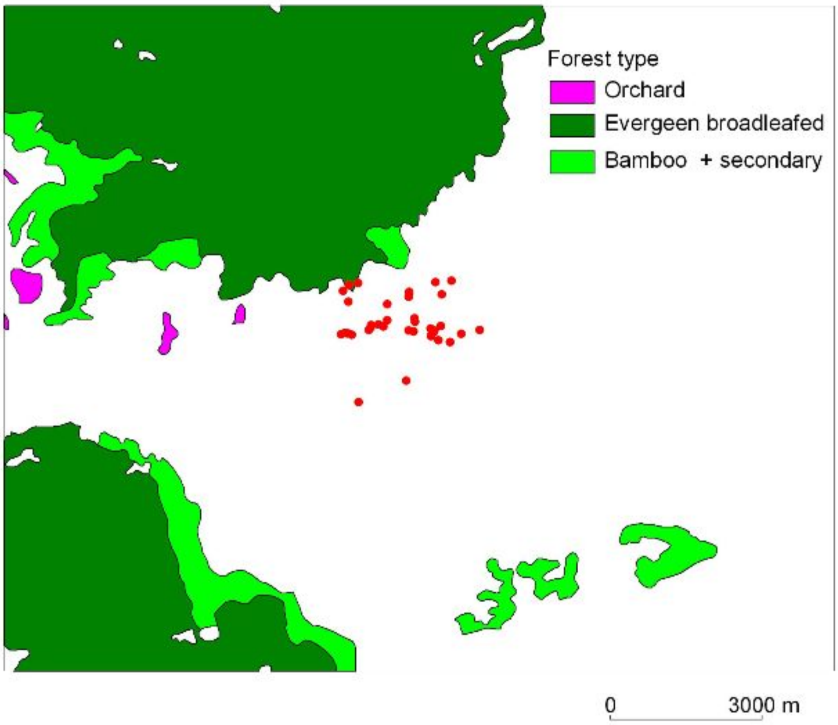


Figure 4.2.2 Overlay in a GIS with relevant forest classes (dots show household points in cluster)

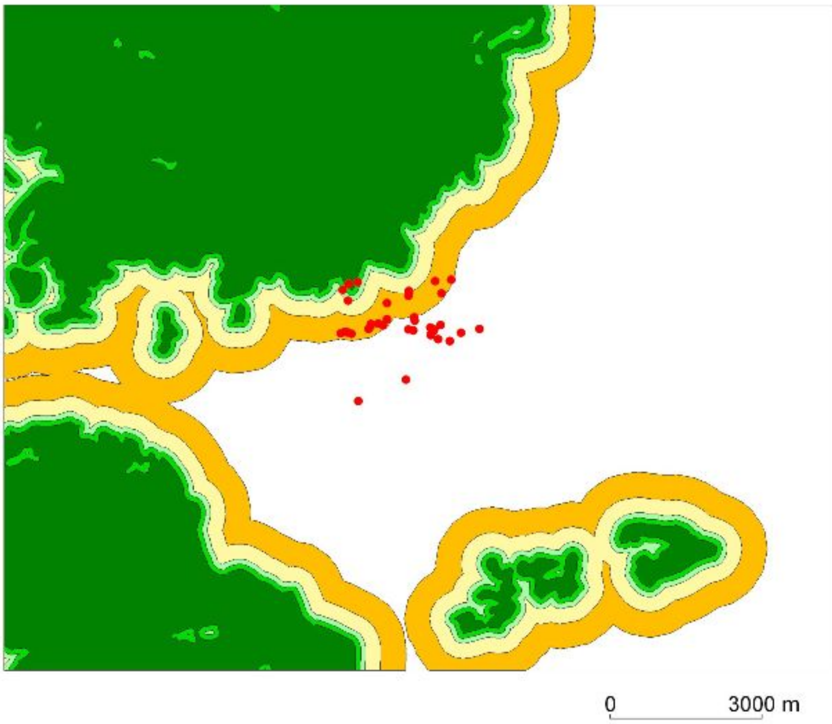


Figure 4.2.3 Some clusters span more than one risk zone (dots show household points in cluster, coloured bands show different risk zones)

Univariate analysis between village-level malaria prevalence and distance to forest (Figure 4.2.4) indicates marked differences in patterns of prevalence depending on the type of forest considered. When considering only the forest types 'rubber plantation' (Figure 4.2.4A) and 'orchard' (graph not shown), for example, distance to forest appears to have little effect on malaria prevalence – although it should be remembered that the confounding effect of other forest types is not reflected in the figure. Much clearer relationships between distance to forest and prevalence are evident for forest classes 'evergreen broad-leafed forest' (Figure 4.2.4B) and 'mixed evergreen and deciduous forest' (Figure 4.2.4C) – although it is also evident that many relatively high risk villages are located beyond a distance of 2 km from forest. For 'riparian' and 'bamboo and secondary' forest types (Figures 4.2.4D and 4.2.4E) there also appears to be clear negative associations between prevalence and distance to forest – although again, these relationships would be confounded by the presence of other forest types.

Arguably a more realistic and accurate assessment of the impact of distance to forest can be achieved by calculating distance to aggregated forest classes. For example. much clearer patterns in the prevalence data, over relatively short distances, emerge if we aggregate forest types in Figures 4.2.4A, B and E (together with 'orchard', not shown) to derive an 'intermediate' definition of forest cover (Figure 4.2.4F). If we then make our forest definition more 'inclusive' by adding forest classes shown in Figures 4.2.4C and 4.2.4D, the apparent importance of distance becomes even more marked – with very few villages further than 750-1000 m from the forest experiencing significant levels of infection.

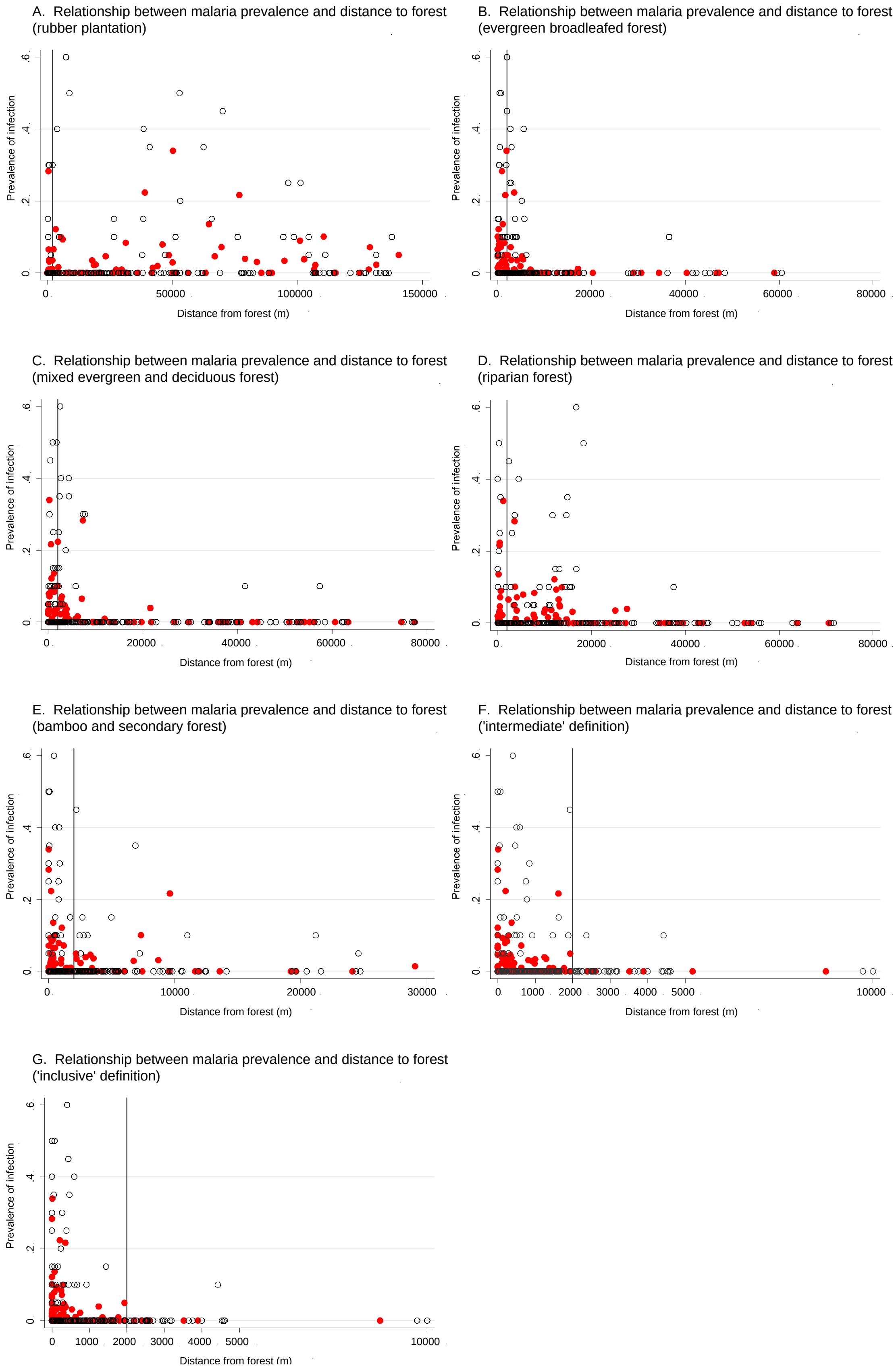


Figure 4.2.4 Graphs showing relationships between distance to forest and malaria prevalence at clusters (closed circles) and at mini-prevalence sites (empty circles) for selected individual forest types (Graphs A-E) and for two aggregated forest classes (F and G). Vertical lines indicate a distance of 2000 m from the forest edge.

4.2.3 Analysis of prevalence by risk zone

Figure 4.2.4 suggests that a broad relationship exists between distance to forest and malaria prevalence at village level – with a marked drop in levels of infection in settlements located further than 1000 m from the forest edge. However, it is not clear from these graphs whether any clear patterns exist *within* the 0-1000 m zone.

To assess these patterns, each cluster or mini-prevalence site was assigned to one of the following risk zones (conforming to those adopted by CNM), based on average household location or the central GPS position respectively:

Risk zone 1: within forest
Risk zone 2: within 200 m of forest
Risk zone 3: 201-500 m from forest
Risk zone 4: 501-1000 m from forest
Risk zone 5: >1000 m from forest

In this case we chose to use the 'intermediate' definition of forest (Section 4.2.2), principally because this was used in the initial selection of survey villages.

Figure 4.2.5 shows the variations in malaria prevalence when survey results are reorganised according to the risk zones above. The results of locally weighted regression (lowess smoothing) suggest a general decline in prevalence as anticipated risk of infection (on the basis of risk zone) declines. However, this rate of decline is extremely flat, especially when moving from risk zones 1-3 (*i.e.* from 'within forest' to areas within 500 m of the forest), and the degree of scatter for individual observations within each risk zone is large. This scatter is especially pronounced in the case of Figure 4.2.5B, and is probably indicative of the fact that mini-prevalence buffers were calculated using single points to represent the village location – while for clusters, buffers were calculated for each household individually. From the point of view of future work, this suggests that assigning risk categories to villages on the basis of single GPS points is probably not a sound approach – particularly as some villages are stretched over distances of several kilometres.

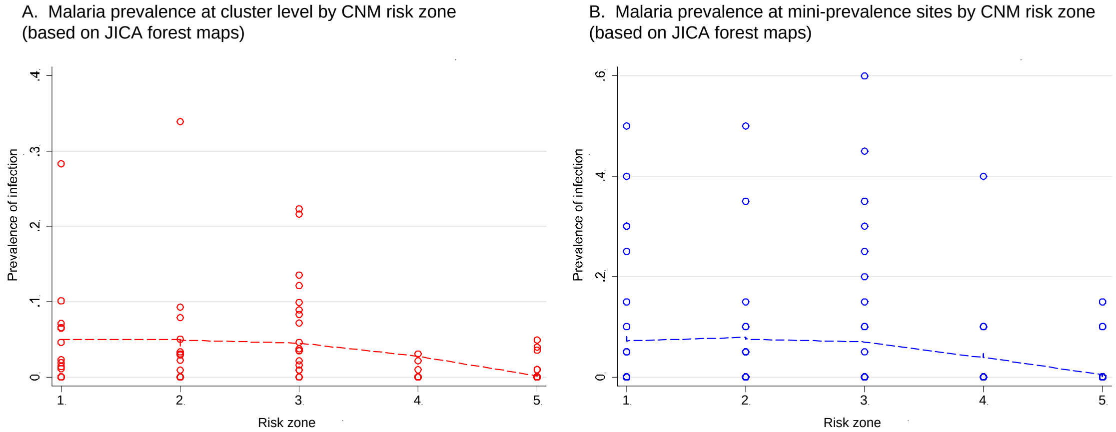


Figure 4.2.5. Variations in levels of malaria prevalence according to CNM risk zone for (A) cluster-level data and (B) data from mini-prevalence sites. Risk zones are determined by distance to forest, as indicated by JICA forest maps.

4.2.4 Alternative measures of exposure

Distance to forest is an attractively simple indicator of exposure, but alternative approaches may provide more meaningful measurements of the effect of forest from an epidemiological standpoint. Specifically, the proportion of forest within defined distances of a village may provide a better indication of potential human-vector contact than distance alone.

To test this we calculated a series of distance buffers around each cluster or mini-prevalence site and overlayed these clusters with the GIS data for forest (Figure 4.2.6). For each site we were then able to calculate the land area represented by different types of forest and express this as a proportion of total land area at given distances from each site. This exercise was carried out for distance buffers of 200, 500, 1000 and 2000 m for both clusters and mini-prevalence sites.

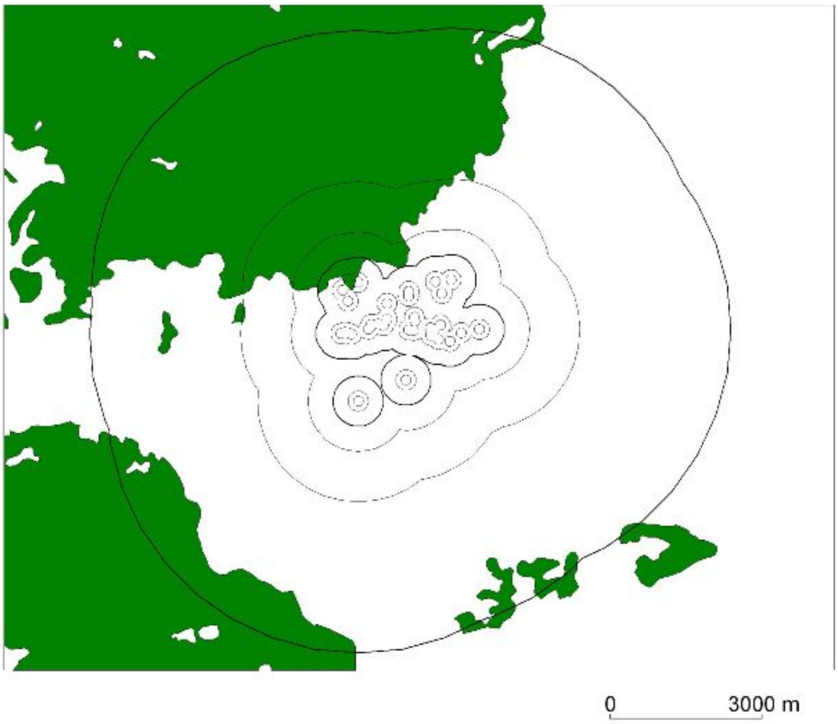


Figure 4.2.6 Using buffers to calculate area of forest at set distances

Perhaps surprisingly, results from this analysis showed no clear trends – and this was consistent for all forest types at all buffer distances. Results are typified by Figure 4.2.7, which shows graphs of prevalence for cluster and mini-prevalence sites against the proportion of forest at distances of 200, 500, 1000 and 2000 m. Poor correlations between prevalence and area of surrounding forest may be the result of inaccuracies within the JICA GIS data. Alternatively, it may be that area is actually a rather poor measure of exposure – and that other measures (*e.g.* length of forest boundary within certain distance thresholds) may have a better predictive value. These issues need to be explored in more detail in subsequent stages of analysis.

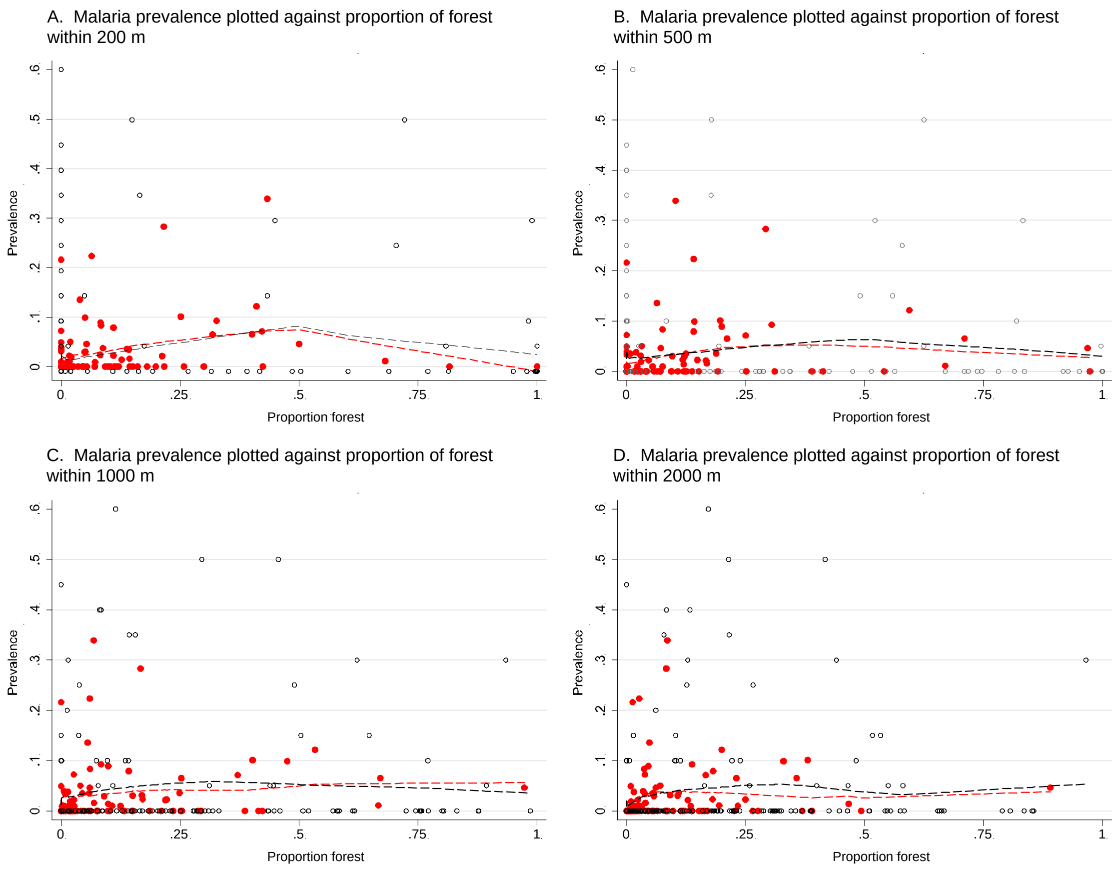


Figure 4.2.7 Graphs showing the proportion of intermediate forest against malaria prevalence at clusters (closed circles) and at mini-prevalence sites (empty circles) at distances of 200-2000 m.

4.2.5 Alternative indicators of forest

One of the main disadvantages of using existing GIS maps of forest coverage is that they are essentially 'static' and updating them is expensive, time consuming and beyond the capability of all but highly specialised teams. For these reasons there is a need to explore alternative ways of classifying village-level risk on a more dynamic basis, so that village-level classification of malaria risk can be updated as required (for example to reflect changing forest distribution).

In this project we explored three alternatives to using forest maps to predict risk: (i) rapid assessments of risk based on expert opinion; (ii) rapid GPS surveys of forest points at survey locations; and (iii) estimates of forest cover or vegetation index from satellite remote sensing. Preliminary results from these analyses are described in Annex 5.

4.2.6 Implications of results from geographical analysis

Although the analysis presented in this section and Annex 5 has been preliminary, the results would appear to have a number of significant implications:

1. Of the different measures evaluated, distance to forest, as measured by GPS survey, appears to provide the best measure of 'exposure' to forest – as indicated by relatively strong correlations between prevalence at clusters/mini-prevalence sites and GPS distance. Given that little time was available to train fieldworkers in

identifying different forest types or carrying out the GPS surveys, it would also appear that this constitutes a relatively robust method for carrying out rapid evaluations of village-level risk. The main drawbacks of the method are (i) the need to visit each village to take the GPS readings; and (b) the difficulty of drawing up suitable fieldwork protocols that minimise inter-operator error.

2. Estimates of village level risk (based on categorical risk zones) from expert opinion also appear to perform well when compared to prevalence measurements. The accuracy of this approach in terms of distinguishing *relative* malaria risk at village level (*i.e.* when risk is expressed categorically) still needs to be assessed – but it seems likely that expert opinion may represent a timely and cost-effective way of obtaining rapid estimates of village-level risk.

3. Analysis using GIS datasets for forest cover indicated a clear pattern of declining malaria prevalence with increasing distance from the forest edge. However, this pattern was not evident for all forest types and no clear patterns could be discerned within the 0-1 km buffer. This suggests that while existing forest maps may be useful for developing mask layers for excluding low risk villages (those further than 2 km from forest, for example), they are unlikely to be useful for differentiating levels of risk among the non-excluded villages. This is likely to reflect the fact that the satellite data on which the JICA forest estimates are based are now somewhat outdated.

4. Using the same GIS datasets for forest, the *proportion* of forest within defined distances of villages proved to be a poor predictor of malaria prevalence – and this finding was consistent for all forest types over a range of distance buffers. New measures of exposure (*e.g.* length of forest boundary) need to be explored.

5. Of the three RS-based datasets used in the current analysis, MODIS vegetation index data (EVI and NDVI) appear to have most potential from a risk-mapping perspective. There are a number of advantages to using these data: they are available free of charge; they have a spatial resolution well suited to national-level risk mapping; and their high temporal resolution allows compositing to remove clouds. It is likely that further transformations of the VI data (or, alternatively, transformations of raw spectral data) may improve their predictive value – and this will be explored in subsequent analysis.

4.3 Malaria prevention

Baseline indicators of knowledge of transmission and prevention and of prevention behaviour are shown below:

Core Indicators - prevention	
C2	% of target population who can explain how malaria is transmitted and prevented
C3	% of families living in endemic areas that have sufficient treated bed nets
C4	% of population at risk sleeping under insecticide treated nets the previous night, measured during peak malaria transmission season
Supplementary Indicators	
S5	% of children under-5 sleeping under treated bed nets that have sufficient treated bed nets the previous night

4.3.1 Knowledge of malaria transmission:

Core indicator C2: % of target population who can explain how malaria is transmitted

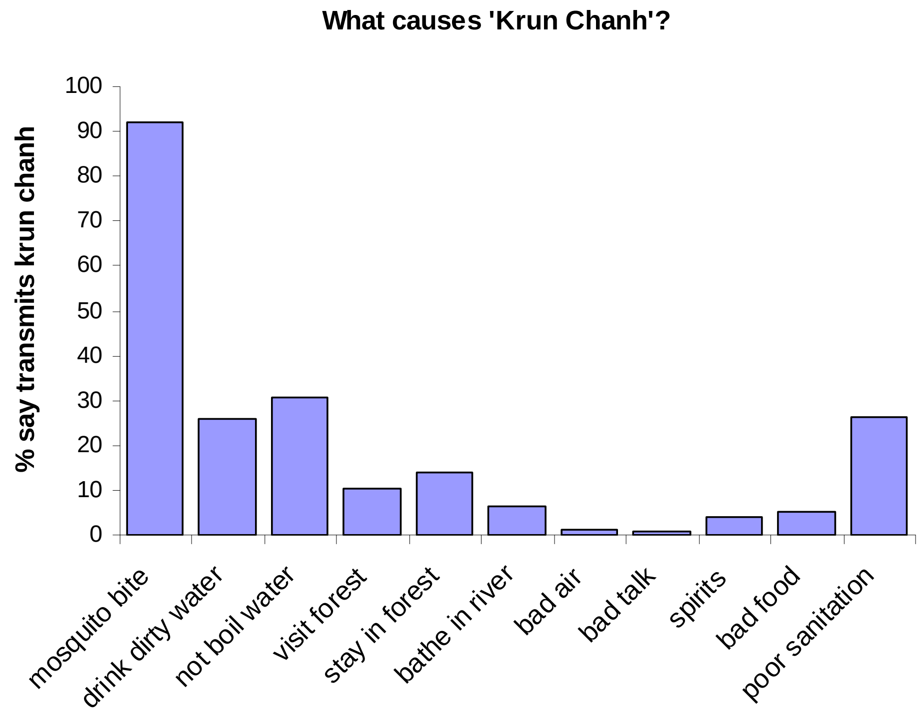


Figure 4. 3.1 Causes of 'krun Chanh' cited by respondents

Interpretation: Recognition that mosquito bites cause malaria is very high (92.0%), but some other causes, not related to malaria, are also mentioned, notably drinking dirty or unboiled water.

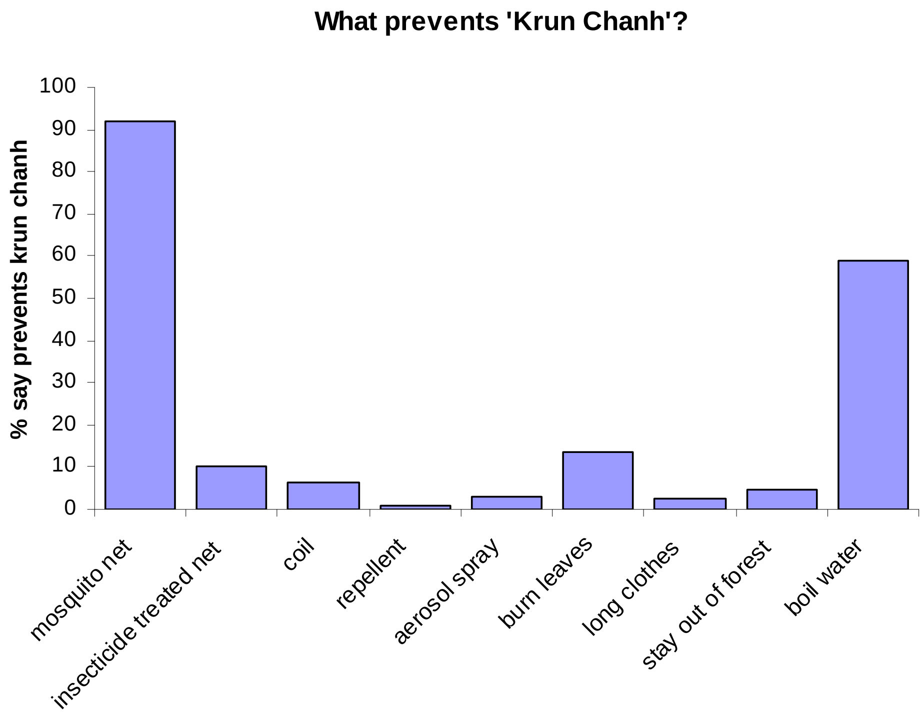


Figure 4. 3.2 Means to prevent 'krun chanh' cited by respondents

<u>Interpretation</u>: Recognition that mosquito nets prevent malaria is very high (92.2%), but some other actions, not related to malaria, are also mentioned, notably boiling water. Awareness of ITNs is very low: they were specifically mentioned by only 10%. We did not prompt specifically for net-treatment awareness: perhaps we should have asked what you can do to a net to make it work better.

Table 4.3.1 Knowledge of transmission by domain and riskzone ("Knowing malaria transmission" is defined as one or more of the responses: "mosquito bite" or "visit forest" or "stay in forest". "Knowing malaria prevention" is defined in three alternative ways, as specified in the column heads.)

		% knowing how malaria is transmitted	% knowing how to prevent		
			Net	Net + another correct	ITN
Risk Zone	1	94	93	35	11
	2	93	91	34	11
	3	93	92	32	8
Domain	1	94	94	32	10
	2	96	95	41	17
	3	90	88	28	4
Poorest quintile	Q1	93	92	31	12
2nd quintile	Q2	91	90	33	11
3rd quintile	Q3	93	91	38	13
4th quintile	Q4	91	92	29	6
Least poor quintile	Q5	96	95	37	10
Total		93	92	34	10

Interpretation: This confirms what was seen in the histograms. Functional knowledge of both transmission and prevention are both high, and include awareness of the association between malaria and forest.

Knowledge of the role of mosquitoes in transmission varies only to a small degree between domains, and hardly at all between risk zones (i.e with proximity to forest). Knowledge of transmission in domain 1, which contains the highest proportion of ethnic minority and very isolated communities, was no worse than in the other domains.

The only serious gap in knowledge is about ITNs. Note that what is missing is knowledge of the insecticide, not knowledge of nets. Almost everyone knows that mosquito nets are good for prevention, and this varies only to a small degree between domains, and hardly at all between risk zones (i.e with proximity to forest). The frequency with which nets are mentioned suggests that this knowledge is effectively universal.

It should be noted that there is a small discrepancy between the way the question was asked and the definition agreed by the Task Force for this indicator. The original plan was to define "adequate knowledge of prevention" as mentioning "use of a net" plus one other correct response. However, although the questionnaire permitted multiple responses, the interviewer did not solicit more than one response. Moreover, net-use is certainly much more effective than any of the other supposedly "correct" responses, and some of these (e.g. wearing long clothes, use of an aerosol), lack the support of good quality scientific evidence.

For these reasons, it is recommended that respondents who mentioned "use of a net" should be regarded as having adequate prevention knowledge, whether or not they also mentioned another method. It is further recommended that health education messages should focus on increasing the proportion of people who mention insecticide treatment, and that this proportion should be regarded as the most important indicator of further improvements in knowledge of prevention in the future.

Table 4.3.2 Availability and Knowledge of where to buy nets. The question was: "if you decided to buy a bednet now, would you go to buy it at <NAME> market or from a nearer place or from a place further away?" For each village, we established the name of the local market normally used by village people. This was done by consulting the national community database and by asking the head of the village. The name of this market was used by the interviewer in place of <NAME> in the question.

Nearer	At local market	Further away	Not buy / other	Don't know	N
%	%	%	%	%	
19	**71**	**7**	**1**	**1**	**3204**

Interpretation: Nets are very widely available, everywhere. The commonest place to buy is the local market, and most of those who wouldn't buy there would get the net somewhere closer. Very few would have to go further away. There is remarkably little variation between domains and risk zones and socioeconomic groups, except that those in the poorest quintile are more likely to say that they wouldn't buy. There is no tendency for people living within or close to the forest to say that they would have to buy further away.

Table 4.3.3 Knowledge of where to get insecticide treatment: "If you decided that your nets needed to be treated or retreated with insecticide, where would you go?"

		Wait for project/ health staff	Go to health centre/ project office	Others (pharmacy, market, shop, etc)	Don't want	Don't know	N
		%	%	%	%	%	%
CMBS Risk Zone	1	30	6	1	1	63	1439
	2	34	4	2	0	60	892
	3	17	2	1	1	80	871
Domain	1	41	1	1	0	57	1056
	2	37	6	2	0	54	1079
	3	8	3	1	1	86	1067
Poorest quintile	1	33	3	0	1	64	595
2nd quintile	2	34	3	0	0	61	641
3rd quintile	3	28	3	2	0	68	652
4th quintile	4	23	3	1	1	73	641
Least poor quintile	5	20	6	2	1	71	671
Total		27	4	1	1	68	3202

<u>Interpretation</u> Few people know where to get insecticide, and most of these people are waiting for the government to come and give it to them. Going to fetch insecticide is seen as an option by very few people. We didn't ask a preliminary question as to whether people did want insecticide (perhaps we should have done). But there were surprisingly few responses of "don't want insecticide". It is notable that people in domain 3 are less likely to say that they would wait for the project or health staff to bring insecticide, and more likely to report not knowing how to obtain it.

4.3.2 Prevention indicators: levels and patterns of ITN coverage

Core Indicator C3	% of families living in endemic areas that have sufficient treated bed nets[3]

Net ownership rates

The indicator selected by the Task Force to measure net ownership is “the proportion of households in endemic areas that have sufficient nets”, where sufficient is defined as a people:net ratio of less than 2.3, i.e. the household has at least one net for every 2.3 people.

Actually the survey data suggest that this is NOT an appropriate cut-off for “sufficient” in this setting, i.e. it is excessively rigorous. In the survey as a whole, 87% of under-fives in surveyed households were actually sleeping under a net, and similarly high levels of net coverage and usage were present everywhere, in all sub-groups (table 4.3.7). These coverage rates are impressively high, and surely imply that, in practice, all but a small minority of households had “enough nets” to cover small children.

According to the official definition, however, if “sufficient” is defined as less than 2.3 people per net, then only about 37% of households had “sufficient” nets (table 4.3.4). So this definition is clearly inappropriate. Further analysis of the person:net ratios observed in survey households, and their relationship to levels of usage by under-fives, will be needed in order to re-define a more appropriate cut-off. This is discussed in more detail below. For the moment, the key point is that the overall person:net ratio in the survey population was 2.6, and this was sufficient to give a usage rate in under-five children of almost 90%.

Net ownership is surprisingly high: of the surveyed households, 95% reported owning one or more nets, 56% reported owning one or more ever-treated nets, and 24% reported owning one or more ITNs (i.e. recently-treated nets).

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[3] **Definitions:**
- “**Net**” = a mosquito net or a hammock net, whether treated or not;
- “**Never-treated net**” = a net that according to q24 has never been treated with insecticide;
- “**Ever-treated net**” = a net that according to q24 has been treated with insecticide at some time in the past;

“**ITN**” or “**Insecticide-treated net**” = a net that according to q25 has been treated or retreated with insecticide within the last 12 months, or a net that according to q19 and q20 has been obtained within the last 12 months from a project (Govt or NGO) source (and is therefore assumed to be pre-treated).

Table 4.3.4: Percentage of households with sufficient *nets*, i.e. at least one net for every 2.3 people

Riskzone	%	N	Total
<250m	36.4	552	1535
250m to <1km	39.9	355	914
1km to <2km	34.8	347	914
Domain	**%**	**N**	**Total**
1	37.9	416	1128
2	32.1	387	1131
3	41.6	451	1104
Quintile			
Q1 (poorest)	28.2	203	666
Q2	31.1	210	672
Q3	33.6	221	676
Q4	38.3	259	665
Q5	50.1	360	682
Total	37.2	1254	3363

"Sufficient" = at least 1 net for 2.3 people, by household
Denominator: Households

Table 4.3.5: Percentage of households with sufficient *ITNs*, i.e. at least one net for every 2.3 people

Riskzone	%	N	Total
<250m	7.7	133	1535
250m to <1km	9.7	78	914
1km to <2km	3.7	38	914
Domain	**%**	**N**	**Total**
1	8.0	72	1128
2	12.2	150	1131
3	1.6	27	1104
Total	7.0	249	3363

"Sufficient" = at least 1 net for 2.3 people, by household
Denominator: Households

Using the person:net ratio, by household, as an indicator of "sufficient".

The use of "sufficient" is unusual, and its meaning has to be defined. This sub-section discusses this issue, using illustrative examples drawn from the data on nets (rather than ITNs).

Within Southeast Asia, a commonly used index of coverage is the number of people divided by the number of nets (i.e. the people: net ratio). It is also a convention, within Cambodia, and we believe also regionally, to use "less than 2.3 people per net" as the standard for this index, in order to define programme targets and to estimate procurement needs. This standard is not widely used by programmes outside the region, and its success within the region seems to be attributable to its simplicity and usefulness in practice. Here, therefore, we employ the conventional standard of "less than 2.3 people per net" for this indicator.

However, when we designed the survey, we were unsure of the exact nature of the evidence on which this figure is based. For this reason, and in order to be confident that achievement of this people-per-net ratio does actually produce “sufficient” coverage of target groups, we have collected the detailed data needed to fill this gap in the evidence. Later, we will analyse how net usage by target groups varies with variation in the people-per-net ratio. We will define what level of usage by target groups is associated with the standard ratio of 2.3, and will consider re-defining the target if it this is necessary.

This analysis is, however, complicated by the level at which the ratio is calculated. Here, for the GFATM indicator, it is used as a household-level index, but we suspect that this is novel, and that in the past it was used mainly as a community-level index, for prioritising communities for intervention, and for estimating procurement needs. This makes a difference. To illustrate this, consider Table 4.3.3. In the whole survey, there were 6782 nets and 17755 people. So in the whole sample, there was one net for every 2.6 people, implying that overall in the survey population, the target of one net for every 2.3 people has not been achieved. But if we disaggregate by cluster, and calculate a separate ratio for each cluster (from the 10 surveyed households in each cluster), we find that 30 % (27 / 90) of clusters met the target (with a ratio of less than 2.3 people per net), compared to the 37% of households that did so. Moreover, there is good deal of discordance between cluster and household levels: in clusters that do meet the target (cluster ratio<2.3), there are many individual households that fail to meet the target (household ratio>2.3), and vice versa (Table 4.3.3).

For present purposes, i.e. tracking progress towards coverage goals, the household ratio is appropriate. For other purposes – e.g. for identifying villages that should be targeted either for ITN distribution or for insecticide re-treatment only - the cluster-level ratio may be more useful. It should be noted that the results are slightly different depending on how they are calculated.

However, setting a required standard of 1 net for every 2.3 people may be excessively demanding. It will be important to analyse the relationship, at household level, between the people:net ratio and the proportion of under-five children who are covered. However it should be noted that more than 80% of children are already covered by a net, even though only 37% of households have “sufficient” nets according to the 2.3 cut-off. So it seems quite possible that further analysis will show that this cut-off is unnecessarily demanding, and that very high levels of net use occur even with people:net ratios of >2.3.

Table 4.3.6 Cluster- versus household-level person:net ratios: classification of households according to the person-net ratio, as calculated either at cluster level (columns), or at household level (rows).

		Numbers of households in clusters with cluster-level ratios of		
		Cluster ratio > 2.3 (63 clusters)	**Cluster ratio < 2.3** (sufficient nets) **(27 clusters)**	**All 90 clusters**
Number (%) of Households with a household-level ratio	**HH ratio > 2.3**	1703 **69.9%**	406 **43.8%**	2109 **62.7%**
	HH ratio < 2.3 (sufficient nets)	733 **30.1%**	521 **56.2%**	1254 **37.3%**
	Total HH	2436 **100.0%**	927 **100.0%**	3363 **100.0%**

Interpretation: Person-net ratios, with the standard cut-off of one net for every 2.3 people, give slightly different figures when used to define ownership of “sufficient” nets at the household level rather than sufficient coverage at the community level.

Even in communities with lower levels of coverage (i.e. overall ratio >2.3) which might for this reason be selected for additional ITN distribution, some 30% of households already have “sufficient” nets for themselves.

Table 4.3.7 Percentage of people, of children under five years, and of pregnant women, who slept under a net or an ITN last night, by domain, risk zone, old risk category and socioeconomic status.

		% population slept under:			% U5s slept under:			% pregnant women slept under:		
		Any net	ITN	N	Any net	ITN	N	Any net	ITN	N
		%	%		%	%		%	%	
CMBS Risk Zone	1	86	23	*6848*	90	24	*901*	85	15	*165*
	2	87	26	*4293*	89	24	*545*	89	17	*73*
	3	79	11	*4569*	81	11	*450*	83	7	*68*
Risk category 2001	1	86	31	*4878*	91	30	*636*	88	22	*115*
	2	88	35	*2120*	85	30	*261*	83	11	*38*
	3	86	18	*2540*	86	16	*302*	98	9	*37*
	4	90	12	*2058*	95	18	*257*	90	26	*35*
Risk category 2005	1	85	32	*3861*	89	32	*534*	84	33	*86*
	2	81	8	*1722*	83	8	*216*	84	13	*50*
	3	89	20	*3026*	92	16	*364*	92	1	*60*
	4	73	8	*1909*	77	13	*242*	83	10	*40*
Domain	1	82	22	*5204*	85	22	*686*	77	18	*100*
	2	82	34	*5281*	85	31	*663*	87	15	*103*
	3	87	5	*5346*	90	6	*547*	91	8	*103*
Total		84	20	*15831*	87	20	*1896*	86	13	*306*

Interpretation: Usage levels are high, and probably adequate for nets, but lower and inadequate for ITNs. ITN usage is limited NOT so much because people lack nets, but because the nets they use are untreated, or not recently treated.
Under fives have approximately the same probability of using a net as the whole population, i.e. there is no evidence that they are given higher or lower priority for net use, or ITN use, than other members of the family. There is some evidence (borderline significance?) that ITN use rates are lower among pregnant women than others. This is investigated in the next table.

C4	% of population at risk sleeping under insecticide treated nets the previous night, measured during peak malaria transmission season
S5	% of children under-5 sleeping under treated bed nets that have sufficient treated bed nets the previous night

Table 4.3.8 Comparing usage of nets by different age-groups

	% slept last night under				
Age	**Did not use a net**	**Never-treated net**	**Previously-treated net with expired treatment**	**ITN**	**Total N**
<5	13	48	19	20	1916
5-14	15	47	17	21	4717
15+ M	20	46	16	18	4185
15+ F	16	49	16	19	5013
Pregnant F	14	55	18	13	306

Interpretation As previously shown, the great majority of people sleep under nets, but only a small proportion sleep under a recently-treated ITN. "These data show further that more or less the same proportion again sleep under "previously-treated" nets, i.e. nets that were treated more than 12 months previously. These are presumably a mixture of project nets, and commercial nets that were treated in dipping campaign(s) more than a year before.

This applies to all age-groups and both sexes of adult – including young children. This finding contrasts with those seen in NetMark surveys in several African countries. These showed that in net-owning families, young children and adult women are favoured for net-use, i.e. they are consistently and substantially more likely to be using the net (or ITN) than adult males and older children.

The data suggest that compared to other adult women, pregnant women are slightly more likely to be using a never-treated net, and are less likely to use a recently-treated ITN. In other words, pregnant women are using nets just as much as everybody else, but it seems that some may be choosing to use an untreated net instead of a treated one. One possible explanation, suggested by qualitative work in other countries, is that fears of chemical toxicity and teratogenicity may be inhibiting ITN use by pregnant women.

Table 4.3.9 Ownership of nets

		% (number) of households owning:													
		0 nets	1 net	2 nets	3 or more nets	N	Mean nets per HH	Median nets per HH	0 ITN	1 ITNs	2 ITNs	>=3 ITNs	N	Mean ITNs per HH	Median ITNs per HH
CMBS Risk Zone	1	5	30	37	28	1535	1.85	2	70	14	10	7	1535	0.57	0
	2	2	29	37	32	914	1.96	2	68	12	12	7	914	0.53	0
	3	6	29	30	36	914	1.99	2	86	4	6	4	914	0.31	0
Risk zone 2001	1	3	28	37	31	1108	1.91	2	60	16	15	10	1108	0.63	0
	2	2	31	40	28	462	1.91	2	61	13	17	8	462	0.63	0
	3	2	30	35	33	52	1.99	2	78	10	7	4	52	0.44	0
	4	1	30	35	34	417	1.98	2	85	8	5	3	417	0.35	0
Risk zone 2005	1	5	29	36	30	936	1.83	2	57	19	16	9	936	0.68	0
	2	3	31	34	32	343	1.98	2	87	7	4	2	343	0.22	0
	3	2	25	41	32	608	1.99	2	76	8	9	7	608	0.36	0
	4	13	32	29	26	389	1.79	2	89	6	2	3	389	0.31	0
Domain	1	5	30	35	31	1128	1.87	2	70	13	11	7	1128	0.44	0
	2	5	32	36	27	1131	1.88	2	60	14	16	10	1131	0.81	0
	3	2	26	33	38	1104	2.01	2	92	10	2	2	1104	0.19	0
Poorest quintile	1	8	47	31	14	666	1.50	1	76	14	8	2	666	0.44	0
2nd quintile	2	4	39	35	22	672	1.72	2	69	13	12	6	672	0.53	0
3rd quintile	3	3	34	34	28	676	1.87	2	70	12	12	6	676	0.52	0
4th quintile	4	4	19	39	37	665	2.10	2	79	7	8	6	665	0.42	0
Least poor quintile	5	2	12	33	53	682	2.40	3	78	5	9	8	682	0.52	0
Overall		4	29	35	33	3363			75	10	10	6	3363		

Interpretation: There is no shortage of nets, but there is a major shortage of ITNs!! 96% of families have at least one net! 68% of families have two or more nets!! One-third of families have three or more nets!!! This is consistent everywhere, with remarkably little association with distance from forest or with the risk categories defined in 2001. (The same is also true for the 2005 risk categories). However, there is a clear relationship between socioeconomic status (SES) and the number of nets owned: the mean number of nets-per-household is 1.5 in the poorest quintile of households and 2.4 in the least poor quintile.

By contrast, 75% of families have zero ITNs. As expected, ownership of ITNs is noticeably higher closer to the forest (by risk zone) and especially in the 2001 risk categories 1&2. All this confirms that net ownership is not lacking, and that the most important barrier to ITN coverage is that these nets have not been treated in the last 12 months. In contrast to nets, ownership of ITNs is remarkably equitable across SES groups.

Table 4.3.10. Source of net vs treatment history of net.

	"Has the net ever been soaked with insecticide?"			
Source	**Yes**	**No**	**Don't Know**	**N**
Government / NGO / Project	**80 %** 2026	**19 %** 474	**0.7 %** 17	**100 %** 2517
Commercial Market/Shop/Hawker	**18 %** 686	**82 %** 3143	**0.1 %** 3	**100 %** 3832
Gift/Relative/Other	**32 %** 135	**66 %** 279	**2 %** 10	**100 %** 424

Interpretation: This table helps to validate responses to two questions: "where did the net come from?" and "has it been treated?". It shows that responses to these two questions are remarkably consistent with the distinctive pattern that we would expect from our knowledge of net supply systems. Health services and projects have almost always distributed treated (not untreated) nets, and conversely, commercial net-sellers almost exclusively sell untreated nets. So this is consistent with users' reports that 80% of project nets have been treated, and that 82% of nets reportedly bought from commercial sources are never-treated. The fact that 18% of commercial nets were said to have been treated could reflect confusion on the of owners, but it could also reflect the activity of net-treatment campaigns. There were surprisingly few "don't knows". The congruence of the responses with our *a priori* expectations provides strong corroboration for the validity of both these questions, i.e. "where did you get your net?" and "has it ever been treated?"

Table 4.3.11 Sources of nets by risk zone

		Source of net					
		Government Health Service NGO / Project	Market stall	Shop	Itinerant seller	Gift / Other / Don't know	N
		%	%	%	%	%	
Risk Zone	1	47	36	0.4	12	6	2969
	2	36	37	0.7	17	7	1877
	3	21	57	1.5	14	7	1928
Overall		37	42	1	14	6	6774
Total number		2517	2859	54	920	411	6774

Interpretation: The majority of nets, 57%, are bought from commercial sources. Projects and health services are an important source in risk zone 1, closest to the forest, where they have supplied about 47% of nets. In zone 3, a much smaller proportion of nets (only about 21%) has come from the government. Most government / project nets (55%) are found in villages of risk zone 1. Although forest-fringe have this higher coverage of government nets, overall net ownership and coverage is no higher than in other areas. Is this because people are poorer, and without the free nets coverage would be lower, or is it because people are buying fewer nets for themselves because they don't need to do so?

The association of malaria infection with use of nets was examined to see if the risk of malaria was higher in people not using nets (Table 4.3.12)

Table 4.3.12 Association of net use and malaria prevalence in different age-groups

	% malaria slide positive		Total number	
Age	**Did not use a net**	**Did use a net**	**Did not use a net**	**Did use a net**
<5	2.9	3.0	160	1,028
5-14	9.7	1.9	285	1,627
15+ M	8.1	3.1	436	1,844
15+ F	2.2	1.2	419	2,637
Pregnant F	12.5	2.3	42	253

There was very little difference in malaria slide positivity rate in children under five using nets or not, while other age groups had a higher positivity rate if not using a net. The difference was significant in 5 to 14 year olds, adult men and pregnant women. At first sight these results are surprising, suggesting nets provide less protection to children under five years. They also suggest greater protection of pregnant than of non-pregnant women. Further analysis of these data will be undertaken later to understand them better. For instance, are older people often away from home when not using net, what effect does net treatment have? Are the young children more likely to be in house with a treated net, which may offer some protection?

4.4 Malaria treatment

The questions on malaria treatment in the household survey included a series on knowledge about treatment and a series on treatment seeking. The health centre survey included questions on stocks of drugs and diagnostics as well as on availability of microscopes and training of staff. The outlet survey looked at availability of drugs.

4.4.1 Knowledge of treatment

Questions on recognition of malaria and knowledge of treatment practice were designed to act as a baseline for measuring changes in 1) knowledge of malaria related to educational interventions and 2) knowledge of use of Malarine related to promotion of highly subsidised drugs through private providers. They provide data for the following supplementary indicators:

Supplementary indicators

S1 % mothers and care takers able to recognize signs and symptoms of danger of a febrile illness in a child <5 years.
S8 % awareness of Malarine among the targeted populations
S9 % of target groups who know where to obtain testing and treatment for malaria
S10 % of target groups who know that Malarine treatment is effective only if entire course is taken

Table 4.4.1 shows the signs and symptoms most commonly noted by respondents in order of frequency.

Table 4.4.1 Number and % respondents mentioning each sign and symptom (number respondents = 3,363) (q37)

Sign/symptom	%	N
Fever	83.8	2,845
Chills	75.1	2,542
Headache	42.3	1,469
Body ache	12.4	448
Don’t know	11.9	361
Loss of appetite	8.8	277
Other	7.8	275
Sweating	5.0	181
Diarrhoea	1.7	55

Interpretation: The National Treatment Guideline for Malaria (November 2004) cites fever, chills and sweating as the cardinal symptoms of uncomplicated malaria with a longer list of other common signs and symptoms. The first two were identified by the great majority of respondents, while only 5% mentioned sweating. One of the commonly used Khmer language terms for malaria Krun Nheak means literally fever with chills. Headache is very frequently associated with malaria by respondents. 10.7% (361) respondents did not know any signs and symptoms of malaria, suggesting the need for awareness raising.

Table 4.4.2 shows recognition of signs and symptoms of malaria by risk zone and by domain.

Table 4.4.2 % 'households' recognise signs and symptoms of malaria

Riskzone	%	N	Total
<250 m	72.0	1096	1535
250 m to <1km	70.9	649	914
1km to <2km	71.1	664	914
Domain	**%**	**N**	**Total**
1	70.3	778	1128
2	80.0	898	1131
3	63.7	733	1104
Total	71.2	2,409	3,363

definition: those who know both fever and chills are symptoms
denominator: household respondents

Using the definition above the table shows little variation by risk zone, but a slightly lower knowledge in domain 3 where people have less exposure to malaria and control programme activities. 71% of households recognising signs and symptoms points to gaps in education programmes which can be tracked in the follow-up survey.

S1	% mothers and care takers able to recognize signs and symptoms of danger of a febrile illness in a child <5 years.

This supplementary indicator is largely derived from the following question, although the data are based on respondents, who may or may not be mothers and caretakers.

Table 4.4.3 Percentage and number of respondents mentioning each sign and symptom indicating serious fever (q38)

Sign/symptom of severe malaria	%	N
Very hot (high fever)	82.2	2,805
Unconscious	29.2	951
Convulsions	19.5	651
Not eating	12.2	405
Fast breathing	9.2	309
Other	9.4	301
Don't know	7.9	244
Frequent vomiting	6.9	239
Yellow eye colour	4.1	138
Very pale skin	3.7	127
Diarrhoea	3.2	89
Not breastfeeding	0.7	21

Interpretation: 7% (244) respondents did not know any signs and symptoms of malaria, suggesting again the need for awareness raising.

The Cambodia community IMCI module specifies unconsciousness, convulsions, fast breathing, high fever, not eating, not breastfeeding, frequent vomiting, diarrhoea as *general danger signs* requiring the patient to go to hospital. The percentage mentioning at least one of these signs and symptoms was 91.9 (n= 3,090).

The community IMCI module specifies *malaria danger signs* requiring the patient to go to hospital as loss of consciousness, dizziness, chills/shaking and high fever. The percentage mentioning at least one of signs and symptoms like these (unconsciousness, convulsions, high fever) was 90.3 (n= 3,035). These results suggest that people are well aware of danger signs.

S9 % of target groups who know where to obtain testing and treatment for malaria

Table 4.4.4 Percentage and number of respondents specifying different places they would go for a malaria test (q41).

Health Facility	%	N
Public Sector	*Total public: 69.1*	*2,250*
Government health centre	42.4	1,432
Government hospital	24.5	731
Village malaria worker	1.2	54
Village health volunteer	0.8	28
Government health post	0.2	5
Private Sector	*Total private: 25.4*	*909*
Private doctor	18.7	681
Private hospital / clinic	5.3	175
Pharmacy/drug shop	0.9	36
Private laboratory	0.4	15
Traditional practitioner	0.1	2
Other	0.3	11
Don’t know	5.4	193

Interpretation: Most people did have some idea of where they may obtain a test and specified predominantly public sector facilities. This is quite surprising given the high rates of use of the private sector, but could reflect limited access to diagnosis in the private sector. The high public sector usage is not, however, borne out by information on what respondents actually did when a household member had fever. Of 212 people seeking a test 41.6% chose public sources, and 58.4% used private providers (Table 4.4.10)

Table 4.4.5 Percentage and number of respondents specifying different places they would go for advice or treatment (q44)

Health Facility	%	N
Public Sector	*Total public: 64.9%*	*2,108*
Government health centre	40.8	1,362
Government hospital	21.9	662
Village malaria worker	1.0	43
Village health volunteer	0.9	34
Government health post	0.3	7
Private Sector	*Total private: 32.3%*	*1,142*
Private doctor	22.6	828
Private hospital / clinic	5.6	176
Pharmacy/drug shop	3.6	126
Private laboratory	0.2	5
Traditional practitioner	0.3	7
Other	0.5	18
Don’t know	2.4	95

<u>Interpretation</u>: Again most people specified public sector sources with a very low (3.8%) of people specifying that they would use pharmacies and shops. This result is somewhat surprising, as use of private providers is generally considered to be widespread in Cambodia. Possible explanations are that the public sector services are indeed more widely used than the private sector, there was a reluctance to answer the question accurately or respondents thought the question was where should they go. Actual percentage use of public and private sector by the respondents for household members with fever in the last two weeks was 24% public sector and 76% private sector (see Table 4.4.8).

Table 4.4.6 % ‘households’ know where to go for testing and treatment of malaria

Riskzone	%	N	Total
<250 m	97.4	1392	1427
250 m to <1km	97.3	836	862
1km to <2km	99.5	867	871
Domain	**%**	**N**	**Total**
1	95.7	1013	1042
2	98.8	1056	1074
3	99.0	1026	1044

Definition: know where to go for testing and treatment of malaria according to the question on where the respondent would go for advice or treatment and accepting all answers except village health volunteer, traditional healer and “don’t know”.
Denominator: households (respondents)

<u>Interpretation</u>: This table responds to indicator S9, and shows a very high rate of knowledge of sources of treatment, which is uniform across risk zones and domains.

S8 % awareness of Malarine among the targeted populations

A component of the round 2 GFATM grant is to restart the promotion of subsidised Malarine but with a much greater subsidy than before. Malarine was provided previously, but new supplies had not been made available recently and prices made use very limited, so that high familiarity was not expected. A+M is provided as first-line treatment to parasitologically diagnosed cases in public sector facilities. It was unfortunately not found practical to ask separately about Malarine and A+M because pretests suggested respondents had difficulty distinguishing the two.

Table 4.4.7 % 'households' aware of Malarine and /or A +M

Riskzone	**%**	**N**	**Total**
<250 m	42.4	636	1512
250 m to <1km	42.5	350	909
1km to <2km	52.6	469	909

Domain	**%**	**N**	**Total**
1	26.8	309	1112
2	60.9	638	1126
3	44.4	508	1092
Total	46.1	1,455	3,330

Definition: those *who have heard of Malarine and/or A&M*
Denominator: households (respondents)

Interpretation: 46% of respondents had heard of Malarine and/or A+M, and there was little variation among the three risk zones (q47). Knowledge was greatest in domain 2 and lowest in domain 1. This may reflect the level of commercial market in drugs, and provides a useful baseline for education strategies. Careful consideration will be needed on the messages to transmit to potential buyers. As shown later (Table 4.4.11) antimalarial drug use for fever is lower than use of other more general antipyretics. It is important not to promote Malarine excessively to those unlikely to need it.

93% of respondents, who had heard of Malarine and/or A+M reported that it was used for treating malaria, 0.6% for fever, 0.1% for other purposes, and 7% did not know (q48).

59% of those who had heard of the drugs knew that the durations of treatment is 3 days, while 40% did not know, 0.3% suggested 2 days, and 1% suggested more than 3 days (4-30 days) (q49).

S10 % of target groups who know that Malarine treatment is effective only if entire course is taken

41% of 815 respondents specified that patients would get sick again if they took fewer days than recommended, while 29% cited other reasons, 1% thought nothing would happen, and 28% did not know (q50). Responses to the question on consequences of not taking all the tablets (q51) were similar.

4.4.2 Treatment practice – patients

Core indicator	
C1	% of people seeking treatment from trained providers within 48 hours of developing a fever
Supplementary indicator	
S2	% seeking treatment from trained provider/total cases of febrile illness

In order to derive the data for core indicator C1 four questions were analysed. Question 52 (any fevers in the household in the last two weeks) provides the denominator, question 55 (did they seek advice or treatment) and question 56 (where did they seek it) provide information on the percentage treatment from a trained provider and question 59 (how long after fever started did they seek advice or treatment) determines whether it was in 48 hours. Supplementary indicator S2 is the first two parts of this.

Table 4.4.8 Sources of advice or treatment for fever in the last two weeks for respondents or household members (q56 – not sought = q55) :

Health Facility	%	N
Public Sector	*Total 24%*	*329*
Government hospital	5.7	77
Government health centre	15.3	208
Government health post	0.7	9
Village malaria worker	1.2	16
Village health volunteer	1.4	19
Private Sector	*Total 76%*	*1,021*
Private hospital / clinic	3.4	46
Private laboratory	0.2	2
Pharmacy/drug shop	27.9	381
Private doctor	43.0	586
Traditional practitioner	0.4	6
Other	1	13
Don't know	0.1	1

Interpretation: The percentage people seeking treatment in the private sector is very high (76%) and the reverse of what people said they would do (65% said they would seek advice or treatment from public sector providers; see Table 4.4.5). This emphasises the importance of ensuring better quality of care in the private sector as well as addressing barriers to use of public facilities.

Table 4.4.9a % seeking treatment from trained person within 48 hrs (Core Indicator 1)

Risk zone	%	N	Total
<250 m	37.8	344	959
250 m to <1km	41.3	214	543
1km to <2km	42.1	225	529
Domain	**%**	**N**	**Total**
1	36.0	227	649
2	41.3	308	797
3	43.8	248	585
Total	40.8	783	2,031

Definition: seek treatment from a trained person within 48 hours of developing fever
Note: in this table (Table 4.4.9a) trained providers include all but village health volunteers and traditional practitioners.
Denominator: all people with a fever (Questions 52, 55, 56 and 59)

Table 4.4.9b % seeking treatment from trained person within 48 hrs excluding pharmacy / drug shop

Risk zone	%	N	Total
<250 m	24.5	237	959
250 m to <1km	29.3	141	543
1km to <2km	28.3	153	529
Domain			**Total**
1	21.5	144	649
2	29.6	213	797
3	30.2	174	585
Total	27.8	531	2,031

Note: in this table (Table 4.4.9b) trained providers include all but village health volunteers, traditional practitioners and pharmacy drug shop..

Interpretation: Tables 4.4.9a and b respond to Core Indicator C1. Table 4.4.9 used the definition of trained providers agreed during the analysis, and shows a percentage of 40.8. This percentage clearly indicates a need for improvement. However, interpretation of this indicator is difficult. If pharmacist/drug shop is excluded the percentage drops to 27.8%. Since it is known that many people buy drugs from untrained medicine sellers, it is proposed that future surveys carefully distinguish trained pharmacists from untrained medicine sellers. The difference between the two rates shows that shops are an important source of treatment within 48 hours

Table 4.4.10 Sources of a diagnostic test for fever in the last two weeks for respondents or household members (q70 – not sought = q69)

Health Facility	%	N
Public Sector		
Health facility	32.7	70
Village malaria worker	8.9	22
Private Sector		
Health facility	58.2	118
Pharmacy/drug shop	0.2	2

Interpretation: Points to note here are that private sector facilities provide a majority of diagnostic tests, and this would be an important avenue to explore further. In the public sector 8.9% of diagnostic tests were provided by village malaria workers showing that this programme has significant reach; in fact it provides 24% of all tests reported in the public sector. It is important to recall that the survey sampling is focused on areas near forest where VMWs are deployed, and the proportion would be lower in a nationwide survey, but these are the areas with most of the malaria risk.

Drugs taken by respondents or other household members with fever in last two weeks

A wide range of drugs was cited for treatment of fever, and the commonest in all risk zones and domains was a drug cocktail, the second commonest was paracetamol and third commonest were others or "don't know".

Table 4.4.11 Percentage of fever cases taking drugs who used antimalarials by CMBS risk zone and domain

Risk zone	% taking antimalarials	N	Total taking drugs
<250 m	4.7	27	614
250 m to <1km	7.9	22	347
1km to <2km	8.3	25	326

Domain	% taking antimalarials	N	Total taking drugs
1	4.6	18	438
2	10.8	54	617
3	1.1	2	232
Total	7.3	74	1287

Interpretation: The percentage of drugs taken which were known antimalarials was generally low, and interestingly the percentage was higher in domains and risk zones with lower malaria. The high rate in domain 2 (northwest) may relate to the history of high malaria risk there or to greater access to money. It may also relate to occupation, as forest workers may fear they have malaria.

Of course, drug cocktails often do contain antimalarials, and further analysis may show that the percentages are therefore substantially higher than presented here.

A clear strategy is needed on how antimalarials (Malarine) should be promoted in the private sector, so that it is more available to those at greatest risk but unnecessary consumption does not increase. Steps to link its use increasingly to parasitological diagnosis should be encouraged.

4.4.3 Treatment practice – providers

Core indicators

C5 % of patients with malaria in public health facilities prescribed correctly according to national guidelines

C6 % of public health facilities which maintain stocks of antimalarials and rapid tests with no out-of-date stocks

Supplementary indicators

S6 % of public health facilities able to confirm malaria diagnosis according to national guidelines

S7 % availability of antimalarial regimens other than A+M and Malarine in the market

S11 % of public health facilities reporting no disruption of stock of antimalarials for more than 1 week during the previous 3 months

Health Centres (public sector)

Twenty-four health facilities were surveyed. However, the completeness of the data collection was limited, as health facility staff had not been informed of the visits in advance, and there was limited staff capacity to respond to the questions. Observation of consultations was undertaken for 26 health workers with 66 consultations observed. Only six of these were malaria patients.

Table 4.4.12 Services provided by the health centres

Service	% providing	Number providing	Number of health centres responding
Malaria case management	100	23	23
Inpatients	39.1	9	23
Laboratory	60.9	14	23
Antenatal	100	23	23
IMCI	95.8	23	24
ITN promotion	66.7	16	24
Treatment of severe malaria	25	6	24

Distance to the nearest referral hospital was as follows:

within 5 km 2
6-10 km 2
11-20 km 5
21-50 km 10
> 50 km 4

Outpatient registers were present in all health centres with 67% being up to date and 88% in the MOH format.

C5	% of patients with malaria in public health facilities prescribed correctly according to national guidelines

88% (21 out of 24) health centres claimed to have the national malaria treatment guidelines with 71% (15) of these being the latest December 2002 version. This is not adequate, but it has been observed in the past that guidelines may be given to a health facility and not shared with all staff.

However, most *Plasmodium falciparum* cases were treated with the recommended first-line drugs A+M.

The lack of national guidelines and frequent drug stockouts severely limit the capacity of the health facilities to provide adequate treatment of malaria.

C6	% of public health facilities which maintain stocks of antimalarials and rapid tests with no out-of-date stocks

Table 4.4.13a. % of public health facilities reporting no disruption of stock of antimalarials/RDTs

Health Facilities	%	N
Surveyed	100	24
1st line antimalarials (A+M)	42	10
2nd line antimalarials (Quinine only)	25	6
RDT (Optimal or Paracheck)	42	10

Table 4.4.13b. % of public health facilities reporting no out-of date stocks of antimalarials/RDTs

Health Facilities	%	N	Number facilities reporting
1st line antimalarials (A+M2)	93.8	15	16
1st line antimalarials (A+M3 and A+M4)	100	17	17
2nd line antimalarials (Quinine tablets)	92.3	12	13
RDT Optimal	100	5	5
RDT Paracheck	100	12	12

Interpretation: The level of stockouts shown here is very high and needs investigation. However, presence of expired drugs and diagnostics was less of a problem with very few expired drugs found and diagnostics found.

S11	% of public health facilities reporting no disruption of stock of antimalarials for more than 1 week during the previous 3 months

Hardly any facilities at all reported less than one week disruption of stock over the last three months for any antimalarial. One facility each had less than one week disruption of stocks of tetracycline, artesunate tablets and suppositories, and 4 of quinine injection. All which reported (N=8) had stockouts of the firstline drug.

S6	% of public health facilities able to confirm malaria diagnosis according to national guidelines

Table 4.4.14 Laboratory review in the health centres

Question	% positive response	Number positive responses	Number of health centres responding
Use microscopy	82.4	14	17
Use RDT	47.1	8	17
Enough slides last 3 months	81.3	13	16
Lab register present	82.4	14	17
Register up to date	70.6	12	17
Register in MOH format	82.4	14	17
Slides sent for quality control in last 3 months	40.0	6	15
Possess national diagnosis guidelines	42	10	24
Guidelines are latest	25	2	24

Interpretation: It would be useful to check if the health centres without microscopy had RDTs. Only 42% of facilities possessed the national diagnosis guidelines with only 25 % (2) of these being from 2002, the others being 1994 and before. Slide supplies are reasonably adequate. Rates of quality control suggests an active system. Overall, the status of the laboratories was not bad.

Drug outlets (private sector)

S7	% availability of antimalarial regimens other than A+M and Malarine in the market

Out of target numbers of 90 village outlets and 45 market outlets 80 and 43 were sampled respectively. All market outlets had other antimalarials than Malarine and A+M.

The types of outlets were:

Clinic	2
Pharmacy or drug shop`	61
General store or shop	54
Drug seller in open market	6

Thus there were few market stalls, and most outlets were pharmacies or general shops.

Table 4.4.15 Drugs and tests sold in drug outlets (n= 123)

Drug / diagnostic test	% of outlets selling	Number
Malarine (child dose)	4.9	6
Malarine (adult dose)	22.0	27
A+M2 (artesunate/mefloquine)	7.3	9
A+M3	7.3	9
A+M4	14.6	18
Artekin	7.3	9
Mefloquine alone	19.5	24
Artesunate tabs alone	44.7	55
Artesunate suppository	1.6	2
Artesunate injection	25.2	31
Artemether tab	4.1	5
Artemether injection	19.5	24
Artemisinin	7.3	9
Quinine tab	48.0	59
Quinine injection	30.1	37
Tetracycline/doxycycline	93.5	115
Chloroquine	56.9	70
Primaquine	3.3	4
Cotexin	6.5	8
Drug cocktail	52.9	65
Aspirin	61.0	75
Paracetamol	99.2	122
Other	44.7	55
Paracheck	14.6	18
Malacheck	10.6	13
Optimal	2.4	3

The three most popular drugs were artesunate alone, quinine tablet and paracetamol.

The price of Malarine ranged from 2,500 to 10,000 riels (median 3,000, mean 4,786). This is rather low compared with the recommended selling price of 7,500 riel before the recent higher subsidy began. The main reasons for not buying it were no demand from customers and people not knowing about it. Unavailability and cost to buy stock were not cited often.

Stock levels ranged from 0 to 60 blister packs (median 2.5, mean 6.25). 14 out of 28 bought stocks within the last week, 7 within the last month and 14 more than a month ago.

4.5 Socioeconomic characteristics in relation to malaria

The household survey attempted to assess the relative wealth of households by noting their assets. This is called a principal components modelling. A range of household facilities and goods is scored on the basis of judgement by people familiar with the population. Most items were those used in the latest Demographic and Health Survey with a few additions.

The items and facilities checked and the scoring used were as follows with the highest scores for the items associated with the least poor:

Drinking water
6 "private tap/vendor/bottle" 5 "rain" 4 "well/borehole" 3 " public/shared" 2 "public well/spring" 1 "river etc"

Toilet facility
2 "toilet" 1 "field"

Ownership of household goods
3 if electric=1 | tv=1 | phone=1 | fridge=1 | bucket=1 | wardrobe=1 | sewmachine=1
2 if radio=1 | bed=1 | cows or buffalo=1 | pigs=1 | battery=1
1 if waterjar=1 | floormat=1 | kettle=1 |chicken or duck =1

Household fuel
4 "elec/gas" 3 "wood" 2 "charcoal" 1 "other"

Roof type
4 "tile" 3 "iron" 2 "thatch" 1 "other"

Floor type
4 "tile" 3 "wooden" 2 "bamboo" 1 "earth"

Transport score
4 "car" 3 "moto" 2 "oxcart" 1 "bike"

After scoring the households are ranked in order of “wealth” and divided into five equal groups known as socioeconomic **quintiles**. The first or lowest quintile is the poorest, and the highest (fifth) is the least poor. The following tables show the percentage of people slide positive according to the socioeconomic status of their household and the percentage of households in each domain and in each CMBS risk zone by socioeconomic quintile:

Table 4.5.1 % positive slides by socioeconomic quintile

Slide result	Quintile					
	1	**2**	**3**	**4**	**5**	**Total**
% positive	7.4	3.3	3.7	1.1	0.4	2.7
Number positive	132	61	45	21	7	266
Total Number	1685	1677	1653	1705	1700	8420

Table 4.5.2 Domain of household by socioeconomic quintile

Domain	**Quintile**					
	1	**2**	**3**	**4**	**5**	**Total number**
1	22.1	23.7	20.8	15.8	17.7	1127
2	19.4	22.3	21.9	20.9	15.5	1131
3	10.3	11.9	16.5	25.6	35.8	1103
Total number	666	672	676	665	682	3361

Table 4.5.3 CMBS risk zone of household by socioeconomic quintile

CMBS Risk zone	Quintile					
	1	2	3	4	5	Total number
1	23.7	20.9	18.9	19.6	16.9	1534
2	18.6	21.0	19.9	19.8	20.8	913
3	9.6	14.3	19.5	24.6	32.0	914
Total number	666	672	676	665	682	3361

<u>Interpretation:</u>
There is a very strong association of malaria positivity with low socioeconomic status, ranging from 7.4% to 0.4% in the poorest and least poor quintiles, which is more than 18 times greater.

Both domain and risk zone 3 have their highest percentage of households in quintile 5, while domains and risk zones 1 and 2 have their highest percentage of households in poorest two quintiles (1 and 2). This indicates firstly that people in the provinces covered by domain 3 (the southeast) are wealthier than elsewhere and secondly that within 2 kilometres of the forest households closer to the forest (risks zones 1 and 2) are poorer than those further away (zone 3).

5 Conclusions and Recommendations

Interpretation of results has been included with presentation of the results. This section highlights the most notable findings.

5.1 Implications of proximity to forest for control strategy

An important finding of the survey is the similarity of epidemiological and socioeconomic results between CMBS risk zone 1 (0-250 m from forest) and CMBS risk zone 2 (251 m to 1 km), whilst CMBS risk zone 3 (1 to 2 km) results are different. This applies to slide positivity, RDT positivity, spleen rate and socioeconomic status.

Table 5 Distribution of slide positivity, RDT positivity, spleen rate and socioeconomic status by CMBS risk zone

CMBS Risk zone	Slide positive	RDT positive	Enlarged spleen	Lowest SES quintile (Q1)	Highest SES quintile (Q5)
< 250 m	3.4	5.4	3.7	23.7	16.9
250 m to <1km	3.6	4.6	3.5	18.6	20.8
1km to < 2km	1.4	0.7	0.8	9.6	32.0
All zones	2.7	3.9	2.9		

There is, however, evidence of some low level transmission (based on data in children) in the 1 to 2 km zone. These findings can be used to reconsider intervention strategies. The current distinction in intervention strategy between 0 to 200m compared to 201 to 1 km from forest is not justified by the data presented here.

Decisions on malaria control strategy *beyond* 1 km need to take careful account of resource availability, prioritising preventive interventions within 1 km. Decisions to provide preventive interventions beyond this distance would need to be weighed against investing in, for example, better access to effective antimalarial diagnosis and treatment over broader geographical areas or programmes to address other non-malaria health problems. It would be important to assess which strategy is likely to save more lives.

Caution is needed, however, in interpreting the data because of the complexities of the relationship to forest (type of forest, extent of forest coverage, actual distribution of forest as opposed to mapped distribution). The implications of the geographical analysis findings are discussed in section 4.2.6.

5.2 Status of Core Indicators

Indicator	Result at baseline survey 2004
C1 % of people seeking treatment from trained providers within 48 hours of developing a fever	40.8% (including pharmacist/ drug shops), 27.8% (excluding pharmacist / drug shops) †
C2 % of target population who can explain how malaria is transmitted and prevented	93.1% know how malaria is transmitted (mosquito bite or visit to / stay in forest. 92.0% know mosquito bites cause malaria. 92.0 % know mosquito nets prevent malaria, 33.6% know nets and one other correct measure, but only 10.2% mentioned ITNs
C3 % of families living in endemic areas that have sufficient treated bed nets	7.0% households have sufficient ITNs and 37.2% "sufficient" nets*.
C4 % of population at risk sleeping under insecticide treated nets the previous night, measured during peak malaria transmission season	19.6% of whole population, 19.8% of children under five and 13.1% of pregnant women slept under an ITN the previous night. Note that net coverage (as opposed to ITN coverage) was very high.
C5 % of patients with malaria in public health facilities prescribed correctly according to national guidelines	88% have recent treatment guidelines. Most treatments were with correct drugs. 42% had latest diagnosis guidelines. Outpatient observations were inadequate to measure this indicator, and full documentation of routine supervision data is recommended
C6 % of public health facilities which maintain stocks of antimalarials and rapid tests with no out-of-date stocks	Percentage facilities mainaining stocks: 42% first line drugs, 25% second line antimalarials, 42% RDTs. Facilities with out-of-date stocks: 2% firstline, 8% second line, 0% RDTs

† "Trained providers" are defined as all the categories of provider except: option a) village health volunteers and traditional healers and option b) village health volunteers, traditional healers and pharmacist/shopkeeper. In future surveys pharmacists and shopkeepers should be classified separately, as the former are trained and the latter not trained.

* Note that this definition of "sufficient" may be excessively demanding: although only 37% of households have "sufficient" nets by this definition, there is already almost complete coverage of children with nets: 87% of under-fives already sleep under a net.

5.3 Status of Supplementary Indicators

Indicator	**Result at baseline survey 2004**
S1 % mothers and care takers able to recognize signs and symptoms of danger of a febrile illness in a child <5 years.	91.9% mentioned at least one general danger sign and 90.3% at least one malaria danger sign
S2 % seeking treatment from trained provider/total cases of febrile illness	69.6% sought treatment from a trained provider if pharmacist/ drug shop is excluded and 97.6% if they are included, but it is known that many drug shopkeepers are not trained.
S3 % of families using IBNs correctly *(this indicator has not been used, as there is no definition of "correctly". It is partly covered by C3 and C4)*	-
S4 % of families that have sufficient treated bed nets *(this indicator duplicates C3)*	-
S5 % of children under-5 sleeping under treated bed nets that have sufficient treated bed nets the previous night	19.8% children under five slept under an ITN the previous night
S6 % of public health facilities able to confirm malaria diagnosis according to national guidelines	60.9% offered a laboratory service, but only 25% had the most recent guidelines. *Note: without an extensive health facility survey this indicator would be more appropriately measured by documentation of routine supervision and quality control of slides.*
S7 % availability of antimalarial regimens other than A+M and Malarine in the market	100%
S8 % awareness of Malarine among the targeted populations	46.1% were aware of Malarine or A+M (it was not possible to find out about Malarine separately)
S9 % of target groups who know where to obtain testing and treatment for malaria	92.6% of people know where to obtain testing and treatment. 69% cited public sector sources and 25% private sector for testing, and 65% and 32% cited public and private sector for advice or treatment. Actual practice was quite different (see Table 4.4.4).
S10 % of target groups who know that Malarine treatment is effective only if entire course is taken	41% said they would get sick again if they took less than the recommended 3 day treatment.
S11 % of public health facilities reporting no disruption of stock of antimalarials for more than 1 week during the previous 3 months	0% for first-line A+M

5.4 Key recommendations for the programme

1. 1. Rather than distribute more mosquito nets or ITNs, the programme could achieve most impact for its resources by treating and retreating existing nets. The great majority are already sleeping under a net, but these nets are not treated: 48% of children are sleeping under a net that has never been treated, and a further 19% are sleeping under a net that was once treated but the treatment has now expired. Even if a new ITN is given or sold to these households, many or most of these children will presumably continue to use the old untreated one. So, giving away (or selling) more ITNs in malaria endemic areas has only limited scope for improving overall ITN coverage. It can help the minority (13%) who currently do not have any net, but is much less relevant to the majority who are using untreated nets. It will therefore be more effective, as well as cheaper, to treat the nets that are already in use.

2. There are already high levels of awareness of how malaria is transmitted and how this can be prevented, but awareness of ITNs is very low, and this should be the main message about prevention communicated in health education campaigns.

3. Treatment and retreatment of existing nets (and distribution of long lasting insecticidal nets as they become available) should be targeted with priority to CMBS risk zones 1 and 2 (0 to 1 km from forest), as these have higher malaria risk and lower economic status than CMBS risk zone 3. This is a wider target than the current target up to 200m from forest. Access to ITNs can also be facilitated beyond 1 kilometre from forest, particularly with a view to protecting people at occupational risk of malaria.

4. Further geographical analysis is needed to determine the most cost-effective and accurate ways of obtaining rapid estimates of village-level risk. This would explore newly available forest cover datasets.

5. Intense efforts are needed to reduce ruptures of antimalarial drug stocks in public sector health facilities/

6. Promotion of Malarine in the private sector needs to be handled carefully to avoid excessive unnecessary use of antimalarials by people currently using non-antimalarials for fever. The most promising approach would be to promote vigorously the use of parasitological diagnosis to determine the need for treatment. Strategies for increasing access to reliable diagnosis are needed.

7. The higher prevalence in pregnant than in non-pregnant women warrants further investigation, as it may reflect poorer utilisation of insecticide-treated nets, which is indeed what the survey found, and points to the need for more targeted education.

8. There is considerable evidence of malaria transmission in the zone from 1 to 2 km from the nearest forest. The risk is less than for those closer to the forest, but indicates the need for the control programme to include this zone in its control strategies.

9. Certain remote sensing – based approaches appear to have good potential for risk mapping and should be further explored.

10. Malaria slide positivity is strongly associated with the poorest parts of the population. Poverty reduction strategies should include malaria control measures.

11. The health centre survey was not the best way to obtain data for the facility level treatment indicators. In order to obtain the type and amount of data needed to track progress of these indicators, it is recommended that systematic routine data collection through supervision visits and monthly reports would be more appropriate. Health facility surveys of the type used in some countries to assess Integrated Management of Childhood Illness (IMCI) could be valuable, but would need considerably more resources in terms of time and personnel than were available for the present survey. If other health facility surveys are planned by the Ministry of Health, it is recommended that the CNM explores the possibility of adding questions. An important lesson learnt from the health centre survey was the need to notify health centres in advance, since staff were often too busy to spend adequate time with the interviewers, and were sometimes not available for consultation observation.

12. For the most part the process of undertaking the survey worked well. The full engagement of the multiagency taskforce was crucial to the success of the survey; although it is costly in staff time, it should be maintained as an essential component of follow-up surveys.

5.5 Recommendations for future surveys

1. The questions on A+M and Malarine should be separated.

2. Pharmacists and shopkeepers should be defined more carefully and perhaps broken into three classifications: formally trained pharmacists, shopkeepers with on-the-job training and untrained shopkeepers.

3. The definition of “sufficient” nets may be excessively demanding: and should be reconsidered.

4. Collection of more useful health facility data will require a more extensive health facility survey, which would cost more, and systematic collection of routine supervision data.