Title: Exploring the factors influencing the path towards malaria elimination in Myanmar

Subtitle: Situation analysis of malaria control in Myanmar

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Myanmar

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Exploring the factors influencing the path towards malaria elimination in Myanmar

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Public Health

By

Nu Nu Khin

Myanmar

Declaration:

Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis "**Exploring the factors influencing the path towards malaria elimination in Myanma**r" is my own work.

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Dedication

This work is dedicated to Dr. Chit Ko Ko who showed me the academic path from where I rose to pursue my university degree.

I would like to dedicate this work to my beloved husband who has acted not only as a supportive spouse but also as a guardian and care-taker for the children throughout the course of my university education.

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Glossary of Terms and Definitions

Annual Parasite Incidence (A.P.I): (confirmed malaria cases during a year/ population under surveillance)*1000 (malaria foundation international 2000)

Annual Blood Examination Rate (A.B.E.R): calculated as (number of slides examined/ population)* 100 (malaria foundation international 2000).

Certification of malaria elimination: granted by WHO after proving beyond reasonable doubt that the chain of local human malaria transmission by Anopheles mosquitoes has been fully interrupted in an entire country for at least three consecutive years (WHO 2007).

Endemic: applied to malaria when there is a constant measurable incidence of cases and mosquito-borne transmission in an area over a succession of years (WHO 2007).

Epidemic: occurrence of cases in excess of the number expected in a given place and time period (WHO 2007).

High risk population: Population residing in high-risk areas where primary efficient vectors such as An. minimus AND/ OR An. dirus are prevalent and transmission exists throughout the year. Ecology is forest related area (Vector borne disease control 2011).

Low risk population: Population living in receptive areas where only secondary vectors are prevalent, most of the urban and peri-urban areas where no malaria transmission occurred (Vector borne disease control 2011).

Malaria control: Concerned with reduction of malaria morbidity and mortality to a level until it is no longer a public health problem. Control does not aim to prevent all transmission from occurring (WHO 2007).

Malaria elimination: Reduction of malaria incidence to zero in a defined geographical area caused by specific plasmodium species as a result of deliberate effort. Continued measures to prevent re-establishment of transmission are required (WHO 2007).

Malaria eradication: permanent reduction to zero of the worldwide incidence of infection caused by a particular malaria parasite species.

Intervention measures are no longer needed once eradication has been achieved.

Morbidity rate or malaria incidence: the number of newly diagnosed malaria cases during a specified time period in a specified population (WHO 2007).

Mortality rate: the number of deaths due to malaria per 100,000 population at risk per year (Vector borne disease control 2011).

Moderate risk population: Population living in either coastal or plain areas, where primary vector (An. minimus, An. dirus) or secondary vectors (An. annularis, An. sundiacus) are prevalent, in areas where secondary vectors are prevalent with many vector-breeding places and high vector density (Vector borne disease control 2011).

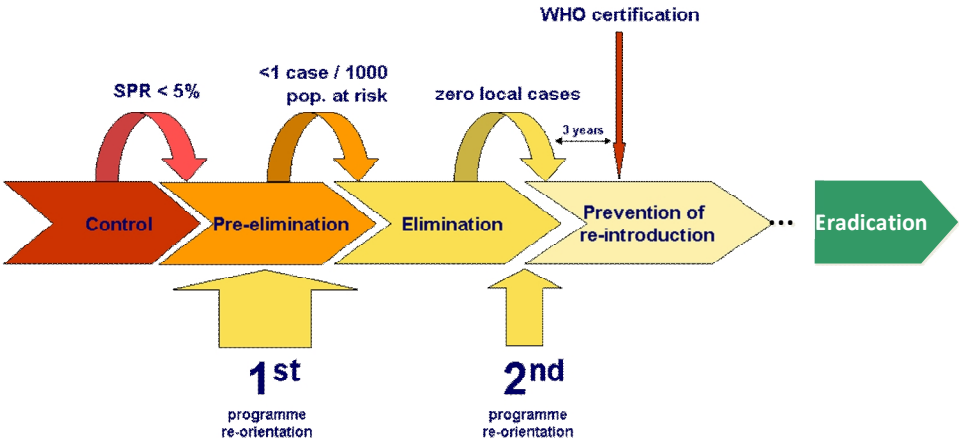
No risk population: People living in areas where no vector is prevalent, also known as non-receptive areas (Vector borne disease control 2011).

Population at risk: People who have more chances of getting malaria infection AND/OR who have more chances to develop severe form of the disease and liable to death (Vector borne disease control 2010a).

Path to malaria elimination:

The path towards malaria-free status is characterized by four distinct programme phases: control, pre-elimination, elimination and prevention of reintroduction. Each phase has a specific set of programme interventions needed for prevention, treatment, surveillance, monitoring and evaluation and health system strengthening. Progression between stages is determined by a set of programmatic and epidemiological criteria. The concept of control is reducing malaria cases and deaths by providing preventive method, diagnostic testing and treatment of the entire population at risk. During the elimination phase, malaria is no longer considered to be a public health problem and intervention becomes more focused on detecting all malaria cases, preventing onward transmission, managing malaria foci, and managing imported malaria cases (WHO 2014).

Progression from control to elimination for countries with low-to-moderate endemicity



A field manual for low and moderate endemic countries

According to the WHO recommendations, when the malaria incidence rate in a geographic area is consistently less than five new cases or fewer per 1000 population at risk per year (WHO 2008) or where less than 5% of all febrile patients with suspected malaria actually carry the malaria parasite (WHO 2007), the case load is considered manageable enough to go to the elimination phase. At that point the country can start staff reorientation towards the elimination phase as transitional stage of pre-elimination. Thereafter, when the malaria incidence rate declines progressively to below 1 per 1000 population at risk per year and necessary programme adaptation has been made, the country can move to the elimination phase. Finally after a three year period in which no local transmission has been reported by a good surveillance system, WHO certification for elimination can be requested and the country can start the second program orientation to enter the prevention of re-introduction phase (WHO 2008).

Radical cure: Elimination of parasites actually responsible for attack of malaria (Kakkilaya 2006).

Receptivity: the abundant presence of anopheline vectors and the existence of other ecological and climatic factors favouring malaria transmission (WHO 2007).

Stable malaria: the amount of transmission is high without any marked fluctuation over years though seasonal fluctuations occur (Kakkilaya 2006).

Sporozoite Rate(%) for each species: (Number of positives for sporozoites/Number dissected)* 100 (Kakkilaya 2006).

Slide positivity rate: the proportion of slides found positive among the slides examined (WHO 2007).

Unstable malaria: Amount of transmission changes from year to year (Kakkilaya 2006).

Acronyms

ACT	Artemisinin-based Combination Therapy
AL	Artemether-Lumefantrine
AMT	Artesunate Monotherapy
API	Annual Parasite Incidence
BMIF	Bi-Regional Malaria Indicator Framework
CAPM	Control and Prevention of Malaria
CFR	Case Fatality Rate
CM/SCM	Complicated Malaria/Severe and Complicated Malaria
CQ	Chloroquine
DDT	DichloroDiphenylTrichloroethane
DoH	Department of Health
FBO	Faith-Based Organization
GDP	Gross Domestic Product
GF	Global Fund
GFATM	Global Fund for Aids, Tuberculosis and Malaria
GMS	Greater Mekong Sub-region
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HMIS	Health Management Information System
IRS	Indoor Residual Spray
ITNs	Insecticide Treated Nets
I/NGOs	International / National Government Organizations
JICA	Japanese International Cooperation Agency
KAP	Knowledge, Attitude and Practice
LHVs	Ladies Health Visitors
LLINs	Long Lasting Insecticide Treated Nets
MARC	Myanmar Artemisinin Resistance Containment
MDG	Millennium Development Goals
MIs	Malaria Inspectors
MMA	Myanmar Medical Association
MMR	Maternal Mortality Rate
MNCH	Maternal Newborn and Child Health
MoH	Ministry of Health
MS	Malaria Supervisors
MSF	Médecins Sans Frontières
MWs	Midwives
NHL	National Health Laboratory
NMCP	National Malaria Control Program

PS	Permanent Spray man
PSI	Population Service International
RAI	Regional Artemisinine Initiative
RDT	Rapid Diagnostic Test
RHC	Rural Health Centre
SP	Sulphadoxine-Pyramethamine
TB	Tuberculosis
TES	Therapeutic Efficacy Study
TPA	Total Patient Attendant
TPR	Total Positivity Rate
UNICEF	United Nations Children's Fund
UNDP	United Nation Development Programme
UNOPS	United Nations Office for Project Services
VBDC	Vector Borne Disease Control
WHO	World Health Organization
WMR	World Malaria Report

Abstract

Background: Myanmar bears the largest malaria burden in the South East Asia Region. However the incidence and mortality show a decreasing trend and the proportion of malaria cases in outpatient and inpatient departments are also decreasing significantly. Moreover malaria high risk areas are shrinking and malaria free risk areas have been expanding over the last two decades.

Objective: To explore the factors influencing the path towards malaria elimination in Myanmar in order to inform about the current challenges and give recommendations to policy makers about the way forward.

Study method: The thesis is conducted using review of the literature from Myanmar and other countries. The WHO Bi-Regional malaria indicator framework (BMIF) was used as a guide to collect the relevant articles, reports and information per objective and analyze the literature systematically.

Findings: Major challenges are: lack of political commitment, poorly regulated drug control system, poor health care coverage, inadequate knowledge regarding prevention and treatment of malaria, shortage of malaria staff, no case-based surveillance system, large gaps in ownership and utilization of bed-nets, no replenishment strategy for torn bednets, inadequate operational research, and inadequate coordination among partners. The regional and international cooperation, external funding, private public partnership, community involvement and engagement of other sectors are potential opportunities and strengths for malaria elimination.

Conclusions and recommendations: Some townships have already met the WHO elimination criteria. Increasing political commitment, strengthening IEC/BCC units, improving ITNs programme, intensifying drug regulatory committees, improving coordination among implementing partners, developing solid database systems and conducting operational researches are recommended.

Key words: malaria, control, elimination, tools, Myanmar.

Word count: 12198 words

Introduction

Robust investments in malaria control over the past decade have yielded a remarkable reduction of global malaria cases. According to WMR2013, malaria incidence rates declined by 25% around the world and mortality rates were reduced by about 42% globally.

Since malaria elimination is the ultimate goal of any malaria control programme and it can only be envisaged when the malaria incidence rate in a geographic area is consistently less than five new cases per 1,000 populatyion at risk per year and the case load is considered manageable enough to go to the elimination phase (WHO 2008).

Currently four countries have been certified by WHO as having eliminated malaria: the United Arab Emirates (2007), Morocco (2010), Turkmenistan (2010), and Armenia (2011) (WHO 2014). Of the 10 countries in the South East Asia Region of WHO, Sri Lanka is in the elimination phase, and Bhutan and the Democratic People's Republic of Korea are in the pre-elimination phase, while the rest including Myanmar are still in the control phase (WHO 2013c) but Thailand and Cambodia have already targeted malaria elimination with short, medium and long term plans in their national strategic plan.

When I was working in the Central Vector Borne Disease Control (VBDC) as an assistant director, I saw the overview of my country's malaria situation and noticed that the malaria incidence rate and mortality rate have dramatically been reduced during the last two decades. So my curiosity and interest bloomed when I saw this figure and I would like to analyze Myanmar's current malaria situation and determine whether Myanmar can move forwards towards malaria elimination.

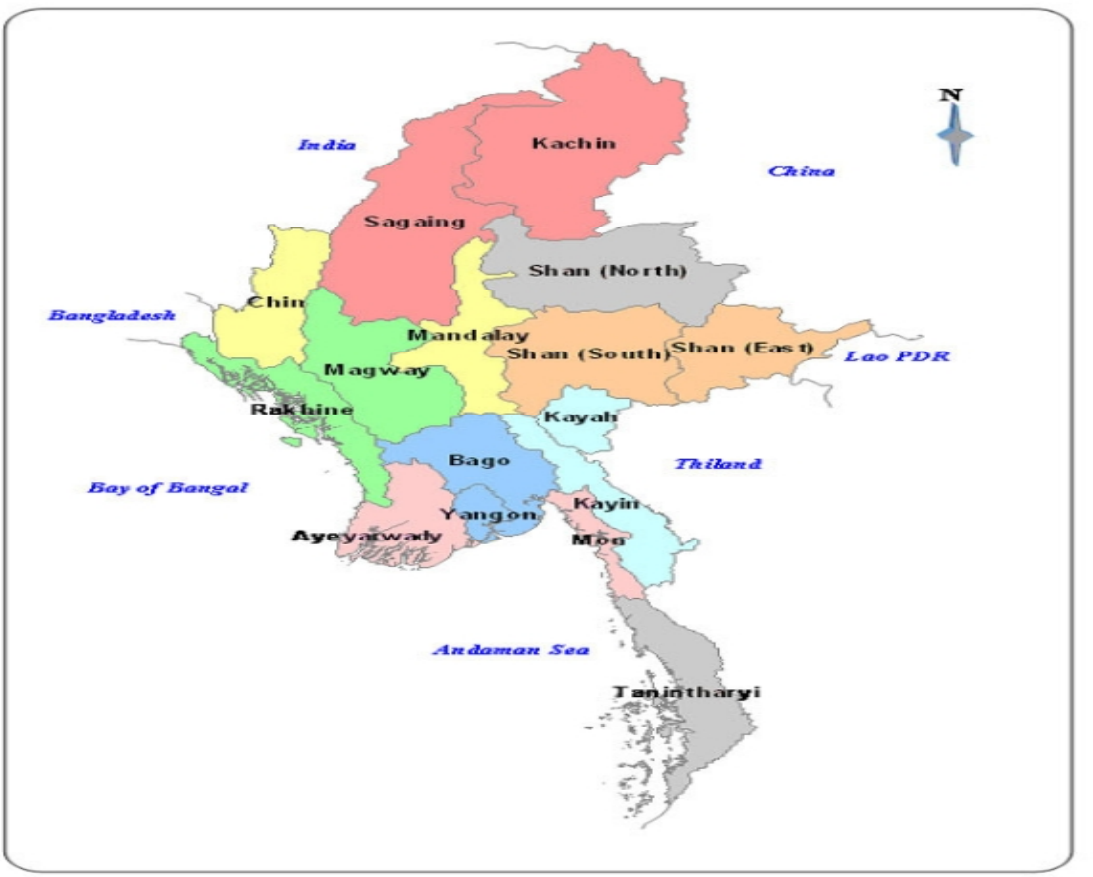
Moreover with the country returning to democratic rule on 31th March 2011, the new constitution establishes an independent executive, legislative and judiciary at both national and sub-national level, introducing decentralizing the administrative structure. With this changing environment and opening opportunities in political and social sectors, this could be the right time to carry out this elimination program effectively with both internal and external support region by region and ultimately eradicate it nationally to make Myanmar totally malaria free.

Chapter One: Background information

1.1 Geographic and socio-demographic features

The Republic of the Union of Myanmar is the largest country in mainland South East Asia. It is approximately the size of France and England combined with a land area of 676,578 square kilo-metres. It is bordered by the People's Republic of Bangladesh and the Republic of India on the west and north-west, on the north and north-east by the People's Republic of China, the Lao People's Democratic Republic and the Kingdom of Thailand on the east and south east (see figure 1).

Figure 1: Country boundary and administrative division of the Republic of Union of Myanmar 2011



Source: Health in Myanmar, 2008

Administratively it is divided into Nay Pyi Taw Union Territory and 17 States and Regions. It is subdivided into 70 districts, 330 townships, 84 sub-townships and 64,134 villages. It has approximately 60.38 million people (2012) with a population growth rate of 1.01 percent per year. More than 70% of the population resides in rural area with a population density of 89 people per square kilo-metre (Ministry of Health 2013). Myanmar is the 24th most populous country in the world with 0.75% of the world's population and it is the 40th largest country by area. (World population review 2014). Geographically, it has three well marked natural divisions, the western hills, the central belt and the Shan Plateau on the east with the continuation of highland in the Tanintharyi, the southern point of Myanmar. Great diversity exists between the regions due to the rugged terrain in the hilly north which makes communication difficult.

Myanmar is composed of diverse ethnic groups speaking over 100 languages. The main ethnic groups are Bamar, Kachin, Kayah, Kayin, Chin, Mon, Rakhine and Shan. The Bamar (68% of total population) live in the central part of eight regions (Yangon, Bago(E), Bago(W), Irrawady, Tanintharyi, Magway, Sagaing and Mandalay) while the other ethnic groups are living in the peripheral nine states (Kachin, Kayah, Kayin, Chin, Mon, Rakhine and Shan). Shan state is geographically subdivided into three parts, the eastern, northern and southern parts for ease of field operation. About 89.4% of population is Buddhists while the rest are Christians, Muslims, Hindus and animists (Ministry of Health 2012b).

1.2 Climate

Myanmar has a tropical climate with three distinct seasons, the rainy, the cold and the hot season. The average annual rainfall is 508 centimeters in the coastal and northern areas, about 254 centimeters in the delta area, 203 centimeters in the hills and approximately 50-60 centimeters in the central zones. The average temperature ranges from 9.9° C to 34° C in different states and regions. The minimum temperature for parasite development of Plasmodium falciparum and Plasmodium vivax is approximately 18° C and 15° C respectively (Patz and Olson 2006).

1.3 Economic situation

Myanmar is a resource rich country but still suffers from pervasive government control, insufficient economic policies and rural poverty. Approximately 26% of the population is living below the poverty line. It was

ranked 149 out of 187 countries on the human development index in 2012 (UNDP 2013).

Myanmar's Gross Domestic Product (GDP) was 53.14 USD billion in 2012. The GDP per capita in Myanmar was 824.19 US dollars in 2011. The GDP annual growth rate is 6.5% and the annual inflation rate is 6.26%. Government expenditure on general health is 1.3% of its total expenditure (WHO 2012). The total expenditure on health per capita is 26 US$ and is equivalent to 2% of GDP (WHO 2013e). This places Myanmar among the lowest eight of 192 countries by percent health expenditure.

1.4 Health System of Myanmar

The Ministry of Health (MoH) has the leading and stewardship role of the overall health system. Policy making, planning, budgeting, regulation and coordination among key governmental and non-governmental stakeholders are its main roles and responsibilities. Under the MoH there are eight functional departments (Ministry of Health 2013). The health system is organized hierarchically (Annex 1).

The Department of health (DoH) is the largest department responsible for providing comprehensive health care services throughout the country which has a pluralistic mix of public and private systems. The first administrative level is States/Regions and townships are the core planning and implementation units in health. Decentralization of health system in Myanmar, although not clearly specified, is linked to the political, administrative and fiscal decentralization process in the country which is in line with the 2008 constitution, but the federal ministries still control the state ministries through a top-down approach; most functions are centralized, especially human resource management (Nixon et al 2013).

Some ministries also provide health care for their employees and their families. These include the Ministries of Defense, Railways, Mines, Industry, Energy, Home and Transport. The Department of Medical Research focuses research mainly on malaria, HIV/AIDs, and TB. The Department of Food and Drug (FDA) takes care of the safety and quality of food, drugs, medical devices and cosmetics and also notifies the public as well as States/ Regional drug supervisory committees about counterfeit and illegal medicines. The National Health Laboratory is responsible for routine laboratory investigation, special laboratory task force, training, research, and quality assurance (Ministry of Health 2013).

1.5 Overview of the National Malaria Control Program (NMCP)

The NMCP is part of the National VBDC programme, under the Division of Disease Control, Department of Health (DOH) of the Ministry of Health. It is mandated to formulate plans, policies, setting standards and norms related to malaria prevention and control, providing training, conducting operational research, epidemic preparedness and outbreak control and providing consultative and advisory services to other implementing agencies. It has a strong vertical structure and is staffed with over 2000 people (see annex 5) with different capacities at the central and State/Regional levels. At the township and village level malaria control is integrated into the general services. At that lower level basic health staff and village volunteers deliver malaria services with the technical input from the State/Regional and central levels. A brief history of the NMCP in Myanmar is outlined in the following table.

Table 1: Chronology of key milestones for malaria control in Myanmar

Year	Key milestones
1950	The malaria programme in Myanmar begins with pilot projects in the Shan State.
1957	The malaria eradication programme is focused on vector control using DDT for IRS.
1973	The malaria eradication programme is changed to the malaria control programme due to financial and operational constraints.
1978	The malaria programme is integrated with other mosquito borne diseases such as Dengue Haemorrhagic Fever, Lymphatic Filariasis and Japanese Encephalitis
1993	The Global Malaria Control Strategy was adopted (Amsterdam Declaration in Oct 1992). Suspend routine IRS and provide selective IRS. Antimalaria treatment policy by using monotherapy (CQ, SP, mefloquine, quinine).
2000	Introduction of monovalent RDT (paracheck) can detect P.f only.
2002	Adoption of a new treatment policy by using RDT &ACT (artesunate plus mefloquine) for P.falciparum and chloroquine for non P.falciparum. Introduction of ITN programme.
2006	Introduction of polyvalent RDT (Combo) & distribution of 700 microscopes.
2008	Revised new treatment policy by recommending three ACT. (artesunate plus mefloquine, artemeter plus lumefantrine, Dihydroartemisinin-piperaquine).

2010	Updated treatment policy by adding primaquine drug for P.f. malaria.

Source: Formulated by author (2014). Note data from reports

The overall goal of Myanmar NMCP is to reduce malaria morbidity, mortality and socioeconomic loss due to malaria. It has two specific objectives: (1) to reduce malaria morbidity and mortality by 50% of the level in 2015 (baseline: 2005 data), and (2) to achieve MDG Goal 6 - combat HIV/AIDS, TB and Malaria. The following strategies are undertaken to achieve this goal (VBDC 2010a):

1. Information, education and communication regarding malaria causation, prevention and control for increasing the awareness of the community down to the grass roots level.

2. Selective and sustainable preventive measures including vector control.

3. Prevention, early detection and containment of epidemics.

4. Early diagnosis and appropriate treatment.

5. Inter-sectoral collaboration with health related sectors.

6. Community involvement in malaria prevention and control activities.

7. Capacity building of different categories of health staff.

8. Field operational research.

Chapter 2: Problem statement, objectives and methodology

This chapter presents the outline of the study. It provides the problem statement of malaria, justification, objectives of the study and the study method with conceptual framework.

2.1 Problem Statement

Malaria is one of the leading causes of death in the developing world. It is a disease common in the tropics. Globally, according to a WHO report, an estimated 3.4 billion people were at risk of malaria in 2012 (WHO 2013c)**.** Of these, 1.2 billion are living in high risk geographical areas. Almost half of these people live in the African Region (47%) and one third (37%) in the South-East Asia Region. Worldwide, it is estimated that there are 250-500 million cases and nearly 1 million deaths annually. Every second a child dies of malaria somewhere in the world and pregnant women are four times more likely to get sick of malaria and twice as likely to die than men (Adjei 2010).

Malaria related burden causes enormous socioeconomic burdens for those living in tropical and subtropical regions of the world (Feachem et al, 2009a). It takes a high toll on households and health care systems, and impedes economic development in endemic countries (WHO 2009). Malaria also discourages foreign investment, increases people's out of pocket expenditure on health care, and impairs children's ability to learn, particularly those who survive from severe illness (World Bank 2012).

Cerebral malaria caused by P.falciparum has a high case-fatality rate (30-40%) and neuropsychological sequelae especially seen in developing countries. Other adverse effects like anaemia, miscarriage, stillbirth, prematurity and low birthweight are also serious concerns when pregnant women contract falciparum malaria infection during pregnancy (Holding and Snow 2001).

Malaria endemic countries are constantly trying to control the disease and reduce the burden of the disease to a certain level until it becomes no longer a public health problem with an elimination goal. There are six countries in the Greater Mekong sub-regions (GMS) in South East Asia namely; Yunan province of China, Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Vietnam. Among the six Mekong countries, Myanmar contributed with over 2 million cases in 2010 (President's malaria initiative 2013). More than 60% of the people (40.7 million) live in a malaria risk area. More than 80% of the area of Myanmar is malaria endemic, mainly in

rural areas, border areas and some peri-urban places. The malaria high risk groups are not only those living in risk areas but also some non-immune internal migrants (laborers at development projects such as dams, irrigations, roads, mining, logging, rubber plantations, etc.), subsistence farmers in the forest and forest-fringe, wood and bamboo cutters, charcoal production and forest related workers. Pregnant women and children under five residing in malaria risk areas are the most vulnerable groups and men above 15 years are affected most (VBDC 2010b). In 2011, children under five with malaria contributed to 11% of total malaria cases and pregnant women with malaria is 1.2% of all malaria cases. This thesis intends to explore, describe, and analyze the factors influencing the path towards malaria elimination in Myanmar.

2.2 Justification

Although Myanmar has a higher disease burden than its neighbouring countries, tremendous progress has been made through scaling-up of both preventive and curative interventions with resulting reduction in morbidity and mortality. The scale-up of such efforts can be correlated with the decreasing trends observed for morbidity and mortality associated to malaria and with the 17% reduction of high-risk areas during the last two decades (Fig 2 and 3). Moreover the annual proportion of malaria cases in outpatient and inpatient departements and the case fatality rate (CFR) are decresing significantly (Table 2). The slide positivity rate of P. falciparum dropped from 41% to 24% among the 135 intervention townships for the period of 2007-2011 (Mendis et al 2012). Such results allow us to question about the possibility of moving to the malaria elimination phase in Myanmar.

Figure 2: Trend of Malaria Morbidity and Mortality in Myanmar (1990-2012)

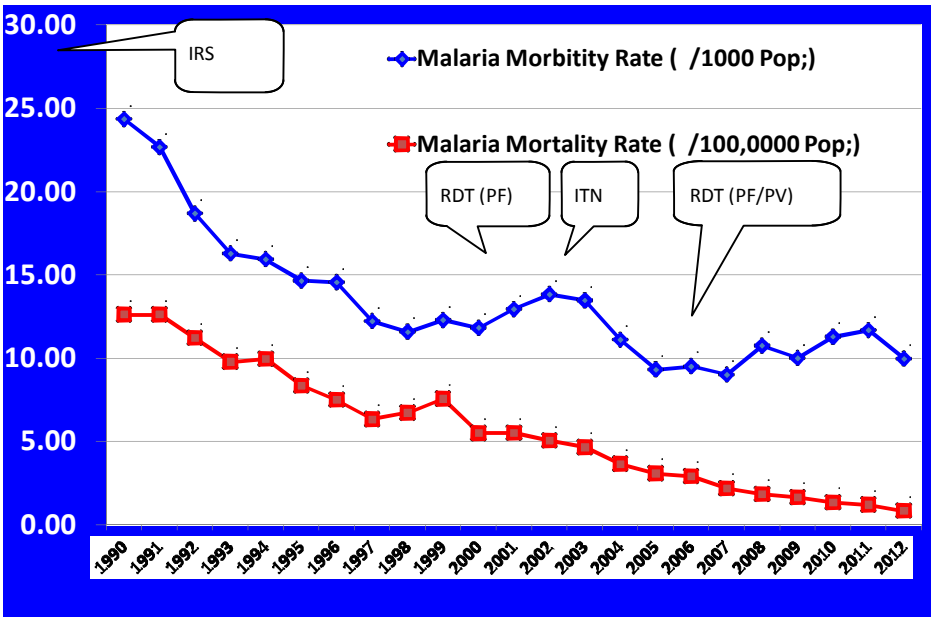
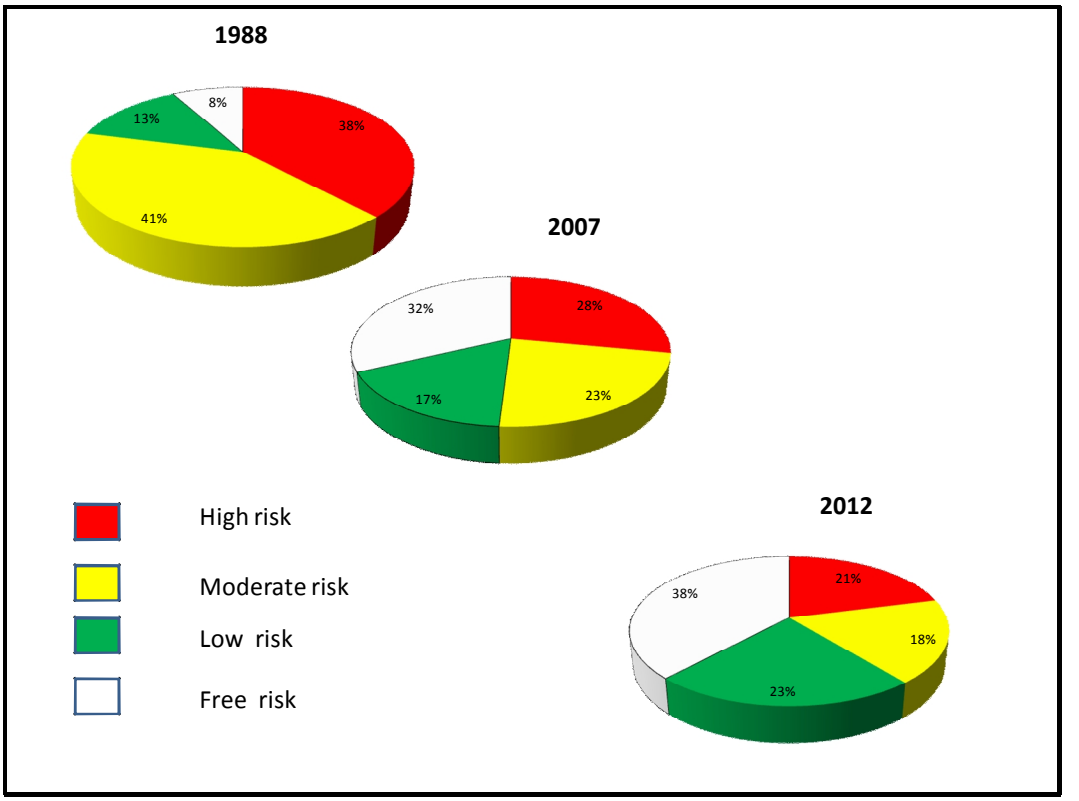


Figure 3: Proportion of Malaria Risk Areas in Myanmar



Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2012

Table 2: Proportion of malaria cases and deaths in health facilities

Year	Outpatient departments			Inpatient departments						
	TPA	Total Malaria	%	TPA	Confirmed malaria	%	CM/SCM	Total death	Death Due to malaria	CFR
2000	4,782,515	499,998	10.45	520,045	81,562	15.68	9,035	13,807	2,556	3.13
2001	5,197,974	576,684	11.09	596,720	87,120	14.60	11,932	15,319	2,760	3.17
2002	5,356,533	639,546	11.94	613,791	82,512	13.44	12,545	14,636	2,649	3.21
2003	5,209,552	641,305	12.31	618,319	71,910	11.63	12,986	14,032	2,462	3.42
2004	5,195,986	544,122	10.47	600,939	58,646	9.76	10,737	13,222	1,982	3.38
2005	5,455,940	466,323	8.55	639,236	62,073	9.71	9,818	13,595	1,734	2.79
2006	5,880,978	461,093	7.84	616,709	54,760	8.88	9,189	12,043	1,521	2.78
2007	6,354,467	467,667	7.36	683,291	53,220	7.79	9,054	11,921	1,163	2.19
2008	6,828,384	586,766	8.59	740,615	47,514	6.42	10,158	11,473	1,087	2.29
2009	6,986,664	543,720	7.78	795,420	47,772	6.01	8,739	9,940	972	2.03
2010	7,425,040	649,522	8.75	863,367	43,602	5.05	6,939	11,119	788	1.81
2011	7,652,804	535,720	6.97	826,220	33,732	4.08	5,379	11,022	581	1.72

Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2011

Some of our neighboring countries like Thailand and Cambodia have developed a national strategy targeting malaria elimination and Sri-Lanka has already reached the malaria elimination phase. In order to keep abreast with neighboring countries and to contribute to the "Global Malaria Eradication" initiated by Bill and Melinda Gates (Moonen et al, 2010) most importantly with the expectation of reduced malaria related burden and its consequences like anemia, reducing poverty due to direct and indirect cost of malaria, to increase educational attainment, to increase productivity, to improve the climate for tourism and foreign investment Myanmar needs to eliminate malaria. If malaria elimination is undertaken properly it can also contribute to overall health system strengthening and will also enhance equity by serving those pro-poor populations (Feachem et al 2009b). If Myanmar does not eliminate malaria, especially the resistant strain of P.falciparum to artemisinine timely in line with elimination targeting neighboring countries, Myanmar can be a gateway of spreading artemisinin resistance from Asia to Africa and would set back the global success and achievement in malaria control and elimination effort (Bureau of Vector

Borne Disease 2010). This thesis seeks to contribute to the body of knowledge on Malaria elimination feasibility in Myanmar.

2.3 Objectives

2.3.1 Overall objective**:** to explore the factors influencing the path towards malaria elimination in Myanmar in order to inform policy makers about the current malaria situation and give recommendations for the way forward.

2.3.2 Specific objectives:

1. To describe the current malaria epidemiology in Myanmar.
2. To analyze the situation of the current malaria control programme in Myanmar.
3. To explore the opportunities and barriers to achieve malaria elimination.
4. To inform respective authorities about the current challenges in the malaria control phase and to give recommendations about the way forward.

2.4 Methodology

The methodology of this thesis was a literature review of the articles from other countries, published and unpublished reports from Myanmar national malaria control programme like annual VBDC reports, monthly reports, annual presentation, quarterly presentation starting from the central level down to states and regional levels. The WHO Bi-regional malaria indicator framework (see Figure 4 and the original framework can be seen in annex 6) has been adapted as a guide to collect and analyze the information systematically. The national strategic plan for malaria prevention and control (2010-2015) was used to identify the gaps between Myanmar and other countries and WHO guidelines specifically describing malaria elimination. Moreover the WHO malaria program phases and milestones on the path towards malaria elimination were used to determine which administrative level meets the epidemiological criteria (see in definition section).

2.4.1 Literature Search

This literature search was done using different search engines like Pubmed and Google Scholar with the help of key words. Other organizational websites like the WHO website, the World Bank website, the malaria consortium website, the KIT Library and the Global Fund websites were also

used to find relevant references. Email and phone contact with colleagues from Myanmar NMCP was also made.

Key words used for search include malaria, epidemiology, control, elimination, eradication, prevention, case management, surveillance, regional cooperation, public private partnership, engaging other programme and sectors, political stability, financial stability, insecticide susceptibility, drug resistance, feasibility, conceptual framework, insecticide-treated net, indoor residual spraying, artemisinin–based combination therapy, and Myanmar.

2.4.2 Inclusion and exclusion criteria

Literature in English from 1990 to date is included. However, some literature before 1990 is also used because of its relevance in key information describing the background history of NMCP and the geographical distribution of disease in Myanmar. Literature in other languages is excluded.

2.4.3 Conceptual framework

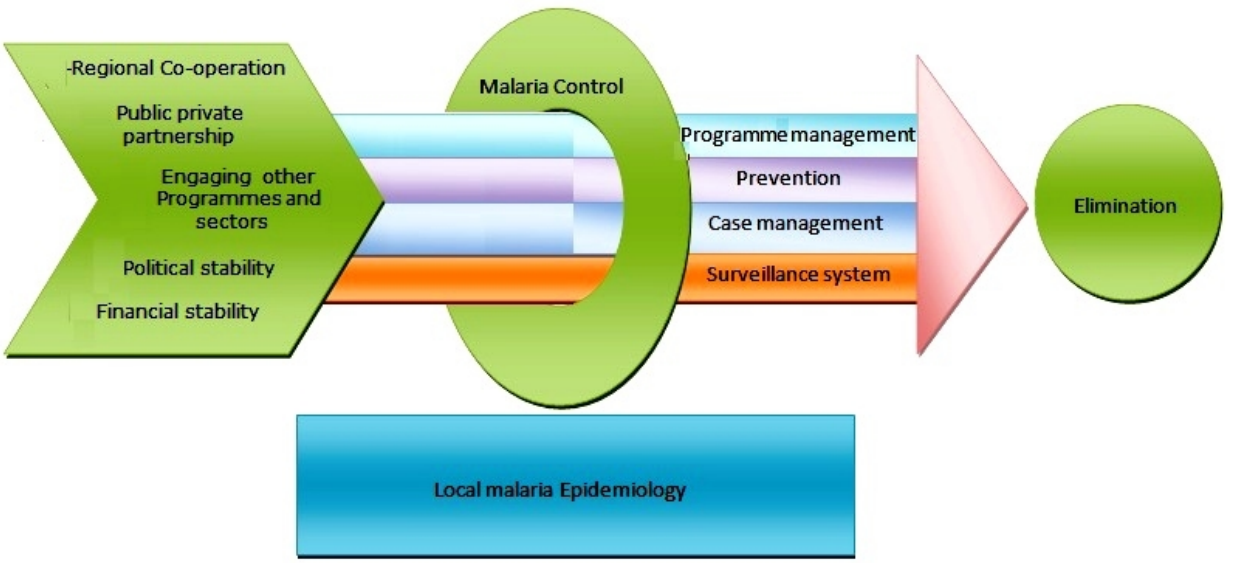
The following framework was adapted from WHO Bi-regional malaria indicator framework (BMIF) of the Greater Mekong Sub- region because the original framework was built for monitoring and evaluation of malaria control and evaluation in the Greater Mekong Sub- region, while the framework needed for this thesis was more on elements and factors influencing malaria elimination. This framework has two goals and three components. The two goals are malaria control and malaria elimination. The three components are: 1. Local malaria epidemiology, 2. Current situation of national malaria control and 3. Potential opportunities and barriers for malaria elimination in Myanmar.

The first component comprises the burden of disease, the geographical distribution of the disease, the seasonal trend, and the vector situation of Myanmar, the parasites and drug resistance situation and the epidemiological feasibility of some areas of Myanmar. The second component includes programme management, malaria prevention, and case management and qualify surveillance system. The last component includes system strengthening strategies such as regional cooperation, public private

partnership, engaging other programme and sectors, political stability and financial stability.

Another framework for assessing the feasibility of malaria elimination in Zanzibar was also found but there is not enough information to use that model in terms of technical, financial and operational feasibility.

Figure 4: conceptual framework



Source: Adapted from Malaria Control and Elimination in the Greater Mekong Sub-region.

Chapter 3: Study Findings

This chapter is divided into three sections. The first section is about the current malaria situation and epidemiology in Myanmar. The second is about the situation of the current malaria control programme and the last is about the opportunities and barriers towards the malaria elimination goal.

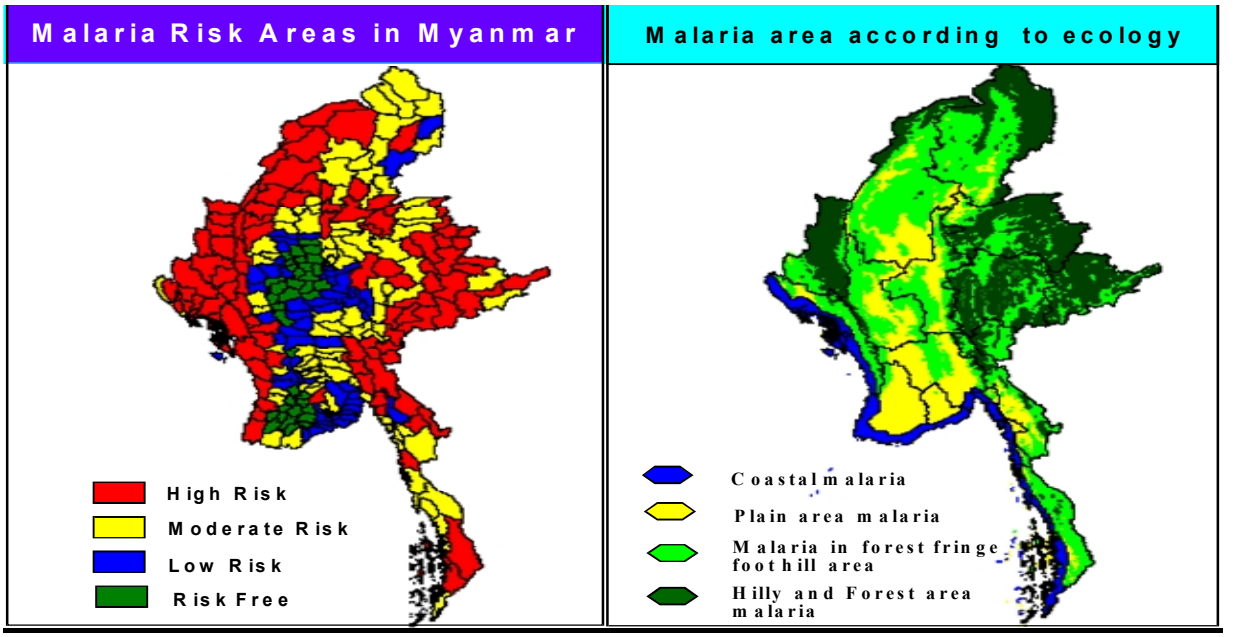
Section 3.1 Current Malaria situation and epidemiology in Myanmar

For effective targeting and implementation of malaria control and elimination, it is essential to have a detailed understanding of disease epidemiology. Agent (parasite), Host (human), vector (mosquitoes), environment and their interaction have influenced malaria epidemiology (MacDonald 1957, Maharaj et al 2013). Geographical distribution, burden of disease, seasonal trend, vulnerable population, malaria vectors, malaria parasites, socio-economic determinants and epidemiological feasibility of States/Regions are described in this part.

3.1.1 Geographical distribution of malaria

In Myanmar malaria transmission mainly occurs in forested foothills below 1,000 meters. Usually the temperature above 1,000 meters is too low which slows the time of the sexual phase of the parasite's life cycle and thus leads to low transmission. In Myanmar most of these malaria transmission areas are close to international borders which can be seen in Figure 5.

Figure 5: Malaria Risk Areas and Ecological Zones in Myanmar, 2007

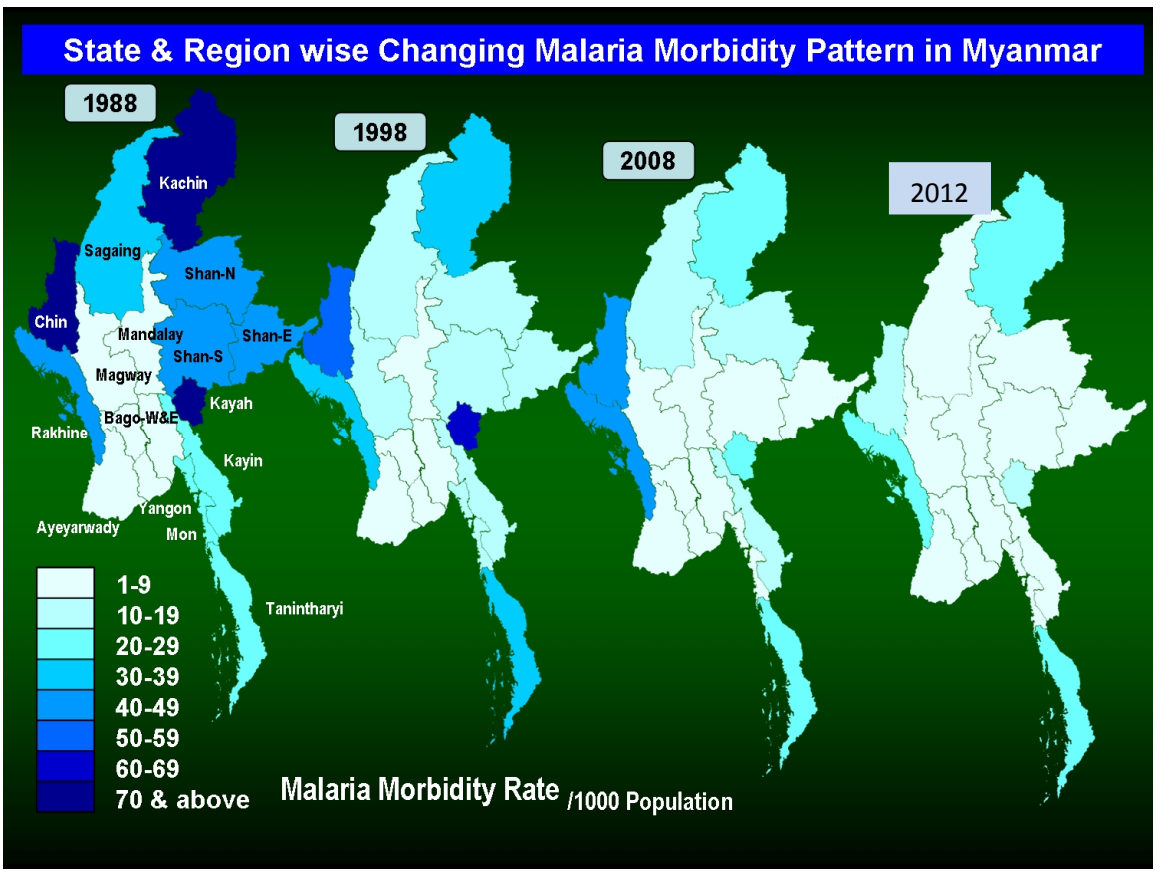


Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2012

Depending on the long-term malaria data, the country has been divided into areas of risk free (no risk), low, moderate and high risk for malaria. Depending on ecological determinants of malaria it is partitioned into four: 1. Coastal Malaria, occur along the coastal line starting from Rakhine state, Ayeyarwady region, Mon state and Tanintharyi region and mainly transmitted by An.sundaicus. 2. Plain area malaria**.** Malaria is highly unstable in the plain area compared to other areas and tends to cause outbreaks especially in road and dam construction sites and transmitted by some weak vector like An.annularis and culicifacies. 3. Forest fringe malaria is usually transmitted by An.minimus and 4. Forest related malaria occur in highlands usually above 600 metres above sea level and is transmitted by An.dirus. Forest related malaria contribute to more than 60% of malaria cases each year (Vector Borne Disease Control 2010b).

3.1.2. Burden of disease

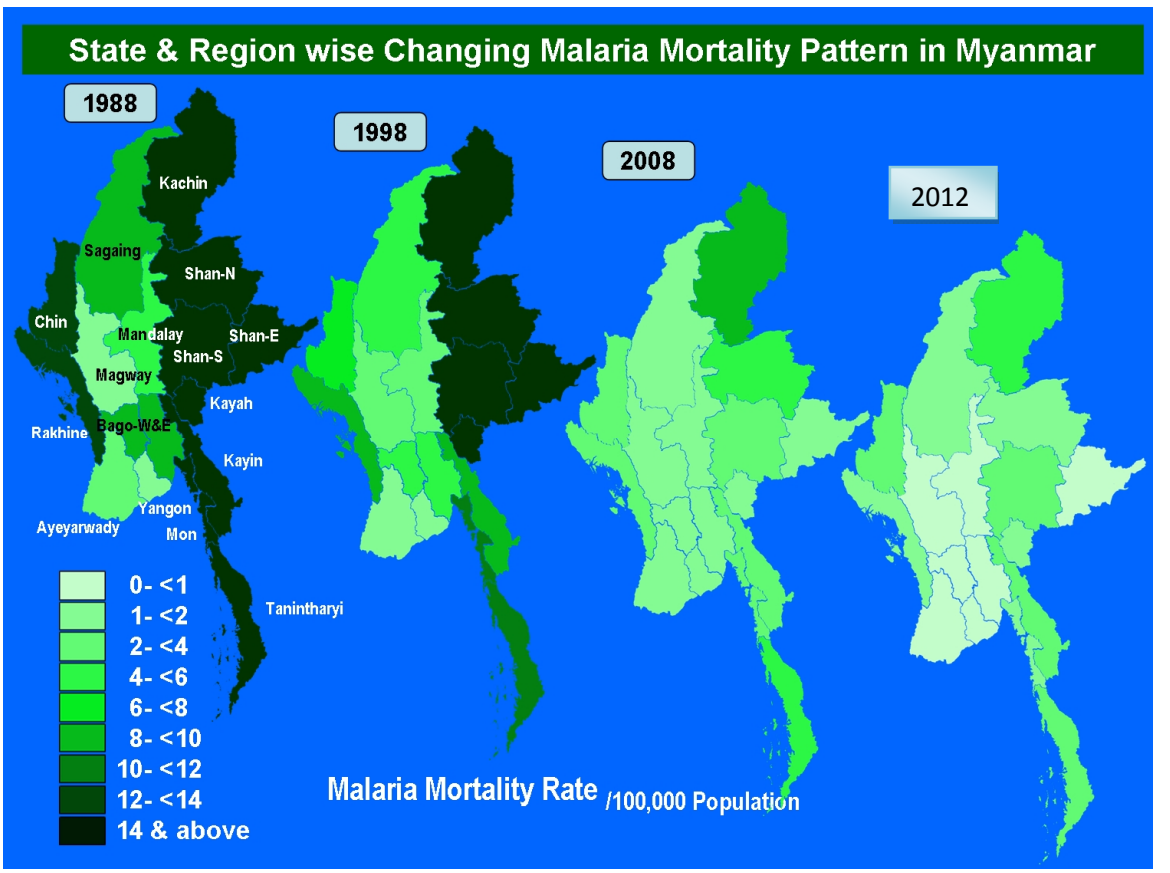
Figure 6: Malaria Morbidity in Myanmar (1988-2012)



Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2013

Malaria morbidity is shrinking in Myanmar (see Figure 6) decade by decade and the 2012 disease burden was still high in only four of the border States (Kachin, Chin, Rakhine and Kayah) and in the Tanintharyi Region. Multiple factors have contributed to the malaria burden reduction such as increasing international funds, community involvement in malaria prevention and control, partnerships with implementing partners and other health related sectors, deforestation and economic development (WHO 2009). A possible explanation for the high burden of the disease from 1988 to 1998 is over diagnosis based on clinical history, while after 2006 because of introduction of RDT, fewer cases were recorded based on confirmatory tests.

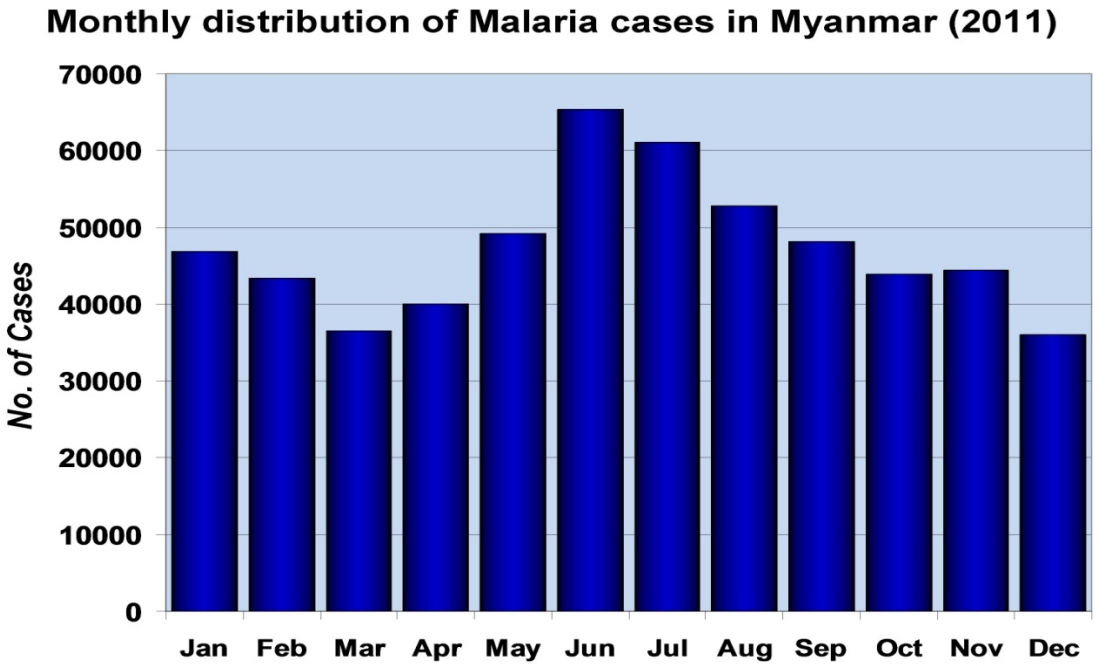
Figure 7: Malaria Mortality in Myanmar (1988-2012)



Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2013

From this figure we can conclude that the malaria mortality rate reduced remarkably in Myanmar during the last three decades apart from some border areas where the mortality rate is still high. Factors contributing to high mortality in the border areas are poor communication, low literacy rates of ethnic minorities, inaccessibility to health services, multidrug-resistance P.falciparum and non-immune migrant population (WHO 2010).

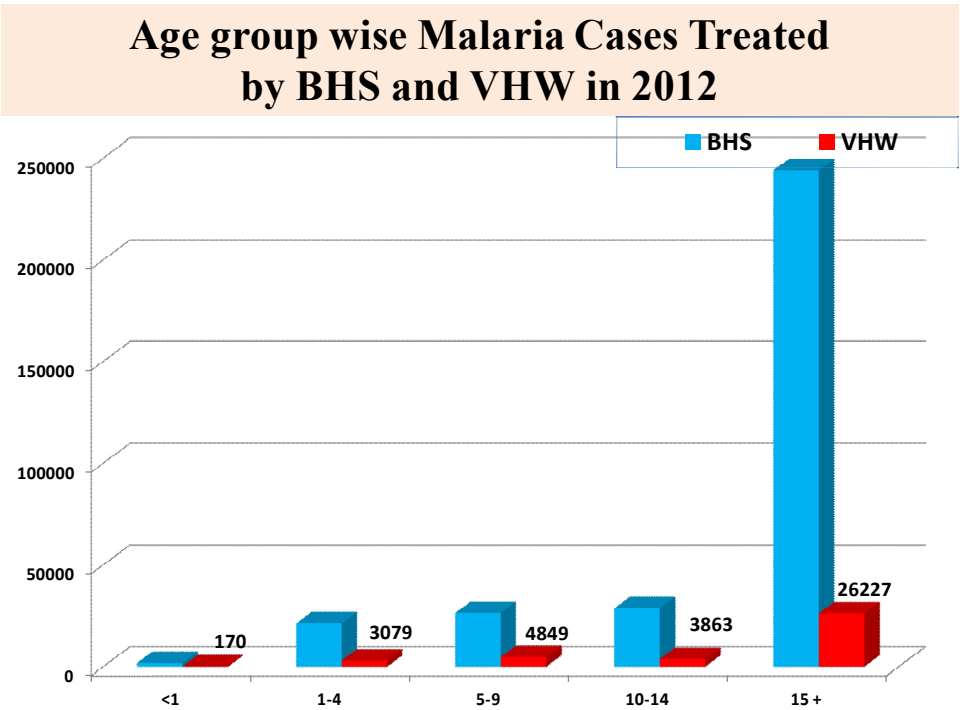
Figure 8: Seasonal Trend of malaria cases in Myanmar (2011)



Source: Central VBDC annual report 2011

Figure 8 illustrates that malaria transmission occurs throughout the whole year, but there is a seasonal peak in the monsoon and post monsoon period starting from June to November (Vector borne disease control 2011).

Figure 9: Age distribution of malaria cases in Myanmar (2012)



Source: vector borne disease control annual presentation, Ministry of health, 2013.

According to the above figure, malaria cases are more prevalent in the age group above 15 which accounts for 65% of blood confirmed malaria infections. Male are more affected than female. The predominance of malaria cases in adult males is a reflection of the high exposure to malaria most probably due to occupations such as mining and forest-related activities like wood cutting, bamboo cutting, teak extraction, charcoal production, construction and rubber plantation work.

3.1.3 Vulnerable population

This population refers to pregnant women, children under five years old, adults over 65 years, ethnic minority groups, mobile/migrant populations and forest-goers (WHO 2011).

In Myanmar malaria in children under five is 11% of all malaria cases and contributes to 10.68% of out-patients and 13.31% of inpatient admissions. Due to their biological vulnerability, severe complication like severe

anaemia, hypoglycemia and cerebral malaria are features of severe malaria more commonly seen in children than in adults (WHO 2013a).

Pregnant women contribute to 3% of all malaria cases and high parasite resistance to sulphadoxine-pyrimethamine in Myanmar precludes the use of intermittent preventive treatment.

There are other vulnerable groups like the population over 65 years, HIV-positive patients and forest-goers but there is no available information about them in Myanmar.

Non-immune migrants and other mobile populations are regarded as vulnerable as most to them compound their non-immunity with poor health seeking behavior like seeking treatment from unregulated private vendors, increased exposure to substandard drugs or oral artemisinin based monotherapy (WHO 2013b). Although these migrant groups are well known, apart from those in the Tanintharyi region it is difficult to quantify them due to their high mobility, seasonality of their work, lack of organization and coordination among themselves and inadequate coordination between health sector and the agencies responsible for development projects. But according to the censuses conducted in 1973 and the census of 1983, they formed 2.9% and 3.4% of the population (Ministry of immigration and population 2014).

Because of geographical terrain and poor communications, and poor access to quality health services, the ethnic minority groups living in remote areas are among those at the highest risk and vulnerability.

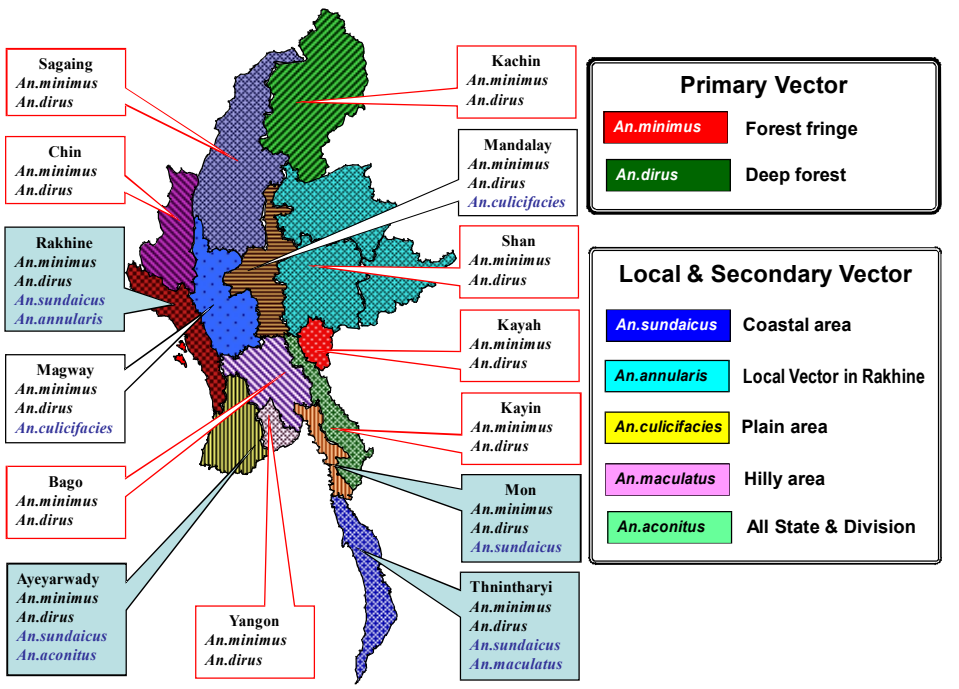
3.1.4. Malaria vector situation in Myanmar

In Myanmar, 8 out of 37 species of Anopheles are malaria vectors (Figure 10) and classified into primary vectors. An. minimun (Forest fringe) and An. dirus (deep forest) have sporozoite (infective stage of malaria parasite to human) rates of 2 to 4%. Secondary or local vectors are An. sundaicus in Coastal areas, An. culicifacies in plains areas with sporozoite rates of 1 - 2% and suspected vectors (An. macultatus in hilly areas and An. aconitus with sporozoite rates <1%) in all States and Regions. An. annularis is a local vector in Rakhine state and is highly resistant to DDT. Some local vectors in Bago, and Magway regions show resistance to the pyrethroid insecticide

which is the third line for IRS, and some show resistance to insecticides in distributed LLIN (50% mortality in Netprotect, 38.8% mortality to AAGNet) in the Ngaphae township of Magway region (Win, 2013).

A peculiar feature to Myanmar is that the primary vector An. dirus and An. minimus breed on deep wells in Mon and Sagaing states (NMCP-WHO, 2011). Deforestation and climatic change drive mosquitoes to cities which were previously malaria free areas (Cherry Thein, 2011).

Figure 10: Vector species in different states and regions in Myanmar



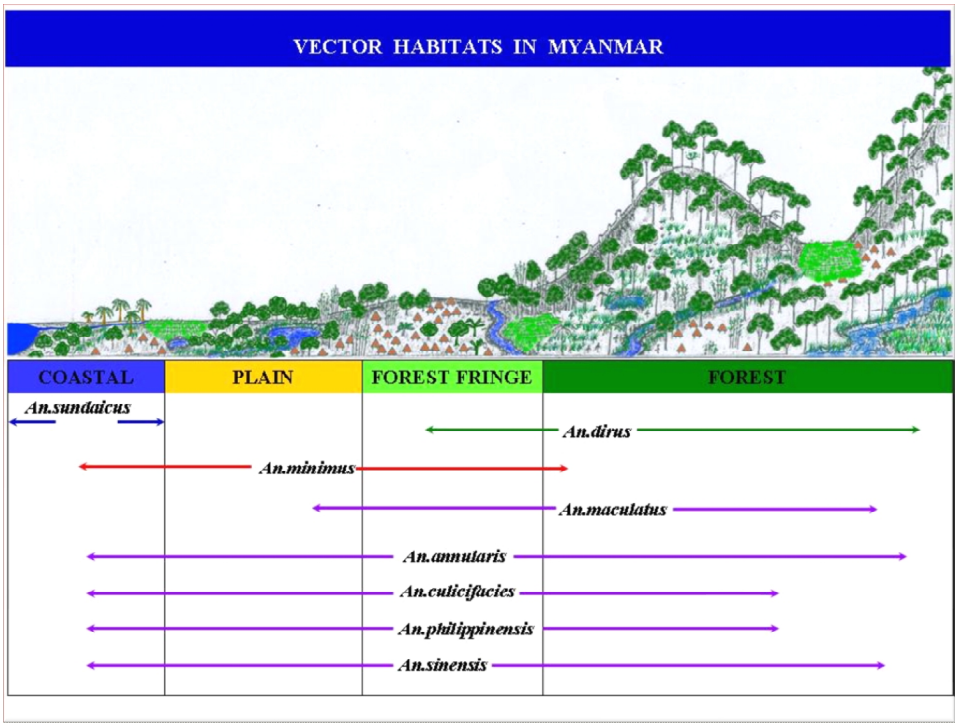
Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2012

3.1.5 Ecological distribution of vectors

Figure 11 shows the main vector for malaria (An. dirus) is more prevalent in deep forest and forest fringe areas, usually breed in pools, swamps, hoof marks, earthen wells under shade and An. minimus is prevalent in hill tracts, foothill areas and plain areas. They usually breed in slow running streams, rice fields, and shallow wells. Both An.dirus and An.minimus are

highly anthropophilic, i.e, they mainly feed on humans and bite during the later part of night. An. dirus usually rests outdoor but An. minimus rest and feed both indoors and outdoors and the rest are prevalent in all four geographical areas (NMCP-WHO 2011).

Figure 11: Vector Habitat in Myanmar

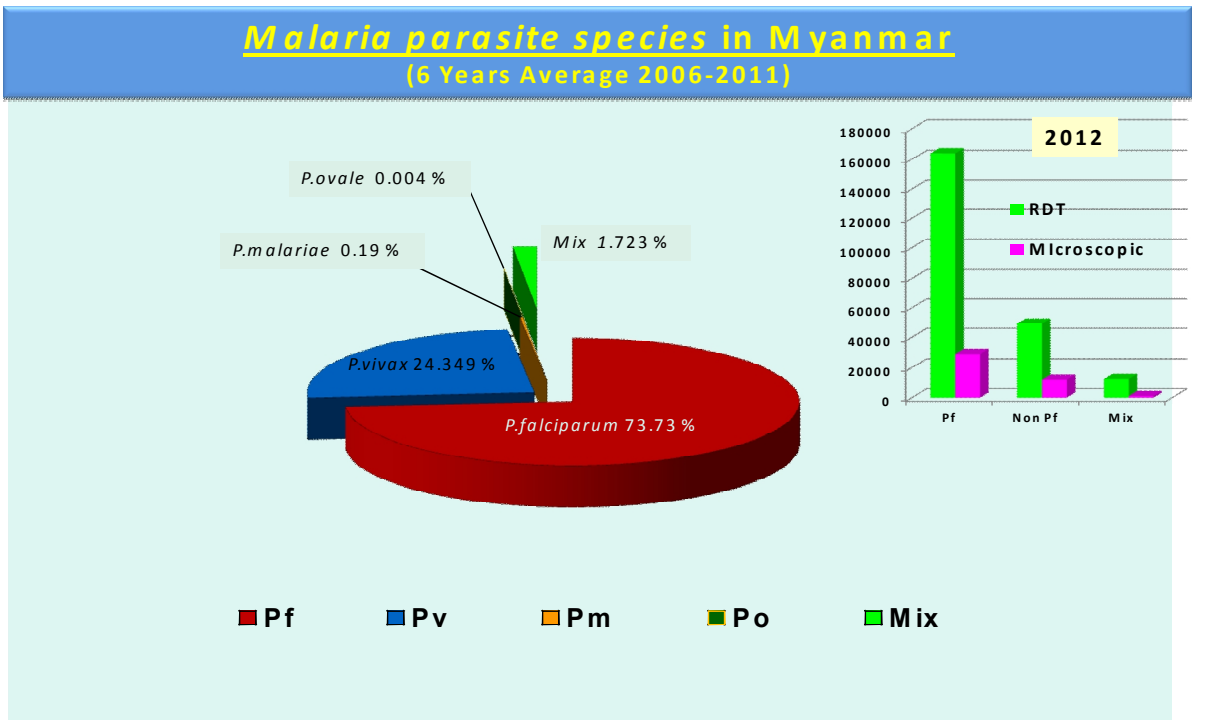


Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2012

3.1.6 Malaria Parasite species and drug resistance situation in Myanmar

Myanmar has two major species of plasmodium: P. falciparum and P. vivax with occasional reports of P. malariae, P. ovale and even rare zoonotic infection of P. knowlesi which are illustrated in Figure 12 (VBDC 2010b).

Figure 12: Malaria Parasite species in Myanmar



Source: Source: Vector Borne Disease Control, Myanmar Ministry of Health, 2012

In Myanmar P. falciparum has been resistant to chloquine, sulfadoxine-pyrimethamine (SP) and mefloquine. Currently the Myanmar Thailand border showed evidence of P. falciparum resistance to first line anti-malaria drugs (ACT) in the vivo therapeutic efficacies studies (NMCP-WHO 2011). This drug resistance problem has put Myanmar in the global spotlight as the lethal form of malaria parasite may lose the efficacy of first line drugs.

Figure 13: Spatial distribution of patients with P. falciparum parasitaemia on day three after treatment with ACT in Greater Mekong Region (2006-2010)

Source: NMCP, MoH, Myanmar 2011

This map correlates with the spread of artemisinin resistant strain of P. falciparum starting from Thailand and Cambodia border in 2002 and Thailand-Myanmar border in 2010. In 2002, the pailin Province of Cambodia had late treatment failure with artesunate + mefloquie combination at day 28 and parasitaemis after three days of treatment with Dihydroartemisinin-

piperaquine. A similar result was found at the China-Myanmar border. In Myanmar based on results from in vivo therapeutic efficacy studies of ACTs, three geographical tiers have been defined. Tier 1 (Tanintharyi region, Mon state and Bago east region) which has evidence of artemisinin resistance and in bordering areas with tier 1 is tier 2 (Kayin, Kayah and Kachin states) and tier 3 is the the rest of the country (NMCP-WHO 2011).

Antimalaria drug efficacy investigations are also conducted in Myanmar. High treatment failure rates to first line ACTs (artemether-lumefantrine) and artesunate-mefloquine were found in the eastern border of Myanmar such as Tanintharyi region, Mon state and Eastern Bago region (NMCP-WHO 2011).

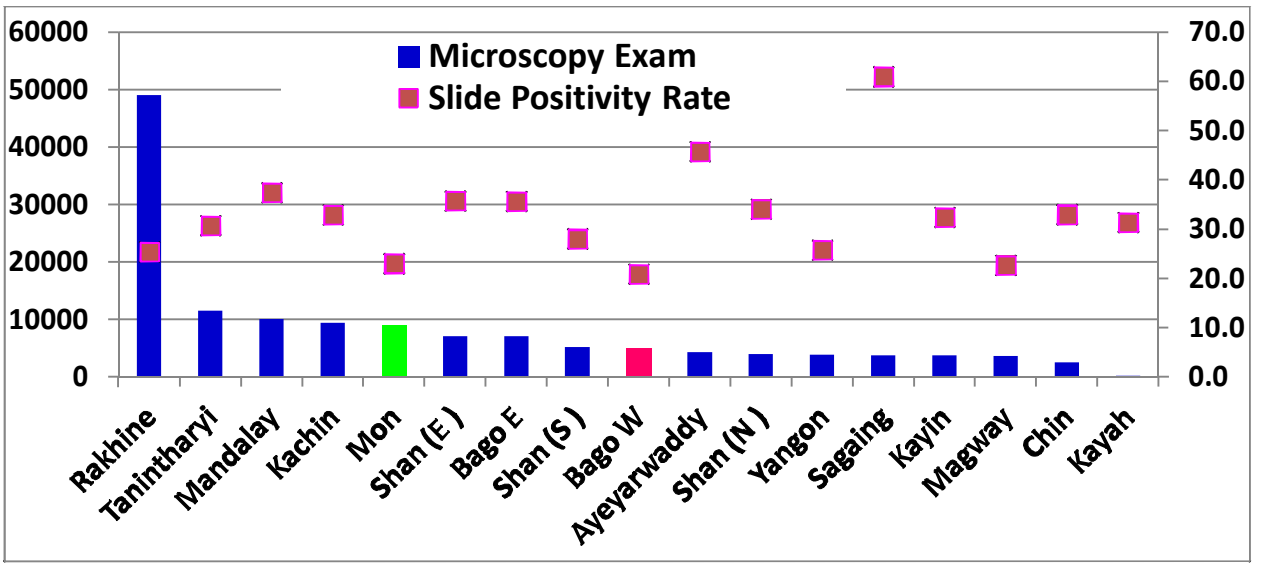
3.1.7 Social and economic determinants

In Myanmar all age groups have the same risk of contracting malaria if they live within 1 km of a forest. In villages that are farther away from a forest, the risk is usually confined to adult men, who enter the forest for socioeconomic reasons. They usually go in groups and stay in the forest for several days and even months sometimes in temporary shelters with no protection from mosquito bites and also most of them left mosquito nets home to give priority to the family members (VBDC 2010b).

3.1.8 Epidemiological feasibility assessment of different States and Regions

According to the WHO programme phases and milestone on the path towards malaria elimination (see definition section), the first cut-off point of slide positivity rate of the different States/Regions are shown in the following figure 14.

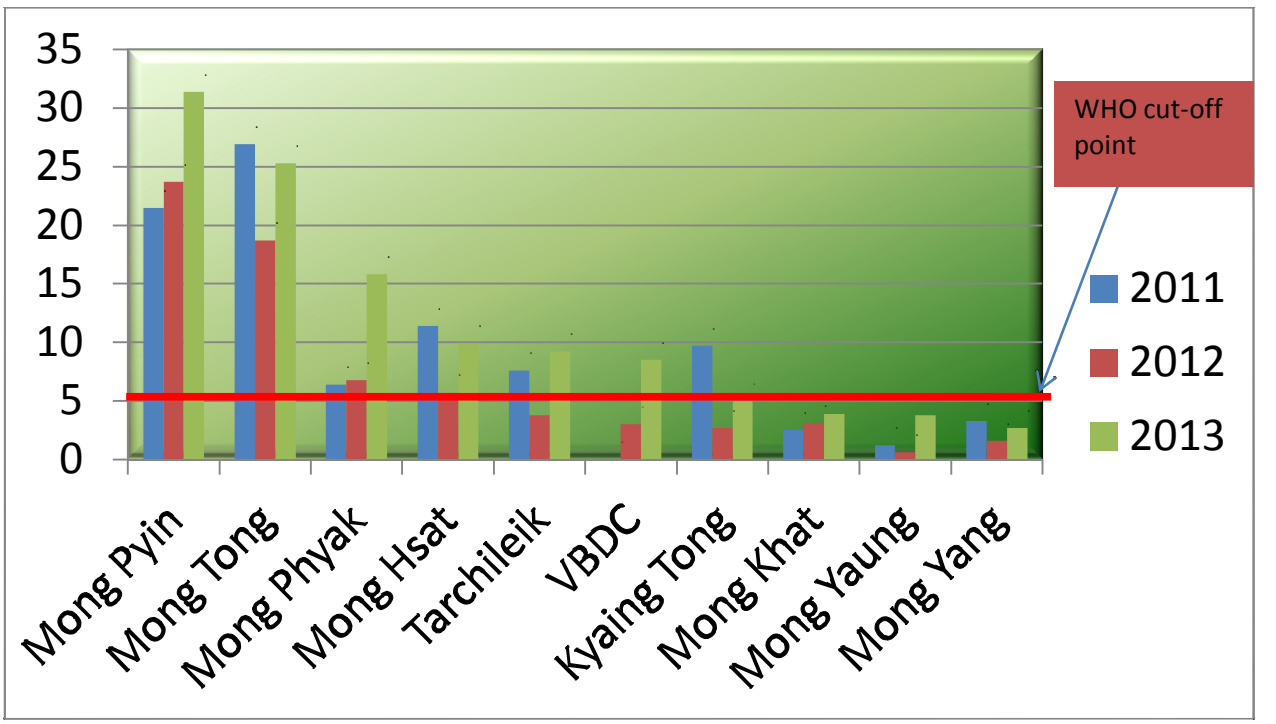
Figure 14: Slide positivity rate of different states and regions in Myanmar (2012)



Source: Source: Vector Borne Disease Control, annual evaluation pp, 2013.

This figure (VBDC 2013) shows that no state or region meets the WHO criteria of slide positivity rate less than 5%. The Sagaing region has the highest positivity rate (60%). Mon state, Bago (W), Yangon and Magwe regions have the lowest positivity which is around 20%. Shan (E), Bago(E) and Shan (N) show average positivity rates of 30%. Among the three average states/regions, Eastern Shan state was chosen because of data availability for lower districts/townships level positivity rate which is shown in Fig 15.

Figure 15: Township-wise malaria positivity rate in Eastern Shan State (2011-2013)



Source: Vector borne disease control annual presentation, Shan State (East) 2013.

As mentioned in the definition section when the malaria incidence rate in a geographic area is consistently less than five new cases per 1,000 people at risk per year (Slide positivity rate less than 5%) the case load is considered manageable enough to go to the elimination phase.

This figure shows that three townships (Mong Khat, Mong Yaung, Mong Yang) have the lowest positivity rate which also meet the epidemiological cut-off point <5% of pre-elimination phase among the nine townships in the state. According to this finding, we can conclude that although the national level, and state/regional levels do not meet the first cut-off point, it is clear that some districts/townships have already met the pre-elimination criteria.

The decreasing trend of malaria incidence of Eastern Shan State (2001-2012) can be seen in Figure 16 of Annex 8.

Section 3.2: Current Malaria Control Program

In this part, program management, policy and strategies of the current malaria control programme are explained.

3.2.1 Malaria programme management

To get effective and smooth implementation of malaria intervention there is a need of a good program management especially for resource mobilization.

3.2.1.1 Human resource management

This is the most important input to get malaria elimination. Without adequate health care coverage in malaria risk areas, malaria transmission cannot be interrupted. According to WHO, there should be a minimum of 23 doctors, nurses and midwifes per 10,000 population to deliver essential health services. This can also be a benchmark for malaria services (WHO 2014a). The current health workforce in Myanmar is 1.49 per 1,000 people which is below the WHO minimum recommended threshold of 2.3 per 1,000 population to achieve MDG (Ministry of health 2012a). According to the WHO, to achieve elimination the recruitment of additional staff, contracting and remuneration should be sufficiently flexible and decentralized to ensure that staff is sufficiently qualified to perform with professionalism and integrity (WHO 2014a, WHO 2007).

In Myanmar the detailed organization set up starting from central level down to state/regional level, and township level can be seen in annexes 2 to 5 and many professional staff cadres are vacant. Among 2,392 approved posts (see detail in annex-5) in the malaria control programme, only around 1,600 are filled (NMCP-WHO 2011). The NMCP is responsible for technical support of health staff involved in malaria control intervention while the department of health (DOH) is the main authority responsible for deployment and transfer of health staffs which is highly centralized (Nixon et al 2013).

3.2.1.2 Procurement and supply chain management system (PSM)

The procurement and supply chain management system is crucial to ensure that the malaria intervention reaches the end users and is available at all treatment sites. The Myanmar NMCP is responsible for forecasting antimalarial medicines and other supply requirements depending on epidemiological data and past consumption and is procured by the WHO. The logistic section of the NMCP is responsible for distribution of all the malaria commodities to all public health sector including volunteers through State/Region offices.

An external review found some stock out and a number of expired or nearly expired drugs in some public health facilities (Mendis et al 2012). A possible explanation is the short shelf-life of ACTs which is two years combined with delays in procurement and supply management to reduce the remaining optimal six month shelf-life significantly.

3.2.1.3 Surveillance and management information system

A strong surveillance system is very important for malaria control and elimination in order to obtain complete and accurate information on malaria incidence which is necessary for programme design and implementation. The design of a surveillance system depends on the level of malaria transmission and resource availability. For malaria elimination, the surveillance system should be case-based and every confirmed case should be notified and fully investigated in order to know the epidemiological link - if the infection was imported or acquired locally by mosquito-borne transmission. There are two source of information for monitoring of malaria indicators: 1. Routine information systems, and 2. Household surveys (WHO 2013c).

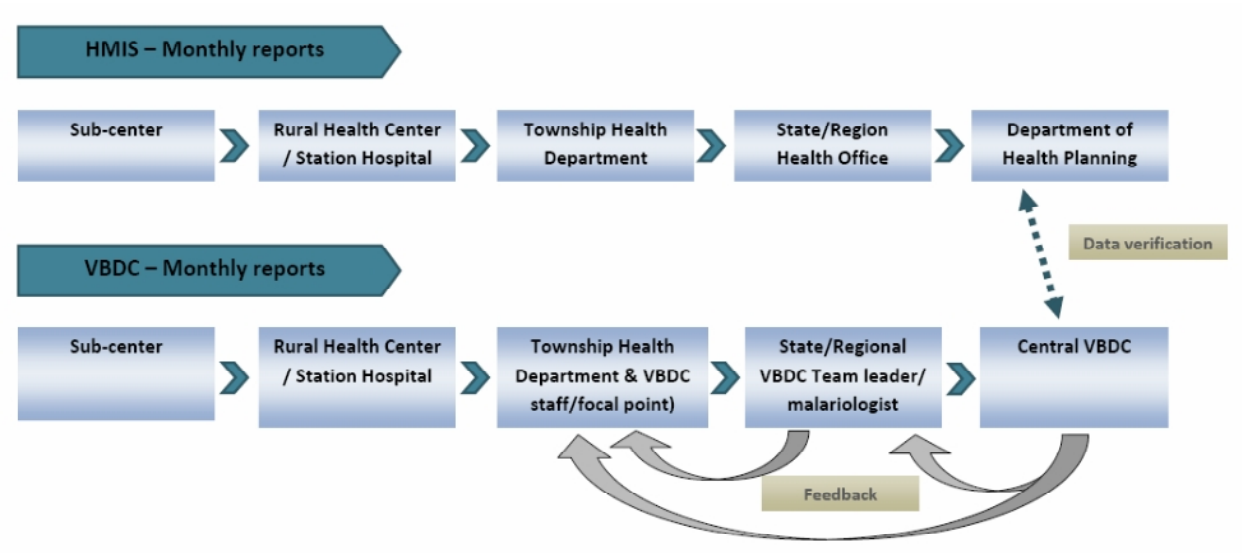
For malaria elimination, a reliable, regularly updated village database and civil registration system are necessary to map out the malaria risk areas and good disease surveillance systems are needed (WHO 2014a).

In Myanmar malaria is one of the 17 diseases under the national surveillance system and reported monthly through the health management information system (HMIS). There is also a parallel system through a vertical vector borne disease control channel on a monthly basis (VBDC 2010c) (see figure16). The information concerning malaria relies solely on the routine

reporting system using a standardized malaria case register which includes aggregation of age groups of the patient, diagnosis, treatment, logistic information and other malaria preventive activities. The collected data is used as reporting purposes rather than to prompt specific control action (Malaria Consortium 2013a). In addition there is no population information after the census carried out in 1983. A third census was conducted in April 2014 to international standards but the results are not yet available (Ministry of Immigration and Population 2014).

The routine data from the health centre and township level are aggregated manually to prepare monthly reports and are sent to the State/Region by post. At the State/Regional level, data from the townships are captured in Excel spreadsheets by data assistants from temporary project staff and then posted to the central VBDC and WHO. Though routine data related to malaria control interventions from NGOs and private sectors are required to be submitted to the township level, this is a challenge as there is no incentive for the private sector to send their reports and they are not conform to MoH reporting requirements (VBDC 2010c).

Figure 16Myanmar HMIS Report flow/system



Source: Monitoring and evaluation plan, NMCP, Myanmar, 2010.

3.2.2 Malaria control policy and strategies

3.2. 2.1 Prevention

In the prevention section the two most powerful and most broadly applied interventions are: 1. ITN/LLIN intervention, 2.indoor residual spray and other preventive measures like environmental control, other vector control and IEC/BCC are described.

3.2. 2.1.1 Information, Education and communication (IEC)/BCC (Behavior change communication)

This is the process of giving correct and relevant information to the communities through various communication channels to adopt positive behavior in order to empower people for more effective decision-making in health (Roll Back Malaria 2008).

Increasing awareness of the community regarding malaria causation, prevention and control is the first strategy of NMCP. NMCP developed IEC material in different local languages for various ethnic groups and different target groups mainly focusing on regular use of insecticide treated nets, early seeking to diagnosis and prompt treatment (VBDC 2010b).

Other implementing partners like PSI and JICA also have their own approach of IEC/BCC although all materials are supposed to be reviewed and approved by the Health Department of MoH (Mendis et al 2014). PSI developed a communications program focusing on behaviour change in malaria prevention through mobile video units and conducted BCC sessions at the community level. JICA also developed an IEC plan for the Kokant ethnic groups and selected population in the Bago region (VBDC 2010b).

One knowledge, attitudes and practices survey with regard to malaria control in an endemic rural area of Myanmar showed that over 63% of respondents received information about malaria from experience or family members, 19% from friends, 12% from community leaders, and only 2.6% from basic health workers, 0.6% from TV and 0.4% from books and radio. Belief regarding the causes of malaria show only 64% of respondent know malaria is due to the mosquito bite while 18.9% thought it was due to dinking/bathing in spring water, eating bananas (8%), eating indigestable food (2%) and change of weather (1.3%). Only 58% of respondent knew that bednets can prevent malaria. For personal protection only 51% of

respondents used bednets and the rest are using burning dry leaves, mosquito coils, insecticide spray, and burning herbs. Treatment seeking behavior showed that only 2.8% sought treatment at public hospitals, 42% took self treatment and 6% went to private hospitals and the remainder took treatment by unqualified providers or even took no treatment (Kyawt and Pearson 2004). This study showed that rural populations are inaccessible to malaria health services, have inadequate knowledge of malaria prevention, poor health seeking behavior, poor practice of malaria preventive measure, and some even have misconception about malaria.

3.2.2.1.2 Insecticide-treated nets/Long-lasting insecticidal nets (ITNs/LLINs)

The principle of insecticide treated nets and IRS is to reduce human-vector contact and shorten the life span of mosquitoes so that they do not survive long enough to transmit the parasite (WHO 2013d). WHO recommend universal coverage of ITN/LLIN to all population at risk. To achieve this target one ITN should be distributed to approximately every two persons at risk. To cover households with odd numbers of members, it is adjusted to one ITN/LLIN for every 1.8 persons at risk of malaria. To ensure the coverage is maintained, this mass distribution campaign should be every three years and other complementary campaigns like continuous distribution through antenatal and routine immunization service is needed. The distributed LLINs should be free of charge (WHO 2013c).

The Myanmar NMCP's objective is to ensure that 80 percent of the population in high and moderate risk areas are protected by ITNs/LLINs by the year 2015 (VBDC 2010b).

A study conducted in the eastern part of the country in 2008 revealed that 80 to 97% of families owned mosquito nets. However, in other parts of the country, bed net ownership was highly variable (as low as 20 % and as high as 90%) (CESVI 2008). A study conducted in Chin, Sagaing and Kachin States showed that 87.8% of households owned at least one bednet, only 68-85% of the people interviewed slept inside mosquito nets the night before the survey and 85% of the nets used were purchased with own money especially in non-project areas (MCC-WHO 2008). Some men reported not to bring bednets along with them when they went to forest and gave priority to their family members to use them at home.

One study result from Rakhine State shows that the local malaria vector bites in the early evening and outdoors. The peak biting time is 6 pm to 7 pm with 51% of anophelines caught before 8 pm. This study did not show any difference in malaria infection, spleen rate, haemoglobin concentration or weight for height between the villages with and without ITNs (Smithuis et al 2013).

Another study conducted on migrant workers at a palm oil plantation site in the Tanintharyi Region and a rubber plantation site in Mon State in 2014 revealed that ITN ownership was 82.3% while utilization rate was 56.9%. Misuse of ITNs for animals and fishing were also noted in that study. This indicates high net attrition rate. Some complain that there is no replenishment of worn out nets and some noticed that after few months of using the ITN, mosquito can rest on the net (Myat et al 2014).

Similar studies world-wide found a huge discrepancy between ownership and use of ITNs or high attrition rate of bednets. These can be seen in Kenya 95% vs 59% (Githinji et al 2010), 70% vs 53% in Nigeria (Ye et al 2012), 90% vs 77% in Tanzania (Ruhago et al 2011).

The correct hanging method is one of the important universal access indicators. It should hang over the sleeping place, tucked or weighted down under the mattress or by the sleeping mat. Only 69.9% of net user hung their nets correctly in Ethiopia (Batisso et al 2012). There is no study concerning the correct use of bednets by asking the users to demonstrate the correctness of the hanging method in Myanmar.

3.2.2.1.3 Indoor Residual Spraying (IRS) and other vector control methods

Indoor residual spraying is the application of long-lasting, residual insecticide to potential malaria vector resting surfaces where the vector might contact with the insecticide and thus reduce vector longevity and density. It also reduces human-vector contact through repellent action and thus leads to reduction of malaria transmission (WHO 2013d). The WHO recommends spraying should be universal coverage or at least 80% of houses in the target area (WHO 2013c).

Since Myanmar has year round malaria transmission, at least two spray rounds per year are needed to cover all the transmission cycle (WHO

2013d). In Myanmar and because of high operational cost, insecticide resistance, community acceptability and environmental pollution, instead of routine IRS, selected IRS is conducted during outbreaks and prevention of outbreaks in new settlements and development projects in malaria risk areas and some localized areas of multiple parasite resistance P.falciparum malaria (VBDC 2010b). DDT is the first line of choice for endophilic (indoor resting), endophagic (indoor biting) vectors, malathion is the second line of choice for outdoor resting vector and pyrethroid is the third line for those area which show resistance to DDT and malathion (Win, 2013).

IRS in combination with ITN/LLIN is recommended in artemisinin resistance affected areas in order to maximize the protection of the population at risk. In addition, mosquito density can be reduced by larval source management. This can be done by permanently or temporarily reducing the larval habitat or by adding larvicide into standing water. Such environmental management methods are rarely used in Myanmar.

Housing is another important factor for preventing human-vector contact. Poor housing with open ceilings, walls, or windows and doors without screening, or wide or unscreened eaves, favour mosquito access into the house (WHO 2014a). This can be seen in one study conducted in the north west of a Burkina Faso where children living in iron-sheet roofed houses had significantly lower risk of getting P. falciparum malaria infections than those living in mud roofed houses (Ye et al 2006).

3.2. 2.2 Case management (Early diagnosis and prompt treatment) (EDPT)

The main objective of EDPT is to reduce malaria morbidity and mortality by ensuring rapid diagnosis and complete cure of plasmodium infection and thus preventing the progression to severe and complicated malaria, reducing the transmission by reducing the human reservoir and preventing the emergence and spread of resistance to antimalarial. To achieve this objective, each and every suspected cases should be tested and every confirmed case should be treated with a quality antimalarial drug (WHO 2013d).

3.2. 2.2 .1 EarlyDiagnosis

Early diagnosis and prompt treatment is the main intervention to reduce the severity and duration of disease and prevent malaria mortality. Achieving these elements depends on the health seeking behavior of patients and the quality of health services (Giao et al 2005).

Prompt access to quality treatment is important for reducing malaria morbidity and mortality. Obtaining timely and effective treatment depends on the network of individual households, communities and health systems. Myanmar targeted giving treatment to confirmed malaria cases within 24 hours after onset of the symptoms. Bivalent RDT (combo) has been used in Myanmar since 2006 which can detect both P.falciparum and P.vivax. Because of infrastructural and resource challenges which prevent the use of gold standard microscopy the national malaria control programme is relying on RDT in peripheral health facilities (VBDC 2010b).

Since the annual blood examination rate (ABER) is a standard indicator of the adequacy for case detection the overall ABER for Myanmar was 2.54 in 2012 and the highest ABER (38%) was found in the Bokepyin township of Taninthayi region where 87% malaria testing was done by volunteers (Malaria consortium 2013a).

Because of increasing availability and accessibility of RDTs especially at village levels, vacant microscopic post and non-functioning microscope, microscopy services have deteriorated over the past few years. Though microscopy is the gold standard method for malaria diagnosis, and RDTs are intended for use in health facilities where microscopy is unavailable or in inaccessible areas but over 90% of tests were carried out using a RDT and even at a township hospital with microscopic facility (Malaria consortium 2013a).

Regarding the quality assurance of RDTs, only WHO prequalified RDTs were procured and a number of cooler boxes were distributed for pilot testing for storage of RDTs as well as drugs in remote health facilities. Moreover all malaria positive slides and 10% of negative slides are to be sent to central VBDC laboratory section but only few microscopists follow this instruction according to my observation and supervision reports.

3.2. 2.2.2 Approriate Treatment

Every confirmed case should be treated with WHO recommended five ACT for uncomplicated P. falciparum malaria: 1. artesunate plus mefloquine, 2. Artemether-lumefantrine, 3. Aartemether-lumefantrine, 4. Artesunate plus amodiaquine, 5. Artesunate plus SP (WHO 2013c).

But in Myanmar most malaria cases have been treated based on clinical criteria for many years. In 2002 Myanmar changed its malaria treatment policy from monotherapies for the treatment of P. falciparum malaria to adopting an ACT-artesunate plus mefloquine on the basis of therapeutic efficacy testing. Aartemether-lumefantrine (Coartem, Lumertam) was introduced as an alternative first-line medicine in 2005 and dihydroartemisinin-piperaquine in 2008. So three ACT co-formulated forms (Artemether-Lumefantrine, Artesunate-Mefloquine, Dihydroartemisinin-piperaquine) are recommended for all confirmed cases of uncomplicated P. falciparum malaria. (VBDC 2008). The national treatment policy can be seen in detail in Annex 7.

But according to my observation during supervision and monitoring, adherance to treatment guidelines is still a question in some health facilities. Some medical doctors including specialists in public sectors do not follow the national treatment guideline. Similar irrational use of drugs exists in private sectors (VBDC 2010b). Another finding revealed that although three ACTs are recommended in the national treatment policy, only one ACT (AL) is available in the public sector and more than three ACTs are available in the private sectors and artemisinin monotherapies are still widely available in Myanmar (Mendis et al 2012).

Another study on practices of medical practitioners indicates that they were also prone to use artemisinin monotherapy in arbitrary doses and combinations. Antimalarial treatments provided in private sector were mono drug instead of combination and they belong to a single brand, AA, pharmacy (NMCP-WHO 2011).

Primaquine uses as a gametocidal drug of P.falciparum and as a radical cure for P.vivax in the current treatment guideline has a potential haemolytic anaemia especially if the patient has G-6 PD deficiency. One study conducted in Thailand indicated that there was 6.6% prevalence in the Myanmarese population residing in malaria endemic areas of Thailand by using PCR-RFLP method (Phompradit P et al 2011). Also one adherence to six doses regimen of artemeter–lumefantrine among uncomplicated

plasmodium falciparum patients in Ethiopia showed that only 38.7% of cases adhere treatment properly (Lemma et al 2011). There is no study information available concerning the prevalence of G-6 PD and drug compliance in Myanmar.

Section 3.3 Opportunities and barriers for malaria elimination

In this section, regional cooperation, public private partnerships, engaging other programmes and sectors, political stability and financial stability are presented as potential opportunities and barriers for malaria elimination. These are also important elements for system strengthening for malaria elimination (WHO 2007).

3.3.1 Regional Cooperation or initiative for malaria elimination

Regional cooperation and cross border initiatives are crucial as there is the potential risk of importation of insecticide resistant mosquito and drug resistant parasites from neighboring countries. It can cause focal malaria outbreaks if countries share a border with high malaria disease burden and poor malaria control (Maharaj et al 2013).

The purpose of the regional cooperation is to address the cross-border issues of population migration, parasite and vector movements as well as the development and spread of vector and parasite resistance within the region. It is mainly focused on the international collaboration and implementation of effective vector and parasite control interventions at a regional level.

Cross border initiatives for provinces bordering on Myanmar are in place to deliver effective preventive and curative services to those at most risk for malaria and conduction supranational meetings to inform country programmes, donors and partners on progress made and to strengthen regional linkage mechanisms to exchange quality, standardized, comparable data on drug quality and behavior contributing to emergence and spread of resistance.

To consolidate and improve upon national improvement, a regional approach looking beyond the national boundaries is needed. Currently there are 39 townships along the borders of Myanmar. The six member countries of the

Greater Mekong sub-region consolidate efforts in reducing malaria morbidity and mortality in the region (WHO 2010).

Moreover the Global Fund has pledged 100 million US$ for three years starting from 2014 to 2016 for all GMS countries as the Regional Artemisinin Initiative (RAI). There is cross-border collaboration to effective control of multi-drug resistance P. falciparum among the migrant population between GMS countries (WHO 2014b).

Similar international efforts include the Lubombo Spatial Development Initiative (LSDI) is a regional cooperation between Mozambique, South Africa and Swaziland to tackle high malaria burden area in the northern part of South Africa, eastern Swaziland and southern Mozambique. After five years of LSDI strategy, malaria incidence decreased by 99% in South Africa part, 98% in Swaziland and 92% in southern Mozambique (Maharaj et al 2013). In Myanmar all the implementation is still in process and there is no evidence of measuring the impact of regional cooperation between Myanmar and neighboring countries.

3.3.2 Public private partnership (PPP)

With the objective of increasing coverage, improving the quality of care and controlling excessive health care costs to users, involvement of commercial (private-for-profit) or philanthropic (not-for–profit) organizations are important for malaria prevention and control. Public-private partnership enables countries to pool know-how and resources, and to combine the different strengths of public and private organizations (WHO 2006).

It is estimated that 60-75% of malaria cases are either self-medicated or treated in the private sector. So the contribution of the private sector in the management of malaria cannot be ignored and must be incorporated especially as the program moves towards elimination (WHO 2009).

The private sector consists of a heterogeneous group of private medical clinics, licensed and unlicensed medicine shops, indigenous herbal practitioners, pharmacists and mobile hawkers which are largely unregulated (WHO 2006).

In Myanmar, some professional associations, MMA and PSI, are also engaging private practitioners in collaboration with VBDC. They have conducted training and continuing medical education (CME) at different

states and regions concerning malaria case management to ensure good quality malaria diagnosis and treatment in the private sector.

Most private providers receive no guidance from the public sector on diagnosis and treatment but receive information from pharmaceutical companies or distributors (Kamat et al 1997).

3.3.3 Engaging other programs and sectors

The risk of malaria is linked to population mobility due to socio-economic factors, notably development project including dam construction, road construction or maintenance, mining, logging, seasonal jobs like rubber plantation work, charcoal baking, wood cutting, bamboo extraction, and security reason to new settlement. The risk is also high in international borders and thus need for inter-sectoral co-operation for effective implementation of national malaria control activities. Important elements in relation to malaria elimination are: Government, civil society, the military and the business sector (WHO 2014a).

3.3.3.1 Government

At the central level, the National Health Committee has a mandate to promote inter-sectorial collaboration and cooperation for health. At the State/Regional level and the local level, State/Regional health committees and township health committees have to ensure such cooperation and collaboration.

Collaboration between generalized and specialized government institutions at central, regional and local level is crucial for addressing enforcement and regulation. Within the health sector, Central VBDC in collaboration with the Food and Drug Administration (FDA) Department, in banning the sale of oral artesunate monotherapy (AMTs) and strengthening the regulatory capacity, action and enforcement of the ban. FDA does not intend to renew the licenses for importation and production of artesunate monotherapy. This is followed by regulatory actions and law enforcement by the local authorities. Moreover NMCP is conducting market surveys and buying drug samples and sending to FDA for quality assurance (VBDC 2010b).
According to the study conducted in 2001 (Newton et la 2001) from Cambodia, Laos, Myanmar, Thailand and Vietnam showed that although the

physical appearance of the tablets and packing look like the real one, 38% of artesunate samples did not contain artesunate. Some fake or substandard antimalaria drugs and artesunate mono drugs are still widely available in some drug stores in Myanmar (VBDC 2007, Mendis 2012).
In collaboration with the Department of Medical Research, in vivo therapeutic efficacy study (TES) were conducted in some states and regions with two ACTs recommended in the national treatment guideline in the year 2007, 2009 and 2010 (NMCP-WHO 2011).

Outside the health sector, the Ministry of Forestry collaborates with the Ministry of Health at different levels in training of CHW in health education, ITN activities, LLIN distribution, malaria diagnosis, and treatment with ACT in some strategic and high risk areas. For epidemic preparedness, VBDC teams also work closely with the Ministry of Construction mainly focusing on case finding and management, IRS and chemoprophylaxis in some projects. NMCP also collaborates with the Ministry of Education providing malaria in the school curriculum and to ensure mobilization of students in malaria prevention and control activities.

As mentioned in the introduction, other ministries like the Ministry of Defense, Railways, Mines, Industry, Energy, Home and Transport are also providing healthcare for their employers and their families but there is no integration or engagement in malaria control activities.

3.3.3.2 Business/corporate sector

Malaria reduces productivity, increases employee absenteeism, increases health care spending and has a negative impact on business and also diminishes public health budgets because the overall labor force is weakened by sickness and absenteeism, investments and tax revenues are reduced. Investing in malaria control in three private companies in Zambia showed remarkable progress in malaria incidence which dropped by 94% in a 10 year period (Roll Back Malaria 2010).

Some **commercial sectors** like Yuzana Company Ltd. has palm oil, rubber plantation and prawn breeding operations in the Tanintharyi region of Myanmar and is also involved in malaria control through its partnership with CAPM. This company provides fixed and mobile clinics for more than 50,000 mobile workers. The clinics provide diagnostics and treatment of malaria,

on-job training and monitor malaria in migrant populations leaving the company through check points (Herve 2013).

Another development actor in the Tanintharyi region is Dawei Development Company limited which is building a deep sea port facility and a petrochemical complex and which brought in over 50,000 migrant workers from other parts of Myanmar and Thailand. CAP-malaria is conducting malaria prevention and treatment through distribution of long lasting bednets, and providing fixed and mobile clinics to diagnose and treat cases in remote worksites (Kheang 2012).

3.3.3.3 Civil society

Myanmar NMCP has partnerships with international organizations, INGOs, national NGOs and national civil society partners in early diagnosis and appropriate treatment of malaria through mobile clinics to extend the malaria control interventions to remote areas. The main activities were led by NMCP and technically supported by UN agencies and financially supported by donor communities and complemented by the work of implementing partners. At the community level, FBOs, MCC and MMCWA assist in malaria prevention and control activities including health education on ITNs, LLIN distribution and patient referral.

Although township medical officers from township health departments are responsible for all public health services including malaria, their efforts are largely focused on hospital administration and curative services with little attention being paid to disease prevention. As a result, there is inadequate coordination of the activities among multiple implementing partners (INGOs and local NGOs) which lead to duplication of and gaps in malaria prevention and management in terms of area and activities including volunteer recruitment process (Mendis 2012).

3.3.3.4 Military: Since soldiers and police forces are often exposed to fatal malaria during missions in the forest, the full cooperation of military health services is crucial for malaria elimination. Apart from a therapeutic efficacy study there is no document found regarding partnership in malaria prevention and case management.

3.3.4 Political stability

Myanmar has become a democracy after half a century of military dictatorship and just three years of tentative reform. Although ceasefires have been signed in most of the ethnic conflicts, a comprehensive peace deal remains a distant dream. Fighting between government forces and most ethnic armed groups in Northern Kachin State, Kachin Independence Army (KIA) and Eastern Myanmar have continued. There are approximately 90,000 internally displaced Kachin who are inaccessible to UN humanitarian assistance and over 400,000 due to decades of conflict in Eastern Myanmar (Human right watch 2013).

In June 2012, sectarian violence between Rakhine Buddhists and Rohingya Muslims erupted in Rakhine state resulting in the displacement of 100,000 people. This sectarian violence broke out again in 17 townships of nine states in October with the displacement of 35,000 additional people. Though media freedom improved in 2012, it is still highly restricted and especially those articles related to corruption, illicit drugs, forced labor, child soldiers and critical of the government are restricted (Human right watch 2013).

3.3.5 Financial stability

Long term predictable and sustainable funding is vital for the malaria elimination programme to cover planned and unexpected expenses (WHO 2007, WHO 2008).

Figure 20 Financing to NMCP

Source: world malaria report 2013.

There is low government contribution in malaria intervention and the Myanmar NMCP is heavily dependent on donor support as mentioned in the figure above. In the immediate term, such funding support is an opportunity which malaria control programme is benefiting from and programme implementation is enhanced. However, the sustainability of malaria control programme achievements in the long run is dependent on government funding commitment to the programme. These external funds are managed by the principal recipient, UNOPS and there is no direct support to the government health system (Mendis et al 2012).

Chapter 4: Discussion

This chapter discusses and analyses the findings of the previous chapter to identify the priority problems to address for improving the national malaria control programme intervention in order to achieve the ultimate goal of malaria elimination.

4.1. ITNs programme still needs to achieve universal coverage of the global and national target.

IRS and ITNs remain the frontline interventions for malaria vector control but there are many factors contributing to universal coverage and effective utilization of ITN. IRS should be complemented with ITNs/LLINs for malaria elimination. Currently, malaria transmission reduction in Myanmar relies solely on ITNs/LLINs. If the universal coverage has been achieved, equity in access and use of ITNs among different population will be attained. When there are disparities in persons protected by ITNs, it is important to identify which populations benefit from intervention and which do not.

Currently low ownership and utilization of ITNs especially among the highest risk groups is a major contributing factor for the high burden of malaria especially in border areas. The major barrier to utilization is due to limited accessibility, availability and low affordability in non-project townships. The author has not found any financial risk protection mechanism to prevent catastrophic health expenditure for the poor in Myanmar. To be effective, pro-poor strategies need to be in place. Also there is a lack of prevention strategy for outdoor transmission for specific risk groups like rubber tappers who work outside during the peak biting time of mosquitoes and early biters in Rakhine State. The strategy for replacement of torn nets is also lacking and thus a replenishment strategy of worn out nets should be considered. Another important thing is that mosquitoes can adhere to bednets after six months of usage according to one survey respondent. This indicates that durability of bednets should be tested and BCC on washing practice also need to be conducted. Although operational research has been acknowledged as a necessity for effective malaria control programme, very few studies have been conducted on insecticide persistence on distributed

LLIN. Insecticide resistance should be tested at least once a year in some sentinel site if LLIN and IRS are the main vector control (WHO 2013c).

Although the global target of the universal coverage and the national target of achieving 80% coverage is required, protection of high risk groups including migrant workers for either political reason or socio-economic reasons, new settlements in endemic areas and ethnic minorities are lacking. A new innovative approach and intervention should be carried out for these specific groups.

The wide gap between bednet ownership and utilization is a serious matter to handle in order to achieve effective utilization of bednets. Effective BCC can address this gap and can also solve the problems of misuse and failure to bringing bednets to forest-related risk areas and misconceptions about the benefit of bednets. The need to purchase the bednets can hinder bednet ownership and utilization rates and therefore increase the malaria disease burden. Bednets should be a public good and distributed free of charge in collaboration with implementing partners.

Also current bednet surveys should include the assessment of the correct hanging method of bednets by asking the participant to demonstrate it. Though people own and utilize their bednets, if the hanging method is not correct, human vector contact cannot be prevented. Change of vector behavior and insecticide resistance is a serious matter and highlights the programme to do more research in order to get more evidence based effective tools.

Bednet coverage can be enhanced by engaging the private sector, community involvement and integration with other programs and other health services provided by ministries including the military. However, current rapid scale-up in treatment of conventional nets and distribution of LLINs by multiple partners including private sectors are fragmented and mosaic in coverage and duplication of activities due to inadequate coordination at the implementation level. Again current political instability is an issue for bednet distribution especially to migrant groups including internally displaced people and ethnic minorities in border areas.

Moreover to achieve the global and national target of the ITN programme, continuous and sustainable supply of LLINs, human resource and infrastructure including a reliable supply system management are essential.

But currently there is a severe shortage of workforce for effective implementation of malaria interventions and most importantly the lower level has little decision room for human resource management. In addition all malaria commodities for prevention and case management are donor dependent and donor driven activities. There is no direct contribution of donor funds to the government and no clearly articulated political commitment for sustainable funding for malaria elimination. Though external funding seems to be a large amount, it just covers about 80% of malaria commodities mainly focusing on case management and insecticide treated nets while the remaining small proportion are using in capacity development and rarely used in infrastructure development and disease surveillance systems. If the current external funding stops, there will be a serious funding crisis in Myanmar.

4.2. To achieve the objective of testing every suspected malaria cases, treating every confirmed cases and getting treatment within 24 hours after getting signs and symptoms of malaria is still a challenge for Myanmar.

The high mortality rates attributed to delayed diagnosis and treatment can lead to increase gametocyte, thereby contributing to a higher transmission potential. Achieving these objectives depend on correct knowledge of malaria signs and symptoms, early treatment seeking behavior with qualified medicine and access to health services. As mentioned in the findings section only a small percentage of malaria cases have access to public health facilities. Inadequate knowledge of the cause of malaria, prevention methods and improper treatment behavior and misconception indicate ineffective IEC programmes and poor health care coverage.

In case finding activities some health facilities are still practicing clinically suspected malaria treatment which is inappropriate for an elimination programme and should be replaced by confirmatory test (Feachem 2009b).

The program should test all fever cases in all areas where resources are available which is necessary for malaria elimination and RDT are provided down to community level. But variability in test quality may occur if it is of poor manufacture or exposed to high temperatures during transport and storage. Most of the central part of Myanmar has high temperatures especially during the summer season. This can cause false positives and false negatives and thus contribute to over-reporting and under-reporting of

malaria cases. Current cooler box distribution should give priority to central parts of Myanmar based on equity basis. Although minilabs were provided in states/regions level for quality control of fake drugs, most of the VBDC staff have inadequate capacity to perform this activity and there is low or even no utilization of minilabs in my observation. The resource persons for minilabs need additional training to deliver their services.

The national level ABER for Myanmar is only 2.54 and API is only valid if the ABER exceeds 10% during the Global malaria eradication era and during an elimination phase this should be higher than 10%. Some area have low ABER and high TPR and this could be due to poor coverage of existing public health facilities (malaria consortium 2013a).

For malaria elimination, the drug policy should change to radical treatment of P.vivax and gametocyte treatment for P.falciparum is recommended by WHO. Myanmar has already revised and practiced this treatment since 2010 so there is no policy gap in the treatment guideline. Most countries target P.falciparium first for malaria elimination as P.vivax needs a long treatment regime of 14 days which could challenge drug compliance (WHO 2008).

There is no information available to ensure patient drug compliant to first line drugs in Myanmar. As Myanmar has already suffered from ACTs resistance problems the underlying causes may not only be artesunate monotherapy but also fake or substandard drugs. Non-adherence to the full six-dose course can also create drug resistance. Therefore we also need to consider conducting this kind of survey in Myanmar to find out other root causes of drug resistance.

According to study results of Thailand, the prevalence of G6PD is high in the Myanmarese population residing in Thailand and there is no available information about the prevalence of G6PD deficiency in Myanmar. Primaquine has been used in treatment of both P. falciparum and P. vivax which can cause severe haemolysis especially in G6PD deficient population.

The private sectors and NGO clinics play a vital role in malaria diagnosis and case management as they are the first contact for the majority of fever cases. Training on malaria diagnosis and case management should involve them to ensure good quality malaria diagnosis by using recommended RDTs and effective treatment with ACT according to national guidelines.

Failure to adhere to malaria treatment guidelines may be due to drug stock out, lack of training of lower level health workers on malaria case management and unavailability of the treatment guidelines in health facilities. The supply system management of the health system has to make sure there is no stock out of first line antimalaria drugs at any health facilities. Training should be conducted if necessary and guidelines should be provided to all health facilities.

The widely availability of artesunate monotherapy, fake and substandard indicate poorly a regulated drug control system and it can fuel the current drug resistance problem. Therefore a current market survey, banning and regulation of legislation for licensing of mono drugs should be strengthened in collaboration with the FDA.

4.3. To achieve case based Surveillance system for malaria elimination

It is widely accepted that case-based and evidence-based systems are appropriate to support a malaria elimination phase (WHO 2007). In Myanmar because of high and moderate transmission (parasite prevalence rate (2-9year) >10%), individual case-based surveillance cannot be carried out. Instead the NMCP relies on routine reporting systems and the use of aggregate data from health facilities of different levels. It is also integrated to wider HMIS and disease surveillance system.

Evidence from one assessment report indicates that peripheral level BHS and volunteers are quite capable of generating high quality data required for an effective case-based system. In place of monthly Excel spreadsheet reporting an innovative tool like a database system should be considered. Moreover real time reporting is another important prerequisite for rapid response to each case. Real-time reporting requires innovative tools and also technical capacity with adequate human resources is needed to make this system work effectively. For instance a new tool being successfully practiced in Cambodia is e-health through web/email and m-health through mobile phone to get real time data to facilitate immediate action which should be adopted as the Internet is widely available in most of the area down to township level and mobile phone down to village level in Myanmar.

It is useful to get real-time data about individual patients with day 3 positive results and stock levels of antimalaria drugs at health facilities level and the private sector can refer malaria cases through SMS technology (Malaria consortium 2013b). Current NMCP Data is only representing government health facilities. It does not capture malaria cases from private nor NGOs and those ministries who provide health care services. There is neither the incentive nor proper instruction or channel for them to send data to the public sector. It is therefore the malaria cases in WHO reports that contribute to the estimated annually based on average slide positivity rate of 35%. This can be an over or underestimate of malaria cases in Myanmar. A census of private health care providers should be listed and integration of private health facilities into the national malaria surveillance system is essential for malaria elimination. Moreover regional cooperation and community involvement are also important elements for completeness and timeliness of surveillance data.

For malaria elimination, the official HMIS system is not sufficient to cover the needed data and the development of the disease specific case based surveillance system with its own database is essential. Surveillance systems need to develop new tools and strategies that will replace passive surveillance of morbidity with active and prompt detection of infection including confirmation of interruption of transmission by detecting present and past infections, particularly in mobile populations.

4.4 Limitations of the study

This study has some limitations. Firstly, within the limited time available, the search on the source was not exhaustive. Secondly, there is limited literature on malaria control programme and particularly on drug compliance, adherence to treatment guidelines among the health care providers, supply system management, coordination and partnership. Some of the information is based on my observation during supervision and monitoring.

Lastly the data for this thesis were collected through the routine NMCP reporting system and the HMIS system which represent government health facilities only. Most of the Myanmar VBDC reports and presentations are unpublished and grey literatures.

Chapter 5: Conclusions

The malaria morbidity and mortality has declined remarkably over the last decade due to extensive malaria prevention and improved case management effort making some malaria risk areas meet the pre-elimination phase of WHO's malaria elimination continuum, while some areas are still in the control phase. Despite the remarkable achievements, Myanmar NMCP still faces a wide range of constraints which impede the path towards malaria elimination in the country.

Major constraints are: little decision space on human resource management in implementation level, poor healthcare coverage especially among migrant populations and ethnic groups, political instability, donor dependent and donor driven activities, no direct external funding support to the government, only small proportion of financial resources were used in disease surveillance, human resource development and infrastructure development.

Moreover there is no clearly articulated political commitment for malaria elimination, inadequate coordination among implementing partners at the implementation level, and inefficient database systems to include private sector, I/NGOs and other health providing ministries. There is no strategy for outdoor transmission, poor knowledge of malaria prevention and treatment, poor health seeking behavior and poorly regulated drug control system. There is lack of operational research on the prevalence of G6PD deficiency and also drug compliance.

However regional and international cooperation, external funding, public private partnership, community involvement and engagement of other sectors are potential opportunities and strengths for malaria elimination in Myanmar. Overall it is worthwhile to invest in this elimination programme as it is directly contributed to six MDGs: MDG 1 (eradicate poverty), MDG 2 (achieve universal primary education), MDG 4 (reduce child mortality), MDG 5 (improve maternal health), MDG 6 (combat HIV/AIDS, malaria and other diseases) and MDG 8 (Develop a global partnership for development). Taking all these factors into consideration and a feasibility assessment of financial, technical and operational capacities, Myanmar can start the malaria elimination process specifically targeting P. falciparum first as a pilot project in some townships which have already met the elimination criteria.

Chapter 6: Recommendations

The following recommendations are made based on feasibility, equity and ethical consideration.

1. Policy recommendations
   Malaria elimination policy should be initiated by the government with full political commitment. The elimination programme should be piloted from the townships that have already met the WHO criteria.

2. Intervention recommendations
   2.1 To achieve the global and national target of the ITNs programme, the following points are recommended to the NMCP.
   - The intense and sustained promotion of ITNs should be done to create demand, stimulate supply, and promote ownership and appropriate usage through media, franchising method and BCC approach in cooperation with the private sector.
   - Ensuring affordability by the poor can enhance bednet utilization especially in non-project areas so the planning process should include pro-poor population either through a subsidized programme or a voucher system.
   - Replenish strategy to replace torn bednets.
   - Regular mass distribution of bed nets should be every three years to ensure the coverage.
   - ITN programs should integrate with the maternal and child health programme and delivery of ITNs during antenatal care visit will be an effective measure to cover the vulnerable group of under-five children and pregnant women.
   - Engaging other related ministries and commercial sectors for tracing of migrant groups, ethnic minorities and new settlement areas is needed.

   2.2 For outdoor transmission the following is recommended.
   - Distribution of repellent combined with ITN should be considered.
   - Entomological information concerning resting and biting behavior of the vector is essential before ITNs are deployed.

   2.3 The NMCP needs to create a strong IEC/BCC unit in cooperation with the Health Education department of the MoH and

involvement of all implementing partners to achieve a uniform intervention approach.

2.4 To ensure that all cases are microscopically confirmed, the following points are recommended to NMCP, NHL and DOH.

- Current vacant microscopist posts should be filled and current human resource management should give more decision room to the implementation level.
- Existing microscopist training should be strengthened not only in detection of parasites but they also need to be trained them in effective maintenance and minor repair of microscopes in order to reduce the number of non-functioning microscopes.
- Quality assurance activities like cross-checking of examined slides, giving feedback of the results, and more supportive supervision should be strengthened. Referrence facilities for quality assurance of microscopy and RDT are needed.

2.5 To strengthen the drug regulatory committee at all levels.

- Carrot and stick synergy in Public Private Partnership which is being practiced in Thailand should be adopted. The carrot is a strategy of providing or subsidizing of supplies to the private sector to deliver malaria services and the stick means MoH should deliver official letters of banning of AMT. Police force should conduct regular visits to private sectors and drug stores to identify and investigate counterfeit anti-malarias and enforce ban on oral AMT.
- Mystery clients should be used to check AMT in private and drug stores.
- Importation of AMT, fake/substandard antimalaria at border check points should be strengthened.

2.6 NMCP Myanmar should develop a solid demographic database system.

- Private sectors, I/NGOs and other health care providing ministries need to be included to get a complete data.
- For real time reporting, cell phone (m-Health) or real-time internet web-based (e-Health) reporting from individual cases and the private sectors are needed.

2.7 NMCP should strengthen the local level coordination by involving TMOs and other implementing partners for effective utilization of resources.

3 Research recommendations to the Department of Medical Research:

- Research should be conducted regarding Glucose - 6 -phosphate dehydrogenates (G6 PD) prevalence especially in high endemic areas.
- Study should be conducted on treatment adherence for uncomplicated malaria.
- KAP study on malaria prevention and case management.

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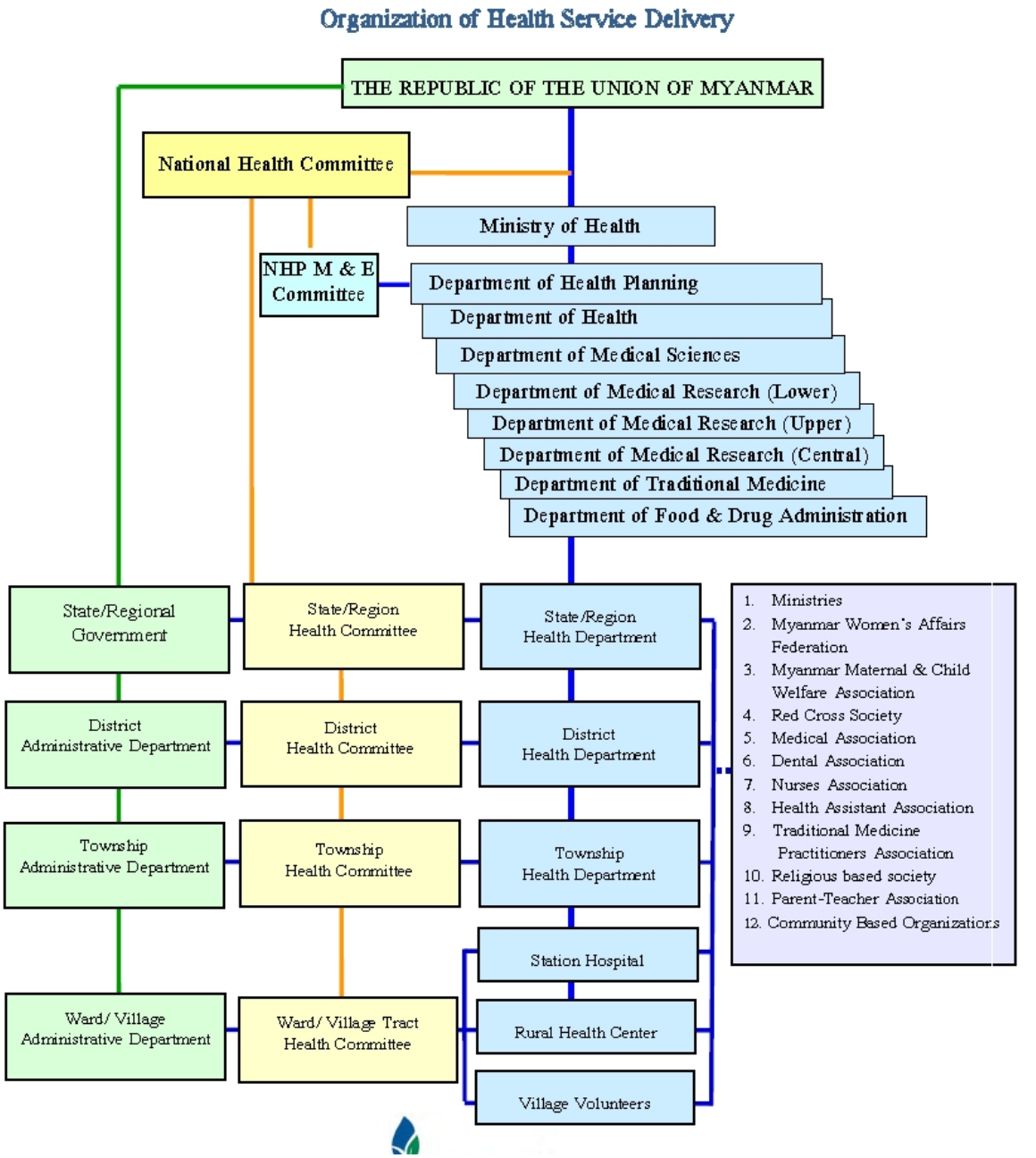
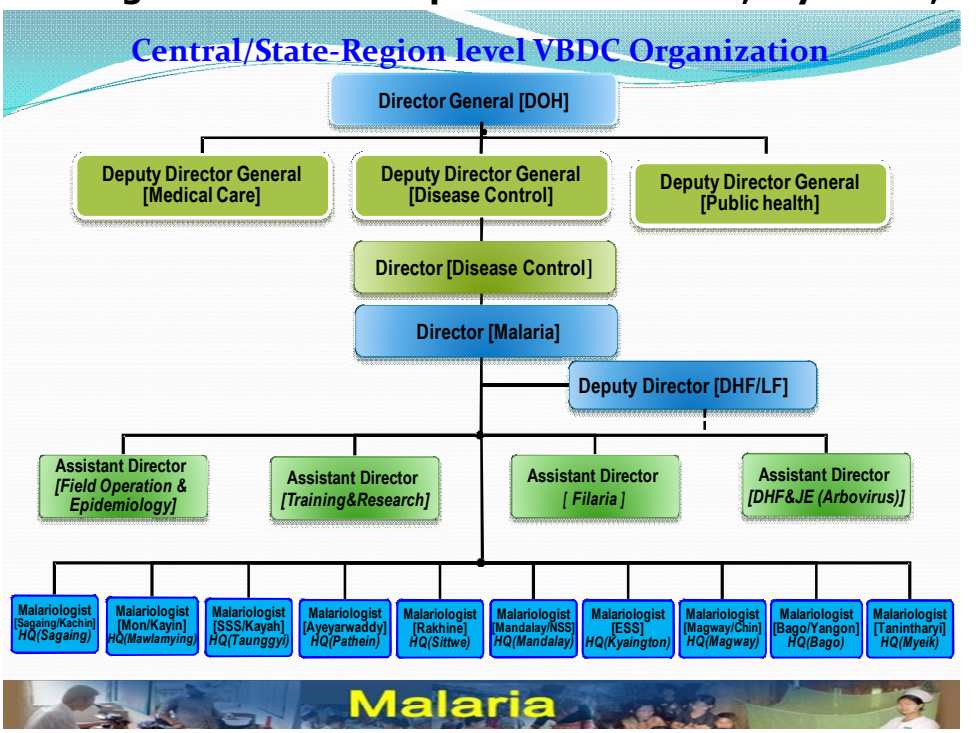
Annexes

Annex1: Organizational set up and staffing pattern



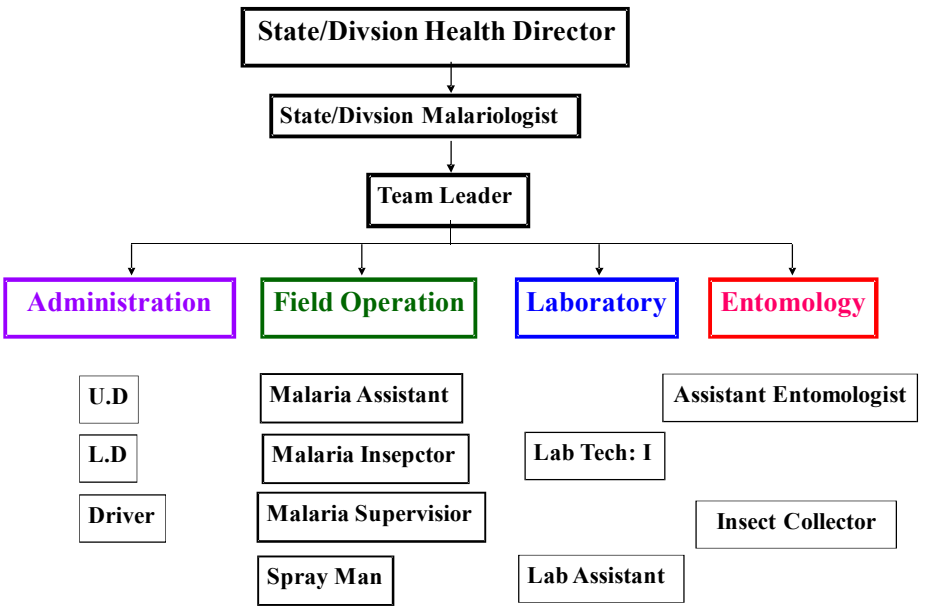
Source: Health in Myanmar 2013

Annex 2: Organizational setup of central VBDC, Myanmar, 2012



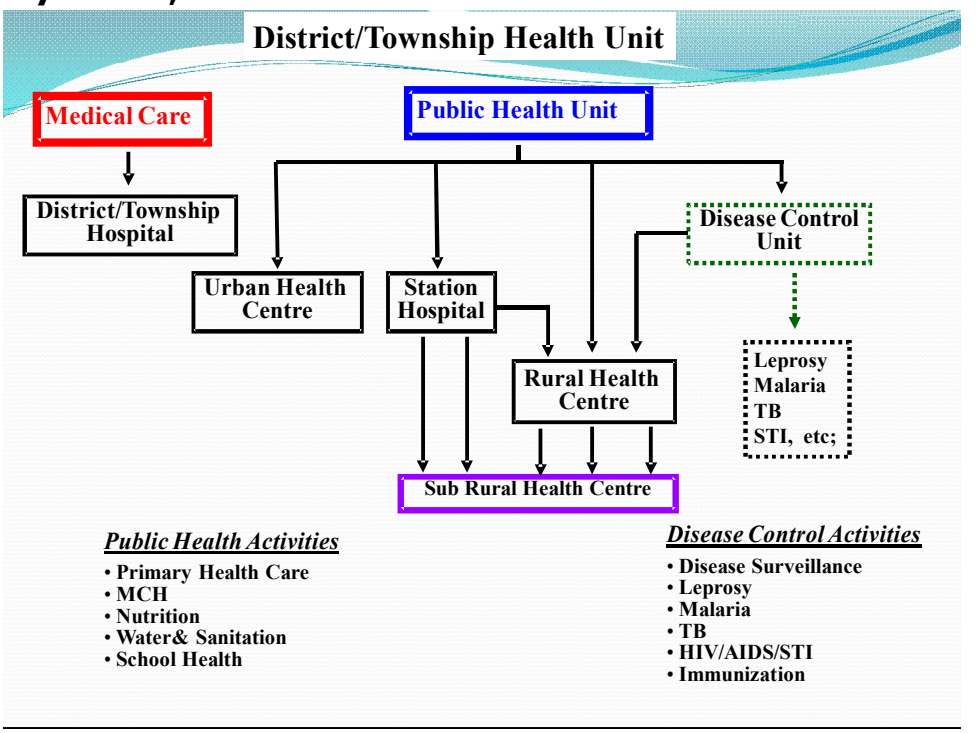
Source: Central VBDC, MoH, Myanmar

Annex 3. Organizational set up of State/ Region VBDC, Myanmar,2012



Source: Central VBDC, MoH, Myanmar

Annex 4. Organizational set up of District/ Township VBDC, Myanmar,2012



Source: Central VBDC, MoH, Myanmar

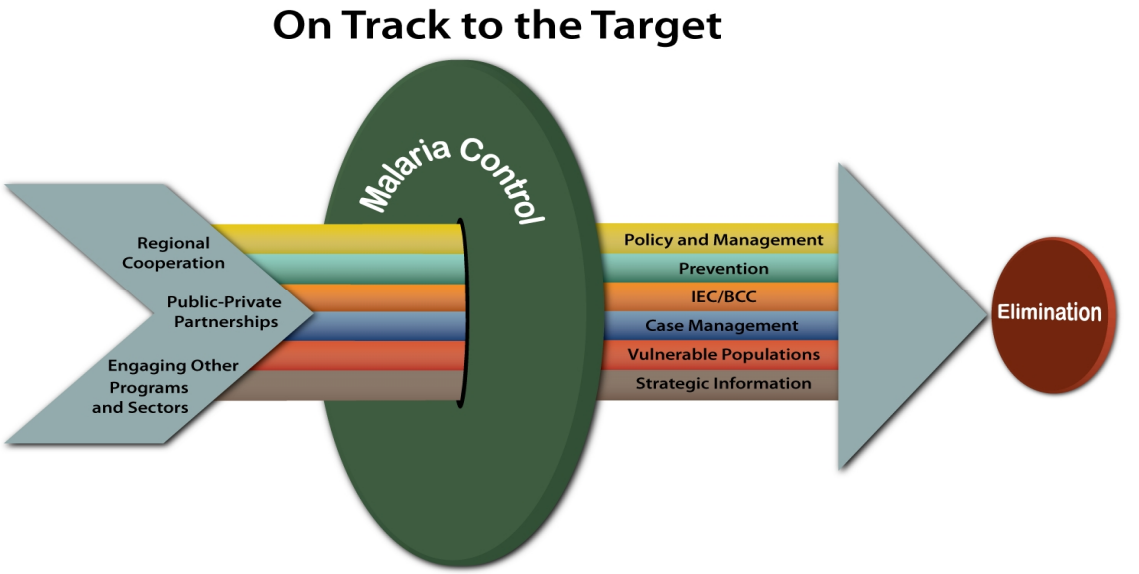
Annex 5. Manpower of VBDC staff, Ministry of Health,Myanmar 2011

SN	Designation	Central	State/Region	Township	Total
1	Deputy Director	1	-	-	1
2	Malariologist	4	9	-	13
3	Senior Entomologist	1	-	-	1
4	Senior Medical Officer	2	-	-	2
5	Administrative officer	1	-	-	1
6	Medical Officer	4	12	-	16
7	Statistician	1	-	-	1
8	Entomologist	6	1	-	7
9	Field operational officer	1	-	-	1
10	Medical technologist	2	-	-	2
11	Branch clerk	1	-	-	1
12	Assistant Statistician	2			2
13	Sub assistant Engineer	1	-	-	1
14	Assistant Entomologist	4	15	-	19
15	Malaria Assistant	3	22	25	50
16	Senior technician	1	-	-	1
17	Health Assistant	1	-	-	1
18	UD clerk (Account)	4	8	-	12
19	Store clerk	2	4	-	6
20	Technician Grade 1	11	34	-	45
21	Malaria Inspector	2	22	-	24
22	Mosquito Inspector	4	-	-	4
23	Upper division clerk	5	-	-	5
24	Entomology. technician	2	-	-	2
25	Lower division (Account)	-	2	-	2
26	Entomology Assistant	3	5	-	8
27	Technician Grade II	8	-	-	8

28	Mosquito Dissector	1	-	-	1
29	Microscopic	1	-	-	1
30	Lower division clerk	5	10	-	15
31	Typist	4	3	-	7
32	Insect collector	11	35	-	46
33	Malaria supervisor	2	46	517	565
34	Sprayman (permanent)	16	84	350	450
35	Spreayman (Temporary)	22	-	780	802
36	Others	85	102	-	187
Total		224	414	1754	2392

Source: VBDC, MoH 2011

Annex 6: Original framework



Source: Malaria Control and Elimination in the Greater Mekong Sub-region

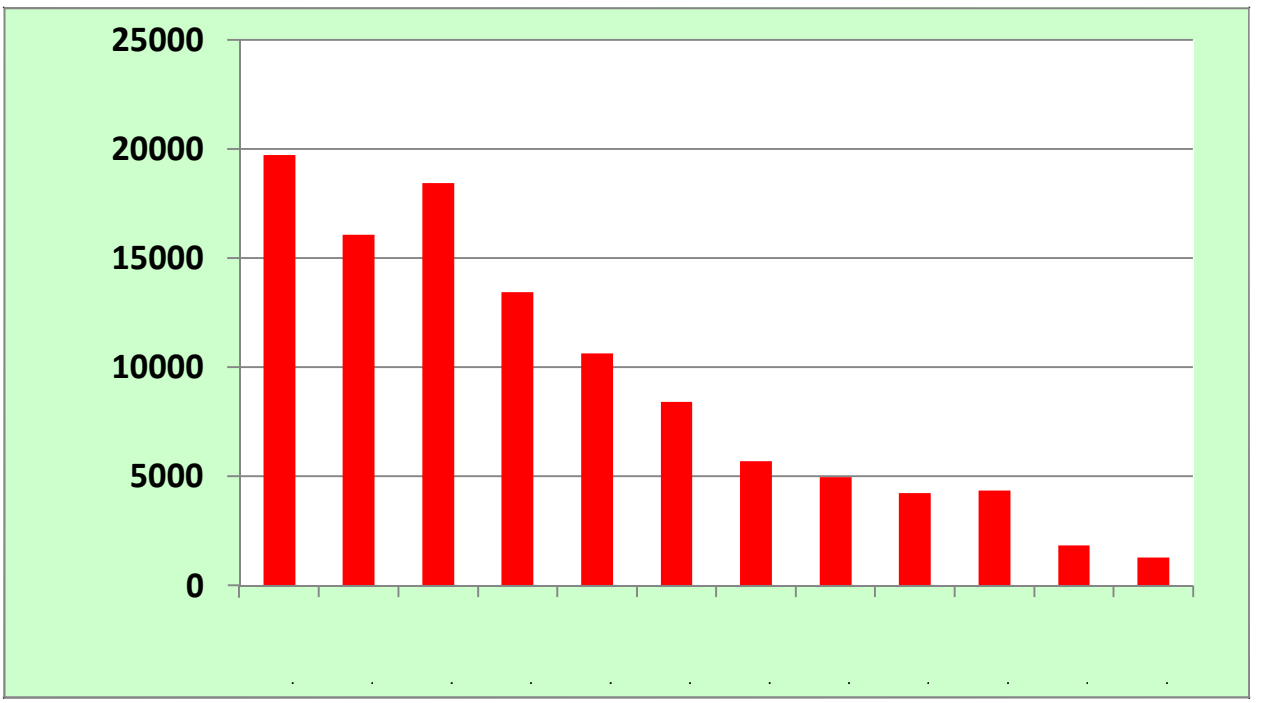
Annex 7: National policy for treatment of malaria in Myanmar

The national malaria treatment policy was based on the following principle.

a. P.falciparum malaria cases should be treated with recommended ACTs.
b. A single dose of primaquine (0.75 mg/kg) is added to the ACT as a gametocide on third day of treatment in the treatment of P.falciparum in 2011.
c. P.vivax and P.ovale , cases are treated with chloroquine for 3 days and primaquine for 14 days to prevent relapse. An eight week dosage of primaquine is preferred in order to reduce the risk of intravascular haemolysis in G-6-PD deficiency patients.
d. For P.malariae, chloroquine for three days is recommended.
e. For mixed infection, either of the three ACT for P.falciparum plus a full course of primaquine for P.vivax is recommended.
f. Malaria during pregnancy is treated with quinine plus clindamycin in the first trismeter, and ACTs in the second and third trimester.
g. Parenteral artesunate was adopted as first choice for treatment of severe and complicated malaria and pre-referral treatment. Injection quinine and artemeter are also used in severe cases. (National Malaria Treatment Policy 2008).
h. Diagnosis and treatment of malaria is free in the public sector.
i. Given resources constraints, the priority is to deploy RDTs and ACTs in townships with the highest malaria burden.

Annex 8

Figure 17: Malaria incidence trend of Eastern Shan State (2001-2012)



Source: state VBDC annual presentation, Eastern Shan State, 2012.