ACCELERATE MALARIA CONTROL PROGRAM IMPLEMENTATION IN ETHIOPIA; STRENGTHS AND WEAKNESSES

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

by

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ETHIOPIA

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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 **'Accelerate malaria control program implementation in Ethiopia; strengths and weaknesses'** is my own work.

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LIST OF ABBREVATIONS

ACT	Artemisinin-based Combination Therapy
API	Annual Parasite Incidence
CSA	Central Statistical Agency
DDT	Dichloro-diphenyl-trichloroethane
DPCD	Diseases Prevention and Control Directorate
EDHS	Ethiopian Demographic and Health Survey
EPHI	Ethiopian Public Health Institute
GCAO	Government Communication Affairs Office
GDP	Gross Domestic Product
GGHE	General Government Health Expenditure
HC	Health Centre
HDI	Human Development Index
HEP	Health Extension Program
HEWs	Health Extension Workers
HMIS	Health Management and Information System
HP	Health Posts
HSDP	Health Sector Development Plan
IEC/BCC	Information Education Communication/Behaviour Change Communication
IMR	Infant Mortality Rate
IPT	Intermittent Preventive Treatment
IRS	Indoor Residual Spray
ITNs	Insecticide Treated Nets
IVM	Integrated Vector Management
KAP	Knowledge Attitude and Practice
LLINs	Long Lasting Insecticidal Nets
LSM	Larval Source Management
MCST	Malaria Control Support Team
MDGs	Millennium Development Goals
MIS	Malaria Indicator Survey
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
MoLSA	Ministry of Labour and Social Affairs
NGOs	Non-Government Organizations
NHA	National Health Account
NMA	National Metrology Agency
NMCP	National Malaria Control Program
NSP	National Strategic Plan
PHC	Primary Health Care
PHCU	Primary Health Care Unit
PHEM	Public Health Emergency Management
PMI	President's Malaria Initiative
RBM	Roll Back Malaria
RDTs	Rapid Diagnostic Tests
SNNPR	Southern Nation Nationalities and peoples Region
SUFI	Scale-up for impact
THE	Total Health Expenditure
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

GLOSSARY

- **Indoor residual spraying** is an operational procedure and strategy for malaria vector control involving spraying interior surfaces of dwellings with a residual insecticide to kill or repel endophilic mosquitoes.
- **Insecticide resistance** is the ability of mosquitoes to survive exposure to a standard dose of insecticide; it may be the result of physiological or behavioural adaptation.
- **Insecticide treated net** is a net (usually a bed net) designed to block mosquitoes physically that has been treated with safe, residual insecticide for the purpose of killing and repelling mosquitoes which carry malaria. It is a light weight fabric made of cotton, silk, polyester (nylon) or other material impregnated with insecticide, having openings too small to allow entry of mosquitoes or other insects, there by offering protection from malaria and other vector-borne diseases.
- **Integrated Vector Management (IVM)** is a rational decision making process for the optimal use of resources for vector control. It aims to improve efficacy, cost effectiveness, ecological soundness, and sustainability of vector control interventions for control of vector borne diseases.
- **Intermittent preventive treatment in pregnancy (IPTp):** A full therapeutic course of anti-malarial drugs given to pregnant women at routine prenatal visits regardless of whether the woman is infected with malaria.
- **Larval source management** is management of aquatic habitats (water bodies) that are potential habitats for mosquito larvae in order to prevent complete development of immature stages. The four types of larval source management are: *source modification*, *source manipulation*, *larviciding*, and *biological control.*
- **Long-lasting insecticidal net:** A factory-treated mosquito net made of material into which insecticide is incorporated or bound around the fibres. It must retain its effective biological activity for at least 20 WHO standard washes under laboratory conditions and for three years of recommended use under field conditions.

(Source: WHO malaria terminology, 2016(b))

ABSTRACT

Background: Malaria remains a major public health problem in Ethiopia. About 60% of the population is at risk of malaria infections. More than 70% of malaria cases are due to *P. falciparium* while *p. vivax* also causes a significant number of illnesses. Ethiopia's malaria control program dates from the early 1950's. Despite the progress to date, the program will need to accelerate its impact in order to achieve its goals.

Objective: To describe and analyse factors influencing the implementation of malaria control program interventions in Ethiopia in order to formulate recommendations for program managers and policy makers to improve program performance.

Methodology: A review of literature of malaria that is available through internet search using 'search words' was done. An adapted RBM framework was used to describe and analyze malaria control interventions.

Findings: Findings show gaps in all critical areas of malaria interventions. The main challenges that need priority are poor program management and implementations; lack of strategic prioritization and stratification of different malaria interventions according to epidemiological risk strata, lack of skilled human resources; low LLINs coverage and utilization; low capacity to implement IVM; insufficient malaria diagnosis and treatment and a need to address seasonal migrant farm workers.

Conclusion: The malaria control program has limited technical oversight and guidance, lacks coordination, and information flow for local and national actions. It needs strong commitment and support to increase the coverage and utilization the main interventions.

It is therefore recommended to establish a system of accountability with malaria systems support, prioritize high risk areas in line with malaria risk stratification, train program focal persons and HEWs, strengthen LLINs free distribution and involve private sectors, target planning and strengthen sentinel sites for IRS, build capacity on confirmatory diagnosis, and present anti-malaria commodities.

Key words: Ethiopia, malaria, control program, implementation

Word count: 13,183

INTRODUCTION

I have worked for the Ministry of Health (MoH) of Ethiopia at the Diseases Prevention and Control Directorate (DPCD) of the National Malaria Control Program (NMCP) as malaria control program officer for almost three years. I am a graduate of Health Education and Promotion profession and also have experience during my work in the Pastoralist Health Promotion and Diseases Prevention Directorate (PHPDP) of MoH on the malaria program. My work with NMCP has given me an opportunity to work on regional, zonal and district malaria control program implementations and to visit community based health posts and households to monitor the implementation of malaria prevention and control interventions. This opportunity enables me to witness the success and challenges of the malaria control program.

Malaria is a life-threatening vector borne disease that is transmitted to humans by the bite of an infected *Anopheles* mosquito (Mitikie et al, 2005). It is a global public health problem which affects an estimated 150 to 303 million cases every year. The majority (90%) of malaria deaths occur in sub-Saharan Africa and children aged under five years account for 78% of all malaria deaths (WHO, 2014(b)). As in many sub-Saharan Africa countries, malaria has remained a major public health problem for many decades in Ethiopia. Ethiopia is the second most populous country in Africa and about 60% of its total population live in malaria risk areas. Both *plasmodium falciparum (PF)* and *plasmodium vivax (PV)* are prevalent parasites. PF is a leading cause of outpatient visits, hospitalizations and deaths in the country (MoH, 2014(b)).

Ethiopia shifted into a malaria control strategy after a global malaria eradication programme became infeasible in the country. Since 2005 the MoH of Ethiopia has embarked on a scale-up for impact (SUFI) of malaria control interventions (MoH, 2006). As a result of SUFI, malaria admissions and deaths among children under five declined by 81% and 73% respectively between 2001 and 2011 in areas below 2000 meter compared to the level predicted by pre-intervention years (Aregawi et al., 2014). However, major malaria control interventions like Long Lasting Insecticidal Nets (LLINs) and Indoor Residual Spray (IRS) coverage and utilization is still low.

Recently, the MoH has endorsed new National Malaria Control Strategic Plan (NSP) 2014-2020 (MoH, 2014(c)). The key targets of this NSP are to reduce malaria cases by 75% from the baseline in 2013; to achieve malaria elimination within specific geographical areas with historically low malaria transmission (i.e., highlands and arid areas) and to reach near zero malaria deaths (one death per 100,000 population at risk) in the remaining malaria-prone areas of the country by 2020 (MoH, 2014(c)). The main strategies of the National Malaria Strategic Plan (NSP) 2014-2020 are:

- Community empowerment and mobilization
- Early diagnosis and case management of confirmed malaria cases
- Selective vector control (LLINs, IRS, Larval control)
- Elimination of malaria in low transmission areas
- Surveillance and response
- Monitoring and Evaluation
- Program Management

It is important to analyse factors influencing the effective implementation of the NMCP assuming that the strategies are the right ones to achieve the program objectives. The national targets will not be achieved with the existing trend in progress. Learning from the previous implementation challenges of the control strategies and from the current ones, it is crucial to identify and address the problems in order to improve program implementation to achieve its objectives. The implementation of the malaria program is progressing slowly and the results achieved so far seem deteriorating. Apart from the ecological and metrological factors, short term and seasonal migration of large number of seasonal migrant farm workers to malaria endemic areas of the country are contributing to increased malaria risk infection (Schicker et al., 2015; Deresse et al., 2007(a)). Thus challenges influencing the program implementation are not critically examined and problems are not prioritized. Hence, the aim of this thesis is to describe and analyse factors influencing implementation of NMCP, and identify the main challenges in order to formulate recommendations for program managers and policy makers for effective implementation of malaria control program strategies.

CHAPTER ONE

1. BACKGROUND INFORMATION ON ETHIOPIA

This chapter contains background information on geography and climate conditions, demography, economy, administrative structure, health system and financing**.**

1.1 Geography and climate conditions

Ethiopia is a landlocked country located in the Horn of Africa. It is bordered by six countries: on the north by Eritrea, on the east by Djibouti and Somalia, on the south by Kenya and on the west by Sudan and South Sudan. The surface area is 1.1 million square kilometres. The topographic features range from the highest peak, Ras Dashen, 4,620 meters above sea level in the north east down to Dallol depression at 110 meters below sea level in the east. The Great East African Rift Valley divides the highlands into two: the west-northern and the south-eastern highlands. The climatic condition of the country varies with the topography. Hence, the climate type is predominantly tropical monsoon (NMA, 2013). There are three types of agro-ecological zones induced by topography and climate:

- “Kolla” or hot lowlands below approximately 1,500 meters above sea level
- “Wayna Dega” or midlands between 1500 m and 2400 m; and
- “Dega” or cool temperate highlands above 2400 m sea level

Mean annual temperature range from 10˚ (16˚C) in the “Dega”, to 16˚ (29˚C) in the “Weyna Dega”, and to 23˚ (33˚C) in the “Kolla”. In general the highlands receive more rain than the lowlands with annual rainfall ranging from 500 mm to over 2,000 mm in the highlands and from 300 mm to 700 mm in the lowlands (NMA, 2013). The topographic features and climate diversity are the most important determinant of malaria distribution across the country.

1.2 Demography

Ethiopia is a home to more than 80 nations, nationalities and peoples. Some ethnic groups vary in population from about 1,000 to 40 million persons (CSA, 2007). The total population has been estimated as 90 million in 2015 according to the projected national population census of 2007 (CSA, 2015). It is the second most populous country in Africa, having a male to female ratio of 50.2 to 49.8 with annual growth rate of 2.6%.The majority (83%) of the population live in rural areas making Ethiopia a less urbanized country. The average household size is 4.7 with a total fertility rate of 4.1 births per woman. The pyramidal age structure of the population retains young people with children under age of 15 years accounting for nearly half (45%) of the total population while those above 64 years account only for 4% (EDHS, 2014).

1.3 Economic condition

Ethiopia's economy is predominantly dependent on agriculture which accounts for almost half of the Gross Domestic Product (GDP) with 80% of exports and 80% of total employment (MoFED, 2010). The agricultural sector contribution has been related to diversification of agricultural production, expansion of small and medium scale irrigation schemes and management and utilization of natural resources (MoFED, 2010). In the last decade, Ethiopia has registered impressive economic development averaging 11% per annum (MoFED, 2010). However, according to the report of Ministry of Labour and Social Affairs (MoLSA), the national unemployment rate was 4% and youth unemployment rate was 5.4% in 2013 (MoLSA, 2013). The proportion of population living under the poverty line was 29.2% in 2009/10 (MOFED, 2010). The general literacy rate of men aged 15-49 is higher than women (67% versus 38% respectively). Disparity of gender literacy rate is widespread across the country. Literacy is higher for urban women (69%) than rural women (29%) (CSA, 2011).

1.4 Administrative structure

After the downfall of the military regime in 1991, the Ethiopian constitution introduced in 1995 created a federal government structure (GCAO, 2015). The Federal Democratic Republic of Ethiopia is composed of nine regional states: Tigray, Afar, Amhara, Oromia, Somali, Southern Nation Nationalities and peoples region (SNNPR), Benishangul-Gumuz, Gambella and Harari regional states; and two city administration councils: Dire Dawa and Addis Ababa. The regional states and city administrations are sub-divided into zones, woredas (districts) and kebeles - the smallest administrative unit of about 5,000 people (GCAO, 2015). The geographic location and political history of the country has formed a discrepancy in health system infrastructure among regions. The semi-pastoral regional states (Afar, Somali, Gambella and Benishangul-Gumuz) health system is poor (GCAO, 2015).

1.5 Health system

Ethiopia's health policy was formulated in 1993 and has democratized and decentralized the health care system; preventive, promotive and curative components of health care are prioritized; and private sectors and Non-Governmental Organizations (NGO) participation has been encouraged (GCAO, 2015). The health service delivery is organized into three tier system mainly provided by the public sector (see annex A). (MoH, 2015(d)). These are:

- **Primary Level Health Care**: composed of Primary Health Care Units (PHCUs) and Primary hospitals. PHCUs consist of Health Centres (HCs) and five satellite Health Posts (HPs). They provide both preventive and basic curative services for up to 25,000 people. Primary hospitals serve an average of 100,000 people.
- **Secondary Level Health Care:** composed of General hospitals that provide health services for at least 1 million people.

- **Tertiary Level Health Care:** consist of specialized hospitals that serve about 3 .5 to 5 million people.

The majority of the Ethiopian population still suffers from a high rate of morbidity and mortality from communicable diseases and nutritional disorders (MoH, 2014(b)). The general health status remains poor. According to the United Nations Development Programme (UNDP) report 2013, Ethiopia's Human Development Index (HDI) was 0.435 which is in the low human development category (UNDP, 2013). About 80% of diseases (malaria, pneumonia, diarrhoea, malnutrition, neonatal problems, and HIV/AIDS) are attributable to preventable conditions that are related to personal and environmental hygiene (WHO, 2012). Major vital health indicators show the need to improve the health system (see table 1).The Infant Mortality Rate (IMR) was 59 per 1,000 and the under-five mortality rate was 88 per 1000 live births in 2011 (CSA, 2011).

Table 1 Health and health related indicators

S.N	Indicators	Achievement	Sources
1	Primary health care coverage	95%	MoH, 2014(b)
2	Life expectancy	63.6 years	CSA/EDHS, 2011
3	Total fertility rate (per woman)	4.8	CSA/EDHS, 2011
4	Under five Mortality rate (per 1,000 live births)	88	CSA/EDHS, 2011
5	Infant Mortality Rate (per 1,000 live births)	59	CSA/EDHS, 2011
6	Maternal Mortality rate (per 100,000 live births)	676	CSA/EDHS, 2011
7	Contraceptive prevalence rate (%)	29%	CSA/EDHS, 2011
8	Skilled birth attendant (%)	15%	CSA/EMDHS, 2014

1.6 Health care financing

Ethiopia's health sector financing comes from multiple sources including household out-of-pocket spending which accounts for 34% of Total Health Expenditure (THE), the government treasury (federal, regional, district and municipal levels) accounts for 16% of THE, bilateral and multilateral donors and Non-Governmental Organizations (NGOs) account for 50% of THE in 2010/11 and other private enterprises (MoH, 2014(a)). Out of pocket expenditure as percentage of private health expenditure was as high as 78% in 2014 (WHO, 2014(a)). General Government Health Expenditure (GGHE) per capita in 2014 was US $16, far less than the WHO's recommended US $34 in 2001 and revised to US $60 by 2015. The WHO National Health Account (NHA) indicators database report of Ethiopia for 2014 shows that THE is 5% of GDP while General Government Health Expenditure (GGHE) is 59% of THE (WHO, 2014(a)). Health Insurance schemes are not yet introduced in the Ethiopian health sector.

CHAPTER TWO

2. PROBLEM STATEMENT, JUSTIFICATION, OBJECTIVES, METHODOLOGY AND ANALYTICAL FRAMEWORK

This chapter contains problem identified, justification, objectives, methodology and a study framework used for the research are outlined.

2.1 Problem Statement

Malaria is an infectious disease that remains a global public health problem. According to WHO estimates, about 3.2 billion people were at risk of malaria in 2015. Globally malaria caused about 214 million new cases and the disease killed about 438,000 people in 2015 (WHO, 2015). Among the all malaria deaths an estimated 90% occur in sub-Saharan Africa. There is an on-going malaria transmission in 95 countries and territories globally (WHO, 2015). Ethiopia is one among these countries. Ethiopia is shared the highest burden of malaria infections in all ages in the East African region (WHO, 2015). An estimated 60% of the population of the country is at risk of malaria infection (MoH, 2014(c)). This evidence shows that malaria is still a leading cause of morbidity and mortality.

Malaria infection is caused by plasmodium parasites. *Plasmodium falciparum* is the most prevalent parasite which accounts for 70% while *Plasmodium vivax* accounts for 30% (MoH, 2014(b)). *Plasmodium falciparum* is lethal malaria with a case fatality rate of about 10% in hospitalized adults and up to 30% in children less than 12 years old (Mitikie et al., 2005). However, another study shows among infectious diseases malaria is a leading cause (15%) of children under five deaths (Liu et al., 2012). It has been reported that the majority of malaria deaths occur in rural Ethiopia (Deresse et al., 2007(a)).The actual number of malaria cases per year is not well known in Ethiopia. However, according to the Public Health Emergency Management (PHEM) routine surveillance report, on average more than 4.1 million annual malaria cases were reported between 2011 and 2014 (PHEM, 2014). The national malaria indicator survey (MIS) shows that the prevalence of malaria among all age groups increased from 0.9% to 1.3% between 2007 and 2011 in areas below 2000 m (EPHI, 2007 & 2011).

Malaria distribution and transmission in Ethiopia occurs with spatial, seasonal and inter-annual variation (Alemu et al., 2013). The most recent malaria stratification done in 2014 based on both Annual Parasite Incidence (API) and altitude/elevation shows that out of 545 districts classified as malaria risk areas; 157 districts are categorized as high; 287 districts are moderate, 101 districts are classified into low and the remaining districts are classified as malaria free areas (see table 2). Malaria transmission mainly occurs up to 2000 meter above sea level but can also occasionally affect areas up to 2300 meter (Alemu et al., 2013). The level of malaria risk and transmission intensity is seasonal (Alemu et al., 2013). The peak malaria incidence period is from September to December after the main rainy season from June to September while the minor

transmission period is from March to May during and after the brief rainy season from February to March covering south and south-western lowland parts of the country (MoH, 2014(c)).

Despite the efforts made to scale-up malaria prevention and control interventions, malaria continues to be a major public health problem especially for the rural people. In terms of major malaria intervention coverage, only 55.2% of households at risk of malaria have at least one mosquito net and about 64.5% of children under five slept under a net in a household that owned at least one mosquito net. In addition, only 46.6% of households were protected by IRS in the last 12 months preceding the survey (EPHI, 2011).

Ethiopia has adapted the WHO/RBM technical strategies to improve provision of prompt access to effective treatment, selective vector control (IRS, LLINs), early detection and control of malaria epidemics (MoH, 2012). LLINs, IRS and early diagnosis and treatment are primary interventions of malaria control in Ethiopia where malaria transmission is unstable, seasonal, and has characterized by frequent and wide spread focal epidemics (Kebede et al., 2010). Recently, there has been a commitment from the Ethiopian government and its partners to fight malaria. The national malaria strategic plan for 2014-2020 which serves as a guiding document of malaria control program in the country has been developed (MoH, 2014(c)). The goals of malaria control strategic plan are:

- By 2020, to achieve near zero malaria deaths (no more than 1 confirmed malaria death per 100,000 population at risk);
- By 2020, to reduce malaria cases by 75% from the 2013 base line;
- By 2020, to eliminate malaria in selected areas with historically low malaria transmission.

Thus, stratified priority interventions of malaria control are proposed according to the WHO/RBM guidance for high, moderate, low and free areas in order to achieve the program objectives by 2020 (table 2 shows proposed malaria interventions). Accordingly about 68% of the population (excluding the malaria free population) living in high, moderate and low transmission areas were planned to be covered by LLINs (100% ownership and 80% of use). In addition to LLINs, targeted households in high transmission areas would be also covered 100% by IRS (MoH, 2014(c)). About 32% of population living in low risk area adjacent to high land fringe areas would be covered by IRS to protect from anticipated epidemics. Other intervention strategies including case management, surveillance and epidemic control, and community empowerment would be implemented in all strata (MoH, 2014(c)). Then, as it is indicated in the strategy, after those targets would be achieved, step by step shrinking of malaria risk map of the country is expected.

Table 2 Malaria risk stratification of districts and planned malaria interventions, Ethiopia, 2014

Strata	API cases/1000 population	Elevation (m)	Population		Districts		Interventions					
			Total	%	No.	%	LLIN	IRS	LC	Case mgt	Surveillance	IEC/ BCC
FREE	0	≥2000m asl	33,639,639	40	290	35	-	-	-	X	X	X
LOW	>0 AND <5	<2000m asl	11,153,499	13	101	12	X	X*	Wa	X	X	X
MODERATE	≥5 AND <100		28,410,564	34	287	34	X	-	Wa	X	X	X
HIGH	≥100		11,023,284	13	157	19	X	X	Wa	X	X	X
Grand Total			**84,226,986**	**100**	**835**	**100**						

Wa: where applicable; LC: larval control; x*: epidemic prone areas (source: MoH, 2014(c))

However, implementation of strata based stratified intervention a strategy has not yet started. Still some districts hold the highest burden of malaria and require redoubling the efforts of malaria control interventions to reduce the disease burden. Implementation of interventions seems uniform across the strata without prioritizing the high burden districts and not targeting pocket areas like development corridors or projects. This finding is supported by recent survey documenting low access to preventive and curative malaria services in development corridors putting the migrant farm workers at a significant risk of malaria infection (Schicker et al., 2015). This has been facilitating malaria parasite transport to other areas of the country when they return to home (Schicker et al., 2015). Thus, rather than shrinking the transmission it is transported to non-malaria areas by farm workers returning from development corridors or projects (Schicker et al., 2015). Furthermore, the malaria control success achieved so far seem to be deteriorating and unsustainable. In general, malaria cases were declining slowly in high-burden areas and at the country level (PHEM, 2014). As a result malaria is causing high morbidity and impedes socio-economic development (Deressa et al., 2007(a); Alemu et al., 2013; RBM, 2015).

2.2 Justifications

The reason for deciding to analyse factors influencing effective implementation of malaria control strategies in Ethiopia is that this has not yet been critically examined and prioritized according to the health needs of the population. The disease affects mainly pregnant women, young children and people with little or no exposure to malaria infection and migrant workers (Deressa et al., 2007(a); Schicker et al., 2015).

Evidence shows that effective implementation of malaria interventions like LLINs, targeted IRS, microscopic examination and RDTs for confirmatory diagnosis and use of ACT are essential in malaria endemic countries (RBM, 2014). Ethiopia has endorsed and implementing these WHO/RBM approved malaria interventions for many years but the coverage and utilization is still low. Implementation of the current NSP is not progressing well. Thus, malaria incidence is declining only slowly (PHEM, 2014). Hence, it is important to learn from the previous problems and identify the main challenges in order to accelerate the NMCP implementation.

As a national malaria control program officer, it is also an opportunity for me to critically analyse why malaria control interventions are not effective in reducing malaria incidence in Ethiopia. Furthermore, there are very few and fragmented reports documenting the challenges and gaps on NMCP interventions. Also, no study has been conducted which analyses all factors together to establish a general overview of malaria control program system in Ethiopia with the aim of identifying the gaps and providing recommendations to the identified problems. Thus, this study will describe and analyse malaria control interventions and factors influencing its implementation altogether. The result of this study will add to the available knowledge of malaria control implementation ongoing in Ethiopia. It will also identify gaps in the malaria control program for which evidence-based recommendations will be given to improve malaria control program.

2.3 Objectives

2.3.1 General Objective

To describe and analyse factors influencing implementation of the malaria control program interventions in Ethiopia; in order to provide recommendations for program managers and policy makers to improve implementation of malaria control program interventions.

2.3.2 Specific Objectives

- To describe the current malaria situation/epidemiology and trends in Ethiopia.
- To describe and analyse factors influencing implementations of the current malaria control strategies in Ethiopia in order to identify implementation gaps.
- To describe good practices of effective implementation of malaria control program strategies from other countries in order to recommend alternative strategies for Ethiopia.
- To formulate recommendations for program managers and policy makers based on the study findings in order to improve NMCP performance.

2.4 Methodology

2.4.1 Search strategy

A literature review was used as the methodology for this study to search relevant documents, articles and reports on malaria prevention and control programs. Data for the study is from the review of both published and unpublished literature (e.g., MoH activity reports). For grey literature, Google was used to search various websites of Ethiopian government organizations (MoH, CSA, EPHI, GCAO, MoFED, MoLSA) and the websites of UN agencies like WHO, World Bank, UNICEF and Global Fund, RBM, and PMI to access and retrieve guidelines, policy documents, articles, fact sheets and reports.

A comprehensive systematic search was done using a database of Pub Med and VU e-library to search for published articles, reports and peer reviews using search words both separate and in combination. Search words are used for each study objectives separately to retrieve articles as illustrated in Table 3. Then, further screening of titles and abstracts was done using both inclusion and exclusion criteria. After reading the abstracts those which suited the study purpose were further read in detail.

Table 3 Search table

Sources	**Search words used by objectives**		
	Objective 1	**Objective 2**	**Objective 3**
PubMed Google scholar VU e-library	“malaria”, “Ethiopia”, “malaria incidence”, “malaria prevalence”, “epidemic”, “*Anopheles* mosquito”, “temperature”, “altitude”, “breeding sites”, “dam construction”, “migrant farm worker”, “outbreak”, “epidemic”	“Indoor residual spray”, “artemisinin-based combination therapy”, “diagnosis”, “treatment”, “confirmatory test”, laboratory test”, “bed nets”, “Insecticide treated nets”, “long lasting insecticide nets”, “temephos”, “larvicides”, “vector control”, “sentinel sites”, surveillance”, “environmental management”, “knowledge”, “attitude”, “Practice”, “community participation”, “ coverage”, “access”, “challenges”,	“malaria strategies”, “malaria control interventions”, “improving utilization of mosquito nets”, “improving access to malaria control”, “improving implementation”, “improving coverage”
Websites Ethiopian MoH, EPHI, GCAO, NMA, MoLSA, MoFED, CSA	“malaria”, “climate”, “temperature”, “malaria indicator survey”, “stratification”, “surveillance”	“challenges” , “Dichloro-diphenyl-trichloroethane (DDT)” “sentinel surveillance”, “gender”, “illiteracy”, “awareness”, “socio-economic”,	“improving malaria interventions”, “improving implementation”

Websites of UN agencies (WHO, UNICEF, UNFPA), GF, RBM, PMI	“malaria”, “Ethiopia”, “*Anopheles* mosquito”, “temperature”, “altitude”, “stratification”	“ stratification”, “challenges”, “bed nets”, “Indoor residual spray”, “artemisinin-based combination therapy”, “Insecticide treated nets”, “long lasting insecticide nets”, “knowledge”, “attitude”, “Practice”, “utilization”, “coverage”	“malaria program”, “malaria control interventions”, “preventing malaria”

Inclusion and exclusion criteria: malaria specific interventions and epidemiology studies done from the year 2005 including this year’s articles published in English and freely online available were included since 2005 was the start of scale-up of malaria interventions in Ethiopia. But some cross-references dated back to before 2005. All other articles that did not meet the criteria were excluded. Articles that were not freely accessible were not included. Articles that were only available as abstracts without access to full text version were also not included.

2.4.2 Limitations of the search

Since only freely accessible peer-reviewed articles published in English were used in this study, articles not freely accessible and published in other languages were left out. As this study searched for articles only published after the year 2005, some relevant articles might have been be missed. Regarding studies conducted in Ethiopia, the limited number of recent studies and differing methodologies might influence generalization of the results. These limitations were addressed during analysis by using multiple sources of data with similar context of multiple studies done across different parts of the country. Also mostly peer-reviewed articles were included.

2.4.3 Analytical framework

2.4.3.1The Roll Back Malaria (RBM) framework

RBM is a global partnership established in 1998 with the aim to halve the malaria burden by 2011 and again renewed its commitment to halve malaria burden by 2015 (Remme et al., 2001). The WHO, World Bank, UNDP and UNICEF are partnered together and have created the RBM movement. Through an extensive consultative process, a framework for monitoring the outcomes and impact of RBM has been developed. The framework identifies critical areas used to monitor different malaria control intervention strategies altogether which leads to reduction of malaria burden (Remme, 2001).

The framework is flexible as it allows countries like Ethiopia to select the most appropriate interventions for their context. It is also straight forward in linking to malaria epidemiology; intervention strategies and health sector development vary considerably between countries and regions. The framework specifically illustrates how the different interventions influence the burden of malaria. The framework identified four critical components that contain different evidence based interventions which lead to reduction of malaria burden. Though the framework has been adapted for this study, it is important to illustrate the original version (see annex B) which is explained below:

1. **The impact on malaria burden:** This refers to reduced malaria related mortality and morbidity as a result of the implementation of strategies.
2. **Improvements in malaria prevention and treatment:** This is the main focus area. Malaria prevention and treatment are the most important interventions for reducing the burden of malaria. These includes protections like the effective use of LLINs, IRS, timely detection and control of epidemics, intermittent treatment during pregnancy, community participation; and early diagnosis and appropriate treatment.
3. **Health sector development:** This refers to relevant health policies, health sector management, service delivery with adequate funds and skilled staff.
4. **Support and partnerships:** These include intersectoral linkage between research institutions and MoH; and effective national partnership to generate the necessary resources and provide technical support to the malaria control program.

2.3.4.2 Adapted version of the RBM framework

This study adapted the RBM conceptual framework developed for monitoring malaria indicators (Remme, 2001). The study framework was adapted for the purpose of this study. The adapted framework is illustrated in figure 1. The original framework was developed to monitor indicators of malaria control programs. The framework is selected as it enables to review the overall malaria control program in more comprehensive way. Hence, for the purpose of this study in the adapted critical components of the framework, “national malaria program management” is linked together with the “Health System”. Epidemic detection and response is added under the protection component as it is a very important intervention for long term malaria interventions planning. This study is however assuming that effective implementation of malaria interventions will lead to reduction of the malaria burden as indicated by RBM. Hence, this study framework will be used to guide study findings and discussion on existing malaria control interventions in Ethiopia and identifying factors influencing its implementation.

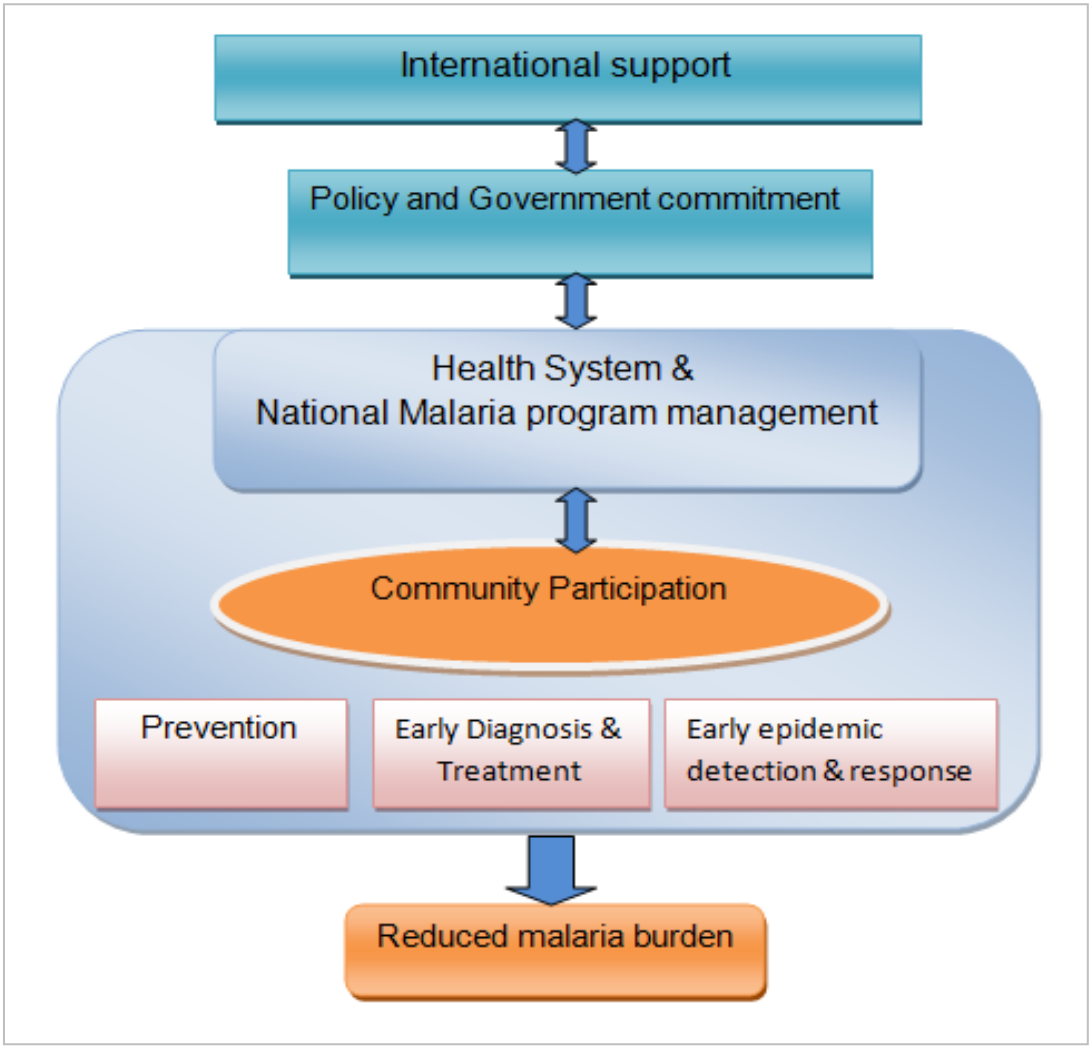

Figure 1 Adapted RBM study framework

CHAPTER THREE

3. STUDY RESULTS/FINDINGS

This chapter describes study findings under three sub-headings: the current malaria situation/epidemiology and trends, NMCP strategy implementation challenges, and good practices or lessons from other countries.

3.1 MALARIA EPIDEMIOLOGY AND TRENDS IN ETHIOPIA

3.1.1 Current malaria situation in Ethiopia

In Ethiopia, altitude and weather conditions are the two most important determinants of malaria transmission pattern (Ayele et al., 2012). The interaction of mountainous terrain with variable weather conditions, seasonal rainfalls, and variable temperatures creates diverse micro-climates which are suitable for mosquito breeding and transmission (Alemu et al., 2013). Due to household location at various altitudes and distance from malaria vector breeding sites, malaria infection risk is not evenly distributed and varies within a district and even within kebeles (Ayele et al., 2012; PMI Ethiopia, 2015).

Ethiopia is a tropical country and highly vulnerable to climatic hazards like drought and floods. As a result, the current effect of *El Niño*[1] has been severely affecting the rainfall pattern in Ethiopia (UNICEF, 2016). At a time when Ethiopia had made progress in improving health status of its nations, *El Niño* becomes a threat to gains made in control of malaria and others communicable diseases (UNICEF, 2016). On the other hand, the current socio-economic situation of the country is also playing a pivotal role in expansion of malaria infections (Schicker et al., 2015). Ethiopia has been recording impressive economic development led by the agriculture sector according to IMF[2] 2014. The expansions of small and large scale irrigation, and construction of dams are increasing the mosquito vector population which in turn increases malaria transmissions among the dwellers and workers (Jalata et al., 2013; Kibret et al., 2010).

In addition, mobile populations or migrant farm workers moving into these development projects/corridors increase the risk of malaria transmission. A study done on development projects in the North Gonder of Amhara region shows high prevalence of

[1]El Niño is a periodic appearance of unusually warm and cool sea-surface temperatures in the central and eastern equatorial Pacific Ocean http://iri.columbia.edu/wpcontent/uploads/2014/06/ElNinoBulletinJuneFINAL.pdf

[2]*IMF- International Monetary Fund* http://www.afrol.com/articles/28991

malaria was observed among migrant farm workers that originated from relatively proximate areas (Schicker et al., 2015). An estimated 350,000 individuals travel to areas of large-scale agricultural farming cash crops in North Gonder every year (Schicker et al., 2015). The absence of stratified strategies targeting migrant farm workers and low access to malaria care is putting migrant workers at risk of malaria infection. For the fear of the impact of insecticides on export of cash crops, IRS and LLINs are refused in these areas. However, their return home may facilitate parasite transport to other areas which increases incidence (Schicker et al., 2015).

A new map of malaria risk was developed in 2014. Based on malaria annual parasite incidence (API) calculated from the routine surveillance data of more than 800 districts and with a combination of altitude, four broad malaria strata were identified (MoH, 2014(c)). These malaria transmission risk strata are classified as high with API (>100 cases /1,000people), medium (5-99.9 case/1,000people), low (0.1-4.5 cases/1,000 people), and malaria-free (~0 case) areas. Areas with high malaria transmission risk are located in the lowlands and midlands of the western border with South Sudan and Sudan, with additional high transmission areas in or near the Rift Valley which extends from the southwest to northeastern parts of the country. Most populated highland areas are classified as malaria-free (API=0) (MoH, 2014(c)). Figure 2 illustrates Ethiopian map of malaria risk.

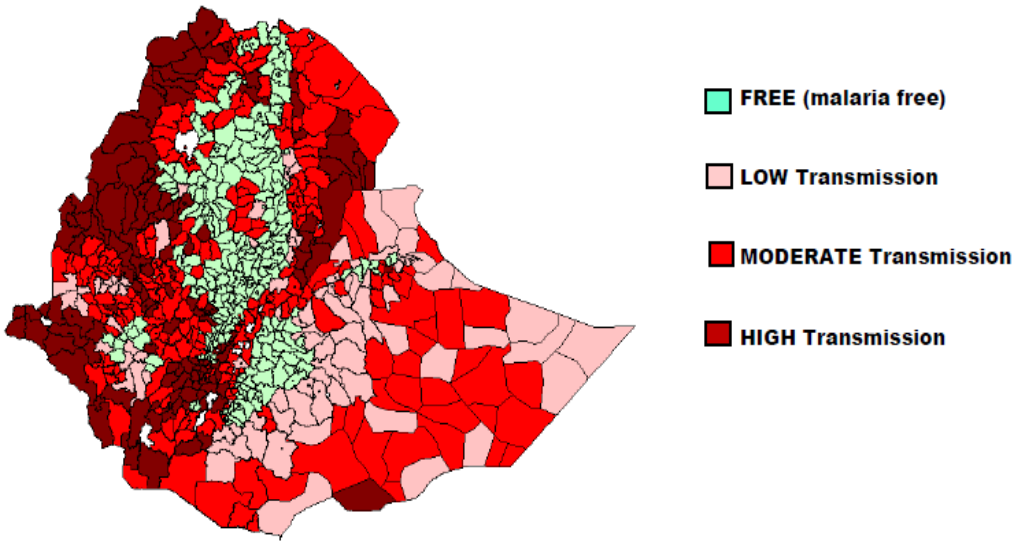

Figure 2 Malaria risk map of Ethiopia by districts 2014 (Source: MoH, 2014(c))

3.1.2 Trends of malaria cases in Ethiopia

Malaria inpatient cases in all ages reduced by 54% and malaria deaths by 68% between 2005 and 2011 compared to what was predicted based on 2001-2005 trends according to hospital based surveys in areas below 2000m (Aregawi et al., 2014). Contrastingly, about 70% of malaria cases are managed at the HP and HC levels and the surveillance system is not such a strong that the finding did not actually reflect the situation (EPHI, 2014). The history of variable malaria transmission in Ethiopia shows malaria incidence fluctuating over time. Figure 3 from the PHEM routine surveillance database shows annual malaria case reports (PHEM, 2014). The data shows that reported malaria cases were fluctuating over time. During 2010 and 2012, the total number of malaria cases seemed to reach high peaks. But, according to a MoH report, during 2010-2014 there was high expansion of additional health posts at kebele levels that started reporting of malaria cases and the reported malaria cases were also not only confirmed cases (MoH, 2015(b)).

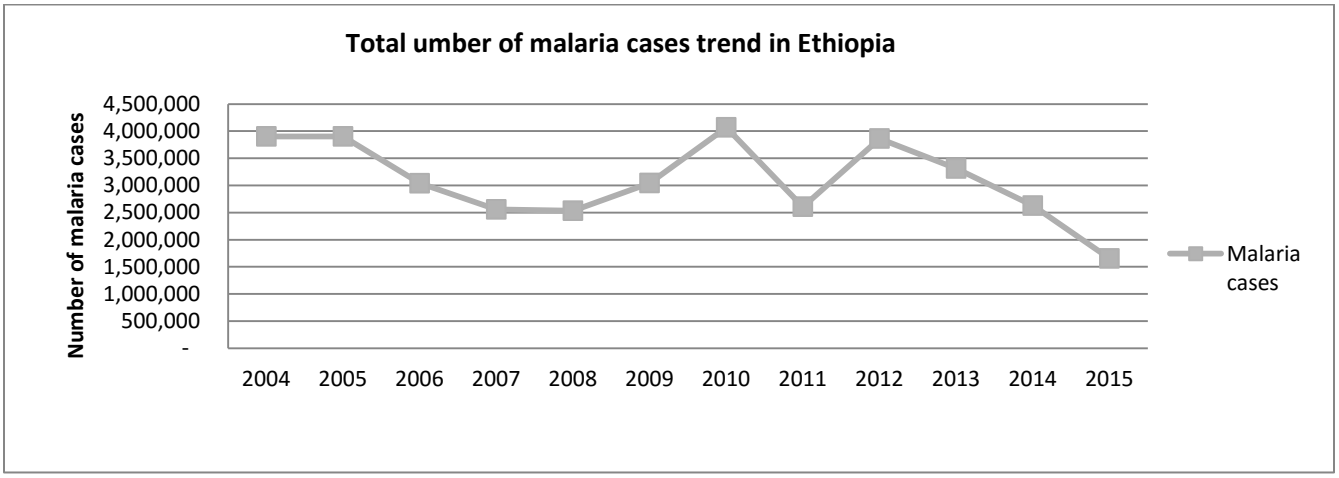

Figure 3 Number of malaria cases trend (Source: PHEM surveillance database, 2016)

The malaria cases trend from 2013 shows good progress in reduction of malaria incidence. However, the situation of this year (2016) makes reaching the 2020 target of 75% reduction in malaria cases and elimination of malaria in part of the country uncertain. PHEM routine surveillance weekly reports from health facilities show that the national total malaria cases in 2016 are building up from week 16 with completeness 90.1% (see figure 4). This weekly PHEM report shows that the highest numbers of malaria cases have been reporting from week 19 in 2016 and crosses the 2014 and 2015 trends as of the same week (PHEM, 2016). The increasing number of malaria cases varies across regional states. From the reported malaria cases specifically for week 22, Amhara region accounted for 35% of all cases. Numbers of malaria cases are also increasing in Benishangul Gumuz, Tigray and Gambella regions when compared to

the same week of year 2014 and 2015, (PHEM, 2016). This increase of malaria cases overlaps with the small rainy seasons from February to March that cover the south and south western part of the country.

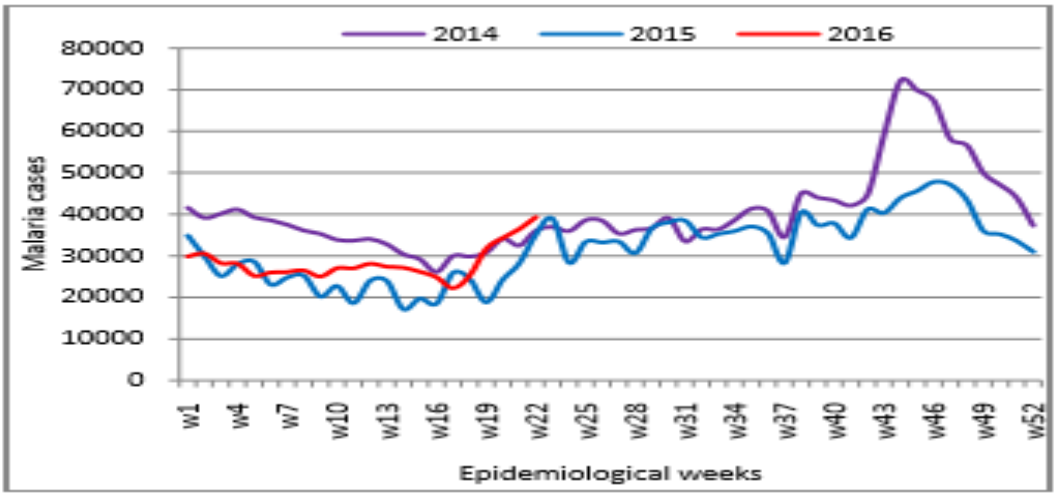

Figure 4 National malaria cases weekly trend 2016 (Source: PHEM weekly bulletin, 2016)

3.2 NMCP STRATEGY IMPLEMENTATION CHALLENGES

This sub-section describes the NMCP critical component challenges based on the adapted study framework.

3.2.1 International Supports

Ethiopia's RBM partnership forum is known as National Malaria Control Support Team (MCST). It was established in 1998 to respond to the ongoing malaria epidemics in the country (MoH, 2009). The MCST is composed of members from government organizations, and national and international NGOs (MoH, 2009). The MCST is retained as the central level RBM task force and ensures that all partners are guided by the NSP.The MCST has greatly contributed to the malaria control program in Ethiopia in terms of providing technical guidance on malaria interventions and mobilizing resources by influencing international donor agencies like the Global fund (MoH, 2009).

Since the creation of Global Fund in 2002, Ethiopia has been a grant recipient for malaria and other diseases. From 2002 to November 2014, Ethiopia received over US $477 million in malaria grants (GF, 2015). For the current allocation period (2014-2016), US $150 million allocated to malaria (GF, 2015). This available funding for the current period covers only 36.3% of the financial need which is not enough to cover the most important interventions. Other organizations like the President’s Malaria Initiative (PMI) are also supporting the program in Ethiopia (PMI, 2015) but the government financial

contribution to malaria control program is still low. According to the 5th (2010/11) NHA, the government has allocated US $16.5 million which is 7% of the total expenditure on malaria (MoH, 2014(a)). This indicates that the malaria control program is highly donor dependent. If the aid stopped, the program would fall into trouble.

3.2.2 Policy and Government Commitment

MoH/NMCP and stakeholders have endorsed the Global and Regional WHO/RBM strategies and targets in line with the Millennium Development Goals (MDGs) and Health Sector Development Plans (HSDP) (MoH, 2011). In 2014 the government of Ethiopia again showed its commitment by launching the NSP 2014-2020 setting bold and ambitious goals (MoH, 2014(c)). The Ethiopian government structure is a decentralized federal structure. As a decentralization process, the responsibility of malaria control is transferred to regions, zones, districts and down to the kebele level. The role of NMCP is limited to policy formulation, provision of technical guidelines, assisting in training and acquiring resources and commodities for the regions (MoH, 2012). They have autonomy to implement the national malaria control strategy.

At national level there is good leadership and commitment. However, the relationship between national level NMCP guidance and the implementation by regions, zones, districts and kebeles varies accordingly. Their political commitment and priority of the program vary. There are problems of management, coordination, governance and technical oversight and guidance of the overall malaria control program, communication, and information flow to use local information for local action and reporting (MoH, 2011).

3.2.3 Linkage of NMCP Management with the Health System

The control of malaria program in Ethiopia has a long history of more than five decades. The malaria control program began as a pilot control project in the 1950's and then it was launched as national eradication campaign in the 60's (WHO, 2016(a)). As WHO and the country realized that malaria eradication would not be feasible in Ethiopia, the strategy shifted to a centralized vertical control program in the 1970's. Then, after the transitional government in 1993, the malaria control program was integrated into the HSDP of the country at which point the malaria program management was decentralized down to the district level. Malaria service provision is also integrated into health service delivery down to the kebele level (MoH, 2014(c)). The Health Extension Program (HEP) is at the base of health service delivery where malaria prevention and treatment activities are fully integrated (MoH, 2015(a)). However, Health Extension Workers (HEWs) are overburdened with other competing activities and have limited capacity to implement malaria interventions (Teklehaimanot, 2013).

Implementing malaria interventions requires good management, trained human resources and systems support particularly for malaria commodity supply management and information systems (Woyessa et al., 2013). Thus, integration of malaria control programs into health systems is crucial for effective implementation of malaria control

interventions. NMCP works in collaboration with supply management agency for procurement and distribution of anti-malarial drugs and supplies, with the research institute of Ethiopian Public Health (EPHI) for malaria research, and within EPHI works with the public health emergency management responsible for weekly routine surveillance data, and within MoH other units including resource mobilization, and Health Management and Information System (HMIS) in order to implement malaria related activities (MoH, 2011). There are challenges of overall management, coordination and communication with these different units that are critical for malaria control.

Malaria commodities procurement and supply management: procurement and distribution of millions of LLINs, ACTs, RDTs, IRS insecticides and other supplies that were previously outsourced to partners has been shifted to the Pharmaceutical and Fund Supply Agency (PFSA) (MoH, 2011). The PFSA is in the process of expanding its regional hubs for the whole country health care medical products and commodities. Due to its limited capacity in infrastructure, transportation and poor logistics management information systems at all levels there is inadequate information about quantification, stock outs / over stocks; product expiry and irrational in malaria areas (Daniel et al., 2012).

Malaria information system: the goals of Ethiopia's NSP are to eliminate malaria in historically low-transmission areas and achieve near zero deaths due to malaria by 2020. To monitor the progress towards these goals, an effective surveillance system that can target focal areas of infection, capacity to identify transmission hotspots, and monitor near real-time malaria data to rapidly identify changes in malaria transmission, morbidity and mortality is essential (Yukich et al., 2014). No active surveillance system is introduced. Thus, different sources of malaria information are used. HMIS implementation has reached 97.4% of public health centers and hospitals as of 2014 (MoH, 2014(b)). Weekly surveillance report are delayed and do not fully address all malaria endemic areas (Jima et al., 2012). This makes it difficult to detect outbreaks or epidemics in a timely manner and actual number of malaria.

Human resource: the malaria control program is facing shortage of malaria expertise and human resources at all levels (Woyessa, 2013). The lack of trained human resources and personnel attrition are a major challenge for effective implementation of malaria control (Woyessa et al., 2013). Maintaining the success gained and achieving the malaria control and elimination goals with the present human resource profile will be difficult for the country (Woyessa et al., 2013). The shortage and maldistribution of malaria control experts are due to the failure to retain the vertical control program experts within the health system, lack of a malaria training centre and inadequate motivation and retention strategies for malaria experts (Woyessa et al., 2013). Despite there being more than 38,000 HEWs with formal basic primary health care training including malaria prevention, diagnosis and treatment deployed throughout the country,

malaria control at the community level is partly ineffective (MoH, 2015(a)). Malaria control activities at kebele level are competing with the other 17 health extension packages (MoH, 2015(a)). HEWs are also overburdened by kebele council works that limit their time to fully engage in implementing the packages and inadequate refresher training for HEWs (Teklehaimanot, 2013). In addition, there is frequent rotation or turnover of malaria focal person staff at regional, zonal and district levels. This limits the ability to establish leadership, experience and expertise in malaria programs to provide support for HEWs and to management of the program as well (Woyessa et al., 2013).

3.2.4 Community Participation

Community participation is a core component in malaria prevention and treatment. In Ethiopia, the community based malaria control program was established in early 1992 in Tigray region by volunteer community health workers to provide malaria diagnosis and treatment services for the army and community at village level (Ghebreyesus et al., 2000). MoH later developed an innovative community-based strategy called the Health Extension Program (HEP) run by HEWs to deliver preventive, promotive and selected high impact curative services including community based malaria control and treatment (MoH, 2015(a)). HEWs play key roles in malaria control interventions, vector control operations, treatment and referral of cases as well as community mobilization thus improving access to the rural community and remote areas (MoH, 2015(a)). The institutional arrangement in which every kebele has two HEWs as part of the country's health system regular work force is a breakthrough for success of malaria control implementation (MoH, 2015(a)). The provision and scale up of malaria interventions LLINs, IRS including ACTs and RDTs are implemented by HEWs at HP or kebele level (Salam et al., 2014; Kebede et al., 2010).

However, the implementation of the approach has become a challenge to the malaria control program. An evaluation done by Columbia University on HEP implementation processes and HP’s performances identified problems like inadequate follow-up and regular supportive supervision, rapid turnover of HEWs, lack of capacity building on malaria diagnosis and management. Thus their activities were not well coordinated and lack adequate mechanisms and systems for quality assurance (Columbia University, 2010). As a result, diagnosis with RDTs and recognition of the clinical symptoms of malaria is often inadequate; and there is interruption of drug and RDTs supply at the kebele level (Daniel et al., 2012).

Community mobilizations through HEWs are not widely implemented to improve awareness and health seeking behavior (Fetene et al, 2016). Another government owned initiative - Health Development army (HDA) is under way. The network leaders are facilitating the work of HEWs on empowering women on their own health problems including malaria prevention (Maes et al., 2015).

3.2.5 Preventions

3.2.5.1 Long-Lasting Insecticidal Nets (LLINs)

Mosquito nets have been used as the main malaria vector control strategy in Ethiopia for the last two decades. Their distribution through the health care delivery system was first introduced in the resettlement sites of western Tigray region in 1997 through a cost recovery system (Mitikie et al., 2005). Then, as it was outlined in the HSDP and NSP all households living in malaria risk areas have the right to protect themselves from malaria infection using mosquito nets (MoH, 2006). Hence, the MoH introduced free distribution of LLINs since 2005. The mass distribution strategy of two LLINs per household in malaria endemic areas had distributed 23.8 million LLINs by the end of 2007 (Shargie et al., 2008). Between 2008 and 2009, 2.1 million nets were distributed, and 17.1 more were million distributed between 2010 and 2011. Thus, a total of 43.1 million LLINs were distributed to people living below 2,000 m in all regions between 2005 and 2011 (Aregawi et al., 2014). Even though the national target is to sustain 100% LLINs coverage in malaria risk areas the national MIS showed that the ownership of LLINs in households living in malaria area (below 2,000 m) was 54.8% (owning at least one LLIN) and 23.6% owning more than one LLIN. Net ownership at higher altitudes (above 2,000 m) was also found to be lower with 37.9% of households owning at least one net (EPHI, 2011).

The existing policy guide used to determine the required number of LLINs per household depends on family size (MoH, 2012). Table 4 shows the distribution guide used to distribute LLINs. Importantly, there is a substantial problem with the existing distribution guide. It is not covering all the sleeping beds in the households to ensure every household member sleeps under LLINs (Birhanu et al., 2015). In addition, the distribution is only for registered households in the kebele and their families. It is not addressing migrant farm workers who sleep outdoors (Schicker et al., 2015). As the LLIN procurement and distribution is owned by the central PFSA it is difficult to access from the market in the country. In general, LLIN distribution lacks strategic prioritization and stratification according to epidemiological risk strata**.**

Table 4 Guideline used to determine the number of LLINs per household in Ethiopia

S.N	Family Size	Number of LLINs to be supplied
1	1 to 2	1
2	3 to 5	2
3	6 to 7	3
4	More than or Equal to 8	4

Source: MoH, 2012

LLIN replacement time is another challenge. The procurement and distribution process takes too long to reach the target population. In some cases nets are distributed after the transmission season has passed (Daniel et al, 2012). Despite the replacement strategy of LLIN replacement after three years, it is unlikely that all LLINs are still in use after three years or more. This is supported by MIS 2007 which showed that actual LLIN ownership and usage fall short of predictions based on “administrative” coverage rates (EPHI, 2011). A substantial number of LLINs are damaged beyond use before the end of their expected lifespan (i.e., 3-4 years) (EPHI, 2011). Other findings show that it is likely that up to 40% of LLINs are “lost” (e.g. due to wear and tear or alternative use) by the end of the second year of ownership (Teklemariam et al., 2015). The effectiveness of LLINs in reducing malaria incidence and mortality depends on the interrelated factors of possessing sufficient number of LLINs, proper utilization, and timely replacement of nets (Sena et al., 2013).

Besides the efforts for improving access to LLINs, utilization remains low. According to MIS 2011, net utilization among children under five in households living below 2,000 m who owned nets was only 64.7% (sleeping under an LLIN the night previous the survey) and 50% in households above 2,000 m. Of women aged 15 to 49 living below 2000 m altitude and who owned at least one net, 36.4% had slept under LLIN the night preceding the survey. In malaria-endemic areas (below 2,000 m), 35.3% of pregnant women had slept under a net and 34.7% had slept under an LLIN (EPHI, 2011). Table 5 shows factors influencing LLIN utilization and ownership in Ethiopia.

The social-economic factors are the main challenge for LLIN utilization and ownership. Some findings revealed that net ownership differed by wealth status of households. Rich people owned more nets and sought malaria treatment than the poor people (Sena et al., 2013; Astatkie, 2010). Poor people also hold a disproportionate malaria infection risk and prevention measures may not reach the poor and remote areas well (Biadgilign et al., 2012). Other socio-economic factors like type of housing conditions (Ayele et al., 2012); illiteracy, lower income, and distance from health facilities were related to malaria infection and use of preventive measures (Sena et al., 2013). The national MIS 2011 supports only 44.6% of the poorest households owning at least one net compared to 66.4% of the richest households (EPHI, 2011).

Table 5 Summary findings of articles on LLINs ownership and utilization in Ethiopia

Authors	Tittles	Study design	Study area	Factors influencing LLINs ownership and utilization	Critics
Teklemariam et al, 2014	Ownership and utilization of ITNs	Cross-sectional (CS)	Harari, E/ Ethiopia	Households (HHs) educational level, knowledge about transmission of malaria by mosquito bites and mosquito nets as prevention tool	mass distribution of LLINs alone not effective if not combined with social mobilization
Sena et al, 2013	Predictors of LLINs ownership & utilization	CS Comparative	SW/ Ethiopia	The probability of owning two or more LLINs was positively related to age, marital status of HH head, relative wealth index, distance to nearest health facility, accessibility to transport, residence and HH size	Knowing and considering community specific contexts are very important while LLINs distribution
Berhanu et al, 2015	Access to and use gaps of LLINs	CS & Qualitative	Jimma, SW Ethiopia	Behavioral driven gaps (perceived low efficacy of nets, lack of awareness, fear of impregnated chemical, shape & color of the net, sleeping outdoor) and seasonality of mosquitoes bite	Targeted evidence based IEC/BCC messages are required to address target population
Fuge et al, 2015	KAP of pregnant women	Community based CS	Shasho goS/Ethiopia	Knowledge of pregnant women about malaria and LLIN does not merely guarantee proper practice of LLIN	Skill-based training on hanging of LLINs and utilization for target population is crucial
Schicker et al, 2015	Malaria and migrant farm workers	A venue-based survey	Amhara, Ethiopia	mobility patterns influences low coverage of LLINs and IRS and Low access to malaria care which is putting mobile farm workers at risk of malaria infections	Proper targeting and identifying population at risk and vulnerable groups help in addressing malaria inequity problem
Deribew et al., 2012	The effect of HH heads training	RCT	Gilgel Gibe, SW Ethiopia	Household level skill-based training has a marked positive effect in the utilization of LLINs	Distribution of LLINs combined with skill-based training will improve utilization

3.2.5.2 Vector Controls (IRS and Larviciding)

IRS is the application of long-acting chemical insecticides on the walls and roofs of houses and domestic animal shelters in order to kill adult vector mosquitoes that land and rest on these surfaces (MoH, 2012). IRS is an effective intervention for obtaining rapid large-scale impact on both mosquito vector populations and malaria morbidity and mortality in high malaria strata and epidemic prone areas (PMI Ethiopia, 2014). IRS was first implemented in the mid-1960s in Ethiopia when it was used as one component of vector control intervention (MoH, 2012).

Dichloro-diphenyl-trichloroethane (DDT) was widely used until it discontinued in 2011 due to the wide spread mosquito resistance (Biscoe et al., 2005). Discontinuation of DDT however left behind large stocks of obsolete DDT in storage sites throughout the country (Charles, 2012; PMI Ethiopia, 2014). A 2011 inventory revealed that there are approximately 928 tons of DDT at districts, Zones and regional stores throughout the country. In addition, about 450 tons of DDT are at the Adami Tulu pesticide processing plant and 250 tons of DDT are in the Adama store of the Oromia regional health bureau (PMI Ethiopia, 2014). The prolonged storage of the insecticides which are often poorly packaged in substandard storage and under insecure conditions poses a significant risk to human health and environment (PMI Ethiopia, 2014). This has resulted from a lack of proper targeting and limited capacity to run IRS interventions. In addition, it has made storage space unavailable for new insecticides, and affects trust and willingness to allocate resource for new insecticides.

Due to the high level resistance to DDT and cross resistance between DDT and pyrethroids, the vector is also highly resistant to deltamethrin (PMI, 2014). Based on the available results of insecticide resistance monitoring, deltamethrin was replaced with bendiocarb and propoxure in 2013, both from carbamate class (MoH, 2015(c)). However, insecticide efficacy studies show an increase of *Anopheles* mosquito resistance to bendiocarb in areas like Bahirdar, Jimma and Abaya (PMI, 2014; Ye-ebiyo et al., 2016). Hence the national vector control program is facing the challenge of resistance to both insecticides from the carbamate class. Thus it is clear that there is only limited and highly expensive insecticide option left for IRS program for Ethiopia. Annex “C” illustrates insecticides used in Ethiopia.

The entomological monitoring component of the IRS program is not strong and regular in Ethiopia (Charles, 2012). There are not enough strong sentinel surveillance sites for monitoring of insecticide resistance across the country (Yukich et al., 2014; Charles, 2012). Within the existing 10 sentinel sites for the whole country, there are major limitations in generating timely and accurate data, use of diagnostic tools and making data useful, difficulty in generalizability and representativeness for decision making (Yukich et al., 2014).

The capacity to implement Integrated Vector Management (IVM) is extremely limited primarily for some inter-connected reasons: a decentralized IRS operation with limited capacity; lack of human resources (trained and professional); limited country-specific insecticide monitoring research; and a lack of well-established communication networks within the MoH, other ministries, and outside research organizations and financial constraints (Yukich et al., 2014; Biscoe et al., 2005). Other substantial problems of IRS implementation are inadequate equipments (pumps, sprayers, and nozzles); lack of trained spray personnel or spray maintenance technicians, lack of supervision during IRS; illegal diversion of insecticides for other agricultural use; and poor quality of the insecticides (Charles, 2012). Despite its overwhelming challenges, Ethiopia has increased IRS coverage. Prior to 2007 about 20% and by 2011 about 46.6% of targeted households in areas prone to malaria epidemics are sprayed prior to the rainy seasons (EPHI, 2007 & 2011). The MoH administrative report shows IRS coverage of targeted households had increased to 83.9% in 2013 (MoH, 2015 (b)). However, the current IRS implementation is not according to epidemiological risk strata.

Larviciding is another vector control intervention used in areas where water collections cannot be managed by using human power (MoH, 2012). Larviciding refers to sustained weekly spraying of chemicals or use of biological agents to kill mosquito larvae (Fillinger & Lindsay, 2011). Like environmental control measures, the impact of larvicides will depend on the skills of identifying mosquito breeding sites (Fillinger & Lindsay, 2011). Hand application of larvicides can reduce malaria transmission by 70-80% in settings where mosquito larval habitats are defined (Fillinger & Lindsay, 2011). In Ethiopia, temephos (abate chemical) has been used for larviciding (MoH, 2012). However, due to the need for repeated applications, lack of hand pumps and human resources, it was not widely used (Jalata et al., 2013). To date, other means of vector control interventions such as repellents have not been introduced by NMCP.

3.2.5.3 Environmental Control

The nature of malaria transmission in Ethiopia has spatial, temporal and spatiotemporal heterogeneity (Alemu et al., 2013). In unstable malaria transmission areas like Ethiopia, detecting and considering the spatiotemporal heterogeneity would be very important for strengthening environmental control (Alemu et al., 2013). The variety of mosquito breeding sites in Ethiopia include accumulations of water near roads; borrow-pits used to extract soil and stones for house constructions; micro-ponds used to harvest rain water for horticulture and small scale irrigations; banks or rivers and creeks created after rainy seasons and development-linked activities like small and large-scale irrigation schemes that lead to environmental manipulations (Jaleta et al., 2013). Larval source management (LSM) at community level was underutilized in Ethiopia due to the attention shift to LLINs and IRS interventions; lack of skill to identify positive larvae, no reporting and monitoring system environmental control activities, and widespread variation in spatial and temporal distribution of *Anopheles* larvae (Kibret et al., 2010).

However, large-scale LSM can be effective method of malaria control, especially when combined with LLINs (Fillinger & Lindsay, 2011).

3.2.5.4 Information Education and Communication (IEC/BCC)

General awareness of women of age 15 to 49 years and of populations at risk about malaria transmission, symptoms and prevention methods is essential to ensure consistent and efficient use of prevention methods and seeking treatment (Fuge et al., 2015; Chipwaza et al., 2014). According to MIS 2011, only 71.2% of women aged 15 to 49 years reported that malaria is caused by mosquito bite and about 63.4% knew about mosquito nets as a prevention tool against mosquito bites (EPHI, 2011). Also, as mentioned earlier, the general literacy rate among women in the country is 38% (CSA, 2011). There are individual, household and environmental related factors that influence awareness of malaria control interventions among households living at malaria risk areas (Tesfaye et al., 2012). The low perception and belief of the cause of malaria resulted in decreased motivation and inconsistent mosquito net use among women age 15 to 49 years (Tesfaye et al., 2012).

Community education combined with community based malaria interventions including LLINs distribution, IRS and environmental control has a significant effect in reducing malaria incidence and prevalence (Salam et al., 2014). A study done in Tanzania shows after community education the use of LLINs and seeking treatment has improved (Chipwaza et al., 2014). In that study of community education, almost all of study population had enough knowledge about malaria transmission and control methods. They participated in different preventive interventions like using bed nets, management of mosquito breeding sites like filling holes and pits, surrounding cleaning, stagnant water drainage, larviciding activities and screening windows which proved reduction of malaria morbidity and mortality (Chipwaza et al., 2014). Community education is a contributing factor for community participation in malaria control activities and increased treatment seeking behavior. However, awareness alone is not enough. A study done in Arbaminch shows the community had awareness about the cause of malaria but they sought treatment outside health facilities and used self-medication (Astatkie, 2010). Except for some irregular house to house follow up by HEWs, there is no active IEC/BCC program, and mass mobilization activities.

3.2.6 Early Diagnosis and Treatment

Another important malaria intervention is prompt and accurate diagnosis and treatment within 24 hours of onset of illness. Prior to 2005, access to malaria diagnosis in Ethiopia reached only 30% (MoH, 2011). Since 2005 with the introduction and scale-up of RDTs, malaria diagnosis and treatment has been increased (Aregawi et al., 2014). Access to early diagnosis and treatment of malaria has improved with the increase of primary health care (PHC) coverage which has reached 94.5% with more than 16,251 HPs and 3,335 HCs have been constructed in order to achieve universal health coverage (MoH, 2014(b)). Also there are more than 4,000 private for profit and not for profit clinics and over 38,000 HEWs were deployed at the community level (MoH, 2014(b)).

The national guideline underlines that diagnosis of all fever cases should be confirmed by laboratory tests either by blood film microscopy or RDTs (MoH, 2012). Microscopy is used at hospitals and HCs while RDTs are used at the HP level by HEWs. Active case finding is not implemented. National MIS 2011 revealed that among children under five living below 2,000 m who had suffered from fever in the two weeks preceding the survey only 51.3% sought medical attention within 24 hours of onset of fever (EPHI, 2011). The malaria diagnosis and treatment is partly ineffective at communities despite HPs expansion and HEWs deployment. The factors are low awareness of the community, lack of demand creation activities, lack of trust on HEWs and anti-malaria drugs and supply interruptions (Teklehaimanot, 2013). Furthermore, a case control study on six health centers in Jimma zone indicated a lack of lab technicians and skilled health providers, and stock outs of anti-malaria drugs affecting the quality of service provision and associated with delay in seeking treatment of malaria from health facilities (Getahun et al., 2010; Deressa et al., 2007(b)).

An assessment of malaria diagnostic capacity in five administrative zones of Oromia region shows malaria diagnosis either by microscope or RDTs are available in 90% of health facilities surveyed (Hailegiorgis et al., 2010). But there are significant gaps in laboratory services including laboratory infrastructure, function microscopes, laboratory supplies, and trained human resources that could impact the quality and accessibility of malaria diagnosis (Hailegiorgis et al., 2010). In addition, inadequate diagnosis and treatment service will affect the patient's/care givers treatment seeking behavior (Hailegiorgis et al., 2010). The weak system of quality assurance of both government and private clinics including regulation of private clinics has made it difficult for the poor in remote areas to access and afford malaria diagnosis and treatment services (Deressa et al., 2007(b)).

3.2.7 Early Epidemic Detection and Response

The terms "epidemic" and "outbreak" of malaria have been typically related to context specific changes from existing national or local baseline malaria cases or rates (Mitikie et al., 2005). As a result of diverse topography and climate changes in Ethiopia, malaria transmission patterns vary geographically, seasonally and between years (Alemu et al., 2013). The unstable nature of malaria transmission is due to abnormal minimum increased temperature has led to an "epidemic-prone" situation (Negash et al., 2005; Alemu et al., 2013). Historically, the unstable nature of malaria transmission was characterized by frequent focal outbreaks and cyclical epidemics. Nationwide malaria epidemics occurred in the years 1958, 1988, 1991/2 and 1997/8 including highland parts of the country (Negash et al., 2005).

A large-scale devastating epidemic occurred at irregular intervals of between 5-8 years (Guthmann et al., 2007). During the 2003/2004 large scale epidemic, more than 2 million malaria cases and 3,000 deaths were reported (Guthmann et al., 2007). In addition, in July 2003, an outbreak in Damot Gale district of Wolayita Zone in SNNPR was confirmed by a sharp increase in *p. falciparum* positive results among children treated. Within three months 10,308 malaria cases were reported with a 3.6% attack rate (Guthmann et al., 2007). Since this epidemic, except for some case build up, the number of reported epidemics or outbreaks decreased (Jima et al., 2012). However, at districts and lower level health facilities there is a weak routine malaria surveillance system for monitoring malaria trends, lack of timely reporting, and limited capacity of detecting and using data for actions (Jima et al., 2012).

3.3 Good practices or lessons from other countries

3.3.1 The case of Tanzania's LLINs social marketing

According to World Bank finding on Tanzania's pilot project, involvement of the private sector is fundamental to scale up LLIN interventions and to address inequity among the poor and remote areas (World Bank, 2008). Public-private partnership in Tanzania has improved LLIN ownership and utilization in malaria endemic and remote areas (World Bank, 2008). Social marketing employs commercial marketing techniques to increase demand for service. In Tanzania, a variety of behavior change communications and social mobilization activities (sensitization meeting with community leaders, setting promotional activities like setting up posters, billboards, distributing leaflets in schools, and mass communication campaigns like sporting events, local drama and entertainment presentations) were used to increase community awareness (World Bank, 2008). Thus among the poorest quintile, ownership and utilization of mosquito nets were increased from 58% to 83% and from 20% to 73% respectively between 1997 and 2002. Survival among children between the ages 1 month and 4 years has increased by 27% (World Bank, 2008). Also in Kenya, social marketing of LLINs by

private providers through a voucher system by government subsidy has increased LLIN ownership and utilization among the poor and remote areas (Tilson, 2007).

The 1993 Ethiopian national health policy encouraged private provider/sector involvement in the health sector. But, the role of the private sector on LLINs is not clearly defined in the 2012 national malaria control and treatment guideline (MoH, 2012). It needs a policy support for private sector involvement. The procurement and distribution of LLINs in Ethiopia is owned by a government. The free distribution of LLINs focuses only the rural population. This situation affects the role of private sector involvement in improving accessibility of LLINs for the urban areas, hard to reach areas, and for daily labourers working in development corridors and projects (Schicker et al., 2015).

3.3.2 Intermittent Preventive Treatment (IPT)

It is clear that malaria increases the risk of complications during pregnancy. IPTp is a useful intervention in reducing maternal death, low birth weight and anemia which is associated with *plasmodium falciparum* in sub-Saharan Africa (Aponte et al., 2009). It is also a cost-effective intervention which can be delivered along with antenatal care visits (Conteh et al., 2010). However, IPTp for malaria during pregnancy is not yet introduced by the NMCP in Ethiopia. IPTp with sulfadoxine-pyrimethamine for pregnant women is not implemented due to the relatively low intensity of malaria transmission in most parts of the country (PMI Ethiopia, 2015). However, findings showed that IPTp with sulfadoxine-pyrimethamine was safe and efficacious across a range of malaria transmission settings (Aponte et al., 2009).

CHAPTER FOUR

4. DISCUSSION

Slow decline of malaria incidence in Ethiopia

Available data indicates malaria cases trend decline slowly, or fluctuate overtime and in some situations it reverse. This lead to malaria remains a major cause of morbidity and mortality especially in the rural areas. About 51 million people, or 60% of country's population are at risk of malaria (MoH, 2014(c)). Each year about 2 to 4 million people suffer from malaria illness (PHEM, 2014). The recent surveillance data reveals reported number of malaria incidences has crossed the 2014 and 2015 baseline of the same week before the main transmission period. Despite the progress to date, the control program is not enough resilient to reverse the impact of malaria. Still about 157 (19%) of districts have shared the high burden of disease and one third of districts (34%) hold moderate transmission (MoH, 2014(c)). Most of the high and moderate district categories are located adjacent to each other. These districts are known by stable malaria (year-round transmission; limited to the western lowlands and river basins (MoH, 2014(c)).

The primary factor of persistent transmission in these areas is lack of strategic prioritization and stratification of different malaria interventions according to epidemiological risk strata. The fact that currently all the programme elements are attempted to be implemented with equal importance and equal coverage in all parts of the country while actually the division of the country in four different strata of malaria risk is a reason to stratify interventions and do different (combinations of) interventions in these different strata. By doing so it will not only be more effective in each strata; it will also reduce chances of wasting precious resources by trying to implement certain interventions in areas where they are not needed and therefore spreading the malaria programme resources too thinly to have a maximum impact. The following are the main challenges of the program control which further contributing to the slow decline of malaria incidence in the country.

Poor Program Management and Implementation

The current NSP 2014-2020 has indicated stratified malaria interventions to reduce malaria burden. The strategy well describes the program goals and proposed stratified interventions for high, moderate and low malaria transmission areas according to WHO/RBM priority interventions to achieve the program goals. Despite the strategy being in place, implementations of interventions are not according to epidemiological risk strata. In some districts, there is a fear to switch from the double use of LLINs and IRS interventions to a single intervention that was previously implemented unsystematically. Program managers and political leaders at regional, zonal and district levels are not mobilized and convinced on stratified malaria interventions and

prioritization. Thus, inappropriate targeting and prioritization of preventive interventions are not focused on the remote and high burden areas. For example, districts sharing a high burden of malaria and development project areas, or seasonal migrant farm workers need special attention. Low coverage of LLINs and IRS interventions in the target population, limited capacity of HEWs, and the current natural phenomena like drought and flooding are factors contributing for the increase of malaria infections.

Effective implementation of malaria control program interventions requires good management, leadership and governance at all levels. The leadership and political commitment to sustain the control efforts and shift to the pre-elimination phase in limited areas at national level is encouraging. The nationwide malaria control program implementation, which led by government policies and strategic plans, requires strengthening the lower administrative hierarchies. The existing policy platform of HEWs deployment at kebele level helps the implementation of community-based malaria interventions: environmental management, distribution of LLINs, IRS and provision of malaria diagnosis and treatment near to the community (Fetene et al., 2016). However, there are gaps in coordination and management of the policy. Ethiopia's NMCP has weaknesses especially in terms of program management, human resources, coordination, communication and information flow with malaria systems support particularly PFSA, EPHI and program focal persons which are very crucial for effective implementation (Woyessa et al., 2013).

The lack of coordination between NMCP and systems support contributes to the problems identified at all levels in malaria commodities supply management. This is further aggravated by the bureaucratic processes and limited infrastructure of PFSA that lead to distribution being not aligned with the transmission seasons (Daniel et al., 2012). Poor logistics and pharmaceutical information flow, inadequate quantification, and poor transportation to health facilities in the rural areas where most of malaria cases are treated result in health posts stock-outs as the main challenge. Anti-malarial drugs and supplies, LLINs, IRS insecticides are not procured in a timely manner and distributed to the target health facilities or reaching households.

Despite routine malaria surveillance being understood as a crucial component for the NMCP for monitoring and taking timely action, there is currently a critical gap between NMCP management under MoH and EPHI responsible for routine surveillance data. It is difficult for the MoH/NMCP to access in a timely manner and to use surveillance data that are managed under EPHI apart from MoH/NMCP (Jima et al., 2012). The collected information is not quickly informing the NMCP. An active surveillance system especially for elimination parts is not introduced yet and the existing surveillance system is not covering all HPs / malaria kebeles.

Regarding human resources, HEWs are the forefront implementer of both malaria prevention and treatment activities at the community level. Despite an opportunity for malaria program to improve access, HEWs have no proper training on malaria diagnosis and treatment, have rapid turnover to urban areas, are overburdened with tasks of other competing programs, lack refresher training, lack supportive supervision, and interruption of anti-malaria drugs at HPs are affecting the quality of service provision as well as their motivation (Teklhaimanot, 2013). Shortages of trained health workers and frequent turnover at the district level also affect the overall program management at the lower level. Despite a policy support of HEWs, malaria expertise needs attention for program management.

Furthermore, stakeholder support is very important but NMCP is highly dependent on donor aid which is not enough to cover main interventions. The government financial contribution including regional, zonal and district administration is very minimal. Implementations depend on budget from the NMCP even for routine activities like supportive supervision for HEWs. Thus, program monitoring and evaluation at lower levels is very weak. Unfortunately, if the funding stops, the sustainability of the program will be under question. There should be financial contribution at each level as some interventions like IRS insecticides are getting expensive and upgrading surveillance systems need resource and to show program ownership and sustainability.

Generally malaria program management has limited technical oversight and guidance of the overall malaria control program at all levels, lacks coordination, communication and information flow at all levels for local action and for regional and national information for procurement and distribution of supplies and harmonization of activities with systems support. Thus, to further decrease the malaria infections, strong political commitment from the government, and international support and mobilizing resources is crucial to increase the coverage and utilization main interventions.

Low LLINs coverage and utilization

LLIN is the most effective component of malaria vector control. As studies found, it has been proved to reduce malaria incidence, morbidity and mortality in endemic and seasonal malaria transmission. It has a direct relation to increasing child survival and reducing complications during pregnancy. Thus, improving access and utilization of LLIN in the community living in malaria risk areas is important.

In Ethiopia, LLIN coverage and utilization is low. This is one of the key factors for the increase of malaria incidence in the country. This results from inappropriate targeting and maldistribution of LLINs. The low ownership of LLIN is due to limited availability, accessibility for the households in the low socio-economic status. The free distribution is not as per the replacement period and not fully addressing all sleeping beds in the household. The policy is also not targeting the urban dwellers in the malaria cities and daily workers in development projects. The free distribution sustainability is also under

the question of when the funding will stop. Procurement and distribution of LLINs are owned only by government. Absence of a policy support to involve private sectors on LLINs is another factor for the limited availability. However, studies found social marketing of LLINs through public-private partnership would increase ownership and utilization among the target population and in the remote areas.

Despite the limited access and low ownership of LLIN, its utilization also low. The factors are low awareness and wrong perceptions about LLIN, preference of the shape and colour of LLIN, seasonality of malaria transmission, and low socio-economic status. Community participation plays a great role in improving awareness and changing the wrong perception towards LLIN. To support this there is no active IEC/BCC activity for community education and mass mobilization to raise demand.

Low capacity to implement Integrated Vector Management (IVM)

Vector control through IRS has been shown to be effective in reducing malaria morbidity and mortality. It is still used as effective vector control intervention and recommended by WHO/RBM for endemic and epidemic prone countries (RBM, 2015). IRS is highly applicable for seasonal malaria transmission and epidemic prone countries like Ethiopia. In Ethiopia, the capacity for vector control implementation is low. The factors are shortage of trained supervisors, spray technicians and spray men, lack of finance, poor insecticide transportation, storage and management; and shortages of spray pump and spare parts. Inappropriate targeting and poor housing conditions are affecting IRS effectiveness and coverage. This poor planning and implementation of IRS has left many tons of obsolete insecticides in the country which in turn affect the willingness to invest on IRS intervention at the district level. Widespread resistance to insecticides in is another challenge. The program is left with few options and expensive insecticides that require budget and proper targeting according to the epidemiological risk strata. To monitor insecticide residual efficacy and other studies, representativeness of sentinel sites a problem for IRS operation (Yukich et al., 2014).

Insufficient malaria diagnosis and treatment

Studies showed that timely and accurate diagnosis and treatment of malaria is a key element of malaria control program. It mainly depends on provision of good quality service and improving health seeking behaviour. Despite improving access, malaria diagnosis and treatment is partly ineffective at the community level. The factors are lack of trust on HEWs, inadequate capacity of HEWs, anti-malaria supply interruption and low community awareness. In addition, in some health facilities, non-functional microscopes, a lack of laboratory supplies, and a lack of lab technologists affect the provision of good quality services. There is also poor quality assurance system of RDTs and microscope and regulation of private providers' adherence to treatment guideline. It is also important to note IPT intervention is not included in the NSP.

The urgency to address seasonal migrant workers

Currently seasonal migrant farm workers play a key role in Ethiopian malaria epidemiology. Mobile people, especially seasonal migrant farm workers, are a challenge to malaria control efforts. They facilitate malaria parasite transportation to other areas. Each year, a large number of seasonal migrant farm workers are move to seek employment on small and large-scale farms. The seasonal variation of harvesting time creates favourable condition to move from the highland to lowland areas. The highlanders with low immunity migrate to the lowland project areas. In the development corridors /projects, there are no targeted and inadequate malaria control interventions (Schicker et al., 2015). There are no suitable unit structures/shelters for LLINs hanging and IRS application. In some cases there is even no structure for sleeping, with farm workers sleeping under a tree. Health facilities are not available in the sites to provide malaria diagnosis and treatment or public health facilities are distant for farm workers, who also face difficulty finding means of transportation to seek treatment. In addition, there is no coordination among stakeholders; documented data on expected number of seasonal farm workers at each site and the numbers of sites are not well registered. MoH is expecting private owners of the investment will cover the problem. But, there is no existing system to provide malaria commodities and supplies for private farm owners. It also requires country representative study on migrant farm workers and looking for alternative malaria control interventions for migrant workers. It is also important to note that the youth unemployment rate in the country is high which is contributing to the increase of malaria infections.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Despite the scale-up of malaria interventions effort through a markedly expanded HEP, the Ethiopian MCP has weaknesses. There are challenges on all intervention strategies. However, the main challenges are poor program management and implementations, the lack of skilled human resources, the lack of strategic prioritization and stratification of interventions according to epidemiological risk strata, low LLIN coverage and utilization, low capacity to implementation IVM, insufficient malaria diagnosis and treatment, and the need to address seasonal migrant farm workers. These are prioritized in order to accelerate the reduction of malaria incidence and sustain the gains of malaria control.

Addressing the issue of poor program management is very important to improve the overall program performance. The better leadership and program management at the national and regional levels need to provide technical support and improve the lower level program coordination, monitoring and evaluation. Program coordination and alignment of malaria related activities with systems support and in particular malaria commodity supply management and malaria surveillance systems should be improved. A system of accountability and transparency to meet the required responsibilities to improve the program management needs to be established. Failure to address the shortage of skilled human resources and the frequent turnover has limited the technical oversight, guidance, experience and overall program management. In addition, the lack of refresher training and supportive supervision for HEWs affects the quality of services delivery at the community level.

Low LLIN coverage and utilization is another important gap for the increase of malaria incidence. The free distribution of LLINs should be strengthened for targeting children under five and pregnant women combined with community participation and mass mobilizations to create demand and improve utilization. For others there is a need for policy support for private sectors involvement to improve LLINs availability and coverage in the country. Private sector participation through social marketing with voucher mechanisms by government subsidy is crucial in addressing population at risk and remote areas. Thus, involvement of private sectors and other concerned bodies are also important to address seasonal migrant farm workers that become challenge to malaria control. This is important in addressing the program inequity issue.

Low capacity to implement IVM has left behind tons of obsolete insecticides and affects the willingness to invest on IRS in the country. The contributing factors are shortages of trained human resources, spray technicians, and spray pumps and lack of maintenance affects IRS operation effectiveness and coverage. To address the problem, proper planning and targeting high risk areas, train human resources, and improve sentinel sites.

In conclusion, in order to better implement and achieve the NSP objectives in a more effective and efficient way, it is important to improve the overall program management and coordination with malaria systems support, train and supervise health workforce, increase LLIN coverage and utilization, improve the capacity of IVM, improve diagnosis and treatment, and address seasonal migrant farm workers. Political commitment and resource mobilization is also very important to ensure the program ownership and sustainability.

5.2 RECOMMENDATIONS

5.2.1. To improve program management and implementations

- Prioritize high risk malaria areas and migrant workers in order to implement high impact malaria interventions according to their health needs and in line with malaria risk stratification.
- Conduct awareness creation and advocacy for political leaders, program managers and community mobilization on stratified malaria interventions for effective utilization of interventions and limited resources.
- Establish a system of accountability and transparency among malaria systems support (PFSA and EPHI) to ensure the unmet responsibilities are addressed.
- Conduct intensive advocacy and mobilization of political leaders and program managers at all levels to ensure political commitment and program ownership to improve the overall program coordination, management, resource allocation and mobilization at all levels.
- The national and regional program managers should strengthen supportive supervision activities, mid-year and annual program reviews to provide technical support and appropriate tools of program monitoring in order to strengthen program management at lower levels.
- Conduct timely malaria commodities micro planning at each level to solve the procurement and supply chain management at all levels.
- Develop human resources gap analysis at all levels; training need analysis; capacity building and retention strategy with concerned authorities.
- Conduct refresher training to ensure all HEWs are updated and provide quality services of malaria diagnosis and treatment

5.2.2 To improve LLINs Ownership and Utilization

- Strengthen the free distribution strategy of LLINs targeting children under five and pregnant women in a continuous way.
- Pilot social marketing technique of LLINs through public-private partnership with the existing private sectors in the health sector (for-profit and not for-profit) in the county. It needs to develop a policy support for private sectors involvement to ensure accountability and transparency. Therefore, it is recommended to introduce a social

marketing intervention using the private sector and possibly implemented with use of a voucher system with a government subsidy to address the poor and remote areas.
- Provisions of community education (IEC/BCC) activities using different communication tools and conduct mass mobilization in order to improve community awareness and perceptions about mosquito bites and use of LLINs.

5.2.3 To improve IVM implementation

- Strength and expand sentinel sites with skilled human resources and equipments to improve the entomological monitoring and insecticides residual efficacy studies.
- Conduct micro-planning of IRS in order to fulfil all the necessary logistics for IRS operation and appropriately target kebeles/households as per the epidemiological risk strata.
- Facilitate consultative workshop with concerned stakeholders on ways to dispose obsolete insecticides within or outside the country to clear out the occupied stores and reduce its consequences.

5.2.4 To improve malaria diagnosis and treatment

- Build capacity of HEWs and laboratory technicians on confirmatory testing and ensure availability of diagnostic supplies and anti-malaria drugs for all health facilities located in malaria risk areas.
- Provide technical support for HEWs and HDA to mobilize community to improve treatment seeking behaviour and start active case findings in elimination areas.
- Pilot IPT in high risk malaria areas and include in the NSP for pregnant women.

5.2.5 To address seasonal migrant farm workers

- Establish a working taskforce with concerned representatives of MoH, MOA, MoLSA, and Investment Agency, and representative of farmer unions to ensure coordination and share tasks to address malaria in development projects/corridors.
- Conduct an assessment on malaria prevention and control situation in the development corridors or projects to generate evidence for proper planning malaria interventions and target seasonal migrant farm workers.
- Establish and include surveillance systems in development corridors/projects in order to monitor malaria cases trend in this high risk areas.

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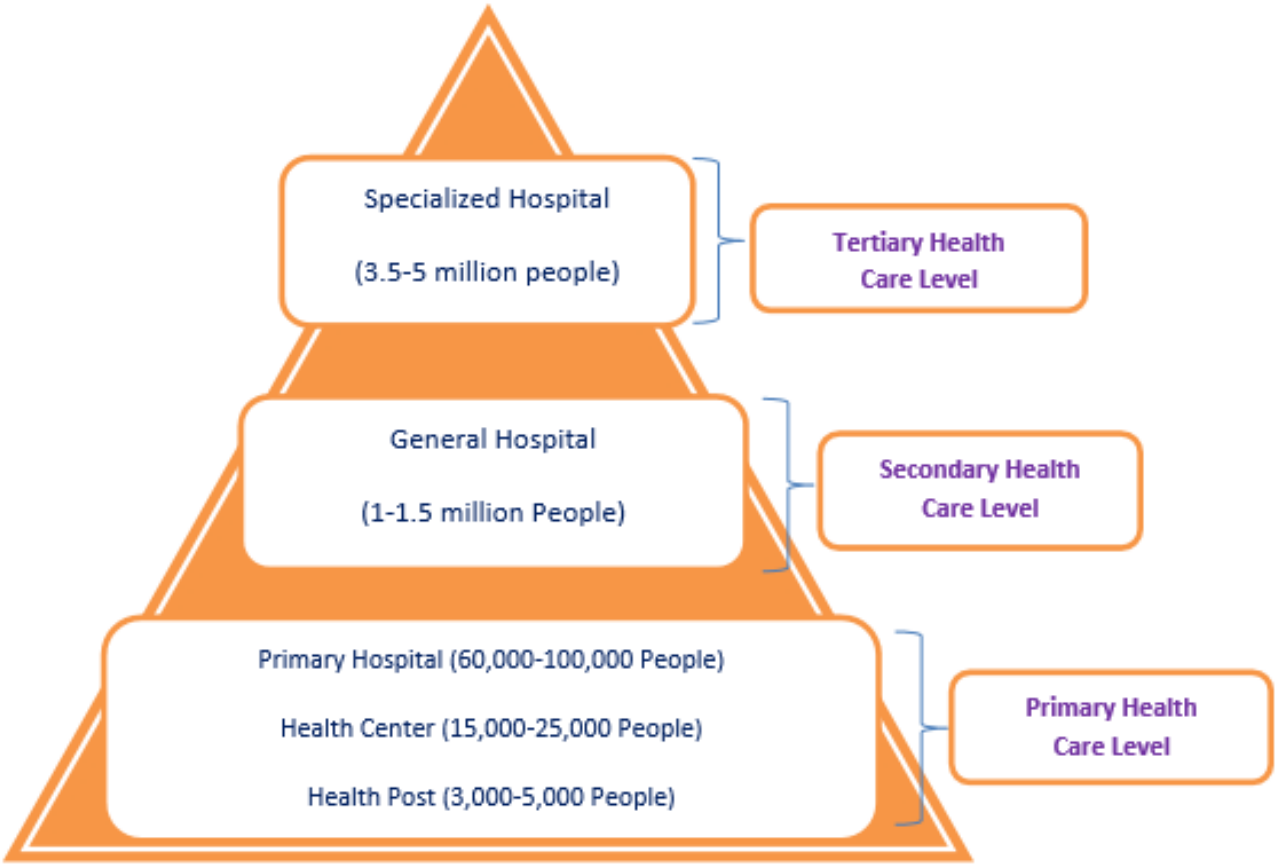
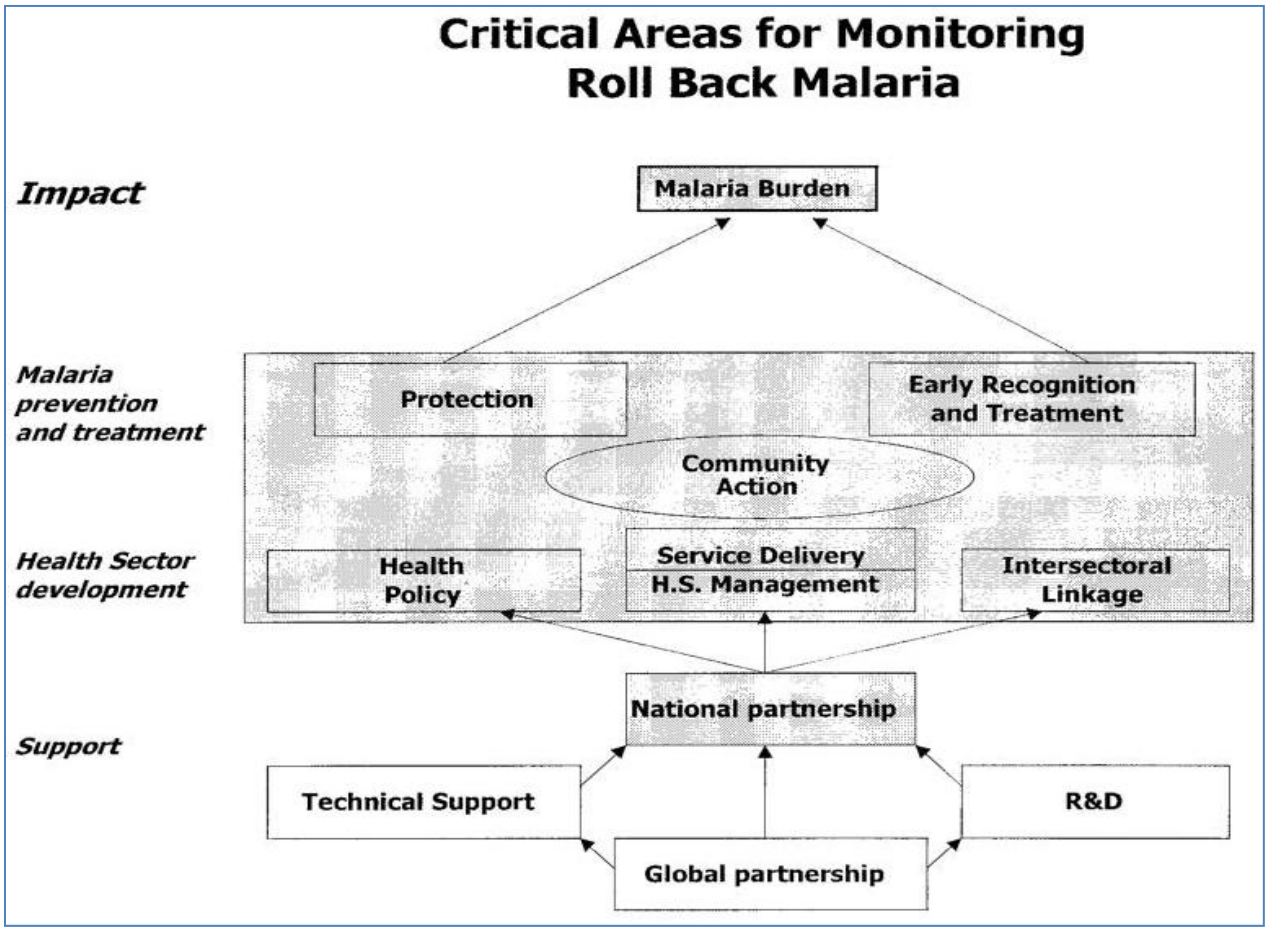
Annexes

A. Ethiopian Health Tier System



Source: Health Sector Transformation Plan 2015/16-2019/20, MoH, 2015(d)

B. Toward a framework and indicators for monitoring RBM



Source: Remme et al., 2001

C. Data on the use of insecticides for malaria control in Ethiopia, 2010-2015

NB: Before 2010, for about five decades DDT (Organochlorine) was used for IRS in Ethiopia.

S/N	Implementation year	Compound/ Product	Class	Formulation	Concentration	Type of application
1	2010	Deltamethrin	Pyrethroid	WP	2.5%, 25%	IRS
2	2011	Deltamethrin	pyrethroid	WP	2.5%, 25%	IRS
		Bendiocarb	Carbamate	WP	80%	IRS
3	2012	Temephos	Organophosphate	EC	50%	Larviciding
		Bendiocarb	Carbamate	WP	80%	IRS
		Propoxur	Carbamate	WP	50%	IRS
		deltamethrin	pyrethroid	WP	2.5%	IRS
4	2013	Bendiocarb	Carbamate	WP	80%	IRS
		Propoxur	Carbamate	WP	50%	IRS
		Deltamethrin	Pyrethroid	WP	2.5%	IRS
		Temephos	organophosphate	EC	50%	Larviciding
5	2014	Bendiocarb	carbamate	WP	80%	IRS
		Propoxur	Carbamate	WP	50%	IRS
		Temephos	Organophosphate	EC	50%	Larviciding
6	2015	Propoxur	carbamate	WP	50%	IRS
		Bendiocarb	Carbamate	WP	80%	IRS

WP: wettable powder; EC: emulsifiable concentrate

Source: Management Strategy for Malaria Vector Control in Ethiopia, MoH, 2015(c)