

Community Engagement for Targeted Malaria Elimination in Lao PDR (Laos)

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Abstract

The emergence of artemisinin-resistant malaria in Southeast Asia has prompted malaria control programs to expedite efforts to eliminate malaria. One suggested approach is the mass administration of antimalarials (MDA) to entire target population regardless of malaria infection. MDA is one of the central components of Targeted Malaria Elimination (TME), an approach recently piloted in Laos. For MDA to be successful (leading to interruption of local malaria transmission), a high population coverage is critical. Among myriad factors, community engagement has been recognized as critical to promoting high coverage. The main aim of this study was to design, execute and assess a locally suitable community engagement strategy that can promote the uptake of and adherence to MDA. This study utilized a longitudinal mixed method approach. In addition to the local social and cultural factors, five main elements of community engagement that contributed to high population coverage were identified: 1. Stakeholder and authority engagement: a stepwise approach from central to the local level; 2. Local human resources: recruitment and training of local community members to execute TME; 3. Formative research: an exploration of the local social and cultural context to guide the community engagement; 4. Responsiveness: flexible and adaptable approach based on the demands and needs of the community and 5. Sharing control/leadership with the community: joint decision making with the community members. Various factors contributed to the high population coverage recorded in the Lao TME study (above 85%): community engagement to promote the concept of asymptomatic malaria and the rationale for MDA, baseline understanding of malaria as a health concern, perceptions that TME was worthwhile, provision of free primary health care, partnering of the research with local volunteers and

authorities, building social relationship with community members and the cohesive nature of the communities that boosted the trust and participation in MDA.

The Precis provides a brief background and rationale for the thesis

Chapter 1 outlines the overall concept of community engagement in health related research including how community engagement was an integral component of the targeted malaria elimination (TME) study in Laos. TME entailed a multi-pronged approach including mass drug administration (MDA), consisting of dihydroartemesinin piperaquine and a single low dose primaquine for 3 days for 3 consecutive months, and a quarterly blood survey for a year in the targeted population regardless of the malaria infection. The concept of asymptomatic malaria infection in apparently healthy populations and the rationale of MDA made TME a complex biomedical research and the accompanying community engagement. TME was conducted across four nations in the Greater Mekong Sub-region (GMS), namely Myanmar (two study sites), Cambodia, Vietnam and Laos, and was accompanied by community engagement to promote population coverage and adherence to MDA. In the wider literature, community engagement has been an evolving concept over the years and is now regarded to be an essential component of ethical health research. Nevertheless, there are divergent concepts and goals ascribed to community engagement in biomedical research, which pose challenges related to its evaluation.

Chapter 2 describes a systematic review on community engagement within mass antimalarial administration (MDA) conducted over the last century (published between 1913 and 2015) with additional update on literatures so far. This review builds on a previous review on mass

drug administration and delves deeper into the population coverage, community engagement activities and the relationship between them. Fifty one papers, which described MDA in 26 countries, were included. Studies were conducted in diverse healthcare and social contexts using various antimalarial regimens using a range of study designs. Twenty-eight articles reported only population coverage; 12 described only community engagement activities; and 11 community engagement and population coverage. Average population coverage was 83% but methods of calculating coverage were frequently unclear or inconsistent. Community engagement activities included providing health education and incentives, using community structures (e.g. existing hierarchies or health infrastructure), mobilizing human resources, and collaborating with government at some level (e.g. ministries of health). Community engagement was often a process involving various activities throughout the duration of the intervention.

Chapter 3 describes formative research conducted in four villages (that were selected as TME sites in Laos based on high malaria prevalence) before TME was initiated. This research involved a mixed methods approach which looked at the community members' health seeking behaviour, health concerns, and their baseline understanding of malaria (including asymptomatic malaria infections) and mass drug administration. Respondents reported that health care was sought at both local traditional practitioners and the health centres, and depended upon the severity of illness and recognition of the illness. One major determinant of health seeking at health centres and the hospital was the availability of money, coupled with the distance to the health centre/hospital, road conditions, and the availability of transport and gasoline for the vehicle (primarily motorbike).

Formative research further explored the knowledge, attitude and perceptions related to malaria, asymptomatic malaria infections and MDA. The concepts of asymptomatic malaria infection and MDA as a tool to eliminate malaria were relatively unknown to villagers. Malaria was considered as a major health concern and villagers generally could tell the signs and symptoms of malaria. Malaria transmission was often linked to the nature of their work in the forest ('mosquito bite at forest') and unhygienic conditions in the village. Villagers were motivated to take antimalarials while asymptomatic and those who showed intention to take part as a volunteer in MDA were more likely to perceive the possibility of asymptomatic malaria infections. Incorporating the local knowledge and perceptions about malaria can help in designing locally suitable malaria control programme. Current and future malaria control/elimination programmes could benefit from greater collaboration with the locally accessible/available sources of treatment, such as health volunteers and traditional healers. Collaboration can become effective by building the capacity of these local health care providers so that they can ultimately sustain the malaria control efforts.

Chapter 4 describes the essential elements of community engagement drawn from the experience of designing and implementing community engagement in Laos. Five key elements were identified that included: 1. Stakeholder and authority engagement, which proceeded from national level, to regional/district and local level; 2. Local human resources, particularly the recruitment of local volunteers who were integral to the design and implementation of activities in the study villages; 3. Formative research, to rapidly gain insight into the local social and economic context; 4. Responsiveness, whereby the approach was adapted according to the needs of the community and their responses to the various study components and 5. Sharing control/leadership with the community in terms of decisions on the organization of TME

activities. The community engagement that accompanied TME in Laos had to deal with challenges of implementing a complex study in remote and linguistically isolated villages. Despite these challenges, the study had high levels of community participation. Lessons learnt from this experience will be useful for planning future studies and intervention programmes in diverse social and cultural contexts.

Chapter 5 describes the various factors that led to high participation in the Laos TME study. A mixed methods approach was used to explore these factors. A quantitative survey showed that participation in TME was associated with attendance at community engagement activities, knowledge that blood tests were for malaria diagnosis, family members' participation in the TME study and perceptions that TME was worthwhile. Consistent with the quantitative findings, qualitative methods further delved into the contextual factors and mechanisms involved in promoting population coverage. Community engagement activities to promote the concept and rationale of MDA for asymptomatic malaria, baseline understanding of malaria as a health concern, provision of free primary health care, partnering of the research with local volunteers and authorities, building social relationship with community members and the cohesive nature of the communities boosted the trust and participation in MDA.

Chapter 6 explores the rationale and principles underpinning the community engagement in wider health related research. This chapter looks at the broader aims of community engagement, the ethical values and the instrumental values of community engagement. Drawing from the experience of conducting health-related research and the literature pertaining to it, community engagement is essential for research in low-income settings for the following seven reasons: 1) respecting communities; 2. building trust and social relationships; 3. maximizing benefits, minimizing risks and exploitation; 4. supporting the individual consent

process; 5. understanding vulnerabilities; 6. facilitating legitimacy and 7. achieving recruitment targets.

Chapter 7 describes an overview of all the chapters with the objective of summarizing the findings by each chapter. Community engagement strategies that accompanied TME in Laos are applicable for future malaria control programmes in the GMS and beyond. Principles and elements identified in this study are broadly generic and are applicable to a wide spectrum of health related research. Community engagement that was embedded in a complex biomedical research programme (TME) in a remote setting in Laos also engendered intrinsic properties, such as generating ownership by the community members, building local capacities and bringing more sustainable changes such as through increasing health literacy, improving water and sanitation and the overall level of hygiene in the villages. Community engagement had common elements across the TME sites in the GMS that includes collaboration with authorities and community members that in turn engenders social relationships, trust and ultimately sustenance of the desired goal. For future MDA roll out and implementation programmes, lessons from the current study include the importance of collaborating with community members such that training local staff, building local capacity and handing over responsibility may be executed without additional resources, leading to sustainable control and elimination of diseases such as malaria.

This thesis is based on my own independent work, except where acknowledged.

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List of publications resulting from this work

1. Adhikari B, James N, Newby G, von Seidlein L, White NJ, Day NP, Dondorp AM, Pell C, Cheah PY: Community engagement and population coverage in mass anti-malarial administrations: a systematic literature review. *Malar J* 2016, 15:523.

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6. Adhikari B, Phommasone K, Pongvongsa T, Soundala X, Koummarasy P, Henriques G, et al. Perceptions of asymptomatic malaria infection and their implications for malaria control and elimination in Laos. *PLoS One* 2018, 13:e0208912.

7. Adhikari B, Phommasone K, Pongvongsa T, Koummarasy P, Soundala X, Henriques G, et al. A mixed method study of treatment-seeking behaviour for febrile illnesses and its implications for malaria control and elimination in Savannakhet Province, Lao PDR (Laos). 2018 (Manuscript submitted to Journal).

8. Adhikari B, Pell C, Cheah PY. Why community engagement is essential for ethical health-related research in low-income settings 2018 (Manuscript submitted to journal).

Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
AOR	Adjusted Odds Ratio
CAB	Community Advisory Board
CDC	Centre for Disease Control, USA
CE	Community Engagement
CI	Confidence Interval
DDT	Dichlorodiphenyltrichloroethane
DHA	Dihydroartemesinin
DOT	Directly Observed Treatment
FGD	Focus Group Discussion
GMS	Greater Mekong Sub-region
IDI	In Depth Interview
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
LLIN	Long Lasting Insecticide Treated Bed nets
LMIC	Low and Middle Income Country

LOMWRU	Lao-Oxford-Mahosot Hospital-Wellcome Trust Research Unit
MDA	Mass Drug Administration
MORU	Mahidol Oxford Tropical Medicine Research Unit
PHC	Primary Health Centre
PMM	Phoun Mak Mee (village)
SSI	Semi-structured Interview
OTP	Oi Tan Tip (village)
qPCR	quantitative Polymerase Chain Reaction
RCT	Randomized Controlled Trial
RDT	Rapid Diagnostic Test
SPSS	Statistical Package for the Social Sciences
TME	Targeted Malaria Elimination
TT	Tha Thay (village)
UNICEF	United Nations Children's Fund
VMW	Village Malaria Worker
VHV	Village Health Volunteers
WHO	World Health Organization
XT	Xuang Tai (village)

CHAPTER I

Introduction

1.1 Background and Rationale

This thesis describes the design, implementation and impact of community engagement for a community-wide health intervention study, targeted malaria elimination (TME) in Laos. Drawing on mixed-methods research that accompanied the TME study, the thesis also outlines how, in terms of impact on participation in the study, community engagement was entangled with the local social context. Building on the lessons learnt from this, the thesis also discusses the broader value of community engagement for ethical health-related research, and the complexities of evaluating community engagement.

Defining community engagement

Community engagement remains a nebulous term with varied uses across the domains of health promotion, health-related research and policy-making [1]. The US Centres for Disease Control (CDC) defines community engagement as a process of collaborative work with groups of people affiliated by geographic proximity, interest or situations to address issues affecting the well-being of those people [2]. In practice, alongside health-related research, community engagement connotes a wide variety of activities, such as conducting meetings with community members, and community advisory boards, involving members of the community in designing and implementing research activities [1, 3], and innovative approaches such as participatory community drama [4, 5].

Drawing from the literature, an operational definition of community engagement relevant to this study is a process of working collaboratively with the relevant partners which includes all

stakeholders and community residents by sharing responsibility and power in achieving common goals [1-3, 6, 7].

A brief history of community engagement

This diversity stems from developments over the last 50 years in how scientists have sought to increase the involvement of communities in health-related research, and their reasons for doing so.

In the 1970s and 1980s, the involvement of target communities in health-related research was minimal. There were also clear disparities between researchers and participants regarding their comprehension of study rationale and decision-making roles [8]. In the early 1990s, North American and European Acquired Immune Deficiency Syndrome (AIDS) activists increasingly demanded a role in decision-making in research. This led to the establishment of community advisory boards (CABs) [8, 9], which were composed primarily of non-scientists to advise on study protocols and help to educate communities about health-related research [9]. Subsequently, through the 1990s and early 2000s, reflecting the events in the West, CABs were established in Africa and Asia to meet the demands of major research sponsors [8, 9]. However, within a few years, the limitations of CABs, in terms of representing communities, became clear and researchers began to consider alternative approaches to foster collaboration with potential study participants and target communities [8].

Subsequent controversies spurred the scientific community to invest more in involving participants and target communities in health-related research. For example, the 2004 failure of the tenofovir trial in Cambodia, Nigeria, Cameroon and Thailand, was thought to be caused by lack of adequate collaboration with target communities [10, 11]. Also, during the 2014-

2015 Ebola outbreak, inadequate involvement of communities was identified as contributing to local opposition to Ebola research. This received global attention and prompted calls for more investment in community engagement [12-15].

With changes in disease epidemiology and availability of funding, health-related research has been increasingly conducted in remote and low-income communities. In such contexts, there are often economic and educational disparities between study staff and participants [9, 16]. Such inequalities can contribute to suspicion, refusal and non-compliance among participants [17]. This can lead to studies being prematurely ended with inadequate sample size and therefore an inability to generate the high-quality evidence needed to realize the study's intended social value [10, 11, 15]. In low-income settings, poverty, malnutrition, lack of health care infrastructure and disease burden brings additional challenges [16, 18]. For instance, researchers might be obliged – prompted by demands from communities or professional or personal responsibility – to address the burden of disease that is unrelated to the area of research. This could divert resources away from achievement of the study aims.

The aims of community engagement

In the wider global health literature, community engagement is used for a variety of reasons. Some scholars view it as an essential component of ethical good practice in research and health programmes; others prioritize community health benefits through ensuring the success of an intervention [1, 3]. Goals of community engagement ranges from ensuring the relevance of the research to the communities, assessing whether research is acceptable to the particular community, minimizing the community disruption, avoiding exploitation by ensuring fair distribution of the benefits of research, and safeguarding social, economic and political

characteristics in research [1]. The divergent definitions and goals of community engagement complicate the evaluation and comparison of community engagement across studies [1].

In light of this, despite the growing literature on principles and goals of community engagement, there is little consensus on how to evaluate community engagement [18]. While adhering to the principles of community engagement, for example collaborative partnership with the community members and respecting individual's voluntariness to participate [18, 19], the level of participation of community members in research could be one way to evaluate it [20]. However, such an evaluation needs incorporation of a multitude of factors (for example: local social and cultural context, the nature of the research and the mechanism of outcome) that contributes to the participation [19].

Rationale for targeted malaria elimination

The emergence of artemisinin resistance in the Greater Mekong Sub-region (GMS) and its spread to countries within the region and westward towards Africa may have catastrophic consequences [21]. This has prompted scientists and malaria control programmes to expedite the control and elimination of malaria within the region [21-25]. As a potential tool to eliminate malaria in "hotspots" of high prevalence, Targeted Malaria Elimination (TME) is being trialled in Laos, Vietnam, Cambodia and Myanmar (registry entry accessible from the link below) (https://clinicaltrials.gov/ct2/show/NCT01872702?cond=malaria&cntry1=SE%3ALA&rank=3)

TME entails a multi-pronged approach including mass drug administration (MDA), consisting of administering a three days course of dihydroartemesinin piperaquine and a single low dose primaquine for three consecutive months regardless of the malaria infection along with quarterly blood survey for a year in the targeted population (Figures 1.1 and 1.2) [26]. If MDA is proven successful in interrupting malaria transmission in the target area, future malaria control programmes can adopt such a method and scale it up to the entire at risk population in the GMS region [26].

Factors affecting success of mass drug administration

The effectiveness of MDA is predicated on several factors, including high population coverage (>80% coverage based on the modelling studies) [27]. Achieving high coverage is a challenge for several reasons. For example, explaining the rationale for taking antimalarials when asymptomatic can be difficult because of the complex scientific concepts that underlie the approach [28]. Furthermore, target communities are often remote with poor access, villagers tend to be highly mobile and populations can be divided by political affiliations [3, 29-32].

Population coverage and Community engagement

To promote coverage, programmes of MDA often incorporate community engagement [3, 26-28, 33]. Most scientific reports of MDA however offer little detail on how community engagement is designed and what activities it entails [3]. Although community engagement has been identified as essential to increase the population coverage of MDA, little has been published on its nature and the principles to tailor community engagement to suit a particular context [3, 34]. Past failures of "one size fits all strategy" for community engagement has

further prompted scientists to explore the local cultural context to guide the suitable community engagement [34].

My DPhil research focuses on the community engagement that was undertaken alongside the TME pilot study in southern Savannakhet Province, Laos. At the outset, a systematic review [3] was conducted to explore the community engagement activities that accompanied MDA conducted over the last century until 2015, which guided the initial design of community engagement for the the Lao TME study.

This thesis draws on implementation research [35-39], building on the systematic literature review, and comprising formative and concurrent data collection that informed the design, implementation and evaluation [40] of community engagement as part of the TME pilot study in Laos. The following paragraphs and chapters describe the various components of this research.

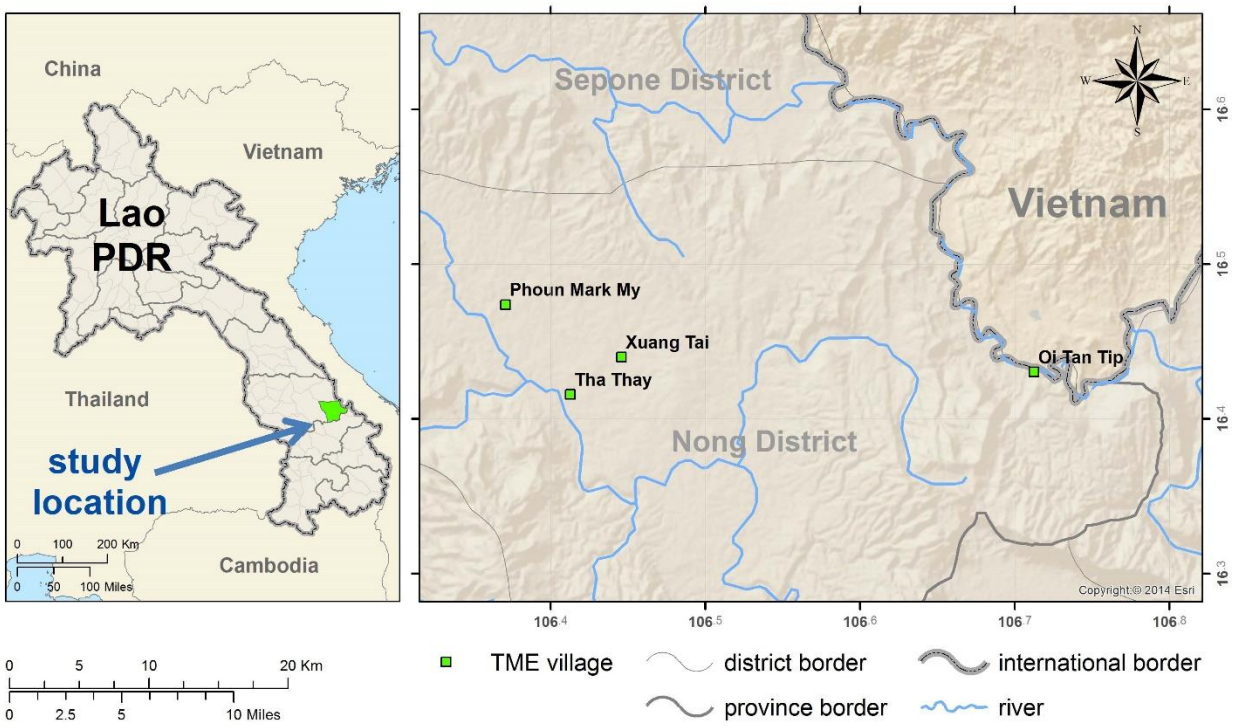


Figure 1. 1 TME study sites in Savannakhet Province of Laos

1.2 Research Questions

This study aims to answer the following questions:

- What is currently known about community engagement and population coverage in mass antimalarial administration and what is the relationship between population coverage and community engagement?
- In the TME study villages, what are community members' attitudes, perceptions and practices regarding malaria and asymptomatic malaria infections?
- How can findings from formative research be used to design an appropriate and tailored community engagement programme?
- What were the elements of effective community engagement that contributed to its effectiveness?
- What are the factors related to community engagement contributing to high population coverage in TME?
- What are the broader goals of community engagement in ethical health-related research?

1.3 Objectives

The main aim of this study is to design locally suitable community engagement strategies through formative research incorporating elements from the published literature, with modification based on ongoing observations, and explore the factors that contributed to population coverage including the role of community engagement in TME project in Southern Savannakhet Province, Laos.

1.3.1 Specific Objectives

- To review the current level of knowledge on community engagement and population coverage in mass antimalarial administration and the relationship between the two through systematic literature review.
- To explore health seeking behaviour for febrile illnesses, including malaria, and factors affecting it.
- To explore baseline knowledge, perceptions, attitudes and practices towards malaria and MDA in Southern Savannakhet Province, Laos.
- To design and execute the community engagement programme based on the published literature, baseline findings and formative research and adapt it based on the ongoing observations in southern Savannakhet Province, Laos.
- To explore the contribution of community engagement and other factors to population coverage (uptake and adherence to MDA) in Southern Savannakhet Province, Laos.
- To review the broader aims of community engagement in ethical health related research

1.4 Overall methods

To examine and tailor the community engagement for the TME pilot study in Laos, we followed a mixed-methods implementation research approach [35]. Implementation research focuses on how to promote the uptake and successful implementation of evidence-based interventions and policies [36-39, 41-43]. At the outset, we conducted a systematic review of community engagement in mass antimalarial administration, evaluating the research conducted over the last century. Subsequently, at the field site in Laos, my research focused on community engagement embedded as a sub-study of TME (Figure 1.2). During the field study, the

implementation research incorporated a variety of data collection techniques that included: observations of daily life and study activities throughout the duration of TME (which I recorded in field notes); focused group discussions (FGDs) and a questionnaire-based survey as a part of formative research before TME was implemented and; semi-structured interviews (SSIs), informal interviews, and a questionnaire-based survey during and after the MDA rounds.

The analysis of the overall implementation of TME (including community engagement) continuously fed into the design, implementation and adaptation of the community engagement [6].

1.5 My role and responsibilities

I was responsible for overall implementation of community engagement for TME in Laos and promoting high population coverage to maximize the potential for a successful outcome for the TME pilot study (i.e. interrupting local falciparum malaria transmission). At the outset, I led the systematic literature review of studies of mass antimalarial administration conducted over the last century to explore the relationship between population coverage, community engagement and local social and cultural context. At the same time, I was deployed in Cambodia to observe and learn from a sister TME pilot study and the community engagement. Building on my experience of TME in Cambodia, I was assigned to conduct the community engagement for TME in Laos. After participating in early malaria prevalence surveys conducted in June and July 2015 in Laos, I relocated to Vientiane to begin preparation for TME in Nong District.

The process of designing community engagement started with organizing and conducting meetings with the site TME principle investigator and local researchers, forming the team members, allocating responsibilities and recruiting social scientists for the study. Together with the early planning and logistics management in place for the implementation of TME, I started designing questionnaire for formative research and the community engagement tools, such as health education materials (posters, power point presentations and pamphlets) with the local social scientists and researchers. Thus developed tools were frequently tested and discussed amongst the local TME team.

In November 2015, along with a logistics manager and administrator, a lab technician, and two social scientists, I went to Nong District to setup the TME study. A local health worker was chosen to liaise with the study implementation team and is referred to as a local study coordinator in my thesis. I led the team and was assigned with various responsibilities, beginning with the early formative research, design and implementation of the community engagement and TME.

The design and implementation of community engagement was a reflexive and iterative process. It utilized the discussion amongst the team members, interim data from the survey, FGDs, observations and feedback from the local study coordinator and locally selected village volunteers.

In summary, I took the lead in managing the research team, conducting research, designing and modifying the community engagement and its implementation based on the data analysis and observations. The details of how it unfolded are detailed in each chapter.

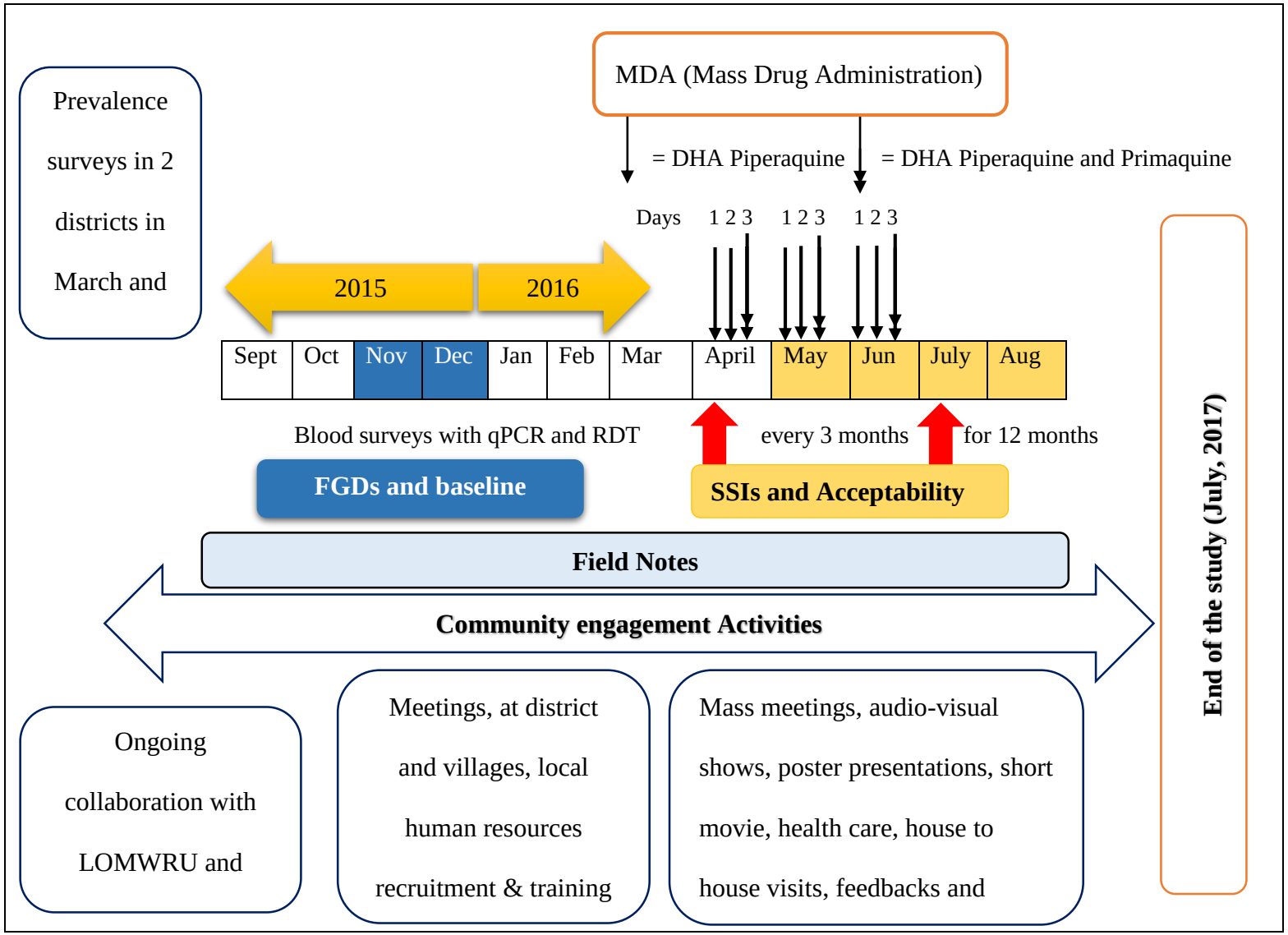


Figure 1. 2 Schematic representation of the data conducted alongside TME and CE

1.6 Local context

Targeted malaria elimination was conducted in four villages in Nong District, Savannakhet Province, southern Laos following an epidemiological survey for high prevalence of malaria [44] (Figure 1.1). This rural area borders Vietnam and is around five hours' drive from the provincial capital, Savannakhet. The local population is comprised of members of *Tri* and *Mangkong* ethnic groups, who are Mon-Khmer-speaking aboriginals. Villages are comprised of between 300 and 500 residents: Oi Tantip (OTP, 512 residents), Phoun Mak Mee (PMM, 480 residents), Thate (TT, 526 residents) and Xuang Tai (XT, 371 residents) [6]. Physically isolated and lacking transportation, community members have limited access to education, health care services, and the government district headquarters (Figure 1.3, 1.4 and 1.5).



Figure 1. 3: Oi Tan Tip (OTP) village near Vietnam border

The villages are located amongst hills and forest and, residents' livelihood depends upon migratory swidden cultivation. Almost all residents rear livestock, such as cows, chicken, pigs and goats as a source of emergency cash (Figure 1.4). Among the local communities, familial integrity and conformism within and between households are highly valued attributes. Household heads or senior family members therefore are often influential in relatives' decisions [45-47]. Within villages, a tendency for communal decision-making, sharing labour and helping one another, is rooted in their shared identity [45]. Village decisions are often made at the community meetings led by the village head and the other leaders, such as senior, security head, village volunteers, health volunteers and the women union head [6].



Figure 1. 4: Phoun Mak Mee (PMM), one of the intervention village with health centre on the left



Figure 1. 5 An intervention sub-village, Thate Geng with local livestock around the residence

Within the TME villages, healthcare facilities are limited: one village (PMM) has a health centre; the distance to the nearest health centre from TT is around 5 km; XT residents' nearest facility is about 7 km away; and for residents of OTP the nearest health centre is about 10 km away from the village. Roads are also often impassable after heavy rains and there is no public transport available. A few village heads and village leaders own small hand tractors and few villagers have motorbikes.

The catchment population for a health facility varies across the villages. In general, one health centre was responsible for three to five villages (1500 to 2500 residents). The facilities are

often under-resourced in terms of the continuous presence of health workers, lack of medical supplies and the services they could offer (each centre consisted of three to four staff headed by a medical assistant). Based on the medical complaints that TME health staff were asked to treat during the study, a large proportion of the health problems in the villages were infectious diseases, such as febrile illnesses, diarrhoea, respiratory illnesses, conditions related to hygiene (e.g. skin infections) and maternal and child health conditions.

Under normal circumstances, villagers pay upfront for health care; during the TME study, residents of target village were entitled to free routine health care, with partial financial support (up to 30% of the total cost) for major accidents and surgical conditions. Participants were also paid travel reimbursements.

Each village is governed by the village head. Other elements of village hierarchies included the "senior" (*nayhom)*, security head, youth leaders, women union head, Lao trade union head, and village health volunteers. Villages are divided into units, each with a unit head. Three TME villages contain sub-villages and each sub-village has its own hierarchy. Although the main village head can exert influence over sub-villages, in practice, sub-village heads are "in charge".

During the TME study, no other organizations were implementing research or health interventions. Notably, there was no malaria control programme.

The detailed insights into the local social and cultural context of these villages were used to design appropriate community engagement for TME and this process is discussed in chapter III onwards. In addition to the local social and cultural context specific to these villages, my thesis delves into the literature pertaining to mass antimalarial administration conducted over

the past century to explore the relationship between population coverage and community engagement and is discussed in detail in chapter II.

CHAPTER II

Community engagement and population coverage in mass administrations of antimalarial drugs: A systematic review of the literature

2.1 Abstract

Introduction

Mass anti-malarial administration drug has been proposed as a key component of the malaria elimination strategy in Southeast Asia. The success of this approach depends on the local malaria epidemiology, nature of the anti-malarial regimen and the population coverage. Community engagement is used to promote population coverage but little research has systematically analysed its impact. This systematic review examines population coverage and community engagement in programmes of mass anti-malarial drug administration.

Methods

This review builds on a previous review that identified 3,049 articles describing mass anti-malarial administrations published between 1913 and 2011. Further search and application of a set of criteria conducted in the current review resulted in 51 articles that were retained for analysis. These 51 papers described the population coverage and/or community engagement in mass anti-malarial administrations. Population coverage was quantitatively assessed and a thematic analysis was conducted on the community engagement activities.

Results

The studies were conducted in 26 countries; in diverse healthcare and social contexts where various anti-malarial regimens under varied study designs were administered. Twenty-eight articles reported only population coverage; 12 described only community engagement activities; and 11 community engagement and population coverage. Average population coverage was 83% but the methods of calculating coverage were frequently unclear or inconsistent. Community engagement activities included providing health education and

incentives, using community structures (e.g. existing hierarchies or health infrastructure), mobilizing human resources, and collaborating with government at some level (e.g. ministries of health). Community engagement was often a process involving a variety of activities throughout the duration of the intervention.

Conclusion

The mean population coverage was over 80% but incomplete reporting of calculation methods limits conclusions and comparisons between studies. Various community engagement activities and approaches were described, but many articles contained limited or no details. Other factors relevant to population coverage, such as the social, cultural and study context were scarcely reported. Further research is needed to understand the factors that influence population coverage and adherence in mass anti-malarial drug administrations and the role community engagement activities and approaches play in satisfactory participation.

2.2 Introduction

Malaria remains a leading global health concern and although, in Southeast Asia, malaria-related morbidity and mortality has seen recent declines, the spread of drug resistant *Plasmodium falciparum* parasites in the region poses serious challenges to prevention and control efforts [21]. If left uncontained, the likely spread of artemesinin-resistant *P. falciparum* from Asia to Africa would have a catastrophic impact in the continent where malaria transmission and malaria related mortality is highest [22].

This scenario has prompted urgent efforts to eliminate falciparum malaria in Southeast Asia [23, 24]. One approach, targeted malaria elimination (TME), combines conventional malaria prevention and control activities (reinforcing the network of village malaria workers (VMWs) to deliver appropriate case management and distribute long-lasting insecticide treated bed nets (LLINs), with the mass administration of an artemisinin based combination therapy. The mass drug administration (MDA) component of TME entails delivering a curative anti-malarial course to all individuals within a community, irrespective of malaria infection status, to interrupt local transmission [26].

Over the past century, MDA has been used as a strategy for malaria control with varying degree of success [27]. Past mass anti-malarial drug administrations, which often entailed sub-therapeutic doses, have been blamed for accelerating drug resistance [26, 48]. This is less likely within TME because therapeutic doses of combination antimalarials are administered [26, 27, 48, 49]. Interrupting local transmission through MDA is dependent on several factors, particularly the local malaria epidemiology, the characteristics of the anti-malarial regimen, and population coverage and adherence (Figure 2.1). In recent years, modelling studies have been helpful in determining the level of coverage required in specific epidemiological

situations to interrupt transmission [50]. The level of coverage required to ensure the effectiveness of the MDA and how to define coverage is debatable particularly with regard to specifying numerator and denominator. For instance, many MDA studies, exclude pregnant women and young children because of concerns of toxicity. It is clear that the local social context and the community engagement activities that accompany the MDA influence coverage and adherence [28, 29, 50-56].

Community engagement is variously defined in the global health literature [1]. Some scholars emphasize community engagement as promoting ethical conduct of research, whereas other definitions focus on 'working collaboratively' with communities 'to address issues affecting the well-being of those people' [1, 2]. With regard to programmes of MDA, community engagement entails a range of activities – for example, employing community members and providing health education – that often focus on promoting population coverage and adherence [2, 34, 54, 57, 58]. Although recognized as influencing coverage, community engagement is often scarcely reported and, to date, little effort have been made to analyse the impact of specific community engagement activities or approaches on MDA coverage.

With a view to designing community engagement activities for TME across the GMS, a systematic review of community engagement and population coverage within mass anti-malarial administrations was conducted [27, 59]. This review examines: 1) population coverage, 2) community engagement activities and 3) the relationship between 1) and 2) in previous mass anti-malarial administrations.

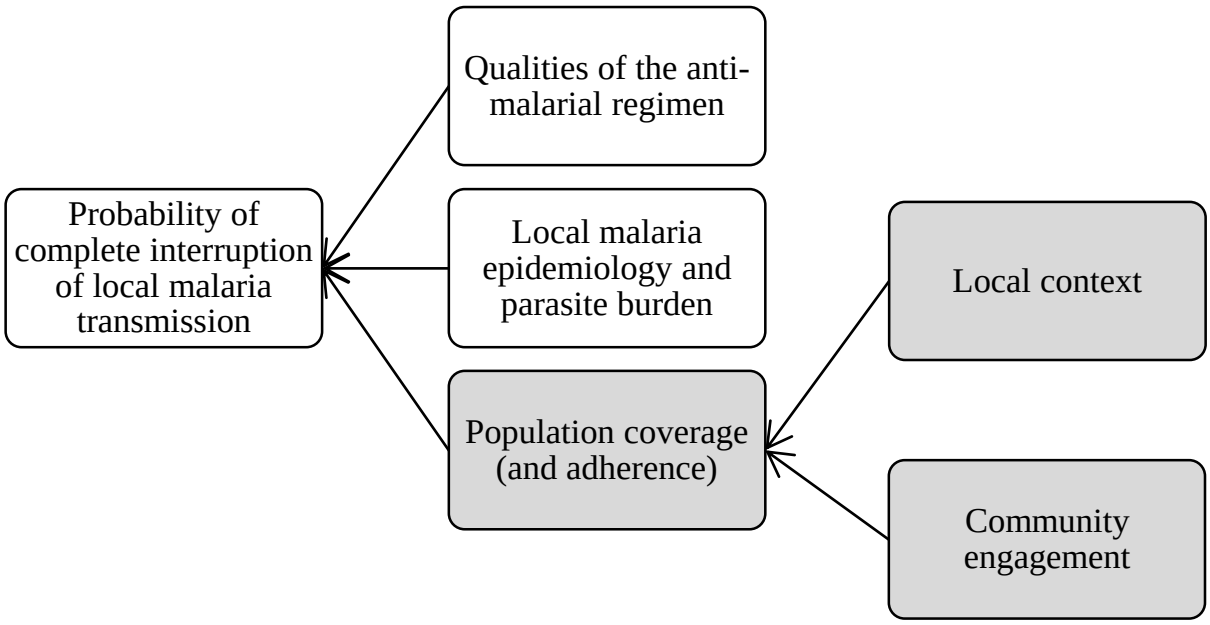


Figure 2. 1 Factors affecting the probability of completely interrupting local malaria transmission through mass antimalarial administration. Highlighted in grey are areas of concern for this review.

2.3 Methods

This review builds upon an earlier Cochrane Review of mass anti-malarial administrations by Poirot et al [59]. For the Cochrane Review, the following databases were searched: Cochrane Infectious Diseases, Group Specialized Register, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Library, MEDLINE+, EMBASE, CABS Abstracts and LILACS. Search terms were: A. Anti-malarials: exp Antimalarials or exp Malaria/ or

antimalarial* or anti-malarial* or schizonticidal* or gametocidal* or hypnozoiticidal* or drug* or treatment* or malaria* and B. Mass Administration: mass or coordinate* or administ* or distribut* or applicat* or use or therap* or treatment*.

From these searches, 3,049 articles were retrieved and reviewed (Figure 2.2). Of these articles, 241 were selected based on the eligibility for MDA [59]. Further review by Newby *et al* [27] identified 16 sub-studies that resulted in a total of 257 full text articles. These 257 articles were subjected to the exclusion criteria listed in Box 1. This resulted in 201 articles published between November 30, 1931 and August 24, 2011 that were assessed for inclusion in the current review.

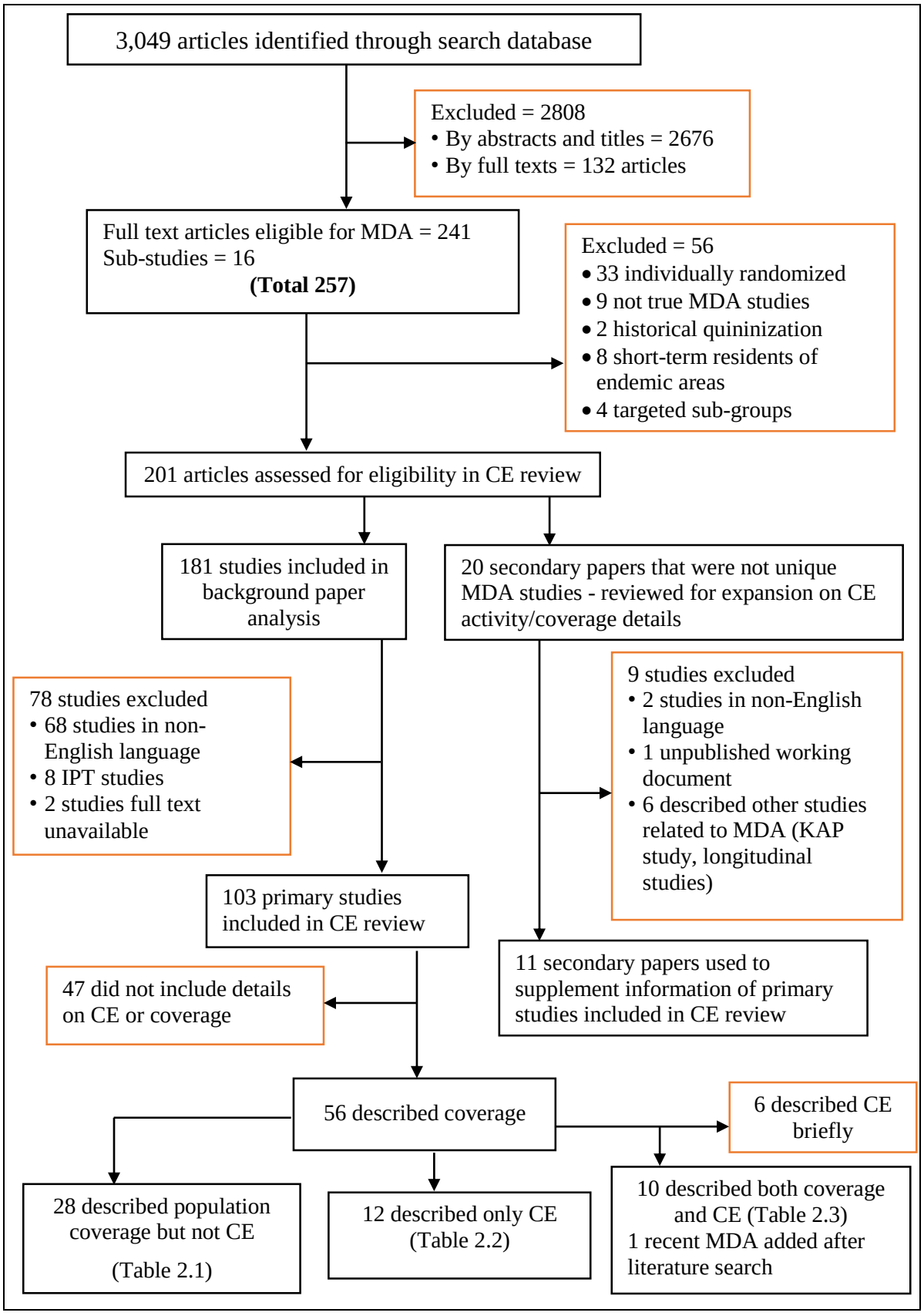


Figure 2. 2: Assembly of the reviewed literature

To examine the maximum number of studies that might have documented community engagement activities and population coverage, articles excluded from previous reviews were included: articles that reported MDA for sub-groups rather than entire populations, described the delivery of inadequate treatment doses, documented the mass screen and treat approach and those that were not unique MDA studies (e.g. multiple publications documenting different components of the same study).

Box 1

Inclusion criteria to assess eligibility for review:

1) All randomized and non-randomized studies of mass administration of antimalarials, including cluster-randomized trials, non-randomized controlled studies and uncontrolled before-and-after studies that measured at least one outcome of interest in the target population
2) Additional: Inclusion of secondary papers related to MDA.

Exclusion criteria to assess eligibility for review:

1) Individually randomized studies
2) Studies in which the primary focus was not MDA (e.g. historical program reviews that merely made mention of MDA activities, community surveys done in conjunction with MDA)
3) Studies using an indirect approach to MDA, where antimalarials are added to essential foodstuffs, usually dietary salt.
4) Historical accounts of mass quinine distribution in the early 20th century
5) Studies targeting short-term residents of malaria endemic areas (e.g. military, labourers)

Two researchers (Bipin Adhikari and Nicola James) independently retrieved and reviewed the articles. Firstly, all the literature pertaining to malaria-related MDAs was reviewed to extract population coverage data. In this review, population coverage has been defined as the total

proportion of the target population who took antimalarials with or without directly observed treatments (DOTS) during the entire course of the MDA. Secondly, the articles were sorted according to the reports of community engagement activities. Thirdly, a thematic analysis of the literature that addressed the population coverage and/or community engagement was conducted.

Of the 201 articles, 181 reported primary studies and 20 reported secondary studies which gave additional details on the primary studies. Seventy eight of the 181 primary studies were excluded. These were 68 non English articles, eight that reported intermittent preventive treatment (IPT) and two of which the full text were not available resulting in 103 studies. Among these 20 secondary studies, nine were excluded: two were in languages other than English, one was an unpublished working document and six described studies indirectly related to MDA (such as knowledge, attitude and practice studies, and longitudinal studies), resulting in eleven secondary studies. Of these 11 studies, two were included in the previous review of community participation by Atkinson *et al* [34]. These 11 articles were reviewed for their additional details on community engagement and coverage and were used to supplement the information detailed in Tables 2.1, 2.2 and 2.3.

2.3.1 Community engagement data extraction and analysis

Of the 103 primary articles, 47 were excluded after a preliminary review because they did not describe population coverage or community engagement activities. Among the remaining 56 articles, six described community engagement only very briefly and were excluded [60]. One

additional article was added during the update of the review [61] resulting in 51 articles retained for analysis. A thematic analysis was conducted on a total of 23 articles, which described community engagement activities. These included 12 articles that described community engagement activities *only* and 11 articles that described population coverage *and* community engagement activities.

2.4 Results

2.4.2 The nature of the reviewed articles

Fifty-one articles reporting the results of studies conducted in 26 countries were retained in the analysis. Population coverage without community engagement was documented in 28/51 (55%) papers (Table 2.1). Twelve of 51 (24%) articles described community engagement activities in detail but not population coverage (Tables 2.2 and 2.4), whereas 11/51 (22%) articles described community engagement activities in detail and population coverage (Tables 2.3 and 2.5). Among all articles reviewed (n=51), median quartile of the studies were conducted before 1965 (Q1=1956, Q2=1965 and Q3=1984).

The studies were conducted in contexts with diverse healthcare infrastructure, health needs, population mobility and population size. For instance, the study in Lebanon involved study villages which were deprived of healthcare centres (physicians or pharmacies were unavailable within 18 kilometres of the village). In addition, the study population was mobile as they often leave the village in search of job and to escape the winter [62]. This had implications in terms of villagers' willingness to follow study instructions, such as not to take other antimalarials apart from the study drug, chloroquine.

In some cases, mass antimalarial administration was conducted as part of research in selected villages, whereas, in others, MDA was part of a national health campaign. An example of the latter is Nicaragua where the entire population was treated. High level of community participation in a literacy campaign in previous year was a stimulus for the nationwide MDA. Prior to mass anti-malarial administration, health campaigns had been conducted for polio vaccination, sanitation and environmental hygiene, rabies control in domestic pets and vaccination against diphtheria, pertussis and tetanus [63].

2.4.3 Population coverage

The 28 studies that documented only population coverage were published from 1931 to 1996 (Table 2.1). The mean reported population coverage in these 28 studies was 82% (range 40% to 100%), with seven (25%) studies reporting a population coverage below 79% (Table 2.1). The 11 articles reporting both population coverage and community engagement activities were published from 1960 to 2015 and described, on average, 84% coverage (range 40 to 100%). Three of the 11 (27.3%) studies reported a population coverage below 79% (Table 2.3). It was often unclear or not specified how the coverage was estimated. For example, in Trinidad and Tobago, 2142 people were given plasmoquine and quinine, but only 1,289 people completed the full course. In this study, the coverage was not reported and the selection of the target population was not mentioned [64]. Similarly, in Sudan, the antimalarials were reportedly taken by all members of the targeted population but no details of coverage, population size or the selection procedure were provided [65].

2.4.4 Community engagement activities

This section describes the type and process of community engagement activities: health education, provision of incentives, utilization of existing community structures, human resource mobilization and steps in community engagement.

2.4.4.1 Health Education

Of the 23 articles (Tables 2.4 and 2.5) with detailed descriptions of community engagement, 12 focused on health education employing the following media and methods: 1) newspapers, written leaflets and posters, 2) audio-visual materials, such as news-bulletins, movies and videos, and 3) meetings with key community persons, announcements in health facilities in conjunction with community members and involvement of local health workers, government health officials and village volunteers.

Two articles, reporting on studies in Nicaragua [66] and Indonesia [67] incorporated large-scale health education on malaria and MDA. Health education was conducted in various different contexts and various methods were applied. For instance, in Tanzania, articles for the general public were written in two local newspapers [68]. In Ghana, weekly health education classes were conducted among the residents and they were asked to spread the message to other villagers [69]. In India, health education sessions were conducted in different levels where community health volunteers played a major role in increasing the awareness in the community [70]. In Vanuatu, intensive health education classes were conducted after coverage dropped and in subsequent round coverage improved [54, 71]. Information dissemination was conducted through newspapers [68], pamphlets and news bulletins [72]. In two studies [73, 74] audio-visual materials were employed to explain the planned intervention [73]. In China, the

health education was delivered through the primary health care system by the means of meetings, films, posters and videos [74].

2.4.4.2 Incentives

Two articles documented the use of incentives in MDA but they did not report the corresponding population coverage [73, 75]. In Venezuela, MDA participants received incentives ranging from a lottery ticket to sugar candy on completion of the entire antimalarial course. In addition, financial incentives were provided to MDA staff for each malaria positive slide [75]. In India, financial incentives – an advance for housing construction – were given to reluctant tribal populations [73].

2.4.4.3 Community structures

Community structures consisted of existing organizations, physical infrastructure, health care providers and health service centres. The involvement of community structures was often a core component of introducing the MDA to the target communities. In India, personnel from the local health centre and additional staff from the district assisted in conducting the MDA [70]. In Kenya, the MDA was implemented in the community through the local district health office [76]. Apart from conducting community meetings and utilizing community structures, a study [61] in Thai-Myanmar border areas utilized an existing community ethics advisory board (Tak Province Community Ethics Advisory Board) [77].

2.4.4.4 Human resource mobilization

Human resource mobilization varied from the simple involvement of community members or health staff to assist with the study to complete hand over of the MDA operations to

government staff. For instance, in The Gambia, a translator and a fieldworker were appointed for consent process with participants whereas the staff at health centre recorded the visits of villagers at health centre [78]. In Cambodia, village malaria workers were recruited to distribute the drugs and monitor drug administration [79]. By contrast, in Nicaragua, a nationwide malaria control program recruited 70,000 people as anti-malaria volunteers who were trained to conduct the census, provide door to door education, promote community participation, distribute drugs and keep records [63]. On Aneityum Island, Vanuatu, village volunteers were selected and trained as MDA staff and were responsible for drug distribution [71].

2.4.4.5 Steps in community engagement

Community engagement was often a process and the MDAs involved participants in various ways throughout the duration of the intervention. For instance, in The Gambia, researchers first discussed the project with and sought cooperation from national and district level members of governmental and health structures. Subsequently, meetings were conducted in the target communities with village elders and other prominent residents in the presence of the government officials [78]. With the consent of village leaders, meetings were held with community members to introduce the purpose and details of the study, which was then followed by the individual consent process. On Aneityum Island, the MDA plan was first formulated by the malaria control programme at the Department of Health. Operationally, MDA was led by the district malaria supervisor and several meetings were held with the communities to explain the MDA's purpose and procedures, and to elicit the community's full commitment to eliminate malaria from the island. Subsequently, 12 village volunteers were selected and trained as MDA staff and antimalarial administration was carried out with the

supervision of a registered nurse who was responsible for healthcare on the island, the district malaria supervisor and central malaria section staff [54, 71].

2.4.5 The relationship between community engagement and population coverage

Among the 11 studies (Tables 2.3 and 2.5) that documented both community engagement activities and coverage, coverage ranged from 40 to 100% [61, 63, 70, 71, 76, 78, 80, 81]. The MDA with the highest reported population coverage (100%) was part of the North Sumatra Health Promotion Project, Indonesia and was on-going for 10 years. In this national initiative, existing village health centres and staff were responsible for the activities, such as collecting fingertip blood samples and examining spleen size. Two village volunteers also worked as recorders and guides and the primary school teacher assisted in identifying and examining pupils [80].

Another successful MDA that reached 95% of the target population was conducted in Kenya, as part of chemotherapeutic campaigns in 1953 and 1954 and as a joint collaboration between WHO, UNICEF and Ministry of Health. In this case, the district health offices were responsible for overall organization and supervision of the MDA and the district health inspector was charged with the daily running of the operation. Most community leaders, such as administrative chiefs, headmen, school teachers and clerks were involved [76].

On Aneityum Island, mass antimalarial administration contributed to the elimination of malaria from the island. Here, the department of health was closely involved: the district malaria supervisor took charge of the programme and delegated responsibilities to local staff from government health facilities. Twelve community members were recruited and trained as MDA staff who carried out day-to-day activities, such as drug distribution, recording and supervision.

The MDA compliance rate decreased from 90 to 79% in the 2nd and 3rd rounds; this resulted from the adverse events related to Chloroquine and the number of tablets participants had to take and, in response, community meetings were held. Additional information was provided and chloroquine was removed from the scheduled antimalarial regimen in the 5th and 9th rounds after discussion with the community [54, 71].

Amongst the articles that reported coverage and community engagement activities, the lowest coverage – 40% – was recorded on the Thai-Myanmar border [61]. Initially, the mean coverage in three villages for the malaria parasite survey was 77%. After discussing the results with community leaders and the Tak Province Community Ethics Advisory Board, MDA was agreed as an intervention. Two of the three villages were inaccessible during the rainy season and so antimalarials could not be administered there. The low coverage was explained in terms of political fragmentation, inaccessibility and high mobility [61].

Table 2. 1: Studies documenting population coverage only (n=28, in chronological order)					
Author, year, country	**Epidemiology (baseline parasitemia)**	**Study type and the context**	**Antimalarial**	**Coverage / %**	**Additional interventions**
Kingsbury 1931 Malaysia [82]	28% (Malaria incidence had been high for many years in the rubber estate).	Non-RCT. Plasmoquine was administered to all individuals living in rubber plantation and the control population was chosen from another rubber plantation estate. The population composed of laborers working in rubber industry and the considerable fluctuation of population was observed over the years.	Plasmoquine	97	larviciding
Kligler 1931 Palestine [83]	69.4% in Children age 0-14 years old.	Before and after study carried out in 5 villages adjacent to Huleh marsh.	Plasmochine + Quinine	80	NR
Gribben 1933 Trinidad & Tobago [64]	NR (259 cases treated during October to December 1931; and 96 cases treated during July 1932	Before and after study (compared malaria cases seeking treatment before MDA and after MDA)	Plasmoquine + Quinine	80	lake draining and oiling

Henderson 1934 Sudan [65]	NR. Heavily infected village.	Non-RCT. 160 members of an isolated community in Sudan (~1/2 of population).	Quinoplasmine + Plasmoquine	100	larviciding
White 1934 India [84]	55%	Non-RCT. Children of age 0-10 years living in a railway settlement and an adjacent village were selected for both control and intervention.	Euquinine, plasmochin	94	larviciding
Ray 1948 India [85]	0.7% in adults to 35% in children	Before and after study conducted in tea estate in India.	Paludrine	75	IRS
Banerjea 1949 India [86]	4.37%	Non-RCT. The study was conducted in rural west Bengal.	Proguanil	89	NR
Van Goor 1950(C) Indonesia [87]	26.5-40%	Before and After study. Different study arms examining the efficacy of monotherapy mainly with varying prophylactic doses of proquanil (a small subgroup was given chloroquine). The goal was to establish an optimal dosing regimen.	Proguanil and Chloroquine	90	NR
Norman 1952 India [88]	NR	Descriptive The chemoprophylaxis in Assam Valley tea estate populations (labourers and their families) was conducted for 6 months. Half of the populations did not take the medicine as evidenced in their examined urine.	Proguanil	52	NR
Archibald 1956	48.7% (5-10 years)	Non-RCT	Pyrimethamine	80	NR

Nigeria [89]		Children with 5-10 years age group were selected for the chemotherapy.			
Clyde 1958 Tanzania [90]	82.6%	Before and After Labourers on tea estate in eastern Usumbara Mountains.	Pyrimethamine	82	IRS
Van Dijk 1958 Netherlands New Guinea (PNG) [91]	11.2%	Before and After Inhabitants of 30 villages in Demta district	Chloroquine	93	IRS with DDT
Afridi 1959 Pakistan [92]	NR	Non-RCT Population at villages near Daur river in Hazara district of west Pakistan	Pyrimethamine	96	NR
Van Dijk 1961 Netherlands New Guinea (PNG) [93]	17.5%	Before and After Inhabitants of Inanwatan. Area is unstable hyperendemic	Chloroquine	97.2	NR
Metselaar 1961 Netherlands New Guinea [94]	12-28%	Before and After The population lived near lake Sentani and were likely to sleep in garden houses	Chloroquine + pyrimethamine	90	IRS with DDT
Ho 1965 China [95]	NR	Descriptive Mass Screen and Treat study.	Chloroquine + Primaquine, Pyrimethamine + Primaquine	95	ND

Ossi 1967 Iraq [96]	NR Annual incidence of malaria cases 2221	Before and After Chemoprophylaxis was conducted in Basrah city with the highest malaria incidence.	Chloroquine + Pyrimethamine	57.5	IRS with DDT
Singh 1968 India [97]	0.98 cases/1000/population/month	Before and After All people in 29 villages in Azamgarh but in subsequent rounds only targeted febrile cases, their contacts and housemates.	Chloroquine, primaquine	72.7	IRS with DDT
Lakshmanacharyulu 1968 India [98]	56.3%	Before and After Labourers within a dam and canal project area previously not know to be malaria endemic	Chloroquine + Pyrimethamine	80	IRS with DDT, larviciding
Onori 1972 Syria [99]	Average monthly number of malaria cases: 46.6	Before and After All individuals in Ghab Village	Chloroquine + Pyrimethamine	85	IRS with DDT
Najera 1973 Nigeria [100]	19%	Non-RCT All villagers older than 3 months from Kankiya district in North Central State	Chloroquine + Pyrimethamine	85.9	IRS with DDT
Schliessmann 1973 Haiti [101]	0.02/1000 population/month	Descriptive No details on drug or the regimen Population of 3 localities within Section Rurale I Varreux	NR	40	IRS with DDT
Paik 1974a British Soloman Islands [102]	27.8%	Before and After study Only Children aged 2-9 years of north coastal areas of Nggela island group	Chloroquine + Pyrimethamine	90	IRS with DDT
Paik 1974b British Soloman	18/1000 population/month	Before and After Study Population of Gilbertese settlements in western district.	Chloroquine + Primaquine	90	NR

Islands [102]		Sleeping outdoor is common here			
Kondrashin 1985 India [103]	In 1980: Pv: 3.4/1000pop/month and Pf: 1.9/1000pop/month	Before and After Inhabitants of 8 PHC (Primary Health Centre) catchment area in five malaria endemic districts of Andhra Pradesh	Chloroquine + Primaquine	85	IRS
Strickland 1986 Pakistan [104]	24.9%	Before and After All individuals above age 3 years. Suspected cases of malaria were treated with chloroquine and individuals with parasitemia were treated with Sulfadoxine and Pyrimethamine.	Sulfadoxine, pyrimethamine	67.3	NR
Hii 1987 Malaysia [105]	46.3 to 55.6%	Before and After The intervention intended to determine the effects of impregnated bed nets. Improver and lack of use and damage to the bed nets and reluctance of the population to take the drugs were noticed.	SP + Primaquine	81.6	ITNs
Babione 1996 Central America (Multiple Locations) [106]	NR	Descriptive Field test in El Salvador. Population and intervention not well described.	Chloroquine + Primaquine	77.5	IRS with DDT, larviciding

Table 2. 2: Studies documenting community engagement activities only (n=12, in chronological order)				
Author, year and country	**Epidemiology (baseline parasitemia)**	**Study type**	**Antimalarial**	**Additional interventions**
Butler 1943 South Pacific [72]	12-16%	Before and After Study was largely a review of the US Navy's malaria control program implemented on an unspecified occupied island in the South Pacific. Natives of 2 villages were recruited into the study.	Mepacrine	NR
Berberian 1948a Lebanon [62]	NR	Non-RCT All persons aged above 6 months of Saideh village	Chloroquine	NR
Chaudhuri 1950a India [107]	50%	Non-RCT Only children were participants in the study.	Proguanil	NR
Edeson 1957 Malaysia [108]	29%	Non-RCT All ages except infants. Inhabitants of rural rice growing area of Negri Sembilan state.	Proguanil	NR
Gabaldon 1959	0.24%	Before and After	Pyrimethamine	IRS with DDT

Venezuela [75]		Population of eastern and western Venezuela. All persons aged >1 month.		
Clyde 1961a Tanzania [68]	Morbidity rate: 76.1% Parasitemia in European children: 11.5%	Before and After Europeans living in Tanga.	Quinine	Bed nets
Charles 1962 Ghana [69]	55.3%	Before and After All aged residents of Akrofu villages	Pyrimethamine	NR
Sehgal 1968 India [73]	1.8%	Before and After All individuals except the very sick, old and the pregnant women	NR	IRS with DDT
Omer 1978 Sudan [109]	40.5%	Non-RCT All residents of 4 villages in Gezira ecological area of Northern Sudan	Chloroquine	NR
MacCormack 1983 Tanzania [110]	NR	Non-RCT The age range of the participants was 0-15 years.	Chloroquine	NR
Dapeng 1996 China [74]	0.8/1000 population/month in 1984	Before and After All residents within high incidence areas in 4 counties in Xinyang prefecture.	Chloroquine + Primaquine	IRS with DDT, ITNs
Song 2010 Cambodia [79]	2-50%	Before and After All residents above 1 year from 17 villages with parasite rates 20% or higher in Kampong Speu Province	Artemisinin + Piperaquine + Primaquine	NR

Table 2. 3: Studies documenting both community engagement and population coverage (n=11, in chronological order)

Author, year and country	Epidemiology (Baseline parasitemia)	Population coverage / %	Type of study and the context	Anti-malarial(s)	Additional interventions
Archibald 1960 Nigeria [81]	48.7%	89.7	Non-RCT Inhabitants of villages in Western Sokoto Malaria Control Campaign	Chloroquine + Pyrimethamine	
Clyde 1962 Tanzania [111]	59.8-64%	95	Before and After Participants of all ages were recruited	Amodiaquine + Primaquine	IRS with DDT
Roberts 1964a Kenya [76]	23%	95	Non-RCT Participants of all ages were recruited and were from highlands in Kenya from 2 districts.	Pyrimethamine	
Garfield 1983 Nicaragua [63]	0.42-0.83 cases/1000 population/month	70	Before and After (Nationwide) Medicine was administered to all persons aged >1 year over 3 days given once to the entire population.	Chloroquine + Primaquine	
Baukapur 1984 India [70]	0.18/1000 population/month	76	Before and After All persons in 2 villages in Valsad District in Gujarat. Migratory population came	Chloroquine	NR

			from malarious areas during study period.		
Pribadi 1986 Indonesia [67]	13.2%	93.7	Before and After Mass chemoprophylaxis among all the individuals in Berakit village.	Chloroquine	
Doi 1989b Indonesia [80]	30%	100	Before and after All aged participants were treated.	SP + Primaquine	NR
Kaneko 2000 Vanuatu [71]	62%	88.3	Before and after MDA was conducted with all individuals in Aneityum islands.	Chloroquine + Primaquine + SP	
Von Seidlein 2003 Gambia [78]	41.6%	85	RCT/Cluster RCT Individuals older than 6 months and all non-pregnant women in 9 villages and placebo in other 9 villages.	AS+SP	
Shekalaghe 2011 Tanzania [52]	0% by microscope and 2.6% by PCR	93	RCT/Cluster RCT Individuals above 1 year were included. People who had received ACTs in 2 weeks prior to the study, pregnant women and people with anaemia received different drug regimen. Four each intervention and control randomly assigned.	AS + SP + Primaquine	Vector Control, Larviciding

Lwin 2015, Thai-Myanmar border [61]	7.3% by microscopy and 18.4% by uPCR in one study village	40	Before and After. Study population consisted of all the villagers excluding children <14 years and pregnant women in Thai-Myanmar border	Dihydro-Artemesinin + Peperaquine	NR

Table 2. 4: Studies documenting community engagement activities only (n=12, in chronological order)					
Author, year, country	**Community engagement**				**Other relevant factors**
	Health Education	**Incentives**	**Community (health) structures**	**Human Resource Mobilization**	
Butler 1943 South Pacific [72]	Bulletins, announcements, short talks and movies.	NR	The medical officer provided direction and information dissemination	Local community members provided manual labour	Mild initial intolerance to the anti-malarial consisted mainly of nausea, vomiting and diarrhoea. Less than 1% of participants showed absolute intolerance, usually manifested by repeated vomiting.
Berberian 1948a Lebanon [62]	NR	NR	Discussion with village head and elders were held and the study was started after their consensus.	NR	Villagers were grateful and demanded for the antimalarials to an extent that villagers in the control arm were also provided with the antimalarials which

					reduced the people in control arm. The population was mobile. For instance, only 160 out of 200 were present in one of the village.
Chaudhuri 1950a India [107]	NR	NR	Young men from the village established themselves to form an anti-malarial society and were affiliated to central anti-malarial society.	A local man worked as a volunteer to visit door to door of the villagers. A filed assistant was appointed for drug distribution.	Some villagers migrated out of the village because of the perennial fear of malaria. Within the village, some villagers were reluctant to swallow the tablets in front of the study staff and preferred to keep it to take later. Adverse events such as vomiting affected others from taking them. There were propaganda about the ill-effects of the medicine which was eventually resolved.

Edeson 1957 Malaysia [108]	NR	NR	In each valley, committees were formed to serve as channels through which villagers were informed about the blood surveys or house spraying and villagers could express their views to the committee as well.	Village volunteer was responsible for drug distribution.	Even though medicine were distributed by a volunteer, there was no actual supervision of participants taking antimalarial).
Gabaldon 1959 Venezuela [75]	NR	Incentives (lottery tickets) were provided for those	Nurses at local dispensaries coordinated with the study in keeping the record of any cases of	Involvement of rural visitors as staff (two types: drug dispensers and blood slide makers/collectors) who were supervised	There were relapses observed in the groups of 5-14 years and 15 years or more after the completion of MDA. These groups took less than designated 18 treatments. This was attributed

		completing MDA. A bonus incentive was given to MDA distributors if their sector was found malaria free.	malaria and preparing the slides.	by inspectors and sub-inspectors. A local doctor was engaged in conversation with few villagers who were reluctant to take the medicine.	to the greater mobility, consequently, it was difficult to find them at their houses.
Clyde 1961a Tanzania [68]	Articles for general public were written in 2 local newspapers.	NR	German Hospitals as health structures were already present.	The medical facilities and treatment was initiated by German health workers and in the established hospitals by Germans.	Government's consensus was sought for the initiation of Malaria control program in Tanga (research site).

Charles 1962 Ghana [69]	Weekly health education class was conducted. Residents were also prepared by preliminary educational propaganda.	NR	The trial formed part of the pilot malaria eradication project supported by Ghana government, WHO and UNICEF.	Anti-malarial distribution was delegated to the formed team consisting of 2 volunteers who were selected from representative clans of the community.	The study town had successfully participated in previous community development projects and the community was deemed to be cooperative. However, reluctance to take the medicine was noticed particularly in children and some informed that the tablets were sold or shared with other villagers.
Sehgal 1968 India [73]	Health education through audio-visual aids and using local literature (language). Intimate and	Incentives were paid as an advance for building houses.	Central to community level health structures and social structures were utilized which included additional staffs recruitment at various positions.	Augmentation of staffs were done in existing positions. In addition, lower qualified community members were recruited for the work.	Geographical inaccessibility was a major barrier for the malaria control program. Reluctance of staffs to work and reluctance of tribal population to the intervention were major barriers which were subsequently resolved.

	personal persuasion was applied for resisting tribal population.				
Omer 1978 Sudan [109]	NR	NR	Ministry of Health was involved in providing the technicians for the check-up of blood slides. Local health structure such as public health office, local school and youth organizations were directly involved.	A school teacher was asked to supervise who was under resident public health officer supervising the operation. 2 or 3 people, generally from the youth organization, helped the night before and in the morning to encourage people to participate	The people in the village were cooperative and appreciated the medical services rendered to them during the previous survey. The purpose of the chemoprophylaxis was explained to them (but no details on how was it conducted) and they volunteered to cooperate.

MacCormack 1983 Tanzania [110]	Health education through meetings was delivered in tier approach to key community persons who in turn educated families.	NR	Anti-malarial supplied by WHO, government committed to the Malaria control plan and health structures present at the rural site coordinated with the project.	The direction and operation of the project was taken care by the medical director of the hospital in the study area. Officials and staffs at local hospital were involved.	As many as 28% of children complained of vomiting and 56% complained of itching, and other unfavourable qualities of chloroquines were indicated for the reluctance to adhere to the medicine.
Dapeng 1996 China [74]	Before introducing the malaria control program in the community,	NR	Malaria control program was carried out through the existing primary health care system already in place.	Additional experts from the provincial and central level were involved in field research, guidance and evaluation. Village	The control program involving malaria treatment and chemoprophylaxis was less successful than the vector control. Bed net impregnation was more accepted in the community than

	health education through the primary health care system, by means of meetings, films, posters, and videos were conducted thus encouraging villagers to participate.			doctors were responsible for the chemoprophylaxis and the clinical care of the patients.	DDT spraying as it killed flea, lice and bedbugs as well.
Song 2010 Cambodia [79]	Village leaders cooperated in	NR	Local health workers from the community and volunteers from	Village malaria workers were recruited to distribute drugs and	The anti-malarial were redistributed in 4 of the study villages because of the lack of

	educating the general (study) population.		the village were involved in the study.	monitor drug administration.	anticipated reduction in malaria. Improper distribution and inadequate training of VMWs were attributed for the lack of reduction and some VMWs were subsequently replaced.
(NR=Not reported, IRS=Indoor Residual Insecticide Spraying, ITN=Insecticide Treated Bednet, DDT=Dichloro Diphenyl Tricholoroethane; ND=Not Done)					

Table 2. 5: Studies documenting both community engagement and population coverage (n=11, in chronological order)					
Author, year, country	**Health Education**	**Incentives**	**Community (health) structures**	**Human Resource Mobilization**	**Other relevant factors**
Archibald 1960, Nigeria [81]	NR	NR	Cooperation was sought with the village authorities (local native authority and the Emir in Council of 3 study village). The purpose of the study was explained to local councils and meetings were conducted with the family heads.	The drug administration was carried out by authorities in-charge and staff (medical officer, the superintendent of rural health and the health sister) at the local health care centre. The local drug distribution team consisted a team leader, a female community attendant, a native authority representative from each ward and the locally recruited labourer.	The acceptance of the small tasteless tablet of Pyrimethamine was far better than the Chloroquine which was often vomited by toddlers. The bitter taste, big size and the number of chloroquine tablets all were disadvantage for the administration.

Clyde 1962 Tanzania [111]	Information disemminatio n through health education sessions and demonstraito n of the advantage of the project.	NR	Cooperation of the public was achieved through involvement of community leaders. Community leaders were sought for any raised problems and various reasons for defaulters.	A medical worker paid visits for treatment on a personal basis to everyone in the study site. Persistent follow up of defaulters was carried out.	Authors attributed the success to correct approach to the villagers through the community leaders and promotion of awareness through health education and demonstration of the advantages of the project.
Roberts 1964a Kenya [76]	NR	NR	A joint collaboration with Ministry of Health of Kenya, WHO and UNICEF. Malaria control was handed over to the district health office (medical officer). Propaganda was introduced about the study, meetings were held with the inhabitants such as at trading centres, dispensaries and schools. A concerted program was organized to inform all the population about the objective of the campaign.	The advisory capacity was provided from the medical headquarters and ministry of health. The daily operation of the project was carried out by the district health inspector. School masters and agricultural scouts were involved as monitors and guides.100 men were selected, trained and recruited on the work.	A joint collaboration and successfully devolved the responsibilities to host government and local structures.

Garfield, 1983, Nicaragua [63]	Literacy follow up classes, health promotion activities were conjoint work with other diseases too.	NR	Malaria control program in Nicaragua was one of a series of national health campaign.	70,000 anti-malaria volunteers trained to conduct a census, provide door to door education about malaria, promote community participation, package and distribute drugs and keep records. In addition, about 10% of the country's total population was estimated to have taken part in promotional activities.	Apart from the coverage of 70% of the whole population, the other benefits were the value of national level census, the long term impact of modifications in malaria control strategies based on campaign results, and the impact of increased citizen awareness on case finding and malaria control efforts.
Baukapur 1984 India [70]	Health education was carried out at different levels. Community health volunteers played a major role in increasing the awareness in the community.	NR	The local health structure and additional health personnel and resources from district headquarters were utilized in this program.	Trained microscopists, leave reserve staffs, community health volunteers, malaria staffs from the district headquarter to local structures were involved in the malaria control program.	The study utilized both local and district level health staffs in both technical and non-technical works (health education) related to the malaria control work.

Pribadi 1986 Indonesia [67]	A comprehensible learning module for the community was prepared to provide the health education. Children's Health education to was given by village teachers (cadres).	NR	The regular monthly meetings of the cadres and the periodical meetings with the health centre officer was conducted concerning the cases of malaria. The health centre and the sub-health centre both were provided with a paramedic who was trained at blood slide preparation and the project.	Nine key persons from the sub village, consisting of school-teachers, heads of the RT's and active young people were selected (cadres/facilitators) who were chosen by villagers co-ordinated by village heads. The cadres were trained on malaria signs and symptoms and treatment. The volunteers/cadres were appointed to distribute the learning module to each house in the village.	Adverse events were reported from some villagers and discussions were held to counteract the misunderstandings and were treated at local health centre.
Doi 1989b Indonesia [80]	NR	NR	Malaria control was one of the activities among other community health activities. A local school teacher, health centre staffs and village volunteers were involved in the implementation of the project.	Part of a national initiative. A health centre staff was responsible for testing the blood samples, examination of spleen and similarly, two community health volunteers were responsible for recorders and guides.	The project operated under the national initiative and the size of the project within the national initiative was proportionately small.

Kaneko 2000 Vanuatu [71]	Aggressive health education were conducted and were attributed for the sustained compliance with the bed net programme. Information disseminatio n on MDA medicine through meetings were conducted after the incidence of adverse events.	NR	The district malaria supervisor and the staff of the central malaria section directed the local malaria intervention activities. Several meetings with community were conducted to explain the purpose and the objective of the MDA.	12 village volunteers were selected and trained as MDA staff and were responsible for drug administration. One village volunteer was selected by the local health committee for the training of malaria microscopy. Thus trained community microscopist and registered nurse cooperated to guard against the future introduction of malaria.	The adverse event such as vomiting and the number of tablets decreased compliance. The meeting was held to answer their questions and additional information was provided to the villagers. In addition, Chloroquine was removed from the regimen after 4th round.
Von Seidlein 2003 Gambia [78]	NR	NR	Discussion and co-operation with national and district level, members of the government district health team was sought. Meetings were conducted in villages in the presence of national and district level government officials to explain	A translator and fieldworker was appointed for consent process with the participants during drug administration. Similarly, two health centre staff recorded the visits of	Because of likely human and mosquito movement between villages, apart from 9 each intervention and placebo-controlled villages, 24 other neighbouring villages were treated which were not included in the study.

			the objective and methods of study and in addition, questions were answered during the meetings. Village elders were engaged in the meetings to discuss about participation at the MDA. The consent of participation was given by the village head.	individuals living in the study village.	
Shekalaghe 2011 Tanzania [52]	NR	NR	Meetings were conducted in all villages and the study was explained to all village leaders and local ten-cell leaders (*balozi)*. A stepwise consent process was applied. At first, the verbal approval was obtained from these local leaders. Verbal household consent was sought after explaining about the study at their household. Three health facilities in the study area were involved in passive case detection. The concept of asymptomatic malaria and the benefits of participation was discussed during community meetings.	Seven study teams consisting of one medically trained individual (medical doctor or medical officer) and 1 or 2 field workers were responsible for consenting, screening participants for the safety and administering drugs. All *balozis* were involved in the monitoring of movement of people in the study area. The approach to give local leaders a central role in explaining the study purposes, drug administration and monitoring migration were considered to	Each household received a household ID card and were entitled to free health care at the local health centres. Number of tablets (24 tablets/3 days; 7/day for 2 days and 10 for 3rd day) were complained as burdensome by some participants. A symptom diary was provided to the parents for their children, where they were asked to record the daily occurrence of fever, headache and body pains.

				influence the community participation.	
Lwin 2015, Thai-Myanmar border [61]	NR	NR	The cross-sectional survey results were discussed with the communities and different containment strategies were discussed. Chemoprophylaxis was endorsed by the residents of the village. Community leaders and key workers were consulted about the project, and approval was obtained from the Tak Province Community Ethics Advisory Board (T-CAB). The T-CAB consists of representatives from both the local ethnic Karen and Burman border communities which has been the primary ethics review body for health care interventions along the border for past 6 years.	Village malaria workers were trained in detection and treatment.	Community participation was low mainly because of difficult access to the communities, which resulted from the terrain and political instability.
(NR=Not Reported, IRS=Indoor Residual Insecticide Spraying, ITN=Insecticide Treated bed net, DDT=Dichloro Diphenyl Tricholoroethane; ND=Not Done)					

2.5 Discussion

This review identified and examined reports of mass antimalarial drug administrations that described community engagement activities and/or population coverage. Conducted between December 30, 1931 and August 16, 2015, MDAs varied widely by anti-malarial regimen, study type, context, community engagement activities, and population coverage. In the following sections, the research questions are discussed with particular regard to the limitations of the reviewed articles.

2.5.1 Population coverage

Amongst the reviewed articles, the mean population coverage for the mass anti-malarial administrations was above 80%, the suggested minimum to interrupt malaria transmission [27]. Amongst the articles that described population coverage and community engagement activities, the mean was even higher. When community engagement involved government and local community structures, coverage was above 85% (range=70-100%) [63, 70, 71, 76, 78, 80, 81] and when community engagement activities depended on the community alone, mean coverage was over 80% (range=40-95%) [52, 61, 67, 111]. These figures suggest cause for optimism with regard to reaching the levels of coverage required to eliminate falciparum malaria from the Greater Mekong sub-Region.

The reporting of how population coverage was calculated was, often absent or inadequate; little detail was offered on the denominator or numerator populations, who was excluded, from anti-malarial administration, or how the total target population was calculated, with regard to including or excluding mobile groups. The absence of such detail limits direct comparisons

across the studies. Ideally, future research on mass anti-malarial administration should report the methods used to calculate population coverage.

The reviewed articles also provide few references to participants' adherence to the antimalarial regimen [67, 71, 72, 81, 110]. This is particularly relevant to multi-dose multi-day antimalarial regimens, and although adherence can be ensured by delivering antimalarials as directly observed therapy (DOT), this is likely to present challenges when part of large scale MDA programme. Low prevalence settings, such as those in the Greater Mekong sub-Region, are also likely to present potential challenges for adherence if DOT is not possible. Future research should address the question of MDA adherence in areas of low clinical malaria prevalence.

2.5.2 Community engagement activities

The reviewed articles described community engagement activities that included the simple provision of information about the MDA to the community, the utilization of existing community structures for MDA implementation, delivery of health education, and building local human resource capacity through training. Some articles provided detailed accounts of the community engagement [54, 66], overall, there was a general lack of detail regarding the approach to community engagement and the activities conducted.

Community engagement approaches have been categorized as top-down (vertical) and bottom-up (horizontal) [34]. Many of the reviewed articles reported a combination of these approaches [63, 70, 71, 76, 78, 80, 81] and community engagement was often a process, involving multiple steps. First, the top-down approach was used to garner support of officials and gain access to the research site [112, 113]. In light of the criticisms of such an approach and the need to gain the consensus of the community, more bottom-up activities were subsequently utilized [114-

116]. This is particularly the case in more recent MDAs [112, 117-119]. In many of the reviewed articles, [52, 63, 67, 70, 71, 76, 78, 80, 81, 111], the use of existing community structures, the local health system and involvement of the community in meetings, health education and training of the local staff were essential features.

Bottom-up approaches to community engagement include community-directed interventions (CDI), which entails community members taking an active role in the planning and execution of an intervention. For MDAs, such activities include carrying out the target population census, distributing drugs, mobilizing other community members and recording treatments provided [54, 63, 79]. In the reviewed Vanuatu study, 12 village volunteers were selected and trained as MDA staff who delivered each MDA dose under supervision. A multi-country review of CDIs to control and manage tropical diseases, including malaria, identified this approach as more effective at increasing coverage and achieving the targeted outcome compared to conventional vertical approaches [57, 58]. This approach was also more cost effective and operationally efficient with community members' enthusiasm described as pivotal in increasing feasibility and sustainability [58].

Analysing and comparing the community engagement activities is complicated by the diverse study conditions under which the MDAs were undertaken. These included controlled trials, which entailed close monitoring of participants, whereas others were less intensive implementation studies. Aspects of these controlled clinical trials, such as the provision of incentives (and/or healthcare), would not be feasible as part of a larger implementation and only qualified lessons can be drawn from such studies. With regard to incentives, during a multi-country study in Africa, the effects of different incentives types were compared: material incentives, such as gift items, money or T-shirts were less effective than "intrinsic" incentives,

such as sense of recognition, the feeling of making a worthwhile contribution and knowledge gained [57, 58]. Reimbursement of transportation costs and household gift items (e.g. soap) was also relevant [57].

In most of the reviewed MDAs, community engagement activities focused on promoting the population coverage and facilitating study operations. However, for many researchers, community engagement now encompasses the broader aim of promoting ethical global health research through, for example, socially responsible knowledge production, capacity development, and health promotion, such as through changes in health behaviour [2, 16, 120]. From this perspective, community engagement cannot be simply evaluated in terms of its contribution to the study aims, in the case of mass antimalarial administration, mainly population coverage.

The local social and cultural context also influences MDA coverage and adherence in various ways: for example, community members' familiarity with antimalarials, perceptions about the seriousness of malaria and its local prevalence can influence people's readiness to take medicines when apparently healthy. The nature of the antimalarial, particularly any adverse events that are associated with it and how they are interpreted with regard to local understandings of illness, is also likely to influence community responses to the intervention. Similarly, the local availability of healthcare prior to the study could influence participation. Political divisions within the target community, and perceived or enacted nepotism can foster resentment and objections towards a MDA.

2.5.3 Community engagement in mass anti-malarial administration - an update

Over the last century, community engagement has been accompanying mass drug administration in various forms, mostly for the instrumental purpose of achieving optimal population coverage [3]. Even more notably, community engagement or some of its components, for example, sensitizing authorities, communities or conducting meetings with the villagers were inevitable for the implementation of MDA, however, were simply covert and un-reported. In recent years, specifically, after the failure of "one size fits all" strategy, the concept of community directed interventions and community partnered strategy began to evolve [3, 34, 58]. This further led to an acknowledgement of the specific cultures and the social contexts where MDAs are conducted [6].

2.5.4 An update regarding recent literature

In recent years (2015 onwards), community engagement activities, processes, challenges and practicalities have been increasingly reported. Many of these reports are from the various TME sites within the GMS [5, 6, 30-33, 46, 47, 77, 121-124] and a few from Africa [118, 119].

2.5.5 Strengths and limitations

This review is the first comprehensive analysis of the published literature on community engagement and population coverage in mass anti-malarial administrations. The findings are limited by the relatively low proportion of articles that documented community engagement activities (45%; 23/51). The findings are also limited by the heterogeneity of study methods, populations and study sites. This is particularly relevant in terms of the methods used to calculate population coverage, which was often reported with insufficient detail to ensure fair comparisons.

2.6 Conclusion

The reviewed MDAs varied widely by anti-malarial regimen, study design, context, era, community engagement activities, and population coverage. The mean population coverage for the reviewed mass anti-malarial administrations was above 80%, but inadequate reporting of coverage calculation methods complicates comparisons between studies. Various community engagement activities and approaches were described, many of which contained limited or no details. Community engagement played a major role in achieving high population coverage in mass antimalarial drug administrations. Amongst the reviewed articles, coverage was highest when community engagement involved government and community structures, such as in Nicaragua and on Aneityum Island. Other factors, such as the social, cultural and study context, may also play an important role but were not investigated by these articles. More research is needed to disentangle the factors influencing population coverage, adherence, and "success" in mass antimalarial administrations, and the role of community engagement activities and approaches. Future research must also 1) report the full methods used to calculate population coverage; 2) provide details of community engagement activities; and 3) evaluate the impact of the local social context as well as the particular community engagement activities and strategies.

2.7 Implications for community engagement in Laos TME

The findings from the systematic literature review were critical in guiding the strategies of community engagement. For example, involvement and collaboration with the existing health facilities, together with the members of the community was found to be crucial. In the reviewed

literature, the importance of community involvement and collaboration as an important element for successful implementation of mass antimalarial administration was consistently reported. Moreover, the review suggested that involving and collaborating with both government authorities and local community members led to higher population coverage. Laos TME utilized such an approach.

Drawing from the literature, I identified that there was a huge gap in reporting of the factors embedded in local social and cultural context. This prompted me to think about exploring and reporting in full the local social and cultural context using mixed-methods. Specifically, this led me to employ elements of implementation research, including formative research to explore the knowledge, attitudes, perceptions towards malaria, MDA, preventive measures, health seeking behaviour and the local social, political and economic context. The details and findings of the formative research are described in chapter III.

CHAPTER III

Baseline survey in TME villages before the design of community engagement for MDA

3.1 A mixed methods study of treatment-seeking behaviour for febrile illnesses and its implications for malaria control and elimination in Savannakhet Province, Lao PDR (Laos)

3.1.1 Abstract

Introduction

Health seeking behaviour for febrile illness and malaria is shaped by the interaction between an individual, social and health services in a given setting. It is critical to explore the determinants of health seeking behaviour in relation to febrile conditions including malaria to guide the current implementation of malaria elimination through mass drug administration and to formulate recommendations for future malaria control programmes in Lao PDR. The main objective of this study was to explore the factors affecting the health seeking behaviour for febrile illnesses using quantitative and qualitative approaches.

Methods

Household heads or their representatives (n=281) were interviewed using a structured questionnaire. Eight to ten people from each study village (n=100) were included for focus group discussions (FGDs). In addition, observations were recorded as field notes (n=130) and were used to supplement the local context including the health seeking behaviour and the health services.

Result

Almost three-quarters (201/281) of respondents reported fever in the past two months. Most (92%, 185/201) sought treatment of whom 80% (149/185) sought treatment at a health centre. Geographic proximity to a health centre (AOR=6.5; CI=1.74-24.25; for those ≤ 3.5km versus those ≥ 3.6km) and previous experience of attending a health centre (AOR=4.7; CI=1.2-19.1) were strong predictors of visiting a health centre for febrile symptoms. During FGDs, respondents described seeking treatment from traditional healers and at health centres for mild to moderate illnesses. Respondents also explained how if symptoms, including fever, were severe or persisted after receiving treatment elsewhere, they preferentially sought assistance at health centres. Access to local health centres/hospitals was often constrained by a lack of transportation and an ability to meet the direct and indirect costs of a visit.

Conclusion

In Nong District, a rural area bordering Vietnam, people seek care from health centres offering Western medicine and from spiritual healers. Decisions about where and when to attend health care facilities depended on their economic status, mobility (distance to the health centre, road conditions, availability of transport), symptoms severity and illness recognition. Current and future malaria control/elimination programmes could benefit from greater collaboration with the locally accessible sources of treatments, such as health volunteers and traditional healers.

3.1.2 Introduction

Over recent years, the decline in malaria incidence and malaria-related mortality in the Greater Mekong Sub-region has prompted countries in the region to consider the prospect of malaria elimination [125]. As states in the GMS adopt strategies to eliminate malaria, identifying and appropriately managing the remaining cases becomes increasingly critical for elimination. In the GMS, the remaining malaria cases together with the burden of parasite reservoir are clustered in hard-to-reach populations, with high mosquito densities, abundance of larval habitats, and human-mosquito interactions, which results from time spent working in forests and the practice of swidden cultivation [44, 126].

Among various methods for malaria control and elimination, strategies piloted for malaria elimination in the GMS include the distribution of long lasting insecticide treated bed nets, mass drug administrations and strengthening of village malaria worker networks to ensure appropriate malaria diagnosis and case management [26]. Several factors influence the success of these interventions: access particularly in the wet season; inadequate healthcare infrastructure; poverty; and human behaviour [127].

How people respond to febrile illness is critical to malaria prevention, control, and ultimately elimination [3, 34, 128-130]. The many factors that influence behaviour include people's understanding of illness, their past experiences, and the available methods of diagnosis and treatment [131]. Understanding treatment seeking behaviour and its underpinnings is important for the design of an intervention package and, particularly, the design of the accompanying health messages and the health education tools [3, 6].

In Laos, several studies have explored health seeking behaviour for number of health conditions, such as maternal and child health [132, 133], sexually transmitted infections [134], respiratory infections [135] and the impacts of available health care infrastructures [136-140]. There is a paucity of published research on health seeking behaviour for febrile illnesses in Laos, specifically focusing on population living in remote, malaria endemic regions. Drawing on qualitative and quantitative data collected prior to a pilot study of targeted malaria elimination (TME), this chapter explores patterns and determinants of treatment seeking behaviour for febrile illness in remote villages in Nong District, Savannakhet Province.

3.1.3 Materials and methods

This mixed-methods study combined a questionnaire-based survey with focused group discussions (FGDs) and structured observations, which were recorded as field notes. The combination of methods allowed for triangulation of formal data collection techniques (questionnaire and FGDs) with recording information on informal behaviours and utterances in real-life situations. The questionnaire-based survey enabled the research team to collect community-wide data and elicit the opinions of all the households in the targeted communities. Such a community-wide approach was taken in the context of MDA, which targeted all community members regardless of malaria infection status. In the villages selected for this intervention (which also included blood tests over three consecutive months), it was critical to thoroughly explore the knowledge, attitude, perceptions and practice towards the febrile illnesses and malaria so as to design a tailored community engagement to maximize the uptake of MDA for the potential interruption of local malaria transmission [14, 17]. FGDs were conducted after the completion of the questionnaire survey to explore the reasons that underpinned responses to the questionnaire survey. Observational field notes were collected

throughout the study period. Observations of behaviours and utterances in the communities where MDA was conducted were used to provide wider information on the local social and cultural context relevant to malaria, febrile illnesses, preventive measures, treatment seeking and the wider healthcare situation, which are not dictated by the themes and topics of the questionnaire survey and FGDs. The observations were recorded in field notes and typed up for analysis.

The design of the questionnaire was based on a review of literature discussed below. The themes addressed in the FGD guide were designed to reflect the topics covered in the questionnaire.

3.1.3.1 Study participants and questionnaire

The four malaria endemic villages (Oi Tan Tip: OTP, Phoun Mak Mee: PMM, Tha Thay: TT and Xuang Tai: XT) selected for TME were the study sites [20]. The study population consisted of one member, preferably the household head, from every household in the four TME villages. There were a total of 281 households in 4 villages (OTP = 65, PMM = 74, TT = 82 and XT = 60). Each respondent, representing a household, was interviewed using a structured questionnaire that consisted of questions on socio-demographic characteristics and health seeking behaviour in response to febrile illness.

Two Lao social scientists interviewed respondents at their household after obtaining written informed consent, mostly in the Lao language. For a few respondents who could not speak the Lao language, a bilingual local study coordinator translated on site to note down the responses by interviewees. A household head or any other representative of house above 18 years old were selected for the study. If members of the household were not present during the survey,

they were followed up later. None of the household members refused to participate. Respondents representing a total of two households were away and interviewed once they returned. Representatives from all households within four selected villages were ultimately interviewed. Interviews lasted between 30 and 45 minutes.

The questionnaire was drafted in English with the help of two Laotian field workers, translated into Lao language and back-translated to English to ensure accuracy and validity. For this study, three sections out of five were retained that included: I. general information about the interview; II. socio-demographic characteristics, such as age, sex, religion and marital status; and III. health seeking behaviour. Socio-economic variables were designed after reviewing the past studies from Laos [134, 135, 140] and elsewhere [30, 51]. Questions on health seeking behaviour for febrile illness were drafted after reviewing past studies, conducted in Laos [134, 135], Uganda [141] and Ghana [142] and further modified to suit the local cultural context.

All data are drawn from participants' responses apart from the approximate distance between household and the health centre, which were estimated by the interviewers. The question on health seeking behaviour was: *"if you have fever, where do you usually go for treatment first?"* Responses such as health centres, health posts and district hospitals including village health volunteers were categorized as "Western health facilities" and other facilities such as "traditional healers", including spiritual healers and sorcerers were categorized as "non-Western medical facilities".

Two field workers pre-tested the data collection tools with the TME study team and 15 volunteer participants around Mahosot Hospital in Vientiane. Further pre-testing was carried out in Nong District with six households. Ambiguities were corrected and simplified.

Data management and analysis

The questionnaire responses were entered into the Open Data Kit application on a smartphone in English (ODK; Available online: https://opendatakit.org/). Two field workers conducted the interviews using two smartphones with on-site translation from either a local study coordinator or a bilingual village volunteer (fluent in Pasha Lao and local ethnic language) and were recorded in English in ODK. All data were extracted into Excel (Microsoft Excel 2013) and analysed in IBM SPSS Statistics for Windows, Version 24.0, Armonk, NY: IBM Corp.

Categorical variables were cross tabulated with health seeking behaviour for febrile illness (attitude) categorized as attending: 1. Western facility and 2. non-Western facility, using Chi squared and Fisher's exact test wherever appropriate. Association was considered significant at p value ≤ 0.05. Similarly, bivariate and multivariate analyses were conducted using logistic regression models to calculate odds ratios.

Logistic regression analysis

Based on their statistical significance (p value ≤ 0.05) and relevance to the research question, variables were categorized to the presence of certain characteristics as 1 and their absence as 0. These variables were analysed into a multivariate logistic regression model. First, bivariate analysis was conducted with the dependent variable (health seeking behaviour categorized as "allopathic (Western) medical facility=1 and non-allopathic facility as "non-Western facility"=0) to calculate crude odds ratio. In the multivariate model, age and sex were controlled for in the model to calculate the adjusted odds ratio. Statistical significance was ascertained at p value ≤ 0.05.

3.1.3.2 Focused group discussions and field notes

Twelve FGDs were conducted with a total of 100 participants (with 8-10 participants per FGD) from four villages and their sub-villages. Each group discussion included eight to ten adult participants (above 18 years and consenting to participate) selected by randomization using a lottery method during village meetings. Some participants also completed the survey questionnaire. Male and female participants were interviewed in separate groups by a male and a female interviewer respectively.

The discussions took place in the home of one of the villagers. The interviewers made use of an open ended questionnaire guide developed by the study team. The FGD questionnaire guide used open questions about health seeking behaviour on broad themes such as *"When and how do you decide to go for treatment when you are sick?"* Each FGD lasted for about 30 to 45 minutes. The discussions were conducted in the Lao language and translated into local language on site. Local language refers to the language spoken by Mon-Khmer speaking aboriginals who reside in these villages. All respondents gave written consent to record and analyse their replies. The discussions were recorded, transcribed and translated into English by the field workers who conducted the FGDs.

In addition to FGDs, field notes were collected based on the observation of the TME- related activities, including the local health infrastructure, road conditions, transportation means and common health practices. Field notes contained the location, subject of the notes, date and descriptions of the issues in question (for example: health services, traditional practices) based on the formal/informal discussions, meetings and interviews. Field notes were taken in English with on-site translation where necessary. A total of 130 field notes were collected from September 2015 to August 2016.

Translated and transcribed FGD transcripts together with field notes were analysed using the qualitative data analysis software QSR NVivo 11. All transcripts were coded line-by-line using pre-set themes (deductive approach) as nodes. Further nodes were added for emerging themes (inductive approach). Based on the research question, all the nodes were analysed for the pattern and the content.

3.1.3.3 Ethics statement

Ethical approval for the study was received from the Lao National Ethics Committee for Health Research (Ref. No. 013-2015/NECHR), Government of the Lao PDR and the Oxford Tropical Research Ethics Committee (1015-13).

3.1.4 Results

3.1.4.1 Health care infrastructure in study villages

Based on the observations captured in field notes, all four villages; Oi Tan Tip (OTP), Phoun mak mee (PMM), Tha Thay (TT) and Xuang Tai (XT) were home to members of the ethnic minorities who belonged to Mon-Khmer speaking aboriginals (Figure 3.1). Residents of the study villages, were mostly *Tri* and *Mangkong* ethnic groups and are described below. OTP consisted of two sub-villages Oi and Tantip both located at the border of Vietnam separated by a river. There is no health centre in OTP and the primary health care was provided by village health volunteers. The nearest health centre was 10 km away. In PMM there is a health centre within the confines of the village and the houses were clustered into a single village. Three sub-villages (Appok, TT main and TT Geng) comprised TT and the nearest health centre was about 3 km away. In XT, there were two sub-villages (Xung Ngai and Xuang Gang) and the nearest health centre was about 5 km away. Amongst the villages, OTP was farthest from the

district hospital (approximate distance to district hospital for OTP ≥ 40 km, PMM ≥ 25 km, XT ≥ 10km and TT was ≥18km). Apart from the facilities offering primarily allopathic services (western medical facilities), traditional healing embedded in spiritual practices, referred in this study as "Animist religion" was available to residents.

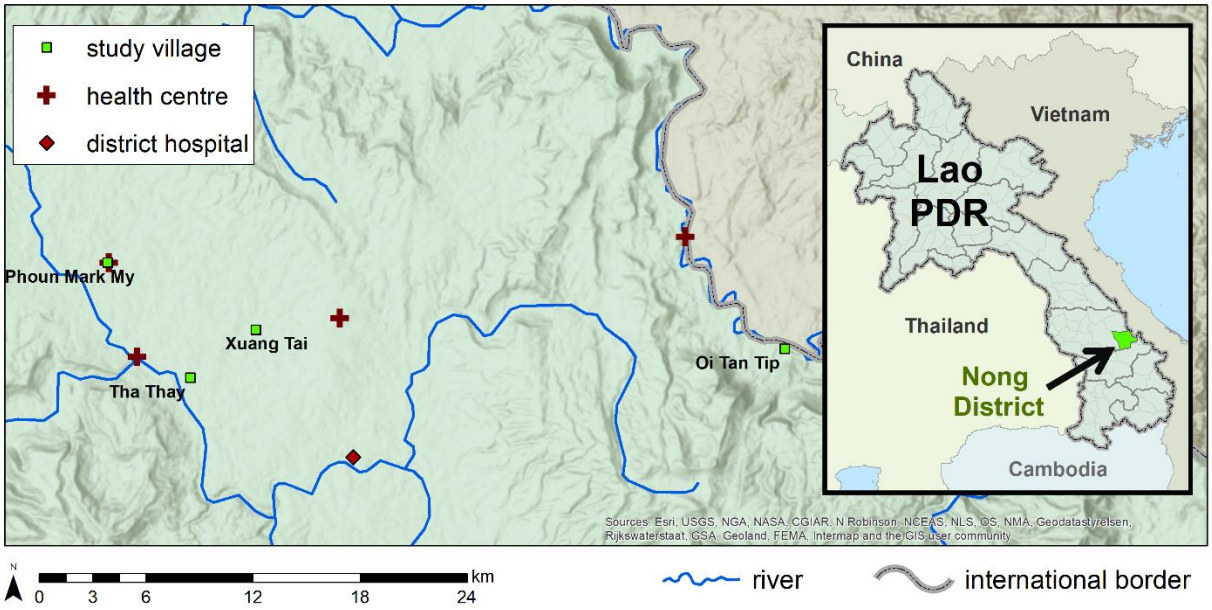


Figure 3. 1: Study villages, health centres and district hospital in Nong district, Savannakhet province, Lao PDR

Data recorded from observations highlighted how traditional healing consisted of mostly informal spiritual practices, specific to this region. In general, traditional healers could be divided into spiritual healers and sorcerers. Spiritual healers were consulted for minor illnesses, and were easily found. For more severe and chronic illnesses, such as repeated fever episodes or persistent weight-loss, sorcerers practicing witchcraft were consulted. The sorcery healing aims to pacify disease-causing spirits by sacrificing animals such as pigs, chicken and cows.

In all villages and sub-villages, traditional practitioners were respected and used alongside the Western medical centres.

Community members also purchased over-the-counter medicines from authorized or unauthorized pharmacies, including, in Nong District, mobile drug vendors who visit from Vietnam. These drugs were commonly bought for minor complaints, such as headache, common cold and lower back pain. They are cheap treatment options compared to the costs of visiting a health centre.

3.1.4.2 Questionnaire based survey

Socio-demographic and household characteristics of participants

Almost all respondents (96%, 269/281) were from the ethnic minority groups that consisted of *Mangkong*=200 (71.2%), *Tri*=65 (23.1%), *Phu Thai*=5 (1.8%), *Vietnamese* (Vietnamese in this study refers migrant population from Vietnam working in Laos)=4 (1.4%), *Ta Oi*=3 (1.1%), *Ka Tarng*=1 (0.4%), *Lao Loum*=3 (1.1%). The majority **(**76%; 201/281) were male, illiterate 76% (214/281) and 73% (204/281) had no formal education. Respondents who had attended a school and were of a high socio-economic status (income >240 USD per month) were more likely to attend a health centre compared to respondents with low socio-economic status (income <60 USD per month) (25/27; 93% compared with 131/192; 68%, p=0.007). Educated high socio-economic group individuals were also more likely to attend western health facilities than respondents who had not attended school and were from a lower socio-economic status (p=0.034; Table 3.1).

Respondents who reported attending western health facilities, were more likely to own a tractor (p=0.013) and lived further from the forest than respondents who owned no tractors or lived

closer to the forest (p=0.007; Table 3.2). Most households (275/281; 98%) owned agricultural land and more than half (153/281; 54%) owned a motorbike (Table 3.3).

Health seeking behaviours

Almost three-quarters of participants (72%, 201/281) reported having fallen sick or having a fever in the past two months (a two-month period was chosen to minimize recall bias) and more than 90% of those (185/201) sought treatment. Half of the respondents (49.1% 138/281) walked to the nearest health centre. A minority (8%, 16/201) who did not seek treatment responded that they were either self-cured, took medicine from village health volunteers or from families or friends. Among those who sought treatment, 71% sought treatment at Western health facilities (200/281). Past health care seeking practices, such as visiting a health centre ($p<0.001$), was associated with the intention to visit Western medical facilities. Other factors such as distance to a health centre ($p<0.001$), a good road to the health centre (p=0.002), and satisfaction with the health centre ($p<0.001$) were associated with increased attendance at Western medical facilities (Table 3.3).

Factors affecting health seeking behaviour using logistic regression

Bivariate and multivariate logistic regression were conducted to explore independently significant factors associated with attendance at a Western health facility. Respondents who belonged to the lowest income group (AOR=0.16; CI = 003 to 0.76; p=0.02), who had sought assistance from a spiritual healer or sorcerer in the past (AOR=0.02; CI=0.005 to 0.08; $p<0.001$) and who preferred medicine over-the-counter (AOR=0.04; CI=0.008 to 0.22; $p<0.001$) were less likely to attend Western medical facility. In contrast, participants who

attended a health centre in the past (AOR=4.69; CI=1.15 to 19.06; p=0.03) and who stayed nearest to the health centre (AOR=6.5; CI=1.74 to 24.25; p=0.005) were likely to attend western medical facility when sick (Table 3.4).

3.1.4.3 Qualitative data

General patterns of health seeking behaviour

A total of 100 participants from villages and sub-villages were included in 12 FGDs which had a similar proportion of male (52%) and female (48%) participants. Their mean age was 37 years, 82% did not attend school and all were farmers (Table 3.5). Health seeking at Western and traditional medical facilities and the factors affecting it are summarized in a schematic diagram (Figure 3.1).

Villagers described a mental map of where to seek care, depending upon the type of illness, and constraints to accessing the facility of choice, such as money, distance and the means of transportation.

> *I: Are there any reasons why someone in this community would not seek treatment?*
>
> *FGD1S1: If they [villagers] do not have money [they will not go]. If they have, they will go.*
>
> *FGD1S2: We do not have money.*
>
> *(All others agreed).*
>
> *I: Are there reasons why someone in this village would not seek treatment (for fever)?*
>
> *FGD1S2: No money*
>
> *I: What about the transportation?*

FGD1S2: Even if you have motorbike, if you don't (have) money for gasoline, you cannot go.

FGD with eight female participants in "Oi" sub-village of OTP.

For mild illnesses (e.g. cold), community members often sought assistance from village health volunteers in addition to buying medicine over-the-counter or taking traditional remedies or herbs, both of which are prevalent practices in the villages (Figure 3.2). For mild to moderate illnesses, respondents were likely to first attend traditional healers and then Western health centres. If villagers recognized specific diseases, such as malaria, diarrhoea and respiratory illnesses, they were more likely to attend a health centre. Respondents described being more likely to attend traditional healers (spiritual healers and sorcerers) if they felt the response at the Western health facility was not satisfactory. Sometimes, respondents described their reasons for visiting traditional healers as embedded in their cultural practices.

I: When you were sick, where did all of you go for treatment?

FGD11S1: Hospital (Health centre).

I: Did you go to the spiritual healer (Yao)?

FGD11S1: Yes, I did. We always do [Yao] first before we go to hospital because this is our culture.

I: What about sorcerer (Mor Pao)?

FGD11S1: We go, if we are very sick.

I: The spiritual healer and sorcerer is the same person or not?

FGD11S1: No! It is not same.

FGD with eight female participants in Xuang Tai.

Community members described how their choices were often constrained by money at each stage: Respondents also described how visiting spiritual healers was more frequent and more economical than visiting sorcerers who were often reserved for moderate to severe illnesses. Money, distance and a lack of appropriate transport were reported as barriers to accessing Western health (facilities) centres. The problems increased if respondents wanted to visit tertiary health centres (e.g. the district hospital, provincial hospital and hospital across the border). Respondents described eloquently how unsuccessful visits to health centres and an inability to seek further care forced them to "return home and wait for death".

I: If somebody feels sick (malaria) in your village, where do they normally go for treatment??

FGD2S1: Danvilay health centre.

FGD2S2: I will buy medicine with village health volunteer.

FGD2S3: Danvilay health centre.

FGD2S5: I will treat (seek treatment) with village health volunteer if it does not work I will go to health centre.

FGD2S1: if the health centre does not work I will go to District hospital, if the district hospital does not work I will go to Savannakhet hospital, if Savannakhet hospital does not work I will come back home and wait to die.

FGD with eight male participants at “Oi” sub-village of OTP.

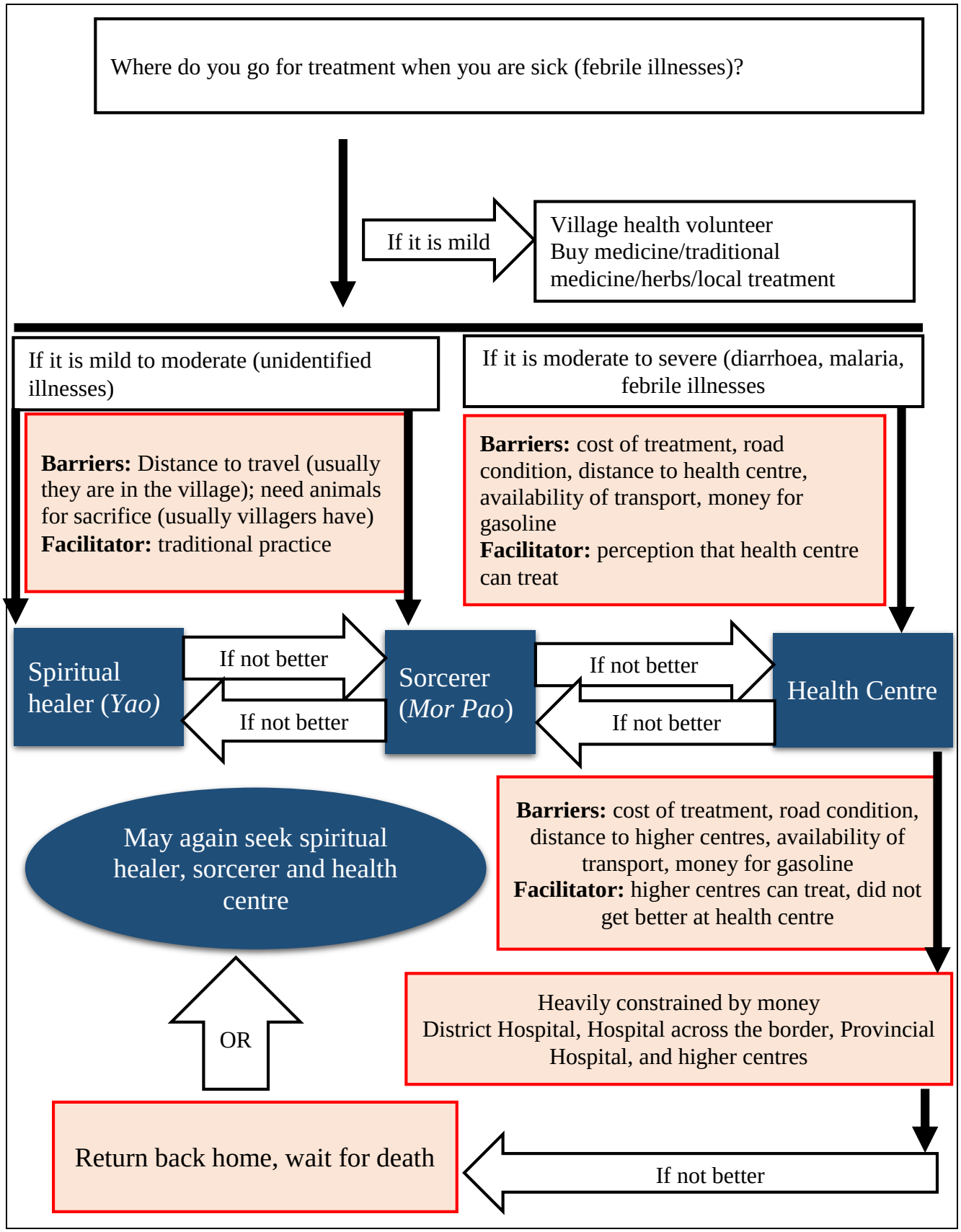


Figure 3. 2 Schematic map of health seeking behaviour of villagers

Table 3. 1: Health seeking behaviour in relation to socio-economic characteristics of the participants (n=281)				
Characteristics	**Total (n=281)**	**Western Medical Facility (n=200)**	**Non-Western Medical Facility (n=81)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
Villages				
OTP	65 (23.1)	52 (26)	13 (16)	0.306
PMM	74 (26.3)	50 (25)	24 (29.6)	
TT	82 (29.2)	55 (27.5)	27 (33.3)	
XT	60 (21.4)	43 (21.5)	17 (21)	
Respondent status				
Family head	188 (66.9)	139 (69.5)	49 (60.5)	0.309
Wife of family head	70 (24.9)	45 (64.3)	25 (30.9)	
Other	23 (8.2)	16 (8)	7 (8.6)	
Age Group				
≤30 years	91 (32.4)	63 (31.5)	28 (34.6)	0.869
31-50 years	138 (49.1)	99 (49.5)	39 (48.1)	
≥51 years	52 (18.5)	38 (19)	14 (17.3)	
Sex				
Male	201 (71.5)	149 (74.5)	52 (64.2)	0.083
Female	80 (28.5)	51 (25.5)	29 (35.8)	
Ethnicity*				
Ethnic minority	269 (95.7)	192 (96)	77 (95.1)	0.472
Other	12 (4.3)	8 (4)	4 (4.9)	
Religion				
Buddhist	9 (3.2)	8 (4)	1 (1.2)	0.213
Animist	272 (96.8)	192 (96)	80 (98.8)	
Marital status				
In relationship	262 (93.2)	186 (93)	76 (93.8)	0.518
Not in relationship	19 (6.8)	14 (7)	5 (6.2)	
Literacy				
Literate	67 (23.8)	54 (27)	13 (16)	0.051
Illiterate	214 (76.2)	146 (73)	68 (84)	

Level of Education				
Not attended school	204 (72.6)	138 (69)	66 (81.5)	**0.034**
Attended school	77 (27.4)	62 (31)	15 (18.5)	
Occupation				
Farmer	254 (90.4)	183 (91.5)	71 (87.7)	0.322
Other	27 (9.6)	17 (8.5)	10 (12.3)	
Monthly Income				
≤500,000 kip	192 (68.3)	131 (65.5)	61 (75.3)	**0.007**
500,001 to 2,000,000 kip	41 (14.6)	33 (16.5)	8 (9.9)	
≥2,000,001 kip	27 (9.6)	25 (12.5)	2 (2.5)	
Don't know/NA	21 (7.5)	11 (52.4)	10 (12.3)	
Daily Expense				
≤1,000 kip	99 (35.2)	72 (36)	27 (33.3)	0.289
1001 to 10,000 kip	120 (42.7)	80 (40)	40 (49.4)	
≥10,000 kip	62 (22.1)	48 (24)	14 (17.3)	
Is the income enough to sustain living?				
Yes	82 (29.2)	52 (26)	30 (37)	**0.047**
No	198 (70.5)	148 (74)	50 (61.7)	
Not sure/Don't know	1 (0.4)	0	1 (1.2)	

***Ka Tarng=1 (0.4%), Lao Loum=3 (1.1%), Mangkong=200 (71.2%), Phu Thai=5 (1.8%), Ta Oi=3 (1.1%), Tri=65 (23.1%), Vietnamese=4 (1.4%)**

Table 3. 2: Health seeking behaviour in relation to household characteristics of the participants (n=281)

Characteristics	**Total (n=281)**	**Western Medical Facility (n=200)**	**Non-Western Medical Facility (n=81)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
What do you own?*				
House	281 (100)	200 (71.2)	81 (28.8)	NA
Land	275 (97.9)	196 (71.3)	79 (28.7)	0.556
Motorbike	153 (54.4)	106 (69.3)	47 (30.7)	0.263
Bicycle	7 (2.5)	3 (42.9)	4 (57.1)	0.109
Tractor	51 (18.1)	29 (56.9)	22 (43.1)	**0.013**
Cars	4 (1.4)	3 (75)	1 (25)	0.673
Cattle	118 (42)	87 (73.7)	31 (26.3)	0.421

TV	53 (18.9)	38 (71.7)	15 (28.3)	0.926
Radio	11 (3.9)	5 (45.5)	6 (54.5)	0.062
Phones	122 (43.4)	91 (74.6)	31 (25.4)	0.165
What are your walls of your home made from?*				
Bamboo	126 (44.8)	94 (74.6)	32 (25.4)	0.253
Wood	189 (67.3)	128 (67.7)	61 (32.3)	0.067
Concrete	1 (0.4)	0	1	0.288
Plastic	10 (3.6)	7 (70)	3 (30)	0.588
Metal	8 (2.8)	3 (37.5)	5 (62.5)	**0.047**
What is the roof of your home made from?*				
Bamboo	21 (7.5)	16 (76.2)	5 (23.8)	0.402
Wood	4 (1.4)	3 (75)	1 (25)	0.673
Plastic	5 (1.8)	5 (100)	0	0.18
Metal	212 (75.4)	147 (69.3)	65 (30.7)	0.234
Shingles	53 (18.9)	41 (77.4)	12 (22.6)	0.175
What is the floor of your home made from?*				
Bamboo	44 (15.7)	31 (70.5)	13 (29.5)	0.909
Wood	251 (89.3)	181 (72.1)	70 (27.9)	0.212
Mud	2 (0.7)	2 (100)	0	0.506
Concrete	8 (2.8)	3 (37.5)	5 (62.5)	**0.047**
Do you have toilet facility at home?				
Yes	22 (7.8)	14 (7)	8 (9.9)	0.279
No	259 (92.2)	186 (93)	73 (90.1)	
Did you migrate from any other village?				
Yes	61 (21.7)	43 (21.5)	18 (22.2)	0.894
No	220 (78.3)	157 (78.5)	63 (77.8)	
If Yes how long have you been living here?				
≤10 years	28 (45.9)	18 (41.9)	10 (55.6)	0.617
11-20 years	17 (27.9)	13 (30.2)	4 (22.2)	
≥21 years	16 (26.2)	12 (27.9)	4 (22.2)	
How far is the forest from your house in km?				
≤1 km	97 (34.5)	57 (28.5)	40 (49.4)	**0.007**
1.1 to 2km	76 (27)	62 (31)	14 (17.3)	
≥2.1km	49 (17.4)	37 (18.5)	12 (14.8)	
NA	59 (21)	44 (22)	15 (18.5)	
How far is the forest from your house in min?				
≤7 min	19 (34.5)	16 (39)	3 (21.4)	0.442
7.1 to 60min	21 (38.2)	14 (34.1)	7 (50)	
≥61min	15 (27.3)	11 (26.8)	4 (28.6)	
How far is your rice field from your house in km?				

≤1 km	75 (26.7)	56 (28)	19 (23.5)	0.331
1.1 to 2km	84 (29.9)	64 (32)	20 (24.7)	
≥2.1km	56 (19.9)	36 (18)	20 (24.7)	
NA/Not own Land	66 (23.5)	44 (22)	22 (27.2)	
How far is your rice field from your house in Min?				
≤20 min	18 (33.3)	13 (35.1)	5 (29.4)	0.577
21 to 60 min	30 (55.6)	21 (56.8)	9 (52.9)	
≥61 min	6 (11.1)	3 (8.1)	3 (17.6)	
How often do you go to forest?				
Everyday	171 (60.9)	126 (63)	45 (55.6)	0.441
Every Alternate Day	68 (24.2)	47 (23.5)	21 (30.9)	
≥Weekly	42 (14.9)	27 (13.5)	15 (18.5)	
***Includes only "yes" answers and since multiple answers were possible, percentage do not add to 100.**				

Table 3. 3: Health seeking behaviour in relation to health centre and past behaviour (n=281)				
Characteristics	**Total (n=281)**	**Western Medical Facility (n=200)**	**Non-Western Medical Facility (n=81)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
Have you ever become sick or had fever in the past 2 months?				
Yes	201 (71.5)	143 (71.5)	58 (71.6)	0.986
No	80 (28.5)	57 (28.5)	23 (28.4)	
If Yes, did you seek treatment? (n=201)				
Yes	185 (92)	134 (93.7)	51 (87.9)	0.14
No	16 (8)	9 (6.3)	7 (12.1)	
If Yes, where did you first seek treatment? (n=185)				
Self-treatment				
No	184 (99.5)	134 (100)	50 (98)	0.276
Yes	1 (0.5)	0	1 (2)	
Sorcerer				
No	137 (74.1)	123 (91.8)	14 (27.5)	**<0.001**
Yes	48 (25.9)	11 (8.2)	37 (72.5)	
Health centre				
No	36 (19.5)	14 (10.4)	22 (43.1)	**<0.001**
Yes	149 (80.5)	120 (89.6)	29 (56.9)	
Other				

No	167 (90.3)	121 (90.3)	46 (90.2)	0.588
Yes	18 (9.7)	13 (9.7)	5 (9.8)	
Which do you prefer more between?				
Lao Traditional Medicine	4 (1.4)	3 (1.5)	1 (1.2)	**0.023**
Western Medical Facilities	274 (97.5)	197 (98.5)	77 (95.1)	
NA	3 (1.1)	0	3 (3.7)	
How far is the nearest health centre from your home in km?				
≤3.5km	94 (33.5)	84 (42)	10 (12.3)	**<0.001**
3.6 to 12km	99 (35.2)	67 (33.5)	32 (39.5)	
≥12.1km	88 (31.3)	49 (24.5)	39 (48.1)	
How far is the nearest health centre from your home in min?				
≤30min	49 (63.6)	22 (52.4)	27 (77.1)	0.065
≥31min	26 (33.8)	19 (45.2)	7 (20)	
NA	2 (2.6)	1 (2.4)	1 (2.9)	
How do you get to the health centre/hospital?				
By walk	138 (49.1)	97 (48.5)	41 (50.6)	**0.002**
By some means	136 (48.4)	102 (51)	34 (42)	
NA	7 (2.5)	1 (0.5)	6 (7.4)	
Is the road to nearest health centre in good condition?				
Yes	214 (76.2)	157 (78.5)	57 (70.4)	**0.002**
No	62 (22.1)	43 (21.5)	19 (23.5)	
Don't know	5 (1.8)	0	5 (6.2)	
Are you satisfied with your nearest health centre?				
Yes	261 (92.9)	192 (96)	69 (85.2)	**<0.001**
No	8 (2.8)	6 (3)	2 (2.5)	
Don't know	12 (4.3)	2 (1)	10 (12.3)	
Can you get medicine on the counter?				
Yes	85 (30.2)	70 (35)	15 (18.5)	**<0.001**
No	188 (66.9)	129 (64.5)	59 (72.8)	
Don't know	8 (2.8)	1 (0.5)	7 (8.6)	
Do you prefer on the counter medicine?				
Yes	23 (8.2)	12 (6)	11 (13.6)	**0.001**
No	246 (87.5)	184 (92)	62 (76.5)	
Don't know	12 (4.3)	4 (2)	8 (9.9)	
If Yes, Why?				
Because it is easy				
No	5 (21.7)	5 (41.7)	0	**0.024**
Yes	18 (78.3)	7 (58.3)	11 (100)	

I don't like to go to health centre				
No	22 (95.7)	11 (91.7)	11 (100)	0.522
Yes	1 (4.3)	1 (8.3)	0	
It is faster				
No	15 (65.2)	9 (75)	6 (54.5)	0.278
Yes	8 (34.8)	3 (25)	5 (45.5)	
It is cheaper				
No	22 (95.7)	12 (100)	10 (90.9)	0.478
Yes	1 (4.3)	0	1 (9.1)	
Because doctors do not prescribe				
No	21 (91.3)	10 (83.3)	11 (100)	0.261
Yes	2 (8.7)	2 (16.7)	0	
Other				
No	22 (95.7)	11 (91.7)	11 (100)	0.522
Yes	1 (4.3)	1 (8.3)	0	
NA				
No	21 (91.3)	10 (83.3)	11 (100)	0.261
Yes	2 (8.7)	2 (16.7)	0	

Table 3. 4: Logistic regression analysis to identify independently significant variables associated with western medicine seeking behaviour

Covariates	**Responses**		**Univariate Analysis**	**p-value**	**Multivariate analysis**	**p-value**
	Yes	**No**	**Crude OR (95% CI)**		**AOR* (95% CI)**	
	Number (%)	**Number (%)**				
Attended school	77 (27.4)	204 (72.6)	1.97 (1.0 to 3.73)	**0.036**	0.53 (0.14 to 2.02)	0.35
Lowest income group	192 (68.3)	89 (31.7)	0.62 (0.34 to 1.15)	0.11	0.16 (0.03 to 0.76)	**0.02**
Perceived enough income	82 (29.2)	199 (70.8)	0.59 (0.34 to 1.03)	0.067	1.1 (0.25 to 4.76)	0.89
Owns Tractor	51 (18.1)	230 (81.9)	0.45 (0.24 to 0.85)	**0.014**	0.29 (0.05 to 1.53)	0.14

House from forest ≥2.1 km	49 (17.4)	232 (82.6)	1.3 (0.64 to 2.65)	0.46	2.88 (0.71 to 11.67)	0.13
Went to Sorcerer	48 (25.9)	137 (74.1)	0.03 (0.01 to 0.081)	**<0.001**	0.02 (0.005 to 0.08)	**<0.001**
Went to health centre	149 (80.5)	36 (19.5)	6.5 (2.97 to 14.23)	**<0.001**	4.69 (1.15 to 19.06)	**0.03**
Prefer western medicine	274 (97.5)	7 (2.5)	3.41 (0.74 to 15.59)	0.11	0.09 (0.004 to 2.09)	0.13
Health centre is nearest (<3.5km)	94 (33.5)	187 (66.5)	5.14 (2.5 to 10.55)	**<0.001**	6.5 (1.74 to 24.25)	**0.005**
Road to health centre is good	214 (76.2)	67 (23.8)	1.53 (0.85 to 2.75)	0.14	0.56 (0.16 to 1.95)	0.36
Satisfied with the health centre	261 (92.9)	20 (7.1)	4.17 (1.63 to 10.64)	**0.003**	2.19 (0.32 to 14.61)	0.41
Can get medicine on the counter	85 (30.2)	196 (69.8)	2.36 (1.26 to 4.45)	**0.007**	1.22 (0.26 to 5.72)	0.79
Prefer medicine on the counter	23 (8.2)	258 (91.8)	0.4 (0.17 to 0.96)	**0.041**	0.04 (0.008 to 0.22)	**<0.001**
***Adjusted for variables age and sex**						

Table 3. 5: Socio-demographic characteristics of FGD Participants (n=100)

	Total	**Village: Number (%)**					
Characteristics	**Number (%)**	**Oi**	**Tantip**	**PMM**	**Keng and Appok**	**TT main**	**XT**
Age Group							
≤35 years	51 (51)	7 (13.7)	12 (23.5)	6 (11.8)	13 (25.5)	7 (13.7)	6 (11.8)
>36 years	49 (49)	9 (18.4)	4 (8.2)	12 (24.5)	5 (10.2)	9 (18.4)	10 (20.4)
Mean=37.58±12.71; Range=18-80 years							
Sex							
Male	52 (52)	8 (15.4)	8 (15.4)	10 (19.2)	10 (19.2)	8 (15.4)	8 (15.4)
Female	48 (48)	8 (16.7)	8 (16.7)	8 (16.7)	8 (16.7)	8 (16.7)	8 (16.7)
Occupation							

Farmer	100 (100)	16 (16)	16 (16)	18 (18)	18 (18)	18 (18)	16 (16)
Education Groups							
Not attended school	82 (82)	12 (14.6)	10 (12.2)	13 (15.9)	17 (20.7)	14 (17.1)	16 (19.5)
1-5 years	16 (16)	4 (25)	5 (31.3)	5 (31.3)	1 (6.3)	1 (6.3)	0 (0)
>6 years	2 (2)	0	1 (50)	0	0	1 (50)	0

3.1.5. Discussion

This is the first study to explore the treatment seeking behaviours for febrile illness in remote villages in one of the poorest districts of Laos with a predominantly ethnic minority population.

In remote villages of Laos, respondents highlighted several barriers to seeking treatment in Western health facilities: the absence of cash, distance to health care providers, absence of transport, the availability of traditional healing practices and the expected costs of health centre visits [132, 134, 135, 138, 143]. Participants with low income were less likely to attend Western health facilities and this reflects the impact of income on health seeking that has been reported in other areas of Laos [132, 133, 136-140].

3.1.5.1 Costs

Cash to pay for treatment came from the sale of domestic animals, such as cows, pigs, goats, chicken and buffaloes. However, during an emergency, it was often impossible to sell domestic animals in a short period of time. The mobile merchants on whom community members depended to make a sale come at unpredictable intervals from Vietnam. This is also specific for Nong District, which borders Vietnam [6]. Economic constraints have been described as a major determinant in many low-income countries, including Uganda [141] and Bangladesh

[144]. Participants with lower incomes reported underutilization of Western health services, delaying the treatment seeking because often the cost of health care exceeded their monthly income.

3.1.5.2 Distance and transport

The proximity of household to the health centre was found to be an important determinant of Western health care utilisation. Respondents who resided closest to the health centre (≤ 3.5 km between house and the health centre) reported being more likely to seek care there. The distance to health centre is a well-established determinant of care utilisation in Laos [132, 133, 135]. Similarly, in Uganda, distance to health centre was found to affect the uptake of health services [141]. In Nepal, longer distance and longer travel time were found to be associated with higher cost and recognized as a barrier for attending health centres [145]. In Nigeria, delay in attending a health centre was associated with longer walking distance to the health centre [146].

Remote villages are often also hotspots for malaria transmission [44]. In such villages, Western health centres were popular sources of care for febrile illness, but community members' access to these services was affected by their socio-economic status and the lack of local infrastructure. Improving essential infra-structures, particularly roads and public transportation, is needed to improve accessibility. However, the remoteness of these villages presents significant challenges to infrastructure development. Building the capacity of existing local village volunteers (village malaria workers) with additional training and strengthening their involvement with the malaria control programmes is one way to mitigate barriers to accessing health services.

3.1.5.3 Other sources of treatment

As in many settings, in Nong District, respondents described how traditional healers are deeply rooted to the local culture and customs [147, 148]. In the study villages, a mix of practices was described, with the preferred source of treatment influenced by illness severity, economic status and road conditions. Decisions were often influenced by the opinions of other household members, the village head, and traditional healers [6, 46, 47]. A mix of traditional and Western medicine has been described in past studies from Laos [149], Kenya [150] and Uganda [151]. Given their prominence and the respect that they garner in the community, malaria control programmes should consider collaborating with traditional healers as a means to strengthening their links to communities.

Amongst community members who participated in the questionnaire, more than a third respondents were likely to seek over-the-counter medication. Popular for minor complaints, such as headache, common cold and low back pain, they are attractive options particularly because of the costs associated with visiting a district hospital or health centre. Since the 1960s [152], medicines have been purchased from authorized or unauthorized pharmacies, including, in Nong District, mobile drug vendors who visit from Vietnam [138].

3.1.5.4 Strengths and limitation

This study used qualitative and quantitative methods for data collection. Three researchers collected data to reduce the possibility of bias caused by the influence of a single data collector. Cultural modesty and conformism including social desirability bias may have affected the data from FGDs and questionnaire. The findings are limited by the fact that this study took place as a baseline and formative research to inform and guide the community engagement and TME.

This study derived the data from on-site translation from bilingual translators who were fluent in *Lao* and the local ethnic language. The ethnic language spoken by the minority groups has no written script and some nuances and meaning could have been lost during translation. This study is also limited by the fact that health-seeking behaviour were explored in terms of febrile illness. In the current context of malaria elimination targeting a sub-clinical malaria reservoir, further research is required to explore knowledge, perceptions and attitudes towards the concept of asymptomatic malaria to inform the appropriate strategies.

3.1.6 Conclusion

Treatment for febrile illness was sought from Western health centres and traditional practitioners, depending upon the severity of symptoms, availability of cash, distance to health centre, road conditions, and the availability of transport. In spite of these barriers health centres were the preferred choice for treatment. Improvements in local infrastructures would probably help to overcome some of these issues but are likely to take time and considerable investment. In light of redoubled efforts to eliminate malaria, however, at least in the short-term, less costly options include strengthening the network of village health volunteers and involving traditional healers. These groups are easily accessible to community members and their roles in malaria control strategies could be strengthened through training and by formalizing their links with these programmes.

3.1.7 Implications for community engagement in Lao TME

These findings clearly showed that there were a multitude of barriers for community members to access health care. Drawing from this study, community engagement in Laos TME was adapted to provide free mobile health care in each village, free treatment at the existing health

centres, deployment of additional physicians in the villages, and transportation facilities to patients and their members if they were attending district hospitals. In addition, locally available village health volunteers were trained and provided with the rapid diagnostic kits for malaria diagnosis and primary health care tools including anti-malarials. Apart from managing the cases of malaria, village volunteers were charged with taking care of patients and worked under the close supervision of TME physicians. How these findings helped to design the community engagement are detailed in chapter IV. In subsequent sub-chapter, I further discuss the knowledge, attitudes, and perceptions towards malaria and MDA in the study villages, so as to guide the community engagement, specifically health education tools.

3.2 Perceptions of asymptomatic malaria infection and their implications for malaria control and elimination in Laos

3.2.1 Abstract

Introduction

In the Greater Mekong Sub-region, malaria elimination efforts are targeting the asymptomatic parasite reservoir. Understanding community perceptions about asymptomatic malaria infections and interventions that target this reservoir is critical to the design of community engagement. This part of the chapter examines knowledge, attitudes, perceptions and practices related to asymptomatic malaria infections and mass drug administration (MDA) in malaria-endemic villages in southern Savannakhet Province, Laos.

Methods

This is a sub-study arising from the methods used in Chapter III (3.1). Themes and variables in this study are focused on knowledge, attitudes, perceptions and practices on malaria and MDA.

Result

A minority (14.2%; 40/281) of respondents agreed that a seemingly healthy person could have malaria parasites in their blood. Half (52%; 146/281) disagreed and one third (33.8%, 95/281) were unsure. During the FGDs, respondents recalled signs and symptoms of malaria (fever, chills and headache), and indicated malaria as a major health problem. Symptomatic and asymptomatic malaria infections were perceived to be associated with their work in the forest and unhygienic conditions. Responses on measures to eliminate malaria included using

mosquito nets, wearing long-sleeved clothes and taking medicine when symptomatic. Most respondents were unaware of MDA as a tool to eliminate malaria.

Conclusion

Awareness of asymptomatic malaria infections and MDA as a tool to eliminate malaria, was low. With the need to target asymptomatic malaria carriers for elimination efforts in the GMS, accompanying community engagement must inform target groups about asymptomatic infection, and also build trust in MDA through the active collaboration of government stakeholders, key local persons and community members. This entails training and devolving responsibilities to the community members to implement and sustain the control and elimination efforts.

3.2.2 Introduction

The emergence of antimalarial resistance in the Greater Mekong sub-Region (GMS) has triggered greater efforts to contain its spread within the region and beyond [21, 26]. This, together with general declines in malaria incidence, has prompted malaria control programs in the region to set targets for the elimination of *falciparum* malaria by 2025 and all malarias by 2030 in GMS countries [24]. Lao Peoples Democratic Republic (Laos) has adopted the goal of eliminating malaria by 2025 [44].

Achieving such goals is challenging for several reasons. First, the emerging resistance to all antimalarials itself poses a serious challenge for containment [153]. Second, malaria tends to cluster in populations that live along international borders, within forested areas and in forest fringes [24]. These communities are often geographically isolated and highly mobile, have low levels of literacy, experience language barriers, include ethnic minorities, endure a lack of health care services and experience high levels of human-mosquito interaction [6].

With recent declines in clinical malaria, there is increasing evidence that asymptomatic parasite carriers play a critical role in sustaining transmission [26]. Seemingly healthy individuals can have chronic carriage of asexual (gametocytes) and sexual forms of the parasite that are critical for transmission [154]. This is particularly the case in low- and seasonal-transmission areas where people with chronic, asymptomatic infections may serve as the infectious reservoir during subsequent seasons [154]. Data from Cameroon, The Gambia, Mali and Senegal indicate that over 25% of individuals with sub-microscopic gametocytes were capable of infecting mosquitoes [155].

Elimination programmes must therefore target asymptomatic malaria reservoirs to eliminate rapidly the disease. Mass drug administration, whereby a complete dose of antimalarial treatment is provided to the entire targeted population, regardless of infection status, is one such approach [26]. Strategies such as mass screening and treatment (MSAT), focal screening and treatment (FSAT) and voluntary screening and testing (VSAT) for malaria require testing all people in a geographical area and treating only positive cases [156, 157]. All these approaches also entail people taking antimalarials when asymptomatic.

Recent MDAs for targeted falciparum malaria elimination have highlighted the challenges related to convincing healthy people to take antimalarials [6, 31, 33, 46, 122]. The rationale for this approach involves complex biological concepts and communicating them to people with low levels of formal education and frequently across language barriers [6, 46, 47]. Furthermore, local decline in clinical *falciparum* cases might mean that malaria is no longer a priority in target communities and reduce the willingness of some people to take antimalarials [33].

The situation is further complicated by the presence of *P. vivax* and *P. falciparum* in Southeast Asia [158]. Unlike *P. falciparum, P. vivax* parasite has a latent liver stage, the hypnozoite, which can cause relapsing infections for months and years [44, 159, 160]. Hypnozoites represent a difficult to eradicate additional parasite reservoir which contributes to ongoing transmission; radical therapy targeting this parasite requires the addition of a 14 days course of primaquine [160], which carries the risk of haemolysis in G6PD-deficient individuals [161]. In remote communities of the GMS, knowledge about malaria species and the mechanisms of infection is however low [6, 33, 47]. Yet after the elimination of *P. falciparum* infections, *P. vivax* infections are likely to persist.

This part of the chapter draws on mixed-methods formative research conducted prior to TME pilot study in Nong District, southern Savannakhet Province, Laos. The chapter explores understandings of asymptomatic malaria infections in a geographically remote area, with a view to designing community engagement strategies to accompany interventions that target the parasite reservoir.

3.2.3 Materials and Methods

3.2.3.1 Study participants and questionnaire

This study utilized the same questionnaire as mentioned in chapter 3 in methods (3.1.3.1 Study participants and questionnaire).

Variables in the questionnaire for section IV (malaria related knowledge, attitudes and practices) and section V (knowledge and attitudes towards MDA) were designed after carefully reviewing the previous studies from Laos [134, 135, 140] and elsewhere [30, 51, 141, 142, 162].

Data management and analysis

All data entered into smartphones using ODK were extracted into Excel (Microsoft Excel 2013) and analysed in IBM SPSS Statistics for Windows, Version 24.0, Armonk, NY: IBM Corp.

Following a descriptive analysis (frequency and percentage) the data were analysed using Chi squared and Fisher's exact tests as appropriate to determine associations. Each respondent was asked whether asymptomatic malaria infections were possible. Depending on the responses made on whether a healthy looking person could have malaria parasites in his/her blood,

answers were categorized as “Yes”, “No” and “Don’t know”. In this study perceptions on asymptomatic malaria infections was treated as an outcome variable and were further dichotomized into “Yes” and “No” (“No” and “Don’t know” were merged together) to explore the association with perception on possibility of asymptomatic malaria infection. All other variables (socio-demographic, knowledge, attitude, practice and perceptions on malaria and MDA) were tested for association with the outcome variable and an association was considered significant at p value ≤0.05.

Further analysis using logistic regression was carried out in which variables were selected based on significant association with perception on asymptomatic malaria infections and the relevance to the research question. For the logistic regression analysis, selected variables were dichotomized, with presence of certain characters/conditions = 1 and absence = 0. At first, a univariate analysis was conducted with the outcome variable (perception on asymptomatic malaria infection categorized as “Yes”=1 and “No”=0) to calculate crude odds ratios. In the multi-variate analysis, selected variables were included into the model to calculate the adjusted odds ratio. Statistical significance was considered if p value ≤0.05.

A quantitative questionnaire was corroborated by development of a questionnaire/topic guide for FGDs with the objective of addressing the reasons behind the particular responses.

3.2.3.2 Focused Group discussions

This study utilized a focused group discussions and the methods described in chapter 3.1.

3.2.3.3 Ethics approval and consent to participate

Ethical approval for the study was received from the Lao National Ethics Committee for Health Research (Ref. No. 013-2015/NECHR), Government of the Lao PDR and the Oxford Tropical

Research Ethics Committee (1015-13). Written informed consent were sought from each participant before each interview and FGD.

3.2.4 Results

3.2.4.1 Questionnaire based survey

Awareness of asymptomatic malaria infections

Of the 281 participants, only 40 (14.2%) thought that a seemingly healthy person could have malaria parasites in his/her blood. Over half (146/281; 52%) rejected this idea and a third (95/281; 33.8%) responded that they did not know (Table 3.6).

Respondents' literacy (illiterate: 22/214; 10.3% versus literate: 18/67; 26.9%; p=0.001), education status (not attended school: 22/204; 10.8% versus attended school: 18/77; 23.4%; p=0.008), occupation (farmer: 29/254; 11.41% versus non-farmer: 11/27;40.7 ;<0.001), monthly income (lowest income group: ≤500,001 kip: 14/192; 7.3% versus middle income group: 500,001 to 2,000,000 kip: 11/41; 26.8%; p<0.001), were significantly associated with the perception of the possibility of asymptomatic malaria infections.

Malaria-related knowledge, practices and perceptions

Almost all respondents, 260/281 (92.5%) had heard about malaria before (Table 3.7 and 3.8). Among these 260 respondents, most could recall the symptoms of malaria such as fever: 231/260; 88.8%, headache: 190/260; 73.1% and chills: 227/281; 87.3%. In the past, a majority received information on malaria from health workers (193/281; 74.2%) and knew that malaria was transmitted by mosquitoes (230/281; 81.9%). Respondents who recalled that mosquitoes transmit malaria were likely to perceive the possibility of asymptomatic malaria infections

(37/230; 16.1%; compared to those who did not: 3/51; 5.9%; p=0.004). A majority of respondents recalled that using mosquito nets at home (274/281; 97.5%) and wearing long sleeves in the forest (262/281; 93.2%) can prevent mosquito bites. Also, a majority (256/281; 91.1%) of respondents recalled sleeping under the mosquito net the previous night at home. On additional prompting, most respondents perceived that malaria was a deadly disease (265/281; 94.3%) and were confident that malaria could be cured by medicine (275/281; 97.9%).

Knowledge, perceptions and attitudes towards MDA

Most respondents described malaria as an important problem in their communities (178/281; 63.3%) (Table 3.9). Respondents who agreed with the idea of asymptomatic malaria infections also agreed that a healthy person with malaria parasite in his or her blood can transmit the infection (23/103; 22.3%; p<0.001). When asked if medicine should be provided to community members with asymptomatic malaria infections, three-quarters (78/103) answered "yes", and this was to "to cure all villagers" (11/29; 37.9%). A majority (241/281; 86%) have not heard about the malaria elimination effort in their village. More than half (162/281; 57.7%) of the respondents replied that malaria can be eliminated from their village and when asked about the ways (options) to eliminate, respondents chose giving medicine to all the villagers (105/162; 64.8%), using mosquito nets (81/162; 50%) and cleaning the surroundings (23/162; 14.2%). Respondents who thought that malaria elimination was possible were more likely to perceive the possibility of asymptomatic malaria infections (Yes: 30/162; 18.5% versus No and Don't know: 10/109; 9.1%; p=0.08). A majority of respondents showed enthusiasm (208/281; 74%) about participating in a future malaria elimination campaign as a volunteer and were likely to

perceive the possibility of asymptomatic malaria infections (Yes: 35/208; 16.8% versus No: 5/60; 8.3%; p=0.08).

Multivariate logistic regression

Using logistic regression, the following factors were found to be associated with the perceived possibility of asymptomatic malaria infections (Table 3.10). 1. Interest to take part in future MDAs (AOR=9.5; CI=1.2 to 75.7; p=0.03). Respondents were asked whether if MDA for malaria was to happen in their village in future, they would take part in it. Respondents with enthusiasm to participate in future MDA for malaria were likely to agree to the concept of asymptomatic malaria infections. 2. Understanding that the rationale of MDA is to cure all people including people with asymptomatic infections (AOR=4.4; CI=1.57 to 12.7; p=0.005). Respondents who thought providing antimalarials to all community members (to cure all people with malaria and asymptomatic malaria infections) were likely to perceive the possibility of asymptomatic malaria infections. 3. The rationale of participating in MDA as a volunteer is to make community free from malaria (AOR=3.3; CI: 1.3 to 8.2; p=0.008). Respondents motivated to contribute as a volunteer in MDA were more likely to perceive the concept of asymptomatic malaria infections.

3.2.4.2 Focused Group Discussions

Characteristics of the participants

One hundred community members were chosen at random to participate in six FGDs each including male and female participants from four villages and their sub-villages (Table 3.5). The mean age of respondents was 37 years, ranging from 18 to 80 years. Fifty two of the 100

respondents were male. All participants were farmers and the majority (82/100) had not attended school.

Knowledge of malaria

Almost all FGD participants showed knowledge of malaria. Locally termed *"Aai moi kap"* (disease mosquito bite) or *"Aai singyet"* (disease chills), respondents often recalled headache, fever, chills, shivering, vomiting, and body pain as symptoms. Some also mentioned vomiting, thirst, cough and cold, and diarrhoea.

Asymptomatic malaria infection as a concept

The concept of asymptomatic malaria infection was new to participants and only a few agreed that a healthy person could have malaria parasites in his or her blood. However, respondents also suspected that they could perhaps have a type of malaria, which they associated with the nature of their work and the cleanliness of conditions in their village. When probed about whether these healthy-looking but infected people could be infectious, almost all participants agreed.

> *I: How do you know if somebody has malaria?*
>
> *FGD7S1: When we go to forest and mosquito bite us.*
>
> *FGD7S2: If a person goes to forest and mosquito bites but we cannot know from the look.*
>
> *FGD7S3: If you see the mosquito bite and if that person has chills that means he/she has got malaria*
>
> *[After a brief pause]*

I: Let's continue. How do you know if someone has malaria?

FGD7S5: By checking temperature

FGD7S6: By mosquito bite.

FGD7S7: if somebody takes medicine and got cured, we can know that person has malaria.

FGD7S8: We know it if somebody goes to hospital and finds out that he/she has malaria.

FGD with eight female participants at a sub-village of TT

I: Do you think that a healthy person (who is walking around and working normally) can be infected?

FGD6S1 (after discussing amongst themselves first): All of us have malaria parasites inside our body because we are thin, we do not live clean, we always go to the forest and mosquito bites us. But for your project [TME] members, you do not have malaria parasite in your body because your lifestyle and living is the opposite to ours.

FGD with 10 male participants at PMM

Malaria as a health problem in the villages

Many respondents described malaria as a major problem in their village. This was linked to the past experiences when many community members died of malaria, that it can be fatal (if left untreated), or the out of pocket expenses for treatment can be a major burden for the household. Respondents described sleeping under a mosquito net as essential to protect from

the malaria and that inadequate mosquito nets prompted concern about this disease. Respondents also explained the presence of malaria in their villages in terms of their living conditions, particularly poor hygiene, and the nature of their work in the forests, where they often receive mosquito bites.

I: Is malaria a big problem in your village and if so why?

FGD6S1: Yes. It is big because a lot of people had malaria, many died and they had to spend a lot of money to treat it. (All other agreed).

FGD with 10 male participants at PMM

I: Malaria is a big problem in your village?

FGD5S2: Yes!

I: Why?

FGD5S2: We eat and stay unclean.

FGD5S8: Our clothes are unclean too, because we don't have money to buy soap for washing clothes.

FGD5S7: Mosquito net is very old and broken.

FGD with 8 female participants at PMM

Ways to eliminate malaria

The respondents gave multiple suggestions regarding how malaria could be eliminated: providing mosquito nets, wearing long sleeves, taking medicine when sick, cleaning the environment surrounding their homes, improving water and sanitation, and building health centres in their villages.

I: Do you think malaria can be eliminated from the village? Why and How?

FGD12S2: Yes, we all the villagers have to sleep under the mosquito net. During the day, we have to wear long-sleeves.

FGD12S4: By using mosquito net.

FGD12S5: Medicine, mosquito net and toilet facility.

FGD12S6: Toilet facility: agreed with S5.

FGD with 8 male participants at XT

I: Do you think malaria can be eliminated from the village? Why and How?

FGD3S2: Yes [malaria can be eliminated], if the project helps.

FGD3S3: Yes, it is possible to eliminate if the project can build a health center here and check our health. And it should have enough doctors.

FGD3S8: By giving out mosquito nets.

FGD with 8 female participants at sub-village of OTP

Taking an anti-malarial when healthy was a new idea. However, most respondents said that they would take it to eliminate malaria from the village and protect themselves, particularly because malaria was recognized as a deadly disease.

Table 3. 6: Socio-demographic characteristics of participants in relation to perception on asymptomatic malaria infections (n=281)				
	Total	**Possibility of asymptomatic malaria infections**		**p-value**
Characteristics	**Number (%)**	**Yes (n=40)**	**No (n=241)**	
Village				
OTP	65 (23.1)	16 (40)	49 (20.3)	**<0.001**
PMM	74 (26.3)	2 (5)	72 (29.9)	
TT	82 (29.2)	5 (12.5)	77 (32)	
XT	60 (21.4)	17 (42.5)	43 (17.8)	
Respondent status				
Family head	188 (66.9)	29 (72.5)	159 (66)	0.35
Wife of family head	70 (24.9)	10 (25)	60 (24.9)	
Other	23 (8.2)	1 (2.5)	22 (9.1)	
Age Group				
≤30 years	91 (32.4)	13 (32.5)	78 (32.4)	0.28
31-50 years	138 (49.1)	23 (57.5)	115 (47.7)	
≥51 years	52 (18.5)	4 (10)	48 (19.9)	
Mean=38.9±14.5, min=18 and max=100				
Sex				
Male	201 (71.5)	30 (75)	171 (71)	0.37
Female	80 (28.5)	10 (25)	70 (29)	
Ethnicity*				
Ethnic minority	269 (95.7)	32 (80)	237 (98.3)	**<0.001**
Other	12 (4.3)	8 (20)	4 (1.7)	
Religion				
Buddhist	9 (3.2)	8 (20)	1 (0.4)	**<0.001**
Animist	272 (96.8)	32 (80)	240 (99.6)	
Marital Status				
In relationship	262 (93.2)	39 (97.5)	223 (92.5)	0.21
Not in relationship	19 (6.8)	1 (2.5)	18 (7.5)	
Literacy				
Literate	67 (23.8)	18 (45)	49 (20.3)	**0.001**
Illiterate	214 (76.2)	22 (55)	192 (79.7)	

Education in years				
Not attended School	204 (72.6)	22 (55)	182 (75.5)	**0.008**
Attended School	77 (27.4)	18 (45)	59 (24.5)	
Occupation				
Farmer	254 (90.4)	29 (72.5)	225 (93.4)	**<0.001**
Other	27 (9.6)	11 (27.5)	16 (6.6)	
Monthly Income				
≤500,000 kip	192 (68.3)	14 (35)	178 (73.9)	**<0.001**
500,001 to 2,000,000 kip	41 (14.6)	11 (27.5)	30 (12.4)	
≥ 2000,001	27 (9.6)	11 (27.5)	16 (6.6)	
Don't know	21 (7.5)	4 (10)	17 (7.1)	
Do you have toilet facility at home?				
Yes	22 (7.8)	4 (10)	18 (7.5)	0.38
No	259 (92.2)	36 (90)	223 (92.5)	
Did you migrate from any other village?				
Yes	61 (21.7)	13 (32.5)	48 (19.9)	0.06
No	220 (78.3)	27 (67.5)	193 (80.1)	
How far is the forest from your house in km?				
≤1 km	97 (34.5)	10 (25)	87 (36.1)	0.24
1.1 to 2 km	76 (27)	13 (32.5)	63 (26.1)	
≥2.1 km	49 (17.4)	5 (12.5)	44 (18.3)	
NA	59 (21)	12 (30)	47 (19.5)	
How often do you go to forest?				
Everyday	171 (60.9)	24 (60)	147 (61)	0.26
Every alternate day	68 (24.2)	7 (17.5)	61 (25.3)	
≥Weekly	42 (14.9)	9 (22.5)	33 (13.7)	
***Ka Tarng=1 (0.4%), Lao Loum=3 (1.1%), Mangkong=200 (71.2%), Phu Thai=5 (1.8%), Ta Oi=3 (1.1%), Tri=65 (23.1%), Vietnamese=4 (1.4%)**				

Table 3. 7: Knowledge, practices, perceptions and attitudes towards malaria of participants in relation to perception on asymptomatic malaria infections (n=281)				
	Total	**Possibility of asymptomatic malaria infections**		**p-value**
Characteristics	**Number (%)**	**Yes (n=40)**	**No (n=241)**	

Have you heard of malaria before?				
Yes	260 (92.5)	38 (95)	222 (92.1)	0.71
No	18 (6.4)	2 (5)	16 (6.6)	
Don't know	3 (1.1)	0	3 (1.2)	
What are the symptoms of malaria? (n=260)*				
Fever	231 (88.8)	33 (86.8)	198 (89.2)	0.42
Headache	190 (73.1)	32 (84.2)	158 (71.2)	0.06
Muscle pain	46 (17.7)	12 (31.6)	34 (15.3)	**0.01**
Vomiting	45 (17.3)	7 (18.4)	38 (17.1)	0.5
Chills	227 (87.3)	32 (84.2)	195 (87.8)	0.34
Where did you get the information on malaria from? (n=260)*				
Village Meetings	3 (1.2)	1 (2.6)	2 (0.9)	0.39
Health workers	193 (74.2)	24 (63.2)	169 (76.1)	0.07
Banners	2 (0.8)	2 (5.3)	0	**0.02**
Other	49 (18.8)	8 (21.1)	41 (18.5)	0.42
Don’t know	41 (15.8)	13 (34.2)	28 (12.6)	**0.002**
Where would you like to get health information from?*				
Village Meetings	59 (21)	9 (22.5)	50 (20.7)	0.47
Health workers	137 (48.8)	23 (57.5)	114 (47.3)	0.15
Banners	56 (19.9)	6 (15)	50 (20.7)	0.27
Entertainment	52 (18.5)	9 (22.5)	43 (17.8)	0.3
Other	13 (4.6)	2 (5)	11 (4.6)	0.57
Don’t know	31 (11)	5 (12.5)	26 (10.8)	0.46
Malaria is transmitted from*				
Water	14 (5)	2 (5)	12 (5)	0.61
Soil	1 (0.4)	1 (2.5)	0	0.14
Forest	55 (19.6)	9 (22.5)	46 (19.1)	0.37
Mosquito	230 (81.9)	37 (92.5)	193 (80.1)	**0.04**
God	1 (0.4)	0	1 (0.4)	0.85
Uncleaned Surrounding	30 (10.7)	4 (10)	26 (10.8)	0.57
Don’t know	29 (10.3)	0	29 (12)	**0.009**
How do you prevent mosquito bites at home?*				
Using mosquito net	274 (97.5)	40 (100)	234 (97.1)	0.33
Using repellents	5 (1.8)	1 (2.5)	4 (1.7)	0.53
By smoking	2 (0.7)	0	2 (0.8)	0.73
Wearing Sleeves	16 (5.7)	3 (7.5)	13 (5.4)	0.4
How do you prevent mosquito bites at forest?*				
Using mosquito net	1 (0.4)	0	1 (0.4)	0.85
Burning fire	11 (3.9)	2 (5)	9 (3.7)	0.48

Using repellents	7 (2.5)	5 (12.5)	2 (0.8)	**0.001**
By smoking	1 (0.4)	1 (2.5)	0	0.14
Wearing Sleeves	262 (93.2)	39 (97.5)	223 (92.5)	0.21
*Multiple answers were possible and percentage does not add to 100, analyses were made against "yes" and "no".				

Table 3. 8: Knowledge, practices, perceptions and attitudes towards malaria of participants in relation to perception on asymptomatic malaria infections (n=281)

	Total	**Possibility of asymptomatic malaria infections**		**p-value**
Characteristics	**Number (%)**	**Yes (n=40)**	**No (n=241)**	
Did you sleep under the mosquito net last night?				
Yes	256 (91.1)	38 (95)	218 (90.5)	0.27
No	25 (8.9)	2 (5)	23 (9.5)	
If Yes, how often do you sleep under the mosquito net?				
Everyday	247 (96.5)	35 (92.1)	212 (97.2)	0.13
Sometimes (>2-3 days in a week)	9 (3.5)	3 (7.9)	6 (2.8)	
How many mosquito nets do you have at your home?				
≤2	156 (55.5)	23 (57.5)	133 (55.2)	0.46
≥3	125 (44.5)	17 (42.5)	108 (44.8)	
Do you think you can get malaria if anybody in your family/neighbour has malaria?				
Yes	164 (58.4)	27 (67.5)	137 (56.8)	0.26
No	83 (29.5)	11 (27.5)	72 (29.9)	
Don't know	34 (12.1)	2 (5)	32 (13.3)	
If Yes, how? (n=164)*				
Touch	75 (45.7)	8 (29.6)	67 (48.9)	**0.05**
Air	11 (6.7)	0	11 (8)	0.12
Mosquito	108 (65.9)	21 (77.8)	87 (63.5)	0.11
Water	33 (20.1)	4 (14.8)	29 (21.2)	0.32
Food	34 (20.7)	4 (14.8)	30 (21.9)	0.29
How do we know if a person has malaria?*				
Blood	178 (63.3)	30 (75)	148 (61.4)	0.06
Fever	73 (26)	14 (35)	59 (24.5)	0.11

Health worker	90 (32)	11 (27.5)	79 (32.8)	0.32
Other	33 (11.7)	2 (5)	31 (12.9)	0.11
Is malaria a deadly disease?				
Yes	265 (94.3)	40 (100)	225 (93.4)	0.24
No	12 (4.3)	0	12 (5)	
Don't know	4 (1.4)	0	4 (1.7)	
Are you scared of malaria?				
Yes	277 (98.6)	39 (97.5)	238 (98.8)	0.58
No	3 (1.1)	1 (2.5)	2 (0.4)	
Don't know	1 (0.4)	0	1 (0.4)	
Can malaria be cured by medicine?				
Yes	275 (97.9)	38 (95)	237 (98.3)	0.4
No	3 (1.1)	1 (2.5)	2 (0.8)	
Don't know	3 (1.1)	1 (2.5)	2 (0.8)	
*Multiple answers were possible and percentage does not add to 100, analyses were made against "yes" and "no".				

Table 3. 9: Knowledge, perceptions and attitudes towards MDA of participants in relation to perception on asymptomatic malaria infections (n=281)

	Total	**Possibility of asymptomatic malaria infections**		**p-value**
Characteristics	**Number (%)**	**Yes (n=40)**	**No (n=241)**	
Is malaria a big problem in your community?				
Yes	178 (63.3)	29 (72.5)	149 (61.8)	0.06
No	43 (15.3)	8 (20)	35 (14.5)	
Don't know	60 (21.4)	3 (7.5)	57 (23.7)	
Do you think a person in your village can have malaria parasite without being sick?				
Yes	34 (12.1)	26 (65)	8 (3.3)	**<0.001**
No	144 (51.2)	9 (22.5)	135 (56)	
Don't know	103 (36.7)	5 (12.5)	98 (40.7)	
Can a healthy person with malaria parasite in his body transmit to others?				
Yes	103 (36.7)	23 (57.5)	80 (33.2)	**<0.001**
No	94 (33.5)	13 (32.5)	81 (33.6)	
Don't know	84 (29.9)	4 (10)	80 (33.2)	

If Yes, should we provide medicine to all the villagers?				
Yes	78 (75.7)	17 (73.9)	61 (76.3)	0.26
No	19 (18.4)	6 (26.1)	13 (16.3)	
Don't know	6 (5.8)	0	6 (7.5)	
If Yes, why? (n=78)*				
To cure all villagers	29 (37.2)	11 (64.7)	18 (29.5)	**0.01**
To eliminate malaria from the village	15 (19.2)	4 (23.5)	11 (18)	0.42
To prevent malaria transmission in the village	41 (52.6)	9 (52.9)	32 (52.5)	0.59
To prevent us from malaria	34 (43.6)	7 (41.2)	27 (44.3)	0.52
Have you heard of malaria elimination in your village?				
Yes	40 (14.2)	8 (20)	32 (13.3)	0.14
No	224 (79.7)	32 (80)	192 (79.7)	
Don't know	17 (6)	0	17 (7.1)	
Do you think malaria can be eliminated from your village?				
Yes	162 (57.7)	30 (75)	132 (54.8)	**0.04**
No	66 (23.5)	7 (17.5)	59 (24.5)	
Don't know	53 (18.9)	3 (7.5)	50 (20.7)	
If Yes, how? (n=162)*				
By giving medicine to all villagers	105 (64.8)	24 (80)	81 (61.4)	**0.04**
By using mosquito net	81 (50)	17 (56.7)	64 (48.5)	0.27
By taking regular medicine	9 (5.6)	1 (3.3)	8 (6.1)	0.47
By cleaning surrounding	23 (14.2)	6 (20)	17 (12.9)	0.23
Don't know	11 (6.8)	1 (3.3)	10 (7.6)	0.35
Other	30 (18.5)	6 (20)	24 (18.2)	0.49
Would you participate in malaria elimination as a volunteer?				
Yes	208 (74)	35 (87.5)	173 (71.8)	**0.08**
No	60 (21.4)	5 (12.5)	55 (22.8)	
Don't know	13 (4.6)	0	13 (5.4)	
If Yes, why? (n=208)*				
I want to make my community free from malaria	127 (61.1)	29 (82.9)	98 (56.6)	**0.002**
I want to help my community	85 (40.9)	14 (40)	71 (41)	0.53
Malaria is a big problem in my community	6 (2.9)	2 (5.7)	4 (2.3)	0.26
Other	14 (6.7)	0	14 (8.1)	0.06
Don't know	21 (10.1)	1 (2.9)	20 (11.6)	0.09
Have your ever heard about MDA before?				

Yes	257 (91.5)	36 (90)	221 (91.7)	0.66
No	16 (5.7)	2 (5)	14 (5.8)	
Don't know	8 (2.8)	2 (5)	6 (2.5)	
Would you take part in MDA in future?				
Yes	198 (70.5)	39 (97.5)	159 (66)	**<0.001**
No	82 (29.2)	1 (2.5)	81 (33.6)	
Don't know	1 (0.4)	0	1 (0.4)	
*Multiple answers were possible and percentage does not add to 100, analyses were made against "yes" and "no".				

Table 3. 10: Logistic regression on knowledge, attitude and perceptions predicting the perception on asymptomatic malaria infections

Covariates and analysed sample	**Total**	**Univariate Analysis**	**p-value**	**Multivariate analysis**	**p-value**
	Number (%)	**Crude OR (95% CI)**		**AOR (95% CI)**	
Animist religion (n=281)	272 (96.8)	0.01 (0.002 to 0.13)	**<0.001**	0.11 (0.001 to 0.17)	**0.001**
Living for less than 10 years in the village (n=61)	28 (45.9)	6.0 (2.58 to 14.03)	**<0.001**	2.69 (0.75 to 9.6)	0.12
Forest less than 1 km away (n=281)	97 (34.5)	0.59 (0.27 to 1.26)	0.17	0.18 (0.03 to 0.86)	**0.03**
Use of repellents at forest for prevention (n=281)	7 (2.5)	17.0 (3.18 to 91.39)	**0.001**	2.72 (0.23 to 31.75)	0.42
MDA is to cure all people (n=78)	29 (37.2)	4.69 (2.0 to 10.92)	**<0.001**	4.47 (1.57 to 12.72)	**0.005**
I want to make my community free from malaria (n=208)	127 (61.1)	3.84 (1.83 to 8.0)	**<0.001**	3.35 (1.36 to 8.21)	**0.008**

I will take part in MDA in future (n=281)	198 (70.5)	20.11 (2.71 to 149.0)	**0.003**	9.56 (1.2 to 75.76)	**0.03**

3.2.5 Discussion

3.2.5.1 Asymptomatic malaria infection as a concept

This is the first study to explore awareness of asymptomatic malaria infections in remote malaria-endemic communities in Laos. Asymptomatic malaria infection was a new concept and most respondents did not agree with the possibility that a seemingly healthy person could have "malaria parasites" in his or her body. For those who were open to the concept of asymptomatic malaria, infection was often perceived to be associated with living conditions (poor hygiene and a lack of mosquito nets) and outdoor work (swidden farming and forest visits). Associating malaria with forest work and hygiene is not unique to Laos: research in sub-Saharan Africa and Southeast Asia has shown that community members often associate the risk of getting malaria from work in the forest and with poor hygiene [33, 163-165]. This is reflected in epidemiological research that has associated working in the forest and residing near the forest fringes with *Plasmodium* infections [166, 167].

Difficulties with grasping the idea of asymptomatic malaria infection have been reported elsewhere. In Cambodia even after intense community engagement accompanying mass drug administration, community members and some study staff members struggled with the concept of asymptomatic *Plasmodium* infections [33]. Partial understanding, however, did not prevent community members from participating in MDA in Cambodia, Laos, or other sites [6, 31, 33, 46, 47, 122]. A multitude of factors embedded in local social and cultural context, community engagement, provision of health care and both monetary and non-monetary incentives have been found to affect the participation in Laos and elsewhere [6, 31, 33, 46, 47].

3.2.5.2 Malaria as a health problem in the villages

In southern Savannakhet, as in western Cambodia, past experiences of malaria-related morbidity, mortality and treatment costs meant that malaria was described as a major health problem [33]. In such remote communities, community members' perception of malaria as a major health problem further suggests that they were open to malaria control programs including MDA [6, 46, 47]. Malaria as a health concern was one of the factors motivating community members to take part in subsequent pilot studies of MDA in these villages [47]. In addition, members of these remote communities often have little access to healthcare because of a lack of local facilities, poverty and poor transport infrastructure [6, 46, 47]. Thus constrained by the limited health care infra-structure and the economic burden that malaria entailed, respondents were further motivated by the perceived/real health benefits directly linked to MDA and the ancillary care TME provided [46, 47].

3.2.5.3 Ways to eliminate/prevent malaria

Conventional malaria prevention measures – using mosquito nets, wearing long sleeves, treatment with antimalarials when sick – were well known to respondents. Unsurprisingly, respondents were unaware of MDA as a potential malaria prevention strategy but showed enthusiasm towards participating in future MDAs. Intention to participate and enthusiasm to volunteer in MDA was also found amongst respondents in Cambodia [162]. In Laos, this was also reflected by a relatively high participation rate in subsequent MDA (>87% participated in three rounds of MDA) [6, 46, 47]. Participation in MDA was associated with attending study meetings, awareness of the study aim and the perception that MDA was worthwhile. Decisions about participation were also influenced by other household and community members [46]. Often community members were motivated to participate in the MDAs because of the perceived potential health benefits rather than understanding the scientific concept and rationale of MDA [46, 47].

Mass drug administrations were accompanied by intensive community engagement. This entailed: informing and involving stakeholders and authority figures from central to the local level; recruitment and training of local volunteers who were integral to the design and implementation of activities; formative research to rapidly gain insight into the local social and cultural context, responsiveness whereby the approach was adapted according to the needs of the community and sharing control/leadership with the community in designing and executing program activities [6]. These elements were key in executing activities such as meetings, design of health education tools and house to house visits and were aimed primarily at promoting uptake of MDA [6, 46, 47].

3.2.5.4 Implications for malaria control programmes

Malaria control programmes in the region are dependent on the peripheral health system and may not be able to undertake such intense community engagement and sensitization as in the pilot study that followed this research [6]. Programmes, however should incorporate the active collaboration of stakeholders, including policy makers, local health care workers, traditional healers and community members. This entails building a collaborative partnership with communities wherein members of the target populations can be trained to form a community malaria task force. Sharing responsibilities with community members can garner the "sense of ownership" and sustain malaria control and elimination efforts. Community collaborative work may require considerable background work, however, this was found economical compared to the vertical disease control programmes in Africa [57, 58]. Such methods have been increasingly advocated and were found to be economical and sustainable in disease control programmes [57, 58, 120].

3.2.5.5 Strengths and limitations

The strengths and limitations in this study are the same as described in chapter 3.1.5.5. Specifically in this study, it is possible that village heads who had previously been involved in sensitization meetings regarding the pilot study conducted by higher authorities beforehand had disseminated information on MDA and its rationale to fellow community members, which could have affected some of our results.

3.2.6 Conclusion

In remote areas of Laos, prior to sensitization, awareness of asymptomatic malaria infections and MDA as a tool to eliminate malaria was low. This reflects attitudes to asymptomatic, *P.*

falciparum infection elsewhere in the GMS. Nonetheless, malaria remains a major health concern and community members can generally describe its signs, symptoms and transmission. In the context of declining clinical *falciparum* and the higher proportion of *vivax* malaria, maintaining enthusiasm to clear the asymptomatic falciparum parasite reservoir presents a challenge. Malaria control programmes should invest in community engagement that, as well as seeking to inform people about asymptomatic infection, builds trust through the active collaboration of government stakeholders, key community members (community health workers, traditional healers and local leaders) and the wider community. This entails training and devolving responsibilities to the community members to sustain the control and elimination efforts.

3.2.7 Implications for community engagement in Lao TME

Findings from this study highlighted how only a minority of the village population perceived that a healthy person could have malaria parasites in their blood. Although we anticipated that asymptomatic malaria infection would be a new concept in these research-naïve communities, findings from this study reiterated that comprehensive health education tools were critical to explain this concept. In addition, the qualitative methods provided deeper insights into how community members perceived and constructed the concept of asymptomatic malaria, particularly community members' belief that visiting forests was associated with an asymptomatic malaria. These findings helped us to modify health education tools, in particular, poster II (figure 4.6), which we adapted to approximate the local context and community members' work in the forest, demonstrating the association with asymptomatic malaria infection. How these findings helped to design the community engagement are further detailed in chapter IV.

CHAPTER IV

Elements of effective community engagement: lessons from a targeted malaria elimination study in Laos

4.1 Abstract

Introduction

Mass Drug (antimalarial) Administration (MDA) is currently under study in Southeast Asia as part of a package of interventions referred to as Targeted Malaria Elimination (TME). This intervention relies on effective community engagement that promotes uptake and adherence in target communities (above 80%).

Objective

Based on the experienced of designing and implementing the community engagement for TME in Laos, in this chapter the elements of effective community engagement for mass antimalarial administration are presented.

Methods

The design and implementation of community engagement, which took place from September 2015 to August 2016 was recorded as field notes, meeting minutes and photographs. These data underwent qualitative content analysis.

Results

The community engagement strategy that accompanied TME in Laos was successful in terms of contributing to community wide participation in mass anti-malarial administration. Based on thematic analysis of field notes, five key elements were identified: 1. Stakeholder and authority engagement, which proceeded from national level, to regional/district and local level; 2. Local human resources, particularly the recruitment of local volunteers who were integral to the design and implementation of activities in the study villages; 3. formative research, to

rapidly gain insight into the local social and economic context; 4. Responsiveness whereby the approach was adapted according to the needs of the community and their responses to the various study components and 5. Sharing control/leadership with the community in terms of decisions on the organization of TME activities.

Conclusions

TME in Laos achieved a high population coverage. Community engagement was integral to TME and was focused on promoting population coverage. Five key elements identified in this chapter reflects the major components of community engagement that accompanied TME in Laos. These elements derived from the TME pilot study can be applicable to intervention programmes in diverse contexts.

4.2 Introduction

Although global malaria-related morbidity and mortality is declining, artemisinin-resistant *Plasmodium falciparum* parasites have recently been detected in Southeast Asia. The possibility of these parasites spreading to Africa – a potential public health disaster – has prompted a shift from malaria control to elimination in Southeast Asia [21-24]. As part of a package of interventions, referred to as Targeted Malaria Elimination (TME), mass antimalarial administration (MDA) – the presumptive treatment of an entire community to interrupt completely local malaria transmission – is currently under study across the region [26].

The effectiveness of mass antimalarial administration is predicated on several factors, including high population coverage [27]. Achieving high coverage is a challenge for several reasons. For example, explaining the rationale for taking antimalarials when asymptomatic can be difficult because of the complex scientific concepts that underlie the approach [28]. Furthermore, target communities are often remote with poor access, villagers tend to be highly mobile and populations can be divided by political affiliations [3, 29-32].

To promote coverage, programmes of mass drug administration (MDA) often incorporate community engagement [3, 26-28, 33]. Most scientific reports of mass antimalarial administration however offer little detail on how community engagement is designed and what activities it entails [3]. Community engagement is often simply a short-hand for activities, such as discussions with village leaders and mass meetings to provide health education [3]. Although such activities are likely to have limited impact in terms of uniting fragmented

communities, such activities, if appropriately designed can, for example, promote understanding of the benefits of MDA and contribute to uptake in communities [30].

In the wider global health literature, community engagement has multiple meanings. Some scholars view it as an essential component of ethical good practice in research and health programmes; others prioritize community health benefits through ensuring the success of an intervention [1]. The divergent definitions and goals of community engagement complicate the evaluation and comparison of community engagement across studies [1]. Efforts have been made to identify common elements in "successful" community engagement, with some scholars providing general principles for broad health-related research [168] and others building on experience from specific research on vector-borne diseases [169].

Laos, along with other states in the Greater Mekong Sub Region has committed to the goal of eliminating malaria by 2030 [170, 171]. To achieve this, an intensification of malaria prevention and control activities – such as MDA – are required [26]. Understanding effective community engagement to accompany such efforts is imperative to ensure their uptake in the target communities.

From the outset of TME in Laos, a broad definition of community engagement, as a process of working collaboratively with relevant partners who share common goals and interests, was used [1-3, 168]. Established frameworks [2, 169] were used to guide community engagement with the primary aim of promoting uptake of MDA to maximize the probability of interrupting local malaria transmission (which was the overall aim of TME). In target communities, inhabited by majority of ethnic minorities, with language barriers and high poverty, this chapter

identifies elements of effective community engagement that accompanied the TME implementation in Laos.

4.3 Methods

4.3.1 Data Collection

The data presented in this chapter were collected in field notes, meeting minutes and photographs taken during the process of designing and implementing community engagement for the TME study in Laos.

Field notes (n=125, roughly one field note for a community engagement activity per day, taken from September 2015 until August 2016) were based on observations made by members of the research team of the activities. Field notes were taken during the TME events and recorded the description of events (date, location, approximate number of participants, and theme of events), participation of villagers, informal and formal conversations, reactions and reflections by the villagers. Field staff were encouraged to reflect on their observations based on their knowledge about the significance of the events and the issues. Minutes and photographs were also taken of meetings, volunteer selections, training activities, community gatherings, house-to-house visits and other TME activities.

Initially, published frameworks for community engagement were used to guide data analysis. [2, 169]. As analysis progressed it became clear that the frameworks required substantial modification to incorporate the emerging elements of the community engagement. During line-by-line coding, the codebook was therefore adapted to collate the different elements of community engagement that contributed to its success.

4.3.2 An overview of community engagement

Apart from early planning and joint partnership with National Malaria Control Program (Center of Malariology, Parasitology and Entomology or CMPE), community engagement began in September 2015 with initial meetings, held at provincial and district level to introduce the study to health authorities and political leaders (Figure 4.1). Subsequently, meetings with the heads of the TME villages were held.

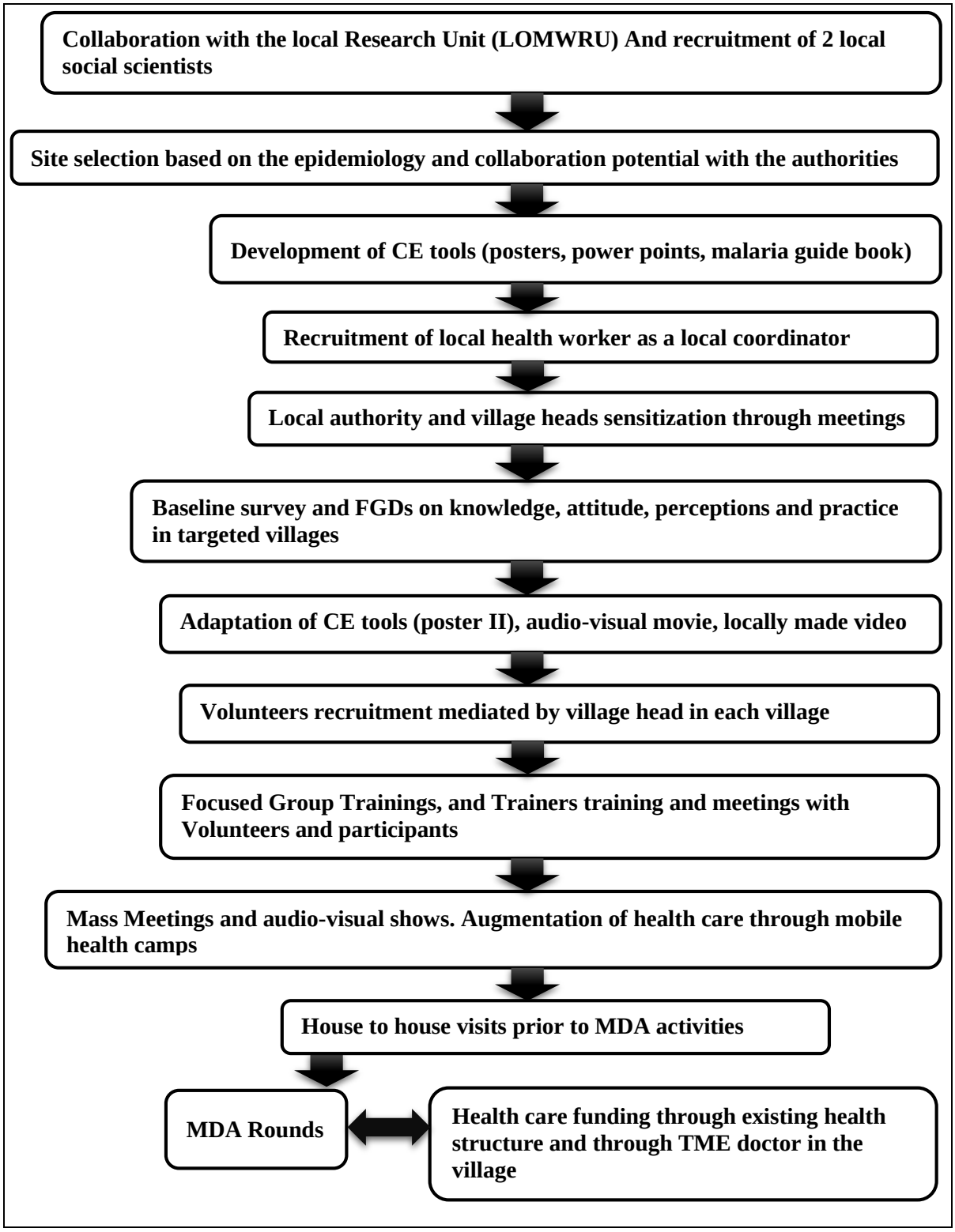


Figure 4. 1 Steps in Community Engagement

As part of TME, community engagement activities were undertaken to promote the uptake of MDA and blood surveys. Drawing on past experience, a systematic literature review [3], formative research and ongoing feedback from stakeholders, community engagement was tailored to the local context [6]. This entailed a stepwise process of collaborating with the authorities at province, district and the villages. In the villages, volunteers (10 in each village) were selected by the TME team and the village head, trained and – together with the TME team – they helped design and implement community engagement using a variety of activities (Figure 4.2, Figure 4.3 and Figure 4.4) [6].



Figure 4. 2 Volunteers training using the malaria guidebook and posters at XT



Figure 4. 3 Volunteers training using pictorial description of the concept of asymptomatic malaria and the rationale for the study



Figure 4. 4 Study rationale and concept exercise with volunteers at XT

This included the design of educational tools, such as audio-visual shows, a malaria guidebook, posters (Figure 4.5 and 4.6), and locally made videos which consisted of messages on the concept of asymptomatic malaria, and the rationale for MDA and blood tests.

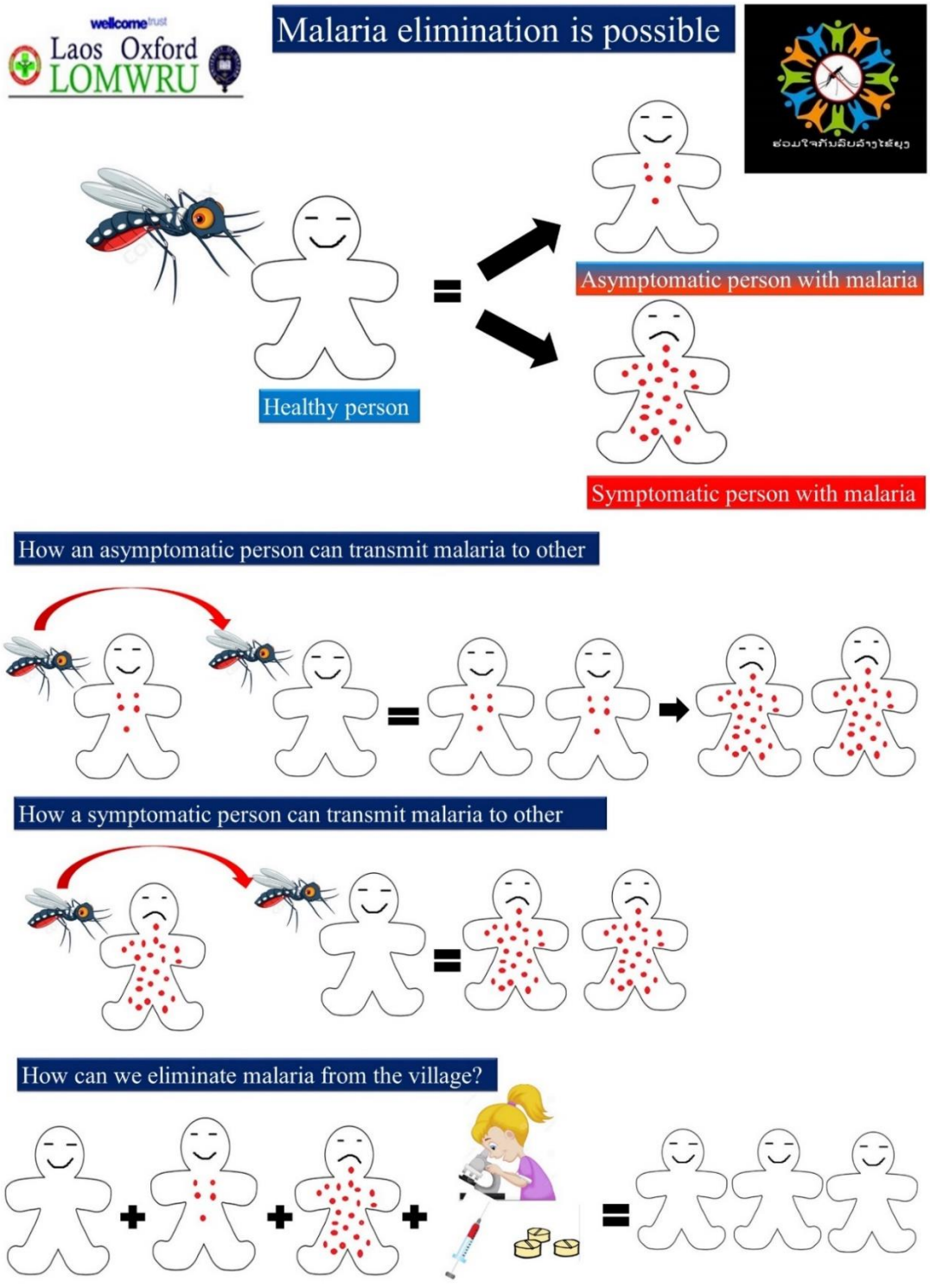


Figure 4. 5 Poster I describing symptomatic and asymptomatic malaria with rationale for MDA



Figure 4. 6 Poster II describing the contextualized picture of malaria and the elimination campaign

These posters including locally made videos were the main educational material used during community meetings (Figure 4.7 and Figure 4.8) and home visits [6].



Figure 4. 7 A mass meeting in TT, explaining TME procedures using a poster



Figure 4. 8 A mass meeting in OTP (control village) about the rationale and procedure of the study

Community engagement activities were similar across all four villages (intervention and control) villages). However, as the residents of intervention villages were offered antimalarials in the first year, community engagement, and health care were tailored and intensified in response to reported adverse events and rumours [6].

Participants were reimbursed, a total of 100,000 Kip for 3 days (~USD 12), for their travel and opportunity costs when participating in TME activities, such as blood surveys or MDA. As a token of appreciation for hosting the study, all participants were provided cooking utensils (a

set containing bowls, plates and spoons), T-shirts printed with the malaria prevention message and blankets during the cold season. As a part of malaria control efforts, Long Lasting Insecticidal Nets (LLINs) were provided to all community members. During mass meetings, blood surveys and MDA rounds, participants were offered snacks (e.g. soya milk, cake, toffies and biscuits).

All residents were provided with free primary health care, additional financial support (transport and hospital cost) for any severe cases (malaria or adverse events due to antimalarials, and for any severe illnesses whatever the cause) when they were referred to the higher health care centres (district hospitals and provincial hospitals) [6]. In each village and sub-village, the need for potable water was met by installing the water pumps (n=8) [172].

In the intervention villages, as the MDA rounds began, households with non-participants were visited by study team members (including myself). Household members were informally asked for their reasons not to participate in an informal and respectful way, following local customs. Any misconceptions and lack of understanding were clarified using the posters and sometimes by explaining the study again. None of the community members were chastised for their lack of participation. Instead, we invited these household members to meetings and to observe the MDA procedures. Non-participating members were equally respected without discrimination when it came to distribution of incentives, such as utensils, blankets and community incentives, including the water pumps.

Community engagement also incorporates the wider aim of engendering ethical global health research through, socially responsible knowledge production, capacity building and health promotion, and through sustainable changes in health behaviour [1-3, 120]. Although the community engagement effort in TME was largely aimed at promoting population coverage,

there were some potentially sustainable effects of community engagement, for example, through health education and health promotion [46]. Health education about malaria, the benefits of early health seeking behaviour and preventive behaviours, such using bed-nets and the knowledge on risk of malaria may have increased health (malaria) literacy [6, 46]. In the villages, local village volunteers were trained to diagnose a suspected case of malaria using RDTs and provide antimalarials under the supervision of the TME physician and/or health centre staff [6]. Overall cleanliness and hygiene was often discussed with community members during meetings. These components may well have a longer term benefit to the communities. Nevertheless, because TME was a clinical trial, the accompanying activities including primary health care offered by the study ream could not be continued after the project ended in June, 2017.

4.4 Results

In the following section, the elements underpinning the community engagement effort are outlined. In geographically isolated villages where a majority of residents belonging to ethnic minorities, along with high poverty and language barriers, conducting a complex research project (TME) was challenging. Reflecting on the processes and the activities of community engagement, the elements of community engagement are described below.

4.4.1 Stakeholder and authority engagement

The existing close relationship between the Mahidol Oxford Tropical Medicine Research Unit (MORU) and the Lao-Oxford-Mahosot Hospital Wellcome Trust Research Unit (LOMWRU) aided preparation for TME in Laos. LOMWRU had previously collaborated with CMPE and the Savannakhet Provincial Malaria and Parasitology Station, and this became an important

element of preparing for and implementing TME. Working with these partners and building on their experience of coordinating activities in the area allowed the identification of relevant local stakeholders, and with the support of the provincial malaria station, meetings with district-level leaders were organized. These meetings were intended to inform and seek their opinions concerning the objectives, design and implementation of TME. The partners also helped to identify the key persons to coordinate study implementation.

Local stakeholders, including the District Head, health workers from the Nong District Health Department and health centres participated in TME and community engagement activities, such as village meetings, MDA and health care provision. The District Head's participation in village level meetings assisted in setting up the study and promoted the authority and credibility of the project. Similarly, health workers' involvement during MDA to provide health care further helped engender the trust in the villages.

4.4.2 Local Human Resources

In Vientiane, two Laotian field workers with backgrounds in social science were recruited to join the TME team (consisting of two PhD researchers, a physician, a lab assistant, a logistician and a local coordinator) and trained to design, implement and evaluate the community engagement.

The main language in the TME villages is ethnic dialect spoken by members of *Tri* and *Mangkong* ethnic groups, an oral language with no written script. To most of the TME staff, recruited from outside the villages, the local language was incomprehensible. Only a small minority of villagers spoke *Lao*, the most widely spoken language in Laos. To deal with these language difficulties (and for other reasons outlined below) the team recruited a local

coordinator who was familiar with the village authorities and spoke the local language. Village volunteers were recruited (at first only as interpreters) immediately after initial community meetings at the district health centre, when TME was introduced to community leaders and prominent village members (elders, women union head and youth volunteers). The TME team, together with the village heads, interviewed candidates to select at least 10 volunteers per village who then underwent training on aspects of TME and were assigned responsibilities. Volunteers were given a daily allowance for their contribution to TME. Volunteers were assigned a specific number of houses within the existing unit (a village consisting of 80 households had around six units) for their community engagement activities, particularly reporting on and addressing villagers' concerns about coordination with the TME team.

Village volunteers formed an integral part of TME, beginning with the planning of the TME activities, and then in coordinating and executing these activities. One notable contribution was their role in building the trust between TME and the villagers, ensuring effective two-way communication and ownership of the project.

4.4.3 Formative research

The study villages had not previously been sites for biomedical research and the TME staff had little experience of remote and ethnic dialect-speaking communities. Therefore, to conduct appropriately designed community engagement, the TME team had to rapidly gain insight into the local social and economic context. In response, during the preparatory phase of the study, formative research was undertaken to identify the characteristics of the population and the general context (chapter 3.1 and 3.2).

This formative research was carried out prior to commencing community engagement activities in each village and continued throughout the study (chapter 3). Its findings influenced the overall approach, design and implementation of community engagement activities in the target communities. Data were collected through a questionnaire-based survey, focus group discussions, meetings and observations. In addition to exploring the socio-demographic characteristics of the population, data were also collected on the knowledge, attitudes and perceptions about malaria and MDA, and the local context, such as the availability of health services, water, sanitation and hygiene and the leadership structure.

Data on socio-economic status, health care, language, knowledge, attitude and perceptions towards malaria and MDA were helpful in adapting the community engagement activities and responding to the characteristics of particular village, particular household and the cohorts within the sub-villages.

The formative research, for example, strengthened the background knowledge about the low levels of literacy in the villages. For instance, poster I (figure 4.2) was designed based on the previous experience in other TME sites and anticipating the low literacy level in the village, whereas poster II (figure 4.3) was modified to suit the local context of the village through the findings from formative research. The image in poster II (figure 4.3) was designed to approximate the local context, including a sketch that resembles life in the study villages. The research also helped to identify particular villages and households where malaria was poorly understood or where there were rumours or misconceptions about the study. In response, volunteers and the TME team members made specific household visits and made use of health education tools.

4.4.4 Responsiveness

The initial design of the community engagement was derived from the past research [2, 3, 169], from the experience of team members at other TME study sites, and from the findings of formative research. During the study, the community engagement strategy was altered according to the needs of the community and their responses to the various study components. These changes were informed by the ongoing monitoring that took place in the villages: the network of volunteers and TME staff made observations, meetings were held in each village with local leaders and whole communities, and volunteers made house-to-house visits with the TME health education tools (posters and malaria guide book) and noted villagers' feedback about the study and whether they had understood the health message.

The nature of community engagement activities was mostly similar and equally prioritized all 4 villages. However, as the intervention villages took antimalarials, there were specific concerns relating to the adverse events (both real and perceived) and large number of villagers demanded IV saline infusions (perceived to replace the weakness caused by medicine). The study team responded by augmenting health care through the deployment of TME doctors in the villages, providing health education and conducting meetings with the affected cohorts, villagers and volunteers while the 2 control villages were provided with free health care at the existing health centres.

In one study village (PMM), the first round (day 1) participation during MDA was seemingly lower than in the other villages. The village volunteers therefore held meetings and garnered feedback from the community members. It became clear that there were rumours about the blood being drawn forcibly from children by restraining them in the crucifixion position, with arms stretched out. In response, study staff, along with the volunteers, visited the non-

participants' households (13 of 78 households in PMM) and provided clarifications and counselling. In subsequent rounds, participation rose notably.

During the study, number of rumours circulated. These rumours included the blood draw causing people to "run out of blood", "bringing other illnesses" and causing "weakness". Villagers were also reticent to take medicine when not sick. This resulted in part from a poor understanding of the concepts underpinning the rationale for and objectives of the study – drug resistance and asymptomatic malaria. In response, volunteers visited households and used the posters (figures 4.2 and 4.3) to explain the concept of symptomatic, asymptomatic malaria and discussed the rumours about the blood draw. In village meetings, study staff also spoke about the goal of eliminating malaria from the village, asymptomatic malaria and the reasons for blood tests which were commonly misinterpreted and poorly understood by the villagers.

The ongoing formative research highlighted the broader socio-economic and health needs of residents in the TME villages. The study team was therefore able to respond to these needs and to alleviate some of the difficulties that the communities faced, for example by installing a water pump and providing completely free health care.

4.4.5 Sharing control/leadership with the community

The recruitment of village volunteers by the study team with the approval of their respective village heads promoted local ownership of the study and aimed to build trust in the villages. The volunteer training – in group meetings – aimed to ensure that they understood the rationale behind the study and its activities. In addition to providing health education, some of the village health volunteers were further trained to conduct malaria rapid diagnostic tests and were provided with medicines for first aid, including antimalarials. Volunteers provided basic health care under the guidance from TME physicians.

Through regular training and supervision by TME staff, village leaders and volunteers were involved in the day-to-day implementation of the study. Decisions on the organization of TME activities, such as the timing of the MDA, surveys, and community engagement activities were taken jointly by the village volunteers and TME staff. Their participation facilitated greater involvement of villagers, for example, through reporting their concerns about MDA, health problems and/or adverse events linked to MDA.

Table 4. 1: Five elements of effective community engagement: lessons from a targeted malaria elimination study in Laos
1. Stakeholder and authority engagement
2. Local human resources
3. Formative research
4. Responsiveness
5. Sharing control/leadership with the community

4.5 Discussion

As outlined in Table 4.1, the elements of community engagement that underpinned the success of TME in Laos contrast somewhat with the principles that Lavery and colleagues derived from a dengue control project in Mexico [169]. Particularly, the experience of successfully implementing TME in Laos highlighted the importance of following a sequence of the steps in implementing community engagement. For instance, securing permission from the authority,

an inherent component within stakeholder engagement, was the first step in setting up the study in Laos.

4.5.1 Stakeholder and authority engagement

Taking a stepwise approach was key to the success of community engagement for TME in Laos. This entailed sensitizing authorities, seeking consensus and collaborating with government at different levels and then selecting and training volunteers to conduct MDA. Similar processes have been reported in the community engagement that accompanied recent malaria MDAs, for example, in Vanuatu [54], Gambia [48], Nicaragua [66], Liberia [119], Cambodia [79] and Sierra Leone [118]. Although the exact nature of the individual steps and the order in which they are taken depends on the nature of the intervention and the local context, for TME in Laos, engagement with authority figures, who acted as gatekeepers was a crucial first step. The importance of taking a step-wise approach is perhaps taken for granted by researchers who have extensive experience of community engagement [169].

4.5.2 Local Human Resources

Recent literature on community engagement has highlighted the benefits of "community-directed" interventions, whereby community members take the lead in the implementation of a study or intervention, with external monitoring and supervision provided by experts [2, 58, 120]. Generally, this approach has two components: selecting and training the villagers (building local capacity); and handing over responsibilities (increasing ownership). In recent years, building local capacity and sharing leadership to increase ownership have been recognized as core principles in community engagement [173]. In Lao TME, volunteers were selected and trained on TME and community engagement, and assigned responsibilities. With

such an approach, apart from building the local capacity and increasing the ownership and garnering villagers' trust, Lao TME significantly benefitted from volunteers' constant presence in the village: they acted as a conduit for villagers' feedback, which was helpful in modifying the strategies of community engagement throughout the duration of TME. These core principles were also essential elements of successful community engagement in Vanuatu [54] and West Africa [57].

4.5.3 Formative research

Formative research plays a critical role in the process of designing and implementing community engagement. Such research aims to identify potential participants' beliefs, values, attitudes, knowledge and behaviours related to the health problem of interest and provide insight into key aspects of the local context [174, 175]. With regard to malaria control programmes, past failures of "one size fits all" has prompted the development of such a tailored approach [34]. Recently in Nigeria, formative research was found valuable in designing a tailored chemoprevention intervention for malaria [176]. Nevertheless, in many malaria control programmes to date, little formative research has been reported in terms of informing community engagement [3, 34]. For Lao TME, quantitative and qualitative methods were essential to the design of engagement strategies for particular village and sub-villages.

4.5.4 Responsiveness

Lavery and colleagues' principles of community engagement include: "characterize and build knowledge of the community, its diversity and its changing needs" and "understand community perceptions and attitudes about the proposed research" [169]. These points are certainly relevant and can be operationalized as "formative research" and "responsiveness".

Responsiveness entails continuous monitoring of the community's response to the intervention and the community engagement activities and adapting the approach accordingly. Providing information, which has been identified as a principle of community engagement [169], is one component of "responsiveness". However, the experience of community engagement for Lao TME, suggests that it was not adequate to "provide information", but rather the information must be contextually relevant and comprehensible.

4.5.5 Sharing control/leadership with the community

Sharing leadership with the community is an established goal of community engagement, whereby community members are prepared to undertake responsibilities and actively participate in decision making [2, 57, 58]. In the Lao TME study, village volunteers, including members of village hierarchies, were first trained and later took on multiple responsibilities with close supervision from TME team. Such a method of sharing control and leadership with the community has been shown in the past to be successful when the community takes the lead and strives to achieve the goals of the project [58]. Sharing leadership with the community has multiple benefits. An immediate benefit is the reduction of the study team's workload. In the long term, sharing leadership increases ownership which can promote intrinsic motivation through feeling of making a contribution to the community, recognition, status, knowledge & skills gained, and appreciation from stakeholders and the community [57]. For instance, in the case of Lao TME, volunteers were motivated to resolve the issues within the villages by themselves whenever they could. In Vanuatu, responsibilities were shared by community members and all the structures of the government, even after ultimate elimination of malaria through ongoing monitoring for new imported cases [54]. Similarly in West Africa, the

community took the leadership in the planning, execution and monitoring of the disease control programme and achieved successful outcomes [58].

4.5.6 Implications for future MDAs and health interventions

The community engagement that accompanied MDA in the Lao TME study was adapted to the particularities of the research site, cultural context and the study design. The study site was remote and is home to an ethnic (*Tri and Mangkong*) minority population. In addition to their geographic and linguistic isolation, the TME villagers were research naïve and showed low levels of literacy. Nong District is one of the poorest district (poorest in Savannakhet province) in Laos and villagers had little access to potable water and sanitation [177, 178].

The site's characteristics therefore presented challenges in terms of achieving high coverage of MDA plus regular blood draws, such as, dealing with the language barriers between the majority of study staff and villagers. This meant that communication with the villagers relied on interpreters, and therefore messages about the study and villagers' responses to questioning were often simplified. The latter for example limited the team's grasp of local understandings of malaria. The term "malaria project" was used for TME, whether referring to the community engagement activities or the mass antimalarial administration. It was therefore difficult to separate villagers' opinions and perceptions of the community engagement activities from the other TME activities.

Despite these challenges, Lao TME was successful in terms of securing a high participation from the community in all the activities including the achievement of high population coverage. Achieving this suggests that the community engagement was successful in spite of

the difficulties described above, and that the lessons learnt from this experience can be applied to studies and intervention programmes in diverse contexts.

4.6 Conclusion

Community engagement as an integral part of TME contributed to promotion of the uptake of and adherence to MDA. Based on the experiences of implementing a complex biomedical research (TME) in a remote, linguistically isolated, resource poor and research naïve context, this chapter has described elements of successful community engagement. This is not intended to be a prescriptive guide for community engagement in other contexts but these elements formed the backbone of community engagement in a challenging context. Community engagement activities were partially pre-designed but undertaking formative and ongoing research was key to the ability to adapt to the needs of the local communities and address emerging issues during the study.

4.7 Reflections on community engagement in Lao TME

This chapter described the processes and steps of community engagement. Reflecting on these processes and steps of community engagement, I was able to thematically synthesize the elements that became the pillars of the community engagement for Laos TME. This chapter helped me to explain how formative research together with ongoing observations, a major element of implementation research, informed the community engagement design. As briefly discussed in this chapter, community engagement was focused to promote the population coverage and adherence to mass drug administration in Lao TME. In subsequent chapter V, I discuss the overall factors that affected population coverage in Lao TME using quantitative and qualitative methods.

CHAPTER V

Factors associated with population coverage of Targeted Malaria Elimination (TME) in southern Savannakhet Province, Laos

5.1 Quantitative

5.1.1 Abstract

Introduction

Targeted Malaria Elimination (TME) in Laos included three rounds of Mass Drug Administrations (MDA) against malaria followed by quarterly blood surveys in two villages in Nong district at Savannakhet province. The success of MDA largely depends upon the efficacy of the anti-malarial drug regimen, local malaria epidemiology and the population coverage. In order to explore the reasons for participation in TME, a quantitative survey was conducted after the completion of the three rounds of MDA.

Methods

The survey was conducted in two villages with a total of 158 households in July and August 2016. Among the 973 villagers eligible for participation in the MDA, 158 (16.2%) adults (>18 years) were selected, one each from every household for the interviews using a quantitative questionnaire.

Results

150/158 (94.9%) respondents participated in at least one activity (taking medicine or testing their blood) of TME. 141/150 (94.0%) respondents took part in all three rounds MDA including blood tests. 17/158 (10.7%) were partial or non-participants in three rounds of MDA. Characteristics of the respondents which were independently associated with completion of three rounds of MDA included: attending TME community engagement meetings [AOR=12.0 (95% CI 1.1 to 20.5) (p=0.03)], knowing that malaria can be diagnosed through blood tests [AOR=5.6 (95% CI 1.0 to 32.3) (p=0.05)], participation of all members of the household

[AOR=4.2 (95% CI 1.3 to 14.0) (p=0.02)], preferring all aspects of TME [AOR=17.2 (95% CI 1.6 to 177.9) (p=0.02)], and the perception that TME was important [AOR=14.9 (95% CI 1.3 to 171.2) (p=0.03)].

Conclusion

Complete participation in TME was significantly associated with participation in community engagement activities, knowledge that the blood tests were for malaria diagnosis, family members' participation at TME and perceptions that TME was worthwhile. A responsive approach to community engagement that includes formative research and the involvement of community members may increase the uptake of the intervention.

5.1.2 Introduction

The spread of multidrug resistant *Plasmodium falciparum* in the Greater Mekong sub-Region (GMS) has added urgency to malaria elimination efforts [21-25]. Targeted Malaria Elimination (TME) has been proposed as a multi-pronged strategy to accelerate elimination in the GMS. TME comprises: 1) the strengthening of village malaria workers (VMWs) to provide appropriate case management and distribute long-lasting insecticide treated bed nets (LLINs) and 2) mass drug (antimalarial) administration (MDA) and quarterly blood survey (Figure 5.1 and 5.2). To date, this strategy is being evaluated in the Thai-Myanmar border area, Cambodia, Vietnam and Laos [26].



Figure 5. 1 Antimalarial administration to a paediatric participant in an intervention village (TT)



Figure 5. 2 Blood draw from an adult participant at intervention village (TT) for qPCR

The main purpose of TME as a pilot project is to interrupt the local malaria transmission and if successful can become a useful tool for future malaria control and elimination programmes in the GMS [26]. The probability of interrupting local malaria transmission through MDA depends on the dynamics of local malaria transmission, the efficacy of the antimalarial

regimen, and the coverage in the target populations [3]. Achieving a sufficiently high uptake in the target population – estimated at around 80% of all residents – is challenging for several reasons [3, 27]. For example, target communities in the GMS, where malaria transmission persists, are often isolated with limited healthcare infrastructure. Apparently healthy, participants must adhere to the complete treatment regimen [30] and concerns about potential and real side effects can discourage uptake and adherence [33].

To maximize coverage in target populations, community engagement often accompanies MDA [3, 26, 27]. This entails a range of activities to support and facilitate the uptake of an intervention and adherence. These activities include, providing health education during community meetings and house-to-house visits [1, 3]. Community engagement is also a means of promoting sustainable change through increasing the health literacy of the population and building local capacity [1, 28, 120].

To date, several questionnaire-based studies have examined the factors that influence coverage of mass anti-malarial administration in the GMS [30, 32]. These studies found that investments in providing information to villagers through trustworthy informants were essential to increase participation. No research has so far focused on the uptake of MDA in Laos, where this strategy has also been evaluated. In light of the specific social, cultural, health system and epidemiological circumstances in Laos, with a view to informing current and future malaria elimination campaigns, this chapter explores the factors associated with participation in MDA as a part of TME.

5.1.3 Materials and methods

5.1.3.1 Data collection

To assess villagers' socio-demographic characteristics, their knowledge, attitudes, perceptions and experiences regarding TME, a survey using a questionnaire was conducted in July and August 2016 following three rounds of MDA. All households (n=158) within the intervention villages were included in the survey. One adult (above 18 years of age) from each house was interviewed.

One of two trained social scientists approached the household head at his/her residence and asked his/her consent to participate in the survey. If the household head was not present, the interviewer sought consent from and interviewed any other adult household member. If consent was given, the questionnaire was administered face-to-face at the respondent's household. The majority of the questionnaires were administered in the local language (127/158; 80.4%) with the assistance of trained local volunteers who could translate between *Pasha Lao* and the local language. Each survey lasted about 20 to 30 minutes.

The questionnaire was adapted from a version used to assess the same factors in diverse settings, including The Gambia [51], Thai-Myanmar border [30] and Vietnam [32]. The questionnaire was translated, pre-tested and checked for clarity, language and comprehensibility with Lao researchers at the Laos-Oxford Mahosot Wellcome Trust Research Unit in Vientiane, then with 20 respondents in Vientiane, and finally at the Nong District headquarters with local household heads (n=6). After each round of pre-testing minor revisions were made.

The questionnaire contains five sections (Section I: consent, interviewer's initials, date, language of interview and participation in TME, Section II: socio-demographic characteristics of the study participants, Section III: knowledge about malaria and MDA, Section IV: experience of TME and Section V: Perceptions on TME). All variables broadly representing these sections were analyzed with the outcome variable "participation in TME".

5.1.3.2 Data management and analysis

The questionnaires were single entered into a Microsoft Excel spreadsheet. Consistency and outlying data were cross-checked against the paper questionnaire which was used to collect data. Participation in MDA was categorized into 1. Complete participation and 2. None/Partial participation. Complete participation referred to respondents who took all 9 doses of DHA-piperaquine plus low dose primaquine in the three rounds of MDA and partial or none referred to respondents who took less than 9 doses or did not participate at all. Initial analysis included frequency and percentage of socio-demographic variables in relation to participation. Comparisons were made using the Chi squared test or Fisher's exact test as appropriate. Significant associations were considered if p value ≤ 0.05. For logistic regression, all putative predictor variables were dichotomised, "0" representing "Absence or No" and "1" representing "Presence or Yes". Considering the high correlation between many of the variables, variables representing a question or a theme relevant to the research question (what are the factors affecting complete participation in MDA?) were selected for univariate and multivariate analysis. A logistic regression model was used to test the association between the predictive variables and the outcome variable (0=partial/none participation and 1=complete

participation). Variables, thematically relevant to research question such as participation in meetings, knowledge about MDA, experience of participating in MDA and perceptions towards MDA, were explored and included in the final logistic regression model adjusting the effect of confounders. The fit of the model was assessed using Omnibus Test of model coefficients (p value ≤ 0.05) and Hosmer and Lemeshow Test (with p value ≥ 0.05). Data were analyzed using IBM SPSS version 24.

5.1.4 Results

5.1.4.1 Participation in MDA and TME

The questionnaire was administered in two villages, with a combined population of 1,017 (according to the TME census conducted in July 2016). Of these villagers, 973 were eligible for MDA after excluding infants under six months, pregnant women and severely sick people. Of 973 residents, 855 (87.8%) participated in TME (blood survey and MDA until 3 rounds). The questionnaire was administered to 158/1017 (16.2%) adults from 158 households in the intervention villages. Most respondents (150/158; 94.9%) participated in TME, with 141 "complete participants" (141/150; 94%) who took the anti-malarial and had their blood tested in all three monthly rounds, and seventeen (17/158; 10.7%) partial or non-participants. Among these 17 partial or non-participants, 9 (9/17; 52.9%) took part in at least one round of MDA and blood testing, eight (47.1%) did not participate at all.

5.1.4.2 Socio-demographic characteristics

The majority of the respondents were the household head (100/158; 63.3%), less than 40 years old (108/158; 68.3%) and male (124/158; 78.5%; Table 5.1). Most of the respondents were from the *Mangkong* ethnic group (153/158; 96.8%) and animists (154/158; 97.5%). The

majority of the respondents had limited formal education of less than 5 years (143/158; 90.5%) and were illiterate (115/158; 72.8%). Most (140/158; 88.6%) of the respondents had a monthly income less than 500,000 LAK (60 USD). Only a few (21/158; 13.3%) had access to a latrine at home and most defecated in the forest/fields. None of these socio-demographic characteristics were statistically significantly associated with participation in TME.

5.1.4.3 Knowledge about MDA and malaria

All respondents (100%; n=158) had heard about the TME project in their village (Table 5.2). Among 141 "complete participants", 137 (97.2%; p=0.005) participated in concerted sensitization efforts (district health team, village health workers and study staff) compared to only 4 who did not. Complete participants (138/141; 97.9%; p<0.001) were more likely to attend the meetings/events conducted by TME than partial or non-participants (n=2). Explanation of TME by the village head (p=0.005), volunteers (p=0.008) and TME staff (p<0.001), was associated with complete participation. Respondents who had the intervention explained to them were more likely to complete participation than respondents who had not received an explanation (p<0.001). Respondents who understood malaria transmission, knew signs and symptoms of malaria (fever, headache, chills/shivering), diagnosis (through blood test in TME) and the process of treating malaria (by taking medicine) were more likely to participate in the MDAs than respondents who were not aware of these facts (p≤0.005).

5.1.4.4 Comparison of knowledge related to malaria before and after MDA

An ad hoc comparison of knowledge between the baseline (formative) survey and the post MDA survey showed some interesting findings (Figure 5.3). More participants after the completion of MDA perceived that a healthy looking person could have malaria parasites

compared to before community engagement (39.9% of 158 versus 12.1% of 281). At baseline, 63.3% (of 281) of respondents believed that malaria could be diagnosed by blood test, this rose to 87.3% (of 158) after MDA, presumably as blood tests were the main diagnostic method in the TME study. A higher number of respondents could recall that they have heard about MDA (an increase from 92.5% to 100%).

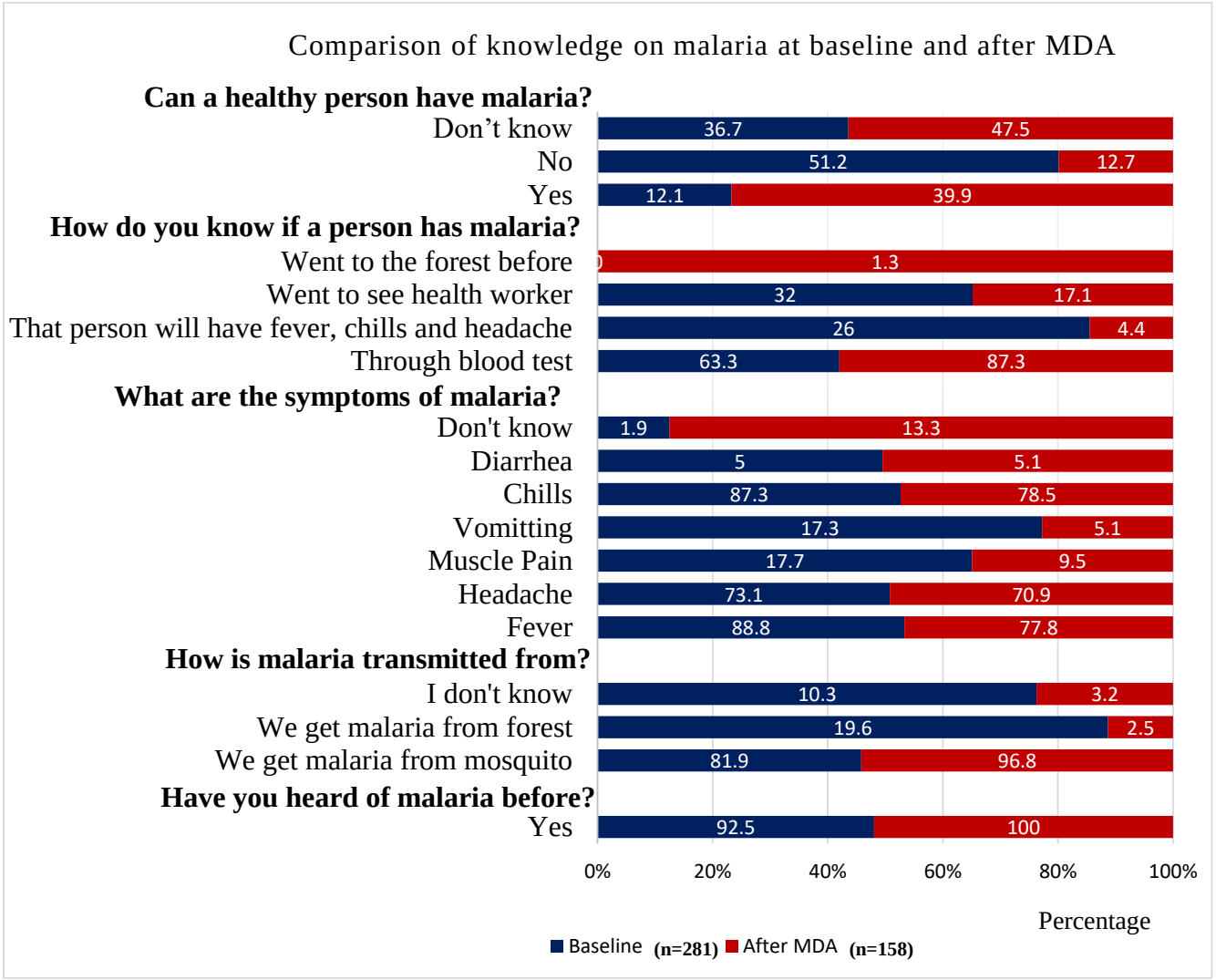


Figure 5. 3: Comparison of knowledge related to malaria at baseline and after MDA

5.1.4.4 Experience of TME

All "complete participants" provided a blood sample and took part in MDA. Eight of 17 incomplete or non- participants in the MDA did not take the antimalarial and gave no blood sample (Table 5.3). The complete non-participants, did not take part in MDA or blood testing for several reasons, including "fear of the blood test". Nine other respondents, could not complete the participation because s/he "was travelling", "was busy", "was pregnant" and "developed adverse events due to the medicine" (not shown in table). Respondents from households where everyone participated were more likely to be complete participants than participants from households with incomplete participation ($p=0.008$). The absence of complaints in other household members after taking the antimalarials was associated with the complete participation ($p=0.012$).

5.1.4.5 Perceptions of TME

The majority of the respondents who thought they received adequate information about the TME study were more likely to complete participation than respondents who felt they had been inadequately informed ($p<0.001$; Table 5.4). Respondents who knew that the study drugs were intended to kill malaria parasites in their body were more likely to complete participation than respondents who were not aware of this ($p<0.001$). Those who did not think the study drugs could cause side effects were more likely to be complete participants than those who were afraid of side effects ($p=0.013$). Respondents who knew that blood tests can diagnose parasitaemia were more likely to complete participation than respondents who did not know

this fact (p<0.001). Respondents who liked all aspects of TME (p<0.001), felt that TME was important (p<0.001) and thought that they would participate in future TME (p<0.001) were more likely to be complete participants than those respondents who did not agree.

5.1.4.6 Logistic regression model

Five variables were found to influence completion of participation: 1) attending meetings; 2) understanding that blood tests were for the diagnosis of malaria; 3) coming from households in which all members participated; 4) liking all aspects of the MDA; and 5) the perception that MDA was worthwhile (Table 5.5).

Table 5. 1: Socio-demographic and economic characteristics of the respondents in relation to participation (n=158)

	Participation			
Characteristics	**Partial/none (n=17)**	**Complete (n=141)**	**Total (n=158)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
Respondent status				
Family Head	12 (70.6)	88 (62.4)	100 (63.3)	0.35
Other	5 (29.4)	53 (37.6)	58 (36.7)	
Age group				
≤29 years	6 (35.3)	47 (33.3)	53 (33.5)	0.72
30-40 years	7 (41.2)	48 (34)	55 (34.8)	
≥41 years	4 (23.5)	46 (32.6)	50 (31.6)	
Sex				
Female	5 (29.4)	29 (20.6)	34 (21.5)	0.28
Male	12 (70.6)	112 (79.4)	124 (78.5)	
Ethnicity				
Lao Lum	1 (5.9)	1 (0.7)	2 (1.3)	0.16
Mangkong	16 (94.1)	137 (97.2)	153 (96.8)	
Other	0	3 (2.1)	3 (1.9)	
Religion				
Animist	16 (94.1)	138 (97.9)	154 (97.5)	0.36
Buddhist	1 (5.9)	3 (2.1)	4 (2.5)	
Marital Status				
In relationship	17 (100)	129 (91.5)	146 (92.4)	0.24

Not in relationship	0	12 (8.5)	12 (7.6)	
Literacy				
Illiterate	14 (82.4)	101 (71.6)	115 (72.8)	0.26
Literate	3 (17.6)	40 (28.4)	43 (27.2)	
Education in years				
≤5 years	16 (94.1)	127 (90.1)	143 (90.5)	0.5
≥5.1 years	1 (5.9)	14 (9.9)	15 (9.5)	
Occupation				
Farmer	16 (94.1)	131 (92.9)	147 (93)	0.66
Other	1 (5.9)	10 (7.1)	11 (7)	
Monthly income				
≤500,000 kip	16 (94.1)	124 (87.9)	140 (88.6)	0.72
≥500,001 kip	1 (5.9)	15 (10.6)	16 (10.1)	
Don't know	0	2 (1.4)	2 (1.3)	
Daily expense				
≤3000 kip	12 (70.6)	76 (53.9)	88 (55.7)	0.14
≥3001 kip	5 (29.4)	65 (46.1)	70 (44.3)	
Properties owned*				
House	16 (94.1)	141 (100)	157 (99.4)	0.1
Land	17 (100)	135 (95.7)	152 (96.2)	0.49
Motorbike	10 (58.8)	107 (75.9)	117 (74.1)	0.11
Tractor	6 (35.3)	48 (34)	54 (34.2)	0.55
Cars	1 (5.9)	4 (2.8)	5 (3.2)	0.43
Cattles	9 (52.9)	69 (48.9)	81 (51.3)	0.54
TV	1 (5.9)	31 (22)	32 (20.3)	0.1
Radio	0	8 (5.7)	8 (5.1)	0.39
Mobile	5 (29.4)	56 (39.7)	61 (38.6)	0.29
Material of the wall*				
Bamboo	6 (35.3)	29 (20.6)	35 (22.2)	0.14
Wood	13 (76.5)	113 (80.1)	126 (79.7)	0.46
Concrete	0	2 (1.4)	2 (1.3)	0.79
Plastic	0	4 (2.8)	4 (2.5)	0.63
Metal	0	3 (2.1)	3 (1.9)	0.7
Material of the roof*				
Bamboo	1 (5.9)	8 (5.7)	9 (5.7)	0.65
Wood	1 (5.9)	1 (0.7)	2 (1.3)	0.2
Plastic	1 (5.9)	3 (2.1)	4 (2.5)	0.36
Metal	13 (76.5)	105 (74.5)	118 (74.7)	0.56
Shingles	3 (17.6)	30 (21.3)	33 (20.9)	0.5

Material of the floor*				
Bamboo	2 (11.8)	11 (7.8)	13 (8.2)	0.42
Wood	16 (94.1)	130 (92.2)	146 (92.4)	0.62
Mud	0	3 (2.1)	3 (1.9)	0.7
Concrete	0	5 (3.5)	5 (3.2)	0.56
Presence of Toilet Facility at home				
Yes	3 (17.6)	18 (12.8)	21 (13.3)	0.4
No	14 (82.4)	123 (87.2)	137 (86.7)	
***If No,* you defecate at (n=137)**				
Field	0	2 (1.6)	2 (1.5)	0.8
Forest	14 (100)	121 (98.4)	135 (98.5)	
Migrated from another village				
Yes	6 (35.3)	45 (31.9)	51 (32.3)	0.48
No	11 (64.7)	96 (68.1)	107 (67.7)	
***If Yes,* years of living (n=51)**				
≤15 years	4 (66.7)	25 (55.6)	29 (56.9)	0.47
≥15 years	2 (33.3)	20 (44.4)	22 (43.1)	
Distance between forest and house in km				
≤1 km	10 (62.5)	82 (59.9)	92 (60.1)	0.53
≥1.1 km	6 (37.5)	55 (40.1)	61 (39.9)	
Distance between rice field and house in km				
≤2 km	12 (75)	89 (68.5)	101 (69.2)	0.414
≥2.1 km	4 (25)	41 (31.5)	45 (30.8)	
Frequency of visit to forest				
Everyday	9 (52.9)	87 (61.7)	96 (60.8)	0.77
≥ Every alternate day	7 (41.2)	48 (34)	55 (34.8)	
NA	1 (5.9)	6 (4.3)	7 (4.4)	
*Multiple answers were possible; percentage exceeds 100; analysis were made between "Yes" and "No"				

Table 5. 2: Knowledge about TME and Malaria of the respondents in relation to participation (n=158)				
	Participation			
Characteristics	**Partial/none (n=17)**	**Complete (n=141)**	**Total (n=158)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	

Heard about the current malaria elimination project				
Yes	17 (100)	141 (100)	158 (100)	NA
Heard through/from*				
District health team/village health workers/study staffs	13 (76.5)	137 (97.2)	150 (94.9)	**0.005**
Neighbour	0	1 (0.6)	1 (0.6)	0.89
Village Head	10 (58.8)	109 (77.3)	119 (75.3)	0.089
Don’t know	1 (5.9)	4 (2.8)	5 (3.2)	0.43
Discussed the information about TME with another person				
Yes	2 (11.8)	40 (28.4)	42 (26.6)	0.25
No	14 (82.4)	98 (69.5)	112 (70.9)	
Don't know	1 (5.9)	3 (2.1)	4 (2.5)	
Attended meetings/events conducted by TME				
Yes	11 (64.7)	138 (97.9)	149 (94.3)	**<0.001**
No	6 (35.3)	3 (2.1)	9 (5.7)	
TME was explained to you by*				
Village Head	10 (58.8)	124 (87.9)	134 (84.8)	**0.005**
Volunteers	9 (52.9)	117 (83)	126 (79.7)	**0.008**
TME staffs	9 (52.9)	132 (93.6)	141 (89.2)	**<0.001**
Frequency of explanation about TME by study staffs				
Up to 30 times	8 (47.1)	128 (90.8)	136 (86.1)	**<0.001**
Can't remember/Don't know	9 (52.9)	13 (9.2)	22 (13.9)	
Frequency of explanation about TME by non-study staffs				
Up to 20 times	10 (58.8)	137 (97.2)	147 (93)	**<0.001**
Can't remember/Don't know	7 (41.2)	4 (2.8)	11 (7)	
Causes of malaria				
Mosquito	15 (88.2)	139 (98.6)	154 (97.5)	0.058
Other/I don't know	2 (11.8)	2 (1.4)	4 (2.5)	
We get malaria from*				
Forest	2 (11.8)	2 (1.4)	4 (2.5)	0.058
Mosquito	14 (82.4)	139 (98.6)	153 (96.8)	**0.009**
Signs and symptoms of malaria*				
Fever	8 (47.1)	115 (81.6)	123 (77.8)	**0.003**
Headache	7 (41.2)	105 (74.5)	112 (70.9)	**0.007**
Muscle pain	1 (5.9)	14 (9.9)	15 (9.5)	0.5

Vomiting	1 (5.9)	7 (5)	8 (5.1)	0.6
Chills/Shivering	8 (47.1)	116 (82.3)	124 (78.5)	**0.003**
diarrhoea	1 (5.9)	7 (5)	8 (5.1)	0.6
Don't know	6 (35.3)	15 (10.6)	21 (13.3)	**0.013**
Diagnosis of malaria*				
Through blood test	10 (58.8)	128 (90.8)	138 (87.3)	**0.002**
That person will have fever, chills and headache	0	7 (5)	7 (4.4)	0.44
Went to health worker	14 (82.4)	117 (83)	131 (82.9)	0.58
Went to forest before	2 (11.8)	0	2 (1.3)	**0.011**
An asymptomatic villager can have malaria parasite				
Yes	3 (17.6)	60 (42.6)	63 (39.9)	**0.04**
No	1 (5.9)	19 (13.5)	20 (12.7)	
Don't know	13 (76.5)	62 (44)	75 (47.5)	
Ways to eliminate malaria from the village*				
By Giving medicine to all the villagers	6 (35.3)	117 (83)	123 (77.8)	**<0.001**
By using mosquito nets	1 (5.9)	6 (4.3)	7 (4.4)	0.55
By Cleaning the surrounding	0	2 (1.4)	2 (1.3)	0.79
Don’t know	9 (52.9)	18 (12.8)	27 (17.1)	**<0.001**
*Multiple answers were possible; percentage exceeds 100; analysis were made between "Yes" and "No"				

Table 5. 3: Experiences of TME of the respondents in relation to participation (n=158)				
	Participation			
Characteristics	**Partial/none (n=17)**	**Complete (n=141)**	**Total (n=158)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
Provided blood for test during MDA				
Yes	9 (52.9)	141 (100)	150 (94.9)	**<0.001**
No	8 (47.1)	0	8 (5.1)	
***If Yes,* reasons (n=150)**				
I want to check malaria	4 (44.4)	53 (37.6)	57 (38)	0.8

I am scared of malaria	1 (11.1)	27 (19.1)	28 (18.7)	
I am scared of illness	0	10 (7.1)	10 (6.7)	
I want to be free from malaria	2 (22.2)	19 (13.5)	21 (14)	
I want to have a good health	1 (11.1)	25 (17.7)	26 (17.3)	
Other	1 (11.1)	7 (5)	8 (5.3)	
Took medicine for mass drug administration				
Yes	9 (52.9)	141 (100)	150 (94.9)	**<0.001**
No	8 (47.1)	0	8 (5.1)	
***If Yes,* reasons (n=150)**				
I want to be free from malaria	5 (55.6)	61 (43.3)	66 (44)	0.39
I want to have a good health	1 (11.1)	54 (38.3)	55 (36.7)	
I am scared of malaria	1 (11.1)	15 (10.6)	16 (10.7)	
I am scared of illness	1 (11.1)	5 (3.5)	6 (4)	
Other	1 (11.1)	6 (4.3)	7 (4.7)	
***If Yes,* location of the MDA (n=150)**				
Village hall	7 (77.8)	101 (71.6)	108 (72)	0.56
Village centre	2 (22.2)	18 (12.8)	20 (13.3)	
Other	0	20 (14.2)	20 (13.3)	
No Response	0	2 (1.4)	2 (1.3)	
Medicine distribution centre was convenient				
Yes	9 (100)	138 (97.9)	147 (98)	0.83
No	0	3 (2.1)	3 (2)	
Distance between the medicine distribution centre and your house				
≤100 meter	4 (40)	99 (70.2)	103 (68.2)	0.055
≥101 meter	6 (60)	42 (29.8)	48 (31.8)	
Number of people in your household				
≤6	10 (58.8)	80 (56.7)	90 (57)	0.54
≥7	7 (41.2)	61 (43.3)	68 (43)	
Everyone in my house participated in TME				
Yes	4 (23.5)	81 (57.4)	85 (53.8)	**0.008**
No	13 (76.5)	60 (42.6)	73 (46.2)	
I had complaints after taking medicine				
Yes	3 (33.3)	27 (19.1)	30 (20)	0.25
No	6 (66.7)	114 (80.9)	120 (80)	

***If Yes*, complaints started after**				
Round 1	1 (33.3)	24 (88.9)	25 (83.3)	**0.041**
Round 2	1 (33.3)	2 (7.4)	3 (10)	
Round 3	1 (33.3)	1 (3.7)	2 (6.7)	
Household members had complaints after taking medicine (n=153)				
Yes	3 (23.1)	36 (25.7)	39 (25.5)	**0.012**
No	9 (69.2)	103 (73.6)	112 (73.2)	
No one took the medicine	1 (7.7)	0	1 (0.7)	
Don't know	0	1 (0.7)	1 (0.7)	

Table 5. 4: Perceptions on TME of the respondents in relation to participation (n=158)

	Participation			
Characteristics	**Partial/none (n=17)**	**Complete (n=141)**	**Total (n=158)**	**p-value**
	Number (%)	**Number (%)**	**Number (%)**	
Received enough information about the TME				
Yes	9 (52.9)	137 (97.2)	146 (92.4)	**<0.001**
Don't know	8 (47.1)	4 (2.8)	12 (7.6)	
Purpose of the medicine given to villagers*				
To kill malaria parasite in our body	8 (47.1)	132 (93.6)	140 (88.6)	**<0.001**
To protect from malaria	10 (58.8)	111 (78.7)	121 (76.6)	0.068
Gives me strength/energy	5 (29.4)	1 (0.7)	6 (3.8)	**<0.001**
Don't know	3 (17.6)	4 (2.8)	7 (4.4)	**0.028**
MDA medicine caused many illness in your village				
Yes	0	4 (2.8)	4 (2.5)	**0.013**
No	9 (52.9)	113 (80.1)	122 (77.2)	
Don't know	8 (47.1)	24 (17)	32 (20.3)	
Other villagers thought that medicine caused illness				
Yes	0	4 (2.8)	4 (2.5)	0.08
No	9 (52.9)	105 (74.5)	114 (72.2)	
Don't know	8 (47.1)	32 (22.7)	40 (25.3)	
Purpose of the blood test*				

To test for malaria parasite	7 (41.2)	121 (85.8)	128 (81)	**<0.001**
To test for all the diseases	0	5 (3.5)	5 (3.2)	0.56
To check if we were healthy	0	1 (0.7)	1 (0.6)	0.89
Don't know	10 (58.8)	19 (13.5)	29 (18.4)	**<0.001**
Purpose of the blood test thought by villagers*				
To test for malaria parasite	4 (23.5)	81 (57.4)	85 (53.8)	**0.008**
To check all the diseases	0	4 (2.8)	4 (2.5)	0.63
To check if we were healthy	0	3 (2.1)	3 (1.9)	0.7
To sell	17 (100)	140 (99.3)	1 (0.6)	0.89
To clean our blood from diseases	1 (5.9)	0	1 (0.6)	0.1
Don't know	12 (70.6)	54 (38.3)	66 (41.8)	**0.011**
Number of people with malaria will decrease this year				
Yes	7 (41.2)	90 (63.8)	97 (61.4)	0.18
No	0	2 (1.4)	2 (1.3)	
Maybe	0	3 (2.1)	3 (1.9)	
Don’t know	10 (58.8)	46 (32.6)	56 (35.4)	
***If yes,* reasons**				
Because we took medicine	6 (85.7)	82 (91.1)	88 (90.7)	0.31
We tested blood and took medicine	0	5 (5.6)	5 (5.2)	
Other	1 (14.3)	3 (3.3)	4 (4.1)	
If only a group of people take medicine, consequences are				
Medicated group will have less malaria	5 (29.4)	86 (61)	91 (57.6)	0.07
Both groups will have less malaria	0	1 (0.7)	1 (0.6)	
Don't know	12 (70.6)	53 (37.6)	65 (41.1)	
No Response	0	1 (0.7)	1 (0.6)	
Disliked about TME				
Blood test	2 (11.8)	4 (2.8)	6 (3.8)	0.31
Unable to go to work	0	1 (0.7)	1 (0.6)	
Inadequate incentive	0	1 (0.7)	1 (0.6)	
Other	15 (88.2)	135 (95.7)	150 (94.9)	
If other, specify				
I like all	8 (53.3)	134 (99.3)	142 (94.7)	**<0.001**
I did not participate	7 (46.7)	0	7 (4.7)	

I did not like any	0	1 (0.7)	1 ((0.7)	
I think TME is important				
Yes	8 (47.1)	135 (95.7)	143 (90.5)	**<0.001**
Don't know	9 (52.9)	6 (4.3)	15 (9.5)	
***Yes,* because (n=143)**				
It will make me/us healthy	4 (50)	81 (60)	85 (59.4)	0.54
They are here to treat us	1 (12.5)	12 (8.9)	13 (9.1)	
We can eliminate malaria	1 (12.5)	12 (8.9)	13 (9.1)	
To treat/prevent malaria	0	17 (12.6)	17 (11.9)	
Other	2 (25)	13 (9.6)	15 (10.5)	
I would participate in future TME				
Yes	8 (47.1)	130 (92.2)	138 (87.3)	**<0.001**
No	4 (23.5)	3 (2.1)	7 (4.4)	
Yes, only if	0	5 (3.5)	5 (3.2)	
Don’t know	5 (29.4)	3 (2.1)	8 (5.1)	
Reason for current participation in TME*				
Because I wanted to get rid of malaria	8 (80)	109 (77.3)	117 (77.5)	0.6
Because I wanted to be healthy	5 (50)	83 (58.9)	88 (58.3)	0.4
Other	0	2 (1.4)	2 (1.3)	0.87
I would not participate if not provided following items				
Free health care	3 (30)	65 (46.1)	68 (45)	0.62
T shirts	0	2 (1.4)	2 (1.3)	
All of the above	2 (20)	34 (24.1)	36 (23.8)	
Even if nothing	5 (50)	38 (27)	43 (28.5)	
Other	0	2 (1.4)	2 (1.3)	
I would recommend TME to others				
Yes	5 (41.7)	38 (27)	43 (28.1)	**0.004**
No	4 (33.3)	63 (44.7)	67 (43.8)	
Don’t Know	2 (16.7)	40 (28.4)	42 (27.5)	
No response	1 (8.3)	0	1 (0.7)	
***If Yes,* reasons**				
Because it will keep us healthy	3 (60)	20 (52.6)	23 (53.5)	0.43
I want to eliminate malaria	1 (20)	12 (31.6)	13 (30.2)	
I want to help them	0	3 (7.9)	3 (7)	
I am scared that they can transmit me	1 (20)	1 (2.6)	2 (4.7)	

Some people do not understand	0	2 (5.3)	2 (4.7)	
***If No,* reasons**				
I don't know how to say	3 (75)	30 (47.6)	33 (49.3)	0.46
Thy don't listen to me	0	14 (22.2)	14 (20.9)	
I don't want to talk	1 (25)	8 (12.7)	9 (13.4)	
Other	0	11 (17.5)	11 (100)	
Ways a village can help in the TME program				
I don't know how to help	5 (41.7)	29 (20.6)	34 (22.2)	0.35
I will help by participating in the project	2 (16.7)	45 (31.9)	47 (30.7)	
We all have to participate	4 (33.3)	58 (41.1)	62 (40.5)	
Other	1 (8.3)	9 (90)	10 (6.5)	
*Multiple answers were possible, percentage exceeds 100; analysis is based on a binary response "Yes" or "No"				

Table 5. 5: Logistic regression on association between covariates with complete participation

	Participation		**Univariate Analysis**	**p-value**	**Multivariate analysis**	**p-value**
	Partial/none (n=17)	**Complete (n=141)**	**Crude OR (95% CI)**		**AOR* (95% CI)**	
Covariates	**Number (%)**	**Number (%)**				
Sensitization by District health team/village health workers/study staffs	13 (8.7)	137 (91.3)	10.53 (2.35 to 47.14)	**0.002**	0.98 (0.04 to 20.54)	0.99
Attended meetings of TME	11 (7.4)	138 (92.6)	25.09 (5.51 to 114.24)	**<0.001**	12.01 (1.14 to 125.99)	**0.03**
Village head explained TME to you	10 (7.5)	124 (92.5)	5.1 (1.71 to 15.19)	0.003	4.54 (0.94 to 21.75)	0.058
Study staffs explained TME up to 30 times	9 (6.4)	132 (93.6)	11.07 (3.65 to 33.61)	**<0.001**	2.97 (0.58 to 15.19)	0.19

We get malaria from mosquito	14 (9.2)	139 (90.8)	9.26 (1.21 to 70.63)	0.032	0.12 (0.002 to 7.60)	0.32
Fever is the sign and symptoms of malaria	8 (6.5)	115 (93.5)	4.97 (1.75 to 14.12)	**0.003**	2.21 (0.46 to 10.63)	0.32
Malaria can be diagnosed through blood test	10 (7.2)	128 (92.8)	6.89 (2.24 to 21.16)	**0.001**	5.68 (1.00 to 32.30)	**0.05**
A healthy looking person can have malaria	3 (4.8)	60 (95.2)	3.45 (0.95 to 12.56)	0.06	0.97 (0.18 to 5.15)	0.97
Malaria can be eliminated by giving medicine to all the villagers	6 (4.9)	117 (95.1)	8.93 (3.01 to 26.51)	<**0.001**	3.87 (0.74 to 20.08)	0.1
Everyone from my house participated	4 (4.7)	81 (95.3)	4.38 (1.36 to 14.12)	**0.013**	4.27 (1.3 to 14.02)	**0.017**
Had complaints after round 1	1 (4)	24 (96)	3.28 (0.41 to 25.94)	0.26	3.01 (0.33 to 26.97)	0.32
Had complaints with my HH members	3 (7.7)	36 (92.3)	1.6 (0.43 to 5.88)	0.48	0.89 (0.21 to 3.73)	0.88
Received enough information	9 (6.2)	137 (93.8)	30.44 (7.68 to 120.62)	<**0.001**	0.37 (0.01 to 11.89)	0.58
Medicine was given to kill malaria parasites	8 (5.7)	132 (94.3)	16.5 (5.13 to 53.02)	<**0.001**	6.77 (0.89 to 51.5)	0.06
Medicine did not cause many illnesses	9 (7.4)	113 (92.6)	0.27 (0.09 to 0.78)	0.016	1.16 (0.12 to 10.91)	0.89
Blood was taken to test for malaria parasite	7 (5.5)	121 (94.5)	8.64 (2.94 to 25.33)	<0.001	0.76 (0.04 to 11.75)	0.84
I liked all about MDA	8 (5.6)	134 (94.4)	21.53 (6.36 to 72.82)	<0.001	17.2 (1.66 to 177.99)	**0.017**
MDA is important	8 (5.6)	135 (94.4)	25.31 (7.21 to 88.81)	<**0.001**	14.94 (1.3 to 171.27)	**0.03**
I will participate if MDA happens next year	8 (5.8)	130 (94.2)	13.29 (4.27 to 41.32)	<0.001	2.34 (0.27 to 20.05)	0.43
I would recommend MDA to others	5 (11.6)	38 (88.4)	0.88 (0.29 to 2.68)	0.83	0.18 (0.03 to 1.05)	0.057

*(AOR=Adjusted Odds Ratio for age and sex)

5.1.5 Discussion

The majority of respondents participated in all three rounds of MDA, which is necessary to clear parasitaemia completely [26, 30]. This study demonstrates that contact with TME staff, particularly during the community engagement meetings, was key to participating in the MDA. Villagers were also likely to be complete participants if all other household members participated. Among the community engagement activities that accompanied the MDA, village meetings were one of the most frequent means of delivering health education to the villagers [6].

A minority of participants never took part in MDA (n=8) because of fears about the blood testing. Others who could not complete the participation (n=9), gave reasons such as travelling, busy due to work and adverse events due to the medicine. Such explanations are consistent with those offered for non or partial participation in past MDAs in the Gambia [29, 51, 179], Vietnam [32] and the Thai-Myanmar border regions [30]. The villagers reasons for partial or non-participation were discussed in meetings, and those who voiced concerns about MDA were sought out and provided with additional health education during house-to-house visits [6].

As has been highlighted elsewhere, the community engagement strategy played an important role in promoting MDA coverage. For example, in Vietnam, participation in TME was also more likely among villagers who could recall that someone had explained to them “what MDA

is" [32]. In Vanuatu, community engagement activities provided a forum for sharing information about the study and resolving concerns raised. This ultimately contributed to the elimination of malaria on one of the islands [54].

Community meetings have been integral part of MDAs in the past [3]. In The Gambia, village meetings were presided over by district level government officials where study objectives and methods were discussed with the villagers and concerns and issues raised by villagers were answered [78]. In Indonesia, cadres chosen by villagers had monthly meetings and were deployed to conduct house to house health education [67]. In Kenya, concerted meetings with the authorities and trained volunteers were held involving different cohorts of the population such as at school, trading centres and the members of the local population [76]. In MDAs in Nicaragua [66], Liberia [119], Cambodia [79] and Sierra Leone [118] meetings were held as part of a stepwise process of CE.

The community engagement and other TME activities were coordinated with volunteers from each village who represented the villagers' interests. Through the volunteers, the villagers were therefore able to take an active role in deciding on and executing TME activities. Such an approach has been recognized as a major element of effective community engagement [3, 54, 57, 58] and indeed community members taking more prominent roles in the design of community engagement had a positive impact on population coverage in a recent MDA in Cambodia [33].

In addition to the community engagement, villagers' experience of the TME study as a whole influenced their participation. Respondents who liked all the components of TME and thought that TME was a worthwhile activity were more likely to participate in the MDA. Even though study staff made the distinction between community engagement and the clinical study,

villagers tended to view the range of activities as part of one "project", which is understandable given the integrated nature of community engagement within TME. Similar findings were reported from a TME study in Myanmar where villagers and staff considered CE an integral part of TME [31]. Consistent with the findings in Laos, perceptions such as "MDA was important" that referred to the whole study were found to be associated with participation in The Gambia [51].

The results also indicate a role for social relationships in the uptake of MDA. Villagers were more likely to be "complete participants" if all household members participated in the study. In Laos, a high value is placed on familial cohesion and integrity [180], and in the study villages, household hierarchies, usually led by a male household head, are important [45, 181]. There was also a tendency for conformism across households in TME villages, likely to be rooted in villagers' ethnic identity and the traditional system of mutual help between the households [45]. As previous ethnographic research has described, these particular ethnic minority communities demonstrate a system of mutual support and labour exchange between households, for example work in the field, housing construction and other daily tasks. This is often termed *"aw wan sai wan"* (to take a day and to give a day) [182]. This interdependence was reflected in the communal community decision which villagers often expressed as *"If all participate, I will participate".*

As well as raising awareness of the study, increasing villagers' familiarity with malaria, and addressing misconceptions, participation in village-wide meetings also generated pressure to conform and participate. Repeated home visits and interactions with TME staff and volunteers, gestures of commensality – sharing and eating food together – and participating in their rituals also strengthened social relationships. Developing ties of this kind, which went beyond the

formal researcher-respondent relationship, prompted reciprocity and encouraged participation. In Myanmar, by following the social conventions (sharing traditional foods with the villagers, participating in social activities such as funerals and festivals), study staff were able to build social relationships and garner trust. Sometimes this meant that villagers participated in MDA in spite of lack of a clear understanding [31]. In The Gambia, developing social relationships between researchers and participants, which were akin to familial bonds, has been recognized as key to building trust and for participation in clinical trials [183].

5.1.5.1 Strengths and limitations

This study took place alongside a clinical trial of TME, which entailed a carefully planned programme of community engagement that began six months before the MDA. Such intensive community engagement may not be possible for MDAs which are part of large-scale malaria control programmes. As part of large-scale implementation, it is also unlikely that blood surveys would accompany the MDA. Further research is needed to assess the factors that influence participation in large scale mass anti-malarial administrations.

The questionnaire used for this study has been employed in locally adapted versions in several previous surveys of factors influencing participation in MDA. The questionnaire also underwent extensive pretesting. However, using a questionnaire alone limits the depth of information on villagers' reactions to TME, community engagement and nature of social relationships. Additional qualitative data collection will provide a more nuanced understanding of attitudes and behaviours when offered MDA in this context. Additional qualitative data collection, particularly using daily observations including the TME activities will provide insight into whether villagers' responses were influenced by desirability bias.

5.1.6 Conclusion

Participation in MDA was associated with involvement in community engagement activities, knowledge that the blood test was for malaria diagnosis, family members' participation in TME and the perception that TME was worthwhile. The comprehensive community engagement strategy, which encompassed formative research, involved villagers in implementing the study and was responsive to the needs and preferences of the community contributed to uptake of MDA in a remote population with low literacy and socio-economic status. Villagers' overall impression of the study also influenced their participation and this illustrates that community engagement cannot be easily extricated from the overall implementation of an intervention. Social relationships were also relevant to participation in MDA, suggesting that rapid implementation that leaves little time for developing such bonds may face additional challenges. Further research is needed to investigate these factors when malaria elimination activities are scaled up.

5.1.7 Reflections on factors affecting population coverage

In this chapter, I used a questionnaire-based survey to analyse the factors affecting population coverage in MDA. The analysis provided insight into factors associated with complete participation in all three rounds of MDA: 1. Attending TME meetings; 2. Awareness that malaria is diagnosed by blood test, 3. Coming from a household where all household members have participated, 4. Preferring all aspects of MDA (such as blood test, taking anti-malarials, incentives and health care) and 5. Perception that TME is worthwhile. In a nutshell, these factors showed an impact of community engagement and the socio-cultural characteristics of these population in achievement of high population coverage and adherence. Nevertheless,

these findings did not fully explain the detail insights on the mechanisms and the relationship between these factors in promoting population coverage. In the following sub-chapter, using qualitative methods, I describe the mechanism on how community engagement together with the factors embedded in local social and cultural context helped to achieve the high population coverage in Laos TME.

5.2. Qualitative:

5.2.1 Abstract

Introduction

As a part of Targeted Malaria Elimination (TME) in the GMS, mass drug administration (MDA) with antimalarials was conducted in four villages in Nong District, Savannakhet Province, Lao PDR (Laos). A high proportion of the target population participated in the MDA, with over 87% agreeing to take the antimalarial. Drawing on qualitative data collected alongside the MDA, this chapter explores the factors that led to this high population coverage.

Methods

Qualitative data collection methods included observations, which were recorded in field notes, focus group discussions (FGDs), and semi-structured interviews (SSIs). Data were collected on the local context, and MDA-related knowledge, attitudes and perceptions. FGDs and SSIs were audio-recorded, transcribed and translated to English. All transcriptions and field notes underwent qualitative content analysis using QSR NVivo.

Results

Respondents recognized malaria as a health concern and described the need for a malaria control programme. The risk of malaria including asymptomatic infection was explained in terms of participants' work in forest and fields, and poor hygiene. During the MDA rounds, there was an improvement in knowledge on the concept of asymptomatic malaria, the rationale of MDA and the blood test. In all four villages, poverty affected access to healthcare and the provision of free care by TME was highly appreciated. TME was jointly undertaken by research staff and local volunteers. Authorities were involved in all TME activities. Ethnic

minority communities inhabited mostly by *Mangkong* were cohesive and community members tended to follow each other's behaviour closely including participation in MDA. Factors such as understanding the concept and rationale of the study, free health care, collaboration with the village volunteers, support from authorities and cohesive communities contributed in building trust and high population coverage in MDA.

Conclusion

Future malaria control program can become successful in achieving the high coverage in MDAs drawing from the success of TME in Laos. The high population coverage achieved in TME resulted from a combination of various factors that included the community engagement to promote the concept and rationale of MDA for asymptomatic malaria in addition to their baseline understanding of malaria as a health concern, provision of free primary health care, partnering of the research with local volunteers and authorities, building social relationship with community members and the cohesive nature of the communities boosted the trust and participation in MDA.

5.2.2 Introduction

The first part of chapter 5, which was designed to highlight the factors affecting population coverage in MDA in Lao PDR, this half of the chapter, further delves into these factors drawing on qualitative data to disentangle their impacts.

To date, social scientists have used qualitative methods in Myanmar [31] and Cambodia [33] to explore how local social circumstances and community engagement activities influence coverage of mass anti-malarial administration within TME. In view of potential mass-antimalarial administration campaigns across the region, further research is needed to examine the community responses to TME in target areas of the GMS that are socially and culturally distinct. This part of the chapter examines how the community engagement activities and the local social and cultural context affected the uptake of mass antimalarial administration in target villages in Laos.

5.2.3 Materials and methods

5.2.3.1 Data collection

Data were collected alongside the main TME study from September 2015 to August 2016. Data collection included observations of study and community engagement activities (recorded in field notes), focused group discussions (FGDs), and semi-structured interviews (SSIs).

Focus group discussions

Focus group discussions were conducted as a part of formative research (methods of FGDs are detailed in chapter 3) before the TME started to inform and design the community engagement:

the aim was to explore the socio-demographic status, health-seeking behaviour, knowledge, and attitudes and perceptions towards malaria and MDA (Figure 1.2 and Table 5.6).

Observations and field notes

Field notes were collected based on the observation of study-related activities, such as meetings, volunteer's training, audio-visual shows, mass meetings, house-to-house visits and MDA. Field notes contained the location, subject of the notes, date and discussions during meetings including the reflections by the observer/note taker. Field notes were made in English with on-site translation where necessary. A total of 130 field notes were collected from September 2015 to August 2016. Field notes included descriptions of the activities and summaries of informal conversations about the study.

Semi-structured interviews

A total of 31 semi-structured interviews were conducted in the local language with onsite translation by a bilingual volunteer or a local coordinator after the MDA rounds in May, June and July, 2016. Respondents were drawn from the two intervention villages, with 16 participants from PMM and 15 from TT. In meetings after the first round of MDA, community members were asked if they were interested in participating in an SSI. Interested community members were visited at their household for interview by a social scientist. Interviews with the same participants were conducted after each round of MDA. During the SSIs, perceptions and experiences of the TME study were explored. All respondents gave written informed consent. The SSIs after round one were recorded using an audio-recording device and notes were taken.

5.2.3.2 Data analysis

Audio-recorded data from FGDs and SSIs were transcribed verbatim and translated into English. Together with the field notes, all the data underwent qualitative content analysis (QSR NVivo 11). The codebook developed for initial analysis was based on the research questions (deductive approach) and supplemented by codes that emerged (inductive approach) during the process of reading and coding the transcripts. The transcripts and the field notes were coded line-by-line and resulting codes were analyzed for patterns and relationship to the research question. The content of the codes guided the themes that are presented in the results.

5.2.4 Results

5.2.4.1 Characteristics of participants

FGDs: As previously described in chapter 3, the mean age of the participants was 37 years (range: 18 – 80 years) and all were farmers (Table 5.6). The majority of the participants (82/100) reported no formal school education.

SSI: Thirty-one participants took part in semi-structured interviews from two of the intervention villages and the same respondents were followed after each rounds of MDA for total of 3 rounds (Table 5.7). The mean age of the SSI participants was 37 years (range: 18 – 70 years) and 61% of participants were male (19/31). The majority (28/31; 90.3%) were farmers and (19/31; 61.3%) had not attended school.

5.2.4.2 Why did villagers participate in targeted malaria elimination?

Villagers' participation in MDA as part of TME in Laos was influenced by diverse contextual and study-specific factors (Figure 5.3). These included villagers' initial recognition of malaria

as a health concern and the subsequent increase in familiarity with the rationale for MDA. The provision of free health care as part of the study was highly valued because – under normal circumstances – villagers' access to healthcare was restricted by poverty and distance to the nearest facilities. The partnership that study staff developed with local villagers to design and implement TME, plus the collaboration with provincial, district, village and the health centre authority figures contributed to building trust in TME. A tendency toward social conformity also played a role in prompting participation.

Malaria as a health concern

In all four villages, malaria was recognized as a major health problem. In the ethnic local language, malaria was translated as "disease-mosquito bite/*aai moi kap*" and "disease-fever with chills/*aai singyet*". Most villagers knew the prominent symptoms of malaria and its likelihood of causing severe illness and death. Respondents were also familiar with protective measures, such as wearing long sleeved clothes and sleeping under mosquito nets. In the initial FGDs, the participants described malaria in terms of a symptomatic illness. They also linked malaria with visiting the forest or rice fields and poor hygiene. Respondents were open to the idea of asymptomatic malaria among the residents of their villages, in contrast to outsiders (such as the TME staff) who they viewed as cleaner or more hygienic, and who did not go to the forest and rice fields. Their understanding of asymptomatic malaria was therefore associative (to the life style and occupation) and did not include reference to parasite loads in blood or its propensity to cause various types of infection.

I: Do you think that a healthy person can have malaria parasite in his/her body? For example: me, do you think I have malaria parasite in my body or not?

R: No, because you look clean. You do not have to go to forest like us. For us, we have to go to forest every day to find food. We do not have good clothes. I just only have one blanket in my house, I have to give it to my husband and my kids.

30 year female FGD participant from sub-village of TT with total of 8 participants.

I: Can you tell me about malaria symptoms?

R: the symptom of malaria is shivering…… then we have to keep (ourselves) warm, nausea and thirst.

I: How do you know that you have malaria?

R: when we get [malaria] we will feel shivering, headache, pain abdomen and have diarrhoea.

I: Do you go to check at the health centre?

R: Yes!

I: After (the) check, what did a doctor do?

R: The doctor gave us a report and gave medicine to us.

SSI1 P9, 32 year, male, farmer, PMM village

Other than referring to a malaria as a disease, no respondents spontaneously mentioned species (such as *falciparum* and *vivax*) of malaria.

Poverty and demand for health care

Poverty affected all aspects of the villagers' life. Their access to healthcare in general was impeded by difficulties in meeting travel and opportunity (time) costs, and paying up-front treatment charges.

I: Are there reasons why someone in this village would not seek treatment?

R2: No money

R7: No transportation

I2: …What about other reasons why someone in this village would not seek treatment?

R7: The road is not comfortable: especially in the rainy season, it is very difficult to go anywhere.

I1: Anything else? Please try to think.

R7: If there is nobody to take care of one's house, find food and take care of one's children.

R8: No driver.

FGD with eight women at PMM village

Issues of access to health care were prominent in the FGDs and apparent during observations during initial visits to the villages, five months before MDA. For example, study staff saw overwhelming uptake by villagers of the mobile health care, provided by TME staff at community engagement events. This highlight villagers' unmet demand for health care and prompted TME staff to offer free and accessible health care during the study.

Intravenous (IV) drips were in particular demand among residents of the target villages. This demand was accentuated in intervention villages after the first round of MDA, when villagers reported adverse events. Villagers viewed IV infusions as a quick way to replenish blood and energy. The IV fluids were acquired from health facilities and usually contained a combination of saline solution and vitamins or sometimes additional intramuscular steroids. During severe bouts of illness, such as fever and dehydration due to acute diarrhoea, villagers often resorted to IV infusions. During informal conversations, respondents reported IV infusions leading to a quick recovery and described a feeling of fluid having been added to the body. In light of their popularity, health staff charged relatively high prices for IV infusions. During TME, the demand for IV infusions from the study physicians (who were offering treatment free of charge) was such that one physician requested a village meeting to explain the appropriate use of IV infusions and their dangers.

Understandings of mass anti-malarial administration

After each round of MDA, SSI respondents were asked about the rationale for taking medicine while asymptomatic. The majority gave reasons such as "to kill the malaria parasite in their body" and they "wanted to be healthy". Respondents were positive about the idea of MDA even though sometimes they did not fully understand the rationale behind this approach or expect any specific health benefit. Nonetheless, villagers' participation was often motivated

by a desire to improve their health accentuated by pre-existing health conditions, and poor health. Such perceptions were common in participants irrespective of gender and age.

I: what do you think about taking medicine, if you are not sick?

R: I do not think about anything, I take it because I want to be healthy.

SSI1P6, 28 year, female, farmer, PMM village

I: What did you think about taking medicine if you are not sick?

R: I am very happy to take medicine but I don't like the tiredness and headache.

SSI P15, 25 years, female, farmer, PMM village

Almost all respondents described the TME study in terms of malaria, for example, describing the aim as "to eliminate malaria", "to treat malaria" or "to help us away from malaria". These responses reflected the way in which TME was presented to villagers: during meetings with villagers, staff reiterated the goal of eliminating malaria and the appeal to work together to achieve the better health. Study posters and other material emphasized this message.

I: Do you know what is this project doing here in your village?

R: Malaria treatment to eliminate malaria away from our village.

I: What is the aim of the project?

R: To make us having a good health.

SSI P10, 40 years, female, farmer, PMM village

Assessing villagers' attitudes towards the community engagement activities that accompanied the clinical activities was complicated by their tendency to view all TME activities as a single undertaking. Other than remembering study activities, such as video shows, meetings, home visits, blood tests and taking medicine, villagers did not talk spontaneously about their preference for particular activities. Upon further probing, villagers often expressed that "they liked [it] all". Villagers often said they received the information on TME either from volunteers or the village head, mostly during the meetings and night video shows. Often during informal conversations with villagers, concerning their reasons for participation, they mentioned "to improve one's health" and "to get rid of malaria".

I: How did you learn about the project?

R: I first heard from village head and volunteers and also during meetings when they explained poster.

I: Did you join any other activities or meeting of our project?

R: Yes! When your project come to do night video shows and during MDA.

I: Did you explain about our project to another person?

R: Yes! I talked to villagers that this project is helping poor people by giving them malaria medicine.

SSI1 P31, 34 years, female, teacher, TT main sub-village

Reported adverse events and other concerns about the antimalarials

After the first round of MDA, many villagers reported adverse events, particularly malaise or tiredness *(local: Yi-yo)*, decreased appetite (*local: Tà é chadoî*), sense of fullness of abdomen (*local: pasai chà)* and food does not taste good (*local: chadoí ta ém*), headache (*local: Ti Plä*) and sleepiness (*local: Yì Bè)*. These events prompted villagers to visit local health facilities and request restorative treatment in the form of an IV infusion. In addition to saline solution and vitamins, villagers requested IV steroids often referred as "*Kakok"*.

In response to these reports, the study team augmented the health care provision in the following ways: study physicians subsequently spent more time in the villages; TME staff liaised with the health centre staff; the quantity and range of medicines available free of charge was increased; and health centre staff along with TME staff visited the households of villagers who reported complaints. Meetings were conducted with the villagers to explain and answer questions about adverse events such as tiredness, loss of appetite and epigastric pain. Apart from providing the symptom-specific treatment, TME staff offered counselling. Specific messages from study staff included:

Any medicine can cause certain discomfort

New medicines are generally less tolerated at first

The medicine is fighting against the parasite in your body

Please feel free to consult our doctors if you have such problems

During the meetings, the specific risks and benefits associated with the IV medicines were discussed.

Soon after increasing health care and education, observations indicated a decline in the number of villagers attending health centres with complaints regarding adverse events. In spite of the adverse events, villagers in both intervention villages participated in subsequent rounds of MDA. Thus the population coverage was stable in both intervention villages in all three rounds (in PMM, coverage was 87%, 86% and 87% in the three respective rounds and in TT, coverage was 87%, 85% and 88% in the three rounds respectively).

I: What was the nature of tiredness, to what extent were you able to work?

R: I could walk, go to the toilet, work at home but could not go to the field.

I: What was the nature of "loss of appetite"?

R: It was decrease in appetite but not complete decrease. The food doesn't taste delicious… and we feel that medicine is still inside the stomach.

Informal conversation with a resident of PMM after TME round 1

Villagers raised concerns about the blood collection (up to 3 ml) following TME: they suggested that "blood is forcefully drawn", that "large quantity of blood is drawn" or they reported being "afraid of needles". These stories had an impact on recruitment, with some of the villagers who refused to participate citing blood sampling, and specifically the large quantity of blood drawn, as reasons for their reluctance to participate. Such groups of refusers were often clusters of friends of relatives. This clustering of refusers was also indicative of a wider trend in villagers' behaviour. In informal conversations, locals described how, "if all participate, I will participate".

The stories emerged in intervention villages after the first round of MDA and spread quickly to neighbouring control villages. Aware of this, study staff responded by involving relevant village authority figures (for example, the village head) in community meetings. The village head from TT (residents of this village were said to be responsible for spreading the rumour) explained and answered villagers' questions, with the support of the TME team. The following day, the majority of villagers participated in the baseline survey (coverage was 90% in XT).

Participating together

Study staff viewed frequent social visits and participating in village activities as a high priority. These included playing pétanque, volleyball, football and (□□□□□) *sepák tákraw* with villagers. Staff also participated in cultural gatherings, such as *Champhi* (religious sanctification ceremony to cleanse a bad spirit that causes diseases to a family member), and funeral ceremonies. During these events, staff ate and drank (often local alcohol [*Lao Khao*]) with the villagers. This built rapport with the villagers. Frequent visits to the villages, overnight stays, and the fact that TME physicians were resident in local health centres strengthened relationships between study staff and villagers. Sometimes, villagers requested a home visit to see their family members who had been too sick to come to the health centre. During home visits, study staff offered diagnosis and treatment whenever possible or helped patients to be transported to a referral hospital. Such interactions helped study staff to understand better the nuances and subtle reactions of villagers' health care requirements and the need to adapt TME activities. Study staff scheduled study activities so as to respect villagers' routines of working in the field and festivities. This included re-opening the MDA venues in sub-villages, and adapting the timing of household visits to offer medicine and health care.

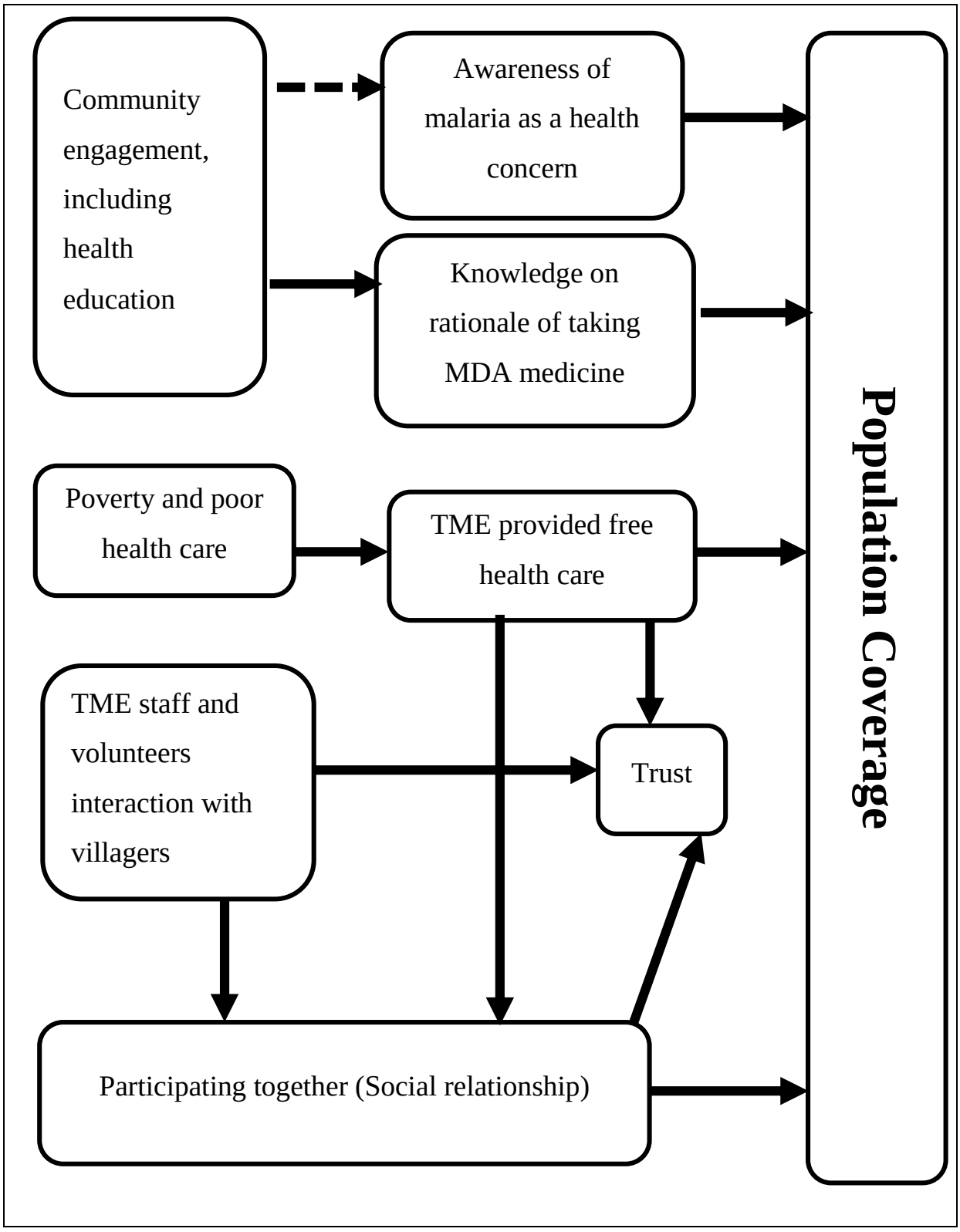


Figure 5. 4 Factors affecting population coverage and participation

Table 5. 6: Socio-demographic characteristics of FGD Participants (n=100)			
		Villages	
Characteristics	**Total**	**Intervention**	**Control**
	Number (%)	**Number (%)**	**Number (%)**
Age Group			
18 to 30 years	38 (38)	19 (36.5)	19 (39.6)
31 to 40 years	32 (32)	20 (38.5)	12 (25)
≥ 41 years	30 (30)	13 (25)	17 (35.4)
Mean=37.58±12.71; Range=18-80 years			
Sex			
Female	48 (48)	24 (46.2)	24 (50)
Male	52 (52)	28 (53.8)	24 (50)
Occupation			
Farmer	100 (100)	52 (100)	48 (100)
Education Groups			
Not attended school	82 (82)	44 (84.6)	38 (79.2)
1-5 years	16 (16)	7 (13.5)	9 (18.8)
>6 years	2 (2)	1 (1.9)	1 (2.1)
Name of the villages			
Oi*	16 (16)	0	16 (33.3)
Tantip*	16 (16)	0	16 (33.3)
Phounmakmee	18 (18)	18 (34.6)	0
Keng and Appok	18 (18)	18 (34.6)	0
Thate Main	16 (16)	16 (30.8)	0
Xuang Tai*	16 (16)	0	16 (33.3)
*Control villages			

Table 5. 7: Socio-demographic characteristics of SSI Participants (n=31)			
		Villages*	
Characteristics	**Total**	**PMM**	**TT**
	Number (%)	**Number (%)**	**Number (%)**
Age Group			
18 to 30 years	15 (48.4)	7 (46.7)	8 (50)
31 to 40 years	6 (19.4)	3 (20)	3 (18.8)

≥ 41 years	10 (32.3)	5 (33.3)	5 (31.3)
Mean=37.35±16.23; Range=18-70 years			
Sex			
Female	12 (38.7)	6 (40)	6 (37.5)
Male	19 (61.3)	9 (60)	10 (62.5)
Occupation			
Farmer	28 (90.3)	14 (93.3)	14 (87.5)
Teacher	2 (6.5)	1 (6.7)	1 (6.3)
Trader	1 (3.2)	0	1 (6.3)
Education Groups			
Not attended school	19 (61.3)	10 (66.7)	9 (56.3)
1-5 years	9 (29)	4 (26.7)	5 (31.3)
>6 years	3 (9.7)	1 (6.7)	2 (12.5)
*SSI participants were from 2 intervention villages			

5.2.5 Discussion

The Laos TME project achieved an 87% population coverage for all 3 rounds potentially sufficient to interrupt malaria transmission. With a background of a community engagement that entailed partnering the research with local volunteers and the authorities, provision of free health care and incentives, various factors contributed to this achievement: villagers' perceptions of malaria and their health care needs; experiences of adverse events, the responses of study staff; and the social relationships that staff developed with participants.

5.2.5.1 Malaria as a health concern

As was recently found in Cambodia, respondents in Laos were familiar with malaria as a symptomatic illness of malaria and recognized it as an important health concern. In both sites, despite gaps in awareness of the details of malaria infection, respondents expressed positive opinions about malaria elimination efforts [33]. As has been described elsewhere in Asia and Africa [163], villagers linked malaria infection to unhygienic conditions, particularly poor

water and sanitation [164, 165]. The associations that respondents made between "being unclean", "visiting local forests" or their "rice fields" and malaria infection meant that they were receptive to the concept of asymptomatic malaria among the residents of their villages and the need to clear latent infections. Although asymptomatic malaria was not perceived to be linked to parasite loads or its propensity to cause various types of infection, such an understanding seemingly facilitated the acceptance of taking an anti-malarial when not ill.

In Cambodia and Laos, respondents were largely unaware of the different malaria species present locally (mainly *P. vivax* and *P. falciparum*) [33]. This is unsurprising because the health education that accompanied TME did not deal with such intricacies [6, 33]. Future malaria elimination campaigns will need to address the importance of vivax malaria, the hypnozoites of *P. vivax* forming a long term reservoir of infection [159, 166] requiring "radical cure" which consists of a 14 day course of primaquine an 8-aminoquinolines [184].

5.2.5.2 Poverty and health care

Villagers were engaged in subsistence farming and had very little access to cash. The resulting poverty restricted their access to health care. Offering a monetary incentive (USD~12 per round that entailed 3 days participation) and providing free health care encouraged villagers to participate. This was particularly important in terms of mitigating the loss of a day's labour in the field or forest entailed [6]. The formative research was key to designing the nature of the incentives, particularly how the health care was offered [6].

Clinical trials, particularly in low and middle-income countries, where health care infrastructure is weak or difficult to access, often include the offer of ancillary care to participants [185-190]. In Malawi, the provision of ancillary care for clinical trial participants

was considered ethically imperative [191]. Ancillary care has also been integrated into the clinical trials run by Shoklo Malaria Research Unit (SMRU), which often recruit vulnerable populations on the Thai-Myanmar border [189].

Many ethicists view the provision of ancillary care as an essential component of ethical research, which must be delineated beforehand and take into account participants' needs, the capacity to help and the investigators' level of engagement with participants [185-189]. Ancillary care within Laos TME included treatment of a wide range of diseases and was responsive to villagers' health care needs. The approach followed reflects that of SMRU [189] and is recommended by some ethicists [186, 188, 192].

The ancillary care often has additional symbolic value for study participants: it indicates an attentiveness to their suffering, engenders a sense of a supportive social relationship and generates trust in the research team. The experiences of participants in the Laos TME study, echoed those of clinical trial participants in The Gambia, for whom the free study health care became conflated with social relationships with study staff, generating feelings of trust, reciprocity and interdependence [183].

5.2.5.3 Understanding of mass anti-malarial administration

As part of community engagement for TME, staff used multiple health education methods to explain the concept of asymptomatic malaria, the rationale for blood testing and MDA. In addition, a community-wide appeal to eliminate malaria from the village was made through posters in village meetings [6, 46]. Villagers' responses indicate that these efforts had some impact, particularly through their familiarity with the overall aim of the study. Their impact on awareness of the details of asymptomatic malaria and the study rationale was less clear. A

questionnaire-based survey that accompanied this research also highlighted how familiarity with the rationale for blood testing and MDA contributed to complete participation in Laos TME [46]. In The Gambia, understanding the rationale of MDA was found to contribute to the participation [51], and in recent MDAs conducted in Vietnam [32] and Thai-Myanmar border [30] inadequate understanding of the rationale of MDA was associated with non-participation.

Familiarity with the study rationale and knowledge of malaria does not always translate into participation in MDA. For example, in one community on the Thai-Myanmar border, although villagers recorded an increase in their knowledge of malaria over the study period, participation in the MDA remained low. Study staff attributed the low participation to political divisions and the resulting antagonism between fractions of the community [30]. This highlights the limitation of health education. It also demonstrates the importance of understanding the local social and cultural context, and incorporating these insights into the design of MDA and the accompanying community engagement. In the Lao TME project, study staff quickly recognized the villagers' preference for dedicated, exclusive study activities in the sub-villages and adapted their approach accordingly [6].

5.2.5.4 Reported adverse events and intravenous fluid

Adverse events after the first round of MDA prompted many villagers to seek IV medication. This was rooted in villagers' belief that IV infusions replenish blood and provide energy. Studies of demand for IV medication have highlighted similar perceptions in north-eastern Thailand (bordering Laos) [193], Indonesia and Uganda [194], and amongst both clinicians and patients [195].

Participants in TME in Cambodia also sought IV medication without clinical justification [33]. This presents a challenge for clinical trials in the region that provide ancillary care. In Lao TME, a multi-pronged approach was taken to counteracting the demand for IV infusions. This included providing health education during community meetings and home visits and intensifying the ancillary health care. This responsive approach was an essential element of the community engagement and contributed to maintaining high population coverage in subsequent rounds of MDA [6]. Similarly, in Vanuatu [54] and Cambodia, [33], the capacity to respond to participants' concerns was key to ensuring high participation throughout multiple rounds of MDA.

5.2.5.5 Participating together and trust

In The Gambia, study staff developed social bonds with trial participants that went beyond the formal researcher-subject relationship, and fostered participation [183]. Similarly, in Myanmar, the TME study staff's involvement in village life – sharing food with villagers and participating in local social activities, such as, funerals and festivals – contributed to the uptake of MDA [31]. In the Lao TME villages, study staff observed a general conformism, with individual's behaviour often influenced by that of other household members and neighbours. As has been generally described in these ethnic minority society, there was also interdependence between households, reflected in sharing labour, communal problem solving and decision-making [46, 182]. This affected participation in TME and often during informal/formal conversations, villagers described how, "if all participate, I will participate". Notably, on the Thai-Myanmar border, MDA coverage was much higher in cohesive than in politically fragmented communities [30]. The questionnaire-based study and quantitative analysis of factors affecting participation in TME also highlighted the influence of other

household members on uptake of MDA [46]. This reflects the high value placed on familial conformity in Laos [45, 181].

5.2.5.6 Strengths and limitations

In addition to the strengths and limitations mentioned in section 5.1.5.6, this study used multiple methods at various time points (FGDs at baseline and SSIs after MDA), supplemented by observations throughout the study period (Figure 1.2). The data in this study could have been affected by cultural modesty and conformism. However, villagers were vocal about the adverse events and in their demand for additional health care. In addition, the TME team's prolonged deployment in the villages, which included overnight stays, helped to develop rapport and to understand the nuances and subtleties of villagers' reactions.

The findings are limited by the fact that this study was conducted in the context of a clinical trial with meticulous procedures accompanied by participant incentives (cash, free health care, T-shirts, sweets, household utensils) and improvement to water and sanitation through installation of water pumps. Control programmes with limited resources for incentives, investment in health care, and improvements in water and sanitation may not be able to offer similar benefits.

5.2.6 Conclusion

In the target communities in Nong District, the coverage of MDA (and blood survey) was high. Several factors contributed to this: villagers' openness to the concept of asymptomatic malaria and their awareness of the disease as a health problem and of the study aim; provision of health care – as part of TME – to communities that have limited access to medical services; a responsive approach to community engagement, whereby villagers' concerns were addressed

promptly; and the social bonds between staff and villagers that promoted trust in the study procedures. Because the study was conducted in the context of a clinical trial, further research in circumstances that more closely approximate implementation is needed to better inform the design of MDA within malaria control programs in the region.

5.2.7 How did TME achieve high population coverage?

Using qualitative methods, in this sub-chapter, I was able to delve deeper into how community engagement together with the factors embedded in local social and cultural context helped to achieve high population coverage. For instance, together with many other community engagement activities, health education using posters helped to reinforce the existing awareness of malaria as a health concern and enhanced the knowledge on rationale for taking medicine and testing blood that led to participation in TME. Collaboration with community members in planning, designing and implementing community engagement further led to boost in trust, building social relationship, reciprocity and thus participation. Similarly, a responsive nature of community engagement that led to provision of free health care to TME villages palliated their health care needs and further boosted the trust and participation in TME. Local social and cultural context of the communities, for example presence of high social cohesion amongst the community members where they tend to closely follow each other's decision also helped to promote their participation.

In chapter V, I have been able to explore the mechanisms how community engagement together with the factors embedded in local social and cultural context helped to achieve the high population coverage. In terms of achieving high population coverage in TME, community engagement can be deemed to be successful. However, community engagement also has

broader goals for ethical health related research. I describe the wider implications of community engagement in ethical health-related research in chapter VI.

CHAPTER VI

Why community engagement is essential for ethical health-related research in low-income settings

6.1 Abstract

In recent years, community engagement has been increasingly promoted in biomedical research and has been recommended in recent research ethics guidelines. Nonetheless, it has received inadequate investment, which has contributed to failures and early termination of research in HIV research and more recently in Ebola trials. These failures and premature termination of studies can lead to adverse outcomes such as waste of resources and inability to generate good evidence for interventions. However, emphasizing the benefits of community engagement in these narrow terms neglects the broader role of these activities as part of ethical research. In this chapter, the reasons why community engagement in health research is essential, particularly when conducted in low-income settings, are explored. Seven reasons outlined are: 1) respecting individuals, communities and local stakeholders; 2) building trust and social relationships; 3) maximizing benefits, minimizing risks and exploitation; 4) supporting the consent process; 5) understanding vulnerabilities; 6) gaining permission, approval and building legitimacy; and 7) achieving recruitment targets. Community engagement in which community members collaborate and share responsibilities with the researchers can help to achieve these goals.

6.2 Introduction

Community engagement has been understood as a concept and strategy to facilitate the smooth conduct of health-related research and achieve its aims and objectives [3]. However, emphasizing the benefits of community engagement in these narrow terms neglects the broader role of these activities as part of ethical research.

This chapter draws on the pertinent literature on community engagement in the context of research in LMICs, along with the experience of and reflections on conducting and evaluating community engagement [1, 3]. Community engagement is defined as a process of working with communities in the planning, design, implementation, and dissemination of research findings, to achieve research goals that are agreed between researchers and communities. Community is defined as a unique collection of individuals who have interests or stake in the conduct and/or outcomes of the given research project and/or the interaction with the research team [7]. A community includes the residents of settlements where health research is conducted, potential study participants, and all other residents in the immediate locality, as well as stakeholders such as the ministries of health, public health authorities, local research institutes and researchers.

6.3 Why community engagement?

6.3.1. Respecting communities

Engagement entails informing, consulting and/or collaborating with members of communities [196, 197]. Engaging – as early as possible in the research process – with all levels of local hierarchies and stakeholders demonstrates respect for communities by acknowledging what is

valuable or important to them as people rather than merely as prospective participants or facilitators of the research project [11].

Informing communities means providing information – in appropriate formats – about the researchers and their professional backgrounds, their institutions, the study aims, recruitment and research procedures, and study outcomes [3]. Appropriate formats can include use of a blend of art and science, such as using pictorial descriptions of the study rationale and objectives or conveying messages through participatory drama and theatre [4-6].

Consulting local stakeholders and community members entails researchers seeking input from them about the suitable ways to recruit study participants, to implement the study and to act respectfully as guests in the community [6]. Since 2009, consulting the Tak Province Community Advisory Board has benefitted the research studies conducted on the Thai-Myanmar border [77].

Collaboration between researchers and communities means that communities are involved as partners and share responsibilities in the research [6, 198, 199]. Such an approach can lead to changes in the study aims and objectives, as has been the case in the recent malaria elimination study in Laos, which involved working with local investigators to prepare study protocols and making joint decisions with regards to the planning and implementing the research [6]. Communities therefore take active roles in selecting, training and devolving the responsibilities to fellow community members who are involved in study implementation [17, 19, 120, 198, 200, 201].

6.3.2. Building trust and social relationships

Trust plays a critical role in the enrolment decisions of potential study participants. When faced with challenging scientific concepts, complex study rationales and uncertain benefits, potential participants often rely on the extent they trust the study staff or the research institution(s) involved [183].

In low-income settings, there are often significant disparities between researchers and participants in terms of education, income and familiarity with the study concepts [17, 30]. These differences can prompt suspicions about researchers' motives and who benefits most from the research, which could foster resentment and opposition [16]. Trust can also be negatively affected by past experiences of research – at individual, community or national level – and local idioms, such as those around blood stealing, which are often entwined with experiences of colonialism, neo-colonialism and exploitation [202, 203]. Often the short and managed interactions with study staff cannot build the trust needed to overcome such concerns [17, 183].

A collaborative approach can begin to address some of these fears and build trust. Involving community members as study staff and training community members to implement a study demonstrates investment in the community [4-6, 8, 46, 47]. Study messages delivered by fellow community members can also bear more credibility than those provided by outsiders [33, 47, 122]. Trust is built through prolonged interactions and fostering social relationships [10, 15, 204].

Social relationships are built during day-to-day interactions between researchers and community members. Sharing time, food and resources is a sign of commensality that can

ultimately lessen a sense of difference between researchers and the host community [30, 31, 47, 183]. Such interactions can blend the differences between intimacy and detachment, researcher and researched and observer and observed [183].

This also highlights how it is often difficult to extricate community engagement from other study procedures and the day-to-day interactions of staff with community members. Viewed in this manner, community engagement is not an independent set of activities but rather an ethos of health-related research that values building social relationships to garner trust [183]. Investing in social relationships can strengthen the opportunities for frank two-way communication.

Building trust in this way can foster good-will towards the entire research community; reducing suspicion and addressing power differentials may eventually create a propitious background for future research [10, 11, 33].

6.3.3. Maximizing benefits; minimizing burdens and exploitation

In low-income settings, there is an increased risk of exploitation of research participants due to poverty, illiteracy and the limited availability of healthcare [16]. Community engagement can help to ensure that research benefits the community and ensure that the participants are not unduly burdened, and are appropriately reimbursed and compensated for any burdens or inconveniences related to the research [7]. Ethics committees have been tasked to review applications to weed out research that is exploitative, but they may not be cognizant of all issues relevant to specific communities. Community engagement can help identify these issues as well as real and perceived risks and burdens that are not obvious to the casual observer, and take the necessary steps to mitigate those risks [7].

Benefits can accrue in the host communities in the short and long term. Immediate or short-term benefits include compensation for time and burdens of participating in research, incentives for participation, ancillary care and broader benefits such as increased health/research literacy, and improvement of basic facilities like water and sanitation [201]. These basic facilities may well be a prerequisite before commencing the study [16, 201]. The recent TME study in Laos has demonstrated that formative research embedded in community engagement can guide the intended benefits of health-related research [6]. It can also identify how and what can be fair, coercive or non-coercive for that particular community which can then guide researchers in nuancing what constitutes due or undue influence in research [19, 47].

Community engagement can have longer term benefits. For example in Vanuatu, as part of a study of malaria elimination, "community microscopists" were trained to diagnose malaria in villages and local health workers were trained on how to monitor malaria incidence [54]. These local healthcare workers continue to diagnose and monitor malaria incidence after the study ended. Another example is on the Thai-Myanmar border where, as part of scaled-up malaria elimination studies, village malaria workers were trained and malaria posts established [205]. These malaria workers and malaria posts continue to function long after the study has been completed.

Community engagement can also have indirect benefits. The Young Person's Advisory Group (YPAG), a junior community advisory board, affiliated to a children's hospital in Cambodia was set up to give young people a voice in research conducted in the hospital [206]. In doing so, the YPAG indirectly promotes health and science literacy among its members, the

children's families and their communities. Such capacity building has the potential to increases the overall health and research literacy of communities [2, 58, 207].

6.3.4. Supporting the consent process

Consent has been established as a critical element of ethical health-related research. The concept is clearly defined, with valid consent to research with competent adults entailing: (1) researchers explaining the proposed study and providing adequate information; (2) prospective participants understanding what is being proposed; and (3) prospective participants being able to make a voluntary choice about joining the study [208]. Community engagement and consent have been said to be two aspects of a single concern, and community engagement can lead research closer to more valid consent [19].

Community engagement can support the consent process in various ways to achieve valid consent. Firstly, community engagement can help tailor the written and verbal information provided to participants. For instance, through community engagement researchers changed written material to a pictorial description of the rationale and objectives in mass drug administration studies [3, 6, 46, 47].

For consent to be valid, the potential participant should also adequately understand the information provided. The participant's ability to understand depends, among other things, on their background knowledge about the disease, health beliefs and education [6, 47]. Community engagement can provide the background information. For example the Village Drama Against Malaria project in Cambodia conducted alongside a malaria study increased awareness about malaria in the community, and facilitated the individual consent process [4].

The third element of valid consent is voluntariness. Voluntariness involves intention and (perceived) freedom from control by external factors [209]. Factors that can impact on voluntariness include social and economic factors. To maximize voluntariness, researchers should ensure that appropriate benefits are offered – too much and the participant may be unduly influenced, too little and the participant will be exploited [209]. Community engagement through formative research can identify social and economic factors that can affect voluntariness and ways to mitigate them, and identify what individual and community level benefits are appropriate [6, 19].

6.3.5. Understanding vulnerabilities

A traditional approach to vulnerability in research has been to label an entire class of individuals as vulnerable [210]. A non-exhaustive list of vulnerable populations includes disabled persons, pregnant women, children, ethnic and racial minority groups, the homeless and the elderly. These groups are considered to be particularly at the risk of harm and are inevitably deprived from most of the benefits in a community [211]. This systematic exclusion from research has resulted in a lack of evidence-based treatment for particular groups, such as children and pregnant women. Furthermore, it would be unfair to exclude a particular population from the benefits of participation: the intervention itself, health care, ancillary care and community-centred services while they live in the same community [212]. An approach where community members are part of the research enterprise [6] can help identify specific characteristics that may render individuals vulnerable, and this can aid in identifying special protections needed in order for these individuals to be included in research studies.

Depending upon the social context, the particular groups who are excluded could be discriminated against within their community owing to the fact that they were excluded (based on their vulnerability) from the research [212]. Careful community engagement can ensure the protection from developing social stigma [213]. For instance, participants with stigmatizing conditions, such as leprosy [214], tuberculosis [215] and HIV [213], may suffer from multiple sources of discrimination (gendered, exclusion from research and the condition itself) caused or compounded by exclusion from research.

6.3.6. Facilitating legitimacy

Community engagement helps to build legitimacy for a study [7]. Legitimacy is formally obtained through ethics committee approvals and permissions from local authorities. Collaborations with local stakeholders can facilitate obtaining formal permissions as it ensures that research takes into account ethical and feasibility issues related to the research design and its operational aspects [6, 169, 216]. Legitimacy is informally obtained through discussions with stakeholders and existing community structures, such as community advisory boards and local authorities [77]. Although primarily an instrumental element of community engagement, delayed study approval has ethical implications, such as opportunity costs and wasting of resources.

Gaining legitimacy and permissions from local authorities alone, however, is not enough. In the past, securing authority permission alone has led to under-participation, leading to studies being prematurely ended and goals left unachieved [34]. Solely consulting authorities meant that there was little sense of ownership of and responsibility for study implementation in target communities [2, 58]. To ensure legitimacy, community engagement should entail a stepwise

approach seeking consultation and collaboration with authorities and stakeholders (from national to community level) [3, 6].

6.3.7. Achieving recruitment targets

Achieving recruitment targets for all types of studies is crucial to maximize the intended social value of a study [28]. Failing to do so means that the study is underpowered or prematurely terminated. This is potentially a waste of resources and puts enrolled participants at risk for no good reason.

Randomized controlled trials, for instance, usually recruit participants based on specific (clinical) criteria. By contrast, large community-based clinical trials, such as mass drug administration (MDA) studies require the participation of a large proportion of the community [3, 27, 28, 217, 218]. In the former, achieving recruitment targets is important for the statistical power of these studies. In the latter, achieving high population coverage is imperative in determining the effectiveness of the intervention in interrupting local malaria transmission. Not achieving the minimum coverage can lead to exposure of these participants to adverse effects of antimalarials without any potential to achieve the study goals [3, 6, 26, 33, 46, 47].

6.4 Conclusion

Over the past 50 years, spurred by activists, community opposition and the premature termination of studies, scientists have increasingly sought to involve communities in health-related research conducted in low income settings. However, emphasizing the benefits of community engagement in these narrow terms neglects the broader roles of these activities as part of ethical research.

This chapter has attempted to answer why community engagement is essential in health research conducted in low-income settings, drawing from literature and our own experience of and reflections on conducting and evaluating community engagement in this context. Seven reasons have been identified to answer why community engagement is essential for research in low-income settings that includes: respecting communities; building trust and social relationships; maximizing benefits, minimizing risks and exploitation; supporting the individual consent process; understanding vulnerabilities; securing legitimacy and achieving recruitment targets. We have illustrated that community engagement in which community members collaborate and share responsibilities with the researchers can help to achieve these goals.

6.5 Implications and way forward

The broader literature highlights how community engagement is an integral component of ethical good practice in health-related research. Although there are divergent opinions on the goals of community engagement amongst the experts, there is some commonality in terms of how community engagement helps to achieve the seven overarching goals. Although, in Lao TME, community engagement was primarily focused on promoting population coverage and adherence (one of the goal of community engagement), reflecting on the process and nature of community engagement (as described in chapter IV), it became clear that these goals were common in TME. Also, it became clear that these goals may have been subtle within the process of community engagement. This chapter highlights these goals. Nevertheless, as described in chapter IV, there are practicalities and associated challenges in achieving these goals.

Moving forward, I reflect on key messages from each chapter together with the implications for future programmatic implementation of malaria control and elimination using mass antimalarial administration in chapter VII.

CHAPTER VII

General discussion and concluding remarks

Targeted Malaria Elimination is a multi-pronged strategy to accelerate malaria elimination in endemic areas with relative low malaria transmission such as the Greater Mekong Sub-region, which includes Laos. This approach comprised 1) training and supporting village health (malaria) volunteers to provide appropriate case management and distribution of long lasting insecticide treated bed nets (LLINs) and 2) mass antimalarial administration and a quarterly blood survey. The strategy was evaluated against the aim of interrupting local falciparum malaria transmission in Thai-Myanmar border [219], Myanmar [31], Cambodia [33, 220], Vietnam [32] and Laos [6, 46, 47, 221]. For TME to be successful, at least 80% population coverage is essential [3, 26, 46]. Community engagement has been established as a critical component of TME to promote coverage and adherence.

This thesis outlines the process of designing, implementing and evaluating the community engagement that accompanied TME in Laos. As a first step, a systematic review of literature on MDA and community engagement during the last century was conducted. The findings from this review broadly guided the strategy of community engagement for TME. To further refine the design, formative research was conducted. Community engagement thus entailed a flexible and adaptive process and collaboration with various authorities from central to the community level. At the community level, authorities and community members were first consulted and later selected and trained as “volunteers” to jointly execute the community engagement and mass drug administration.

In the Laos TME study, out of 973 residents, 87.8% participated in TME (taking antimalarials and testing their blood). In addition to the observation notes which were collected throughout the study, a post MDA survey and qualitative study was conducted to assess the factors affecting population coverage. Increased familiarity with the concept of MDA, awareness of

the study rationale, free ancillary health care and social relationships with community members were associated with complete participation in MDA. The details of how this unfolded are discussed below by thesis chapter.

Chapter 2 examined systematically the literature pertaining to mass antimalarial administrations over the last century and the community engagement accompanying them. The main aim of this systematic literature review was to explore the community engagement activities in relation to promoting a desired population coverage in MDAs. In the literature, a little over a fifth of the papers on MDAs (11 of 51) reported both community engagement and population coverage. Heterogeneity of study methods and sites (local cultural and social contexts) further complicated the comparison of these studies in terms of community engagement and its relationship to the population coverage. Nevertheless, community engagement activities in these MDAs included health education, provision of incentives, utilization of existing community structures (both hierarchical and physical infra-structures), involvement and mobilization of local human resources, and collaboration with both government and local communities. Although these activities were broadly common across the MDAs, the extent and nature of these varied and community engagement was a continually evolving process, rather than a fixed sets of benchmark activities.

In recent years, MDAs that incorporated such an approach (collaboration with government and communities) were able to garner the intrinsic support from host communities and thus ownership and increased levels of participation [54, 57, 58, 63, 79]. Such an approach, whereby communities are given roles and responsibilities in designing, planning and executing MDAs, also referred as “Community Directed Intervention” have gained popularity and demonstrated some success [57, 58].

Furthermore, drawing from the past failure of the "one size fits all strategy", investing in the local social and cultural context to design a locally suitable intervention (community engagement) was recognized to be essential and pivotal [3, 34]. The conclusion from this systematic literature review support the role of community engagement to plan, design and implement through an investment in exploration of the local social and cultural context.

Chapter 3 describes a baseline formative study in four TME villages to explore the local socio-demographics (such as age, sex, socio-economic status and education), health seeking behaviour as well as malaria-related knowledge, attitudes, perceptions and practice, and use of the insights gained to inform and design a locally tailored community engagement. Through a mixed methods approach (a quantitative survey and qualitative methods: FGDs) coupled with observational data (participation with community members such as in meetings, informal conversation and dialogue), this chapter was able to explore a wealth of knowledge on local social and cultural context.

All four TME villages were home to "*Tri and Mangkong"* ethnic minorities with a distinct language, which was incomprehensive to fellow Laotians. Literacy levels were very low and few participants had attended school (which lacked regular teaching staff). Community members' livelihood largely depended on subsistence migratory swidden cultivation with limited cash flow. Except for one village (PMM), most villages did not have a health centre and attending health centre was restricted by availability of limited cash, poor road conditions, few means of transport (no public transport was available), and the cash for buying gasoline. In these villages, community members equally attended traditional health care providers and western health care providers. Community members, however, preferred to attend health centre/western medical facilities when their illness was severe. Nevertheless, attending health

centre/hospital was heavily dependent on the availability of cash. Inability to attend health centre due to economic constraints and "*waiting for death"* at home were common expressions.

Concerning priority diseases and health conditions, most villagers were familiar with malaria (its signs and symptoms) even though it had decreased over recent years. Community members could recall a history of being afflicted by malaria, and stories of "how they lost" relatives and neighbours. The concept of "asymptomatic malaria" and rationale for MDA was new to villagers, however, they described how a healthy community member could have malaria due to their occupational exposure to mosquito bites in the forest and fields, and to unhygienic conditions. In this regard, community members were open to a concept of asymptomatic malaria infection. In terms of preventive measures for malaria, traditional measures, such as using mosquito nets and wearing long sleeved clothes were often mentioned. When specifically discussed, community members were enthusiastic about MDA as a potential intervention, referring to its potential health benefit in reducing the disease burden and the cost it entailed.

In addition to this, understanding the village hierarchies, socio-political organization of these communities, community and household decision making dynamics further informed the design of community engagement.

Chapter 4 built upon the findings of **chapter 3** to design a locally tailored community engagement. Drawing on the experience of designing and implementing community engagement in the remote, isolated TME villages with ethnic minorities, where TME was able to achieve high coverage, the five essential components of such a strategy were elucidated as "essential elements". These are: 1. Stakeholder and authority engagement that entailed a collaboration at national, provincial and local authorities respectively; 2. Local human resources, in which volunteers were recruited and trained to jointly design and implement the

community engagement and TME; 3. Formative research, which incorporated a longitudinal (observation and reflection) mixed method study to gain insight into the local social and cultural context; 4. Responsiveness, in which the community engagement plan was continually adapted based on the needs and concerns raised by the residents of the study villages; and 5. Sharing control/leadership with the community in overall planning, designing and implementing the community engagement and TME activities.

Embedded within these elements was a stepwise community engagement process that entailed engaging the authorities from the top (national level) to the local level; this was essentially the first step of community engagement. Another salient feature within community engagement was the need for adaptiveness and responsiveness in community engagement activities rather than adherence to a fixed set of activities or benchmarks. This in particular needed a careful and responsive tailoring of the activities and labour-intensive efforts. Sometimes, specific activities such as visiting a subset of households, cohorts (particular age groups), or even individuals within the households were necessary to maximise comprehension of the study procedures and rationale. Specific to these villages (given the low literacy and the use of ethnic minority language) and perhaps applicable in general were the values of simplicity of the health messages with contextualized pictorial diagrams, posters and movies. These are consistent with recent methods using arts and drama deployed as a form of delivering health education in Cambodian TME.

Chapter 5 relates research based on a combination of mixed methods (qualitative and quantitative) approaches and observational data collected throughout the study with the objective of exploring the roles of various factors (including community engagement, free health care, incentives, social relationships and local socio-cultural context) contributing to the

high community participation. The survey was conducted after the completion of all MDA rounds in intervention villages and found five characteristics features to be associated with complete participation in all three rounds [46]. These were: 1. Attendance at TME events, which included poster explanations at mass meetings, audio-visual shows and household level meetings; 2. Knowledge that blood tests were for malaria diagnosis, as opposed to the common RDT test for malaria diagnosis in villages; 3. Participation of all household members, which reflected a high value placed on familial integrity and decision making; 4. Equal preference for all aspects of TME, including blood draw, taking medicine and attending meetings; and 5: Perception that TME was worthwhile; Overall, these findings reflected a positive impression of TME in terms of providing health benefit, and was rooted in villagers' health concerns and the limited availability of health care.

These findings were further explored in a qualitative study (SSIs after each round of MDA) that also compared the data from formative research and was coupled with ongoing field observation [47]. Increase in knowledge about the concept of asymptomatic malaria, rationale of blood test and MDA itself were notably valuable intrinsic properties of community engagement. Also, poverty and limited health care in these villages where TME offered a free health care alleviated their stretched health conditions and thus generated a "generosity and caring" for villagers. For example, TME physicians and other staff often visited the households of severely sick individuals and facilitated their treatment at higher level facilities by providing means of transportation and appropriate referral. Because TME partnered with village volunteers and authorities, this further helped to garner the intimate (social) relationship bridging the gap between researchers and community members. Social relationships developed during the course of day to day interaction, commensality-sharing and eating food together,

sharing households for overnight stays, and through participating in their sorrows (funerals) and celebrations *(Champhi).* Social relationships of this kind were able to engender trust which also generated reciprocity, social pressure and conformism to participate in TME.

Chapter 6 is an overarching review of community engagement in generic health research with the objective of demonstrating why community engagement is essential for ethical health-related research conducted in low-income settings. Historically, community engagement emerged as a concept and strategy along with the development of the concept of primary health care [222], with a shift in focus from vertical disease control programmes to community based implementation tailored to the local social and cultural context [34]. In research, however, the role of community engagement developed since the 1970s and 80s with increased demands from women's activists and later HIV activists for a greater role in decision making in research. Despite the realization that a community engagement per se was needed and useful, a series of setbacks (in HIV and Ebola research, for example) led to renewed focus on optimising the nature of the engagement. These setbacks had mainly two implications: 1. The need of a community engagement to successfully accomplish the research and 2. Recognition and application of the broader principles of community engagement so as to make research more ethical. Seven goals of community engagement which are integral to collaborative research are as follows: 1. Respecting individuals, communities and local stakeholders; 2. Building trust and social relationships; 3. Maximizing benefits, minimizing risks and exploitation; 4. Supporting the consent process; 5. Understanding vulnerabilities; 6. Facilitating legitimacy; and 7. Achieving recruitment targets.

In the following section, I reflect on factors that influenced participation in TME, strengths and limitations of my thesis and finally implications from my thesis for scaling up of TME.

The factors affecting participation in TME can be broadly categorized into 1. Community engagement and 2. Local social and cultural factors. Community engagement in Lao TME primarily focused on promoting population coverage and adherence. Drawing on mixed-methods implementation research, I have shown that community engagement helped to enhance awareness of malaria and the rationale for TME amongst the community members. Although community members perceived malaria as a health concern, explaining the complex rationale of TME needed a reiterative process of providing health education, being responsive to evolving issues and counteracting the rumours and misconceptions. In addition to this, community engagement was a process of working together with the village volunteers who were selected, trained and devolved with the responsibilities. This meant that village volunteers actively participated in the design, execution, reflection and implementation. The involvement of volunteers also resulted in social relationships, which also blurred professional roles and personal interactions. This played an important role in building trust and facilitating participation.

It is hard to extricate the role of community engagement from the factors embedded in local social and cultural context that played a critical role in facilitating participation. For instance, the cohesive nature of decision-making in the villages meant that participation was dependent upon fellow household members, neighbours and other community members. Although fostering awareness of the rationale for TME helped to facilitate their understanding about the research to some extent, participation was rooted in that of their fellow household members, neighbours and community members.

My DPhil thesis has some strengths and limitations. The community engagement that accompanied MDA in Lao TME was adapted to the particularities of the research site, cultural

context and the study design. The study site was remote and is home to a local oral language, incomprehensive to fellow Laotians. This study derived the data from on-site translation from bilingual translators who were fluent in the local language and *Lao*. Because the local language is an oral language without a written script, some nuances may have been lost during translation. To minimize this, I involved a variety of bilingual translators, and made significant efforts to learn the local language and important *Lao* and local terms.

In the questionnaire-based surveys reported in chapters III and V, the majority of respondents were household heads. I conducted a meeting with the local research team and village heads before conducting the survey. During this meeting, the participating village heads and members of local research team suggested that interviewing other members of the household when household head was present would be disrespectful. Moreover, household heads were described as most suitable to provide accurate information on the socio-economic circumstances of household members. In addition, household heads are responsible for decision-making for other household members in these communities. For these reasons, if household heads were present at the house, we interviewed household heads.

Because, in these communities, most household heads are male (188/281; 67%), there was a higher proportion of male questionnaire respondents. To counter the gender imbalance in questionnaire respondents and ensure that the perspectives of female community members were incorporated, we conducted a series of single-sex FGDs. Female-only FGDs were also crucial because of the observed gender dynamics in communities, whereby women tended to contribute little to discussions when in the presence of other male community members.

The socio-economic status and literacy level in the villages were low. These characteristics presented challenges in terms of achieving high coverage of MDA plus regular blood draws, such as, dealing with the language barriers between the majority of study staff and villagers.

This thesis used multiple methods at various time points (FGDs and survey questionnaire at baseline, and post MDA survey questionnaire and SSIs), supplemented by observations throughout the study period. Using multiple methods allowed to compensate for the limitations of any single research method. In addition, three researchers collected data to reduce the possibility of bias caused by the influence of a single data collector. Despite this, the extent of interpretation of the local social and cultural context might have been affected by the fact that I was a complete outsider and Lao researchers were from Vientiane and were unfamiliar with these ethnically unique villages. However, having a local study coordinator and the residents of the villages as volunteers helped to mitigate the interpretation bias. In addition, the TME team's prolonged deployment in the villages, which included overnight stays, helped to develop rapport and to understand the nuances and subtleties of participants' reactions. In these study villages, there was a high level of cultural modesty and conformism towards fellow community members and to the TME staff. This might have affected the data from FGDs and SSIs. However, participants were vocal about the concerns and issues. For instance, adverse events and the demand for additional health care.

The findings presented in my thesis are limited by the fact that this study was conducted in the context of clinical trial with meticulous procedures along with participant incentives (cash, free health care, T-shirts, sweets, household utensils), and improvement to water and sanitation through installation of water pumps. Control programmes with limited resources for incentives and investment in health care and improvement in water and sanitation may not be able to offer

similar benefits. However, MDAs for disease control and elimination in non-clinical trial context which may not require frequent blood sampling might be able to achieve higher population coverage.

There are qualified lessons that can be drawn from my thesis for the scale up of TME at programmatic level although an intensive community engagement was critical for TME to achieve high population coverage. For a programmatic implementation, the elements of community engagement identified in my thesis are highly relevant. Some of these elements, such as authority and stakeholder engagement might be taken for granted in programmatic implementation. Community engagement in Lao TME was meticulous and labor intensive. Nevertheless, as opposed to vertically instituted programs, scale up of programs through community collaboration, using local human resources, being responsive to the issues and rumours are essential for the successful implementation. Such a scale-up has been recently implemented in Thai-Myanmar border where local human resources were trained and devolved to diagnose and provide antimalarials through the malaria check posts established in the endemic villages [205]. This particular scale-up of TME has generated an evidence for optimism to tackle multi-drug resistant malaria from the region.

Overall, this thesis provides several new insights into the approach to and process of community engagement. Based on the systematic review of literature pertaining to community engagement strategies that accompanied mass drug administration programmes over the last century, I was able to show how community engagement was scarcely reported in the past, particularly with reference to the local social and cultural context. Insights from the literature review were utilized to guide the design and implementation of the community engagement programme in the Laos TME study. The major conclusion from studying the community

engagement in the Laos TME study was the importance of tailoring the community engagement to local social and cultural context. Providing detailed insights on how community engagement can be optimised to this low resource and culturally distinct settings. Very few previous publications, and none in the mass antimalarial administration literature, have explicitly established and described the elements for effective community engagement. This thesis describes five elements for the design and implementation of community engagement (listed under chapter 4 summary above). This thesis also provides a deep insight into the factors affecting participation in and therefore coverage of the mass drug administration in Laos. Engaging with the broader literature in terms of the ethical goals of community engagement, this thesis provides further insights into the practicalities of these goals and the challenges associated with them. The entanglement of community engagement with research and the local social and cultural context, poses further challenges in the evaluation of community engagement. Nevertheless, aware of these complexities, my research, highlights that close collaboration with community members can help achieve goals of community engagement and the related research aims.

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