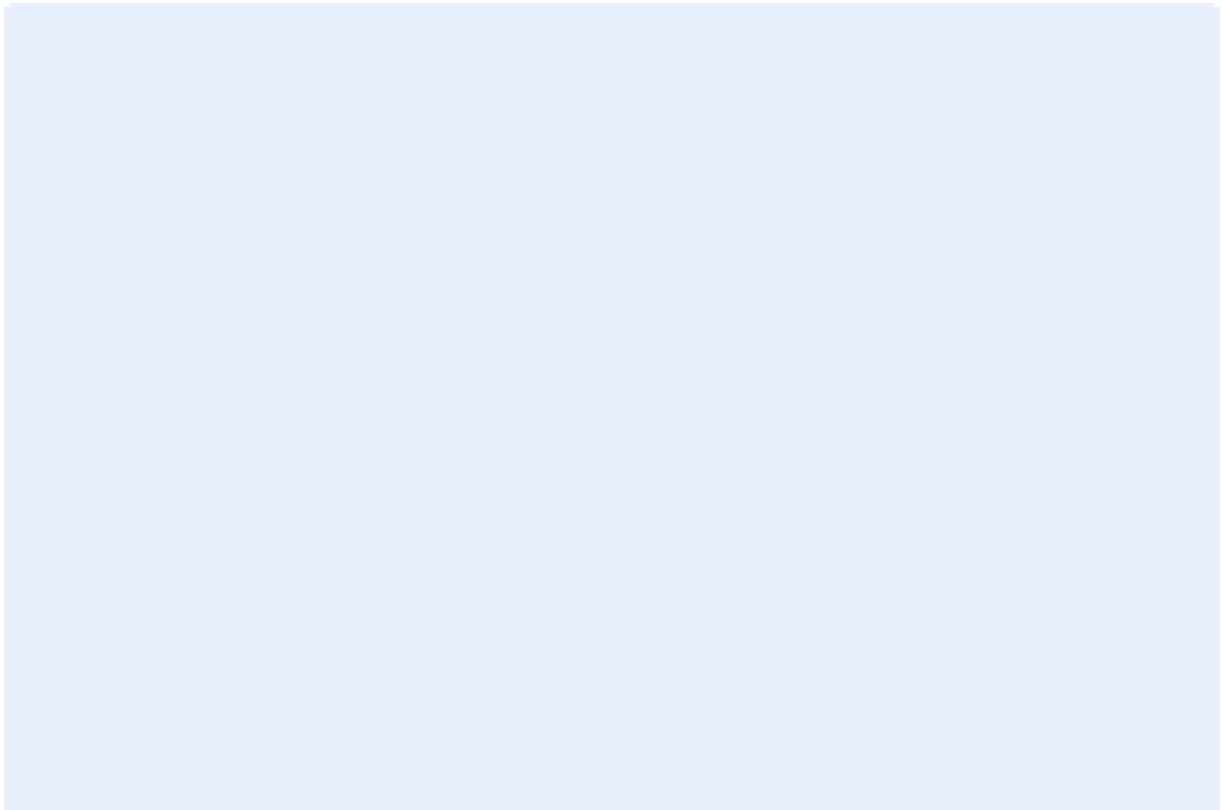


**The evaluation of coverage and usage of malaria
prevention methods and associated malaria risk
factors among populations in areas with malaria
transmission in Thailand**

Thailand Endline Survey 2016



Established in 2003, Malaria Consortium is one of the world's leading non-profit organisations specialising in the prevention, control and treatment of malaria and other communicable diseases among vulnerable populations. Our mission is to improve lives in Africa and Asia through sustainable, evidence-based programmes that combat targeted diseases and promote child and maternal health.

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Executive summary

Thailand has embarked on a mission to eliminate *Plasmodium falciparum* and has developed a National Malaria Strategy for Control and Elimination of Malaria (2011-2016), which is implemented by the National Malaria Control Programme (NMCP). A central component of the national strategy is the development of the National Malaria Monitoring and Evaluation (M&E) plan, which was designed to measure the impact and outcomes of programmatic objectives to:

1. Detect malaria cases (both asymptomatic and symptomatic) and ensure effective diagnosis and treatment and gametocyte clearance
2. Prevent transmission of malaria parasites through effective vector control and personal protection measures among at-risk populations
3. Support elimination of malaria parasites through comprehensive behaviour change communication, community mobilisation and advocacy
4. Provide an effective management system (including surveillance, monitoring and evaluation, and operational research) to enable rapid and high quality implementation of the strategy
5. Interrupt malaria transmission in target districts.

Based on this national M&E plan, the performance framework of a Global Fund Single Stream Funding – Malaria [GF-SSF-M] malaria elimination programme in Thailand was created. The performance framework, like the national M&E plan, contains specific indicators of programme performance that can only be estimated by large-scale household surveys. Three such surveys have been conducted, the first in 2012 (Thailand Malaria Survey (TMS)), the second in 2015 (Knowledge, Attitudes and Practices (KAP) Survey) and the final endline survey in 2016, the Thailand Endline Survey. The results of this final survey are thus presented together with analysis of key indicators across the three survey rounds, with the aim to provide information and recommendations to assist the NMCP in implementing the malaria elimination strategy for the next few years.

The Thailand Endline Survey was a national cross-sectional household survey conducted in May-August 2016 and designed to measure several standard malaria indicators. All malaria endemic villages from 42 provinces under Phase I and Phase II of the GF-SSF-M programme and classified as A1 (transmission for at least six months of the year) or A2 (transmission for less than six months of the year) transmission areas were eligible for inclusion in the study. Provinces were divided into three domains based on geographic location: domain 1: Thai-Myanmar border; domain 2: Thai-Cambodia border; and domain 3: remaining areas. A two-stage stratified cluster sampling design was used, with clusters defined as villages and households as the sampling unit. Heads of the selected households were asked to complete an interview to gather data on household indices and individual-level data on each household member, including temporary visitors staying in the household at the time of the survey.

A total of 2,125 households and 8,231 household members were included in the study from 85 clusters across the three domains. The findings were categorised according to thematic area: demographic background, net coverage and usage, case management and healthcare seeking, malaria knowledge, and practices of forest-goers.

With regard to nets, household ownership of insecticide treated nets (ITNs)/long lasting insecticidal nets (LLINs) showed improvement in this survey compared to the previous survey rounds, but

remained well below universal coverage. Ownership of at least one ITN/LLIN was 52.3% and of sufficient ITNs/LLINs was 40.3%. Ownership of ITNs/LLINs was higher in A1 areas, areas covered under the Global Fund programme, lower income households, households with migrants and in households where the head of the household named an ITN as a prevention method. Most nets owned were conventional nets bought from the private sector market. The proportion of owned nets that were ITNs was very low, at 10%, and was lower in domain 3, despite the proportion of conventional nets being higher in domain 3. A rapid way to increase coverage of ITN/LLIN coverage could be to treat and retreat the nets people already own in addition to free LLIN distribution¹.

Despite coverage increasing, usage of an ITN/LLIN the previous night decreased to 24.9% and analysis of the usage in relation to access to an ITN/LLIN the previous night showed a large behavioural gap in ITN/LLIN usage of 52%. Usage was particularly low among Thai nationals compared to migrants, lower in higher income households and lower in households with a higher level of schooling. This gap in usage needs to be addressed through novel and motivational behaviour change communication that remains effective even when malaria transmission is on the decrease. Usage may also be affected by the type of nets people own or prefer; usage was higher with nets of a larger size, nets with colour and nets made from nylon or cotton. Meeting these preferences may help to increase ownership and usage of LLINs, and lessen current practice where, people buy untreated nets from the private sector.

There were 15% of LLINs over three years old and therefore, had passed their life expectancy for insecticide effectiveness. In addition, 14% of LLINs had holes or tears and 25.6 % were washed too frequently, which also reduced its effectiveness in repelling mosquitoes. There is a need to review how LLINs are replaced and how best to take into account degradation of the nets over time.

Healthcare seeking among fever cases was relatively high (67.5%). However, healthcare seeking within 24 hours was low (26.1%) and had fallen since the previous surveys; it should be noted, however, that the definition of the time of treatment seeking had changed from the TMS and KAP, to the endline survey. Use of public sector healthcare providers among treatment seekers was high; the malaria test rate for people that sought treatment was also high, at almost 20%. There was very limited evidence of misuse of malaria drugs at healthcare providers. However, one-fifth of those with fever did not seek advice from a healthcare professional and instead self-treated. There was also very low usage of malaria posts (MPs) and border malaria posts (BMPs) even in clusters that had these present. Investigation into the choice of healthcare provider and into reasons behind the low uptake of MPs should be encouraged.

Knowledge of malaria in general and of messages related to the containment period was very high and had increased over the course of the three surveys. However, knowledge gaps were found that were related to some key indicators on prevention coverage and case management, such as use of ITNs and seeking a diagnostic test. Exposure to behaviour change communication and retention of the messages were also very high, but it is recommended to revise messages to include the themes identified as behavioural gaps in this survey and to support the NMCP's malaria elimination agenda.

Finally, an analysis of forest-goers revealed differing behaviours depending on the occupational group and reason for visiting the forest. The nuances in frequency of travel to, duration of stay in, and activities in the forest need to be considered when planning interventions and malaria

¹ Ministry of Health, Union of Myanmar and World Health Organization. Strategic Framework for Artemisinin Resistance Containment in Myanmar (MARC), 2011-2015.

messaging. Using nets and alternative personal protection measures are not always appropriate for each sub-group. Furthermore, messages need to take into account both sexes, since females make up a large proportion of the forest-going population.

The findings from the endline survey will help to inform the NMCP of its progress over the past four years, in addition to highlighting the gaps that still need to be addressed in the months and years ahead. The report makes recommendations stemming from the main findings, with the aim that these will be adopted by the NMCP and implementing partners to help Thailand move forward with their goal of eliminating malaria by 2026. A key feature that emerges from the results is the challenge of maintaining and increasing malaria indicators in the presence of reducing malaria transmission and diminishing perception of risk among Thailand's population. This challenge does not only exist in Thailand, but also regionally, and requires novel tools, particularly for vector control, behaviour change and community mobilisation, if elimination is to be achieved.

Introduction

Thailand has embarked on a mission to eliminate *Plasmodium falciparum* and has developed a National Malaria Strategy for Control and Elimination of Malaria (2011-2016), which is implemented by the National Malaria Control Programme (NMCP). The overall goal of the national strategy is to reduce malaria morbidity and mortality, and to move towards the elimination of malaria parasites in Thailand, with the following five objectives:

1. To detect malaria cases (both asymptomatic and symptomatic) and ensure effective diagnosis and treatment and gametocyte clearance
2. To prevent transmission of malaria parasites through effective vector control and personal protection measures among at-risk populations
3. To support elimination of malaria parasites through comprehensive behaviour change communication, community mobilisation and advocacy
4. To provide an effective management system (including surveillance, monitoring and evaluation, and operational research) to enable rapid and high quality implementation of the strategy
5. To interrupt malaria transmission in target districts.

A central component of the national strategy was the development of the National Malaria Monitoring and Evaluation (M&E) plan, which was designed to measure the impact and outcomes of these specific objectives. This national M&E plan formed the basis from which the performance framework of a Global Fund Single Stream Funding – Malaria [GF-SSF-M] malaria elimination programme in Thailand was created. The performance framework, like the national M&E plan, contains specific indicators of programme performance that can only be estimated by conducting large-scale household surveys. Three such household surveys (which include information on prevention and treatment seeking coverage and behaviour) were planned to be undertaken in years 1, 3 and 5 of the GFATM Round 10 malaria grant to monitor progress and feed into the evaluation of the GF-SSF-M malaria elimination programme. As Thailand has recently revised their National Strategic Plan for Malaria Control and Elimination, it is also expected that the planned household survey in year 5 will also be used to determine baseline information for the 2016-2025 period and help identify priority activities to implement in the future strategy.

The baseline household survey was conducted in 2012 and titled Thailand Malaria Survey 2012 (TMS 2012 (DDC Ethics Submission Code 11/55-560)). The objective of the survey was to measure the indicators of programme performance as well as to estimate malaria prevalence. The TMS 2012 was successfully completed and generated useful information for the NMCP. Most importantly, it demonstrated that insecticide-treated net (ITN) usage, knowledge about malaria elimination methods, and malaria prevalence were lower among the targeted population than the NMCP assumed. Because a central aspect of the GF-SSF-M programme's approach is to distribute ITNs and malaria prevention knowledge widely, knowing the full extent of the gap in these two areas helped the NMCP increase its efforts in these areas.

The midline household survey was conducted in 2015 and titled the Knowledge, Attitudes and Practices (KAP) survey (DDC Ethics Submission Code 8/57/-677). The objective of the 2015 KAP survey was to evaluate changes in the coverage and usage of malaria prevention methods since they were measured in the TMS 2012. Since malaria prevalence based on polymerase chain reaction was

estimated to be 0.1% in 2012 and was not expected to drastically increase, the midline study did not include a malaria prevalence survey. The KAP 2015 was successfully conducted between January and March 2015, and generated practical information and recommendations for the NMCP. The survey demonstrated significant increases in malaria knowledge, particularly regarding transmission modes (increased from 41% to 92%) and key containment and elimination messages (increased from 25% to 63%). It also measured substantial increases in the proportion of individuals sleeping under an ITN the previous night (from 29% in 2012 to 39%) in 2015. However, household coverage of ITNs remained low at 51%, with only 39% of individuals surveyed having access to an ITN in their households.

The endline survey was conducted from May to August 2016 and was designed to evaluate the coverage and use of malaria preventive interventions and case management practices among the target population living in malaria endemic regions in Thailand. Similar to the midline survey, this study did not include a malaria prevalence survey, but focused on key net coverage and usage indicators, treatment-seeking behaviours and knowledge of malaria. The results of this survey are presented in this report, as well as a comparison of key indicators across the three surveys– TMS 2012, KAP 2015 and the 2016 endline survey. These results will provide important information to the NMCP on progress made against the indicators of programme performance in line with its malaria elimination plan. In addition to this quantitative survey, a qualitative net preference study was conducted and results of this will be presented in a separate report.

Methodology

Survey design

The Thailand Endline Survey was a national cross-sectional household survey designed to measure standard malaria indicators. All registered households in the country in relevant geographical areas (described below) were eligible for inclusion. In each selected household, a standard questionnaire was administered to one household respondent, typically the head of household or the person primarily responsible for the health of individuals in the household. The interview was divided into sections, each covering different components such as net coverage and usage; knowledge, attitudes and practices of the household respondent in regard to malaria; practices of household members reporting any fever in the previous two weeks; and practices of the forest-goer population. The interview gathered data of each household member, including temporary visitors staying in the household on the survey day and people working in the forest or travelling away from home on a regular basis. Women of reproductive age were not interviewed separately, but pregnancy status was included in the questionnaire and reported by the household respondent. The household survey was designed to target both Thai nationals and non-Thai migrants. There was no specific proportion of Thai, M1 or M2 migrants required for this study. Instead, the study was designed to collect data that reflects the existing proportion of Thai, M1 and M2 migrants in the sampled villages at the time of the study.

Concurrent to the interviews conducted, household members in selected areas were purposively sampled to take part in qualitative net preference study. The methodology and results of this part of the survey are presented in a separate report.

Study sites

All malaria endemic villages from 42 provinces under Phase I and Phase II of the GF-SSF-M programme were eligible for inclusion in the study. Provinces were divided into three domains based on geographic location (Figure 1 and Table 1):

- Domain 1: Thai-Myanmar border
- Domain 2: Thai-Cambodia border
- Domain 3: Remaining areas

Table 1: Division of provinces into the geographical domains

Domain 1: Thai-Myanmar border (10 provinces)	Domain 2: Thai-Cambodia border (6 provinces)	Domain 3: Remaining areas (26 provinces)
1. Chiang Mai	1. Chanthaburi	1. Chonburi
2. Chiang Rai	2. Si Sa Ket	2. Chachoengsao
3. Chumporn	3. Srakao	3. Kamphaeng Phet
4. Kanchanaburi	4. Surin	4. Krabi
5. Mae Hong Son	5. Trat	5. Lamphang
6. Prachabkirkiran	6. Ubon Ratchathani	6. Lamphun
7. Petchburi		7. Mukdahan
8. Ranong		8. Nakhon Ratchasima
9. Ratchburi		9. Nakhon Sri Thammarat
10. Tak		10. Nan

Domain 1: Thai-Myanmar border (10 provinces)	Domain 2: Thai-Cambodia border (6 provinces)	Domain 3: Remaining areas (26 provinces)
		11. Narathiwat 12. Pangnga 13. Phatthalung 14. Phetchabun 15. Phitsanulok 16. Phrae 17. Rayong 18. Sakon Nakhon 19. Satun 20. Songkhla 21. Supanburi 22. Surat Thani 23. SuKothai 24. Trang 25. Uthai Thani 26. Yala

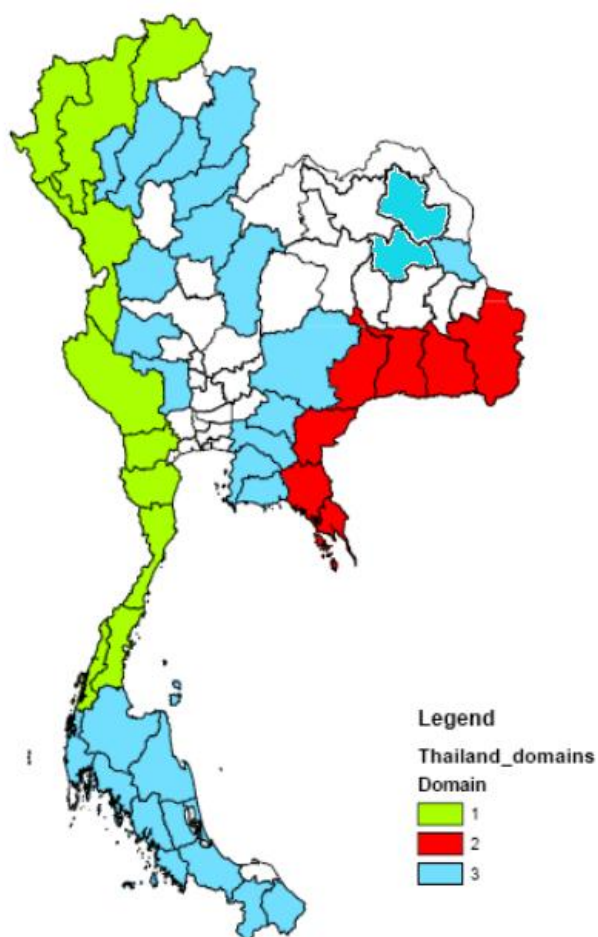


Figure 1: Map of provinces included in each of the three domains of the survey

Domains were further stratified according to malaria risk. In Thailand, villages are stratified into four categories of malaria transmission risk:

- **A1** - perennial transmission area (transmission reported for at least six months per year)
- **A2** - periodic transmission area (transmission reported but for less than six months per year)
- **B1** - high and moderate receptivity (transmission not reported within the last three years but primary and secondary vectors present)
- **B2** - low and no receptivity (transmission not reported within the last three years and primary and secondary vectors absent, suspected vector may be present)

Considering that B1 and B2 areas have no malaria transmission, the survey only included villages within each province that fell into A1 and A2 areas. Stratification into these areas is based on the number of annual malaria cases and an assessment of vector presence. The risk stratification is reviewed annually at the end of fiscal year and the 2015 updated list was used for this survey.

Sampling strategy

The endline survey was a representative cross-sectional household survey using a two-stage stratified cluster sampling design. Clusters were defined as ‘villages’ and the sampling unit was the household, defined as a person or a group of related or unrelated persons who live together in the same dwelling unit, who acknowledge one adult male or female as the head of the household, who share the same housekeeping arrangements, and who are considered to constitute one unit. Where a group of people were living together in the same house but had separate eating arrangements they were counted as separate one-person households. Collective living arrangements (such as boarding schools or prisons) were not considered as households.

As described above, endemic provinces under the GF-SSF grant were divided into three geographic domains. In each domain, a list of villages in A1 and A2 areas was prepared with available data from Bureau of Vector Borne Disease. Clusters were then selected randomly with probability proportionate to size (PPS) until the sample size of clusters within each domain was met.

In the second stage of sampling, a list of all registered households in the village was obtained from local authorities (such as the village leader and Vector Borne Disease Unit (VBDU)), and updated with additional information provided by local non-governmental organisations (NGOs), health facilities and village health volunteers (VHVs). At the village, the list was also updated to include all households in the cluster at the time of the survey, including unregistered households. In each cluster, 25 households were randomly selected with uniform probability for participation.

Only the head² or primary caregiver³ of each selected household were requested for an interview. The study team revisited households with absent heads or caregivers up to three times. If a head of household or caregiver was unavailable or unwilling to participate, the household to the immediate right of the selected household was visited as a replacement.

² The head of household is the person who is acknowledged as such by members of the household and who is usually responsible for the upkeep and maintenance of the household. Source: Chapter 8, “Household Listing Manual” Malaria Indicator Survey: Basic Documentation for Survey Design and Implementation, MEASURE DHS 2013

³ The primary care giver will be considered the person who is acknowledged by household members as being primarily responsible for the health and well-being of household members.

Sample size

Sample size was based on the predicted values in each domain of 'the proportion of households owning sufficient ITNs/LLINs. Values were predicted using results from the previous KAP survey assuming a 10% increase in sufficient ITN/LLIN coverage, an average household size of 3.5, a relative margin of error at 95% confidence of 10%, a design effect of 2.0, a non-response rate of 10%, and surveying 25 households per cluster. Given these parameters the required sample size for each domain was calculated and rounded up to:

- Domain 1: 583 Households, 24 clusters
- Domain 2: 428 Households, 17 clusters
- Domain 3: 1133 Households, 45 clusters
- TOTAL: 2,144 households from 86 clusters

Full details on the sampling size calculation are in Annex 1.

Study period

Data collection took place between May and August 2016.

Inclusion and exclusion criteria

Respondents for the selected households had to meet the following inclusion and exclusion criteria:

Inclusion:

1. Head of household or primary caregiver
2. Adult aged 18 years of age or older
3. Individuals able to provide informed consent to participate in the survey

Exclusion:

1. Individuals who are mentally ill or cannot understand any language used by the interpreter/interviewer

Participants could discontinue their participation in the survey if: 1) the participants cannot spend time to complete the questionnaire, and 2) the participant withdraws consent to participate in the interview

Ethical considerations

Individual informed consent was sought from all respondents before the interviews were conducted. Before each interviewee was requested to provide consent, the interviewer gave a brief description of the study's objectives and expected benefits, the data collection procedure, and the voluntary nature of participation at all stages of the interview. Prior to the scheduled visit for data collection in the study villages, community consent was obtained from the village and commune leaders, who were informed of the purpose and procedures involved. Data was kept anonymous (no names were collected) and stored securely during and after data entry. The informed consent documents, which included two pages of information for the participant, a one-page consent form, and the 106-question survey were approved by The Ethics Committee for Research in Human Subjects, Department of Disease Control, Ministry of Public Health (FWA 00013622) on 3 May 2016 (DDC-EC Ethics Submission code 5/59-045 (Endline survey 2016) version 1.2 dated 4 April 2016).

Data collection

A standard questionnaire was developed in English and then translated into Thai. Quality control was ensured by the back-translation of all questionnaire versions into English to check for accuracy. The Thai version of the questionnaire was also pre-tested for validity and reliability in a cluster not selected for the survey. The questionnaire was developed into an Open Data Kit (ODK) software template for electronic data collection. The ODK tool had data quality checks in place to ensure all fields were filled in correctly before moving to the next question. The survey teams each had an electronic tablet with the questionnaire and were trained on its use and the data quality checks in place. Team supervisors checked each electronic submission at the end of the day before submitting to the online server, from which further checks were made on data completeness.

Selected households were visited by the survey team and informed consent gathered from the head of the household or primary caregiver as described above. The respondent was asked each question in turn to obtain information on all residents in the selected households. Information collected included demographic characteristics, net ownership and usage, fever cases within the previous two weeks and healthcare seeking behaviour, malaria knowledge and attitudes, and practices of forest-goers.

Definitions

Sampling and demographics

Area A1: Perennial transmission area (transmission reported for at least six months per year)⁴

Area A2: Periodic transmission area (transmission reported but for less than six months per year)³

Forest-goer: A family member who spent time in a forest, plantation, garden or farm between six o'clock in the evening and six o'clock in the morning.

Household member: A household may be one person or a group of persons who usually live and eat together on an interview day. This is not the same as a family, which includes only people who are related. Rather, a household includes any group of people who live together, whether or not they are related. For example, three unrelated men who live and cook meals together would not be considered one family, but they would be considered to be members of the same household.

M1: Undocumented non-Thai national who has been in Thailand continuously in the last six months

M2: Undocumented non-Thai national who has not been in Thailand continuously in the last six months

Nets and prevention methods

Conventional net: A net that has never been treated, or an ITN that has not been retreated within the previous 12 months.

Insecticide-treated net (ITN): An insecticide-treated net is a mosquito net that repels, disables and/or kills mosquitoes that come into contact with insecticide on the netting material. There are

⁴ Re-classified annually and obtained from BVBD in November 2015 for survey sampling

two categories of ITNs: conventionally treated nets and long-lasting insecticidal nets. In this survey, we use ITNs to refer to conventionally treated nets which are treated by being dipped into a WHO-recommended insecticide within the previous 12 months. To ensure its continued insecticidal effect, a conventional ITN should be re-treated after three washes, or at least once a year⁵.

Long lasting insecticidal net (LLIN): A long-lasting insecticidal net is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. The net retains its effectiveness without re-treatment for at least 20 WHO-recommended standard washes under laboratory conditions and three years of recommended use under field conditions⁵. In this survey, analysis of household ownership and usage of LLINs includes all branded LLINs that were less than three years old. A three year cut-off was chosen to be in line with WHO recommendations and with Myanmar's national policy for LLIN use. When reviewing the types and characteristics of nets owned, distinctions were made between LLIN <3 years old and those LLINs >3 years old, since this is important for programmatic purposes.

Any net: This group of nets includes all conventional nets, ITNs, LLINs < 3 years of age and expired LLINs (> 3 years of age).

ITN/LLIN: This group of nets includes all ITNs treated within the previous 12 months AND LLINs aged < 3 years.

Sufficient nets: Households with one net per two people in the household.

Access: The proportion of the population with access to an ITN/LLIN within their household the previous night. Also called 'population access' or 'ITN/LLIN access'. This indicator is calculated based on the number of ITNs/LLINs in the household and the number of household members. Over a large sample, it calculates the proportion of people who should have (based on the assumption that one ITN can be used by two people in the household) an ITN to sleep under. It cannot be calculated on an individual basis.

Use/usage of a net: Whether an individual slept underneath the net the previous night.

Use:access ratio: The result when dividing use by access (i.e. use/access). This provides an estimate of the proportion of the population using nets, among those that have access to one within their household. This is a ratio and not a percentage, although it can be interpreted as such. This indicator provides data on the behavioural gap for net use rather than a use gap because not enough nets are available.

Household chemical use: Use of mosquito coil and/or insecticide spray and/or repellent in the household.

Case management

Public sector providers: This group includes malaria clinics, malaria posts (MPs) and border malaria posts (BMPs), Vector Borne Disease Control Units (VBDO) and public hospitals.

Private sector providers: This group includes private clinics, private hospitals and drug stores with a licensed pharmacist.

⁵ WHO Global Malarial Programme, *Insecticide-treated mosquito nets: a WHO Position Statement*.

Knowledge and exposure to messaging

Severe malaria sign and symptoms: Respondent can name at least one sign and symptom of severe malaria as per the 2015 WHO guideline for the treatment of malaria. The list of responses were unconscious, convulsion, fast breathing, yellow eye color, pale skin, bleeding, shock, death, life-threatening⁶.

1/3 key containment messages: Respondent recalls hearing or seeing at least one of the three key containment messages: 1) sleep under an ITN, 2) seek treatment if you suspect malaria, and 3) complete all antimalarial treatment.

Interpersonal communication: This is a grouped source of information that includes: 1) MP/BMP staff, 2) village malaria workers/village health volunteers/migrant health volunteers, 3) malaria clinics, 4) VBDU staff, 5) public health centres/hospitals, 6) teachers, schools, monks, priests, Imam; and 7) family/friends/neighbours.

Information education communication (IEC): A grouped source of information that includes: leaflets, brochures and posters.

Local media: A grouped source of information that includes: local broadcast media, community communication/training by local organisations (e.g. NGOs, CSOs).

Mass media: A grouped source of information that includes: radio/TV, social media and the internet.

⁶ WHO Guideline for the treatment of malaria (3rd Edition) 2015, section 7 treatment of severe malaria.

Results

A total of 2,125 households from 85 clusters were reached and included in the survey, including data on 8,231 household members. One cluster in domain 1 could not be reached as it was too remote. However, the absence of this cluster had no effect on the relative margin of error around our predicted estimates in the sample size calculation and thus the results are valid (Annex 1).

The results of the survey are presented in the following key thematic areas:

1. Demographic background
2. Net coverage and usage
3. Other vector control methods
4. Case management and healthcare seeking behaviour
5. Knowledge of malaria
6. Practices of forest-goers
7. Comparison of indicators from baseline to endline

Issues to consider in the interpretation of the results: Non response and replacement

The intention of the data collection was to obtain information from households on malaria indicators that would be statistically representative of the population living in areas with on-going malaria transmission in Thailand. In order to achieve this, the sampling methodology involved a two-stage cluster sampling similar to those used in standard national surveys such as Multiple Indicator Cluster Surveys (MICS) and Demographic Health Surveys (DHS). When it was not possible to reach selected households, these were replaced with the nearest household to the right side of the selected household.

A total of 429 (24.7%) households were replaced (Table 2). This was consistent across domains and the main reason for replacement was that no household member was at home when the survey teams visited the households. Only a few households refused to take part in the survey. Although data on replaced households could not be collected, analysis was conducted to compare the replaced households with the selected households (Table 3). There were no significant differences between the two groups (households in the original sample and replacement households) for any of the household characteristics investigated.

Table 2: Summary of household replacements during data collection

	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	N	% (95%CI)	N	% (95%CI)	N	% (95%CI)	N	% (95%CI)
Replacement households	429	24.7 (21.4-28.7)	108	23.8 (17.5-31.5)	72	25.7 (18.3-35.4)	249	24.8 (20.7-29.5)
Reasons								
No one at home or no potential respondent at home	260	9.4 (7.8-11.4)	86	11.2 (7.0-17.4)	38	7.3 (4.7-11.2)	136	9.3 (7.6-11.4)
Refused	20	1.1 (0.5-2.5)	5	2.0 (0.5-7.1)	3	1.1 (0.4-3.1)	12	0.7 (0.3-1.4)
Dwelling not found	112	5.0 (3.5-7.1)	47	7.5 (4.5-12.0)	11	3.1 (1.9-5.0)	54	4.4 (2.7-7.2)
Not completed interview	4	0 (0-0.1)	1	0 (0-0.3)	1	0 (0-0.2)	2	0.1(0-0.2)
Other reasons*	145	8.0 (5.9-10.8)	29	4.6(2.9-7.0)	25	10.1 (6.4-15.6)	91	9.1 (6.0-13.4)
Mean number (and range) of households replaced per cluster	5.2 (1 to 16)		4.9 (1 to 9)		4.5 (1 to 11)		5.8 (1 to 16)	

*Other reasons included: respondent with mental illness or unable to understand any language used by the interpreter/interviewer, abandoned house, duplicated household number

Table 3: Summary of key indicators by household replacement status

	Replacement household (n = 429)		Originally sampled household (n = 1,696)	
	n	% (95%CI)	n	% (95%CI)
Proportion of households with more than 4 members	130	27.5 (21.8-34.0)	543	32.2 (28.8-35.8)
Proportion of households with monthly income <5000 baht	133	26.8 (20.4-34.3)	701	33.9 (29.0-39.1)
Proportion of households with any migrant	23	2.9 (1.27-6.48)	111	4.1 (2.8-5.8)
Proportion of households with any forest-goer	127	35.3 (26.3-45.4)	558	40.8 (34.4 -47.6)
Proportion of household with family member attend school	414	96.7 (93.3-98.5)	1635	96.6 (94.7-97.8)

Demographic background

Characteristics of the sampled households and of the heads of the households are shown in Table 4. In total, 10.6%, 95% CI [5.8-18.6] of households were in the A1 transmission risk area, with no significant difference across the three domains. About one-third of households had an income of less than 5000 THB per month, consistent across domains. 3.8%, 95% CI [2.6-5.5] of households included at least one migrant, and this was significantly lower in domain 3 compared to the other two domains at only 0.6%, 95% CI [0.3-1.4]. Almost 40% of households had at least one forest-goer within their household members. This proportion was significantly higher in domain 3 compared to domain 2. There was no difference across domains for the proportion of households containing pregnant women or young infants.

The majority of the head of household across all domains were male and aged between 31 and 60 years. In total, 16.2%, 95% CI [11.3-22.6] of heads of households had not attended school, being highest in domain 1 at 30.9%.

Table 4: Descriptive statistics of the surveyed households (n = 2,125)

	TOTAL (n = 2,125)		Domain 1: Thai-Myanmar border (n = 575)		Domain 2: Thai-Cambodia border (n = 425)		Domain 3: Remaining areas (n = 1,125)	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Risk area								
A1	375	10.6 (5.8-18.6)	125	14.3 (4.3-38.1)	125	16.3 (5.3-40.2)	125	6.4(2.3-16.4)
A2	1750	89.4(81.4-94.2)	450	85.7(61.9-95.7)	300	83.7(59.8-94.7)	1000	93.6(83.6-97.7)
Household income								
<5000 baht	834	32.1(27.7-36.9)	246	33.8 (23.4-46.0)	206	40(28.9-52.2)	382	28.2(23.5-33.3)
≥5000 baht	1291	67.9(63.1-72.3)	329	66.2 (54-76.6)	219	60(47.8-71.1)	743	71.8(66.7-76.5)
Household with a:								
Migrant	134	3.8(2.6-5.5)	107	9.2(4.47-17.2)	21	4.6(2.8-7.5)	6	0.6(0.3-1.4)
Forest-goer	685	39.5(33.4-45.9)	113	32.9(19.2-50.3)	142	29.1(21.3-38.5)	430	47(39.1-55.2)
Pregnant woman	50	2.5(1.6-3.9)	14	3.7(1.7-8.0)	9	1.3(0.5-3.2)	27	2.3(1.4-3.6)
Child aged <5years	573	27.5(24.5-30.8)	160	30.3(26.2-34.8)	99	22.9(17.7-29.2)	314	27.8(23.5-32.6)
Characteristics of the head of the household								
Sex								
Female	582	28.5(25.3-31.8)	139	29(21.9-37.3)	133	32.3(26.3-39.0)	310	26.6(23.1-30.5)
Male	1467	71.5(68.2-74.7)	420	71.0(62.7-78.1)	274	67.7(61-73.7)	773	73.4(69.5-76.9)
Age group								
15 – 30 years	83	3.8(2.3-6.0)	26	2.3(1.0-5.4)	18	7.6(3.9-14.0)	39	3.1(1.8-5.0)
31 – 60 years	1355	67.0(63.8-70.0)	376	66.4(62.1-70.4)	257	60.2(51.9-67.9)	722	70(66-73.6)
60+ years	609	29.2(26.2-32.4)	157	31.3(27.2-35.7)	130	31.9(23.8-41.4)	322	27(23.2-31.2)
Education level								
Never attended school	416	16.2(11.3-22.6)	234	30.9(15.0-53.2)	46	12 (7.4-19.1)	136	10.1(6.6-15.0)
Primary school	1158	57.1(51.1-62.9)	213	40.8(28.7-54.2)	279	67.2(64.1-70.1)	666	61.7(55.8-67.3)
Secondary school or higher	448	26.7(21.1-33.1)	103	28.3(14.4-48.0)	75	20.8(15.2-27.7)	270	28.2(22.6-34.7)
	TOTAL (n = 2,125)		Domain 1: Thai-Myanmar border (n = 575)		Domain 2: Thai-Cambodia border (n = 425)		Domain 3: Remaining areas (n = 1,125)	
Mean Household size (95% CI)	3.87 (3.72-4.03)		3.88 (3.64-4.11)		3.6 (3.45-3.77)		3.98 (3.72-4.23)	

Characteristics of the individuals living in the households are described in Table 5. Overall, the majority of household members were female (51.3%, 95% CI [50.3-52.2] and 48.7%, 95% CI [47.8-49.7] for females and males, respectively). There was no significant difference in the sex and age structure of populations across domains (Figure 2). Very few migrants were included in the survey sample. Only 1.9% of individuals were M1 migrants, while only four individuals were M2. There was a significantly lower proportion of M1 migrants in domain 3 compared to the other two domains. The vast majority of individuals were of Thai ethnicity, but this proportion was significantly lower in domain 1 which showed greater ethnic diversity than the other two domains and a particularly high Karen population (13.0%).

The majority of the population were farmers or wage labourers. In domain 3, rubber farming was the most common form of farming. In terms of *a priori* risk factors for infection, significantly more individuals in domain 1 had never attended school. Almost one-fifth of individuals were forest-goers, with no significant difference across domain, and pregnant women made up 2.3% of the population, also not different across the three domains.

Table 5: Descriptive statistics of household members (n = 8,231)

	TOTAL (n = 8,231)		Domain 1 Thai-Myanmar border (n = 2,201)		Domain 2 Thai-Cambodia border (n = 1,555)		Domain 3 Remaining areas (n = 4,475)	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Sex								
Male	4069	48.7 (47.8-49.7)	1082	49.0 (48.1-50)	770	48.1 (46.2-50.1)	2217	48.8 (47.3-50.3)
Female	4162	51.3 (50.3-52.2)	1119	51.0 (50.0-51.9)	785	51.9 (49.9-53.8)	2258	51.2 (49.7-52.7)
Age group								
0 - 4 years old	668	8.4 (7.5-9.3)	179	9.2 (7.7-10.9)	107	6.7 (5.4-8.3)	382	8.6 (7.5-9.8)
5 - 14 years old	1442	16.9 (15.7-18.1)	407	18.0 (16.7-19.5)	279	15.8 (13.7-18.2)	756	16.6 (15.7-18.1)
Male adults, 15+ years	3023	36.5 (35.4-37.5)	807	36.1 (33.9-38.3)	580	37.4 (36.4-38.4)	1636	36.3 (34.8-37.9)
Female adults, 15+ years	3096	38.3 (37.2-39.4)	807	36.7 (35.9-37.6)	588	40.1 (37.9-42.4)	1701	38.5 (36.9-40)
Nationality								
Thai	7935	98.0 (96.8-98.8)	1946	94.7 (88.2-97.7)	1523	98.0 (96.0-99.0)	4466	99.7 (99.2-99.9)
M1	292	1.9 (1.1-3.1)	253	5.2 (2.2-11.8)	31	1.8 (1.0-3.1)	8	0.2 (0.1-0.8)
M2	4	0.1 (0.0-0.3)	2	0 (0.0-0.1)	1	0.3 (0.0-1.3)	1	0 (0.0-0.3)
Ethnic group								
Thai	6939	90.0 (81.7-94.8)	1235	72.1 (42.3-90.1)	1524	98.2 (96.9-99.0)	4180	96.3 (89.3-98.8)
Shan	67	0.5 (0.1-1.8)	67	0.5 (0.1-1.8)	0	0	0	0
Myanmar	23	0.3 (0.1-0.6)	19	0.6 (0.3-1.3)	0	0	4	0.1 (0.0-1.1)
Karen	771	5.0 (2.3-10.4)	558	13.0 (4.2-34.1)	1	0.0 (0.0-0.3)	212	2.5 (0.6-10.7)
Mon	79	0.3 (0.1-1.1)	76	0.7 (0.1-3.6)	3	0.8 (0.1-3.9)	0	0
Khmer	7	0.1 (0.0-0.3)	1	0	6	0.5 (0.1-1.7)	0	0
Lao	29	0.1 (0.1-0.3)	8	0.2 (0.0-0.9)	21	0.5 (0.1-1.7)	0	0
Thai-Malays	4	0 (0.0-0.2)	0	0	0	0	4	0.1 (0.0-0.2)
Other*	311	3.7 (0.8-14.7)	237	11.6 (2.0-46.4)	0	0	74	0.9 (0.2-4.1)
Occupation								
Child/student	2598	31.1 (29.4-32.8)	702	31.9 (28.7-35.3)	468	28.7 (26.8-30.6)	1428	31.6 (29.2-34.0)
Farmer/gardener	1619	15.6 (10.8-21.9)	592	21.4 (9.3-41.9)	450	30.8 (20.2-43.8)	577	7.1 (4.3-11.6)
Rubber farmer	1234	22.4 (17.9-27.7)	86	16.2 (6.3-35.7)	144	11.7 (4.8-25.6)	1004	29.5 (24.3-35.3)
Wage labourer	1007	11.1 (9.2-13.3)	292	10.3 (7.8-13.4)	229	13.1 (9.0-18.7)	486	10.8 (7.9-14.4)
Jobless/elderly	675	7.2 (6.4-8.1)	180	6.2 (4.7-8.0)	118	6.2 (4.8-8.1)	377	8.1 (7.2-9.1)
Merchant	294	3.0 (2.3-3.9)	92	2.7 (1.1-6.1)	46	3.0 (2.0-4.3)	156	3.1 (2.4-4.1)
Housewife/ husband	255	2.9 (2.4-3.5)	81	3.0 (2.0-4.0)	36	2.3 (1.3-4.0)	138	3.2 (2.6-3.8)
Military	31	0.4 (0.2-0.7)	4	0.1 (0.0-0.3)	9	0.6 (0.3-1.2)	18	0.4 (0.2-0.7)
Civil service	96	1.2 (0.8-1.9)	26	1.0 (0.6-1.5)	6	0.4 (0.1-1.1)	64	1.7 (1.0-2.8)
Others	419	5.1 (4.0-6.5)	144	7.3 (5.5-9.7)	49	3.3 (2.2-4.9)	226	4.5 (3.1-6.5)
Highest education level								
Never attended school	1058	11.2 (7.9-15.8)	592	22.4 (11.3-39.5)	118	7.5 (5.0-11.1)	348	6.8 (4.8-9.7)
Primary	3729	50.0 (46.8-53.3)	838	42.2 (35.1-49.7)	841	58.0 (54.5-61.4)	2050	42.2 (48-54.4)
Secondary or higher	2622	38.7 (35.1-42.5)	578	35.4 (24.3-48.4)	447	34.5 (31.0-38.2)	1597	42.0 (38.3-45.9)
Risk group:								
Forest-goer	1212	18.2 (15.3-21.6)	160	13.0 (7.4-21.9)	265	15.3 (10.7-21.4)	878	22.0 (17.7-27.1)
Pregnant women	51	2.3 (1.5-3.7)	15	3.6 (1.8-7.1)	9	1.3 (0.5-3.6)	27	2.0 (1.3-3.3)

*Other includes: Chinese, Lisu, Moun, Yao

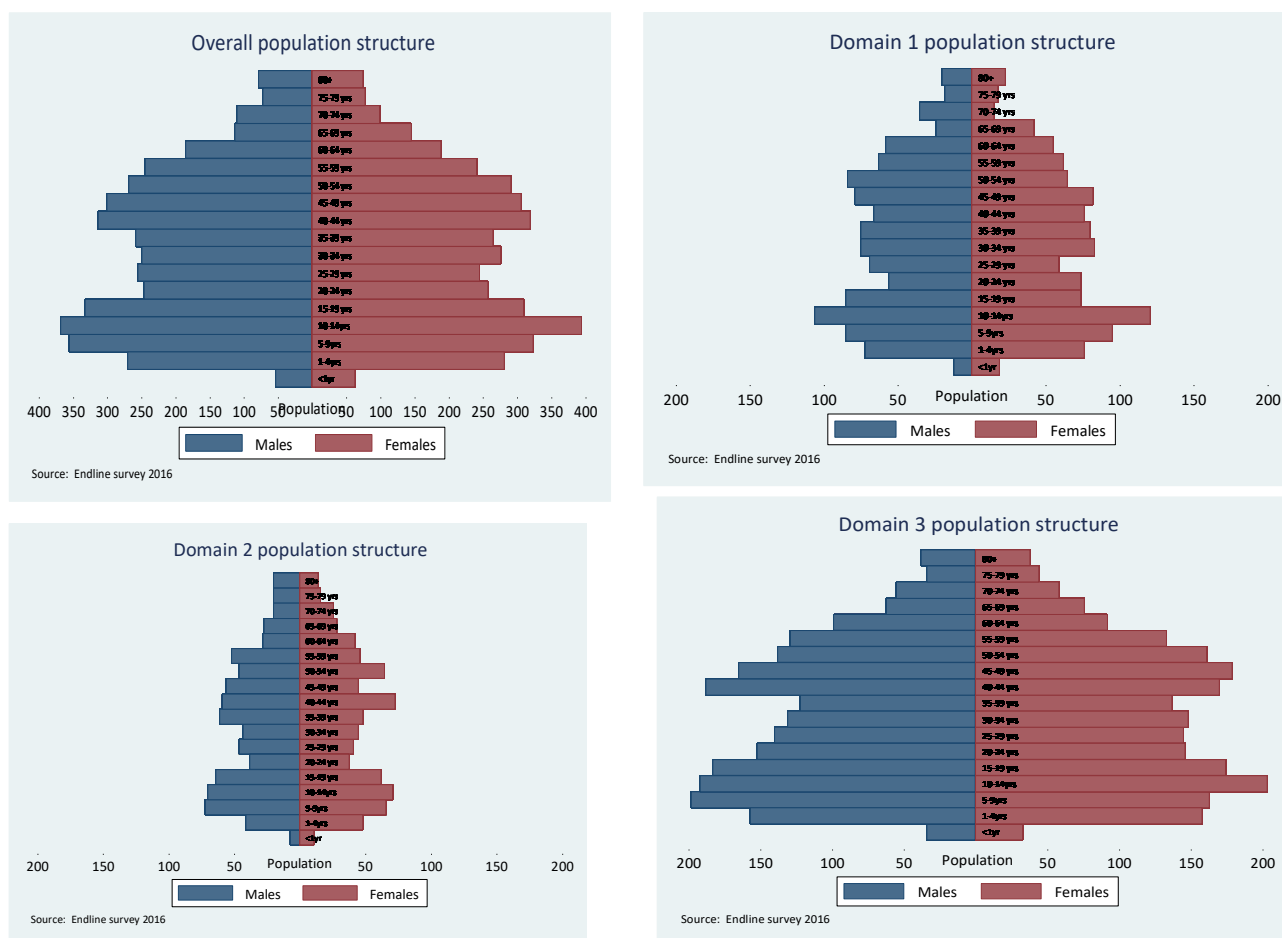


Figure 2: Population pyramids of total survey population and in each domain

Net coverage and usage

Ownership of nets, ITNs and LLINs

Household net ownership of any type of net was high at 90.8%, 95% CI [87.3-93.5] for at least one net and 81.5%, 95% CI [77.0-85.3] for sufficient nets (Figure 3 and 4, Annexes 2 and 3). However, ownership of effective ITNs/LLINs and LLINs was significantly lower. Ownership of at least one ITN/LLIN was 52.3%, 95% CI [44.7-59.9] and of sufficient ITNs/LLINs was only 40.3%, 95% CI [34.4-46.6]. Ownership of at least one LLIN was 46.7%, 95% CI [39.9-53.6] and sufficient LLINs was 32.3%, 95% CI [27.3-37.8].

Ownership of at least one ITN/LLIN or LLIN tended to be lower in domain 3 compared to domain 1, although this did not reach significance (Figure 3, Annex 2). Ownership of sufficient ITNs/LLINs was significantly lower in domain 3 compared to domain 2 at 33.4%, 95% CI [26.9-40.6] versus 55.3%, 95% CI [41.0-68.7] (Figure 4, Annex 3). However, ownership of sufficient LLINs alone was not significantly different across domains.

By risk area, significantly more households in A1 areas owned at least one ITN/LLIN or LLIN (Annex 2), and tended to own more sufficient ITN/LLIN and LLIN, though this didn't reach significance (Annex 3). Households with income under 5,000THB per month tended to have higher ownership of nets than households with income over 5,000THB, though this was not significantly different. There

was no difference in ownership among households with or without forest-goers, although households with migrants had greater coverage of at least one ITN/LLIN (71.2%, 95% CI [60.2-80.1] versus 51.6%, 95% CI [43.8-59.3]). There was also higher ownership of at least one ITN/LLIN among households where the head of the household had not attended school, but no difference in ownership of sufficient ITNs/LLINs (Annex 2 and 3).

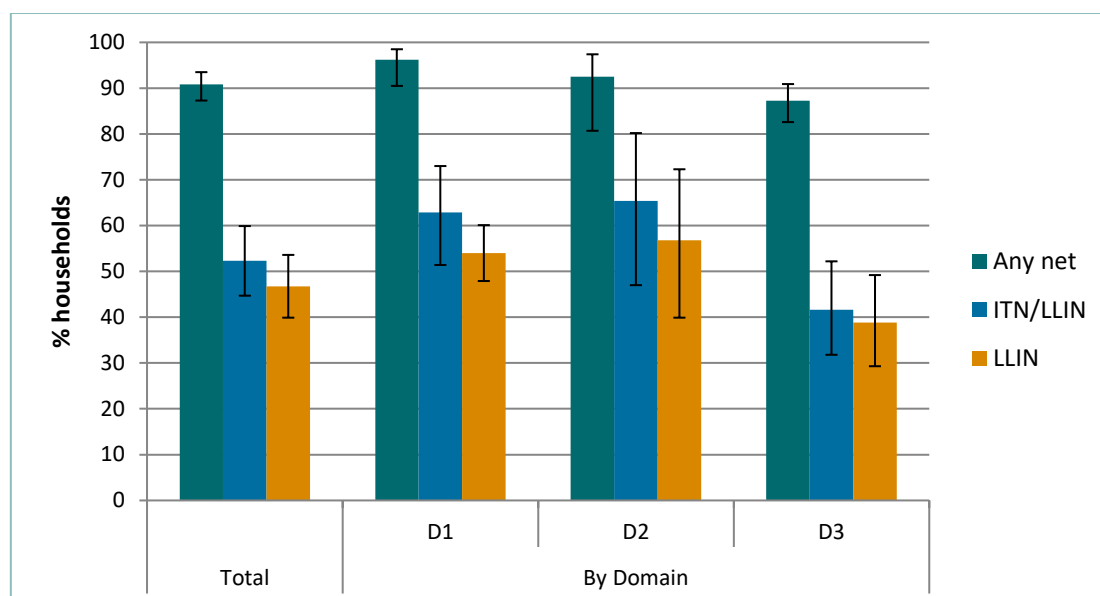


Figure 3: Household ownership of at least one net by type of net

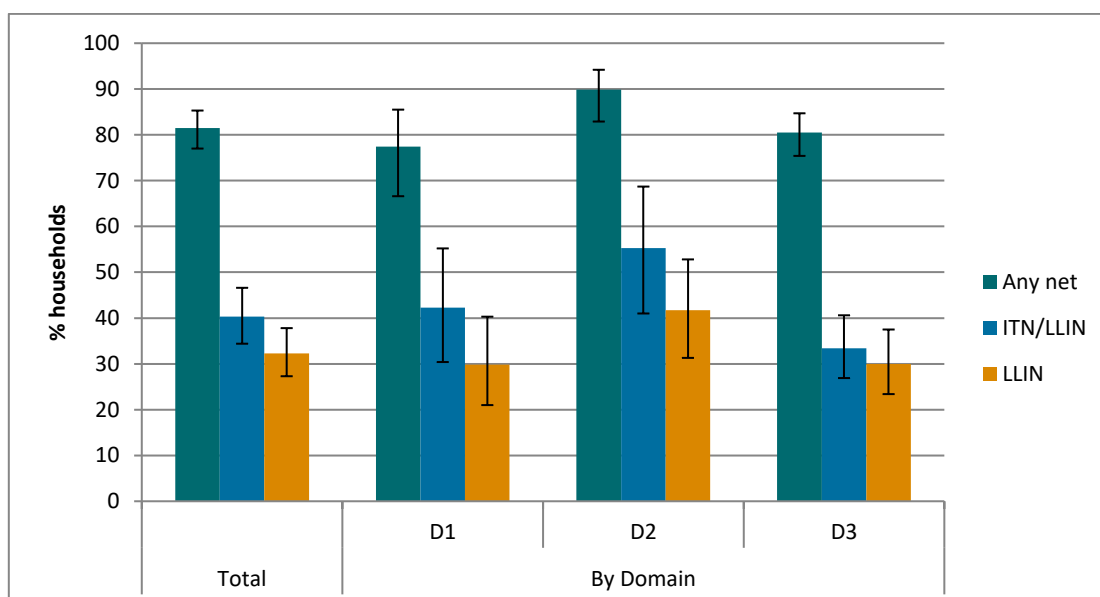


Figure 4: Household ownership of sufficient nets by type of net

Usage of nets, ITNs and LLINs

The proportion of the survey population that used a net of any type the previous night was 68.7%, 95% CI [64.6-72.6]. However, the usage of ITNs/LLINs and LLINs was significantly lower at 24.9%, 95% CI [19.6-31.2] for ITNs/LLINs and 15.1%, 95% CI [11.9-19.1] for LLINs only (Figure 5 and Annex 4).

Usage of any net and ITN/LLIN was significantly lower in domain 3 compared to the other two domains, and tended to be lower for usage of LLINs only although this did not reach significance (Figure 5). Usage of ITN/LLINs and LLINs was also significantly higher in Global Fund project areas and appeared higher in A1 areas although the differences by A1/A2 risk area were not significant (Annex 4).

There was no difference in usage of nets by sex, age group, pregnancy status or whether the individual was a forest-goer or not (Annex 4). Usage of nets, ITNs/LLINs and LLINs was significantly lower among people that had attended school (usage was 57.9%, 95% CI [52.8-62.8], 18.1%, 95% CI [13.6-23.7] and 10.8%, 95% CI [8.3-14.0] for any net, ITNs/LLINs and LLINs, respectively, among individuals that had attended secondary school), among the Thai population (68.3%, 95% CI [64.1-72.2], 24.4%, 95% CI [19.1-30.5] and 14.9%, 95% CI [11.6-18.9] for any net, ITNs/LLINs and LLINs, respectively) and among households earning over 5,000 THB per month (64.6%, 95% CI [60.5-68.5], 19.9%, 95% CI [15.2-25.8] and 11.9%, 95% CI [8.7-16.0] for any net, ITNs/LLINs and LLINs, respectively).

Usage was significantly higher in households where the head of household named the ITN as a prevention method for malaria: 85.6%, 95%CI [79.9-90.9] for any type of net, 52.3%, 95% CI [43.9-60.5] for ITNs/LLINs and 27.1%, 95%CI [21.1-34.2] for LLINs only.

Since ownership of ITNs and LLINs was also associated with some of these variables, usage was looked at only in households with ownership of sufficient ITNs/LLINs and LLINs to see what effect these demographic factors may have when ownership is not a factor. In these households, higher income and education level still correlated with lower usage, and usage was significant lower in domain 3 versus domain 2 and domain 1 (Annex 5).

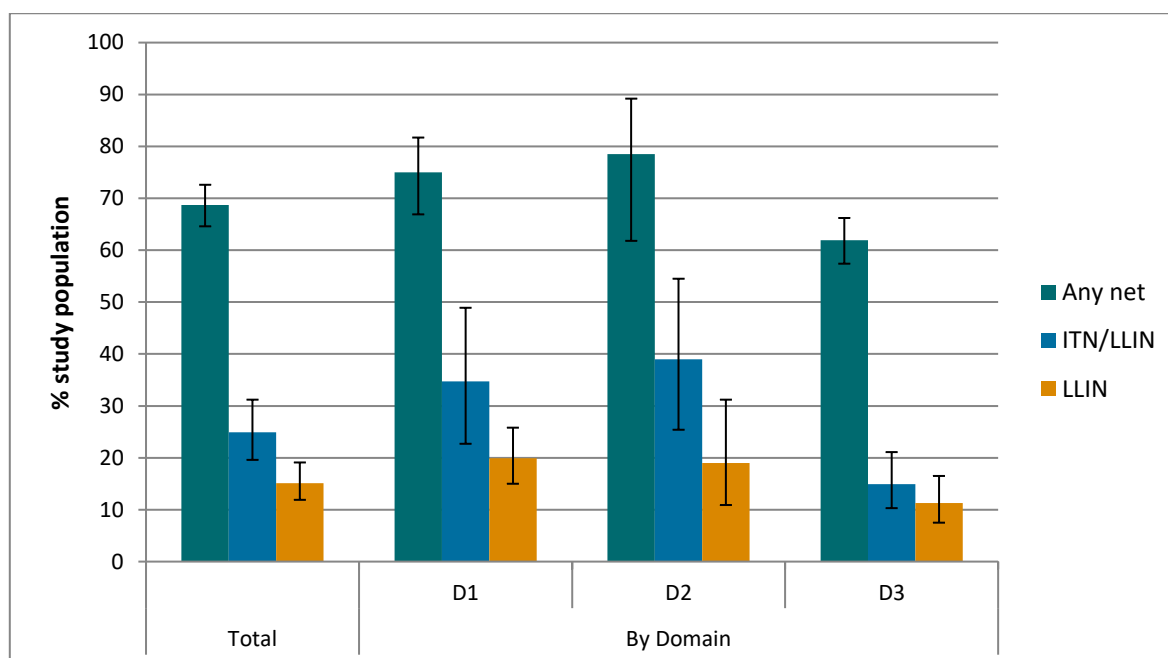


Figure 5 : Usage of net the previous night by type of net

Access and usage

Including the whole study population, access to an ITN/LLIN the previous night was 51.7%, 95% CI [45.1-58.3] (Table 6). Although there was no significant difference by domain, domain 3 appeared to have a lower proportion of the population with access to an ITN/LLIN compared to domain 2 at 44.7%, 95% CI [31.1-53.2] compared to 65.5%, 95% CI [52.9-78.3]. Access was also significantly higher in A1 areas compared to A2 at 70.5%, 95% CI [63.9-77.1].

Table 6: Percentage of population with access to an ITN/LLIN the previous night by study area.

	% with access to an ITN/LLIN the previous night	
	%	95%CI
Total	51.7	45.1-58.3
By domain:		
Domain 1: Thai-Myanmar	54.7	41.0-68.5
Domain 2: Thai-Cambodia	65.5	52.9-78.3
Domain 3: Remaining areas	44.7	31.1-53.2
By risk area:		
A1	70.5	63.9-77.1
A2	49.4	42.5-56.5

The effect of access on usage was explored by looking at use of an ITN/LLIN the previous night among households with and without 100% access to an ITN/LLIN. Usage of ITN/LLIN in the population overall was 24.9% (Figure 5). This significantly increased when considering only households in which people had 100% access to an ITN/LLIN the previous night, to 48.3%, 95% CI [39.6-57.1] (Figure 6, Annex 6). As access to an ITN/LLIN increased, usage increased (Figure 6). However, when access was 100%, usage did not reach 100%, highlighting that access is not the only factor affecting usage.

The ratio of usage:access provides an indication of the behavioural gap. Overall, the ratio was 24.9% usage of ITN/LLIN:51.7% access to an ITN/LLIN, or 0.48, indicating a usage gap of 52% (Annex 6). In domain 3, usage among households with 100% access to an ITN/LLIN was significantly lower than both domain 1 and domain 2, and the usage:access ratio in domain 3 was 14.9%:44.7%, or 0.33, indicating a 67% usage gap due to behaviour. There was no difference between A1 and A2 risk areas.

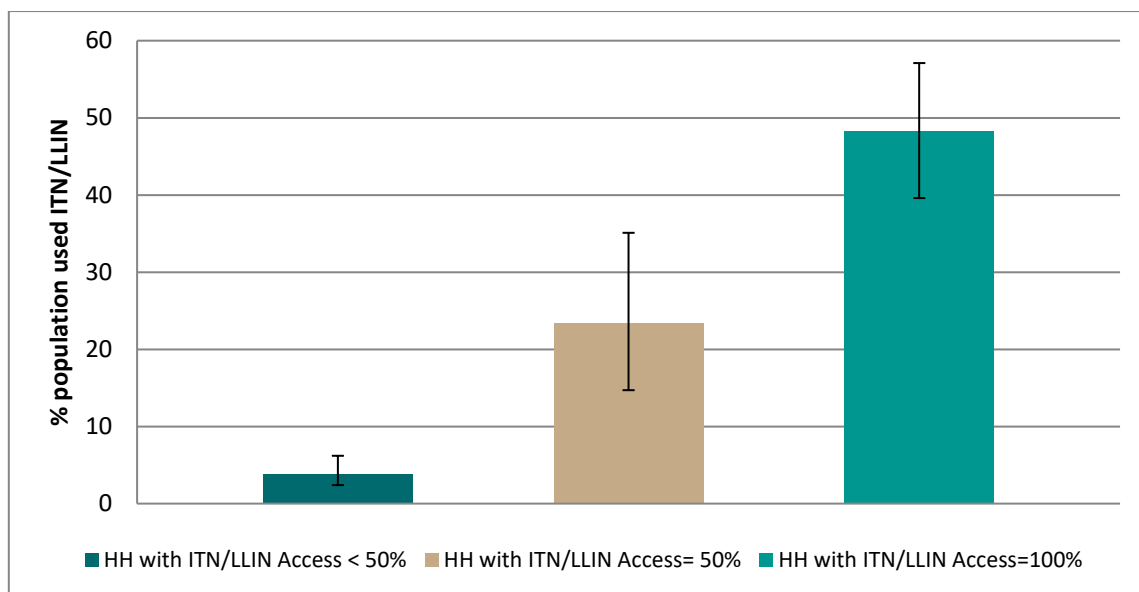


Figure 6: Usage of an ITN/LLIN in households (HH) with different levels of access to an ITN/LLIN the previous night

Reasons nets had not been used

Reasons for not using a net among household members were not gathered since only the head of the household completed the survey. Reasons were instead gathered on why a net itself wasn't used (Figure 7 and Annex 7). The main reason for not using a net the previous night was because it was saved for visitors or future use (43.1%), followed by the reason that they had enough nets in the household (16.6%). These reasons were given even in households that did not own sufficient nets. A total of 8.6% of unused nets were not used because they made the user feel hot/uncomfortable, and other nets were not used because they were too small (5.3%), were not in good condition (2.9%), or not easy to hang (2.6%). There were no significant differences across domains except where, compared to domain 1, domain 3 had a higher proportion of nets that were not used because the household owned enough nets.

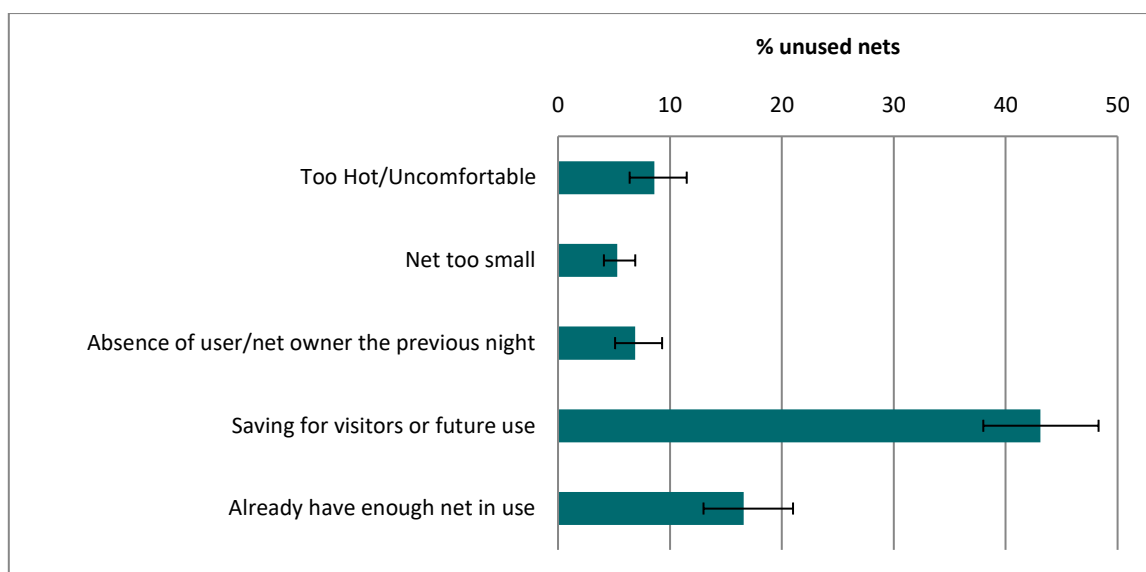


Figure 7: Five most common reasons that a net was not used the previous night to the survey, including any type of net owned (n = 2,259)

Types and characteristics of owned nets

A total of 5,388 bed nets were owned by the surveyed households. More than a half of the nets owned were conventional, untreated nets (60.4%, 95% CI [54.2-66.2]); 25.2%, 95% CI [21.5-29.4] of nets were LLINs aged less than three years; 3.6%, 95% CI [2.5-5.1] of nets were LLINs over three years of age and the remainder were ITNs (10.8%, 95% CI [8.1-14.3]). Domain 3 had a higher proportion of conventional nets and ITNs compared to domain 2 (Figure 8 and Annex 8).

Of all the LLIN owned, 3.6%, 95% CI [2.5-5.1] were aged over three years and thus had passed their effective lifespan. Furthermore, 13.1%, 95% CI [9.3-18.2] of LLINs were damaged with tears or holes. In comparison to LLIN, there was a greater proportion of conventional nets aged over three years and a greater proportion of conventional nets that were damaged (22.7%, 95% CI [19.8-25.8]) (Annex 8). Including all nets, one-fifth had holes or cracks.

With regard to specific brands of LLIN, 'Olyset' and 'Permanet', which were distributed in years 2 and 3 of the Global Fund grant, made up the majority of LLINs found in this survey at 25.5%, 95% CI [21.8-29.6] and 39.1%, 95% CI [32.8-45.8], respectively (Annex 8). Only 2.7%, 95% CI [1.2-5.9] and 11.6%, 95% CI [7.3-18.1] of LLINs were 'Yorkool' distributed under Global Fund in years 4 and 5, respectively. There was no difference in LLIN brand by domain.

The major source of nets was dependent on the type of net. Most LLINs were received from free government distribution, but the majority of conventional nets and ITNs were purchased from the private sector (Figure 9). It was reported that more LLINs were purchased from the private sector in domains 1 and 2 compared to domain 3, despite LLIN not being registered for private sector sale in Thailand (Annex 8). No data was collected on the source of treatment of ITNs.

The majority of LLINs were of white colour and were large enough for two people to use, in line with the specifications of LLINs distributed by the government. The majority of conventional nets were of a larger size to sleep more than two people (57.2%, 95% CI [51.8-62.8]) and there was greater variation in the colour of the conventional nets, including white (37.4%), pink (21.8%) and blue/green (21.4%) (Annex 8).

A few hammock nets were also found in this survey (n = 240). Most of the hammock nets were of the brand Yorkool, which was distributed in Global Fund year 5 (23.5%, 95% CI [10.9-43.5]), though not significantly more than other brands. Most hammock nets had been received from free the government or NGO distribution and the vast majority had holes/tears in them at the time of the survey (Annex 9).

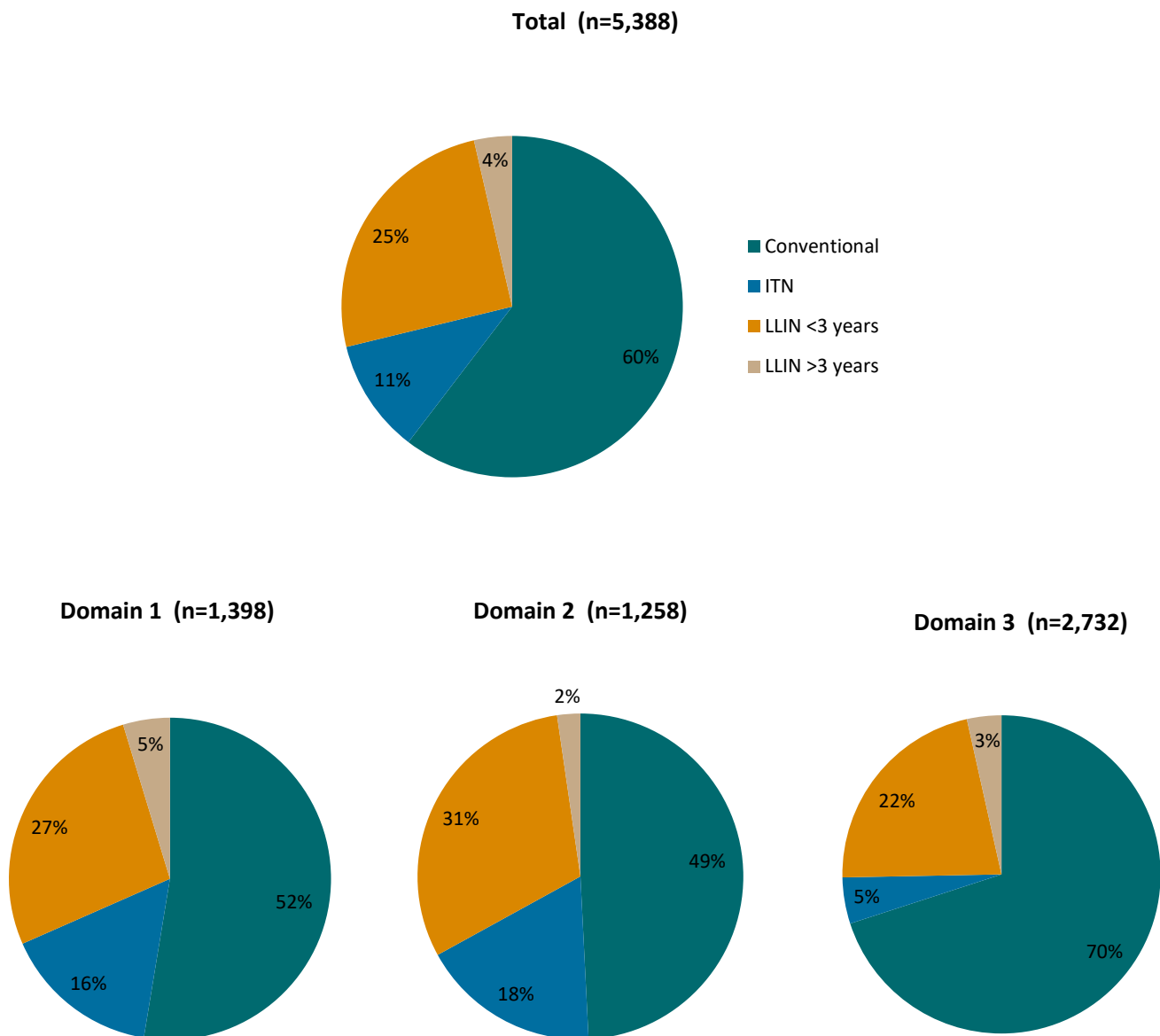


Figure 8: Breakdown of the types of nets owned across each domain

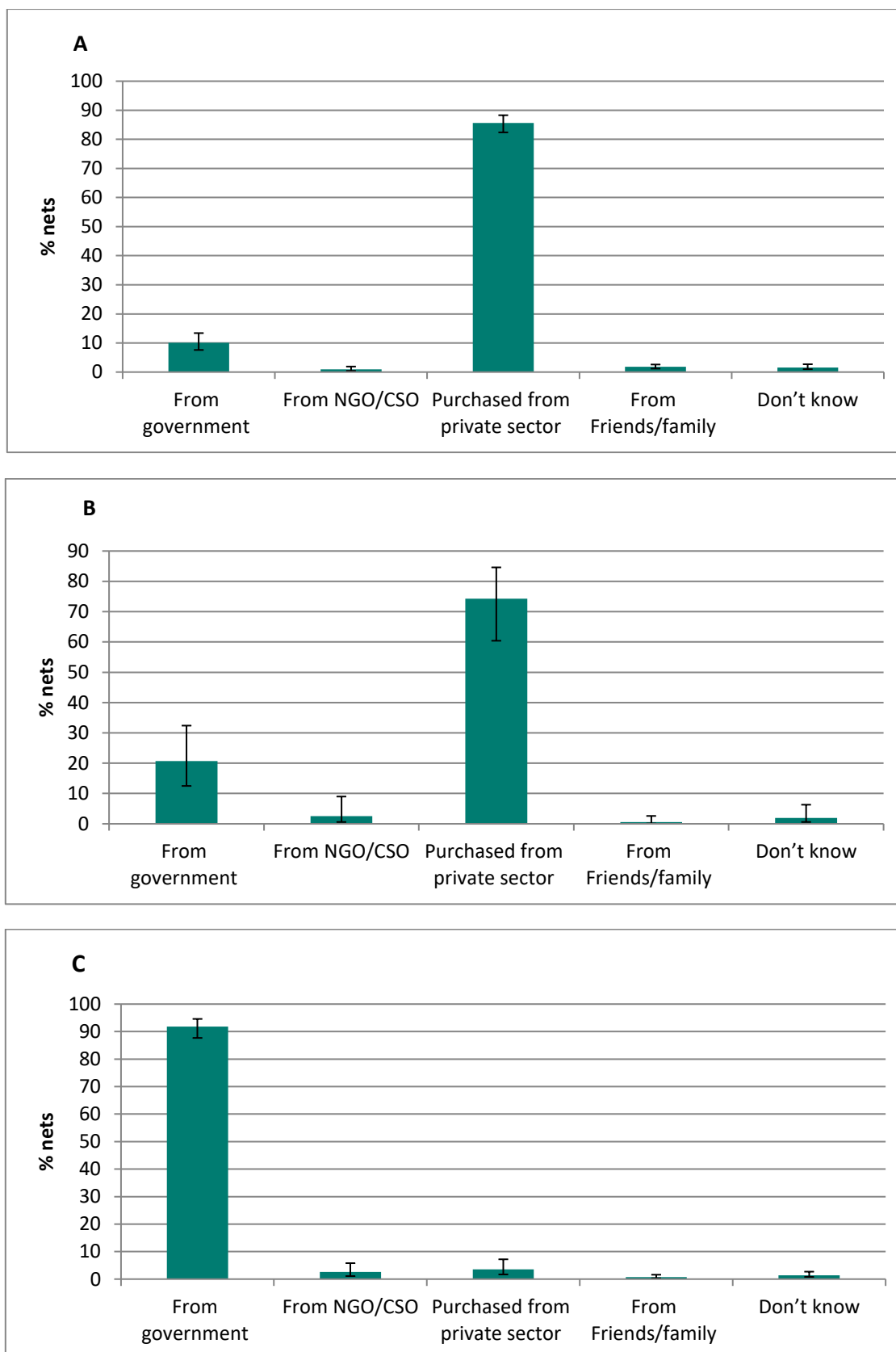


Figure 9: Source of owned nets by a) conventional nets, B) ITN only (treated last 12 months), c) LLIN only (including LLIN of any age)

Characteristics of nets used last night

Usage was analysed according to different characteristics of the nets (Table 7). ITNs were used significantly more than other types (80.7%, 95% CI [75.3-85.2] of ITNs were used last night), followed by conventional nets (64.3%, 95% CI [60.7-67.7]) and then LLIN (22.7%, 95% CI [44.3-56.1]). Usage of damaged nets was significantly greater than usage of undamaged nets (76.7%, 95% CI [72.4-80.4] versus 57.0%, 95% CI [53.6-60.3]), consistent across domains. Usage of larger nets that could sleep more than two people was also significantly higher than smaller nets. Usage of pink or multicolour nets was higher than white colour of nets, and usage of cotton or nylon nets appeared higher than other material types although confidence intervals overlapped.

Table 7: Usage of nets according to different characteristics of the nets. Percentages show what percentage of each net type was used the previous night.

Net characteristics	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Type of net								
Conventional	1936	64.3(60.7-67.7)	458	59.3(51.1-66.9)	368	66.7(61.2-71.8)	1110	65.7(61.9-69.3)
LLIN (any age)	851	50.2(44.3-56.1)	251	59.3(46.3-71.2)	202	48.6(40.0-57.2)	398	44.9(38.7-51.2)
ITN	511	80.7(75.3-85.2)	210	86.8(76.0-93.1)	171	79.5(75.4-83.0)	130	71.2(57.1-82.1)
LLIHN	70	30.1(22.4-39.2)	29	33.6(20.6-49.7)	13	22.4(8.6-46.8)	28	34.0(23.8-45.9)
Cracks or holes								
No crack or hole	2371	57.0(53.6-60.3)	683	56.9(51.0-62.6)	476	55.9(46.3-65.0)	1212	57.5(52.9-62.0)
Crack or hole	981	76.7(72.4-80.4)	257	84.8(76.9-90.3)	272	78.3(73.0-82.8)	452	70.3(64.8-75.3)
Don't know	16	30.0(17.3-46.8)	8	29.1(14.2-50.6)	6	27.0(9.8-55.6)	2	3.5(9.9-84.4)
Size of net								
Single size	190	49.4(41.3-57.6)	48	38.6(24.4-55.1)	57	50.9(38.7-63.0)	85	52.9(41.1-64.4)
For 2 people	1581	56.4(52.2-60.6)	495	62.7(51.2-73.0)	315	55.2(47.8-62.3)	771	53.5(48.9-58.1)
> 2 people	1595	68.6(65.0-71.9)	405	66.7(58.9-73.7)	382	70.8(63.0-77.5)	808	68.8(64.2-73.1)
Hammock	2	9.0(1.3-43.2)	0	0	0	0	2	27.9(7.8-63.7)
Colour of net								
White	1770	56.2(52.5-59.8)	570	60.2(51.5-68.3)	320	52.8(45.1-60.4)	880	55.1(50.5-59.5)
Blue/green	733	63.6(57.6-69.3)	182	66.5(45.7-82.4)	174	59.8(50.5-68.4)	377	63.7(59.4-67.8)
Pink	594	70.8(65.7-75.4)	123	66.9(48.8-81.2)	170	71.9(65.4-77.7)	301	71.6(65.5-77.0)
Multicolour	268	72.7(63.5-80.3)	71	78.1(57.3-90.5)	89	82.5(61.5-93.3)	108	62.3(54.6-69.4)
Age of net								
< 1 year	852	55.6(50.0-61.0)	218	59.4(48.3-67.9)	202	57.7(47.8-67.0)	432	52.6(44.4-60.7)
1-3 years	1650	64.6 (59.9-69.1)	471	64.4(52.1-75.1)	379	63.5(53.8-72.2)	800	65.3(60.2-70.2)
>3 years	815	61.0(56.8-65.1)	241	63.9(53.1-73.5)	153	60.8(48.0-72.3)	421	59.6(54.5-64.4)
Don't know	51	35.1(19.6-54.5)	18	20.1(4.4-57.8)	20	43.0(21.3-67.9)	13	43.8(26.3-63.1)
Fabric/material								
Polyethylene	263	51.0(42.8-59.0)	92	59.3(41.7-74.7)	47	42.6(31.8-54.2)	124	48.4(38.3-58.6)
Polyester	642	45.8(39.5-52.2)	200	51.4(39.7-62.9)	157	46.0(33.3-59.2)	285	41.1(33.2-49.4)
Lace	119	59.2(48.8-68.9)	34	80.4(70.3-87.7)	8	31.9(18.2-49.6)	77	55.5(42.8-67.6)
Cotton	320	74.9(68.5-80.4)	132	79.6(69.5-86.9)	10	52.3(10.9-90.7)	178	74.0(66.3-80.4)
Nylon	1307	70.3(66.9-73.5)	277	67.3(59.3-74.4)	335	70.6(66.1-74.8)	695	71.6(67.3-75.5)
Others	370	64.8(56.6-72.3)	111	61.6(40.3-79.3)	128	75.3(65.2-83.2)	131	54.9(44.8-64.7)
Don't know	284	56.8(49.0-64.3)	87	59.6(48.7-69.7)	66	61.7(42.0-78.2)	131	52.1(40.4-63.5)

Practices in regard to nets

Heads of households were asked about how often they washed each net (Table 8). Most nets (42.4%, 95% CI [38.3-46.6]) were washed more than three times per month. Considering ITNs and LLINs separately, over half of ITNs and 74.5%, 95% CI [69.2-79.1] of LLINs were washed too frequently according to WHO guidelines⁷. There was no difference in washing frequency across domain.

Table 8: Frequency with which households washed their nets, ITNs and LLINs

Net details	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Washing frequency for all nets								
Never	1714	27.4(24.1-31.0)	440	27.0(20.7-34.4)	424	29.1(23.7-35.2)	850	26.9(22.1-32.3)
>once per month	2125	42.4(38.3-46.6)	435	34.7(25.3-45.3)	542	42(34-50.5)	1148	47.1(41.6-52.7)
Every 2-3 months	1053	18.2(16.4-20.1)	334	21.1(16.0-27.2)	208	16.1(13.0-19.7)	511	17.4(15.4-19.7)
Twice per year	317	5.0(3.7-6.7)	156	9.9(5.8-16.5)	39	2.7(1.7-4.4)	122	3.1(2.1-4.6)
Once per year or less	355	5.7(4.4-7.3)	98	6.1(3.2-11.4)	105	7.5(5.2-10.6)	152	4.5(3.3-6.2)
Don't know	64	1.4(0.8-2.4)	12	1.3(0.3-6.2)	28	2.5(1.3-4.6)	24	1(0.5-1.9)
Washing frequency for ITNs (n = 630)								
Never	41	5.8(3.3-9.8)	18	7.1(2.7-17.4)	13	5.1(3.2-8.0)	10	4.5(1.9-10.3)
>once per month	268	42.0(31.7-53.2)	74	33.5(17.1-55.3)	111	41.5(28.7-55.6)	83	59.4(43.4-73.7)
Every 2-3 months	193	29.5(21.9-38.3)	87	30(17.9-45.7)	62	33(20.5-48.5)	44	22.4(12.8-36.2)
Twice per year	63	9.7(6.3-14.5)	38	16.4(10.2-25.2)	9	4(2.4-6.7)	16	6.4(2.7-14.1)
Once per year or less	56	11.4(7.5-17.0)	23	12.7(6.0-25.2)	23	13.9(9.7-19.5)	10	4.4(1.7-10.9)
Don't know	9	1.7(0.7-1.4)	2	0.3(0.1-1.3)	4	2.5(1.1-5.9)	3	2.9(0.5-15.6)
Washing frequency for LLINs (n = 1731)								
Never	900	47.3(40.9-53.9)	211	36.6(26.5-47.9)	215	43.3(33.6-53.6)	474	57.4(50.6-64.0)
>once per month	395	25.6(20.6-31.3)	93	19.9(14.2-27.3)	139	36.4(24.0-51.0)	163	22.7(19.1-26.8)
Every 2-3 months	255	16.8(12.9-21.5)	89	26.4(18.9-35.6)	53	11.2(9.7-12.8)	113	13.6(10.1-17.6)
Twice per year	77	4.7(3.1-7.2)	41	10.6(6.4-17.3)	6	0.8(0.3-2.1)	30	3.1(1.6-5.7)
Once per year or less	93	4.9(3.1-7.6)	26	6.3(2.3-16.2)	35	6.4(3.5-11.6)	32	2.8(1.6-5.0)
Don't know	11	0.7(0.3-7.6)	1	0.1(0.0-0.9)	7	1.9(0.6-5.8)	3	0.5(0.1-1.8)
Follow correct washing frequency for ITNs (one year lifespan with three washes)								
Correct	160	26.8(19.0-36.5)	79	36.2(20.6-55.4)	45	23(19.3-27.0)	36	15.3(8.4-26.3)
Too frequent	461	71.5(62.1-79.4)	161	63.5(44.5-79.1)	173	74.5(69.2-79.2)	127	81.8(69.5-89.80)
Don't know	9	1.7(0.7-4.1)	2	0.3(0.1-1.3)	4	2.5(1.1-5.9)	3	2.9(0.5-15.6)
Follow correct washing frequency for LLINs (three year lifespan with 20 washes)								
Correct	1325	73.7(68.2-78.5)	367	79.9(72.6-85.7)	309	61.7(48.8-73.2)	649	76.8(72.7-80.6)
Too frequent	395	25.6(20.6-31.3)	93	19.9(14.2-27.3)	139	36.4(24.0-51.0)	163	22.7(19.1-26.8)
Don't know	11	0.7(0.3-1.8)	1	0.1(0.0-0.9)	7	1.9(0.6-5.8)	3	0.5(0.1-1.8)

⁷ Guidelines state that 1) ITNs have a one year lifespan and can be washed three times, therefore washing more frequently than once per four months was considered as being too frequent in this analysis; and 2) LLINs have a three year lifespan and can be washed 20 times, therefore washing more frequently than once per two months was considered as being too frequent in this analysis.

Preferences for new nets

Heads of households were asked whether they would like a new net (Annex 10). 21.9%, 95% CI [18.3-26.0] responded that they did not want a new net; of those that did, the majority said they would wait for free distribution (61.6%, 95% CI [54.5-68.2]). There was almost one-third of households that wanted to buy a new net from the private market. Among all heads of households that wanted a new net, half said they wanted an LLIN but one quarter wanted a conventional, untreated net. Among people that wanted to purchase a net from the private market, most were willing to pay 200-300THB or >300THB for a new net.

In terms of net characteristics, 77%, 95% CI [74.8-79] of people wanted a net that could sleep more than two people and the vast majority wanted a rectangular shape. Cotton or nylon were the most preferred materials for the net, while tuma was least preferred.

By domain, more people in domain 2 stated that they wanted a new net. More respondents in domain 3 wanted a conventional untreated net, while more respondents in domain 1 and 2 preferred to have a treated net (re-dip or LLIN). There was no notable difference in terms of price willing to pay, preferred shape or material.

Other vector control methods

Only 6.2%, 95% CI [3.6-10.4] of households used a wire screen over some or all of their doors and windows (Figure 10 and Annex 11). There was no difference by domain, risk area, household income or households with risk groups. Over one-third of households reported using chemicals to repel mosquitoes. This was higher in domain 3 compared to domain 1 (40.4%, 95% CI [34.9-46.1] versus 28.5%, 95% CI [23.0-34.7]), higher in households with income over 5,000 THB (40.0%, 95% CI [35.2-44.9] versus 29.4%, 95% CI [25.6-33.4]) and in households without any migrants (37.3%, 95% CI [33.3-41.4] versus 18.5%, 95% CI [10.4-30.8]). About one-quarter of households had received indoor residual spraying (IRS) within the previous 12 months, with no difference across domains, risk areas, household income or risk group. There was 53.1%, 95% CI [46.0-60.2] of households that were protected by sufficient ITNs/LLINs and/or IRS in the previous 12 months (Figure 10 and Annex 11).

The primary actions used to protect from mosquito bites in most households were mosquito nets and chemicals (Figure 11 and Annex 12). Only 0.7% of households did not take any action to prevent mosquito bites.

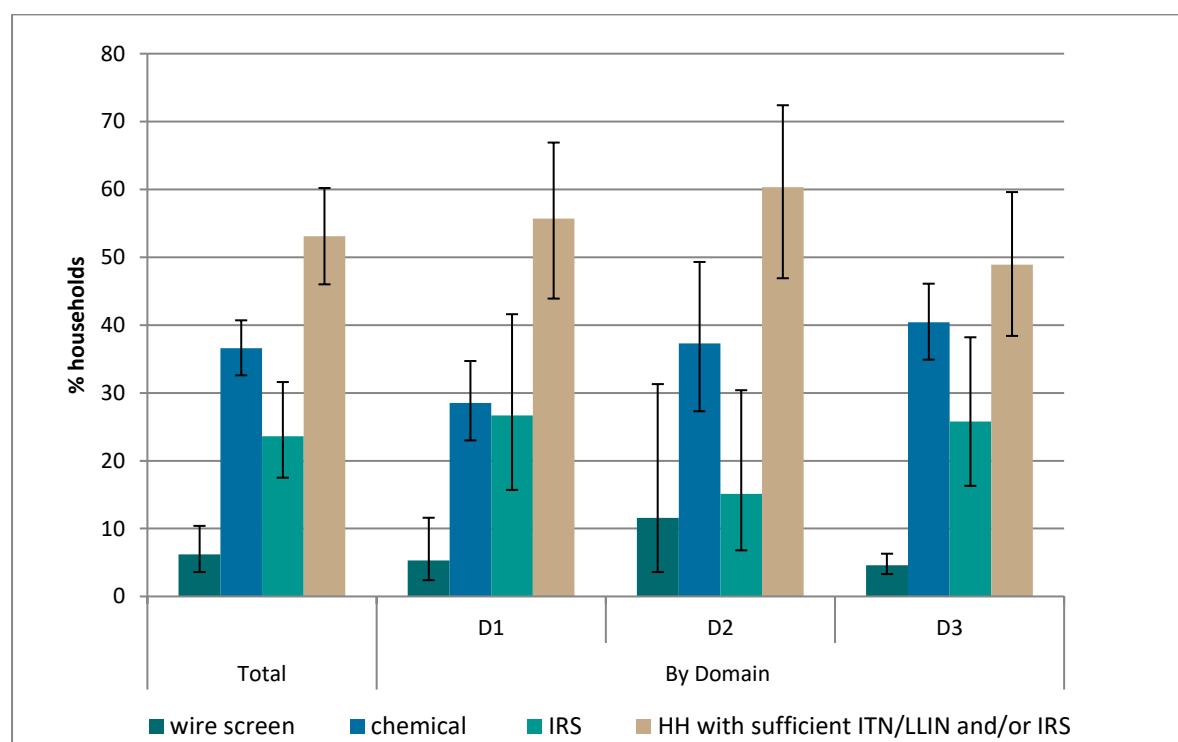


Figure 10: Coverage of wire screens, usage of chemicals and coverage of IRS in the previous 12 months in the surveyed households

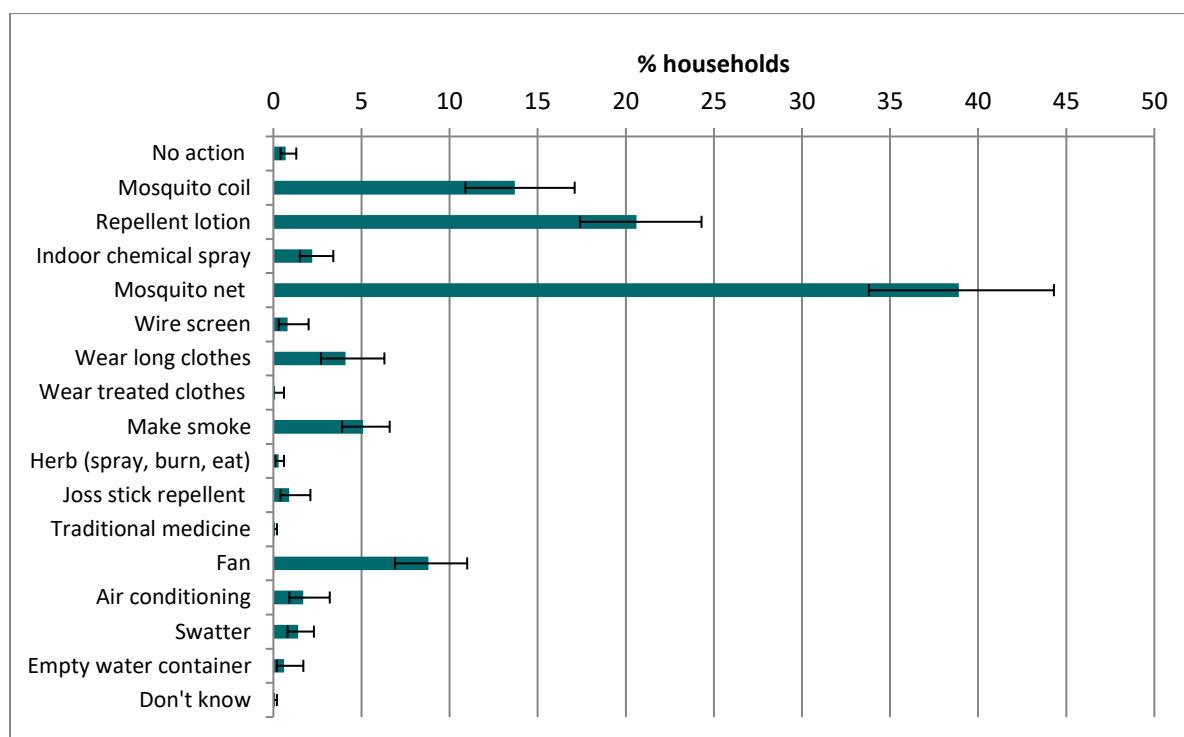


Figure 11: Primary action used by households to prevent mosquito bites

Fever, case management and healthcare seeking behaviour

Among all household members, the reported prevalence of fever in the previous two weeks was 6.5%, 95% CI [5.2-8.1] (Figure 12 and Annex 13). Fever was more frequently reported in domain 3 compared to domain 1, and in infants under five years of age compared to older age groups.

Of the 540 fever cases, 67.5%, 95% CI [60.8-73.6] sought advice and treatment from a healthcare provider but only 26.1%, 95% CI [20.3-32.9] sought treatment within 24 hours of the onset of fever (Figure 12 and Annex 13). There was no difference in the proportion of fever cases that sought treatment or sought treatment within 24 hours across domain, risk area, household income, nor according to any individual risk factor. There were also no differences in treatment seeking according to knowledge or behaviour change communication (BCC) exposure of the household respondent.

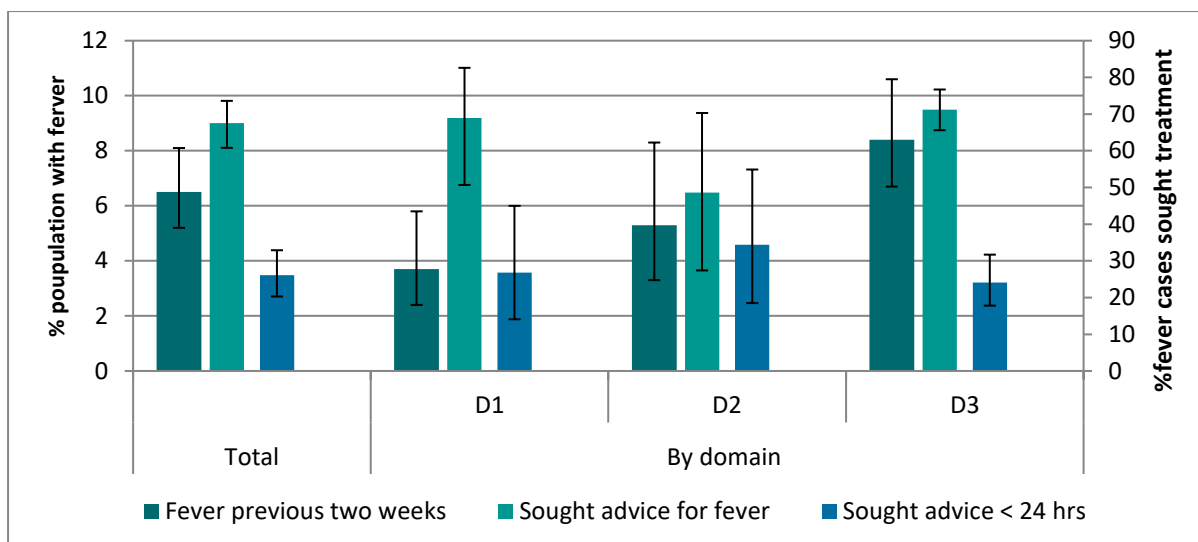


Figure 12: Prevalence of fever in the previous two weeks and proportion of fever cases that sought advice/treatment

Choice of healthcare provider

Among fever cases that sought treatment, the majority visited a public hospital (59.9%, 95% CI [48.8-70.1]), followed by a private clinic/hospital (34.3, 95% CI [23.7-46.9]), consistent across domains and risk area (Figure 13 and Annex 14). According to household income, fewer individuals in households earning <5000THB visited a private clinic/hospital (Annex 14). Very few people visited a malaria clinic or MP/BMP, and no one from domain 2. To investigate whether this was due to MPs/BMPs not being present in the selected clusters, the analysis was disaggregated by clusters with and without a MP/BMP according to a village list provided by BVBD. Even in villages with a MP/BMP present, usage of the MP/BMP was very low. Only one out of 47 (3.9%, 95% CI [0.8-17.0]) fever cases that sought treatment in these clusters went to an MP/BMP (Annex 14).

When healthcare providers were grouped into the private and public sectors, overall about one-third of fever cases visited the private sector, significantly less than the proportion that visited the public sector (Table 9). Although there was no significant difference between domains on the proportion of people that visited the private sector, comparison within domain choice of provider did show a difference. In domain 1, fever cases visited the public sector significantly more than the private sector. However, within domains 2 and 3 there was no significant difference between the proportion of people that visited the private sector compared to the public sector. A significantly greater proportion of people visited the public sector in lower income households and in A1 areas (Table 9).

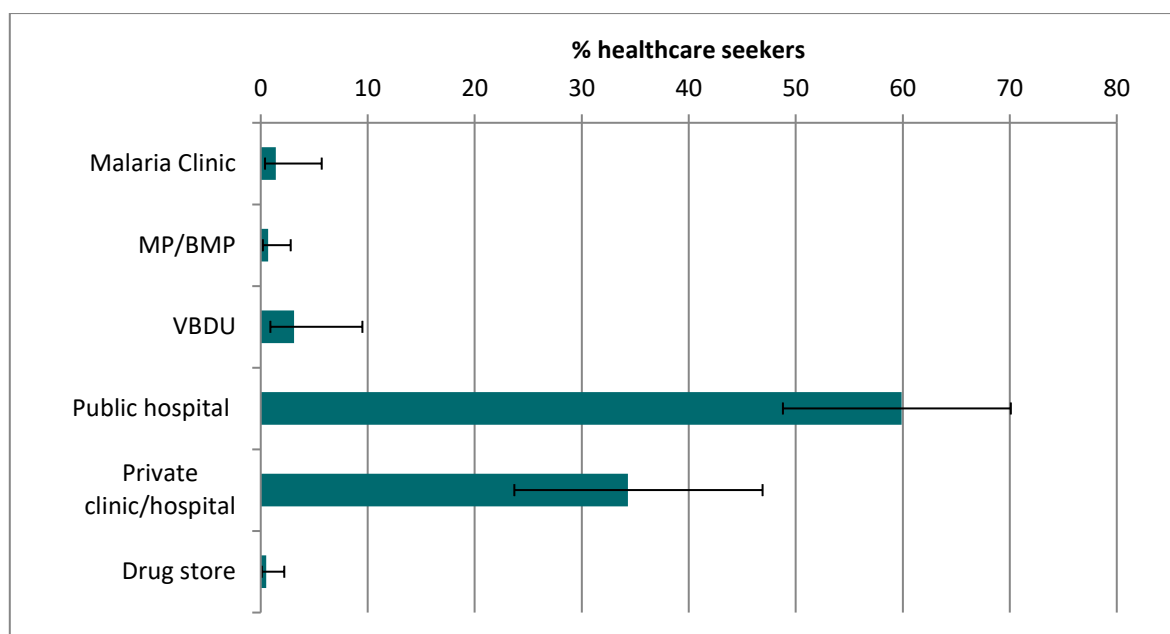


Figure 13: Choice of healthcare provider among fever cases that sought advice and treatment from a healthcare provider (n = 367)

Table 9: Choice of public and private sector health providers among fever cases that sought advice and treatment (n = 367)

	Public sector		Private sector	
	N	% (95%CI)	N	% (95%CI)
Total	271	65.1 (52.7-75.8)	96	34.9 (24.2-47.3)
Domain				
Domain 1: Thai-Myanmar	49	83.8 (57.6-95.2)	7	16.2 (4.8-42.4)
Domain 2: Thai-Cambodia	39	61.9 (35.1-83.1)	16	38.1 (16.9-64.9)
Domain 3: Remaining areas	183	61.5 (46.1-74.9)	73	38.5 (25.1-53.9)
Risk area				
A1	54	88.2 (74.9-95.0)	9	11.8 (5.0-25.1)
A2	217	62.0 (48.7-73.8)	87	38.0 (26.2-51.3)
Income				
<5000	98	88.4 (71.4-95.9)	10	11.6.0 (4.1-28.6)
>5000	173	57.7 (44.4-70.0)	86	42.3 (30-55.6)

Malaria test rates and treatments

The malaria test rate among fever cases that visited a health facility was 18.8%, 95% CI [11.3-29.6], with no difference by domain but significantly higher in A1 areas (42.4%, 95% CI [29.5-56.4]) compared to A2 (15.6%, 95% CI [8.0-28.3]) (Table 10). The malaria test rate was also significantly higher in public sector providers compared to private sector, particularly among those that visited the public hospitals and VBDU.

Of the people that received a test, the positivity rate was 11.2%, 95% CI [5.1-22.9] (n = 8). Since the number was low, confidence intervals were large and no significant association was found for the positive cases with any demographic group or risk factor, although all cases were Thai nationals and none were aged less than five years of age.

Table 10: Malaria test rates by area and type of healthcare provider among fever cases that sought advice and treatment (n = 367)

	Malaria test rates	
	n	% (95%CI)
Total	63	18.8 (11.3-29.6)
Domain		
Domain 1: Thai-Myanmar	15	23.2 (8.9-48.3)
Domain 2: Thai-Cambodia	11	16.1 (8.6-28.2)
Domain 3: Remaining areas	37	18.2 (9.2-32.8)
Area		
A1	24	42.4 (29.5-56.4)
A2	39	15.6 (8.0-28.3)
Healthcare provider		
Malaria clinic	9	9.4 (4.5-18.4)
MP/BMP	3	4.6 (1.9-10.8)
VBDU	12	23.7 (9.4-48.2)
Public hospital	31	49.0 (30.4-67.8)
Public care unit/sub-district level	1	0.6 (0.1-5.0)
Private clinic/hospital	7	12.7 (4.2-32.4)
Type of provider		
Public sector	56	87.3 (67.6-95.8)
Private sector	7	12.7 (4.2-32.4)

Figure 14 shows the flow of fever cases that sought advice and treatment, received a malaria test and received antimalarial treatment. Among the people that sought treatment and didn't receive a malaria test, no one was prescribed antimalarial treatment. However, there was one individual who received a malaria test, had a negative test result but was still given antimalarial treatment. The type of treatment could not be remembered but was given from a private clinic/hospital. All of the cases that had a positive malaria test received antimalarial treatment. All but two of the respondents could not name the type of treatment received. For the two that could remember, one reported receiving chloroquine and primaquine for treatment of a mixed infection, and one reported receiving doxycycline for an unknown species of infection.

A total of 65.1% of fever cases did not seek advice from a healthcare provider and self-treated, equating to 21.0% of fever cases overall that self-treated. Information on the type of self-treatment was not collected as part of this survey.

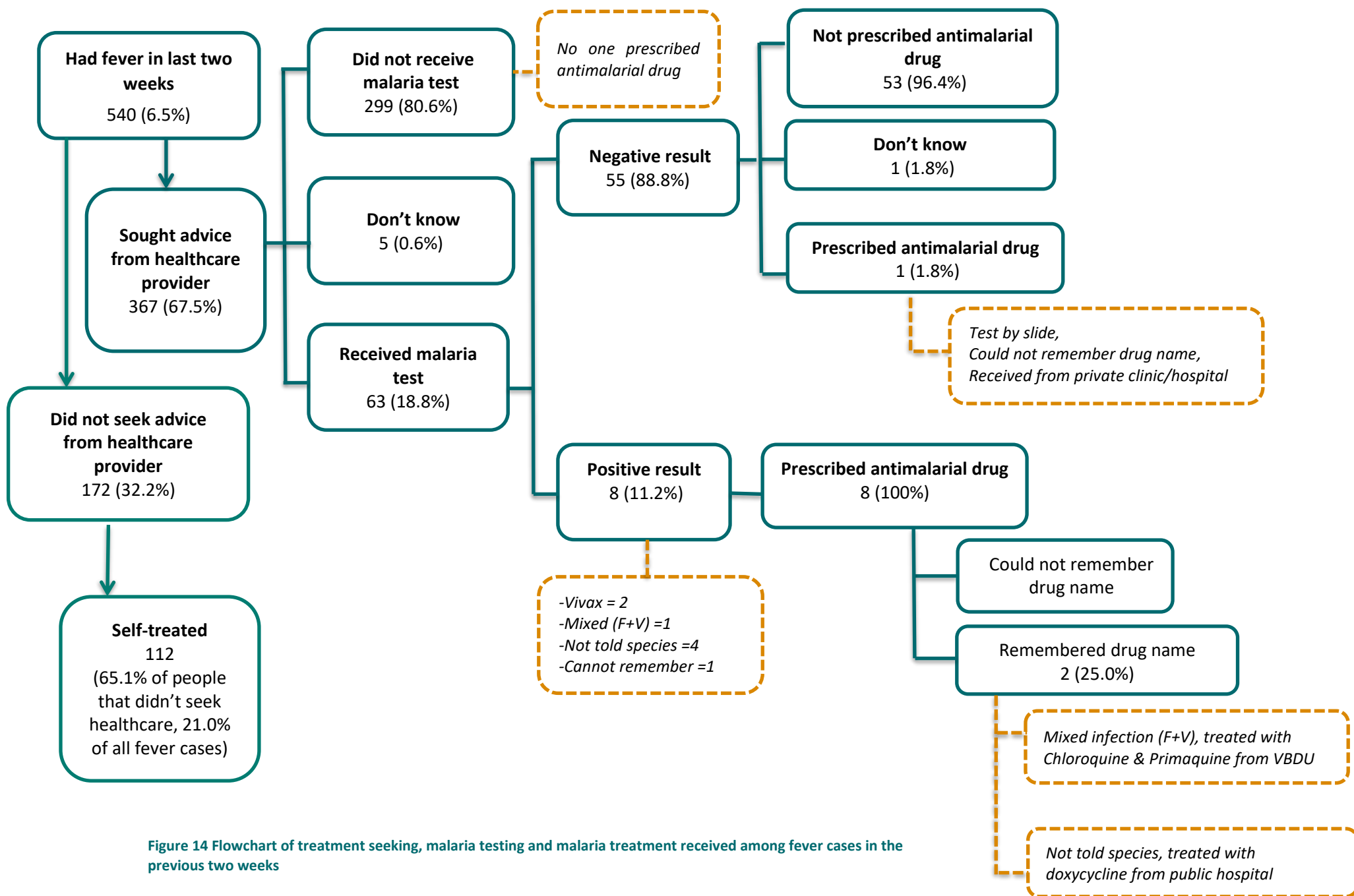


Figure 14 Flowchart of treatment seeking, malaria testing and malaria treatment received among fever cases in the previous two weeks

Knowledge and awareness of malaria

Household respondents were asked about their knowledge of malaria and exposure to malaria messaging. Among household respondents, 98.0%, 95% CI [96.6-98.8] had heard of malaria before, and was high across all domains. There were no differences on knowledge indicators according to sex of the respondent. Key indicators related to different areas of malaria knowledge are presented in Table 11 and subsequent sections present each area in more detail.

Table 11: Key indicators related to knowledge and awareness of malaria

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Heard about malaria	2063	98.0(96.6-98.8)	553	97.4(92.1-99.1)	416	97.8(95.7-98.8)	1094	98.3 (96.7-99.2)
Transmission: Knows by anopheles/jungle mosquito	984	45.8 (41.4-50.2)	232	41.3 (34.3-48.5)	249	61.7 (55.0-68.0)	503	41.9 (36.8-47.2)
Symptoms: Knows fever is a main symptom of malaria	1358	63.9 (60.2-67.4)	342	58.0 (53.9-62.1)	280	66.5(63.3-69.6)	736	66.0 (59.6-71.8)
Symptoms: Knows signs/symptoms of severe malaria	620	28.8 (26.1-31.8)	156	28.7 (21.5-37.3)	170	35.8 (30.0-42.0)	294	26.2 (23.2-29.5)
Prevention: Knows using ITN is a prevention method	245	8.8 (6.7-11.5)	64	9.4 (5.4-15.9)	90	17.7 (13.4-23.1)	91	5.0 (3.0-8.2)
Diagnosis: Knows to confirm diagnosis with blood test	964	44.0 (40.6-47.5)	293	46.2 (37.6-55.0)	167	38.6 (34.8-42.5)	504	45.0 (40.6-47.5)
Treatment: Knows consequence of incomplete treatment	1674	79.0 (74.5-82.9)	445	81.4 (68.6-89.7)	366	83.2 (73.8-89.6)	863	76.1 (71.6-80.1)
Exposure to BCC: Recalls hearing/seeing malaria message in previous 6 months	2018	96.3 (94.7-97.5)	534	95.2 (89.6-97.9)	412	96.8 (94.5-98.2)	1072	96.7 (94.7-97.5)
Knowledge: Recalls 1/3 key containment messages	2003	95.4 (93.4-96.8)	525	93.2 (96.2-96.8)	411	95.9 (92.2-97.9)	1067	96.4 (94.1-97.8)

Knowledge of transmission

The majority of respondents knew that malaria is transmitted by mosquitoes and 45.8%, 95% CI [41.4-50.2] of respondents could specifically name anopheles or jungle mosquito as the vector, and was highest in domain 2 at 61.7%, 95% CI [55.0-68.0] (Table 11, Figure 15 and Annex 15). About one-third of respondents named the dengue vector, *Aedes* mosquito, as responsible for transmitting malaria. Only 4.6%, 95% CI [3.1-6.9] identified staying overnight in the forest as responsible for transmission, and was highest in domain 2. Other incorrect perceptions, such as poor hygiene, were infrequently reported.

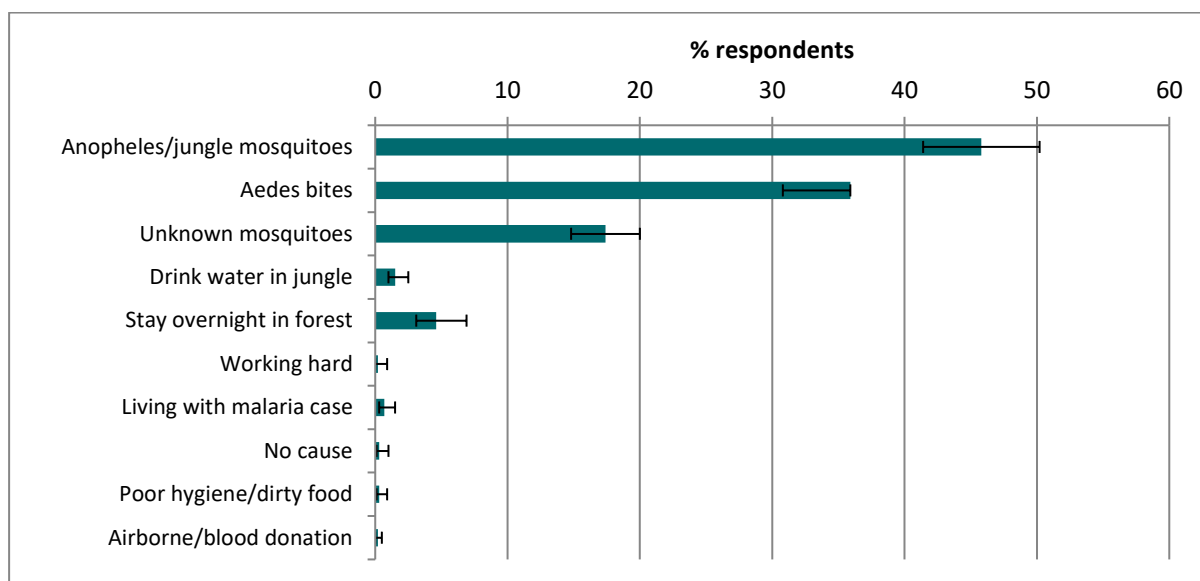


Figure 15: Answers provided by household respondents on the mode of malaria transmission

Knowledge of signs and symptoms

About two-thirds of respondents could name fever as a main symptom of malaria (Table 11, Figure 16 and Annex 16). Chills were also named by two-thirds of respondents, followed by headache and body ache. Knowledge of symptoms was similar across domains (Annex 16). Very few respondents named incorrect symptoms such as respiratory illness or gastrointestinal illness. There were 28.8%, 95% CI [26.1-31.8] of respondents that could name at least one symptom of severe malaria, higher in domain 2 compared to domain 3 (Table 11).

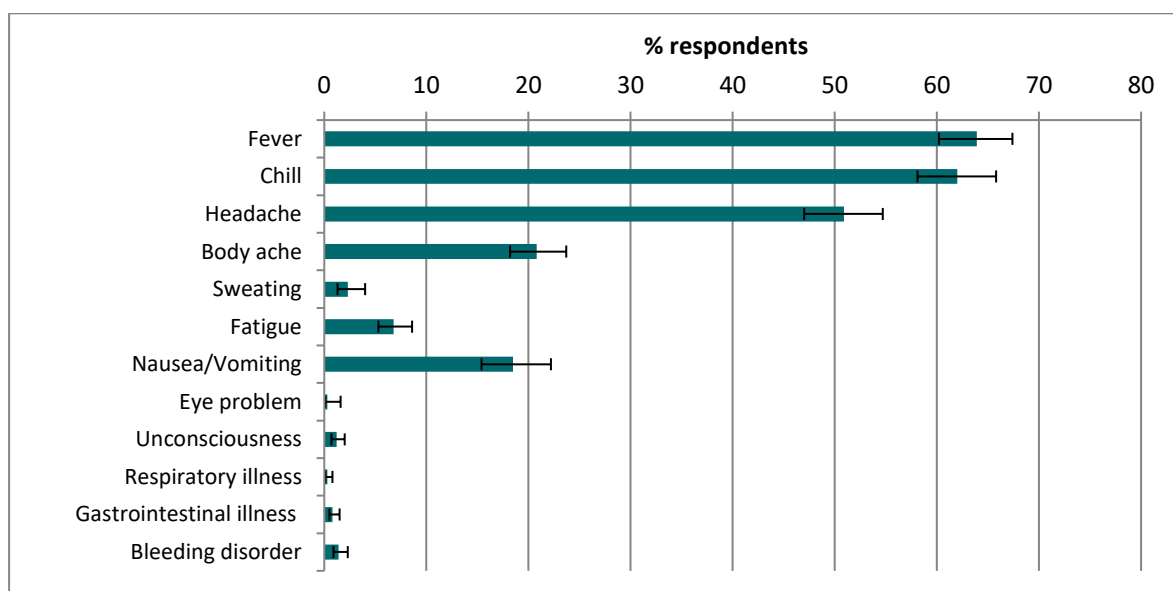


Figure 16: Signs and symptoms of malaria named by household respondents

Knowledge of malaria prevention methods

Two-thirds of respondents could name sleeping under a net as a prevention method but only 8.8%, 95% CI [6.7-11.5] could specifically name sleeping under an ITN (Table 11, Figure 17 and Annex 17). More respondents named using mosquito coils of repellent as a prevention tool than ITN. There were a few misconceptions on the appropriate prevention, mostly naming dengue prevention methods such as emptying water containers and cleaning the environment. There were no differences across domains, except domain 1 named 'making smoke' as a prevention method more frequently than the other domains (Annex 17).

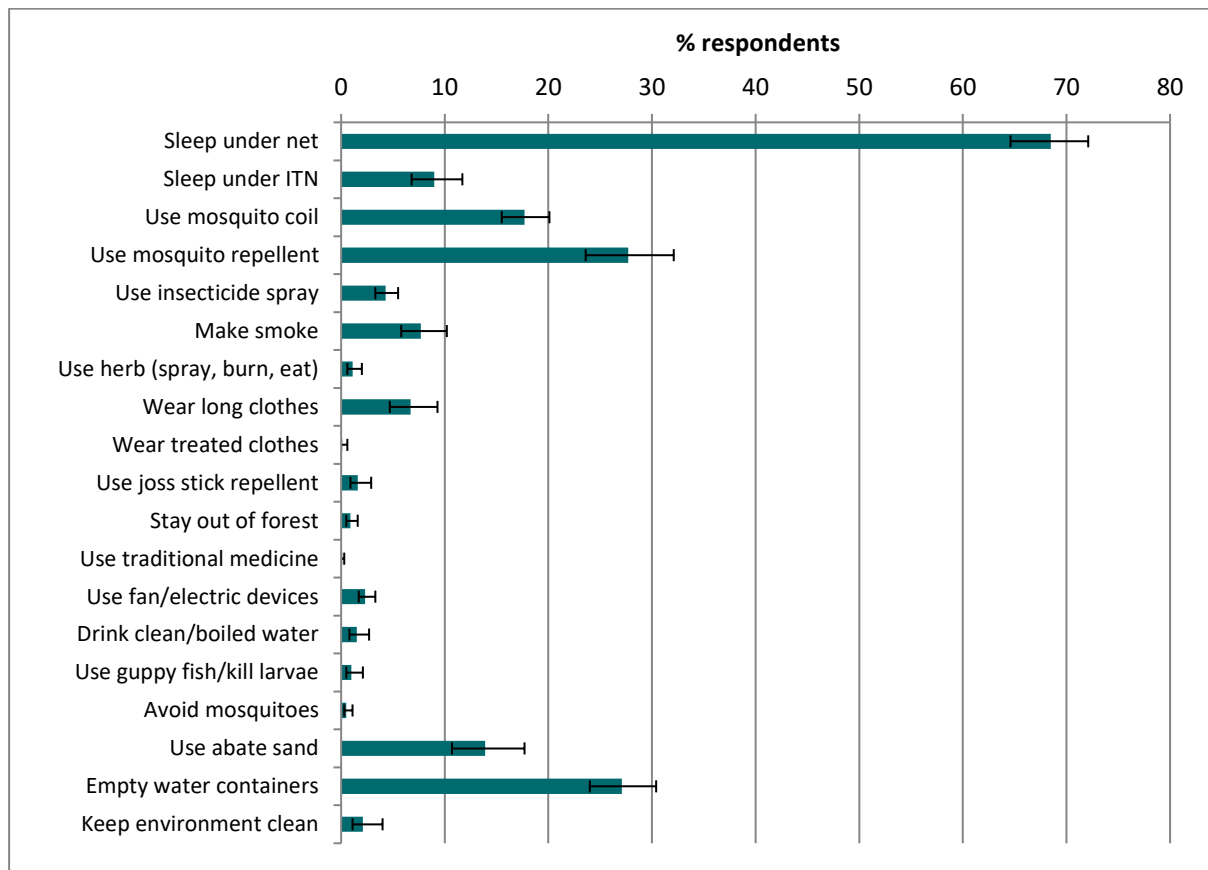


Figure 17: Prevention methods for malaria named by household respondents

Knowledge of diagnosis and treatment

Almost half of respondents knew malaria needed to be diagnosed using a blood test (Table 11 and Annex 18), although a large proportion across domains said that diagnosis can be made by symptoms alone. The majority of respondents could name a place to take a malaria test, with half naming the public hospital, 10.6%, 95% CI [7.9-13.9] naming the MPs/BMPs and 18.3%, 95% CI [13.4-24.5] naming malaria clinics. Most reported that incomplete treatment would not cure the disease or would lead to recurrent illness. However, 16.6%, 95% CI [13.4-20.3] did not know what the consequences of incomplete treatment would be and a few stated that nothing would come of incomplete treatment (Annex 18).

Exposure to malaria messaging

Of all respondents, 96.3%, 95% CI [94.7-97.5] could recall hearing or seeing a message related to malaria in the previous 6 months (Table 11, Figure 18 and Annex 19). The content of the message was remembered by most and messages mostly included those related to seeking diagnosis, completing treatment and follow-up, sleeping under an ITN and allowing government staff to do IRS in the households.

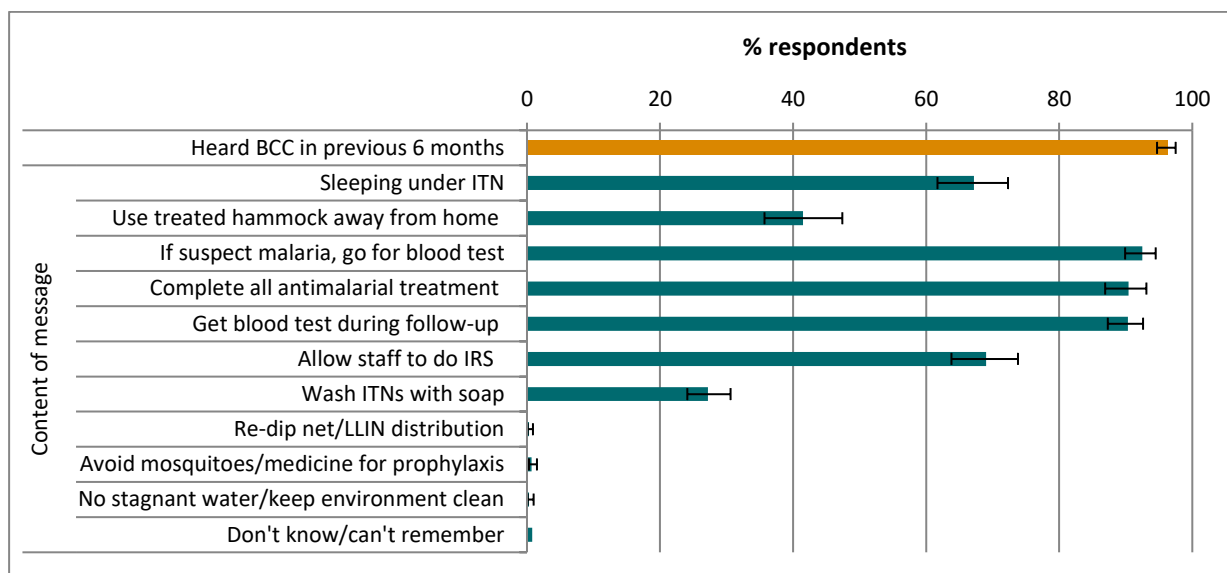


Figure 18: Exposure to BCC among household respondents (orange, n = 2,125) and content of the messages heard among those that had been exposed (green, n = 2,018)

Most messages were received from village health volunteers or public hospital staff, followed by family and friends (Figure 19 and Annex 20). Mass media channels of TV and radio were heard by 14.7%, 95% CI [11.9-18.1]. Alternative channels such as through schools, religious leaders and community organisations were infrequently reported.

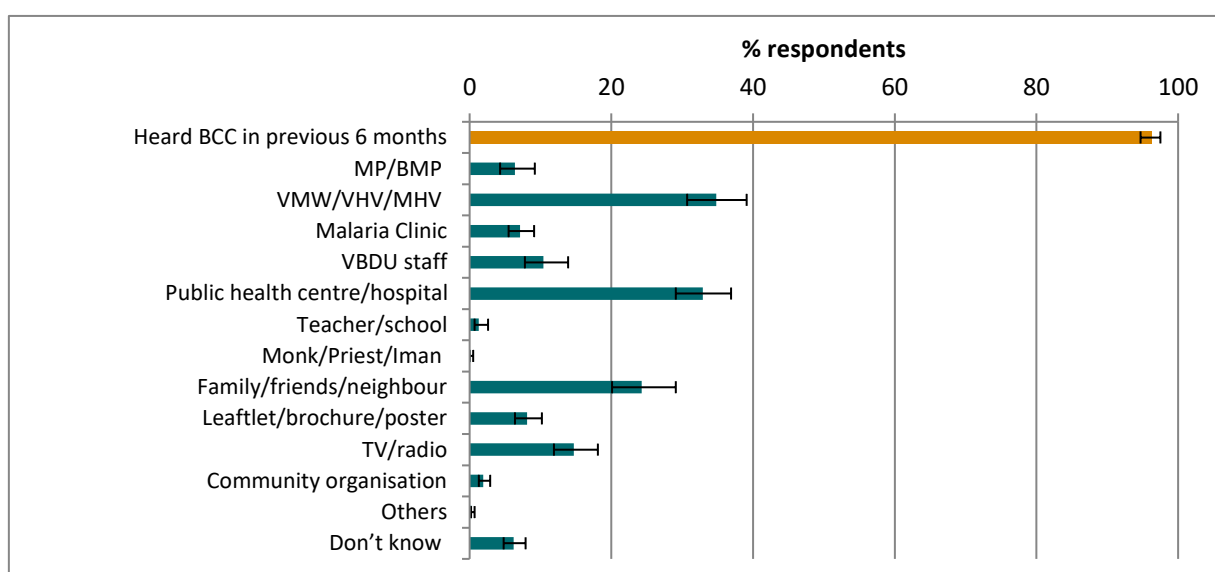


Figure 19: Exposure to BCC of household respondents (orange, n = 2,125) and source of the messages heard among those that had been exposed (dark green, n = 2,018)

Perceptions of malaria

The majority of respondents strongly agreed or somewhat agreed that the forest was a risk for malaria infection, that fever is a main sign of malaria and that malaria can become severe and lead to death (Table 12). The majority also disagreed that malaria did not need treatment. One fifth of respondents strongly or somewhat agreed that LLINs could give you allergy or rash, and there were about 15% of people that disagreed or were impartial to the idea that ITNs/LLINs were better than conventional untreated nets.

Table 12: Perceptions of household respondents on various indicators of malaria risk and usage of LLINs using Likert scale method

	Strongly agree/somewhat agree		Neither agree or disagree		Strongly disagree/somewhat disagree	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
People who stay overnight in the forest have high risk of malaria infection.	1897	90.5 (87.9-92.7)	102	4.2 (2.8-6.3)	126	5.3 (3.9-7.1)
People infected with malaria might develop severe malaria that results in death.	1954	93.0 (90.2-95.0)	105	4.0 (2.7-6.1)	66	3.0 (2.1-4.2)
The primary sign of malaria starts with fever.	1970	93.0 (90.5-94.9)	104	5.0 (3.5-7.3)	51	1.9 (1.2-3.0)
Malaria infected patient does not need treatment as it is self-cured disease.	70	3.2 (2.2-4.7)	67	2.4 (1.3-4.5)	1988	94.4 (91.9-96.1)
Sleeping under LLINs may cause allergies and rash.	413	21.9 (17.4-27.2)	594	30.3 (26.7-34.0)	1118	47.9 (41.4-54.4)
ITNs/LLINs can prevent malaria transmission better than conventional nets/non-insecticide-treated nets.	1796	85.1 (81.6-88.0)	220	10.5 (8.3-13.2)	109	4.4 (3.1-6.1)

Practices of forest-goers

Of the total survey population, 18.2%, 95% CI [15.3-21.6] were forest-goers, with no significant difference across domains (Table 13). Overall, 39.0%, 95% CI [34.9-43.3] of forest-goers were female, particularly high in domains 2 and 3. The majority of forest-goers worked as rubber farmers, particularly in domain 3 which had a greater population of rubber farmers in the whole survey population than the other domains (see demographics in section 1 of results). The majority of forest-goers had attended school, although half had only reached primary level.

Since the majority of forest-goers were rubber plantation workers and this occupational group is known to tend to work overnight on a nightly basis in the rubber tapping season, analysis of forest-goers was also disaggregated into rubber tappers and non-rubber tappers (based on their occupation) to look for differences in different types of forest-goers.

Of the total study population, 13.3%, 95% CI [10.3-17.1] were rubber tappers, and 5.0%, 95% CI [3.9-6.3] were other forest-goers. Among forest-goers themselves, 72.9%, 95% CI [64.1-80.2] were rubber tappers and the rest were non-rubber tappers. Among rubber tappers and non-rubber tappers, the majority were male but a considerable proportion was female in each group.

Table 13: Demographics of forest-goers

Forest-goers	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Total	1212	18.2(15.3-21.6)	160	13.0 (7.4-21.9)	265	15.3(10.7-21.4)	787	22(17.7-27.1)
Sex								
Male	770	61.0 (56.7-65.1)	120	73.8 (69.3-77.9)	169	55.9 (42.4-68.5)	481	58.3 (55.0-61.6)
Female	442	39.0 (34.9-43.3)	40	26.2 (22.1-30.7)	96	44.1 (31.5-57.6)	306	41.7 (38.4-45.0)
Occupation								
Child	50	2 (1.1-3.6)	11	1.8(0.4-7.6)	17	3.1(1.0-9.3)	22	1.9(0.9-3.9)
Military	3	0.3 (0.0-1.5)	2	0.1(0.0-1.2)	1	1.4(0.2-9.6)	0	0
Civil servant	6	0.2 (0.1-0.6)	1	0.1(0.0-1.5)	0	0	5	0.3(0.1-0.9)
Merchant	7	0.5 (0.2-1.2)	0	0	3	0.5(0.1-3.3)	4	0.6(0.2-1.7)
Wage labourer	147	9.3 (6.5-13.1)	16	4.7(3.0-7.4)	50	17.2(12.0-24.0)	81	8.7(5.3-13.9)
Farmer/gardener	235	11.9 (7.0-19.7)	74	23.4(5.3-62.8)	91	29.5(11.3-57.8)	70	4.1(2.0-8.3)
Rubber farmer	713	73.0 (64.2-80.3)	42	65.9(30.3-89.6)	93	46.2(23.5-70.6)	578	81.8(74.8-87.2)
Housewife	3	0.2 (0.1-0.7)	0	0	1	0.1(0.0-1.1)	2	0.3(0.1-1.1)
Jobless/elderly	16	0.8 (0.4-1.9)	3	0.3(0.0-2.3)	5	0.9(0.3-2.7)	8	1.0(0.4-2.6)
Others	32	1.7 (1.0-3.1)	11	3.7(2.3-5.8)	4	1.0(0.3-3.2)	17	1.3(0.5-3.2)
Education								
Never attended school	98	5.4(2.9-9.7)	47	11.2(2.4-39.5)	15	4.9(3.0-7.9)	36	3.7(1.6-8.4)
Primary	681	51.4(44.0-58.6)	57	32.5(20.7-47.1)	157	60.4(48.7-71.0)	447	54.9(49.2-60.5)
Secondary	437	40.9(33.6-48.5)	51	49.9(29.6-70.3)	91	34.3(23.7-46.6)	295	39.7(33.7-46.1)
Others	10	1.6(0.5-4.5)	4	5.2(2.4-11.0)	0	0	6	0.9(0.2-3.3)
Don't know	6	0.8(0.3-2.4)	1	1.1(0.1-8.4)	2	0.5(0.1-2.3)	3	0.8(0.2-3.6)

The primary reason for visiting the forest last time was for rubber planting among all forest-goers (Annex 21) and especially among rubber tappers (Annex 22). Even among non-rubber tappers, 56.0%, 95% CI [45.2-66.2] visited the forest last time for rubber planting. The rest mostly went for farming or foraging for forest products and hunting (Annex 22).

The majority of forest-goers overall travelled frequently and on short trips to the forest (Figure 20 Panel A and Annex 21). Most had stayed overnight in the forest/plantation/farm the previous night (54.9%, 95% CI [44.6-64.9]) or within the last week (32.6%, 95% CI [24.7-41.7]), and had stayed there for just one night (86.7%, 95% CI [81.1-90.8]). Most reported visiting the forest/plantation/farm on a daily (63.9%, 95% CI [55.9-71.1]), followed by weekly basis (29.5%, 95% CI [24.5-35.1]). When analysing rubber tappers and non-rubber tappers separately, differences in the frequency and length of trips to the forest/plantation/farm were apparent (Figure 20 Panel B and Annex 22). Among rubber tappers, 71.7%, 95% CI [63.7-78.5] visited the forest on a daily basis and only 2.4%, 95% CI [0.7-8.0] visited it once monthly or less. Non-rubber tappers had a more varied frequency of staying in the forest. Most visited the forest either daily or weekly, but 17.5%, 95% CI [11.1-26.5] visited just once monthly or less. Non-rubber tappers also tended to stay for a longer length of time in the forest. Rubber tappers overwhelmingly spent just one night in the forest (94.7%, 95% CI [90.4-97.1]), while 65.1%, 95% CI [54.3-74.6] of non-rubber tappers spent one night in the forest but one-fifth spent more than one night in the forest/plantation/farm.

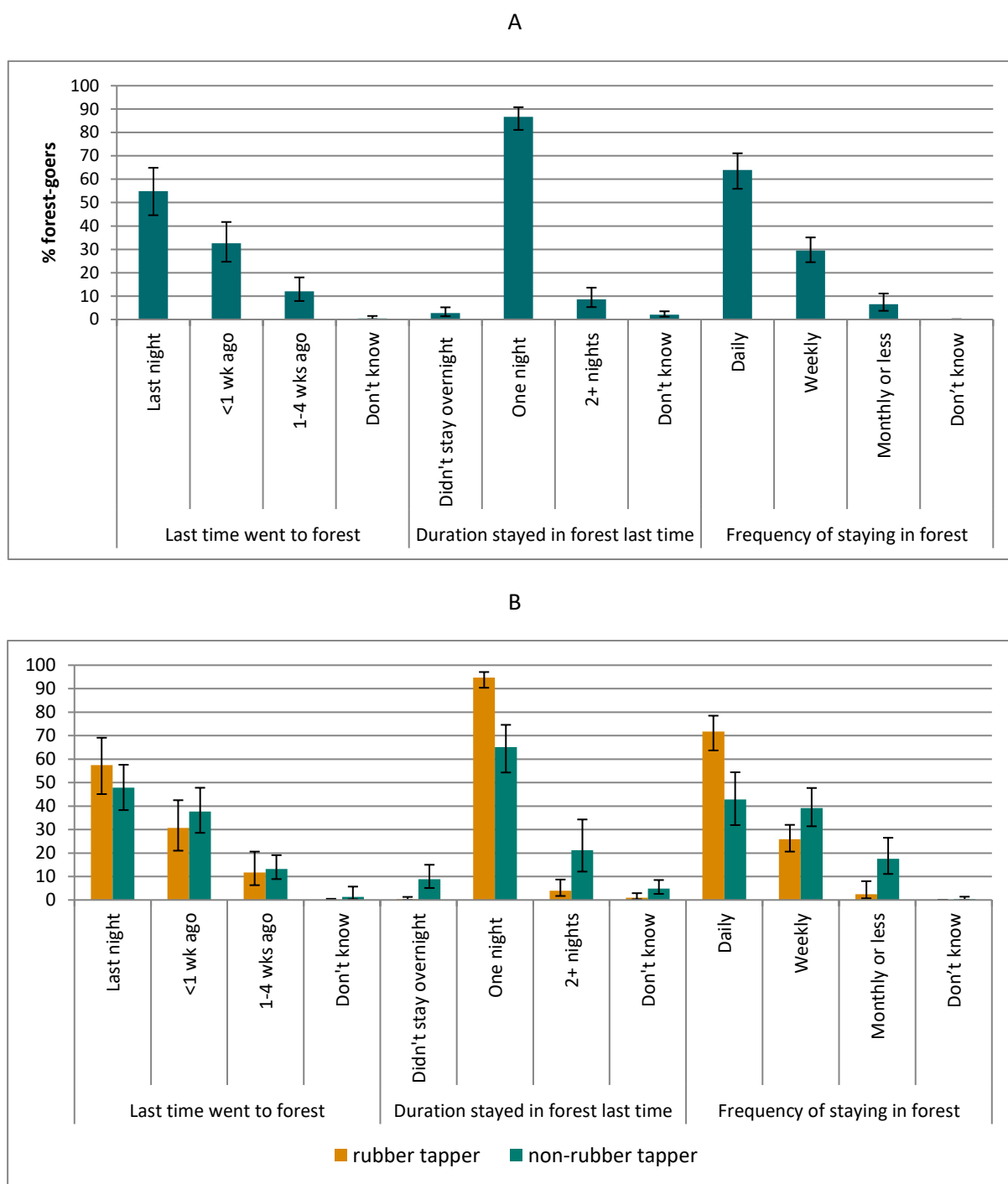


Figure 20: Graph showing time since last trip to the forest, length of last trip and frequency with which forest-goers visited the forest/plantation/farm. A: all forest-goers, B: rubber tappers and non-rubber tappers (based on occupation).

Overall, very few forest-goers had used a net the last time they went to the forest (10.7%, 95% CI [6.7-16.7]) (Figure 21 Panel A and Annex 21). Of those that had used a net, most used an ITN/LLIN. The main reason for not using a net was because they worked all night (Figure 22 Panel A). Looking at the disaggregated analysis, net use among non-rubber tappers was significantly higher than among rubber tappers (28.8%, 95% CI [17.7-43.2] versus 4.0%, 95% CI [2.3-6.8]) (Figure 21 Panel B and Annex 22). For both groups, the main reason for not using a net was ‘working all night’, but non-

rubber tappers had other reasons including not having a net to use, not liking to use a net, having nowhere to hang a net, having too many things to carry, or because they were only staying a short time in the forest (Figure 22 Panel B and Annex 22).

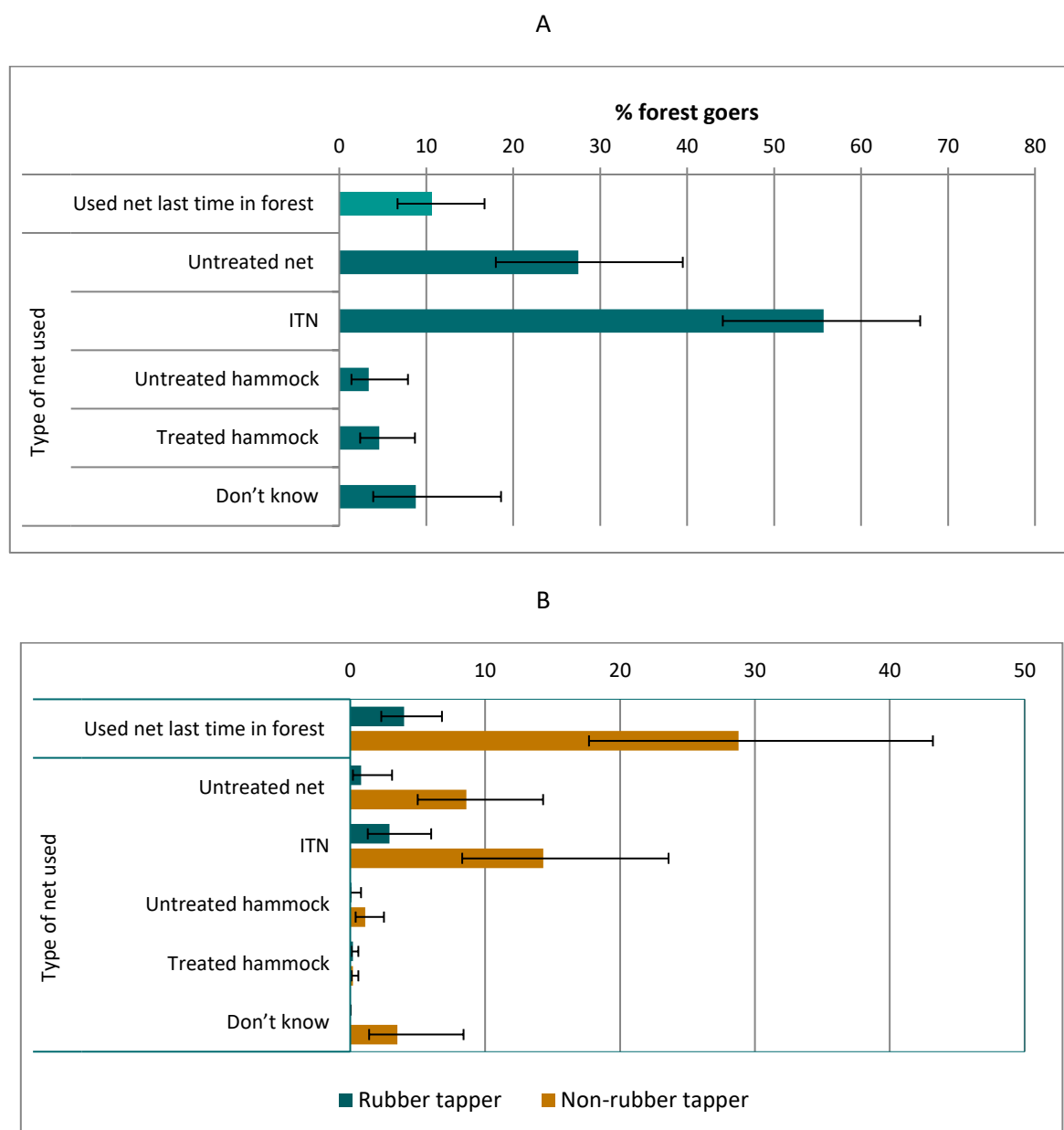


Figure 21: Usage of a net last time they stayed in the forest and type of net used among: Panel A) all forest-goers, and Panel B) rubber tappers and non-rubber tappers

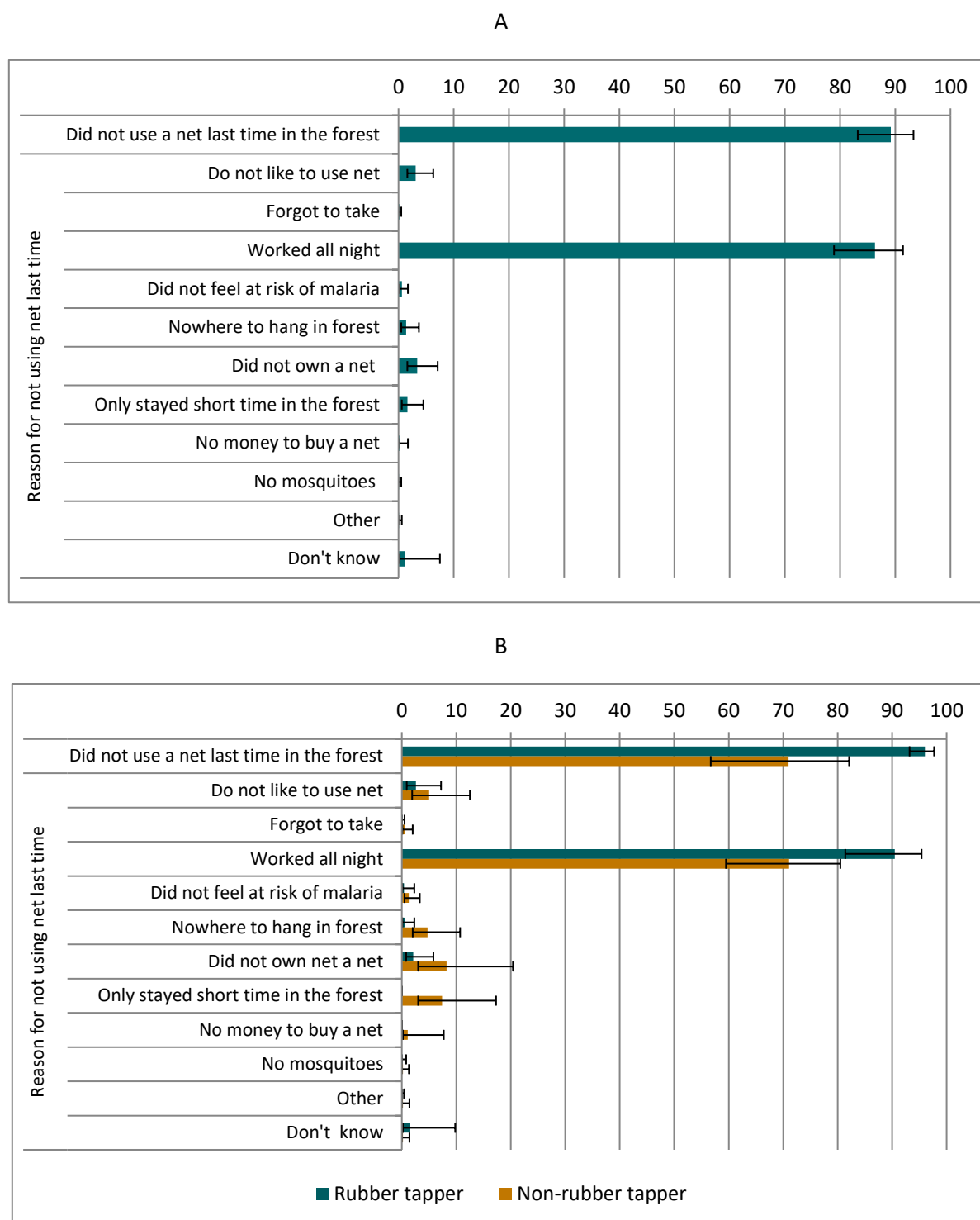
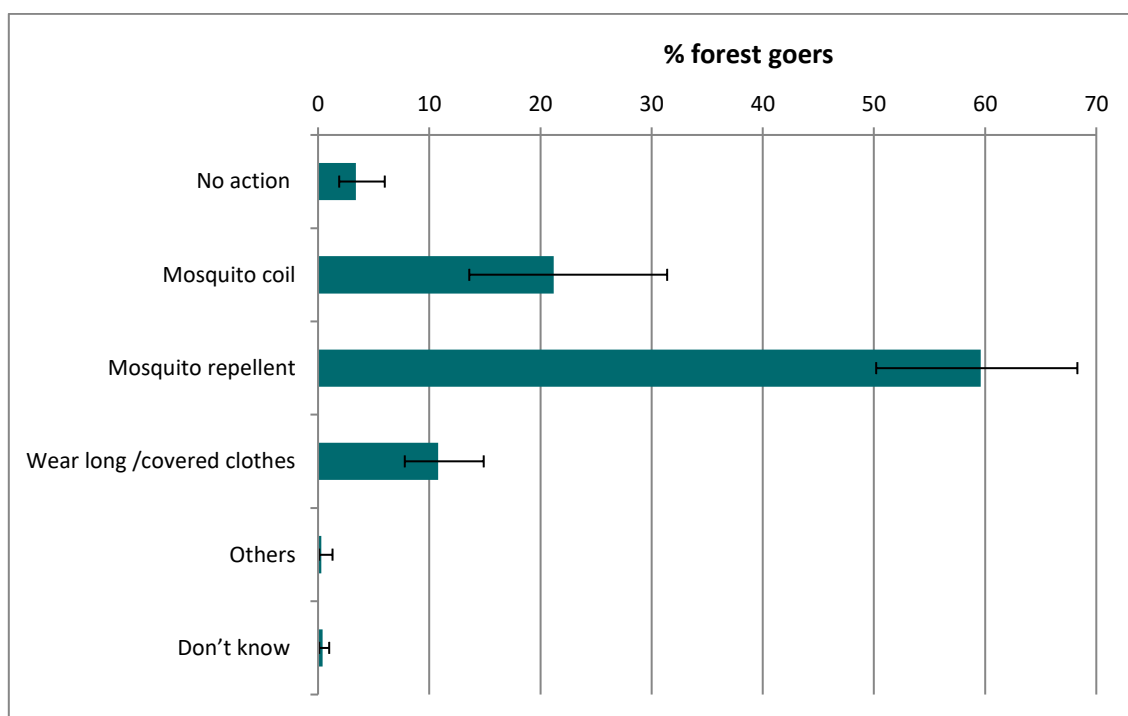


Figure 22 Reasons for not using a net last time they stayed in the forest among: Panel A) all forest-goers, and Panel B) rubber tappers and non-rubber tappers

In terms of alternative protection methods, the use of mosquito repellent last time the forest-goers stayed in the forest was high at almost 60% (Figure 23 Panel A and Annex 21). Mosquito coils were used by about 20% of forest-goers and just over 10% wore long clothes to protect from mosquito bites. In the disaggregated analysis, both groups mostly used repellent as an alternative protection

method, and non-rubber tappers used long clothes significantly more than rubber tappers (20.7%, 95% CI [13.5-30.2] versus 7.2%, 95% CI [4.4-11.3]) (Figure 23 Panel B and Annex 22).

A



B

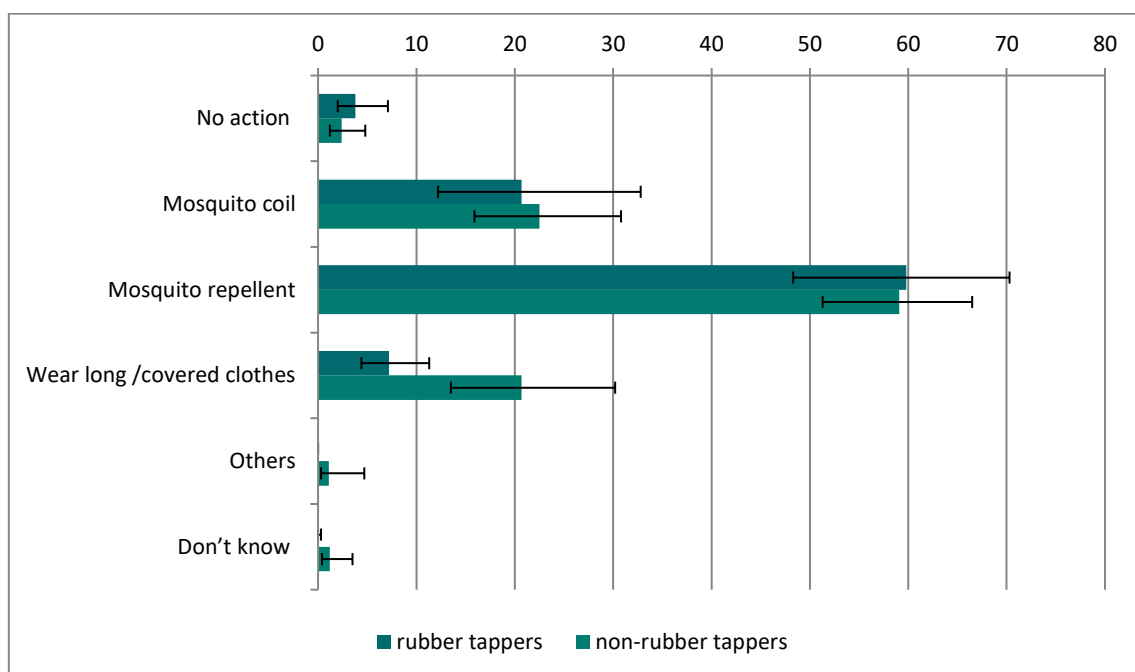


Figure 23: Usage of alternative prevention methods last time they visited the forest by: Panel A) all forest-goers, and Panel B) rubber tappers and non-rubber tappers.

Comparison of key indicators across three survey rounds

Key indicators on prevention, case management and knowledge were compared over the three surveys – the TMS 2012, KAP 2015 and Endline 2016 - to highlight trends and progress made by the NMCP in each area, as well as to highlight remaining gaps and challenges (Annex 23 and proceeding sections).

Net coverage

Over the three survey rounds, household ownership of at least one net, ITN/LIN or LLIN did not show any significant change (Figure 24). However, household ownership of sufficient ITNs/LLINs and LLINs showed a significant increase in the endline survey compared to the TMS 2012 and the KAP 2015 (Figure 25). In the TMS 2012, household ownership of sufficient ITNs/LLINs was 28.6%, 95% CI [24.5-33.0] and showed no significant difference with the KAP 2015 at 22.8%, 95% CI [19.5-26.3]. However, for the endline survey household ownership sufficient ITNs/LLINs nearly doubled to 40.3%, 95% CI [34.4-46.6].

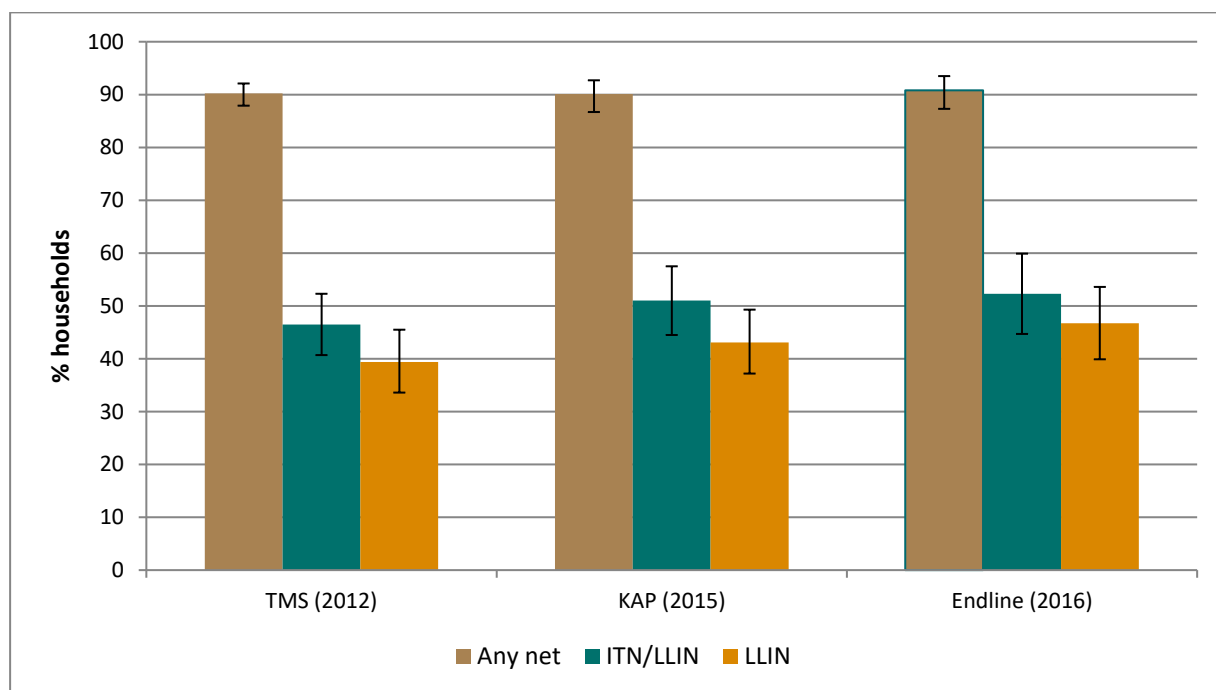


Figure 24: Household ownership of at least one net by type of net across the three surveys

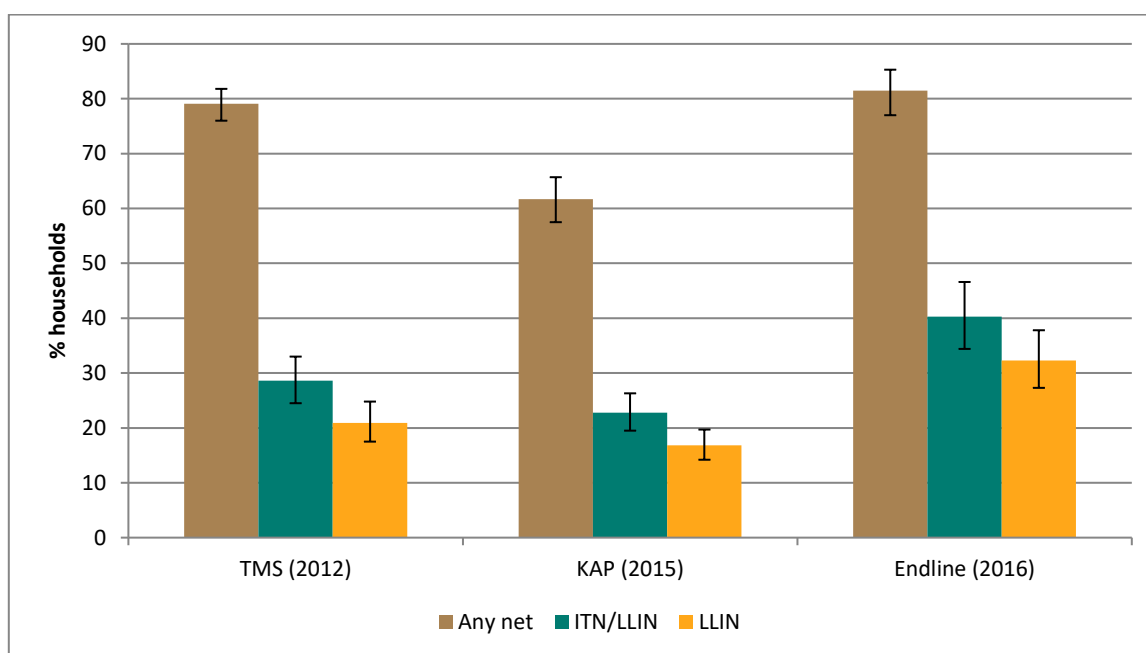


Figure 25: Household ownership of sufficient nets by type of net across the three surveys

Net usage

Despite the increase in household ownership of sufficient ITNs/LLINs and LLINs, usage of nets, ITNs/LLINs and LLINs have all decreased from the KAP to the Endline survey (Figure 26). In the TMS 2012, usage of an ITN/LLIN was 28.6%, 95% CI [24.0-33.6] and this showed significant improvement to the KAP survey when usage of ITN/LLIN was 38.5%, 95% CI [33.7-43.4]. However, in this Endline survey, usage has fallen back to a level comparative to the TMS at 24.9%, 95% CI [19.6-31.2]. Usage of LLIN only also followed the same pattern. Since ownership increased this suggests a larger behavioral gap in the Endline from the KAP survey.

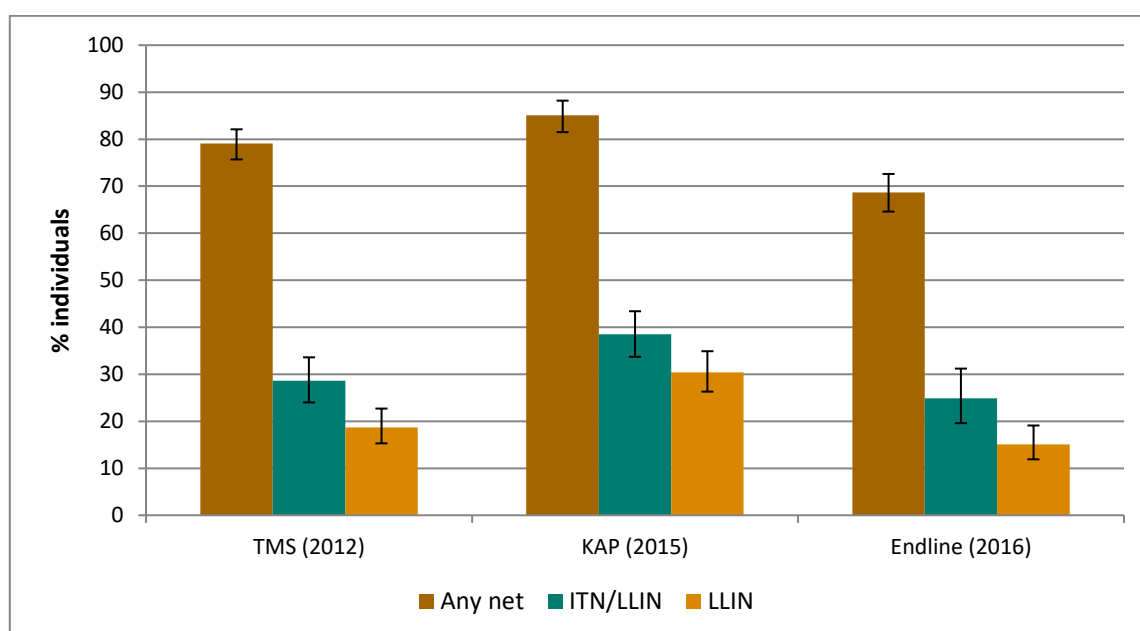


Figure 26: Usage of nets the previous night by type of net across the three surveys

Indoor residual spraying

The proportion of households receiving IRS was comparable between the TMS and KAP (38.7%, 95% CI [32.1-45.8] and 37.2%, 95% CI [29.7-45.3], respectively), but significantly reduced to 23.9%, 95% CI [17.5-31.6] in the Endline survey (Figure 27). Despite this reduction, the proportion of households protected by IRS and/or sufficient ITNs/LLINs remained the same because ownership of sufficient ITNs/LLINs increased over the same period.

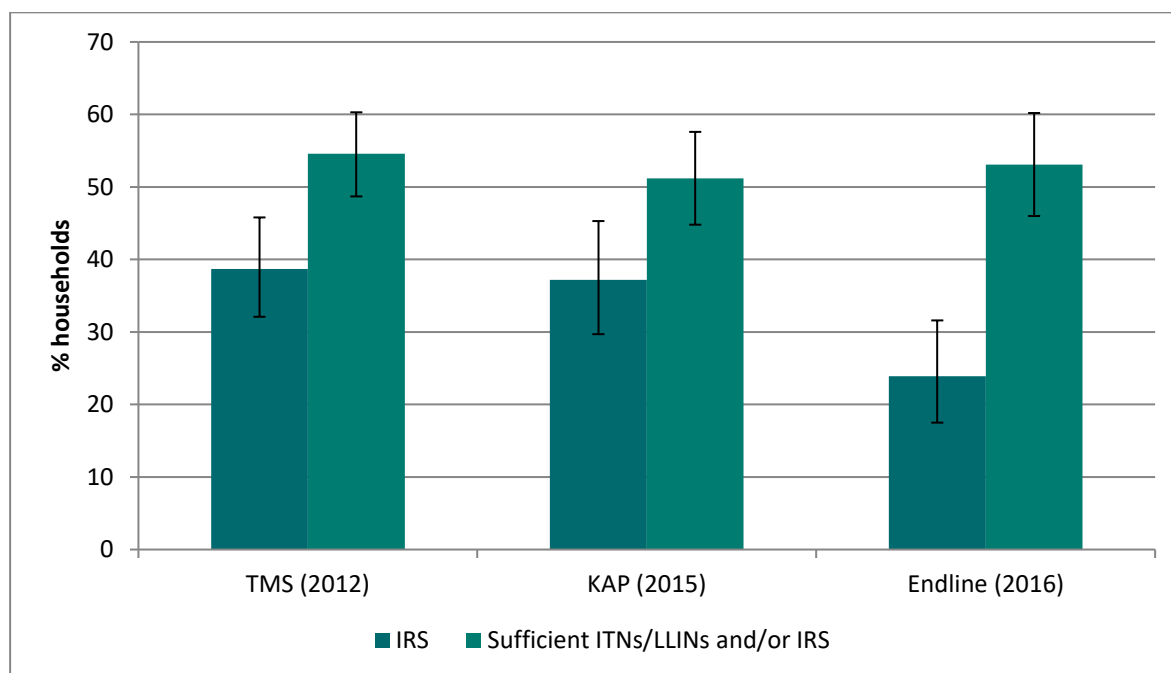


Figure 27: Household coverage of IRS in the previous 12 months, and of IRS in the previous 12 months and/or ownership of sufficient ITNs/LLINs

Healthcare seeking

With regard to healthcare seeking, there was no significant difference in the percentage of fever cases that sought advice and treatment within 24 hours or within 48 hours across the survey rounds (Figure 28). There was also no significant change in the proportion of fever cases seeking treatment that received a malaria diagnostic test (Figure 28).

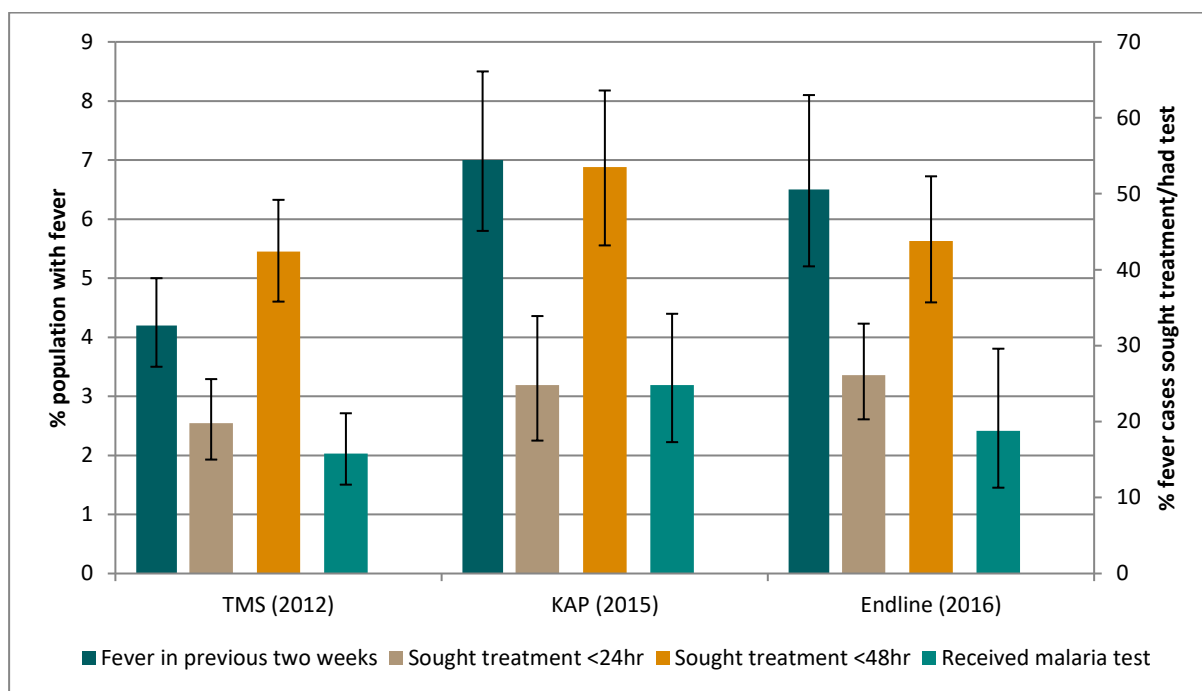


Figure 28: Prevalence of fever and treatment seeking across the three surveys

Knowledge of malaria

The proportion of respondents that had heard of malaria significantly increased from the TMS to both the KAP and Endline surveys (Figure 29). Although the proportion of respondents knowing malaria is transmitted by Anopheles or jungle mosquitoes reduced from the KAP to the Endline surveys, recollection of at least one of the key containment messages significantly increased between each survey round, from 24.7%, 95% CI 19.9-30.2] in the TMS, to 62.8%, 95% CI [54.6-70.3] in the KAP and 95.4%, 95% CI [93.4-96.8] in the Endline survey (Figure 29).

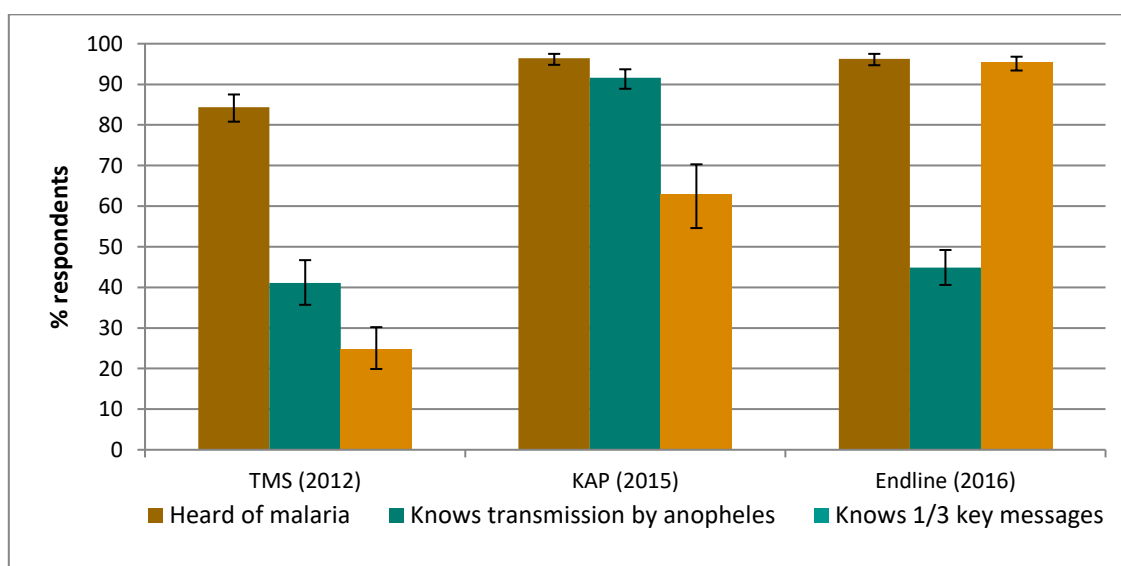


Figure 29: Knowledge of malaria transmission and key containment messages across the three surveys

Discussion

Key findings

This survey was the last of three consecutive surveys conducted to monitor the progress of key indicators to help the NMCP on its goals towards malaria elimination. It has highlighted some areas of improvement and remaining gaps to focus on during implementation of the National Strategic Plan (NSP).

Household ownership of sufficient ITNs/LLINs showed a significant increase in this third survey compared to the previous two surveys. Coverage was higher in A1 areas, Global Fund areas, migrant households and lower income households. This shows positive impact of LLIN distribution by the government since distribution is targeted in these geographic areas and for vulnerable population groups. However, coverage figures are still not optimal. Ownership of nets did not appear to be an issue as ownership of any type of net was very high. However, this stems from the fact that most of the nets owned were conventional, untreated nets bought from the private market. A more rapid way to increase coverage of ITNs/LLINs may be to treat the nets that people already owned as opposed to, or in addition to, distributing new LLINs.

Despite improvements in ownership of ITNs/LLINs, usage of ITNs/LLINs decreased since the previous survey rounds. Although access to an ITN/LLIN the previous night was 51.7%, only 24.9% of people used an ITN/LLIN the previous night. The behavioural gap in the survey population overall was 52%, meaning, among all people that had access to an ITN/LLIN 52% did not use it. This gap was even greater in domain 3 at 67%. As malaria transmission risk goes down, it may be harder to encourage people to use nets. This survey may present the effects of this trend, particularly since usage was lower in population groups not typically associated with malaria risk in Thailand, including Thai nationals (as opposed to migrants), individuals with higher education, and individuals with higher income. Usage was higher in areas with higher transmission risk and with greater resources for interventions and malaria messaging – namely, the A1 and Global Fund areas. Knowledge of ITNs as a prevention tool was also associated with increased usage of ITNs, though whether knowledge leads to usage or vice versa is unknown. Despite this, knowledge of ITNs as a prevention tool was low and this would therefore be a worthwhile message to promote in future malaria messaging. Beyond better knowledge, the behavioural gap will be difficult to address and will need novel effective approaches to behaviour change.

As the survey found, most nets owned were conventional, untreated nets bought from the private market. To look at possible drivers behind this, the usage of nets based on their characteristics was explored. Conventional nets and ITNs were used more than LLINs, as were nets that were of a larger size, coloured and made from cotton or nylon material. Despite LLINs not being used as much, when participants were asked about their preferences for a new net, most wanted an LLIN. However, they also wanted a new net with features that were not served by the LLINs distributed by the government and Global Fund initiatives – namely, nets that were larger in size, had a rectangular shape and made of cotton or nylon. This suggests that people may not be put off by the insecticide in the nets, but are more interested in certain features that would suit their preferences and lifestyle. Most people were also willing to pay 200-300THB for nets that met these preferences. Similar results on net preferences were found in a recent qualitative study in Cambodia and suggest common

preferences across the region⁸. To further investigate this, qualitative interviews were conducted concurrent to the Thailand quantitative survey and are presented in a separate report.

About one-quarter of nets owned were LLINs. Of all the LLINs owned, 15% were over three years old and 14% were damaged with holes or tears. As the outdated and damaged LLINs needed to be replaced, it is important to investigate net attrition, i.e. how long nets remain in use in a household, and to construct net survivorship curves. The durability of LLINs should be defined and measured by the whole process of net loss – from attrition and physical damage to bioassay mortality and the chemical loss of insecticide residue⁹. Net deterioration differs greatly between regions or cultures as care and repair behaviours, maintenance and net use vary from place to place. Thus, nationwide evaluations of LLINs are required and called for by the WHO¹⁰. For example, an evaluation of PermaNet 2.0 retrieved from six countries¹¹ and Olyset nets from seven countries¹² showed large between-country variability of LLIN durability. Net products also vary in material, insecticides, or fibre impregnation technology and the effect such variations have on durability are still largely unknown¹³. This, there is a need for the NMCP to collect and analyse reliable data to inform national procurement decisions to 1) select the most suitable net to plan timely replacement, 2) understand factors associated with net durability to guide BCC including care and repair interventions, and 3) assist industry in product improvement. The NMCP needs to understand LLIN durability in local settings to avoid replacing nets too late, which puts people at risk of disease, and replacing them too often, which can waste limited resources.

In addition to physical damage to the nets, there was some evidence that treated nets were washed too frequently and thus reducing the effective lifespan of their insecticide. The WHO recommends that conventionally treated ITNs are retreated with non-binder insecticide after every three washes, while LLINs and ITNs treated with WHOPES-approved ITKs remain effective for up to 20 washes¹⁴. There needs to be education or behaviour change to address the population washing their nets more frequently than recommended.

Aside from nets, other household vector control measures were infrequently used, including wire screens and chemicals. About one-quarter of households had received IRS in the previous 12 months, which was a decrease since the previous surveys. This decrease is in line with the NMCP strategy to move away from IRS and only use it in new foci¹⁵. Despite the reduction in IRS, households with full protection (IRS and/or a sufficient ITN/LLIN) remained the same over the survey rounds due to the increase in ownership of an ITN/LLIN.

⁸ PSI-PSK. Bed-net usage determinants and user preference in Cambodia. A user-centered design approach to understanding determinants and preferences associated with bed-net product attributes. Lucas-Nene Design / Health; 2016.

⁹ WHO. Guidelines for monitoring the durability of long-lasting insecticidal mosquito nets under operational conditions. Geneva: World Health Organization; 2011

¹⁰ WHO Vector Control Technical Expert Group. Estimating functional survival of LLINs from field data. Report to MPAC September 2013. Geneva: World Health Organization; 2013

¹¹ WHO. Report of the 12th WHOPES working group meeting. Geneva: World Health Organization; 2009

¹² WHO. Report of the 13th WHOPES working group meetin. Geneva: World Health Organization; 2009

¹³ Kilian A. How long does a long-lasting insecticidal net last in the field? *Pub Health J* 2010; 21: 43-47

¹⁴ WHO Global Malaria Programme. Insecticide-treated mosquito nets: a WHO position statement. Geneva: World Health Organization.

¹⁵ Ministry of Public Health. National malaria elimination strategy Thailand 2017-2026. Malaria Elimination Operational Plan, Thailand 2017-2021.

Treatment-seeking among fever cases was relatively high but low for those seeking treatment within 24 hours. This proportion showed no difference between the three surveys. The way in which this indicator was captured changed between the TMS 2012 and KAP 2015 to the final Endline survey. In the TMS and KAP surveys, those with fever cases were asked if they sought treatment on the same day, next day or two days later, with the indicator for less than 24 hours defined as the same day. For the Endline survey, it was specified whether they sought treatment within 24 hours or 48 hours or more. This means that comparatively, the TMS and KAP surveys could be underestimating the proportion of people that sought treatment within 24 hours, and as such, the Endline survey shows either no improvement or could possibly show a decline. The low proportion of people seeking treatment within 24 hours did not appear to be due to a lack of knowledge of fever as a symptom of malaria since this had no effect on treatment seeking. There were also no other factors found that seemed to have an effect treatment seeking. This may, again, be a result of a reduced perception of malaria as a risk and the increased likelihood that the fever is due to another reason.

Although it is encouraging that most healthcare seekers visited public sector services, the proportion visiting the private sector was quite large (about one-third). Since not all private clinics and drug stores are linked to the national surveillance system, malaria tests and cases are potentially missed in national incidence data. It is also harder to monitor the quality and standardisation of care people receive when they are in the private sector.

There was low use of MPs/BMPs even in clusters that had a MP/BMP present. It is not clear what the reasons for this are, since the reasons for the choice of health providers were not investigated. One reason may be a lack of knowledge that a malaria diagnostic test can be received at the MP/BMP, since only 10.6% of respondents named this as a place for a diagnostic test. This does not explain the whole reason for low uptake since use of an MP/BMP among treatment seekers was only 3.9%. It would be recommended to conduct a formative survey to determine the motivating factors and barriers to the usage of MPs/BMPs even in areas that have access to them.

Positively, the malaria test rate was relatively high and there was very limited evidence of misuse of drugs among healthcare providers. However, the test rate was lower in the private sector where one-third of fever cases visited and thus, there is the potential to miss cases with lower use of diagnostics. A finding that is potentially worrying is that 21% of fever cases is self-treated. No data was gathered on what drugs people used for self-treatment or whether any were antimalarials. Investigating what people use to self-treat and what antimalarial treatments are available at health outlets would be a worthwhile exercise to determine whether behaviour change or regulations on drug shops are needed.

In regard to malaria knowledge, knowledge of containment messages was very high and had increased significantly over the three survey rounds. There was also a very high recollection of malaria messages heard over the previous six months and a high retention of the content of the messages. However, some key information were lacking that could potentially impact the other indicators already discussed, such as ITN/LLIN use and healthcare seeking. For example, there was a very low proportion of people that named using an ITN as a prevention tool, and a large proportion did not know that a blood test was required to diagnose malaria. Since naming ITNs as a prevention tool was associated with higher usage of ITNs, emphasising this message could impact levels of ITN use. It is not clear however, whether knowledge increases ownership, or ownership increases knowledge. It is clear that malaria messaging in Thailand has had an impact on knowledge as indicators have improved over the three survey rounds. However, the messages still centre around

themes from the WHO Global plan for artemisinin containment (GPARC) period. With the change in focus of the NMCP from containment to malaria elimination, it may be beneficial to change the content of key messages to fit the elimination context and goals.

The analysis of forest-goers displayed interesting differences among the forest-goer population and highlights the need to consider the different sub-groups within this high-risk population for targeting interventions and behaviour change. Females made up a large proportion of forest-goers; this needs to be considered in behaviour change initiatives and messages since different genders will differ in what they will likely respond to. In this survey, we were able to disaggregate the analysis of forest-goers into two broad occupational groups – rubber tappers and non-rubber tappers. The rubber tapper population mostly visited and worked in the forest/plantation/farm overnight and on a nightly basis; thus, they were unable to use nets. Non-rubber tappers also visited the forest frequently, but there was more variation, with some visiting less frequently or for longer periods of time. Net use was higher in the non-rubber tapper group because fewer worked overnight. In this group, the main reason for not using a net was because they worked overnight, but other reasons included simply not liking to use the net or because there was nowhere to hang one in the forest/farm setting. These findings highlight differences in the behaviour of forest-goers and need to be considered for future malaria interventions. Rubber tappers and other forest-goers who work at night are unable to use nets and thus need to be targeted with personal protection that can be worn while they work – for example, with insecticide treated clothing. Many in this group used repellents, but evidence from Laos and Cambodia shows that compliance to reapplying repellent regularly enough is low resulting in no significant reduction in malaria incidence¹⁶. There is skepticism that outside a trial situation, communities could be convinced to appropriately use topical repellents night in and night out for weeks or months on end to achieve a community-wide impact. A meta-analysis by Wilson et al¹⁷ concluded that repellents were unlikely to impact on malaria, although there is some strong disagreement from some experts on this that argue this fails to take into account community and contextual differences.

On the other hand, personal protection during limited-time exposure for forest-goers who may go daily or weekly to the forest and do not work overnight, topical repellents should be explored. While some of them use nets, not all use an ITN. Some reasons for not using nets are that there is nowhere to hang, therefore, a free-standing net/hammock net or alternative personal protection tools that do not need to be hung up are needed. Other reasons for not using nets are due to attitudes – that forest-goers do not like the net or do not want to use it. These attitudes need to be changed with behaviour change initiatives.

Limitations

There were some limitations to the study, including that few migrants were captured in the survey sample as well as few ethnic minority groups, despite being risk groups for malaria. The survey was designed to be representative of the Thai population, so the proportion of migrants to Thai nationals

¹⁶ Chen-Hussey et al. Can topical insect repellents reduce malaria? A cluster-randomised controlled trial of the insect repellent N,N-diethyl-m-toluamide (DEET) in Lao PDR. *PLoS ONE* 2013; 8(8): e70664. Sluydts V et al. Efficacy of topical mosquito repellent (picaridin) plus long-lasting insecticidal nets versus long-lasting insecticidal nets alone for control of malaria: a cluster randomised controlled trial. *The Lancet Infect Dis* 2016; 16: 1169-77. Gryseels C et al Factors influencing the use of topical repellents: implications for the effectiveness of malaria elimination strategies. *Nature Scientific Reports* 2015; 5: 16847.

¹⁷ Wilson et al. Are topical insect repellents effective against malaria in endemic populations? A systematic review and meta-analysis published in the *Malaria Journal* 2014; 13: 446

is representative of the national population. However, it does limit conclusions that can be drawn about the migrant population itself, particularly M2 migrants. It would be useful to conduct a survey targeting migrants and ethnic minorities specifically to further understand their access to ITNs/LLINs, case management practices and KAP.

The survey was conducted using an ODK template for electronic data collection. While this sped up data collection and management and limited missing data, there were difficulties in designing the template for a complex survey design, as was used in this survey. It would have been beneficial to allot more time in the design phase of the study to ensure that the template correctly captured all the required fields, as well as incorporate steps for better monitoring, such as time-stamping the start and end of each interview. Most difficulties in the data format of the ODK tool were overcome by reprogramming of the ODK output, including forming new fields for multiple answer questions and creating identification numbers to ensure linkage between people, households and nets. However, this took time and expertise to develop and some key fields were missed from the ODK tool, including recording which household member was responsible for answering the questionnaire. Despite this, the electronic data collected had many benefits; the lessons learnt from this survey could be applied for subsequent or similar surveys.

The study team was unable to visit one cluster in domain 1 due to its remote location and difficulty in reaching it. Although this is unfortunate, there was no loss of power with the new sample size with which to estimate the key indicator, and thus results are representative and accurate.

Conclusion

Despite these limitations, the survey conducted was comprehensive, representative of the national population and within each geographic domain, and has provided data on key indicators that would help assist the NMCP in moving forward with its malaria elimination strategy. The three survey rounds have highlighted improvements, but also the difficulties in improving coverage of key interventions in the light of reducing malaria transmission and diminishing perception of risk among the Thailand population. To continue progress toward malaria elimination, novel approaches to behaviour change and community mobilisation are needed. Reintroduction of re-dipping campaigns could be considered instead of or in addition to LLIN distribution in order to improve coverage of treated nets. This would also offer a regular way to communicate key messages to the communities. It is the hope that this survey and the recommendations stemming from the results will assist the NMCP in continuing its progress toward malaria elimination in Thailand by 2026.

Recommendations

Nets

- **To continue and speed up the increase of coverage of ITNs/LLINs, an annual programme of re-dipping conventional nets and ITNs that households already own should be considered as an alternative to, or in addition to, free distribution of LLINs.**

As ownership of nets is very high, coverage of people with treated nets may be achieved more rapidly with a programme of dipping and re-dipping of nets using insecticide treatment kits. This has the benefit of treating nets that people have purchased from the market which meet their preferences in terms of size, colour and fabric. These preferences appear to have some effect on their use in the household. Furthermore, a programme of treatment within the communities and led by community leaders and health volunteers would create a sense of ownership within the community, as well as offer an annual opportunity to educate people on malaria prevention, appropriate healthcare seeking, and the malaria elimination agenda. It is also an opportunity to collect data on the gaps in net coverage and issues with net durability.

- **Conduct a comprehensive review of the current LLIN distribution system in Thailand, including methods used to estimate procurement needs and target LLINs to households, distribution channels utilised and opportunities for the use of alternative service points to increase access, and the methods and indicators used for post-distribution evaluation. This would help determine why gaps in LLIN coverage remain at household level.**

There has been much effort by Global Fund and the Thailand NMCP to distribute LLINs over recent years, yet, gaps at household level remain. The current method used to determine procurement of nets is to take the total population within an area and procure enough nets for two people per net. This does not take into account where people live, e.g. how many people per household, nor the sleeping places of individuals within a household, gender differences with respect to puberty, for which it has been argued a corrective factor should be added to the formula of two people per net¹⁸.

- **To inform procurement needs and ensure timely replacement of damaged and expired LLINs, net durability study results need to be considered with bioassay tests and prospective data on attrition rate.**

BVBD has recently completed a study on net durability in Thailand. To prevent the use of expired and damaged LLINs, the results of this study should be combined with the standards of the proportional hole index (PHI) to determine a cut-off for when LLINs are ineffective and need replacement. This should also take into account results from bioassay tests from nets at different ages to determine accurate life-spans of insecticidal effectiveness. Finally, a prospective study (to limit recall bias) should be conducted using household interviews to determine the attrition rate of different brands of LLINs and ITNs over time.

¹⁸ Kilian A., Koenker H. & Paintain L. Estimating population access to insecticide-treated nets from administrative data: correction factor is needed. *Malaria Journal*, 12:259, 2013.

- **Conduct a formative assessment of the motivating factors and barriers to ITN/LLIN usage in households where ownership and access are optimal and develop appropriate malaria messaging and BCC to improve usage.**

ITN/LLIN usage has decreased despite ownership increasing. There is a large behavioural gap, particularly among the Thai population, higher income households and households with better education. Understanding the reasons for low usage will inform behaviour change initiatives. It is likely that diminishing malaria risk means people are less motivated to use nets. Novel approaches to behaviour change are needed to combat this and instill a sense of responsibility for the malaria elimination agenda. Such methods need to be fully informed by first conducting formative assessments with the different population groups involved since the current evidence-base is not sufficient in scope or quality to reliably inform net promoting interventions or campaigns targeted at individuals who own, but do not (reliably) use, mosquito nets. This requires a significant input of well-designed quantitative and qualitative studies.

- **Produce and distribute information, education and communication (IEC) materials on the correct washing frequency (and technique) for ITN and LLIN.**

The survey found that a large proportion of people wash their treated nets too frequently, thus reducing the effectiveness and lifespan of the insecticidal action. IEC materials need to inform people of the correct washing frequency. Although the survey did not collect information on the washing techniques people used, these IEC materials should inform on correct methods such as avoiding harsh detergents such as bleaching agents and avoiding drying nets in direct sunlight. Messages should be appropriate to the community context.

- **Continue recent efforts to engage with private sector net manufacturers and Thai regulatory bodies to allow registration of locally-made LLINs for supply to the private market.**

LLIN manufacturers do not currently have the approvals and registrations required to allow supply and sale in the private sector. Allowing registration of these products would allow supply to the private sector and if combined with consumer marketing initiatives, could promote the purchase of LLINs by consumers. This would increase coverage of treated nets and reduce the purchase of untreated nets. This would be particularly useful in areas not targeted by free government distribution schemes. The Thailand FDA should be informed about the current WHOPES reforms¹⁹, including updated technical guidelines, resources and publications, WHOPES recommendations and partnerships.

- **Use the findings on the characteristics of nets owned, particularly those purchased from the private market, and on nets used the previous night to inform government and Global Fund LLIN distribution policy as well as private sector net manufacturers. This would help to increase availability of LLINs with features that users prefer and which result in higher net usage.**

¹⁹ WHO initiated reforms to foster innovation, improve efficiency, assure quality and support best use and management of pesticide products include: 1) a Prequalification Team that will review all new applications for evaluation of pesticide products in existing categories, i.e. LLINs, larvicides, products for IRS and space spraying as well as other commonly used public health pesticide products; 2) coordination and supervision of pesticide product testing for any trials that are in process or for products accepted into WHOPES before October 2016; 3) global infrastructure of public health pesticide testing institutions that comply with GLP international standards and capitalise on WHO's existing Collaborating Centres and partner institutions in pesticide evaluation studies.

The nets people buy from the private market have different features to the freely distributed LLINs and the survey found that there were differences in the usage of nets with certain characteristics, particularly size, fabric and colour. Changing the type of freely distributed LLINs to meet some of these preferences may help to improve usage of LLINs. Furthermore, if LLINs were sold in the private market, manufacturers could respond to these preferences to allow a range of consumer choices in shops and markets.

A qualitative net preference study was conducted alongside this quantitative survey which found supporting evidence that size and fabric were important preferences for nets. Similar results were found recently in a net preference study in Cambodia²⁰. To further the recommendation that these preferences should be considered in LLIN distribution campaigns, it would be useful to conduct a crossover design study²¹ on net usage with and without an LLIN that meets user preferences on size, colour and fabric. This would determine whether or not meeting personal preferences has a significant effect on net usage.

Case management

- **Investigate and tackle low healthcare seeking behavior and high rates of self-treatment through three steps:**
 1. Conduct formative assessment of fever cases, healthcare seeking behaviour and those people who self-treat. This will help to determine enabling factors for and barriers to accessing healthcare providers for treatment as well as the decisive factors behind use of self-treatment and choice of drug.
 2. Concurrently to the above assessment, conduct a health outlet survey to determine what antimalarial drugs are on offer and how they are sold/administered.
 3. Use findings from the above assessments to develop IEC materials and messages, behaviour change initiatives, and/or regulations/monitoring of health outlet drug provision to optimise healthcare seeking and reduce inappropriate self-treatment as required.
- **Conduct a community-based assessment on the reasons for low uptake of MPs and BMPs in villages that have the services available and use results to improve uptake, for example, through marketing of services, later opening times, or widening range of services on offer.**

The number of fever cases that visited the MP/BMP even in villages that had these available was very low. It would be important to conduct qualitative interviews and focus groups in these communities to understand why this low uptake may occur and then to implement appropriate procedures as necessary to improve this.

- **Use IEC/BCC to encourage use of public sector services to ensure all cases are captured in the national surveillance system and receive standardised diagnosis and treatment.**

²⁰ PSI-PSK. Bed-net usage determinants and user preference in Cambodia. A user-centered design approach to understanding determinants and preferences associated with bed-net product attributes. Lucas-Nene Design / Health; 2016.

²¹ A crossover study is a longitudinal study in which subjects receive a sequence of different treatments (or exposures). A crossover bed net trial is a repeated measures design in which each group (or arm) is assigned to a sequence of treatments, including at least two or more treatments comprising different LLIN brands.

One-third of healthcare seekers visited private sector providers where the malaria test rate was lower and where they may not be linked to the national surveillance system. Those with fever cases need to be encouraged to use public sector facilities where it is easier to monitor and standardise care, as well as collect accurate incidence data.

Knowledge and exposure to messaging

- **Review and revise the content of malaria messaging to target key knowledge gaps and increase focus on malaria elimination messages.**

Knowledge in general is very high, and has increased for key containment messages. However, gaps are evident on areas that may affect usage of interventions, such as use of an ITN as a prevention method. As the NMCP has now moved away from a focus on containment, the focus should be on communicating the malaria elimination agenda. Thus far, there has been no campaign to teach people about the goal to eliminate malaria, which may be a way to improve motivation to conduct prevention practices in the at-risk populations.

- **Test and implement novel approaches to behaviour change that are appropriate for maintaining motivation to perform malaria prevention activities in the context of reducing transmission risk.**

Such approaches could include using the positive deviance approach to highlight role models in communities that use their LLINs properly or who seek treatment within 24 hours. Linking this to malaria elimination messages could promote community ownership and motivation to contribute to eliminating malaria.

4. Forest-goers

- **Develop and test vector control and personal protection interventions that are appropriate to the behaviour, frequency and duration of stay of different forest-goer groups, as well as target IEC/BCC materials and messages appropriate each group and appropriate to both male and female forest-goers.**

Rubber tappers work overnight on a nightly basis during the rubber tapping season and cannot use nets since they work all night. Targeting BCC/IEC on the use of nets in the forest to this population is thus not a very useful exercise. While this sub-group already use repellent, there is likely to be poor compliance to reapplying the repellent regularly enough for it to be effective. This sub-group of forest-goers thus need to be targeted with personal protection tools such as insecticide treated clothing or materials that can be worn while they work.

Other groups of forest-goers who can use nets either have low use of treated nets, need change in attitudes towards net use, or need nets that are free-standing since there is often nowhere useful to hang a net or hammock. New hammocks that are free-standing have been developed and could be distributed to this group. BCC/IEC to change the attitudes around the use of a net is required and needs to be tailored to target both the young male population and the growing female forest-goer population.

- **Migrants were not well captured in this study yet constitute a risk group similar to forest-goers. It would be beneficial to conduct a migrant survey specifically aiming to capture the M1**

and M2 population and ethnic minority groups to explore coverage and use of nets and personal protection, case management practices and KAP related to malaria.

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Annex 1: Sample size calculation

The sample size estimation is based on predicted coverage of sufficient ITNs.

The required sample size is calculated using the following formula:

$$n_h = \frac{z^2 r(1-r) f k}{p \tilde{n} e^2}$$

n_h -- number of households to be selected per domain.

For the other parameters of the formula, the following assumptions were made:

Parameter	Meaning	Number/Assumption	Explanation
z	The statistic that defines the level of confidence desired	95% level of confidence (i.e. 1.96)	This is generally regarded as the standard for assigning the degree of confidence desired in assessing the margin of error in household surveys
r	An estimate of the key indicator to be measured by the study	30%, 36%, and 18% for Domains 1,2, and 3, respectively	This estimate assumes a 10% increase in sufficient ITN coverage since the 2015 KAP survey
f	The design effect, <i>DEFF</i> : (the ratio of the variance under the sample design to the variance under the assumption of simple random sampling)	2	2 is usually considered the default value for the sample design effect for cluster sampling.
k	A multiplier to account for the anticipated rate of non-response	1.05 corresponding to a 5% non-response rate	Each household will be visited up to 3 times
p	The proportion of the total population accounted for by the target population and upon which the parameter, <i>r</i> , is based	100%	All resident are our study subjects, as the study is estimating the percentage of all people in the household who slept under a mosquito net
$\tilde{n}$	The average household size	3.5	Based on household information from 2015 KAP survey*
e	The precision of the estimate to be attained	With a relative standard error of 0.10 for all Domains, precision is 0.03, 0.036, and 0.018 respectively	10% of r is the level of precision recommended by the United Nations Statistics Division

* Bureau of Vector Borne Diseases & Malaria Consortium. Evaluation of coverage and usage of malaria prevention methods and associated malaria risk factors among populations in areas with malaria transmission in Thailand. KAP Survey 2015. Ministry of Public Health, Bangkok; 2015.

Annex 2: Household ownership of at least one net, ITN/LLIN and LLIN according to demographic characteristics of the households

	Household ownership of at least one:					
	Any type		ITN/LLIN		LLIN	
	n	%(95%CI)	n	%(95%CI)	n	%(95%CI)
Total	1964	90.8(87.3-93.5)	1298	52.3(44.7-59.9)	1152	46.7(39.9-53.6)
Domain						
Domain 1: Thai-Myanmar	550	96.2(90.5-98.5)	387	62.9(51.4-73.0)	325	54(47.9-60.1)
Domain 2:Thai-Cambodia	409	92.5(80.7-97.4)	314	65.4(47.0-80.2)	284	56.8(39.9-72.3)
Domain 3: Remaining areas	1005	87.3(82.6-90.9)	597	41.6(31.8-52.2)	543	38.8(29.3-49.2)
Risk area						
A1	364	96.8 (94.1-98.2)	299	79.8 (70.9-86.5)	264	71.2 (61.1-79.6)
A2	1600	90.1 (86.1-93.1)	999	49.1 (41.1-57.2)	888	43.8 (36.7-51.2)
GF area						
Yes	1620	92.1(88.3-94.8)	1168	59.8(52.1-67.1)	1063	54.1(47.2-60.8)
No	344	85.8(75.2-92.4)	130	23.7(15.2-34.9)	89	18.4(12.4-26.6)
Income						
<5000 baht	808	95.4 (92.8-97.1)	594	62.4 (52.1-71.7)	530	56.3 (47.1-65.1)
≥5000 baht	1156	88.7 (84.0-92.2)	704	47.6 (40.5-54.8)	622	42.1 (35.7-48.8)
HH with > 4 member						
Yes	633	93.9(90.5-96.2)	425	54.1(45.1-62.8)	374	47.9(39.3-56.6)
No	1331	89.5(85.2-92.6)	248	45.9(37.2-54.9)	299	52.1(43.4-60.7)
HH with any forest-goer						
Yes	632	91(86.2-94.2)	405	49.5(41.2-57.8)	374	46.1(38.4-54.0)
No	132	90.7(86.4-93.8)	280	50.5(42.2-58.8)	311	53.9(46-61.6)
HH with any migrant						
Yes	132	98.2(92.3-99.6)	97	71.2(60.2-80.1)	84	60.4(47.3-72.2)
No	1832	90.6(86.9-93.3)	1201	51.6(43.8-59.3)	1068	46.2(39.2-53.2)
HH with any member who has attended school						
Yes	1892	90.6(87-93.3)	1256	52.3(44.6-59.8)	1117	46.7(39.9-53.7)
No	157	9.4(6.7-13)	793	47.7(40.2-55.4)	932	53.3(46.3-60.1)
Head of household attended school						
Yes	1472	89.7(85.7-92.7)	961	49.2(41.2-57.1)	860	44.2(37.1-51.5)
No	417	96.9(93.6-98.6)	288	69(59.9-76.7)	250	60.4(52.1-68.2)

Annex 3: Household ownership of sufficient nets, ITNs/LLINs and LLINs according to demographic characteristics of the households

	HHs with sufficient nets		HHs with sufficient ITNs/LLINs		HHs with sufficient LLINs	
	n	%(95%CI)	n	%(95%CI)	n	%(95%CI)
Total	1771	81.5(77.0-85.3)	940	40.3(34.4-46.6)	769	32.3(27.3-37.8)
Domain						
Domain 1: Thai-Myanmar	461	77.4 (66.6-85.5)	261	42.3 (30.4-55.2)	196	29.8 (21.0-40.3)
Domain 2: Thai-Cambodia	392	89.9 (82.9-94.2)	250	55.3 (41.0-68.7)	193	41.7 (31.3-52.8)
Domain 3: Remaining areas	918	80.5 (75.4-84.7)	429	33.4 (26.9-40.6)	380	30.0 (23.4-37.5)
Risk area						
A1	323	88.1 (81.8-92.4)	203	54.7 (44.5-64.6)	164	44(35.2-53.2)
A2	1448	80.8 (75.9-84.8)	737	38.6 (32.2-45.4)	605	30.9(25.6-36.8)
GF 10 area						
Yes	1457	82.7(77.7-86.8)	826	44.7(38.4-51.3)	683	35.9(30.6-41.6)
No	314	77(66.8-84.9)	114	23.4(15.2-34.2)	86	18.5(10.8-29.9)
Income						
<5000 baht	714	84.1(79.4-88.0)	434	48.3(39.9-56.9)	344	37.8(31.3-44.8)
≥5000 baht	1057	80.3(75.3-84.5)	506	36.5(30.5-43.0)	425	29.7(24.3-35.7)
HHs with > 4 member						
Yes	442	63(54.8-70.6)	175	22.7(17.2-29.3)	128	15.8 (11.2-21.8)
No	1329	89.9(87.1-92.1)	765	48.3(41.9-54.7)	641	39.8(34.3-45.5)
HHs with any forest-goer						
Yes	549	78.5(73.6-82.8)	273	35.5(29.1-42.4)	232	29(23.3-35.5)
No	1222	83.5(78.8-87.3)	667	43.5(36.6-50.6)	537	34.4(28.9-40.5)
HHs with any migrants						
Yes	102	81.8(65.8-91.3)	56	48.6(34.9-62.5)	39	38.4(24.9-54.0)
No	1669	81.5(76.8-85.4)	884	40(33.8-46.5)	730	32.1(26.7-38.0)
HHs with any member who has attended school						
Yes	1699	81.1(76.4-85.0)	896	39.8(33.8-46.1)	732	31.8(26.6-37.5)
No	72	94.8(85.3-98.3)	44	55.9(40.5-70.2)	37	47.6(32.9-62.7)
HHs with head of household who has attended school						
Yes	1368	81.8(76.9-85.9)	723	39.1(32.6-46.2)	603	31.9(26.5-37.9)
No	332	79.9(74.0-84.8)	180	46.4(38.1-54.9)	136	34.6(27.4-42.5)

Annex 4: Usage of net, ITN/LLIN and LLIN the previous night among household members

	% of household members that used a net of any type, ITN/LLIN or LLIN the previous night (n = 8,231)					
	any net		ITN/LLIN		LLIN	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Area						
A1 (perennial)	1225	80.9(74.1-86.3)	602	38.4(29.0-48.7)	330	21.2(16.2-27.2)
A2 (periodic)	4758	67.2(62.6-71.5)	1829	23.3(17.5-30.3)	1143	14.4(10.9-18.8)
Area under GF						
Yes	5028	70.4 (65.5-74.9)	2179	28.8(22.8-35.6)	1388	17.9(14.3-22.2)
No	955	62 (54.1-69.3)	252	10(4.9-19.1)	85	4.3(2.6-7.1)
Sex						
Male	2887	67.5(63.0-71.8)	1207	24.9(19.6-31.2)	746	15.4(12-19.6)
Female	3096	69.8(65.8-73.6)	1224	24.9(19.4-31.4)	727	14.8(11.4-19.1)
Age group						
Less than five years	535	75.9 (70.2-80.8)	198	21.6 (13.9-31.9)	121	13.5(8.2-21.6)
5 - 14 years	1087	70. (65.0-75.5)	460	27.2 (20.2-35.7)	270	16.2(12.0-21.6)
15 years or more	4360	67.5 (63.1-71.6)	1773	24.8(19.6-30.8)	1082	15.1(11.9-18.9)
Nationality						
Thai	5730	68.3(64.1-72.2)	2294	24.4(19.1-30.5)	1389	14.9(11.6-18.9)
M1	251	89.4(83.9-93.1)	136	55(39-70.1)	84	28.2(15.3-46.2)
M2	2	69.5(13.8-97.0)	1	5.7(0.58-41.5)	0	0
Education						
Never attended school	897	86.6(82.6-90.1)	443	44.9(36.3-53.9)	257	25.4(21.2-30.3)
Primary	2853	71.8(67.4-75.8)	1179	26.8(21.2-33.3)	710	16.7(13.0-21.1)
Secondary or higher	1600	57.9(52.8-62.8)	575	18.1(13.6-23.7)	361	10.8(8.3-14.0)
Income						
<5,000 baht	2410	78.8(73.9-83.0)	1194	37.2(29.7-45.4)	790	23.2(18.1-29.1)
≥5,000 baht	3573	64.6(60.5-68.5)	1237	19.9(15.2-25.8)	743	11.9(8.7-16.0)
Forest-goers						
Yes	836	65.1(60.2-69.7)	306	20.5(15.8-26.2)	189	12.3(9.2-16.3)
No	5147	69.5(65.2-73.5)	2125	25.9(20.2-32.6)	1284	15.8(12.3-20.0)
Pregnant						
Yes	27	53.4(40.3-66.1)	14	22.8(9.8-44.6)	9	17.2(6.8-37.0)
No	947	42.6(38.5-46.8)	576	22.7(17.9-28.4)	337	13.4(10.4-17.1)
Household respondent knew malaria transmitted by mosquito						
Yes	2791	69.8(63.0-75.9)	1170	27.1(21.6-33.5)	746	16.8(12.4-22.3)
No	3192	67.8(63.2-72.1)	1261	23.2(16.7-31.1)	727	13.8(10.6-18.2)
Household respondent recalled 1/3 key containment messages						
Yes	5685	69.1(65.2-72.7)	2342	25.1(19.7-31.4)	1423	15.4(12.1-19.5)
No	298	60.3(41.3-76.6)	89	20.3(10.8-34.7)	50	7.8(4.0-14.7)
Household respondent named ITN as a prevention method						
Yes	779	85.6(79.9-90.0)	477	52.3(43.9-60.5)	287	27.1(21.1-34.2)
No	5204	67.1(62.7-71.3)	1954	22.4(17.0-28.8)	1186	14(10.6-18.2)

Annex 5: Usage of ITN/LLIN and LLIN the previous night by demographic factor in households with ownership of sufficient ITN/LLIN and LLIN

Risk factor	Usage of ITN/LLIN in HH with sufficient ITN/LLIN		Usage of LLIN in HH with sufficient LLIN	
	n	% (95%CI)	N	%(95%CI)
Total				
Slept under net	1617	48.3 (39.6-57.1)	849	69.5 (61.9-76.2)
Not slept under net	1518	51.7 (42.9-60.4)	1627	30.5 (23.8-38.1)
Domain				
D1	554	65.3 (45.8-80.7)	262	42.2 (28.5-57.2)
D2	508	59.6 (44.1-73.4)	212	36.3 (21.2-54.6)
D3	555	29.9 (22.0-39.1)	375	22.1 (15.1-31.1)
Risk area				
A1	404	56.8 (47.5-65.7)	188	35.1 (27.8-43.1)
A2	1213	46.8 (36.7-57.2)	661	29.7 (22.1-38.6)
Sex				
Male	800	48.1 (39.3-57.0)	422	30.5 (23.2-38.9)
Female	817	48.5 (39.5-57.6)	427	30.4 (23.2-38.9)
Age group				
0-4 years	110	49.4 (38.1-60.8)	64	34.9 (23.8-47.8)
5-14 years	277	55.2 (44.9-65.0)	136	37.9 (27.3-49.8)
>15 years	1230	46.8 (38.1-55.7)	649	28.8 (22.4-36.1)
Forest goer				
Yes	221	42.3 (32.7-54.5)	110	20.9 (14.9-28.5)
No	1396	49.4 (40.5-58.3)	739	32.6 (25.2-41.1)
Nationality				
Thai	1532	47.7 (39-56.5)	805	30.1 (23.3-37.9)
Migrant	85	68.8 (46.4-84.9)	44	44.9 (21.6-70.7)
Income				
<5000 baht	873	66.4 (58.6-73.4)	469	47.1 (39.9-54.5)
>5000 baht	744	38.4 (29.8-47.7)	380	21.5 (15.8-28.6)
Pregnant woman				
Yes	10	43.3 (16.0-74.5)	4	28.0 (8.1-63.3)
No	383	44.3 (35.5-53.5)	201	27.8 (21.1-35.8)
Education				
Never attend school	292	72.5 (62.2-80.8)	138	47.1 (40.3-54.0)
Primary	821	50.8 (42.3-59.2)	439	33.8 (26.4-42.1)
Secondary	375	35.6 (26.6-45.7)	200	19.5 (13.9-26.6)
Others	126	50.4 (38.4-62.4)	71	34.5 (23.8-47.1)
Don't know	3	13.2 (3.1-41.8)	1	3.4 (0.4-26.3)

Annex 6: Usage of an ITN/LLIN the previous night according to level of access to an ITN/LLIN within the household and the behavioural gap within each sub-population

	% ITN/LLIN usage the previous night						Usage:access ratio (incl. all households)	Behavioural gap in usage (incl. all households)
	HH with 100% access		HH with 50% access		HH with < 50% access			
	%	95%CI	%	95%CI	%	95%CI		
Total	48.3	39.6-57.1	23.4	14.7-35.1	3.8	2.4-6.2	0.48	52%
By domain:								
Domain 1: Thai-Myanmar	65.3	44.9-81.3	30.9	10.8-62.3	6.8	4.1-10.9	0.63	37%
Domain 2:Thai-Cambodia	59.6	43.1-74.2	17.1	4.2-49.4	1.5	0.4-5.5	0.60	40%
Domain 3: Remaining areas	29.9	21.9-39.3	21.8	16.6-27.9	3.0	1.7-5.0	0.33	67%
By risk area:								
A1	56.8	46.3-66.7	19.4	10.3-33.4	8.0	3.9-15.9	0.54	46%
A2	46.8	36.7-57.2	24.0	14.1-37.7	3.6	2.0-6.1	0.47	53%

Annex 7: Reasons that a net was not used the previous night to the survey, including any type of net owned (n = 2,259)

Reason of not using net	TOTAL (n = 2,259)		Domain 1 Thai-Myanmar border (n = 527)		Domain 2 Thai-Cambodia border (n = 592)		Domain 3 Remaining areas (n = 1,141)	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
hot/ uncomfortable	134	8.6(6.4-11.5)	16	6.2(2.8-13.2)	3	1.7(0.6-4.5)	115	13.1(9.6-17.6)
Net too small	126	5.3(4.1-6.9)	32	6.5(3.8-10.6)	31	5.7(4.2-7.8)	63	4.5(3.0-6.7)
Net too big	10	0.3(0.1-0.6)	5	0.5(0.1-1.9)	1	0.1(0.0-0.9)	4	0.2(0.1-0.9)
No mosquitoes	45	3(0.1-0.6)	11	4.6(1.4-14.0)	4	0.5(0.1-2.1)	30	3.3(1.7-6.1)
Too much time/effort to set up net	4	0.1(0.0-0.3)	0	0	0	0	4	0.2(0.1-0.7)
Net for children	13	0.8(0.3-2.1)	3	0.3(0.1-1.5)	6	2.2(0.6-8.0)	4	0.4(0.1-1.5)
Absence of user/net owner the previous night	153	6.9(5.1-9.3)	28	3.3(1.1-9.9)	32	4.9(3.2-7.3)	93	9.9(7.9-12.2)
Net in bad condition	64	2.9(1.8-4.6)	12	1.7(0.5-5.4)	14	3.2(1.3-7.3)	38	3.5(2.0-6.0)
Saving for visitors or future use	1046	43.1(38.0-48.3)	296	47(39.4-54.8)	296	56(43.8-67.5)	454	34.9(29.3-41.1)
Not easy to hang	29	2.6(1.2-5.5)	14	6.5(3.4-12.3)	2	0.3(0.1-1.2)	13	1.5(0.7-3.4)
Already enough net	397	16.6(13.0-21.0)	41	9.8(6.6-14.4)	145	16.8(9.3-28.3)	211	20.3(15.4-26.3)
Rash/irritation/burning pain	5	0.1(0.0-0.4)	3	0.2(0.0-1.4)	1	0.1(0.0-1.1)	1	0.1(0.0-0.5)
Dislike chemical smell	11	0.5(0.2-1.6)	1	0.1(0.0-0.8)	2	0.2(0.1-1.0)	8	0.9(0.63-3.2)
Did not use for sleep	100	3.5(2.7-4.7)	21	4.4(2.9-6.5)	30	4.0(2.5-6.4)	49	2.9(1.8-4.7)
Use when in forest/stay outside	59	2.4(1.5-3.8)	15	3.1(1.5-6.1)	18	2.0(1.0-3.9)	26	2.3(1.1-4.8)
Use to protect/repel mosquito but not at sleep time	28	1.2(0.7-2.1)	16	2.2(0.8-5.5)	1	0.8(0.1-4.9)	11	0.8(0.3-1.9)
Did not like using net	8	0.2(0.1-0.6)	1	<0.1(0.0-0.4)	1	0.1(0.0-1.1)	6	0.3(0.1-1.1)
Others	3	0.2(0.0-0.5)	1	0.2(0.0-1.5)	1	0.2(0.0-1.4)	1	0.1(0.0-0.9)
Do not know	11	1.1(0.3-4.2)	7	3.2(0.7-13.8)	2	0.2(0.1-1.0)	2	0.3(0.1-1.63)

Annex 8: Characteristics of owned nets (excluding hammock nets) including type of net, brand, age and features (n = 5,388)*

	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Net type								
Conventional	3073	60.4 (54.2-66.2)	691	52.6 (41.1-63.9)	611	49.2 (37.8-60.7)	1771	70.0 (62.1-76.8)
ITN 12M	630	10.8 (8.1-14.3)	242	15.8 (8.4-27.5)	222	17.8 (13.3-23.4)	166	4.7 (3.1-7.2)
LLIN < 3 years	1507	25.2 (21.5-29.4)	411	26.9 (23.8-30.2)	398	30.7 (23.4-39.1)	698	21.8 (15.9-29.1)
LLIN >3 year	178	3.6 (2.5-5.1)	54	4.7 (2.5-8.7)	27	2.3 (1.5-3.7)	97	3.5 (2.3-5.4)
Age of net								
Conventional net								
< 1year	727	22.5 (19.5-25.8)	173	20.9 (14.9-28.4)	172	30.7 (24.6-37.5)	382	20.5 (17.5-23.9)
1 years – 3 years	1382	45.3 (42.4-48.2)	315	49.8 (44.5-55.2)	267	41.9 (37.4-46.7)	800	44.3 (40.7-48.1)
>3years	879	30.0 (26.2-34.0)	181	25.5 (15.6-38.8)	138	23.3 (17.7-30.1)	560	34.0 (30.4-37.8)
Don't know	85	2.3 (1.4-3.7)	22	3.7 (1.6-8.5)	34	4.0 (2.3-7.1)	85	1.1 (0.6-2.1)
ITN								
< 1year	86	11.2 (7.7-15.9)	30	6.7 (2.8-15.0)	35	16.9 (12.6-22.3)	21	10.0 (5.3-18.0)
years – 3 years	280	40.3 (34.0-47.0)	99	42.1 (32.5-52.3)	101	36.4 (28.4-45.2)	80	43.8 (29.6-59.1)
>3years	246	46.1 (39.9-52.4)	107	50.0 (40.8-59.1)	78	43.0 (35.4-50.8)	61	44.1 (26.7-63.0)
Don't know	18	2.4 (1.4-4.1)	6	1.2 (0.5-3.3)	8	3.8 (2.0-7.2)	4	2.1 (0.7-6.2)
LLIN								
< 1year	680	36.1 (29.4-43.5)	155	25.9 (16.7-38.0)	155	35.0 (26.8-44.2)	370	44.2 (35.6-53.2)
1 years – 3 years	827	51.4 (46.1-56.6)	256	59.2 (53.6-64.5)	243	57.9 (49.7-65.7)	328	41.8 (35.0-49.0)
>3years	178	12.5 (9.3-16.5)	54	14.9 (8.7-24.4)	27	7.1 (4.9-10.1)	97	13.9 (9.8-19.5)
LLIN brand								
Royal Sentry	65	3.9 (2.0-7.4)	24	5.6 (1.7-16.4)	4	0.7 (0.2-1.8)	37	4.7 (1.9-10.8)
Yorkool no tag	25	1.1 (0.6-1.9)	6	0.6 (0.2-1.8)	8	1.2 (0.3-4.0)	11	1.4 (0.7-2.7)
Yorkool (SSF yr1)	15	1.1 (0.6-1.9)	8	1.2 (0.3-4.0)	7	1.8 (1.0-3.3)	0	0
Yorkool (SSFyr4)	45	2.7 (1.2-5.9)	13	1.2 (0.3-4.6)	15	2.9 (0.8-10.1)	17	3.6 (1.1-10.7)
Yorkool (SSFyr5)	367	11.6 (7.3-18.1)	81	7.9 (2.4-22.6)	74	7.7 (2.9-18.7)	212	16.8 (10.4-26.1)
Yorkool (RAIyr2)	10	0.4 (0.2-1.3)	4	0.2 (0.1-0.9)	2	0.1 (0.0-0.7)	4	0.8 (0.2-3.0)
Olyset (SSFyr2)	454	25.5 (21.8-29.6)	133	26.7 (21.2-33.0)	108	21.9 (15.3-30.3)	213	26.9 (21.0-33.6)

	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Permanet(SSFyr3)	757	39.1 (32.8-45.8)	214	44.9 (34.0-56.3)	237	48.4 (39.4-57.4)	306	29.1 (22.3-37.0)
Dawaplu (RALyr1)	20	1.4 (0.8-2.6)	10	1.8 (0.7-4.7)	2	1.0 (0.3-3.1)	8	1.4 (0.5-3.7)
Don't know LLIN brand	320	13.7 (10.7-17.3)	73	10.6 (5.9-18.3)	83	14.4 (10.0-20.3)	164	15.4 (10.8-21.5)
Source of net								
Any net								
From government	2293	36.6 (31.2-42.3)	691	41.6 (32.6-51.1)	555	38.9 (29.2-49.6)	1047	32.5 (24.4-41.8)-
From NGOs/CSO	114	1.6 (0.9-2.8)	54	2.9 (1.0-8.1)	22	1.2 (0.5-3.2)	38	0.9 (0.4-2.1)
Purchased from private sector	3045	59.0 (53.1-64.6)	680	52.8 (41.6-63.8)	715	56.2 (45.5-66.3)	1650	63.9 (54.9-72.0)
From friend/family	73	1.3 (0.9-1.8)	21	1.0 (0.5-2.1)	14	1.1 (0.7-1.7)	38	1.6 (1.0-2.5)
Don't know	103	1.6 (1.1-2.2)	29	1.7 (0.9-3.3)	40	2.6 (1.4-4.5)	34	1.0 (0.6-1.7)
Conventional net								
From government	354	10.1 (7.6-13.4)	122	14.6 (9.5-21.8)	60	9.1 (5.1-15.7)	172	8.5 (5.5-12.8)
From NGOs/CSO	41	0.9 (0.4-1.9)	23	1.7 (0.4-6.5)	2	0.2 (0.0-0.8)	16	0.7 (0.2-2.1)
Purchased from private sector	2537	85.6 (82.4-88.3)	524	80.6 (72.0-87.0)	497	85.9 (79.4-90.6)	1516	87.8 (83.6-91.0)
From friend/family	56	1.8 (1.2-2.6)	16	1.4 (0.6-3.3)	9	1.8 (0.9-3.5)	31	2.0 (1.2-3.2)
Don't know	58	1.6 (1.0-2.7)	14	1.7 (0.4-6.6)	25	3.1 (1.3-7.0)	19	1.1 (0.6-2.0)
ITN								
From government	130	20.7 (12.5-32.4)	79	31.2 (15.8-52.3)	26	11.0 (6.7-17.7)	25	17.1 (9.7-28.6))
From NGOs/CSO	17	2.5 (0.6-9.0)	8	4.3 (0.8-20.1)	0	0	9	3.3 (0.9-12.1)
Purchased from private sector	469	74.3 (60.4-84.6)	145	61.9 (36.6-82.1)	194	85.6 (76.7-91.5)	130	78.8 (66.2-87.5)
From friend/family	3	0.6 (0.1-2.6)	3	1.4 (0.3-5.4)	0	0	0	0
Don't know	11	1.9 (0.6-6.3)	7	1.2 (0.2-6.7)	2	3.4 (0.8-13.7)	2	0.8 (0.2-3.0)
LLIN								
From government	1804	91.8 (87.7-94.6)	488	88.7 (76.9-94.8)	466	87.8 (82.6-91.6)	850	96.7 (93.7-98.3)
From NGOs/CSO	56	2.6 (1.1-5.8)	23	4.1 (0.8-17.5)	20	3.1 (1.2-8.2)	13	1.1 (0.4-3.2)
Purchased from private sector	39	3.5 (1.7-7.2)	11	5.0 (1.5-15.9)	24	6.7 (3.2-13.6)	4	0.4 (0.1-1.1)
From friend/family	13	0.7 (0.3-1.6)	2	0.2 (0.0-1.5)	5	0.7 (0.2-2.5)	6	0.9 (0.3-3.3)
Don't know	34	1.4 (0.8-2.7)	8	2.0 (0.7-5.3)	13	1.6 (0.5-4.8)	13	0.9 (0.4-2.0)
Size of net								
Any net								

	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Single	400	8.1 (6.5-10.1)	88	5.5 (3.9-7.8)	137	11.7 (8.0-16.7)	175	7.9 (5.7-10.8)
For 2 people	2866	48.0 (42.9-53.1)	815	45.8 (32.4-59.9)	639	50.3 (44.5-56.1)	1412	48.1 (43.4-52.9)
>2 people	2343	43.3 (38.5-48.2)	563	47.1 (35.1-59.4)	569	38.0 (32.9-43.3)	1211	43.5 (39.3-47.8)
Hammock	19	0.7 (0.3-1.5)	9	1.6 (0.8-3.2)	1	0 (0.0-0.3)	9	0.4 (0.1-1.5)
Conventional net								
Single	200	7.7 (6.2-9.6)	52	7.3 (5.4-9.7)	39	10.1 (5.5-17.9)	109	7.2 (5.5-9.3)
For 2 people	1101	35.0 (30.1-40.3)	247	27.3 (16.2-42.0)	195	36.7 (30.8-43.0)	659	37.8 (33.5-42.3)
>2 people	1770	57.2 (51.8-62.8)	390	65.5 (52.4-76.6)	377	53.2 (44.3-61.9)	1003	55.0 (50.6-59.3)
ITN								
Single	16	4.5 (1.6-11.9)	3	0.4 (0.1-2.2)	7	7.8 (2.3-23.5)	6	6.5 (2.0-19.1)
For 2 people	198	37.0 (28.1-46.8)	105	46.1 (31.5-61.4)	48	29.5 (18.4-43.9)	45	32.1 (20.4-46.6)
>2 people	416	58.6 (49.4-67.2)	134	53.5 (38.3-68.0)	167	62.7 (48.9-74.6)	115	61.4 (42.4-77.4)
LLIN								
Single	98	7.6 (5.1-11.1)	24	4.5 (2.3-8.7)	36	10.4 (4.5-22.4)	38	8.1 (4.9-13.0)
For 2 people	1441	78.7 (71.5-84.5)	402	73.7 (54.9-86.6)	368	82.9 (74.4-88.9)	671	79.7 (73.8-84.6)
>2 people	145	13.8 (8.5-21.5)	38	21.7 (10.0-41.1)	21	6.7 (3.4-12.9)	86	12.2 (8.8-16.7)
Colour of net								
Any net								
White	3180	55.2 (51.6-59.8)	937	60.2 (51.8-68.1)	644	50.7 (43.9-57.5)	1599	55.5 (49.2-61.7)
Green	461	7.2 (6.0-8.7)	85	6.4 (4.2-9.6)	184	9.3 (5.8-14.6)	192	6.7 (5.5-8.3)
Blue/light blue	723	14.8 (12.9-17.0)	181	15.3 (12.5-18.6)	144	12.8 (8.4-19.1)	398	15.5 (12.8-18.6)
Multicolor	394	6.7 (5.5-8.2)	94	5.1 (3.5-7.4)	125	10.2 (7.5-13.6)	175	6.0 (4.7-7.7)
Pink	854	14.5 (12.5-16.8)	168	10.1 (7.1-14.0)	246	16.8 (14.3-19.5)	440	16.1 (13.4-19.2)
Don't know	16	0.9 (0.3-2.9)	10	2.9 (1.2-6.9)	3	0.1 (0.0-0.4)	3	0.1 (0.0-0.5)
Conventional net								
White	1078	37.4 (33.1-41.8)	280	37.9 (30.3-46.1)	136	28.3 (21.6-36.1)	662	40.0 (33.7-46.6)
Green	299	8.4 (7.0-10.0)	60	8.5 (5.5-13.0)	83	10.2 (6.6-15.3)	156	7.8 (6.2-9.8)
Blue/light blue	605	21.4 (19.3-23.8)	137	23.0 (20.3-26.0)	103	19.4 (15.4-24.1)	365	21.4 (18.1-25.0)
Multicolor	326	9.4 (7.8-11.3)	81	8.5 (5.5-12.9)	86	13.9 (11.3-17.1)	159	8.4 (6.5-10.8)
Pink	722	21.8 (19.1-24.9)	131	16.4 (12.2-21.6)	182	27.9 (21.7-35.1)	409	22.4 (19.2-25.9)

	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Don't know	16	1.6(0.5-4.8)	10	5.7(2.9-11.0)	3	0.3(0.1-1.0)	3	0.1(0.0-0.7)
ITN								
White	285	47.6(38.8-56.4)	146	61.1(46.8-73.8)	63	32.7(23.9-42.9)	76	47.1(37.1-57.2)
Green	51	7.1(4.0-12.1)	10	3.9(1.7-8.8)	29	7.7(4.6-12.4)	12	12.1(3.4-35.3)
Blue/light blue	107	19.8(13.7-27.8)	37	20.7(11.2-35.1)	37	19.9(10.1-35.4)	33	18.2 (11.3-28.0)
Multicolor	60	9.8(4.6-19.7)	12	3.9(1.2-11.7)	34	18.6(8.6-35.8)	14	5.8(2.9-11.3)
Pink	127	15.8(11.1-21.9)	37	10.4(5.5-18.8)	59	21.2(11.6-35.6)	31	16.8(10.7-25.5)
LLIN								
White	1684	97.8(96.1-98.8)	455	97.9(94.6-99.2)	399	94.4(87.2-97.7)	794	99.7(98.5-100.0)
Green	23	1.3(0.6-2.6)	2	1.6(0.4-6.1)	20	2.6(1.0-6.6)	1	0.3(0.0-1.5)
Blue/light blue	8	0.5(0.1-1.6)	6	0.4(0.1-1.6)	2	1.4(0.3-6.2)	0	0
Multicolor	5	0.5(0.1-1.6)	2	0.2(0.0-1.2)	3	1.6(0.4-6.0)	0	0
Pink	1	0.0(0.0-0.2)	0	0	1	0.1(0.0-0.7)	0	0
Net has tear(s)/hole(s)								
Any net								
Yes	1293	21.7(18.9-24.8)	307	23.8(16.6-33.0)	352	22.7(18.2-27.8)	634	20.1(17.2-23.3)
No	4292	78.3(75.2-81.1)	1148	76.2(67.0-83.4)	977	77.3(72.2-81.8)	2167	79.9(76.7-82.8)
Conventional net								
Yes	778	22.7(20.0-25.7)	154	22.3(19.1-25.8)	164	24.6(19.1-31.1)	460	22.3(18.3-27.0)
No	2213	77.3(74.3-80.0)	524	77.7(74.2-80.9)	404	75.4(68.9-80.9)	1285	77.7(73.0-81.7)
ITN								
Yes	256	40.4(31.2-50.3)	70	38.4(22.7-57.0)	109	38.2(25.7-52.5)	77	47.9(32.2-64.1)
No	374	59.6(49.7-68.8)	172	61.6(43.0-77.3)	113	61.8(47.5-74.3)	89	52.1(35.9-67.8)
LLIN								
Yes	234	14.0(10.3-18.7)	74	20.0(11.0-33.6)	73	14.5(10.1-20.5)	87	9.5(6.5-13.6)
No	1493	86.0(81.3-89.7)	384	80.0(66.4-89.0)	381	85.5(79.5-93.5)	728	90.5(86.4-93.5)

* LLIN category includes effective and expired LLIN (ie. any age of LLIN).

Annex 9: Characteristics of owned hammock nets (n = 240)

Hammock characteristics	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Total	240	3.8(2.8-5.1)	77	4.4(2.6-7.5)	88	5.3(2.9-9.4)	75	2.7(1.7-4.3)
Brand								
Netprotect (SSFyr1)	8	2.4(1.2-4.7)	0	0	7	6.8(3.9-11.6)	1	0.7(0.1-5.1)
Olyset (SSFyr2)	33	10.5(6.1-17.6)	14	12.9(4.2-33.6)	5	4.2(1.7-9.8)	14	14(6.8-26.7)
Yorkool on tag	17	9(3.6-20.9)	3	2.0(0.4-10.1)	5	12.5(2.0-50.5)	9	12.5(5.4-26.5)
Yorkool SSFyr3	19	13.5(4.4-34.7)	6	22.6(3.5-70.1)	12	17.1(5.3-43.2)	1	1.5(0.2-9.6)
Yorkool SSFyr4	25	13.7(6.9-25.2)	6	3(0.8-11.3)	11	20.7(7.4-45.9)	8	17.5(7.4-36.2)
Yorkool SSFyr5	60	23.5(10.9-43.5)	36	38.7(10.2-77.8)	7	6.5(2.0-19.0)	17	24.4(11.4-44.8)
Yorkool RAI yr2	23	7.3(3.4-15.0)	2	0.8(0.2-4.1)	9	7.2(2.5-19.1)	12	13.6(4.8-33.0)
Dawapulus (RAI-yr1)	15	8.1(2.3-24.8)	6	16.5(2.5-60.4)	2	1.9(0.4-8.0)	7	5.6(2.0-14.5)
Don't know LLIHN	40	12.1(6.1-22.6)	4	3.4(0.8-13.6)	30	23.3(10.1-45.1)	6	10.3(2.2-36.4)
Age								
<1 year	131	54.9(39.6-69.4)	43	53.1(21.9-82.0)	41	45.8(32.1-60.2)	47	65.0(39.8-83.9)
1-3 years	84	34.5(21.5-50.3)	28	41.1(14.6-73.9)	32	36.6(21.2-55.4)	24	26.2(11.5-49.3)
>3 years	17	8.2(3.5-18.2)	5	5.4(1.0-24.9)	8	10.5(3.5-27.6)	4	8.8(1.6-36.5)
Don't know	8	2.4(0.7-7.7)	1	0.4(0.0-3.5)	7	7.0(2.0-21.9)	0	0
Source								
Free form government	200	83.9(67.1-93.1)	63	79.7(37.5-96.2)	68	82.0(63.4-92.4)	69	89.7(63.6-97.8)
From NGO/CSO	15	6.6(1.2-29.2)	13	18.7(3.6-58.9)	2	1.1(0.2-5.2)	0	0
Purchased from private sector	14	6.4(2.7-14.6)	1	1.6(0.3-1.7)	9	8.6(3.5-20.0)	4	9.0(1.7-35.7)
From friend/family	4	1.3(0.3-5.8)	0	0	2	2.6(0.3-19.9)	2	1.2(0.2-9.4)
Do not know	7	1.8(0.4-8.2)	0	0	7	5.6(1.0-25.6)	0	0
Tear(s)/hole(s)								
Yes	212	88.2(82.0-92.5)	68	84.7(69.7-93.0)	79	91.3(83.3-95.6)	65	88.8(76.5-95.1)
No	25	11.2(7.0-17.4)	9	15.3(7.0-30.3)	6	6.9(2.9-15.2)	10	11.2(4.9-23.5)
Don't know	3	0.6(0.1-2.4)	0	0	3	1.9(0.4-7.7)	0	0

Annex 10: Preferences for a new net among households that would like a new net, including type of net preferred, preferred features of the net and willingness to pay

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining provinces (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Would prefer a new net								
Yes	1610	77.7(73.6-81.2)	393	78.0(70.5-84.1)	372	90.7(84.5-94.5)	845	72.4(67.5-76.8)
Preferred source of new net								
Wait for free distribution	1111	61.6(54.5-68.2)	278	62.4(43.2-78.4)	250	62.6(57.1-67.8)	583	60.7(51.0-69.5)
Buy from market	472	37.1(30.1-44.7)	100	34.4(17.5-56.6)	116	36.6(31.0-42.5)	256	38.9(29.9-48.7)
Wait for free if not, will buy from market	20	0.9(0.4-2.0)	13	2.3(0.7-7.4)	3	0.4(0.1-1.6)	4	0.3(0.1-1.1)
Any source/type	7	0.4(0.1-1.0)	2	0.8(0.2-3.4)	3	0.4(0.1-1.4)	2	0.1(0.0-0.8)
Preferred type of new net								
Conventional net	310	23.8(19.6-28.7)	65	20.2(13.8-28.6)	50	14.3(9.8-20.6)	195	30.5(24.4-37.4)
Re-dip	267	21(15.8-27.4)	70	30.7(18.7-46.2)	80	24.5(20.6-28.9)	117	14.0(10.8-17.9)
LLIN	955	50(42.5-57.5)	244	43.9(24.4-65.5)	217	54.2(49.2-59.1)	494	51.3(44.8-57.8)
LLIHN	21	0.8(0.2-1.1)	0	0	6	1.0(3.2-2.8)	15	1.1(0.5-2.5)
Price willing to pay if prefer net from market (n = 472)								
<100 THB	5	0.7(0.3-2.0)	2	1.2(0.2-7.3)	2	1.4(0.3-6.7)	1	0.1(0.0-1.1)
101-200 THB	96	19.7(16.0-24.0)	15	15.5(13.5-17.7)	19	17.1(12.8-22.5)	62	23.0(16.9-30.4)
200-300 THB	194	40.2(33.9-46.8)	42	47.7(39-56.5)	52	45.2(39.3-51.3)	100	34.1(27-42.0)
>300 THB	170	39.4(32.8-46.4)	41	35.6(28.7-43.1)	39	36.2(30.5-42.3)	90	42.8(31.7-54.6)
Preferred size of new net								
Single	50	3.3(2.2-5.0)	12	4.5(1.9-10.4)	14	2.9(1.5-5.6)	24	2.8(1.9-4.1)
For 2 people	290	19.7(17.5-22.1)	74	18.3(15.1-22)	62	19.9(14.9-26.1)	154	20.5(17.6-23.6)
>2 people	1278	77.0(74.8-79)	307	77.2(75.2-79.2)	300	77.1(72.1-81.5)	671	76.7(73.1-80)
Preferred shape of new net								
Rectangular	1541	94.1 (90.3-96.5)	382	97.5(94.5-98.8)	362	96.8(94.2-98.3)	797	90.9(84.0-95.0)
Round/conical	31	1.9(1.0-3.6)	6	0.7(0.2-2.5)	3	0.4(0.1-1.6)	8	2.2(1.0-4.5)
Triangle	35	2.8(1.5-5.1)	3	0.3(0.1-1.4)	8	2.2(1.0-4.5)	2	4.5(2.3-8.5)
No preference	11	1.2(0.6-2.5)	2	1.5(0.4-6.3)	3	0.5(0.1-2.4)	238	1.3(0.6-2.5)

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining provinces (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Preferred material of new net								
Cotton	445	30.5(25.3-36.3)	131	29.5(18.4-43.6)	76	21.7(17.2-26.9)	238	35.5(29.1-42.3)
Nylon	554	32.3(28.3-36.6)	116	35.7(27.6-44.8)	134	31.4(26.5-36.8)	304	30.9(25.9-36.3)
Polyester/Polyethylene	194	13(10.3-16.3)	39	14.2(9.5-20.5)	60	17.3(11.8-24.5)	95	10.3(7.5-13.9)
Tuma	160	7.6(5.0-11.5)	27	4.7(1.7-12.3)	59	11.9(5.2-25.1)	74	7.2(4.1-12.5)
Lace	246	16.1(12.8-20.2)	72	15.4(10.6-21.9)	40	17.3(9.0-30.7)	134	16(12.2-20.7)
Any type	14	0.4(0.2-0.8)	8	0.6(0.2-2.4)	4	0.4(0.1-2.1)	2	0.2(0.0-0.7)

Annex 11: Use of other vector control methods in the households including wire screens (on some or all doors and windows), chemicals, and IRS

Household characteristics	% of HHs using wire screen		% of HHs using chemicals to keep mosquitos away		% of HHs with IRS in past 12 months		% of HHs with sufficient ITN/LLIN and/or IRS in the past 12 months	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Total	112	6.2 (3.6-10.4)	672	36.6 (32.6-40.7)	464	23.6 (17.5-31.6)	1202	53.1 (46.0-60.2)
Domain								
Domain 1: Thai-Myanmar	47	5.3 (2.4-11.6)	129	28.5 (23.0-34.7)	158	26.7 (15.7-41.6)	340	55.7 (43.9-66.9)
Domain 2: Thai-Cambodia	26	11.6 (3.6-31.3)	161	37.3 (27.3-49.3)	42	15.1 (6.8-30.4)	261	60.3 (46.9-72.4)
Domain 3: Remaining areas	39	4.6 (3.3-6.3)	382	40.4 (34.9-46.1)	264	25.8 (16.3-38.2)	601	48.9 (38.4-59.6)
Risk area								
A1 (perennial)	13	4.3 (2.2-8.4)	119	31.8 (26.4-37.7)	358	22.5 (16.0-30.8)	262	73.5 (63.5-81.5)
A2 (periodic)	99	6.4 (3.6-11.1)	553	37.1 (32.8-41.7)	106	35.0 (17.4-58)	940	50.7 (43.2-58.2)
Income								
<5000 baht	22	3.9 (1.9-7.9)	215	29.4 (25.6-33.4)	174	26.0 (17.3-36.9)	527	61.5 (52.3-69.9)
>5000 baht	90	7.3 (4.4-12.0)	457	40.0 (35.2-44.9)	290	22.9 (16.7-30.5)	675	49.2 (42.0-56.4)
HH with education at least secondary school								
Yes	81	7.0 (3.5-13.5)	481	39.0 (34.4-43.9)	310	22.2 (15.8-30.2)	746	48.7 (41.1-56.3)
No	31	4.4 (2.5-7.9)	191	30.9 (27.1-35.0)	154	27.7 (19.5-37.7)	456	63.2 (53.8-71.7)
HH with migrant(s)								
Yes	11	6.9 (2.9-15.6)	30	18.5 (10.4-30.8)	32	20.9 (6.4-50.7)	73	60.0 (43.0-74.9)
No	101	6.2 (3.6-10.5)	642	37.3 (33.3-41.4)	432	24.0 (17.5-31.9)	1129	52.9 (45.4-60.2)
HH with forest-goer(s)								
Yes	25	4.8 (2.5-9.0)	142	21.5 (13.5-32.3)	459	58.1 (48.1-67.5)	844	56.6 (48.9-63.9)
No	87	7.2 (4.2-11.9)	322	25.8 (18.8-34.3)	993	63.2 (53.8-71.6)	358	47.9 (38.5-57.4)
HH with pregnant woman								
Yes	1	0.3(0.0-2.5)	11	19(7.7-39.7)	37	73.9(55.8-86.4)	21	42.7(19.3-69.9)
No	111	6.4(3.8-10.6)	453	24.2(17.8-32.0)	1415	60.8(52.4-68.7)	1181	53.4(46.2-60.5)
HH with children under five years old								
Yes	27	6.1(3.4-10.6)	141	25(16.8-35.6)	403	60.9(50.2-70.7)	272	42.2(30.6-54.7)
NO	85	6.3(3.6-10.8)	323	23.7(17.4-31.5)	1049	61.3(52.8-69.1)	930	57.3(50.6-63.8)

Annex 12: Primary action used within each household to prevent mosquito bites

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	%(95%CI)
No action	19	0.7 (0.4-1.3)	7	0.8 (0.3-2.1)	0	0	12	0.9 (0.4-2.0)
Mosquito coil	270	13.7 (10.9-17.1)	44	6.4 (3.8-10.6)	58	12.8 (7.4-21.1)	168	17.9 (14.6-21.9)
Repellent lotion	351	20.6 (17.4-24.3)	75	20.8 (13.3-30.9)	85	21.6 (15.9-28.6)	191	20.2 (16.6-24.3)
Indoor chemical spray	51	2.2 (1.5-3.4)	10	1.3 (0.5-3.6)	18	3.3 (1.4-7.7)	23	2.3 (1.4-3.7)
Mosquito net	977	38.9 (33.8-44.3)	324	47.1 (36.3-58.1)	188	42.8 (30.3-56.3)	465	33.1 (26.9-40.0)
Wire screen	13	0.8 (0.3-2.0)	6	0.6 (0.2-2.0)	5	2.6 (0.8-78)	2	0.1 (0.0-0.4)
Wear long clothes	75	4.1 (2.7-6.3)	18	5.8 (2.8-11.7)	12	2.5 (1.2-4.9)	45	3.9 (2.3-6.6)
Wear treated clothes	2	0.1 (0.0-0.6)	0	0	1	0.1 (0.0-1.2)	1	0.2 (0.0-1.2)
Make smoke	86	5.1 (3.9-6.6)	40	6.9 (4.0-11.7)	11	3.8 (2.1-6.7)	35	4.7 (3.2-6.7)
Herb (spray, burn, eat)	7	0.3 (0.1-0.6)	1	0.2 (0.0-1.5)	2	0.5 (0.1-2.0)	4	0.3 (0.1-0.7)
Joss stick repellent	16	0.9 (0.4-2.1)	6	0.5 (0.2-1.5)	5	3.0 (1.3-7.1)	5	0.2 (0.1-0.7)
Traditional medicine	2	<0.1 (0.0-0.2)	1	0.1 (0.0-0.5)	0	0	1	<0.1 (0.0-0.3)
Fan	175	8.8 (6.9-11.0)	28	6.9 (3.6-12.6)	31	5.4 (3.0-9.7)	116	11.1 (8.7-14.1)
Air conditioning	32	1.7 (0.9-3.2)	8	1.0 (0.3-3.1)	0	0	24	2.8 (1.4-5.5)
Swatter	39	1.4 (0.8-2.3)	5	0.4 (0.1-1.5)	9	1.6 (0.5-5.0)	25	1.8 (1.0-3.1)
Empty water container	8	0.6 (0.2-1.7)	2	1.3 (0.3-4.9)	0	0	6	0.4 (0.2-1.0)
Do not know	2	<0.1 (0.0-0.2)	0	0	0	0	2	0.1 (0.0-0.4)

Annex 13: Prevalence of fever in the previous two weeks among household members and subsequent healthcare seeking behaviour, by demographic background.

	Fever previous two weeks (n = 8,321)		Fever cases that sought treatment (n = 540)		Fever cases that sought treatment ≤24hrs (n = 540)	
	n	%(95%CI)	n	%(95%CI)	n	%(95%CI)
Total	540	6.5(5.2-8.1)	367	67.5(60.8-73.6)	171	26.1(20.3-32.9)
Domain						
Domain 1: Thai-Myanmar	23	3.7(2.4-5.8)	56	68.9(50.7-82.6)	26	26.8(14.1-45.0)
Domain 2:Thai-Cambodia	90	5.3(3.3-8.3)	55	48.6(27.4-70.3)	33	34.4(18.5-54.9)
Domain 3: Remaining areas	367	8.4(6.7-10.6)	256	71.2(65.6-76.7)	112	24.1(17.8-31.7)
Risk Area						
A1	44	6.9 (5.0-9.5)	63	69.8 (58.0-79.4)	26	27.3 (17.5-40.0)
A2	446	6.5 (5.1-8.3)	304	67.2 (59.9-73.9)	145	25.9 (19.6-33.6)
Household income						
<5000 THB	155	5.5 (4.1-7.4)	108	67.0 (50.7- 80.1)	50	27.2 (16.3-41.9)
>5000 THB	385	6.9 (5.5-8.8)	259	67.8 (60.9-73.8)	121	25.7 (18.9-34.0)
Sex						
Male	293	6.9 (5.4-8.8)	205	71.8 (64.1-78.4)	97	29.3 (22.3-37.4)
Female	247	6.1 (4.8-7.8)	162	63.0 (55.3-70.1)	74	22.7 (16.4-30.5)
Age group						
< 5 years	122	16 (12.2-20.8)	95	82.6 (70.9-90.2)	47	34.3 (23.4-47.2)
5 - 14 years	124	8.5 (6.1-11.8)	88	66.2 (53.9-76.6)	49	30.3 (21.3-41.0)
15+ years	294	5.0 (3.9-6.5)	184	62.7 (54.3-76.6)	75	21.6 (15.5-29.2)
Education level						
Never attended	63	6.9 (4.5-10.4)	44	79.4 (65.8-88.5)	20	24.4 (10.2-47.7)
Primary	229	6.2 (4.8-8.1)	147	60.9 (50.0-70.9)	68	23.1 (16.0-32.2)
Secondary	126	4.9 (3.5-6.8)	79	61.4 (49.6-72.0)	33	24.6 (14.9-37.7)
Forest-goer						
Yes	76	6.1 (4.1-9.2)	49	61.3 (46.0-74.7)	18	18.0 (9.8-30.5)
No	464	6.6 (5.3-8.2)	318	68.8 (62.1-74.8)	153	27.8 (21.2-35.5)
Thai/Migrant						
Thai	535	6.6 (5.3-8.2)	362	37.2 (60.4-73.3)	167	25.6 (20.0-32.2)
M1	5	3.5 (1.3-9.5)	5	100	4	71.2 (18.8-96.3)
M2	0		-		-	
Household respondent had heard of malaria						
Yes	533	6.6(5.2-8.2)	362	67.7(60.9-73.8)	167	25.8(20.0-32.6)
No	7	3.9(1.4-10.5)	5	71.7(20.6-96.1)	4	55.6(14.5-90.2)
Household respondent knew main sign and symptom of malaria is fever						
Yes	369	7.1(5.6-9.0)	250	67.9(61.3-73.8)	117	26.3(20.3-33.3)
No	171	5.5(4.0-7.6)	117	67.4(53.1-79.1)	54	26(17.1-37.5)
Household respondent had heard malaria message in previous 6 months						
Yes	518	6.5(5.2-8.2)	352	67.9(61.1-74.1))	162	25.3(19.5-32.1)
No	22	6.8(3.4-13.1)	15	63.9(29.3-88.3)	9	48.2(18.3-79.4)
Household respondent recalled 1/3 key containment messages						
Yes	510	6.5(5.2-8.1)	346	67.8(60.9-74.0)	160	25.4(19.6-32.3)
No	30	7.2(4.0-12.4)	21	65.6(38.0-85.6)	11	40(15.4-70.9)

Annex 14: Choice of healthcare provider among fever cases seeking treatment in the previous two weeks

	Malaria clinic		MP/BMP		VBDO		Public hospital		Private clinic/hospital		Drug store	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Total	5	1.4 (0.4-5.7)	2	0.7 (0.2-2.8)	8	3.1 (0.9-9.5)	256	59.9 (48.8-70.1)	93	34.3 (23.7-46.9)	3	0.5 (0.1-2.2)
Domain												
Domain 1: Thai-Myanmar	3	3.5 (0.4-24.0)	0	0	0	0	46	80.3 (56.6-92.7)	7	16.2 (4.8-42.4)	0	0
Domain 2: Thai-Cambodia	0	0	0	0	1	0.8 (0.1-6.2)	38	61.2 (34.6-82.4)	14	35.2 (14.5-63.5)	2	2.9 (0.3-20.1)
Domain 3: Remaining areas	2	1.2 (0.2-7.1)	2	1.0 (0.2-3.7)	7	4.1 (1.2-12.7)	172	55.3 (42.1-67.7)	72	38.2 (24.8-53.7)	1	0.3 (0.0-1.9)
Risk area												
A1	3	4.8 (0.6-29)	1	2.2 (0.4-12.2)	2	4.4 (0.7-22.9)	48	76.9 (60.1-88)	7	9.1 (3.4-22.2)	2	2.7 (0.3-18.5)
A2	2	1.0 (0.1-6.5)	1	0.5 (0.1-3.3)	6	2.9 (0.7-10.8)	208	57.7 (45.7-68.8)	86	37.8 (26-51.2)	1	0.2 (0.0-1.6)
Household income												
<5000THB	5	5.9 (1.6-19.4)	0	0	91	78.9 (60.5-90.1)	2	3.6 (0.6-19.3)	10	11.6 (4.1-28.6)	0	0
>5000THB	0	0	2	0.9 (0.2-3.8)	165	53.9 (41.1-66.2)	6	2.9 (1.0-8.1)	83	41.6 (29.3-55.1)	3	0.7 (0.1-2.9)
Cluster with MP/BMP												
Yes	0	0	1	3.9 (0.8-17.0)	2	7.7 (1.5-31.4)	34	70.7 (51.1-84.8)	8	13.0 (3.8-36.0)	2	4.7 (0.6-30.0)
No	0	0	1	0.5 (0.1-3.1)	6	2.7 (0.7-10.3)	222	59.2 (47.5-69.9)	85	35.9 (24.7-48.9)	1	0.2 (0.0-1.5)

Annex 15: Answers provided by households respondents on the mode of malaria transmission

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Anopheles/jungle mosquitoes	984	45.8 (41.4-50.2)	232	41.3 (34.3-48.5)	249	61.7 (55.0-68.0)	503	41.9 (36.8-47.2)
Aedes mosquitoes	639	35.9 (30.8-41.3)	169	40.5 (28.4-53.7)	138	30.2 (25.4-35.4)	332	35.8 (30.3-41.7)
Unknown mosquitoes	398	17.4 (14.8-20.5)	143	20.4 (13.7-29.4)	36	7.5 (5.2-10.6)	219	19.8 (16.8-23.2)
Drink water in jungle	55	1.5 (1.0-2.5)	2	0.3 (0.0-1.4)	26	3.7 (1.5-8.6)	27	1.4 (0.8-2.5)
Stay overnight in forest	126	4.6 (3.1-6.9)	24	3.6 (1.7-7.8)	47	11.0 (6.7-17.4)	55	2.7 (1.5-4.9)
Work hard	3	0.2 (0.0-0.9)	0	0	1	<1.0 (0.0-0.4)	2	0.3 (0.1-1.7)
Live with malaria case	16	0.7 (0.3-1.5)	4	0.2 (0.1-1.0)	6	1.3 (0.5-3.1)	6	0.7 (0.2-2.7)
No cause	6	0.3 (0.1-1.0)	1	0.1 (0.0-0.6)	3	1.2 (0.3-4.2)	2	0.1 (0.0-0.4)
Poor hygiene/dirty food	7	0.3 (0.1-0.9)	1	0.6 (0.1-3.7)	2	0.3 (0.1-1.4)	4	0.2 (0.1-0.7)
Airborne/blood donation	4	0.2 (0.0-0.5)	0	0	0	0	4	0.3 (0.1-1.0)

Annex 16: Signs and symptoms of malaria named by household respondents

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Fever	1358	63.9 (60.2-67.4)	342	58.0 (53.9-62.1)	280	66.5(63.3-69.6)	736	66.0 (59.6-71.8)
Chill	1283	62.0 (58.1-65.8)	355	62.4 (54.3-69.8)	288	67.6(62.5-72.3)	640	59.7 (53.5-65.6)
Headache	1013	50.9 (47.0-54.7)	215	49.5 (38.8-60.3)	210	45.3(39.8-50.8)	588	53.8 (50.0-57.6)
Body ache	391	20.8 (18.2-23.7)	111	23.3 (20.1-26.8)	93	22.3(17.6-27.9)	187	19.0 (14.9-23.9)
Sweating	30	2.3 (1.3-4.0)	7	4.5 (2.4-8.3)	5	0.8(0.2-2.4)	18	1.7 (0.9-3.4)
Fatigue	135	6.8 (5.3-8.6)	38	6.3 (4.6-8.6)	29	6.3(4.5-8.7)	68	7.2 (4.9-10.4)
Nausea/Vomiting	347	18.5 (15.4-22.2)	104	20.9 (15.9-27.0)	81	23.5(19.6-27.9)	162	15.3 (11.2-20.6)
Eye problem	9	0.3 (0.1-1.6)	3	0.3 (0.1-1.4)	2	0.4(0.1-1.9)	4	0.2 (0.1-0.6)
Unconscious	30	1.2 (0.7-2.0)	10	1.8 (0.8-4.3)	5	0.9(0.3-2.7)	15	0.9 (0.5-1.9)
Respiratory illness	6	0.3 (0.1-0.8)	1	0.1 (0.0-0.5)	0	0	5	0.5 (0.2-1.4)
Gastrointestinal illness	22	0.8 (0.5-1.5)	5	0.9 (0.3-3.1)	4	0.3(0.1-1.3)	13	1.0 (0.5-1.9)
Bleeding disorder	29	1.4 (0.9-2.3)	11	1.8 (0.7-4.4)	4	1.5(0.5-4.1)	14	1.2 (0.6-2.4)

Annex 17: Methods for malaria prevention named by household respondents

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1,125)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	N	% (95%CI)
Sleep under net	1460	67.1 (63.3-70.7)	399	65.5 (61.0-69.8)	267	60.6 (50.7-69.7)	794	70.4 (65.4-75.0)
Sleep under ITN	245	8.8 (6.7-11.5)	64	9.4 (5.4-15.9)	90	17.7 (13.4-23.1)	91	5.0 (3.0-8.2)
Use mosquito coil	341	17.3 (15.1-19.7)	88	15.3 (12.4-18.8)	67	16.0 (12.3-20.6)	186	18.9 (15.6-22.6)
Use mosquito repellent	526	27.1 (23.0-31.6)	157	36.0 (27.3-45.6)	134	27.4 (21.7-34.0)	235	22.2 (19.6-25.2)
Use Insecticide spray	69	4.2 (3.3-5.4)	17	3.3 (2.1-5.2)	16	5.1 (3.4-7.6)	36	4.3 (3.0-6.3)
Make smoke	148	7.6 (5.7-10.0)	75	15.3 (10.2-22.3)	22	5.0 (3.4-7.4)	51	4.4 (3.3-6.0)
Herb (spray, burn, eat)	20	1.1 (0.6-2.0)	8	2.1 (1.1-4.2)	3	1.1 (0.3-3.8)	9	0.5 (0.2-1.3)
Wear covered clothes	151	6.5 (4.6-9.1)	45	9.9 (6.2-15.6)	39	6.2 (3.3-11.4)	67	4.8 (3.1-7.5)
Wear treated clothes	2	0.1 (0.0-0.5)	0	0	0	0	2	0.2 (0.0-1.0)
Joss stick repellent	21	1.5 (0.8-2.8)	4	0.9 (0.2-3.2)	9	4.2 (2.2-7.8)	8	0.8 (0.3-2.2)
Stay out of forest	23	0.9 (0.5-1.6)	2	0.2 (0.0-0.9)	8	1.0 (0.3-3.0)	13	1.2 (0.6-2.4)
Traditional medicine	3	0.1 (0.0-0.3)	1	0.1 (0.0-1.0)	2	0.2 (0-1.0)	0	0
Use fan/electric devices	47	2.3 (1.6-3.2)	10	2.1 (1.1-4.2)	7	1.4 (0.5-3.9)	30	2.7 (1.8-4.0)
Drink clean/boiled water	30	1.4 (0.8-2.6)	1	0.2 (0.0-1.5)	10	3.6 (1.9-6.8)	19	1.2 (0.5-2.8)
Guppy fish/kill larvae	11	1.0 (0.5-2.2)	2	1.7 (0.7-4.3)	2	0.3 (0.1-1.4)	7	0.9 (0.3-2.2)
Avoid mosquito bites (wire screen, tent, closed house)	14	0.5 (0.3-1.1)	6	1.1 (0.3-3.3)	2	0.3 (0.1-1.5)	6	0.4 (0.1-0.9)
Use abate sand	242	13.6 (10.5-17.4)	69	15.1 (8.6-26.2)	42	14.6 (7.6-25.9)	131	12.4 (10.2-15.0)
Empty water container	537	26.5 (23.5-29.8)	92	15.6 (11.4-20.9)	83	21.8 (16.6-28.1)	362	34.2 (30.4-38.3)
Keep environment clean	34	2.1 (1.1-3.9)	5	1.0 (0.3-3.1)	6	1.1 (0.4-2.9)	23	3.0 (1.4-6.3)

Annex 18: Knowledge on diagnosis and treatment for malaria among household respondents

	TOTAL (n = 2125)		Domain 1: Thai-Myanmar border (n = 575)		Domain 2: Thai-Cambodia border (n = 425)		Domain 3: Remaining provinces (n = 1125)	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
How to ensure malaria diagnosis								
Previous experience	34	1.5(0.8-2.6)	11	2.4(0.8-7.1)	18	2.8(1.1-6.7)	5	0.4(0.1-1.2)
Symptoms	688	35.7(31.8-39.7)	127	25.1(18-33.9)	173	42.9(28.2-47.8)	388	38.4(32.8-44.4)
Go to see doctor	306	13.3(9.9-17.8)	99	19.8(11.6-31.8)	45	10.8(6.9-16.6)	162	10.8(7.4-15.6)
Blood test	961	43.9(40.6-47.4)	291	46(37.5-54.7)	166	38.5(34.7-42.4)	504	45(40.4-49.6)
See doctor and blood test	3	0.1(0.0-0.2)	2	0.2(0.0-0.9)	1	0.1(0.0-0.6)	0	0
Don't know	71	3.5(2.6-4.7)	23	3.8(2.9-4.9)	13	2.7(1.5-4.9)	35	3.7(2.3-5.9)
Place for blood test								
Village Health Volunteer	24	1.6(0.7-3.6)	6	3.4(1.4-8.1)	4	0.6(0.1-2.1)	14	1.1(0.3-3.7)
Malaria clinic	386	18.3(13.4-24.5)	146	21.7(15.0-30.3)	137	38.1(28.1-49.2)	103	8.7(4.1-17.6)
MP/BMP	220	10.6(7.9-13.9)	45	13.6(8.0-22.0)	80	12(6.0-22.6)	95	8.4(6.1-11.5)
VBDU	193	14.7(10.4-20.3)	18	11.6(4.4-27.2)	7	1.6(0.7-4.0)	168	21.4(15.4-29.0)
BVBD	3	0.1(0.0-0.4)	0	0	3	0.4(0.1-2.1)	0	0
Public hospital	1200	50.2(43.1-57.2)	330	44.2(27.2-62.8)	179	41.9(33.6-50.8)	691	56.6(49.8-63.2)
Private clinic/hospital	31	2.4(1.4-4.1)	7	2.8(0.9-9.0)	4	3.0(1.3-6.9)	20	2.0(1.1-3.5)
Traditional doctor	2	0.0 (0.0-0.1)	0	0	0	0	2	0.1(0.0-0.4)
Religious leader	1	0.0(0.0-0.1)	1	0.0(0.0-0.4)	0	0	0	0
Don't know	3	0.1(0.0-0.4)	0	0	2	0.2(0.0-1.1)	1	0.0(0.0-0.2)
Consequence of incomplete antimalarial treatment								
Nothing	28	1.4(0.7-2.7)	8	1.2(0.4-3.3)	3	0.4(0.1-1.4)	17	2.0(0.9-4.3)
Recurrent illness	639	33.2(29.8-36.7)	150	27.7(22.2-33.0)	135	34.7(28.7-41.2)	354	35.5(30.7-40.5)
Severe illness or death	111	5.5(3.9-7.6)	36	9(6.1-13.1)	17	2.8(1.3-6.3)	58	4.6(3.2-6.7)
Cannot be cured	1283	57.9(53.2-62.5)	317	58.2(49.5-66.5)	301	61.2(50.1-71.2)	665	56.5(49.8-62.9)
Don't know	342	16.6(13.4-20.3)	97	13.9(7.3-24.9)	44	13.2(8.5-19.8)	201	19.3(15.9-23.3)
Others	4	0.1(0.0-0.2)	1	0.1(0.0-0.5)	0	0	3	0.1(0.0-0.4)

Annex 19: Exposure to malaria messaging/BCC and content of the messages heard as recalled by household respondents

	TOTAL (n = 2,125)		Domain 1 Thai-Myanmar border (n = 575)		Domain 2 Thai-Cambodia border (n = 425)		Domain 3 Remaining areas (n = 1125)	
	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)	N	%(95%CI)
Recalled hearing malaria message/BCC in previous 6 months	2018	96.3 (94.7-97.5)	534	95.2 (89.6-97.9)	412	96.8 (94.5-98.2)	1072	96.7 (94.7-97.5)
Content of message(s) heard								
Sleep under an ITN	1494	67.2(61.7-72.3)	410	71.1(66.3-75.5))	338	77.5(71.1-82.8)	746	61.1(52.1-69.4)
Use insecticide treated hammock when staying overnight outside the households	903	41.5(35.7-47.4)	243	51.3(40.2-62.4)	214	41.8 (33.2-50.8)	446	36.1(30.8-41.8)
If you suspect someone has malaria, go for blood testing	1927	92.5(89.9-94.5)	498	91(82.0-95.7)	393	89.9(83.6-94.0)	1036	94.3(92.2-95.9)
When infected with malaria, antimalarial treatment must be completed	1863	90.4(86.9-93.1)	484	88.2 (76.3-94.6)	388	90.2(81.3-95.1)	991	91.7(88.4-94.2)
Go to receive blood test during follow-up appointments	1878	90.3(87.3-92.6)	489	90.0(80.4-95.2)	388	87.6(83.4-90.8)	1001	91.5(88.2-93.9)
Allow staff to do IRS	1276	69(63.8-73.8)	398	76(67.9-82.7)	206	55.8(45.8-65.4)	672	70.5(63.2-76.9)
Wash ITNs with soap	574	27.2(24.1-30.6)	155	27.6(24.5-30.9)	113	22.4(17.4-28.3)	306	29(24.0-34.5)
Information about re-dipping of nets/LLIN distribution	5	0.3(0.1-0.9)	2	0.6(0.1-3.4)	2	0.2(0.1-1.1)	1	0.1(0.1-0.5)
Prevention methods to avoid mosquitoes/medicine for prophylaxis	14	0.7(0.3-1.5)	4	0.5(0.2-1.8)	4	0.6(0.1-2.5)	6	0.9(0.3-2.3)
Remove stagnant water/keep environment clean	4	0.3(0.1-1.0)	2	0.7(0.2-3.3)	0	0	2	0.2(0.1-1.0)
Do not know/ cannot remember content of message	28	0.8(0.5-1.5)	9	0.8(0.3-2.3)	4	1(0.3-2.7)	15	0.8(0.4-1.8)

Annex 20: Source of malaria BCC messages among those that heard a BCC message in the previous six months (n = 2,018)

	TOTAL (n = 2,018)		Domain 1 Thai-Myanmar border (n = 534)		Domain 2 Thai-Cambodia border (n = 412)		Domain 3 Remaining areas (n = 1,072)	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Source of message (grouped by type)								
Interpersonal	1429	68.9 (65.2-72.4)	394	72.6 (64.9-79.2)	301	70.1 (62.9-76.3)	734	66.5 (61.1-71.5)
Local media	45	1.7 (1.1-2.6)	4	0.5 (0.1-1.7)	14	1.7 (0.6-4.4)	27	2.2 (1.4-3.5)
Mass media	282	15.0 (12.2-18.4)	72	15.0 (11.5-19.5)	42	9.3 (4.4-18.6)	168	17.3 (13.3-22.1)
Don't know	166	8.1 (6.4-10.3)	15	5.0 (3.1-7.9)	26	9.5 (6.8-13.1)	92	8.3 (5.9-11.5)
Source of message (in detail)								
MP/BMP	161	6.4 (4.3-9.2)	51	9.8 (4.9-18.5)	33	4.1 (1.7-9.8)	77	5.4 (3.3-8.8)
VMW/VHV/migrant health volunteer	678	34.8 (30.7-39.1)	126	32.3 (22.6-43.8)	138	29.6 (21.2-39.6)	414	38.1 (33.7-42.8)
Malaria clinic	153	7.1 (5.5-9.1)	61	10.2 (7.7-13.6)	64	15.7 (12.7-19.3)	28	2.1 (1.1-3.9)
VBDU staff	163	10.4 (7.8-13.9)	32	8.3 (5.5-12.2)	45	15.8 (8.7-26.8)	86	9.5 (6.4-13.9)
Public health centre/hospital	632	32.9 (29.1-36.9)	199	42.3 (35.9-49.4)	86	25.1 (20.1-30.8)	347	31.0 (27.6-34.7)
Teacher/school	29	1.3 (0.7-2.6)	16	2.1 (0.7-6.2)	2	1.0 (0.2-4.0)	11	1.0 (0.4-2.9)
Monk/priest/Iman	4	0.1 (0.0-0.5)	0	0	1	0.1 (0.0-0.6)	3	0.3 (0.1-0.9)
Family/friends/neighbour	611	24.3 (20.1-29.1)	199	24.9 (13.3-41.8)	108	21.7 (17.1-27.1)	304	25.1 (21.5-29.0)
Leaflets/brochure/poster	166	8.1 (6.4-10.2)	48	6.8 (4.1-11.2)	26	9.5 (6.8-13.0)	92	8.2 (5.9-11.4)
TV/radio	275	14.7 (11.9-18.1)	70	14.8 (11.2-19.3)	42	9.3 (4.4-18.6)	163	16.8 (12.8-21.7)
Community organisation	52	1.9 (1.3-2.9)	4	0.5 (0.1-1.6)	18	2.2 (0.8-5.7)	30	2.6 (1.7-3.8)
Other	12	0.3 (0.2-0.7)	2	0.2 (0.0-0.7)	3	0.4 (0.1-2.0)	7	0.4 (0.2-1.0)
Don't know	93	6.2 (4.8-7.9)	15	4.9 (3.0-7.9)	28	9.4 (6.3-13.9)	50	5.6 (3.9-8.0)

Annex 21: Practices of Forest-goers (all forest-goers).

Forest-goers	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Total	1212	18.2 (15.3-21.6)	160	13.0 (7.4-21.9)	265	15.3 (10.7-21.4)	787	22.0 (17.7-27.1)
Sex								
Male	770	61.0 (56.7-65.1)	120	73.8 (69.3-77.9)	169	55.9 (42.4-68.5)	481	58.3 (55.0-61.6)
Female	442	39.0 (34.9-43.3)	40	26.2 (22.1-30.7)	96	44.1 (31.5-57.6)	306	41.7 (38.4-45.0)
Occupation								
Child	50	2.0 (1.1-3.6)	11	1.8 (0.4-7.6)	17	3.1 (1.0-9.3)	22	1.9 (0.9-3.9)
Military	3	0.3 (0.0-1.5)	2	0.1 (0.0-1.2)	1	1.4 (0.2-9.6)	0	0
Civil servant	6	0.2 (0.1-0.6)	1	0.1 (0.0-1.5)	0	0	5	0.3 (0.1-0.9)
Merchant	7	0.5 (0.2-1.2)	0	0	3	0.5 (0.1-3.3)	4	0.6 (0.2-1.7)
Wage labourer	147	9.3 (6.5-13.1)	16	4.7 (3.0-7.4)	50	17.2 (12.0-24.0)	81	8.7 (5.3-13.9)
Farmer/gardener	235	11.9 (7.0-19.7)	74	23.4 (5.3-62.8)	91	29.5 (11.3-57.8)	70	4.1 (2.0-8.3)
Rubber farmer	713	73.0 (64.2-80.3)	42	65.9 (30.3-89.6)	93	46.2 (23.5-70.6)	578	81.8 (74.8-87.2)
Housewife	3	0.2 (0.1-0.7)	0	0	1	0.1 (0.0-1.1)	2	0.3 (0.1-1.1)
Jobless/elderly	16	0.8 (0.4-1.9)	3	0.3 (0.0-2.3)	5	0.9 (0.3-2.7)	8	1.0 (0.4-2.6)
Others	32	1.7 (1.0-3.1)	11	3.7 (2.3-5.8)	4	1.0 (0.3-3.2)	17	1.3 (0.5-3.2)
Education								
Never attended school	98	5.4 (2.9-9.7)	47	11.2 (2.4-39.5)	15	4.9 (3.0-7.9)	36	3.7 (1.6-8.4)
Primary	681	51.4 (44.0-58.6)	57	32.5 (20.7-47.1)	157	60.4 (48.7-71.0)	447	54.9 (49.2-60.5)
Secondary	437	40.9 (33.6-48.5)	51	49.9 (29.6-70.3)	91	34.3 (23.7-46.6)	295	39.7 (33.7-46.1)
Other	10	1.6 (0.5-4.5)	4	5.2 (2.4-11.0)	0	0	6	0.9 (0.2-3.3)
Don't know	6	0.8 (0.3-2.4)	1	1.1 (0.1-8.4)	2	0.5 (0.1-2.3)	3	0.8 (0.2-3.6)
Purpose for going forest								
Picking forest product/hunting	151	5.3 (3.3-8.6)	22	4.8 (1.1-18.6)	66	15.2 (6.8-30.4)	63	3.1 (1.5-6.4)
Gardening/farming	160	9.2 (5.8-14.4)	78	26.9 (9.3-57.1)	32	9.9 (4.0-22.4)	50	3.6 (2.0-6.4)
Rubber/planting	962	87.5 (80.9-92.1)	56	73.5 (37.8-92.7)	180	76.4 (53.7-90.0)	690	94.6 (90.3-97.0)
Visit relatives at border	11	0.4 (0.1-1.0)	3	0.8 (0.1-6.7)	6	0.9 (0.2-3.6)	2	0.1 (0.0-0.6)
Soldier/ranger	15	0.7 (0.3-1.6)	5	0.8(0.1-4.7)	6	2.7 (0.9-8.2)	4	0.2 (0.1-0.6)
House located in forest	7	0.1 (0.0-0.3)	6	0.1(0.0-1.5)	0	0	1	0.1 (0.0-0.4)
Others	6	0.4 (0.1-1.3)	1	1.1 (0.1-8.4)	3	0.8 (0.2-4.0)	2	0.1 (0.0-0.4)

Forest-goers	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Frequency of stay in the forest								
Daily	665	63.9 (55.9-71.1)	59	62.8 (34.2-84.6)	82	35.0 (25.6-45.6)	524	71.3 (64.1-77.6)
Weekly	424	29.5 (24.5-35.1)	54	24.7 (15.4-37.0)	145	47.3 (35.6-59.3)	225	26.6 (20.9-33.2)
Once Monthly or less	120	6.5 (3.7-11.1)	47	12.5 (2.8-41.5)	37	17.5 (11.8-25.1)	36	1.9 (0.9-3.9)
Don't know	3	0.1 (0.0-0.4)	0	0	1	0.3 (0.0-2.1)	2	0.1 (0.0-0.5)
Last time in forest								
Last night	660	54.9 (44.6-64.9)	86	62.5 (51.0-72.7)	157	57.2 (44.2-69.3)	417	52.0 (37.7-66)
Less than a week	422	32.6 (24.7-41.7)	37	17.2 (10.5-26.9)	83	29.6 (20.9-40.1)	302	38.1 (28.1-49.2)
More than a week	125	12.1 (7.9-18.0)	35	20.1 (15.0-26.4)	22	11.0 (7.0-17.0)	68	9.9 (4.6-20.0)
Don't know	5	0.4 (0.1-1.5)	2	0.2 (0.0-1.8)	3	2.2 (0.8-6.0)	0	0
Duration of last stay in the forest								
Not stay overnight	68	2.7 (1.4-5.2)	5	0.7 (0.1-4.0)	43	12.8 (5.1-28.7)	20	0.8 (0.3-1.9)
One night	947	86.7 (81.1-90.8)	88	75.1 (51.6-89.5)	146	67.0 (44.8-83.6)	713	95.1 (90.9-97.4)
More than one night	159	8.6 (5.3-13.6)	66	24.1 (10.2-47.1)	50	11.2 (4.5-25.2)	43	3.2 (1.5-6.5)
Don't know	38	2.0 (1.2-3.5)	1	0.1 (0.0-0.6)	26	8.9 (4.6-16.8)	11	0.9 (0.4-2.2)
Net usage last time stayed in forest								
Yes	220	10.7 (6.7-16.7)	65	22.6 (7.5-51.2)	75	15.9 (6.1-35.6)	80	5.8 (3.0-11.0)
No	991	89.2 (83.2-93.3)	94	77.2 (48.4-92.4)	190	84.1 (64.4-93.9)	707	94.2 (89.0-97.0)
Don't know	1	<1.0 (0.0-0.4)	1	0.2 (0.0-2.5)	0	0	0	0
Type of net used (n = 240)								
Untreated net	71	27.5 (18.0-39.5)	15	14.4 (7.5-25.0)	20	26.7 (14.4-44.0)	36	43.9 (26.2-63.3)
ITN	115	55.7 (44.1-66.8)	39	64.6 (43.4-81.3)	40	51.9 (40.7-63.0)	36	47.7 (29.9-66.2)
Untreated hammock	10	3.4 (1.4-7.9)	0	0	5	6.6 (2.0-20.1)	5	5.3 (1.5-17.3)
ITN-hammock	12	4.6 (2.4-8.7)	1	2.0 (0.5-7.5)	8	11.6 (5.8-21.9)	3	3.1 (0.8-10.9)
Don't know	12	8.8 (3.9-18.6)	10	19.3 (8.6-37.8)	2	3.2 (1.0-9.5)	0	0
Reason of not using net (n = 991)								
Did not like	30	3.1 (1.6-6.3)	6	6.4 (3.2-12.5)	4	0.8 (0.2-4.1)	20	2.8 (1.0-7.8)
Forgot to take	5	0.2 (0.0-0.5)	3	0.3 (0.0-3.8)	1	0.3 (0.0-2.6)	1	0.1 (0.0-0.6)
Working all night	842	86.3 (78.9-91.4)	49	82.8 (54.8-95.0)	152	66.6 (46.6-82.0)	641	91.6 (86.6-94.9)
Not feel at risk of malaria	9	0.6 (0.2-1.7)	1	0.5 (0.0-5.6)	0	0	8	0.8 (0.2-2.4)

Forest-goers	TOTAL		Domain 1 Thai-Myanmar border		Domain 2 Thai-Cambodia border		Domain 3 Remaining areas	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
Nowhere to hang net/many things to carry	20	1.4 (0.5-3.7)	9	2.8 (0.4-17.3)	3	4.3 (1.2-13.6)	8	0.4 (0.1-1.4)
No money to buy	1	0.2 (0.0-1.7)	1	1.4 (0.2-11.5)	0	0	0	0
No mosquito	2	0.1 (0.0-0.5)	1	0.2 (0.0-2.7)	0	0	1	0.1 (0.0-0.9)
No net	40	3.4 (1.6-7.1)	7	1.9 (0.3-12.1)	4	1.1 (0.2-4.8)	29	4.3 (1.9-9.4)
Stay in short time	25	1.6 (0.6-4.5)	6	1.0 (0.2-6.2)	11	7.8 (1.8-28.1)	8	0.4 (0.1-1.1)
Others	2	0.1 (0.0-0.6)	0	0	2	0.5 (0.1-4.6)	0	0
Don't know	5	1.2 (0.2-7.5)	0	0	5	8.2 (2.1-26.5)	0	0
Preventive action								
No action	50	3.4 (1.9-6.0)	6	0.8 (0.1-5.1)	4	1.0 (0.5-4.8)	40	4.8 (2.7-8.4)
Mosquito coil	267	21.2 (13.6-31.4)	12	3.8 (0.8-15.7)	83	27.7 (21.1-35.5)	172	24.9 (15.3-37.5)
Mosquito repellent	674	59.6 (50.2-68.3)	86	76.6 (53.2-90.4)	169	65.8 (57.4-73.3)	419	52.9 (44.8-60.7)
Wear clothes that provide full body coverage	180	10.8 (7.8-14.9)	68	23.1 (11.5-41.1)	43	9.1 (3.5-21.6)	69	7.5 (4.6-11.8)
Others	4	0.3 (0.1-1.3)	1	1.1 (0.1-8.4)	1	0.2 (0.0-1.5)	2	0.1 (0.0-0.4)
Don't know	9	0.4 (0.1-1.0)	3	0.9 (0.1-7.5)	3	0.7 (0.2-2.6)	3.0	0.1 (0.0-0.4)
Fever in the last two weeks								
Yes	72	5.8 (3.8-8.8)	11	3.3 (0.9-11.7)	7	3.3 (1.2-9.0)	54	7.2 (4.8-10.8)
No	1140	94.2 (91.2-96.2)	149	96.7 (88.3-99.1)	258	96.7 (91.0-98.8)	733	92.8 (89.2-95.2)
Seek for treatment								
Yes	38	52.2 (35.0-68.9)	5	43.0 (9.4-84.6)	1	3.9 (0.3-33.7)	32	58.9 (37.7-77.3)
No	34	47.8 (31.1-65.0)	6	57.0 (15.4-90.6)	6	96.1 (66.3-99.7)	22	41.1 (22.7-62.3)
Seek treatment in 24 hours								
Yes	11	11.3 (5.2-22.9)	3	39.7 (7.8-83.6)	0	0	8	8.7 (3.6-19.2)
No	61	88.7 (77.1-94.8)	8	60.3 (16.4-92.2)	7	100	46	91.3 (80.8-94.6)

Annex 22: Practices of forest-goers disaggregated by rubber tappers and non-rubber tappers (based on occupation).

	Forest-goers			
	Rubber tapper		Non-rubber tapper	
	n	% (95% CI)	N	% (95% CI)
% of total study population	707	13.3 (10.3-17.1)	505	5.0 (3.9-6.3)
% of total forest-goer population	707	72.9 (64.1-80.2)	505	27.1 (19.8-35.9)
Sex				
Male	410	58.9 (54.8-62.8)	360	66.6 (59.4-73.1)
Female	297	41.1 (37.2-45.2)	145	33.4 (26.9-40.6)
Reasons of last trip to forest				
Foraging/hunting	5	0.3 (0.1-0.8)	146	18.9 (13.8-25.3)
Gardening/farming	12	1.4 (0.6-2.9)	148	30.3 (20.2-42.6)
Rubber planting	701	99.3 (97.9-99.7)	225	56.0 (45.2-66.2)
Visiting relative in Myanmar/Cambodia border	0	0	11	1.4 (0.6-3.6)
Soldier/ranger	0	0	15	2.6 (1.3-5.3)
House located in forest	0	0	7	0.2 (0.1-1.0)
Other	3	0.4 (0.1-1.9)	3	0.4 (0.1-2.0)
Frequency of staying in the forest				
Daily	485	71.7 (63.7-78.5)	180	42.8 (31.9-54.4)
Weekly	210	25.9 (20.6-32.0)	214	39.2 (31.4-47.7)
Monthly or more	12	2.4 (0.7-8.0)	108	17.5 (11.1-26.5)
Don't know	0	0	3	0.4 (0.1-1.4)
Last time stayed in forest				
Last night	414	57.5 (45.1-69.1)	246	47.8 (38.3-57.6)
Less than a week	245	30.7 (21.0-42.5)	177	37.7 (28.6-47.8)
More than a week	47	11.7 (6.3-20.6)	78	13.2 (8.9-19.1)
Don't know	1	0.1 (0.0-0.5)	4	1.3 (0.3-5.7)
Duration of last stay in the forest				
Not stay overnight	8	0.4 (0.1-1.3)	60	8.9 (5.1-15.0)
One night	663	94.7 (90.4-97.1)	284	65.1 (54.3-74.6)
More than one night	26	3.9 (1.7-8.7)	133	21.2 (12.1-34.3)
Don't know	10	1.0 (0.3-2.9)	28	4.8 (2.6-8.5)
Used net last time in the forest				
Yes	40	4.0 (2.3-6.8)	180	28.8 (17.7-43.2)
No	667	96.0 (93.2-97.7)	324	71.0 (56.7-82.1)
Type of net used				
Untreated net	8	0.8 (0.2-3.1)	63	8.6 (5.0-14.3)
ITN	27	2.9 (1.3-6.0)	88	14.3 (8.3-23.6)
Untreated hammock	2	0.1 (0.0-0.8)	8	1.1 (0.4-2.5)
ITN hammock	3	0.2 (0.1-0.6)	3	0.2 (0.1-0.6)
Don't know	0	0	12	3.5 (1.4-8.4)
Reason of not using a net				
Did not like to use net	12	2.6 (0.9-7.2)	18	5.0 (1.9-12.5)
Forgot to take	1	0.1 (0.0-0.5)	4	0.5 (0.1-2.0)
Working all night	621	90.5 (81.4-95.4)	221	71.1 (59.5-80.5)
Not feel at risk of malaria	4	0.4 (0.1-2.3)	5	1.3 (0.5-3.3)
Nowhere to hang/many things to carry	3	0.5 (0.1-2.3)	17	4.7 (2.0-10.7)
No money to buy	0	0	1	1.1 (0.2-7.7)

	Forest-goers			
	Rubber tapper		Non-rubber tapper	
	n	% (95% CI)	N	% (95% CI)
No mosquito	1	0.1 (0.0-0.8)	1	0.2 (0.0-1.3)
No net	16	2.1 (0.8-5.8)	24	8.2 (3.0-20.4)
Stay in short time	0	0	25	7.4 (3.0-17.3)
Other	1	0.1 (0.0-0.4)	1	0.2 (0.0-1.4)
Don't know	4	1.5 (0.2-9.8)	1	0.2 (0.0-1.4)
Other preventive action used last time in the forest				
No action	34	3.8 (2.0-7.1)	16	2.4 (1.2-4.8)
Use mosquito coil	146	20.7 (12.2-32.8)	121	22.5 (15.9-30.8)
Use mosquito repellent	405	59.8 (48.3-70.3)	269	59.1 (51.3-66.5)
Wear clothes that provide full body coverage	41	7.2 (4.4-11.3)	139	20.7 (13.5-30.2)
Others	0	0	4	1.1 (0.3-4.7)
Don't know	2	0.1 (0.0-0.3)	7	1.2 (0.4-3.5)

Annex 23: Comparison of key indicators across the three survey rounds (TMS 2012, KAP 2015 and endline 2016)

SUMMARY INDICATORS	TMS (2012)		KAP (2015)		Endline (2016)	
	% (n)	95% CI	% (n)	95% CI	% (n)	95% CI
Malaria prevention in the household						
Proportion of households with any net	90.2 (2976)	87.9-92.1	90.1(1509)	86.7-92.7	90.8(1964)	87.3-93.5
Proportion of households with any ITN/LLIN	46.5 (1533)	40.7-52.3	51(8880)	44.5-57.5	52.3(1298)	44.7-59.9
Proportion of households with any LLIN	39.4 (1299)	33.6-45.5	43.1(748)	37.2-49.3	46.7(1152)	39.9-53.6
Proportion of households in target area with sufficient nets (any net)	79.1 (2610)	76.0-81.8	61.7(1008)	57.5-65.7	81.5(1771)	77.0-85.3
Proportion of households in target area with sufficient ITNs/LLINs	28.6 (944)	24.5-33.0	22.8(405)	19.5-26.3	40.3(940)	34.4-46.6
Proportion of households in target area with sufficient LLINs	20.9 (691)	17.5-24.8	16.8(298)	14.2-19.7	32.3(769)	27.3-37.8
Proportion of households with IRS in the past 12 months	38.7 (1278)	32.1-45.8	37.2(545)	29.7-45.3	23.6(464)	17.5-31.6
Proportion of households with sufficient ITNs/LLINs and or IRS in the past 12 months	54.6 (1801)	48.7-60.3	51.2(813)	44.8-57.6	53.1(1202)	46.0-60.2
Malaria prevention – net use among individuals the previous night						
Proportion of individual sleeping under any net	79.1 (8568)	75.7-82.1	85.1(5039)	81.5-88.2	68.7(5983)	64.6-72.6
Proportion of individual sleeping under any ITN/LLIN	28.6 (3094)	24.0-33.6	38.5(2351)	33.7-43.4	24.9(2431)	19.6-31.2
Proportion of individual sleeping under any LLIN	18.7 (2031)	15.3-22.7	30.4(1843)	26.3-34.9	15.1(1473)	11.9-19.1
Malaria knowledge and awareness						
Has ever heard of malaria	84.4 (2786)	80.8-87.5	96.4 (1572)	94.8-97.5	96.3(2018)	94.7-97.5
Knows how malaria is transmitted	41.1 (1356)	35.7-46.7	91.6 (1442)	88.9-93.7	44.9(984)	40.6-49.2
Knows 1/3 key containment messages	24.7 (815)	19.9-30.2	62.8 (327)	54.6-70.3	95.4(2003)	93.4-96.8
Management of fever and malaria						
Prevalence of reported fever in previous two weeks	4.2 (457)	3.5-5.0	7.0 (439)	5.8-8.5	540(6.5)	5.2-8.1
Sought advice or treatment if had recent fever within 24hours	19.8(70)	15.0-25.6	87(24.8)	17.5-33.9	171(26.1)	20.3-32.9
Sought advice or treatment if had recent fever within 48 hours	42.4(150)	35.8-49.2	53.7(171)	43.2-63.6	43.8(263)	35.7-52.3
Received a malaria test if sought treatment	15.8(56)	11.7-21.1	24.8 (74)	17.3-34.2	18.8(63)	11.3-29.6