THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE
DEPARTMENT OF COMMUNITY MEDICINE

Factors Influencing Utilization of Malaria Rapid Diagnostic Tests in Chipata District's Rural, Peri-urban and Urban Health Centers in Eastern Province.

By

Mutinta Siatwinda Malama

Thesis submitted in partial fulfilment of the requirement for the award of Degree in Masters of Public Health.

UNZA 2010

DECLARATION

I hereby declare that this report has not been submitted for a Degree in this or any other University.

Full Names: Mutinta Siatwinda Malama

Signature: .....

Date: 13/07/10

Approval - supervisor

I, the undersigned have read this dissertation and have approved it for examination

Proffessor K. Baboo Date ..... Signature 13/07/2010

Approval - Examiners

This dissertation for Mutinta Siatwinda Malama is approved in partial fulfilment of the requirements for the award of the Degree of Master in Public Health by the University of Zambia

Examiner's Signatures	**Date**
Name: DR S.H. NZALA	
Signature:	13/7/10
Name: Prof S. SIZYA	
Signature:	14/7/10
Name:	
Signature:	.....

Head of Department

Name: Dr C Michelo

Signature: 14/7/10

[redacted]

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: +260-1-250753
E-mail: unzarec@unza.zm or unzarec@zamtel.zm

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

Assurance No. FWA00000338
IRB00001131 of IORG0000774

18 December, 2009
Ref.: 003-11-09

Ms Mutinta Siatwinda Malama
Department of Community Medicine
UNZA School of Medicine
LUSAKA

Dear Ms Malama,

RE: SUBMITTED RESEARCH PROPOSAL: **"UTILIZATION OF MALARIA RAPID DIAGNOSTIC TESTS IN CHIPATA RURAL AND URBAN HEALTH CENTRES IN EASTERN PROVINCE"**

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee meeting on 24 November, 2009 where changes were recommended. We acknowledge receipt of the revised proposal with corrections/clarifications. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat)
- **Ensure that a copy of final results of the study is submitted to this Committee.**

Yours Sincerely,

Dr James Manthali
A/CHAIRPERSON

Date of approval: 18 December, 2009 **Date of expiry:** 17 December, 2010

ACKNOWLEDGEMENT

My greatest appreciation is rendered unto my God the Almighty for seeing me successfully through the MPH course and this dissertation. When He begins a good thing, He is able to bring it to successful end, with much grace and beauty.

Secondly I would like to thank my academic Supervisors: Professor K.S Baboo, University of Zambia Department of Community medicine and Dr Cosmas Zyaambo, University of Zambia Department of Community medicine for their patience and guidance.

I am equally grateful to Chipata District health management team and the Health Centre staff for their enormous support. I would also want to express my appreciation to Ministry of health for funding this dissertation.

Here I cannot fail to mention my course coordinator Dr Wilbroad Mutale for the academic support offered. To the entire team I say thank you very much.

My dear husband, Dr. Kennedy Malama, May God richly bless you. With you I only have to dream and decide to take it on and your support is guaranteed.

Thank you.

I am also grateful to the entire family for bearing with all the inconveniences just to get me through with this work.

Finally my profound gratitude goes to my lovely classmates for their support and encouragement.

ABSTRACT

Rapid and accurate diagnosis is fundamental to effective management and control of malaria. In Zambia the Integrated Technical Guidelines (ITG) for Frontline Heath Workers and the National Integrated Management of Child Illnesses (IMCI) framework stipulate how malaria should be managed. Challenges have been identified with respect to delays and inaccuracy in malaria diagnosis. This study aims at determining the level of utilization and the factors that contribute to utilization of Malaria Rapid Diagnostic Tests (MRDTs) at the district health centres.

A Cross-sectional research study was conducted in Chipata's 13 district health centres and were sampled proportionate to size using rotary technique. A sample of 42 health workers who routinely diagnosed malaria using RDT were interviewed using provider interview questionnaire and a records review of a sample of 26 facility records generated from January 1st to June 30th 2009 was done using a checklist. A sample of 13 Non participant observations were done on each health worker performing MRDTs on the assessment day in all the selected health centres. Qualitative data was analysed using NVIVO software version 2.1 computer package and quantitative data was analysed using the SPSS computer package version 17.

RDT utilisation in the 13 heath centres was above the 2008 district reference level of 30%. The μ RDT group utilization was 64 (± 1SD = 5.99). The lowest utilisation value was 55% and the highest was 73.10%. There was not a time when all the guidelines (ITG, IMCI and Job aid) were available in the selected centres. 21(50 %) of the health workers interviewed were trained. only 4 (30.8%) workers demonstrated high skill for health practice. Out of 42 health workers 2 (5%) had regular supervisions and 40 (95%) had irregular supervisions. The μ group knowledge was 4.66 (± SD 1.66) as the average knowledge level was graded at 4- 6. In all the health centers there was at least one staff designated to perform MRDTs every day. Staff attitudes towards MRDTs were, poor n= 27 (64.3%), average n =13 (40%) and good n= 2 (5%).

The RDT program in Chipata District is yet to meet the set national target of 80% utilization rate. There is need for well-designed technical support supervision program, improved practice (skill), provision of guidelines as well as training to ensure high RDT utilization in areas where microscopy is unavailable or not practical.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ACT	Artemisinin-based Combination Therapy
CHW	Community Health Worker
CSO	Central statistics Office
CQ	Chloroquine
GFATM	Global fund to combat AIDS, Tuberculosis and Malaria
HRP-2	Histidine-Rich Protein 2
IMCI	Integrated Management of Childhood Illness
ITG	Integrated Technical Guidelines for frontline workers
MIS	Malaria Indicator Survey
MRDT	Malaria rapid diagnostic test
MRDDs	Malaria rapid diagnostic devices
NMCC	National Malaria Control Centre
NMFI	Non-Malarial Febrile Illness
NPV	Negative predictive value
P. falciparum	Plasmodium falciparum
P. vivax	Plasmodium vivax
PLDH	Parasite Lactate Dehydrogenase
PPV	Positive Predictive Value
PT	Presumptive Treatment
QAP	Quality Assurance Project
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SP	Sulphadoxine-Pyrimethamine
SPSS	Statistical package for social science
SSA	Sub-Saharan Africa
TDR	Research and Training in Tropical Disease
UNDP	United Nation Development Plan
USAID	United States Agency for International Development

WHA	World Health Assembly
WHO	World Health Organization

CHAPTER ONE – INTRODUCTION

1.1 Background to the Study

Malaria is the leading cause of visitation to health facilities for all age groups in Zambia and accounts for up to 40 percent of all infant mortality and 20 percent of all maternal mortality in Zambia (MoH, 2008). The disease is particularly more prevalent in the rural parts of Zambia than in urban areas. Children and pregnant women remain at higher risk, (Albin and Nesbit, 2008). This makes it an urgent health priority because children and pregnant women are more vulnerable.

Currently the poorest 20% of the world's population bears 58% of the malaria burden, and receives the worst standard of care (Breman, 2004) including the process of diagnosis. Recent advent of rapid diagnostic tests (RDT) for malaria is a significant step forward in case detection, management and reduction of unnecessary treatment (WHO, 1999). With proper implementation, utilization of RDT could make close-to-home diagnosis available in community settings, thus improving the possibility for timely treatment and management of the disease (Egwang, 2007). WHO currently makes recommendations that parasite based diagnosis should be used in all cases of suspected malaria with the possible exception of critical conditions, (Samuel et al, 2008) in order to provide prompt and effective case management.

The 2005 World Health Assembly (WHA) specified that malaria cases and deaths per capital should be reduced by greater than or equal to 50 % between 2000 and 2010, and by greater than or equal to 75 % between 2005 and 2015 (WHO, 2008). The 2006- 2011, Zambia National Malaria Strategic Plan outlined a multifaceted approach to the country's roll back malaria (RBM) program including among other things, providing prompt and effective case management. The diagnosis and treatment of malaria within 24 hours of the onset of symptoms, is a principal objective in the management of malaria in Zambia (National Malaria Control Centre, 2007a) and Font et al, 2001 specified that Malaria control largely relies on the diagnosis and prompt treatment of confirmed cases through the health care facilities.

Malaria cases form important reservoirs for transmission and managing them effectively is critical. Microscopy remains the most established and widely used technique in confirming blood parasitaemia. However, the lack of microscopic examination in most health facilities means that health workers have to rely on clinical suspicion to treat malaria (Font et al 2001). A study done in Zambia by Hamer et al 2007 in 104 health facilities randomly selected in four (4) districts revealed that of the patients with fever (suspected malaria) treated in health facilities for malaria, only 27.8% were subjected to malaria diagnosis and 44.6% had positive test results. Rapid Diagnostic Tests (RDTs) have a place as an alternative to diagnosis based on clinical grounds or microscopy in some situations, particularly where good quality microscopy services cannot be readily provided.

Malaria RDTs have now been integrated into routine practice in several national malaria control programmes including among others, Thailand, Cambodia, and South Africa (WHO, 2003a). Studies done in India (Singh et al 2005) and Uganda (Guthmann et al 2002), revealed that overall specificity, sensitivity, and accuracy of RDTs were > 90 % in areas of different endemicity. This shows that RDTs can be widely used to control malaria. The 2008 Malaria Indicator Survey (MIS) for Zambia reported that, the rollout of artemisinins- combination therapy (ACT) is now complete and RDTs for malaria are available nationwide (MoH 2008b). The introduction of rapid diagnostic tests in most health centers has increased diagnostic services to 73 % of all health centers in the country, (Hamer et al 2007) and it was seen as an accurate alternative in regions where microscopy is not available or not a practical method of diagnosis (Albin and Nesbit, 2008). It is therefore mandatory that provision of RDTs is accompanied by a major change in clinical treatment of patients presenting with a fever (Hamer, 2007).

It is however regrettable that RDTs in Zambia are grossly underutilized as only 27.8 % of all malaria treated cases are subjected to a malaria diagnostic test (Harmer et al, 2007). This undermines the importance of prompt diagnosis and treatment in order to shorten the course of the illness, prevent the illness from becoming severe, prevent death or sequelae from severe malaria and prevent transmission of malaria (MoH, 2004).

Guidelines have been developed by WHO on, performing the test, interpreting the results and acting on the results in order to set a minimum standard for utilization of RDTs (WHO, 2004c). In Zambia guidelines on how to perform RDTs have also been developed by the NMCC (NMCC, 2007a) and the 2009 Integrated Technical Guidelines (ITG) for Frontline Heath workers, (MoH, 2009c), has stipulated that all fever cases or temperature above 37.5 degrees Celsius must be diagnosed with malaria RDTs in facilities were microscopy is not available. Meanwhile the 2007 Integrated Management of Child Illness in Zambia has also guided that all fever cases or temperature above 37.5 degrees Celsius in children less than 5 should be subjected to a RDT (where microscopy is unavailable) unless in critical condition, (MoH, 2007).

The WHO further emphasized that health workers need to be motivated to perform RDTs as they have now been integrated in routine practice, (WHO, 2003b). Supervision and training of health workers to the maximum utilization of malaria RDTs is well documented (WHO, 2004b). The National Malaria Control Center in collaboration with cooperating partners has since 2007 been training health workers of various categories to enable them perform RDTs in order to increase RDT utilization level, (NMCC, 2007b).

Studies done in Sub- Saharan African settings have shown that there are a number of factors that are linked to under utilization of RDTs. For instance, Moonasar et al 2007 study in South Africa revealed stock-out of RDT , inadequate storage facilities and monitoring, nurses relying on clinical judgment to treat, limited training on the use of RDT as some of the challenges in utilization of RDT. Reducing or eliminating factors that influence under utilization of RDTs in Zambia would increase utilization of RDTs and consequently manage malaria effectively to reduce mortality and morbidity of malaria and other diseases. It is therefore necessary to explore the factors influencing under utilization of RDTs.

1.2. Problem Statement

According to the Eastern Province Ministry of Health Annual Report for 2008, malaria was the major cause of hospital admissions in the province, accounting for 55% of the total 57,120 admissions with an incidence of 374.3 per 1000 population and 26.9% case fatality for the whole province, (MoH, 2009a). In Chipata District alone, the total suspected cases for malaria for 2008 was 156,229 with incidence of 334 per 1000 population, (MoH, 2009b). These figures are worrisome as they fall short of the National target of 20 case fatalities per 1000 cases (MoH, 2005b). One of the problems linked to high case fatalities is inability or delay in malaria diagnosis which could be hastened if MRDTs were routinely used. The government of Zambia set a target that at least 80% of suspected malaria patients must be correctly diagnosed by December 2008 and maintained through 2011 (MoH, 2005a). However, for Chipata District like surveys elsewhere and in some parts of Zambia (MoH, 2004 and Hamer et al., 2007) there was a serious departure from the 80% norm. The diagnosed cases (confirmed) in Health facilities in Chipata District in 2008 were 46, 868 accounting for only 30% of suspected cases in all age groups compared to 156,229 total malaria attendances (MoH, 2009b).

A study done in Zambia (Baboo et al 2008) demonstrated MRDTs having sensitivity of 96.1%. A study carried out in Uganda (Guthmann et al 2002) and another study done in India (Singh et al 2005) showed specificity and sensitivity of MRDTs of above 90%. This indicates that there is a great opportunity to achieve the above mentioned targets in Zambia if MRDTs are used as a major diagnostic tool in all the districts of Zambia where microscopy is not readily available.

It must be noted that the problem of under utilization of MRDTs for malaria diagnosis is nationwide (Egwang, 2007) and Chipata District is no exception. At the moment, we have not yet as a district profiled the challenges affecting utilization of malaria RDT within Chipata. We do not know if availability or use of guidelines is a factor in performing a test or whether it has to do with the health worker's attitude. It also leaves researchers to speculate whether inadequate supervision and very limited training on the use of RDT at the Primary Health Care level may be factors

(Moonasar et al 2007). Inadequate staffing levels may also be a factor influencing health workers to perform a rapid diagnostic test.

1.3. Factors Contributing to Utilization of Malaria RDTS

Utilization of malaria RDT can be faced with many challenges which may result in low utilization of these diagnostic tools. Issues of staffing levels may contribute largely in utilization of the malaria RDTs. For example, health workers are less likely to utilize malaria RDTs to diagnose malaria if they have an overload of work. They are more likely to diagnose malaria clinically as it takes less of their time compared to performing a rapid test which takes 10 to 15 minutes for the results to show. With more clients demanding a health worker 'services it is more likely that a health worker will limit the time spent on each client in order to attend to all the clients within the working hours and this may rule out the possibility of performing a malaria RDT. The type of guidelines or instructions may either influence a health worker to utilize or not utilize malaria RDTs. If the guidelines are lengthy involving many steps to follow, it is more likely that the health workers will omit some steps and this may affect the results of the test depending on the step omitted. The inconsistence in the accuracy of the results will discourage the health workers from utilizing malaria RDTs. They are more likely to decide to avoid the whole procedure of performing a malaria RDT and treat malaria based on clinical diagnosis. On the other hand if the guidelines on utilization of malaria RDT are unavailable, the health workers are more likely to ignore the importance of correctly diagnosing malaria as they are used with the traditional practice of clinically diagnosing malaria.

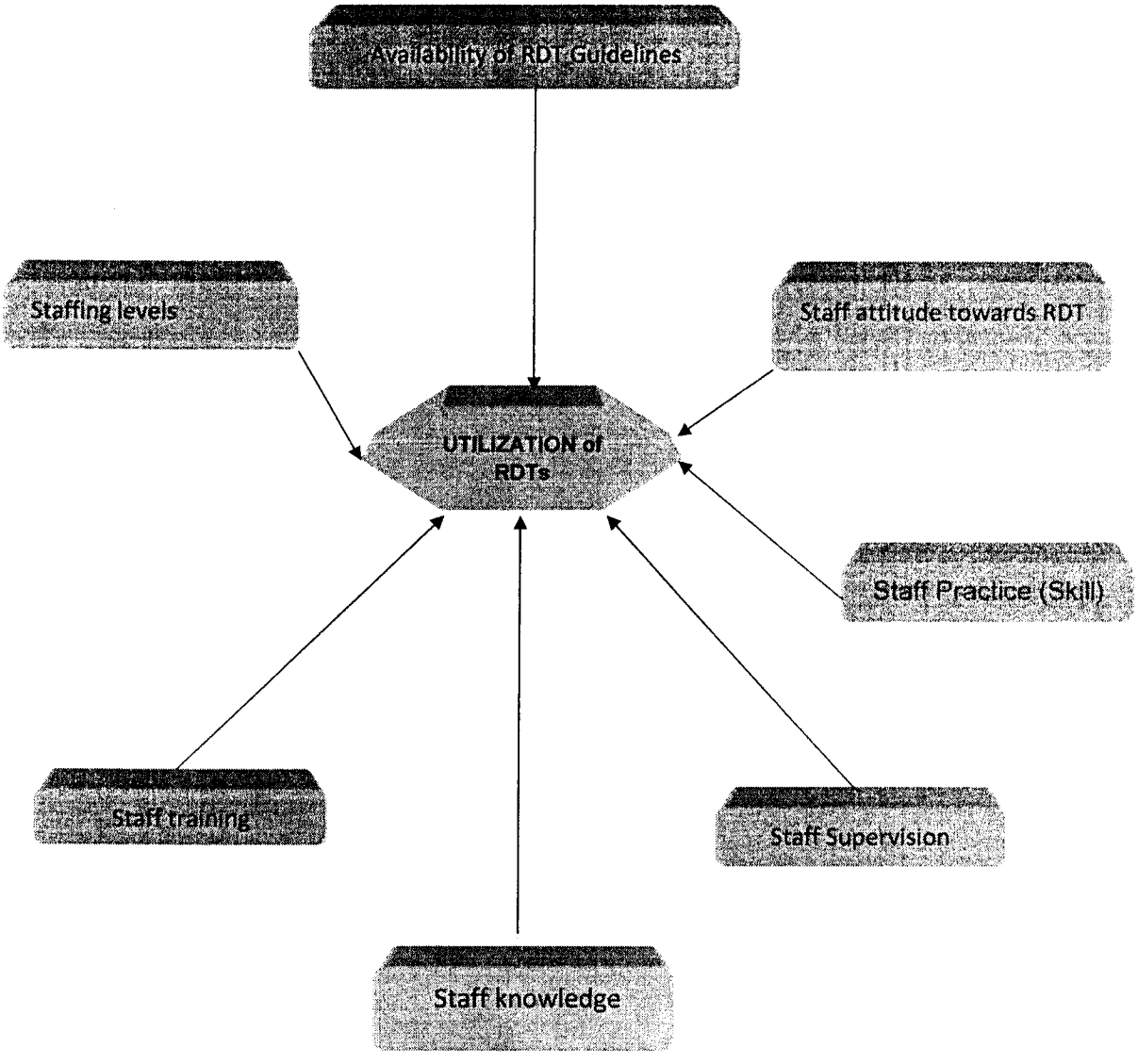
Changing the way of health practice poses its own challenges. The health workers who have been accustomed to a traditional practice of diagnosing malaria clinically are more likely to ignore the need to perform a RDT and continue diagnosing malaria clinically. They may believe so much in their clinical judgement and fail to appreciate the benefits of confirming malaria using malaria RDT. RDT training is also crucial in influencing utilization of malaria RDTs. The RDT training is able to provide the skill needed to perform RDTs. The health workers who have not undergone any formal RDT training are more likely to shun performing MRDTs for fear of making errors

which may eventually affect malaria treatment decisions. The RDT training will give the health worker confidence in performing the test especially that it involves a technique of pricking and withdrawal of blood. The acquired skill after RDT training becomes useful especially for the community health workers who are the majority of those performing the MRDTs in the health centres.

Insufficient knowledge on malaria RDT programme and its procedures may affect health workers utilization of malaria RDT. Health workers may be aware of the need to utilize malaria diagnostic services in order to confirm diagnosis but may have some resistance to perform the tests because of having inadequate knowledge on the importance of confirming malaria cases. The health workers who know and understand the benefits of utilizing malaria RDTs are more likely to utilize malaria RDTs than those who don't. Enough knowledge needs to be provided to health workers on the importance and the benefits of utilizing malaria RDTs. Supervision of malaria RDT utilization provides an opportunity to reinforce the need to perform MRDTs and to check whether it is performed according to the laid down guidelines. The feedback from health workers during supervision allows the authorities to make necessary recommendations in order to encourage utilization of malaria RDTs. Health workers who are often supervised in the utilization of malaria RDT are more likely to consistently perform MRDTs.

The above mentioned factors have been summarized in a conceptual framework shown in the diagram below.

Figure 1.3 Conceptual Frame Work on Factors Associated With Utilization of Malaria RDTs



1.4. Justification

Due to the burden of malaria and its consequences, persistent delays and inaccuracy in malaria diagnosis and treatment this study becomes necessary. The study is expected to inform planning at primary health care and district levels on the challenges that go with malaria RDT utilization. The study will influence future RDT training programs at district level. The study will also make recommendations to encourage proper utilization of RDT in order to assist in prompt case management of malaria in Chipata District. Finally the study is expected to influence increased utilization levels of MRDTs in the health centers and this will increase the number of confirmed malaria cases.

1.5. Literature review

1.5.1. Introduction

Literature review has been arranged and classified according to their focus on one of the following themes:

1. The burden of malaria
2. The need to focus on reliable diagnosis
3. Role of effective Malaria RDT program
4. Limitations of Malaria RDTs
5. Policies and guidelines for malaria RDT
6. Adherence to malaria RDT
7. RDT Training and Knowledge
8. Supervision
9. Health Workers' Attitudes
10. Staffing Levels

This thematization serves as a heuristic device, a convenient way of organizing the work in building answers to the research questions.

Since the researcher is trained in public health, the emphasis of this literature review takes a public health orientation. Nevertheless, examples outside these areas are provided to show that the analytic framework offered can easily be applied to malaria studies from a wide range of disciplines.

1.5.2. The burden of malaria

Malaria is highly prevalent worldwide, with up to 3.3 billion people at risk of malaria in 2006 (WHO, 2008). Of this total, 2.1 billion were at low risk (<1 reported case per

1000 population), 97% of whom were living in regions other than Africa. The 1.2 billion at high risk (> or equal to 1 case per 1000 population) were living in the WHO African (49%) and South –East Asia regions (37%). There was an estimated annual incidence of approximately 247 million cases in 2006 of which eighty six percent or 212 million cases were in the African region (WHO, 2008). In the same year the World Malaria Report shows that an estimated 881 000 malaria deaths occurred in 2006 of which 91% were in Africa and 85% were of children under 5 years of age (WHO, 2008). In 2006, 109 countries were endemic for malaria of which 45 are within the WHO African region that includes Zambia (WHO 2008). In 2007, 4.3 million cases of malaria (confirmed and unconfirmed) were reported in Zambia with 6,149 deaths (MoH, 2008) while Eastern and Northern provinces had the highest annual incidence of malaria, while the disease was lowest in Lusaka province.

Malaria has been estimated to constitute 10% of the overall disease burden in sub-Saharan Africa, being the leading cause of mortality in children aged less than five years and accounting for about 40% of public health expenditure (Adams et al 2004). In Zambia malaria has continued to be pervasive across all sectors of the economy, but the impact is especially felt on the Zambian health sector which is faced with increasing demands on health care for not only malaria but other diseases such as HIV, tuberculosis, and diarrhea to mention a few (MoH, 2006a). Malaria has significant cost implications including direct and indirect economic costs (Sachs and Malaney, 2002) and poses a major setback for economic and other developments. Malaria still presents obstacles to attaining of socioeconomic targets in Africa, with malaria intervention programs costing the continent about $12 billion of its annual gross domestic product (BuaNews/AllAfrica.com reports 2008).

It is reported that over a quarter of a poor family income can be absorbed in the cost of malaria (Malaria Foundation International, 1998) and apart from the cost of prevention , or the opportunity cost of labour lost to illness, each bout of malaria causes its victim to forego , on average,12 days of productive output (Malaria Foundation International, 1998). Furthermore, malaria and fear of malaria may prevent investment and tourism into affected regions, further hampering economic development. In addition the first line treatment for malaria in Zambia, Artemether-lumefantrine (Coartem) is 10 to 12 times more expensive than Chloroquine. (WHO,

2004a). These treatment costs are significant for a country like Zambia with its annual per capital health expenditure estimated at $ US 18 which is lower than the World Health Organization (WHO) recommendation of $ US 33 (MoH, 2006b).

1.5.3. The need to focus on reliable diagnosis.

It has become widely recognized that early diagnosis and effective case management are key to addressing the immediate burden of malaria (WHO 1993; Nabarro and Tayler 1998; WHO 2003b; Keiser and Utzinger, 2004). The clinical symptoms of malaria include fever, chills, perspiration, stiff neck, runny nose, anorexia, headaches, vomiting, malaise, and general danger signs (WHO, 2000a). In much of sub-Saharan Africa (SSA) the decision to treat a patient with an antimalarial is often made solely on the basis of fever, especially for outpatient care (O'Dempsey and McArdle 1993; Chandramohan et al. 2002; Reyburn and Ruanda 2006). The main argument in favour of such presumptive treatment (PT) for malaria is that false negative diagnoses (i.e. failing to identify malaria in a patient) have potentially severe consequences both in terms of health effects and treatment costs. Patients with a false negative diagnosis receive the incorrect treatment and are often sent home leaving them vulnerable to severe malaria and potential death.

Rapid and accurate diagnosis is fundamental to effective management and control of malaria. Modern methods of malaria diagnosis include fluorescent microscopy, flow cytometry, automated blood cell analyzers, serology antibody detection, molecular methods and laser desorption mass spectrometry (Hanscheid 1999). However, conclusive diagnosis still relies predominantly upon clinical presentation and the century old technique of reviewing stained blood smears by light microscopy. Diagnosis by clinical syndrome alone is unreliable (Luxemburger et al. 1998; Bojang et al. 2000, WHO, 2000b; Chandramohan et al. 2002). Light microscopy, the 'gold-standard' in highly trained hands, can provide good sensitivity and specificity while providing parasite density, stage and species differentiation (Kain et al. 1998; Coleman et al. 2002). However, light microscopy is labour-intensive, requires significant technical skills, and can result in therapeutic delays. These diagnostic limitations impact the medical care provided not only in endemic countries at the

periphery of the health care systems, but also in non-endemic areas where the disease is infrequently encountered (Kain et al. 1998).

The introduction of malaria rapid diagnostic devices (MRDDs) in the early 1990s (Shiff et al. 1994) ushered in a new era of diagnosis that was expected to challenge the limitations of other diagnostic tests. MRDDs are intended to allow simple, swift, precise diagnosis of malaria in areas where standard laboratory diagnosis is not available. Ideally, these devices should offer high sensitivity, specificity, rapidity, ease of performance and interpretation, species differentiation, allow for quantitative analysis, and all at an affordable price.

1.5.4. Role of Effective RDT Program

RDT of malaria is gaining increasing importance in health programmes in endemic countries in response to increasing drug costs and recognition of the importance of early, correct treatment to the reduction in malaria morbidity and mortality (WHO 2003a). Prompt Diagnosis and early treatment are vital elements of the management of malaria. Using MRDTs to distinguish fevers caused by malaria parasites from those caused by other illnesses is important for at least three reasons. First, ACT is currently much more expensive than older antimalarial such as sulfadoxine-pyrimethamine (SP) and chloroquine. Rather than giving these more expensive drugs to all patients with fever, MRDTs can help target ACTs to patients who really have malaria. Secondly, many life-threatening illnesses, such as meningitis and acute lower respiratory infection, cause symptoms similar to malaria (fever, chills, malaise, aches, etc.). Treating all febrile cases for malaria means that patients with these other conditions may not get the treatment they really need. Finally, avoiding unnecessary use of ACTs on patients who do not have malaria may help prevent or delay drug resistance; making ACTs effective for a longer period. (The Quality Assurance project and WHO, 2006)

In most of Africa including Zambia diagnosing malaria based on symptoms is normal practice. It is generally estimated that 50 % of Africans who present with fever and treated for malaria may not be infected with malaria parasite, (Medecins Sans Frontieres, 2003). This was actively promoted when malaria treatments were cheap,

safe and easy to use and biological diagnosis was considered too complex and expensive. However this method of diagnosis is very inaccurate, as symptoms of malaria are non specific and may indicate the presence of other febrile infectious diseases, (Medecins Sans Frontiers, 2003)

The result is prolonged and worsening illness and missed opportunities to treat diseases other than malaria, which may be the main cause of illness. Other consequences are the unnecessary use of inappropriate medicines, exposure to potential drug toxicity and wastage of meager economic resources (Barnish et al. 2004). Malaria control and prevention efforts need to be designed for a specific environment in which they will be used and need to take into account the local epidemiology of malaria and the level of available resources. MRDTs can provide parasite-based diagnosis in places where microscopy is not possible or practical. In Zambia utilization of RDT would improve laboratory diagnosis and early treatment for malaria as it requires no special equipments, minimal training is needed, the test and reagents are stable at ambient temperatures, and no electricity is needed.

The introduction of malaria artemisinin combination treatment and rapid diagnostic tests creates an important opportunity to both reduce the burden of mortality from malaria in Africa and improve the treatment of bacterial disease. The MRDTs can be widely applied as a diagnostic tool to control malaria. Studies done among ethnic tribal population in areas of high, low, and no transmission in central India, revealed that overall specificity, sensitivity, and accuracy of MRDTs were > 90 % in areas of different endemicities, (Singh et al 2005). A Study carried out in Uganda revealed similar results (Guthmann et al 2002).

In addition, there are public health reasons for confirming suspected malaria. Over-diagnosis inflates perceived levels of malaria morbidity. It also increases the perceived levels of drug resistance (fever is unresponsive to antimalarials). In areas of high transmission, treatment of patients without parasitaemia leads to unnecessary drug pressure on the parasite by exposing new infections to sub-therapeutic drug levels during their slow elimination phase, (Greenwood 1999).

Beyond diagnosis, the logical utilization of MRDTs is to monitor treatment outcome. As MRDTs can be conducted immediately in the field clinic while the patient is

present, the most important point for a patient is the knowledge that they are infected with malaria parasite as well as dispersing any information for preventive measures of the disease.

1.5.5. Limitations for malaria RDTs

Studies done in Central India detected persistent positivity 24.4 % of treated patients without asexual parasite on day 10 of treatment due to persistent parasite antigen even after the clinical symptoms disappeared and the parasites had apparently been cleared (UNICEF, 2007). Therefore the value of predictability of a test band may be restricted to new, untreated cases. However, the high Negative Predictive Value (NPV) allows to confidently diagnose negative test patients as non malaria patients. The study revealed NPV of 93 %, 99.4 %, 98.4 %, for high transmission area, high to low transmission area and low transmission area respectively. Study also showed that negative result (HRP-2 based rapid test) greatly reduces the probability of malaria, but does not rule out a parasitaemia of greater than 35 000 parasites / µl. (UNICEF, 2007)

Exposure to high temperatures and humidity will have a negative impact on the sensitivity of tests, so that poor storage and distribution conditions are likely to affect the performance of even the best tests, leading to false-negative results. Moreover, the suboptimal sensitivity of some RDT products will give rise to misdiagnosis of malaria. False-negative results – that is, negative RDT results in patients who have malaria parasites – are of particular concern, especially in those individuals who are most vulnerable to severe malaria and death (WHO, 2004a).

Despite limitations, post survey study of all the personnel directly involved in the performance of the RDT were of the opinion that the test was easy to use, decreased stress and potential delay in the diagnosis of falciparum malaria in the field. In another study in India it was shown that RDT could facilitate the early diagnosis and an appropriate therapy in patients with cerebral malaria thereby reducing mortality especially in situations where health services are deficient or absent, (Singh and Saxena, 2005, Singh and Nagpal 2004).

1.5.6. Policies and Guidelines for malaria RDTs

The WHO, together with UNDP, World Bank, WHO Special Programme for Research and Training in Tropical Diseases (TDR) and Roll Back Malaria (RBM), began some years ago to develop policy on the use of RDTs in malaria diagnosis. The joint WHO and United States Agency for International Development (USAID) informal consultation on New prospective of utilization of MRDTs in 1999 outlined a general approach to these issues and defined certain research needs and standards for the wider implementation of RDTs in malaria management (The Quality Assurance Project (QAP) and the World Health Organization 2006).

As a response to the anti-malarial drug resistance situation, WHO recommends that treatment policies for falciparum malaria in all countries experiencing resistance to monotherapies should be, combination therapies, preferably artemisinin-based combination therapy (Samuel et al, 2004). Three available ACT Combinations have been evaluated for safety and efficacy and are recommended for deployment. They include

1. Artemether-lumefantrine (Coartem);

2. Artesunate (3 days) plus amodiaquine and

3. Artesunate (3 days) plus SP in areas where SP efficacy remains high, (Samuel et al, 2004).

By the end of 2005, Artemisinin-based therapeutic combinations were already being used as first-line regimens in Venezuela, Suriname, Guyana, and Ecuador. Over the last three years twenty countries, (seven in Africa), have updated their treatment policies to include ACTs as 1st-line or 2nd-line treatment of malaria. This was based on WHO advice, and was made possible with the participation of RBM partners including Global Fund to combat AIDS Tuberculosis and Malaria (GFATM) and increased mobilization of international funding. By June 2006, thirty-nine African countries had changed their policies to recommend ACT as the first line treatment for malaria (Olumese, 2006). This was to reduce the adverse effects of failing monotherapies (Snow et al 2001) and to limit the spread of drug resistance. This

represents one of the most significant public health developments in malaria control for decades.

To implement these policies, several key challenges remain: increasing sustainable financing of these expensive treatments, improving access to diagnostic services at health facilities and high quality community-based delivery systems, and ensuring these new drugs are used appropriately during clinical management. Of these challenges, under utilization of diagnostic services leading to inappropriate malaria case-management practices are of particular concern.

According to WHO guidelines, the results of parasitological diagnosis for malaria should be available within a short time of the patient presenting with symptoms. However, there are still some cases in which all patients with fever and in critical conditions should be treated for malaria without parasitological diagnoses. One such case is children under 5 years of age in areas with high malaria prevalence. This is because infection with plasmodium falciparum malaria can lead to rapid death in young children, and RDT results can sometimes be misleading. With this view the management of malaria in children should be guided within a national Integrated Management of Childhood illness (IMCI) framework (WHO, 1999). Another example would be in cases of established malaria epidemics (The quality Assurance Project and WHO, 2006). In Zambia the Revised National IMCI framework clearly recommends utilization of malaria RDT in all fever cases or temperature of 37.5 degrees Celsius or above in children less than 5 unless in critical condition (MoH, 2007). The Integrated Technical Guidelines for Frontline Heath workers (ITG) in Zambia has stipulated that all fever cases or temperature above 37.5 degrees Celsius must be diagnosed with malaria RDTs in facilities where microscopy is not available, (MoH, 2009). Special consideration should be given to the expecting mothers who present with fever with no underlying cause so that they are adequately treated for malaria with or without positive RDT results. The use of IMCI guidelines in addition to ITG and RDT guidelines is an advantage as correct diagnosis of malaria using RDT is highly stressed in the holistic management of children presenting with fever or temperature of 37.5 degrees Celsius or above and therefore reminds health workers to perform RDTs. This ensures effective utilization of RDTs and management of malaria.

1.5.7. Adherence to RDT Utilization Guidelines

The guidelines in utilization of RDT by the end user provide an opportunity for the health workers to perform and utilize diagnostic services proficiently. There are several guidelines and instructions which are pertinent to both the professional health workers and community health workers when providing RDT diagnostic services and these include among others, the time taken for a drop of blood on an RDT strip and for any reaction to take place and the minimum time that should elapse before the result is read. If the capture and control lines show a positive response (i.e. a positive result) before the recommended time, that reading is acceptable. If the strip is left too long before reading, there is the possibility of a "back-flow" of blood and buffer appearing as a positive line and indicating a positive result on previously negative strips. These late results should be ignored. All MRDTs must be read within the time period specified by the manufacturers (WHO, 2004a). It is important for health workers to adhere to the guidelines which have been designed to give optimum RDT diagnostic services to a majority of the populations. In Zambia, the National Malaria Control Centre in conjunction with WHO has devised an RDT Job aid card with step by step instructions to aid in utilization of the tests. Furthermore the RDT job aid cards have been translated in the Zambian native languages to make it possible for all the end users to read it. Appendix V shows a sample of an RDT job aid card.

1.5.8. RDT Training and Knowledge

The training and supervision of health workers that will perform MRDTs are vitally important to the utilization of MRDTs. Ideally training may consist of instructions received on the job as well as information gained in formal courses (WHO, 2004b). One of the prerequisites for the acceptability of MRDTs for use is ease of use, and most current MRDTs are designed to ensure this (WHO, 2004a). Concern has been expressed about the ability of some groups of RDT users (principally health volunteers) to read accurately, to discriminate and interpret the intensity of test lines, or to differentiate between all species on the pan-malaria tests. With adequate training, however, community health workers and health volunteers, medical

assistants and nurse aides can use MRDTs effectively, achieving similar acceptably high sensitivity and specificity. In fact, the widespread use of MRDTs is dependent on the possibility of unskilled health persons routinely carrying out the tests.

Three trials – one in the United Republic of Tanzania (WHO,2003b), another in Uganda (WHO,2003b), and the third in the Lao People's Democratic Republic (WHO,2003b) reported on the results of training village health workers, district health workers and village health volunteers respectively. It was clear that it is possible to train unskilled but willing, individuals to become reliably competent in the use of MRDTs. The outcome of any training session will depend on the motivation of the trainees, the subsequent supervision and interest in their performance. In the three experiences quoted, the training took different forms and was of different duration, indicating that it is the quality of training that is more important than the content and duration of the course (WHO, 2004a.).

Harvey et al (2008), study in Lusaka Zambia, concluded that use of malaria rapid diagnostic tests by community health workers is potentially an effective alternative for malaria case management in areas with limited functional microscopy and limited health care personnel or facilities. Findings from this study showed that a well-designed job aid and brief training can ensure high CHW performance. However, Egwang (2007) study in Zambia concluded that RDT training program in Zambia needs to be restructured such that trainees are provided with clear instructions about how to respond to a negative test result. Building on these findings the National Malaria Control Center has developed RDT field test simplified instructions in local languages and a training curriculum aimed at low-literacy community health workers about the correct use of malaria rapid diagnostic tests.

A total of 40 community health workers per district have been trained in 11 selected districts in Zambia including Chipata Districts in Eastern Province (NMCC, 2007b). The training for community health workers is a 4 days training while for professional health workers it is an orientation of one day. The training provides knowledge / skills on how to carry out the RDT correctly, interpret the results, and how to correctly treat malaria following the provided malaria treatment guidelines. The community health worker training includes a package on home management of malaria in which

community health workers are trained to not only use RDT but treat malaria in the community using the ACT. Study done on RDT error conducted in the Philippines concluded that errors could be minimized with the provision of instruction manuals in native language and that a short orientation on RDT use could further improve accuracy by another 10 %, (Rennie et al 2007).

1.5.9. Supervision

Supervision in RDT utilization will help to minimize the number of false positives and false negatives. A false-positive RDT result (a positive result in the absence of parasite) may result in both the patient receiving antimalarials that are not required and the real cause of illness being overlooked and therefore not treated. In addition, false positive results obtained after previous treatment may suggest that the treatment has not worked (treatment failure) and result in unnecessary re-treatment with anti-malarial. At the moment the most common cause of false- positives is probably back- flow , resulting from the test results being read after the time recommended by the manufacturers, (UNICEF, 2007). A false negative result may have far more serious consequences, such as the patient not receiving any anti-malarial treatment or being given inappropriate medicines. Studies done in Tanzania and Uganda however show that false- negative result occurred in cases with low-level parasitaemia such as < 40 parasites / ul blood and < 100 parasites / ul blood respectively, (WHO 2006 and Guttmann et al 2002).

1.5.10. Health Workers' Attitude

It is expected that there will be risks involved with the introduction of MRDTs into any area for the first time. It may be difficult to persuade health workers that MRDTs are more reliable than clinical diagnosis and that treatment should be given according to test results. Over-diagnosis of malaria on this scale also threatens the sustainability of deployment of artemisinins combination treatment. Egwang (2007) study done in Zambia revealed that use of Artemether-lumefantrine in patients who did not have any parasitological diagnostic evaluation was 42.1 % overall. This practice is not unique to Zambia alone and probably reflects the greater problem of over-treatment

with antimalarials in Africa. This over-treatment in the era of costly ACTs probably constitutes a significant financial burden to the economies of resource-poor countries which have to address other pressing development problems.

After years of relying on clinical diagnosis alone, it is likely that some health workers will not believe negative results and will prescribe antimalarial treatment regardless of test results. In addition, health workers may be over-reliant on positive malaria results (the demonstration of concomitant illness in an asymptomatic, but positive, malaria patient (WHO, 2004b). Furthermore health workers may use the MRDTs as screening tools (testing every patient "just to be sure") rather than to support clinical diagnosis in symptomatic patients (WHO, 2004b). Such practices may lead to RDT mistrust and eventually cause health workers to continue diagnosing malaria clinically.

1.5.11. Staffing Levels

Appropriate and adequate human resource is critical to maximally manage the health services in order to facilitate effective and efficient diagnosis of malaria. The current health sector human resource capacity in Zambia is estimated at about 50 % of the recommended establishment, (MoH, 2006c) and this would negatively affect the level of utilization of Malaria RDTs. Rapid Diagnostic tests, in simple kit form, can provide results based on fingerpick or venous blood within minutes. Mayxay et al. 2004 revealed that community health workers can utilize MRDTs after as little as an hour of training. This demonstrates that community health workers would be ideal to perform and interpret the RDTs in situations where staffing levels are inadequate.

CHAPTER TWO - OBJECTIVES

2.0. Research Question

This study was predicated on two research questions:

1. What is the level of malaria RDT utilization in Chipata District?
2. Why are there levels of such magnitude?

2.1. Hypothesis

To link up with the why question and drawing from the conceptual model figure 3.1, one main hypothesis was to be tested which is:

HO: there are no factors associated with utilization of malaria RDTs in Chipata District.

2.2. Main objectives

Drawing from the research questions, the main objective of this study is:

To determine the level of utilization and the factors that contribute to utilization of MRDTs in selected health centres in Chipata District.

2.3. Specific Objectives

In order to achieve this aim, the study intends to:

1. To determine the use of the guidelines for performing MRDTs during the period under study (1st January 2009 to 30th June 2009) in the selected health centres.

2. To determine the availability of the guidelines for performing MRDTs during the period under study (1st January 2009 to 30th June 2009) in the selected health centres.
3. To compare utilization of MRDTs during period under study against the number of malaria RDT trained health workers in the selected health centres.
4. To describe any variations in MRDT utilization in selected health centers in relation to staffing levels.
5. To determine the level of knowledge health workers have in performing MRDTs.
6. To assess whether health workers are meeting expected health practices in performing the MRDTs and how often they are being supervised.

CHAPTER THREE- RESEARCH DESIGN AND METHODOLOGY

3.0. Study Design

In order to meet the set objectives, a cross-sectional research study was chosen. A cross-sectional research was chosen because the researcher collected data on what was going on at only one point in time (January 1st to June 30th 2009). From this the researcher intended to compare different study units on particular attributes

3.1. Study Setting

The study was conducted in Chipata District which is located in the eastern province of Zambia. Chipata District covers an area of 6,112 square km, with a population of 486,953 and a population growth rate of 2.8% (CSO, 2000). The district has 70% of its population being rural and 30% urban. Chipata District has 39 health centers. It has 238 community health workers of which 127 are active (Chipata District action plan / budget, 2009-2011). The district also has Chipata general and Mwami Adventist hospitals. The main industries are cotton ginnery, Cargill cotton marketing company. The Government is the main employer accounting for 25%. Other major employers are the Municipal Council and non-Governmental organizations. 35% of the people in employment are self employed. The town centre consists of traditionally built buildings mainly of one or two storey, with a sprawling, tightly packed market area. Houses in the town are predominately brick built with metal sheet roofs and most have electricity and running water. In the surrounding villages, houses are smaller and usually built from handmade clay bricks with thatched roofs.

The population's per capita income is less than US $1 per day in the rural population. Nearly all residents in the villages are peasant farmers and not in gainful employment with the majority possessing only very basic education or none at all.

This study was conducted in 13 health centres drawn from 39 health centres. These health centres are clustered in three (3) geographical zones of peri-urban 3 (8%), urban 5 (13%), and rural 31(79%) areas. Socio-demographically, the health centres are different. Some health centres have low patient loads and others have high patient loads. The three clusters provided a proportionate sample of 1:2:10 respectively as the population distribution. Only those health centres that satisfied optimum inclusion criteria were selected based on: (i) the availability of previous information regarding reliability of monthly returns data. The centre therefore ought to have had records of suspected malaria cases and RDT consumption data generated from 1st January to 30th June 2009 (ii) health workers ought to have worked for at least six months (January 1st to June 30th 2009) in the same health centre under study and (iii) the centre ought to have staff trained or sensitised in RDT

3.2. Study Population

In order to present the sought reality and from which explanations on determinants of utilization may refer, the decision to include all staff was made for the explicit purpose of obtaining the richest possible source of information to answer the research questions.

3.3. Sampling and Sample Size

3.3.1. Sample size

A sample of 42 health workers who routinely diagnosed malaria using RDT were interviewed using provider interview questionnaire and a records review of a sample of 26 facility records generated from January 1st to June 30th 2009 was done using a checklist. A sample of 13 Non participant observations were done on each health worker performing MRDTs on the assessment day in all the selected health centres.

3.3.2. Sampling Health Centres

There are 39 health centres in Chipata District and these have been **clustered** in three (3) zones of Urban 5((13%), Peri urban 3(8%) and rural 31(79%) centres.

Considering the limited time and the cost of conducting study the researcher used sampling with replacement technique , sampled one **third** (1/3) of the total health canters to give 13 health centres of the existing 39 health centres. Noting that the health centres are not proportionate numerically within the clusters, the researcher opted to sample the centres proportionately to size. This gave representation number of 1, 2 and 10 health centres for urban, peri urban and rural health centres respectively. Following this, each cluster of health centres was subjected to simple random sampling using the rotary technique.

3.3.3. Sampling Health Workers

In order to draw sampling units for study, all health workers who were found at the health facility and who met the inclusion criteria were enlisted on the spot for the study. This was because the health centres are poorly serviced and as such each health worker was given an opportunity to be selected. During the process of randomisation, all health workers belonging to one health centre were assigned two codes. One for personal identification and the other for the health centre.

The Inclusion criteria were:

- Only health workers who would have worked for at least six months (January 1st to June 30th 2009) in the same centre under study were eligible for study.
- Only records of suspected malaria cases and RDT consumption data generated from 1st January to 30th June 2009 were eligible for review.
- Only health centre RDT training and support supervision registers containing data generated from1st January to 30th June 2009 were eligible for review

The exclusion criteria were:

- All Health workers who would have not worked for at least six months (January 1st to June 30th 2009) in the same centre under study were not eligible for study.

- All records of suspected malaria cases and malaria RDT consumption data that were not generated within the stated period were not eligible for review
- All health centre malaria RDT training and support supervision registers not containing data generated from1st January to 30th June 2009 were not eligible for review.

3.4. Data Collection Tools

The study involved the collection of quantitative and qualitative data. Three methods used were:

1. Provider interview: This was a researcher administered questionnaire that was used to collect fixed responses from all providers present on the day of the assessment who routinely diagnosed malaria using RDT. This questionnaire assessed acceptability, knowledge and practice in performing RDT. It also reviewed training, staffing, supervision and the availability of guidelines.

2. Facility Record Review: A checklist was used to collect information on the number of MRDTs performed from January 1st 2009 to June 30th 2009. It collected information on the number of suspected malaria cases treated for malaria from January 1st 2009 to June 30th 2009. The checklist also collected information on malaria RDT training and supervision generated from January 1st to 30th June 2009.

3. Non Participant Observations and One to One Interviews: Malaria RDT guidelines and facility records frame provided a structure for observing how providers utilized or performed malaria MRDTs and asked questions on what was observed. For each facility a minimum of one provider was observed un arranged.

3.5. Procedure

Data was collected during working hours and at other times when the workload was less. The researcher had an opportunity to be with one member of staff at each health centre and examined and documented evidence from records of MRDTs done and total number of antimalarial prescriptions. The number of prescribed antimalarials gave the researcher the number of malaria cases which had been diagnosed (clinically and / or confirmed) from January 1st 2009 to June 30th 2009.

- Records of prescribed antimalarials were checked for at least two days to see how many antimalarials were prescribed from January 1st 2009 to June 30th 2009. The number of prescribed antimalarials gave the researcher the number of clients with suspected malaria cases who could have been diagnosed using MRDTs from January 1st 2009 to June 30th 2009.
- Records of MRDTs were examined to see how many tests were done (number of positive and negative tests) in each health centre from January 1st 2009 to June 30th 2009.
- RDT training and support supervision registers were examined in the company of the health worker to check for the number of health workers trained in RDT and how many supervisory activities were conducted in each selected health centre from January 1st 2009 to June 30th 2009. This allowed an opportunity to make inquiries on interesting findings.
- Health workers involved in performing MRDTs on that day were observed and interviewed using questions related to the research variables.

3.6. Operationalisation of Variables

In this study, the following were the research variables:

Independent variable

Independent variables are factors associated with utilization of malaria RDTs. These factors include: availability of RDT guidelines, staffing levels, staff training, staff knowledge, staff supervision, staff practice (skill) and staff attitudes towards RDTs.

Dependent variable

The dependent variable is utilization of MRDTs which is the observed numeric value of MRDTs done in all malaria attendances that received antimalaria treatment at a health centre. This utilization was measured at three levels as follows: very low counts (less than 59%), low counts (between 60 and 69%) and average counts (between 70% and 79%) and high counts exceeding the threshold of 80%. To compute the numeric value of utilization the formula RDTs done/ total malaria cases was used.

Table 3.6.1 Description of Research Variables

Variable type	Operational definitions	Conceptual definitions
Dependent variable		
Utilization of malaria Rapid Diagnostic Test	Malaria RDT positive result(Checklist)	• Proportion of persons who have clinical signs of malaria diagnosed using a Rapid Diagnostic Test kit and results were positive from 1st January to 30th June.
	Malaria RDT negative result(Checklist)	• Proportion of persons who have clinical signs of malaria diagnosed using a Rapid Diagnostic Test kit and results were negative from 1st January to 30th June.
	Malaria attendances	• Number of persons treated for malaria from 1st January to 30th June.

Independent variables:	Operational definitions	Conceptual definitions
Availability of RDT guidelines	The guidelines required to perform a test by the MRDT programme	Proportion of health centers who have an MRDT job aid card , IMCI guidelines and ITG guidelines
Staffing levels	Availability of staff performing MRDTs	At least one member of staff is available to perform MRDTs
Staff Training	Health workers training (number of health workers trained in MRDT) using– A guide for training at village and clinic level manual.	The pro portion of health workers formally trained and sensitized.
Staff Supervision	Health workers are offered technical support on performing the MRDT and feedback is given. (by the district health authorities or provincial health authorities)	Proportion of 2 out of the 2 planned supervisions in a quarter. (under the period of study we expected 4)

Staff Knowledge	**The use of malaria MRDTs** **The importance of MRDTs in malaria control?** **Limitations for malaria MRDT** **Knowledge on the action to be taken for positive MRDT results?** **Knowledge on the action to be taken for negative MRDT results?**	• **Proportion of health workers that can cite the use of malaria MRDTs** • **Proportion of staff citing correctly at least 2 of the 3 advantages of using a RDT to diagnose malaria.** • **Proportion of staff citing correctly at least 1 of the 2 disadvantages of using MRDTs for diagnosing malaria.** • **Proportion of health workers who will cite correctly that positive test results need to be treated for malaria.** • **Proportion of health workers who will cite correctly that a negative test result need to be managed using national guidelines for managing febrile patients following negative RDT results**
Staff Practices (skill) Staff attitudes towards RDT	Conducting a malaria MRDT Criteria used to perform a MRDT. Actions taken following positive MRDT results? Actions taken following negative MRDT results?	• Proportion of health workers who will be able to follow steps on a - Job aid guideline, (when performing a MRDT). • Proportion of health workers citing correctly the clinical signs and symptoms to consider in order to perform a MRDT • Proportion of health workers who will agree treating a person for malaria following positive MRDT results? • Proportion of health workers who will agree using the national guidelines for managing febrile patients following negative MRDT results. • Proportion of health workers who will strongly agree that MRDTs can be used to diagnose malaria and consequently reduce the burden of malaria.

Socio-demographic characteristics		
• **Sex**	Health workers gender	• Female • Male
• **Experience in RDT program.**	Number of months of experience in RDT program	• 1-2 months • 3-4 months • 5-6 months • 7 months above
Profession	Health workers profession	• Nurse • Clinical officer • EHT • Others
Health centre	Geographic distribution of the health centers where the interviews are taking place	• Urban • Peri urban • rural

Table 3.6.2 Description of Variables, Cut off Points and Indicators

VARIABLES	CUT OFF POINT	INDICATORS
INDEPENDENT		
Staff Knowledge	High	If one scores 7 and above points
	Average	If one scores 4 - 6 points
	Low	If one scores 3 points
Staff supervision	Regularly	If 2 technical support supervision (TSS) occurred in each quarter.
	Irregular	If 1 or non technical support supervision (TSS) occurred in each quarter.
Staff training	Trained	Formal training
	Untrained	Sensitization only
Staffing levels	Adequate	At least one staff designated to perform MRDTs every day and other staff to meet daily loads and tasks
	Inadequate	Staffs not available to perform MRDTs every day and meet daily loads and tasks
Availability of RDT guidelines	Excellent	If one scores 3 points
	Poor	If one scores less than 3
Staff attitudes towards RDTs	Good	If one scores 3 points
	Average	If one score 2 points
Staff practice (skill)	Poor	If one scores 1 points
	Good	If one scores 7 and above
	Poor	If one scores 6 and below

DEPENDENT		
Utilization of RDTs	Failing to reach the target when RDTs done are less than 80% of all malaria attendees that received antimalarial treatment	This could be very low counts (less than 59%), low counts (between 60 to 69%) and average counts (between 70% to 79%).
	when RDTs done Reach or exceed 80% of all malaria attendees that received antimalarial treatment	High counts exceeding the threshold of 80%

3.7. Data Quality Control

While in the field the questionnaires, observation guide and checklist were checked thoroughly by the researcher. On each day after collecting data the tools were checked for completeness and relevance of responses to the study. Data was entered twice in two different data bases to check for differences.

3.7.1 Validity

To ensure validity of data collection tool, **a pilot study** in Katete district was done in three health centres among nine health workers. This was useful in correcting systematic errors, ensuring consistency in flaws of questions and estimating the time taken to answer each questionnaire. Observation guide and checklist were used to validate responses from health workers. The researcher ensured randomization from the outset and allowed nearly all health workers involved in utilization of Malaria RDT in the selected health centers were included. Triangulation method was used.

3.7.2 Reliability

The tools were modified from the National Malaria Control Centre job aid card and the National Malaria Control Centre RDT training guide. Reliability of the instruments was achieved by conducting a pre-test study in order to test the degree of accuracy with which the tools measured factors contributing to utilization of malaria RDT.

3.8. Ethical Considerations

Consent for conducting the study was obtained from the Research Ethics Committee of the University of Zambia and permission to conduct the research was obtained in writing from the Director of Chipata District Health Management Team.Prior to the research, during the research and after the research, ethical principles were applied and adhered to religiously. Burns and Grove (2001), state that the conduct of nursing research requires not only expertise and diligence, but also honesty and integrity. It is further said that conducting research ethically starts with the identification of the study topic and continues through to the publication of the study. The researcher also paid attention to issues such as informed consent and confidentiality.

3.8.1. Consent

Informed consent was obtained before interviewing staff and community health workers

3.8.2. Confidentiality and privacy

The records that were collected from the health centres were kept as a secret to all non concerned and were not given to any partner or project for examination for any purposes. The computer was protected with password to prevent accessing of the file.

3.9. Data Processing and Analysis

Textual data that was derived from open ended questions was analyzed using qualitative content analysis. Since the data was in textual form, it was categorized into themes and analyzed thematically on the computer using NVIVO software version 2.1 computer package. Thematic analysis required the researcher to employ Glaser and Straus's iterative-grounded theoretical approach (Glaser and Straus, 1967; Glaser, 1978; Glaser, and Corbin, 1990). The sources of the themes were the axiomatic propositions that were drawn from sub-themes in the data. By looking at

the propositions, it was then possible for the researcher to inter-relate the categories to the core categories. Core categories were units of analysis with multiple realities that were inductively organised around related topics following the set objectives.

Numerical non textual data that was derived from the checklists and survey questionnaire was analysed using the Statistical Package for Social Science (SPSS) version 17. Analysis of these data involved univariate and bivariate analyses, including frequencies and distributions of all study variables. Chi-square tests were used to detect associations among categorical outcomes because dependent variables were categorical.

In order to determine which factors influenced level of utilisation, key variables to determine associations were tested at $\rho = 0.05$. In statistical hypothesis testing, the ρ value is the probability of obtaining a test statistic assuming that the null hypothesis is true or not. Among statisticians a chi square of 0.05 is a conventionally accepted threshold of statistical significance; values of less than 0.05 are commonly referred to as "statistically significant." Thus, when the chi-square is less than 0.05, we can be confident in rejecting the possibility that no association exists between the independent and dependent variables. As the chi-square increases above 0.05, the likelihood that the observed association occurred by chance increases. The data is presented in the following chapter using significant values set at 0.05, tables, graphs and pie charts for easy communication.

CHAPTER FOUR – RESULTS

4.0 Introduction

The results are presented as follows:

1. Demographic profile.
2. Use of guidelines.
3. Availability of guidelines.
4. Malaria RDT utilisation and training.
5. Variations in MRDT utilisation according to staffing levels.
6. Staff knowledge.
7. Current staff practices in performing MRDTs.
8. The research hypothesis.

4.1 Sociodemographic characteristics

13 health centres were considered and a total number of 42 health workers were interviewed. From this, 24 were males and 18 were females figure 4.1.1)

Sex, Age and type of Job

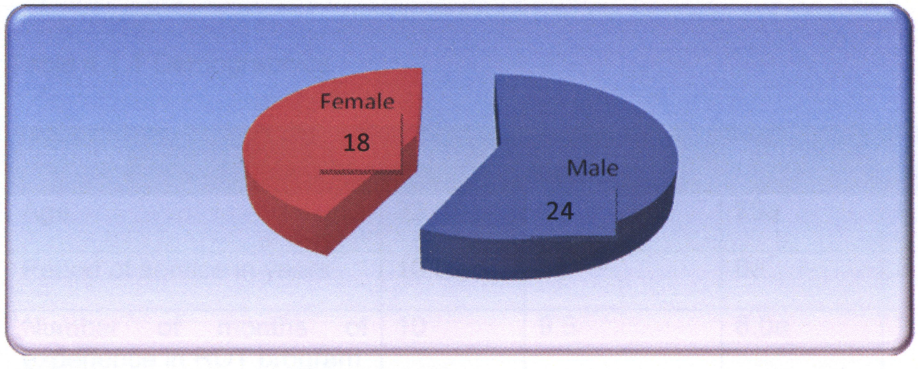


Figure 4.1.1 Sex Distribution

Half of the health centre staff surveyed were community health workers, 13 were nurses, 6 were Environmental Health technicians and a paltry 2 were Clinical officers (figure 4.1.2).

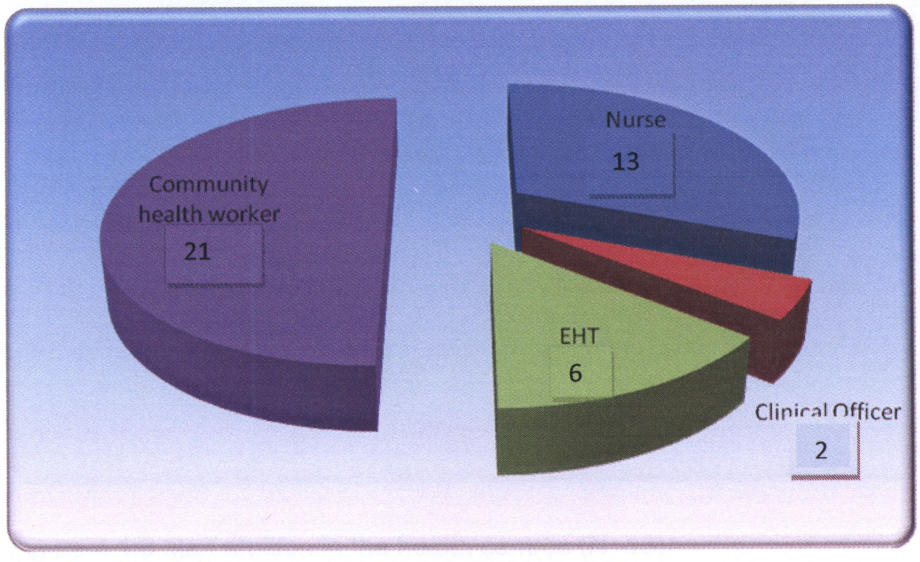


Figure 4.1.2 Staff professional profile

The majority of the staff who were enlisted were falling in the 24 to 40 age range and the median was 31 with a μ age 32 (± 1SD = 4.9) years. Most of the staff had worked between 10 and 15 years and the μ service time was 10 (± 1SD = 3.7). The μ experience time for MRDTs was 10 months (± 1SD = 2.7) (Table 4.1.1).

Table 4.1.1 Demographics

Variable	Mean	Median	Mode	Std. Deviation
Age	32.07	31	29*a*	4.9
Period of service in years	10.52	10	6*a*	3.7
Number of months of experience in RDT program	10	9.5	8.0*a*	2.7

[1] For all these variables with insignia *a*, multiple modes exist and the smallest value is shown

The trained staff attrition in the health centers varied and could be said to be worrisome (figure 4.1.3).

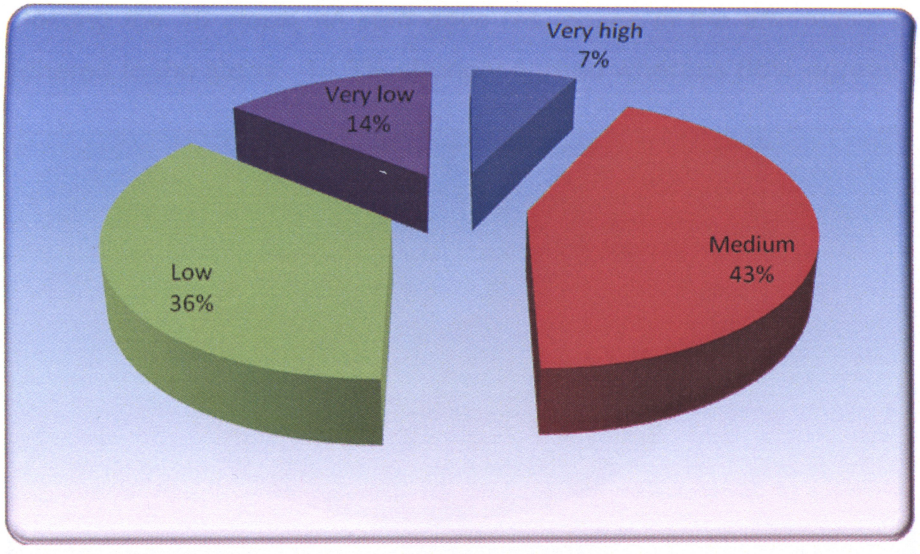


Figure 4.1.3 staff attrition in the health centres (N -13)

4.2 Use of RDT Guidelines[2]

Health centre staff were asked if at all they were using three critical guidelines in making decisions to perform MRDTs and to aid them in performing MRDTs. Interestingly RDT guidelines were widely used in all health centres. It was also noted that staff were able to use both RDT job aid guidelines[3] and ITG guidelines while none were using IMCI guidelines. (Table 4.2.1).

Table 4.2.1 Use of Guidelines

Criterion	F			
	Yes		No	
	n	%	n	%
I use RDT job aid guidelines	42	100%	0	0
I use IMCI guidelines	0	0	42	100%
I use RDT job aid guidelines and ITG guidelines	21	50%	21	50%

[2] To ddetermine the availability and adequacy of the guidelines for performing RDTs during the period under study (1st January 2009- 30th June 2009) in the selected health centres."

[3] Job aids are verbal or pictorial instructions that – when combined with training or supervision – enhance a health worker's ability to correctly perform specific tasks.

In the absence of IMCI guidelines, the staff would either miss most of the under five children or they would include the ineligible under five children. When the staff were further asked with regards to the extent they conducted MRDTs in referring to meeting the 16 steps, all staff gave responses in the affirmative agreeing that they adhered to the steps: 14.3% strongly agreed whereas 86% agreed (figure 4.2.1).

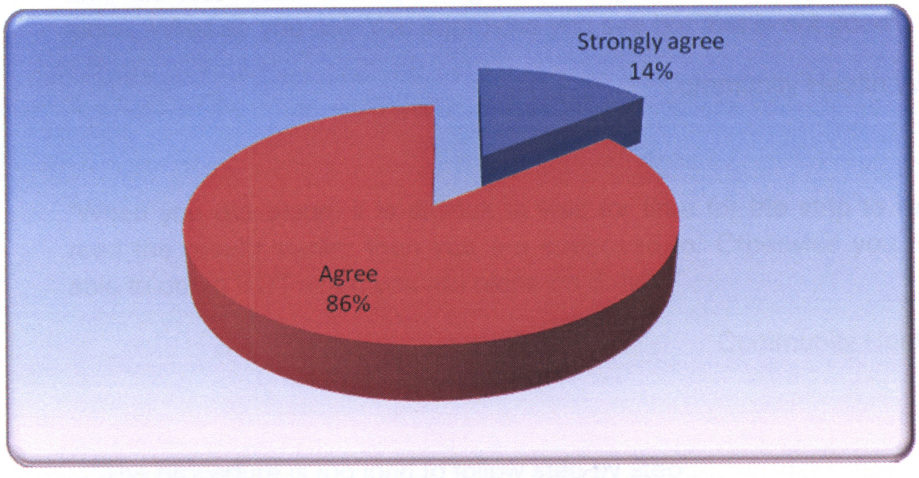


Figure 4.2.1 Extent of Adhering to the Job Aid Guidelines

4.3 Availability of guidelines[4]

The availability of guidelines in the 13 health centres varied from health centre to health centre with IMCI guidelines being unavailable in all, RDT job aid guidelines available in only 45.2% and ITG guidelines available in only 38.1% (Table 4.3.1).

Table 4.3.1 Availability of Guidelines

Criterion	Frequency			
	Available		Not Available	
	n	%	n	%
You said you use RDT job aid guidelines, please show them to me	19	45.2%	23	54.8
You said you use IMCI guidelines, please show them to me	0	0	42	100%
You said you use ITG guidelines please show them to me	16	38.1%	26	61.9

When staff were asked to comment on the problems they faced in their day to day work on MRDTs, withstanding the state of guidelines, it was noted that (i) adherence

[4] Determine the availability of the guidelines for performing RDTs during the period under study (1st January 2009- 31st June 2009) in the selected health centres

to standard operating procedures and (ii) the eventual number of MRDTs done was negatively affected. Below are excerpts from interviews that support the occurrence of particular problems and constraints to work:

> "I do not have any problems with Malaria RDTs. The job aid helps. It is easy to use you know. The only problem I have is when the RDT reacts slowly. Waiting until the test reacts affects doing other things. There are times when you are alone. What do you do? You improvise you see but that is not good".
>
> Community Health Worker

> "When you are alone, it is difficult to wait for time for the strip to react so you read the results earlier than you are supposed to. Otherwise you may not be able to do an RDT when you are alone on duty".
>
> Community Health Worker

> "The procedure is too long to follow step by step"
>
> Community health worker

> "It is not possible to follow all that is needed. You mean those steps on the RDT job aid card?"
>
> Clinical officer

> "I am experienced now and therefore I do not need to refer to the steps on the card".
>
> Nurse

> "It is human to error and you see you get confused over time because we are sometimes told that each manufacturer has its own recommendations for time to read test results".
>
> Community health worker

"There is no watch or clock in our health centre to check time although it's possible for me to estimate time".

Nurse

4.4 RDT Training[5]

A review of training in RDT shows that 50 % of the staff was either formally trained or had been sensitised by colleagues that had formal training within the health centre (Figure 4.4.1).

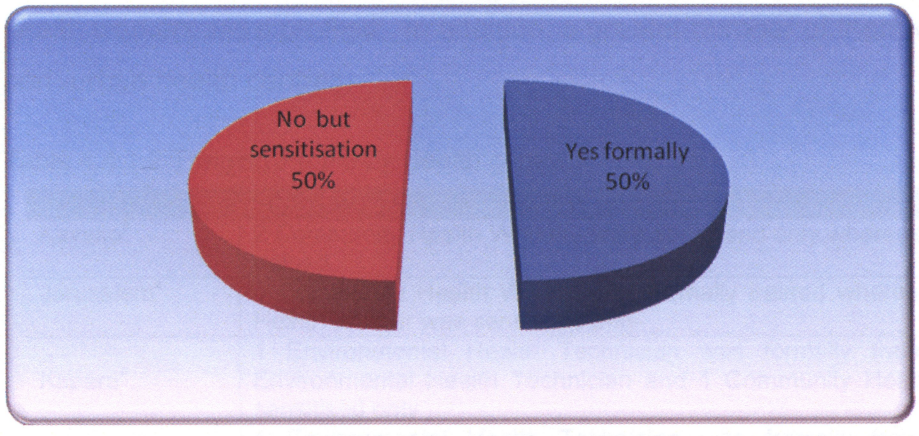


Figure 4.4.1 Level of staff Trained in RDT

However, two detailed profiles of training could be examined to appreciate the quantum and quality of training and the first one is by cadre and the second one is by health centre. It is surprising that there were very few Clinical Officers involved in performing MRDTs and yet they have more prowess in clinical practice than nurses, community health workers and environmental health technicians (Table 4.4.1).

[5] Compare utilization of RDTs during period under study against the number of RDT trained health workers in the selected health centres.

Table 4.4.1 Training Profile by Cadre

	Profession				
	Nurse	Clinical Officer	EHT	Community health worker	**Total**
Trained formally	9	1	3	8	**21**
Not trained but oriented	4	1	3	13	**21**
Total for training by cadre	**13**	**2**	**6**	**21**	**42**

A further review of training within the 13 health centres shows that there were few community health workers who were trained than only oriented and performing MRDTs. The probability of having a health centre with all staff formally trained in the RDT program was very low and the probability was narrowed when community health workers were profiled. In addition, a greater number of them were in rural and peri -urban health centres.

Table 4.4.1.2 Training Profile by Health centre N – 42

Centre	RDT Staff Training status
Kayeka[a]	2 Community Health Workers were sensitised only whereas one nurse was trained
Jerusalem[a]	1 Community Health Worker was formally trained whereas 1 Community Health Worker was sensitised only
Kapara[a]	1 Environmental Health Technician was formally trained whereas 1 Environmental Health Technician and 1 Community Health Worker were sensitised only
Mshawa[a]	1 Environmental Health Technician was formally trained whereas 1 Environmental Health Technician and 1 Community Health Worker were sensitised only
Kasenengwa[a]	1 Nurse and 1 community health worker were formally trained whereas 1 Community Health Worker was sensitised only
Kamulaza[a]	1 Community health worker was sensitised, 1 Nurse was formally trained whereas 1 clinical officer was only sensitised
Vizenge[a]	All staff were formally trained (1 Clinical Officer, 1 Nurse and 2 Community Health workers)
Chiparamba[a]	2 Nurses were formally trained whereas 1 Community Health Worker was sensitised only
Kasenga[a]	1 Community Health Worker was formally trained whereas 1 Nurse and Community Health Worker were sensitised only
Namuseche[b]	1 Nurse and 1 Community health worker were formally trained whereas 1 Community Health Worker was sensitised only
Mnoro	1 Nurse, an Environmental Health Technician and a Community Health Worker were formally trained whereas 2 Community Health Workers were sensitised only
Mchini[b]	1 Community Health Worker was formally trained whereas 1 Nurse and 2 Community Health Worker were sensitised only
Katandala[c]	1 Nurse only was formally trained

Note: a: stands for rural, b: stands for urban and c: stands for peri urban.

4.5 Staff Knowledge[6]

Knowledge level was graded as follows: 0-3 as low, 4-6 as average and over and equal to 7 as high. Most of the respondents n= 32 scored less than 7 in the knowledge domain as compared to n = 10 who scored above the cut of point (in bold). The μ group knowledge was 4.66 (± SD 1.66). The median and mode were 5 and 3 respectively and these were lower than the cut off point of 7.

Table 4.5.1 Knowledge domain

Score out of 8	*f*	%
3.00	18	42.9
4.00	2	4.8
5.00	8	19.0
6.00	4	9.5
7.00	**10**	**23.8**
8.00	0	0
9.00	**0**	**0**
10.0	**0**	**0**
Total	**42**	**100.0**

The health workers that were surveyed demonstrated varying misconceptions about malaria and RDT. In order to buttress these misconceptions and to triangulate the above statistics, below are some excerpts.

> "It is common knowledge that when the test is negative and a person has high fever one may have a mixed infection. These days of various infections, you may have a false negative so it is better to cover someone on antimalarial".
>
> Nurse
>
> "I believe that negative results represent no malaria but what I do when other diseases are ruled out? I just have to settle for Coartem".
>
> EHT

[6] Determine the level of knowledge in performing RDTs using the Job Aid by Malaria Control Centre.

When level of knowledge was cross tabulated with type of cadre, it was interesting to note that as expected knowledge was higher among the highly skilled workers than the unskilled (Community health workers). A great number among community health workers (n = 17) had less knowledge on Malaria RDTs and its importance as compared to the three other cadres. It appears that quality and quantity of knowledge of a professional or cadre played a great role in decision making as well as recounting what the RDT program is as evidenced below (Table 4.5.1.2).

Table 4.5.1.2 Level of knowledge in RDT by Profession

		What is your Profession?				
		Nurse	Clinical Officer	EHT	Community health worker	Total
Level of knowledge in RDT	Low	2	0	2	17	**21**
	Average	6	0	2	3	**11**
	Very high	5	2	2	1	**10**
Total		**13**	**2**	**6**	**21**	**42**

When statistical tests between profession and knowledge were run at $\rho = 0.05$, the association was significant (ρ was 0.025) and we can say that the level of knowledge on RDT is associated with profession.

A further association of knowledge with health centre shows that there were more community health workers who were untrained but only sensitised and performing MRDTs (Table 4.5.1.2). The probability of having a health centre with all staff formally trained and having sound knowledge about the RDT program was very low and the probability was narrowed when community health workers were profiled. In addition, a greater number of community health workers were in rural and peri -urban health centres (Table 4.5.1.3).

Table 4.5.1.3 Profile of Staff by Geography

	Geographical distribution			
Profession	Rural Area	Peri Urban	urban	**Total**
Nurse	10	1	2	**13**
Clinical Officer	2	0	0	**2**
EHT	6	0	0	**6**
Community health worker	15	0	5	**21**
Total	**34**	**1**	**7**	**42**

4.6 RDT Utilization

An assessment of RDT utilisation in the 13 heath centres shows a poor picture. 83.3% of the health centres had utilization less than 70% (the lower limit of the average grade utilization). Only 26.7% had an average utilization more than 70% but less than the ideal grade of 80%. The μ RDT group utilization was 64 (± 1SD = 5.99). Table 4.6.1 shows the utilization profile of the 13 health centres. The lowest value was 55% and the highest value was 73.10%.

Table 4.6.1 RDT Utilization profile N=13

Centre	Geographical Area	% Utilisation	Level of Utilisation
Kayeka	Rural	73.1	Average
Jerusalem	Rural	55	Very Low
Kapara	Rural	66.62	Low
Mshawa	Rural	67.56	Low
Kasenengwa	Rural	60.99	Low
Kamulaza	Rural	58.8	Very Low
Vizenge	Rural	55.69	Very Low
Chiparamba	Rural	69.2	Low
Kasenga	Urban	66.03	Low
Namuseche	Urban	72.53	Average
Mnoro	Rural	60.0	Low
Mchini	Urban	69.30	Low
Katandala	Per-Urban	71.95	Average

4.7 Variations in RDT utilization According to Staffing Levels[7].

Before examining the variations in RDT utilization in the 13 health centers in relation to staffing levels, it is research prudent to first present a profile of number of malaria cases when antimalarials were used, positive cases, negative cases and the differential prescriptions in the 13 centers under study.

From the operational definition, in all the health centers staff were adequate in the sense that there was at least one staff designated to perform MRDTs every day and there were other staff to perform routine tasks.

In the 13 health centers, the μ RDT tests per day was 13.3 (1SD= 3.9) (Table 4.7.1) implying that one staff spends on average 195 minutes or 3.25 hours to only wait for RDT results. This excludes the time taken to prepare the patient for a prick for blood, to prepare the test strip to be ready and discard all the materials to be ready for another patient. From the researcher's observations, for a complete test to be done on one patient required 20 to 25 minutes.

Table 4.7.1 Reported Average MRDTs done by one health worker on a daily basis

Mean	13.3
Median	13.5
Mode	11.0
Std. Deviation	3.9

When malaria case loads were assessed, there were fewer instances when Malaria RDTs were performed than not and that there were more clients not tested for malaria who were put on anti malaria treatment. A cursory look at table 4.7.2 reveals that twice more antimalarials were prescribed (NMP) than positive cases (P) in each heath centre which ought not to be the case.

[7] Objective 3. Describe variations in RDT utilization in selected health centers in relation to staffing levels.

Table 4.7.2 Suspected and Confirmed Malaria Case Loads

Health Centre	Number of malaria cases when antimalarials were prescribed (NMP)	Positive cases (P)	Negative Cases (N)	Differential Prescription [NMP -P]
1. Kayeka	722.00	231.00	297.00	491
2. Jerusalem	4654.00	1204.00	1356.00	3450
3. Kamulaza	4028.00	1792.00	578.00	2236
4. Vizenge	2101.00	586.00	584.00	1515
5. Chiparamba	4557.00	1519.00	1634.00	3038
6. Kasenga	2120.00	420.00	980.00	1700
7. Namuseche	1478.00	322.00	750.00	1156
8. Mnoro	3062.00	1065.00	772.00	1997
9. Mchini	2111.00	705.00	758.00	1406
10. Katandala	1291.00	411.00	518.00	880
11. Kapara	2891	928	998	1963
12. Mshawa	3064	958	1112	2106
13. Kasenengwa	5438	1903	1413	3535

The μ scores for positive, negative results and malaria cases when antimalarials were used were all far wide apart and this was unexpected (table 4.7.3).

Table 4.7.3 Mean Malaria Case Loads

Indicator	Number of positive cases	Number of negative cases	Number of malaria cases when antimalarials were used
Mean	1152	1008	2991
Std. Deviation	753	581	1797

The findings elucidated in the tables above tie well with the evidence from the researcher's observations. The researcher noted that professional staff like nurses and Clinical Officers were generally not available to perform Malaria RDTs and they left community health workers to perform most of the Malaria RDTs. The researcher observed that the trained staff in Malaria RDTs were stretched to obtain histories,

examine patients and vaccinate than conduct Malaria RDTs. The excerpts that follow below in this section elaborate further.

However, when staff were surveyed about adequacy vis a vis performing MRDTs, in nearly all the health centers, 42% of the staff said they were adequate whereas 57% said the staffing levels were inadequate (figure 4.4.1) implying that they needed one more person to conduct Malaria RDTs.

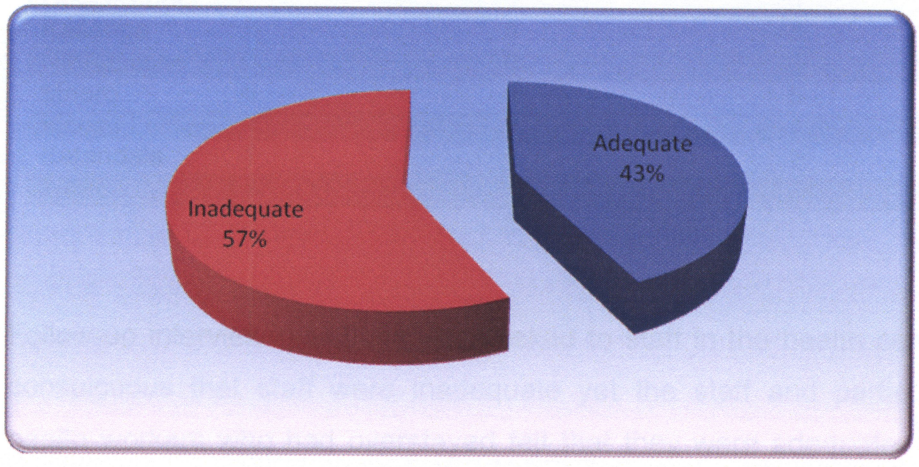


Figure 4.7.1 Staffing Levels Adequacy

Though staff in the 13 health centres said that staffing levels were more inadequate than adequate, there were inter and intra health centre variations (Table 4.7.1). The table below shows the staff adequacy profile according to cadre and health centre name.

Table 4.7.4 Health Centre Staff Adequacy Profile N = 42

Centre	Staffing level	Staffing Response Levels (adequate to meet the daily RDT loads and tasks)	
		Adequate	**Inadequate**
Kayeka	3	3	0
Jerusalem	2	1	1
Kapara	3	3	0
Mshawa	3	3	0
Kasenengwa	3	3	0
Kamulaza	5	0	5
Vizenge	4	2	2
Chiparamba	3	0	3
Kasenga	3	0	3
Namuseche	3	0	3
Mnoro	5	0	5
Mchini	4	3	1
Katandala	1	0	1
Total	42	18	24

Follow-up interview questions were asked to staff in the health centres were it was conspicuous that staff were inadequate yet the staff and particularly community health workers who had overstayed felt that they were adequate. Below are some notable responses:

> "There is no problem in doing MRDTs. I can manage working alone from morning even in the night because I am a doctor for them and they are used. This is how we have been working. There is no shortage. We are okay".
>
> Community Health Worker

> "We are okay because we do each day what we do to those patients we can manage. To other patients, we give them drugs".
>
> Nurse

Further, one would hypothesize that MRDTs are not seen as a priority in cases that merit a test. This is evident from the following descriptions.

> "Yes, I can do MRDTs but you see, I have to screen and prepare the returns. MRDTs are simple and they could be done by community health workers".
>
> Clinical Officer

> "If I do MRDTs, who will do my part? As you know the Community health Worker can just do the basics".
>
> EHT

"There is much to do in the health centre. There are vaccinations to attend to. These expectant mothers you are seeing need an elaborate antennal history. I have to examine them before knocking off".

Nurse

4.8 Current Health Practices in Performing MRDTs[8]

In order to determine health worker skill, that is whether health workers were meeting expected health practices in performing the MRDTs an observation checklist of 8 variables was used. A cut off point was set *a priori* at 6 out of a maximum of 8 points. Any health worker who scored less than or equal to 6 was considered to be a poor performer and above this value, the health worker was considered to be a good performer. Only 13 health workers were observed during the visits made as not all the health centre staff would be performing MRDTs on those particular days scheduled for observations.

Three observations stand out. The first one is that generally out of the 8 critical activities, staff demonstrated clinical prowess in 5 critical areas in which all the 13 observed health workers had skill (Table 4.8.1). Staff had problems in correct timing to read the results and failure to follow the steps while performing the RDTs.

Table 4.8.1 Practices in Performing MRDTs N = 13

Practice Variable	Skill	No Skill
Adequate preparation for the test (5 to 10 minutes) (Skill)	13	0
Correct timing of reading (Skill)	4	9
Correct interpretation of results (Skill)	12	1
Proportion of observed mistakes (Skill)	0	13
Fever (by history or feels hot or temperature 37.5 c) (Skill)	13	0
If malaria test positive or if unable to do test, treat with oral antimalarials (Skill)	13	0
If malaria test is negative, look for other causes of fever (Skill)	13	0
If malaria test is negative and no other cause of fever is found, treat with anti malaria (Skill)	13	0

[8] This relates to objective 5: Assess whether health workers are meeting expected health practices in performing the RDTs (and how often they are being supervised).

The second is that when each worker was assessed across each activity, only 4 workers demonstrated high skill by scoring 7 (see table 4.8.2). When statistical tests between profession and skill to perform RDT as a diagnostic tool were run at ρ = 0.05, the association was not significant (***ρ*** was .516) and we can say that poor health worker skill in RDT is not associated with profession.

Table 4.8.2 Association between Health Worker Practice and Profession

		What is your Profession?				
		Nurse	Clinical Officer	EHT	Community health worker	Total
Skill Total	5 points	1	0	0	0	1
	6 points	2	1	0	5	8
	7 points	1	0	1	2	4
Total		4	1	1	7	13

The third one has to do with mistakes. There were several observed mistakes that were seen ranging from omission, improvisation, misreading and incorrect readings. Of these, misreading invalid test results is a somewhat different issue: while both the manufacturer's instructions and the job aid mention that a test line in the absence of a control line or no line at all means the test is invalid, it was easy to misconstrue this instruction to mean "line = positive, no line = negative."

Table 4.8.3. Showing the skill profile of the health workers

Health Centre	Skill Parameter								
	Test time (5 to 10min)	Reading time	Interpreting of results	Observed Mistakes	Fever	If unable to do the test	If the test is negative	If the test is negative and no other cause	Staff Skill Total
Vizenge	1	0	1	0	1	1	1	1	6
Namuseche	1	0	1	0	1	1	1	1	6
Mchini	1	0	1	0	1	1	1	1	6
Kasenga	1	0	1	0	1	1	1	1	6
Jerusalem	1	0	1	0	1	1	1	1	6
Mnoro	1	1	1	0	1	1	1	1	7
Chiparamba	1	0	1	0	1	1	1	1	5
Kayeka	1	1	0	0	1	1	1	1	7
Kamulaza	1	1	1	0	1	1	1	1	7
Mshawa	1	0	1	0	1	1	1	1	6
Kapara	1	1	1	0	1	1	1	1	7
Kasenengwa	1	0	1	0	1	1	1	1	6
Katandala	1	0	1	0	1	1	1	1	6
Generic Total	**13**	**4**	**12**	**0**	**13**	**13**	**13**	**13**	

It is worthwhile to present additional data on three variables shown in table 4.8.3. What the table shows and the researchers' observations are that errors were rampant among health workers and especially among sensitised community health workers than trained health workers generally. Staff had made test preparation errors and they seemed to have difficulties in following steps. The health workers had problems using manufacturer's instructions and they also omitted key tasks such as cleaning the patient's finger.

Accuracy of test interpretation was rather poor. Most of the tests results were read before the recommended time even when staff were trained or even when job aid guidelines were available. The most common mistake was to read results as negative before time, a faint positive or invalid result as negative. Occurrences of this error declined significantly from rural to urban since the dependency on community health workers to do MRDTs was lower. This picture could be linked with attitudes which are presented below

4.9 Attitudes

Staffs' attitudes towards performing MRDTs were assessed and it was noted that the attitudes were poor for the majority of staff 64% as compared to average scores 31% and good scores 5%.

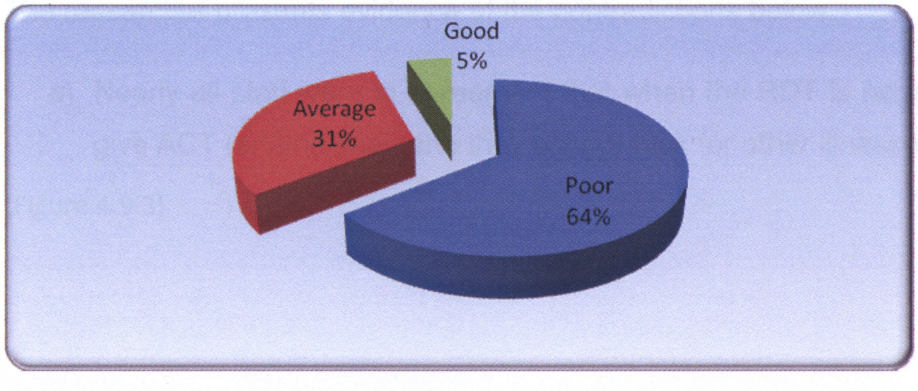


Figure 4.9.1 Attitudes as acceptability

A greater number of staff in the health centres had negative attitudes towards MRDTs. For instance, 64.3% had poor attitudes towards MRDTs rejecting them as

reliable tools for malaria diagnosis as compared to 40% whose attitudes were average and 5% who had good or favorable attitudes (figure 4.9.2).

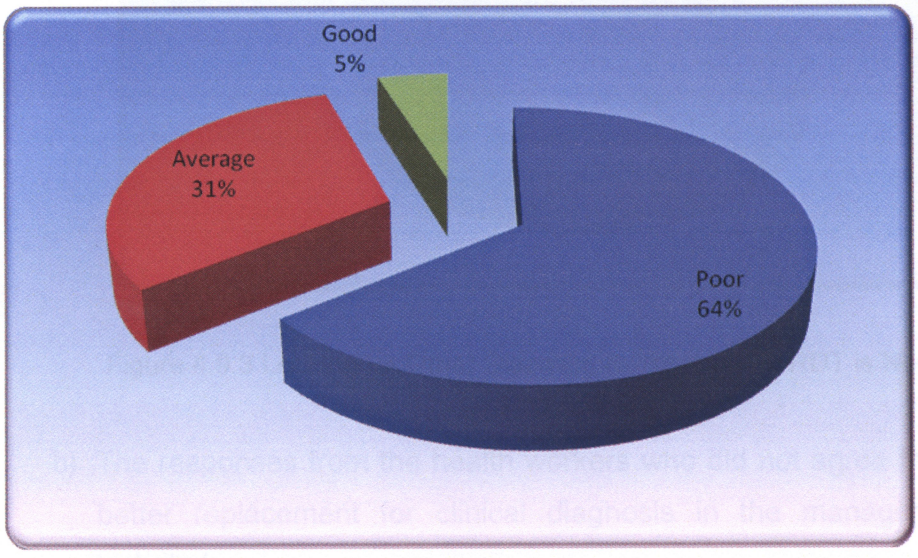


Figure 4.9.2 Attitude towards RDT as a tool

When statistical tests between profession and the attitude of accepting RDT as a diagnostic tool were run at $\rho = 0.05$, the association was not significant (ρ was .946) and we can say that profession is not associated with the attitude of accepting RDT as a diagnostic tool.

This result above and the frequency graph below contradict interview responses. The researcher presents evidence of the contradictions below.

a) Nearly all staff were in agreement that when the RDT is negative they do not give ACT (antimalarial) and they always look for other illnesses and treat.

(Figure 4.9.3)

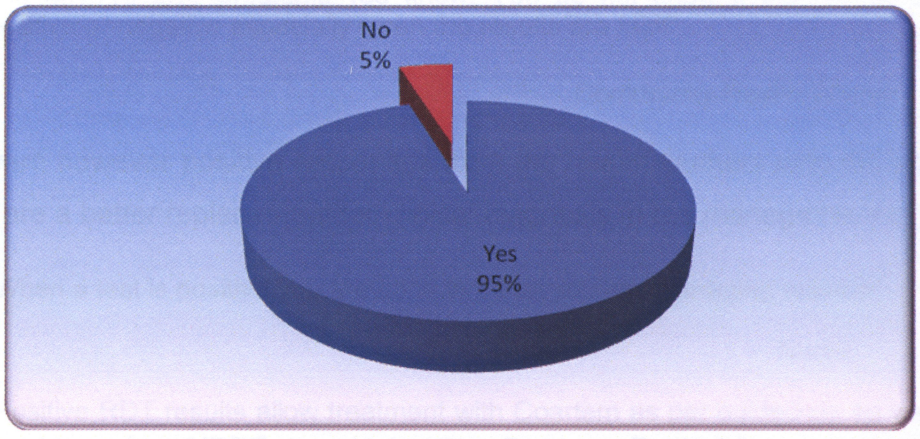


Figure 4.9.3 Looking for Other Diseases to Treat When RDT is Negative

b) The responses from the health workers who did not agree that MRDTs are a better replacement for clinical diagnosis in the management of malaria included:

"We do have some difficulties in RDT preparation sometimes. There are disadvantages when we change kits and you have differing instructions so you tend to forget".

EHT

"As for me, all the clinically diagnosed malaria cases are supposed to be treated and subjecting them to an RDT test could result in missing diagnosis".

Community Health Worker

"When you look at the data that we have, there are too many MRDTs which show negative so you wonder if you can trust these tests, sometimes you have to rely on your clinical experience to diagnose malaria".

EHT

"Managing malaria is easier when you diagnose it clinically other than performing an RDT procedure which consumes time for both health workers and patient".

Clinical Officer

"The MRDTs give problems you know. You do not know if the results are positive or negative especially when the results are faint".

Community Health Worker

There were however positive responses from the health workers who did agree that MRDTs are a better replacement for clinical diagnosis in the management of malaria.

"When a test is positive you are confident that you are managing malaria".

Nurse

"Positive RDT results allow treatment with Coartem as per guidelines so we need to perform MRDTs in order to utilize Coartem effectively".

EHT

"Supply of Coartem to the health centres is dependent on the number of RDT positive results so we need to perform MRDTs in order to realize positive results and supply of Coartem".

Nurse

In trying to link practices and attitudes, 13 facility registers were examined and out of an ideal 4 supervisions in two quarters per health centre, only two rural health centres had four supervisions in two quarters and these are Kamulaza and Vizenge. Out of the 11 health centres, only 5 health centres were supervised once in a quarter and 6 were not supervised at all. A further review of the supervision register showed that health workers were not offered any technical support on performing RDT and no feedback was documented. It was shocking to see that RDT supervision was none existent.

When staff were asked about the regularity of supervision, 5% staff claimed that they were regularly supervised (at least twice every quarter) as compared to 95% (Figure 4.9.4), who claimed that they were irregularly supervised since they were monitored once or not at all in a quarter.

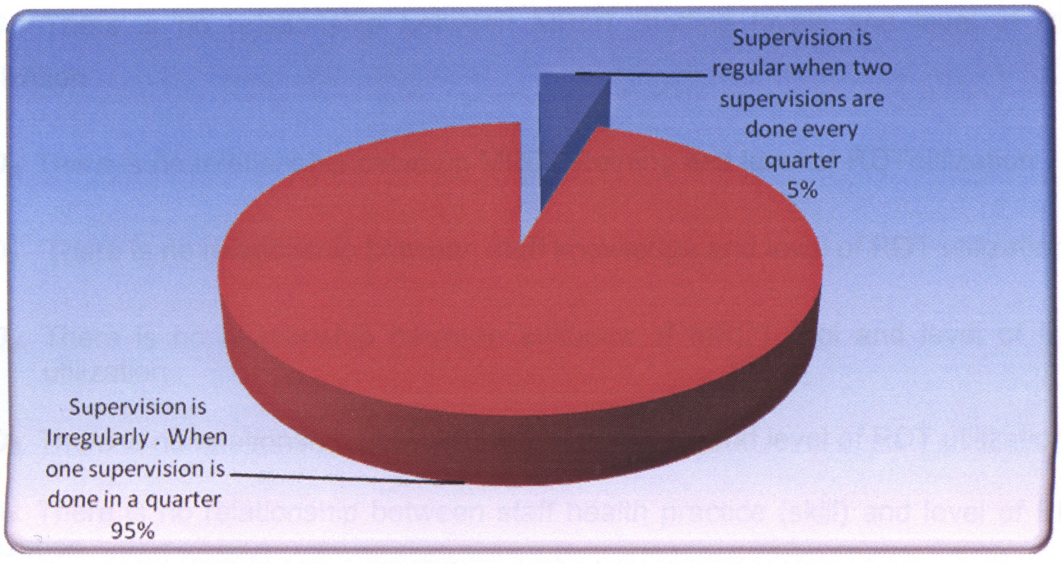


Figure 4.9.4 Rate of Reported Supervision

The profile of supervision was poor irrespective of geography table 4.9.1.

Table 4.9.1 Association between Geography and Supervision

		How often are you supervised on the RDT program?		
		Regular when two supervisions are done every quarter	Irregular when one supervision is done in a quarter	Total
Geographical distribution	Rural	2	29	31
	Peri urban	0	1	1
	Urban	0	10	10
Total		**2**	**40**	**42**

When statistical tests between geography and supervision were run at $\rho = 0.05$, the association was not significant (ρ was 0.689) and we can say that geography and supervision were not associated.

4.10 The Research Hypotheses

This study was set to examine the main hypothesis: HO: There are no factors associated with utilization of malaria MRDTs in Chipata District health centres. From the conceptual model, we derived six hypotheses which were:

HO_1: There is no relationship between MRDT staffing levels and level of RDT utilization

HO_2: There is no relationship between MRDT training and level of RDTutilization

HO_3: There is no relationship between staff knowledge and level of RDT utilization

HO_4: There is no relationship between attitudes of MRDT tool and level of RDT utilization

HO_5: There is no relationship between staff supervision and level of RDT utilization

HO_6: There is no relationship between staff health practice (skill) and level of RDT utilization

HO_7: There is no relationship between use of MRDT guidelines and level of RDT utilization

Table 4.10.1 Summary of Associations

Hypothesis #	ρ value	Interpretation
HO_1	0.305	Not significant to reject HO_1
HO_2	0 .006	Significant to reject HO_2
HO_3	0 .117	Not significant to reject HO_3
HO_4	0 .817	Not significant to reject HO_4
HO_5	0 .006	Significant to reject HO_5
HO_6	0 .002	Significant to reject HO_6
HO_7	Nil	Not computed because Availability of RDT guidelines is a constant

From table 4.10.1 staffing levels, knowledge and attitudes are not associated with the low levels exhibited of utilisation. What seemed to be associated with the low levels of utilization is staff health practice, training, guidelines and supervision. Thus, when the chi-square is less than 0.05, we are confident in rejecting the possibility that no association exists between the variables. As the chi-square increases above 0.05, the likelihood that the observed association occurred by chance increases.

CHAPTER FIVE- DISCUSSION AND CONCLUSIONS

5.0 What this Study Shows

This study examined two research questions and these are:

1. (i) What is the level of malaria RDT utilization in Chipata District and

   (ii) Why are there levels of such magnitude?

From these, six dependent research objectives directed the study and these were:

a) To determine the availability of the guidelines for performing MRDTs during the period under study (1st January 2009- 30th June 2009) in the selected health centres.
b) To determine the use of the guidelines for performing MRDTs during the period under study (1st January 2009- 30th June 2009) in the selected health centres.
c) To compare utilization of MRDTs during period under study against the number of RDT trained health workers in the selected health centres.
d) To describe any variations in MRDT utilization in selected health centers in relation to staffing levels.
e) To determine the level of knowledge health workers have in performing MRDTs.
f) To assess whether health workers are meeting expected health practices in performing the MRDTs and how often they are being supervised.

The data collected from this study have answered the two principal research questions as follows: The level of utilization of RDT in Chipata is above the district levels which were estimated to be at 30% in 2008 according MoH (2009b). However, though the levels showed improvement, the target of 80% is far from

being reached by 2011 since the range across the 13 reliable health centers is 55% to 73.10%. The μ RDT group utilization was 64 (± 1SD = 5.99).

Concerning the reasons for these exhibited levels of utilization, from table 4.10.1 staffing levels, knowledge and attitudes are not associated with the low levels exhibited for utilization. What seemed to be associated with the low levels of utilization are absence of guidelines, training, staff health practice and supervision. In the same vein, the specific findings for each research objectives can be presented as follows:

Research objective 1: Availability of guidelines

The availability of guidelines in the 13 health centres varied from health centre to health centre with IMCI guidelines being unavailable in all , RDT job aid guidelines available in only n= 19 (45.2) and ITG guidelines available in only n= 16 (38.1).

Research objective 2: Use of RDT Guidelines

Staffs were able to use: (i) RDT job aid guidelines and (ii) ITG guidelines. Staff regrettably stated that they were not able to use IMCI guidelines and this had a bearing on the level of utilization. For instance, when malaria case loads were assessed, there were fewer instances when MRDTs were performed than not and that there were more clients untested for malaria who were put on anti malaria treatment. What one would infer from this is that RDT guidelines are critical and one would doubt the claims made by the health workers that they religiously use RDT job aid guidelines and ITG guidelines yet they were conspicuously absent. In addition, twice as more antimalarials were prescribed by the health workers than for positive cases in each heath centre, which ought not to be the case.

Research objective 3: RDT Utilization

RDT utilisation in the 13 heath centres was above the district reference level of 30%. However, for Chipata there was an improvement. n= 10 (83.3%) of the

health centres had an utilization less than 70% (the lower limit of the average grade utilization). Only n= 3 (26.7%) had a moderate utilisation more than 70% but less than the ideal grade 80%. The μ RDT group utilization was 64 (± 1SD = 5.99). The lowest value was 55% and the highest value was 73.10%. The μ RDT tests per day in these centers was13.3 (1SD= 3.9) implying that one staff spends on average 195 minutes or 3.25 hours to only wait for RDT results. This excludes the time taken to prepare the patient for a prick of blood, to prepare the test strip to be ready and discard all the materials to be ready for another patient. From the researcher's observations, for a complete test to be done on one patient required 20 to 25 minutes. That is almost over 50% of the day, health workers ought to spend time on MRDTs alone and this is burdensome considering the demands of health centre activities and personal tasks.

Research Objective 4: Adequacy of Staffing

From the operational definition, in all the health centers staff were adequate in the sense that there was at least one staff designated to perform MRDTs every day and there were other staff to perform routine tasks. However, staff performing MRDTs, claimed that they were inadequate.

Research Objective 5: Staff RDT Knowledge

Most of the respondents n= 32 scored less than 7 in the knowledge domain as compared to n = 10 who scored above the cut of point (in bold). The μ group knowledge was 4.66 (± SD 1.66). The median and mode were 5 and 3 respectively and these were lower than the cut off point of 7. Concerning skill, out of the 8 core and critical activities, only in 5 health centres out of 13 did staff demonstrate clinical prowess. Staff seemed to have problems in correct timing to read the results as well as in interpreting results. When statistical tests between profession and skill to perform RDT as a diagnostic tool were run at $\rho = 0.05$, the association was not significant ($\boldsymbol{\rho}$ was .516) and we can say that poor health worker skill in RDT is not associated with profession.

Research Objective 6: RDT Attitudes

Staffs' attitudes towards performing MRDTs were poor for the majority of staff n= 27 (64%) as compared to average scores n= 13 (31%) and good scores n= 2 (5%).

5.1 Discussion

From what has been shown, a striking pattern found in this study is that there is a marked improvement in meeting the national target of 80%. The results of this study indicate that Community Health Workers in Chipata in spite of the fact that they are less skilled and knowledgeable, they are indeed front line workers in RDT utilization. They can be indeed be relied on at the moment to prepare and interpret MRDTs correctly and safely when supported by appropriate training and frequent supervisions.

The researcher is arguing that conversely, the malaria control program in Chipata cannot expect adequate performance if it relied solely on manufacturer's package instructions in the absence of RDT guidelines. In fact, sole reliance on manufacturer's instructions could be a critical factor for low utilization. This may be responsible for high or low levels of misdiagnosis and mismanagement, putting patients and the community at risk. The researcher is advancing this argument noting the observations of previous research. For instance, in a study "Improving community health worker use of malaria rapid diagnostic tests in Zambia: package instructions, job aid and job aid-plus-training", by Harvey et (2008) it was discovered that Community Health Workers who were using the job aid had significantly higher scores than those relying on manufacturer's instructions both overall and in all sub-categories (preparation, RDT use, safety and interpretation of results). Since most of the Community Health Workers were restricted to the manufacturer's instructions than the use of RDT guidelines it is plausible to say that this may have affected the utilization of a malaria diagnosis. Giving workers

job aids and IMCI guidelines would significantly improve utilization and performance, particularly in the essential steps involving decision to conduct a test and handling of blood and buffer that would influence the accuracy of the results. It is an indisputable fact that the absence of IMCI guidelines, staff would either miss most of the under five children or they would include the ineligible under five children on the treatment for malaria. This could perhaps be one of the factors for low utilization levels since under five use rate of the malaria service accounts for one third to half the load in Chipata health centres.

Practice (skill) is one factor worth discussing. Reading test results too soon was very frequent among staff, perhaps because of lack of supervision, job aids and the other routine tasks they have to do require their input withstanding low staff numbers to do general work (Renny et al., 2007). Mistakes in the preparation and reading of RDT results were common place in this study and literature elsewhere has demonstrated the same (Fryauff et al., 2000). It has been shown that the utilization of rapid diagnostic tests (RDT) in malaria case management is linked with the accuracy of the diagnoses they provide because poor practices may lead to MRDT mistrust and eventually cause health workers to continue diagnosing malaria clinically. Despite their apparent simplicity, previous studies like this one indicate that RDT accuracy is highly user-dependent. As MRDTs will frequently be used in remote areas with little supervision or support minimizing mistakes is crucial.

Concerning staff adequacy and failing to conduct MRDTs optimally by cutting the reading time and improvising on the procedures, though it was a factor in selected health centers, it is not worth worrying about in Chipata. No research has been found to support or reject the notion of inadequate staff on the RDT program cutting short the procedure. This over scores the need for job aid cards which were unavailable. In addition, the assertion that staffs do not have watches or wall clock is not new at all (Renny et al., 2007) and it is a matter that could be addressed since it is critical.

Referring to misreading invalid test results, the findings in this study are similar with those of Knebel et al. (2000) and Moody (2002) and the results suggest that technical supervisory visits are lacking (Gagné et al., 1992). In addition, it must be stated that the utilization and usefulness of these simple rapid diagnostic tests (RDT) in malaria case management depends on consistent periodic supervision Despite their apparent simplicity, previous studies indicate that RDT utilization and accuracy is highly user-dependent.

There are lessons to learn from the Philippine and Laos study by Rennie et al., 2007). These researchers have emphasised the need to re supply job aids, embark on objective purpose driven supportive supervision, extending malaria care beyond the frontiers of the health centre into villages in order to mitigate malaria mortality and morbidity. If more people who are suspected to have malaria could have an opportunity to have an RDT done as close to the family as possible, and if Malaria RDTs are to be sufficiently accurate to form the basis for malaria case management decisions in Chipata where most of the communities are remote areas, it is then clearly necessary for managers of health institutions and program managers of health services to invest the resources necessary to ensure that malaria diagnosis and treatment are extended into villages. These program managers need to ensure adequate training, filed support supervision is enhanced and clear instructions related to the RDT program are in place.

A strategy that has not been currently considered for increasing geographic access to appropriate timely treatment of malaria particularly at village level is the use of Coartem in Chipata by community health workers. Community health workers have played an important role in malaria diagnosis and treatment in many different settings for more than 35 years (Delacollette et al., 1996, and Mayxay et al., 2004). In The Gambia, Zaire, Myamar and Ethiopia, uses of Community health workers led to reductions in malaria mortality (Delacollette et al., 1996; Kidane and Morrow, 2000). Despite this evidence of the benefits of improving access to treatment using Community health workers, some experts remain cautious about this approach, because of concerns that allowing Community health workers to distribute anti-malarials will increase the misuse of drugs and accelerate the

development of anti-malarial resistance (Bloland and Ettling, 1999). Nevertheless, there are two of the programs that stand out in terms of their size and longevity, the Volunteer Collaborator Network of Latin America and the Village Voluntary Malaria Collaborator Program of Thailand. The success of these programs is based on a tradition of active community participation and sustained commitment and support from the national malaria control programs. As epidemiological conditions and program priorities change, the RDT program in Chipata will have to be sufficiently flexible to keep pace.

5.2 Strengths

This study has notable strengths and these are drawn from the following standpoints:

1. The use of the two strategies (inductive and adductive) has led to the development of a survey questionnaire which has generated a set of variables that might later be tested quantitatively in a much wider study than this one. In essence should researchers on Malaria RDTs opt to undertake a study, the tool could be used to solve research problems that tend to be framed as closed ended questions.
2. The study has provided room for readers to appreciate the lived life in the health centers to understand from their points of view the successes and failures of the RDT program.
3. To the research fraternity, the data adds gaps in knowledge and practices where they were missing. The methodology used could be applied in other settings.
4. The study recommendations could be used to foster the RDT program in Chipata. As such the recommendations may be applied by RDT program managers and in charges in improving human resource constraints and service delivery.

5.3 Limitations

The limitations arise from the methodologies that were adopted for this study and the nature of the setting. These limitations play an important role in interpreting study findings and making suggestions for future research. In this study, data came from 13 heath centres out of 39, so it is possible for readers to argue that we could not generalize the findings to the rest of the health centres and health workers in Chipata District. One may also argue that we cannot generalize from these results because the health workers were not randomly selected and only 13 staffs were observed performing MRDTs in only 13 health centers out of the 42 eligible health workers. Though these may appear as imperfections, the researcher conducted a population-based study of health workers in well-staffed and better performing health centers. This adds validity to the findings of a cross sectional study of this nature. However, this was inevitable as the researcher was not able to enlist health centres and staff that had not met the inclusion criteria. Yet in order to collect meaningful data via ethnographic methods, it is crucial to find respondents who could provide details of information. The small population can be seen to limit the study's validity and credibility since one would argue that those staff in the health centres who were excluded could have given a different impetus to the study. However, this study is valid and credible in the sense that the inquiry was very rigorous and the study fulfilled the criteria of a mixed study (Jensen and Allen, 1996; Polit and Hungler , 1999). In addition, the researcher took an extra mile to perform significant tests when just measures of central tendency could have done the description (Blaikie, 2000).

The second limitation is related to the two research strategies that were applied in this study, namely the inductive and adductive strategies outlined by Blaikie (2000). In spite the fact that the two strategies enabled the researcher to collect quantitative and qualitative, the inductive strategy was used only to develop a conceptual model from existing literature and not from a theory of service use or delivery. Therefore the tested hypothesis from the model does not have explanatory power. In addition, though the abductive strategy was used to situate the researcher in the setting and develop interview questions and make

observations based on the RDT job aids, IMCI guidelines and ITG guidelines, the samples that were observed and interviewed on skills component were very few to make generalisations. However, the strategy makes the research credible because the findings have thick descriptions (Stake, 1978; Lincoln and Guba, 1985; Patton, 1990) which may not be obtained using quantitative methods alone. In addition, thick descriptions are a way of achieving a type of external validity. By describing a phenomenon in sufficient detail one can begin to evaluate the extent to which the conclusions drawn are transferable to other times, settings, situations and people. Blaikie (2000) and Strauss and Corbin (1990) claim that qualitative methods can be used to better understand any phenomenon about which little is yet known. This is true about RTDs in Chipata.

5.4 Conclusion

In spite of the limitations of the RDT program, Chipata is doing well though the set target of 80% is yet to be met. The fact that all health centres have scored above the lower threshold of 30%, there is a need to commend staff on the ground and consider awarding them.

The use of malaria rapid diagnostic tests is potentially an effective alternative for malaria case management in areas with limited functional microscopy and limited health care personnel or facilities. Findings from this study show that a well-designed technical supervision support program, provision of job aid, ITG and IMCI guidelines as well as a brief training could ensure high performance and accentuate utilization to above the set national target.

5.5 Recommendations

The lessons learnt from this study provide significant recommendations. First the study has shown that the RDT program is doing well in Chipata in spite of the target not having been reached. We have until 2011 December to reach the target. Second, we must do something in the areas of poor performance and recommendations include:

1. To provide at least minimal on job training in RDT use, even for health

workers with prior healthcare experience. It would go a long way to have a short orientation on correct use of MRDTs and interpretation of results as this may improve accuracy and thereafter utilization levels.

2. The program officers should ensure availability of IMCI and ITG guidelines in all health centres to allow easy decision to utilize RDTs. Referring to misreading invalid test results, there is need for each and every health centre to have Job aid cards visibly displaying the correct interpretation of results.
3. Though geography and staff adequacy were not factors for the elicited utilization, there is need to reduce malaria case loads in the health centers and improve geographic access to timely and appropriate diagnosis and treatment services for Malaria. This is because many strategies including home treatment need to be promoted. This is an important activity for malaria-endemic areas like Chipata where the expense of having the bulk of our members of the community could be diagnosed and be treated correctly. There is evidence of success elsewhere in Africa (Bloland and Ettling, 1999; Bloland et al., 2003). This will lower malaria mortality and morbidly.
4. The difficulties in time required to read the results as well as evidence that prior orientation is required for each MRDT manufacturer illustrate the advantages of maintaining consistency of product design where possible, rather than switching between test formats with a resultant need for re-training. The ministry of health should consider purchasing from RDT manufacturers with RDT timing device into the test itself or providing a low-cost timer along with each box of tests to reduce possible misunderstandings. The district needs to consider providing timers where they are un available.

5. There is need to reflect on the frequency and objectives of our technical support supervision noting that they were not done on a large scale and when they were done, they were just a mere visitation. The researcher is making these suggestions because the results indicate that apparently simple diagnostic tests like RDT are being poorly utilized and interpreted

and yet provision of clear, simple instructions on the spot in form of technical support supervision as well as job on training can reduce these errors. In the same vein monitoring of user behavior is an essential part of rapid test implementation. The district RDT program managers need to develop a log frame of such supervision visitations. They also need to prepare one for the health centre in charges who need so much technical support.

REFERENCES

Adams I., Darko D., and Accorsi S. (2004), **Malaria: A border Explored**. 1(1). Bulletin of Health Information.

Albin L. and Nesbit J. (2008), **Hum Bio 153: Parasites and Pestilence**. Spring.

Baboo K.S., Ndayambaje I., Chizema E. K., Silwaamba G., and Miller J. (2008), **Effectiveness of Rapid Diagnostic test for Malaria Diagnosis in Children under 15 years of Age of Nchelenge District in the Luapula Province of Zambia**. Medical Journal of Zambia, Volume 35 Number 4, 53

Baltes P. B., Reese H. W., and Nesselroade J. R. (1988), **Introduction to research methods, life-span developmental psychology**. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Barnish G, Bates I, and Iboro J. (2004), **Newer drug combination for malaria**. British Medical Journal, 328: 1511-1512.

Blaikie, N. (2000), **Designing Social Research**. Oxford: Polity Press.

Bloland ,B.P., and Ettling, M. (1999), Review: **making malaria-treatment policy in the face of drug resistance**, Ann. Trop. Med. Parasitol. 93 : 5–23.

Bloland,B.P, Kachur,S.P., and Williams,H.A. (2003), **Trends in antimalarial drug deployment in sub-Saharan Africa**, J. Exp. Biol. 206 (2003), pp. 3761–3769.

Bojang K.A., Obaro S., Morison L.A. and Greenwood B.M. (2000), **A prospective evaluation of a clinical algorithm for the diagnosis of malaria in Gambian children**, Tropical Medicine and International Health 5, 231–236.

Breman J. G. (2004). "**Conquering the intolerable burden of malaria: what's new, what's needed: a summary,**" American Journal of Tropical Medicine and Hygiene **71**(Suppl 2): 1-15.

BuaNews/AllAfrica.com, reports 2008

Burns N. and Grove S. (2001). **The Practice of Nursing Research Conduct, Critique and Utilization (fourth ed.)**, WB Saunders, Philadelphia: 191.

Chandramohan D., Jaffar S. and Greenwood B.,(2002).**Use of clinical algorithms for diagnosing malaria.** Tropical Medicine and International Health 7, 45–52.

Coleman R.E, Maneechai N. and Rachaphaew N. (2002).**Comparison of field and expert laboratory microscopy for active surveillance for asymptomatic Plasmodium falciparum and Plasmodium vivax in western Thailand**. American Journal of Tropical Medicine and Hygiene 67, 141–144.

Creswell, J. W. (1998). **Qualitative inquiry and research design, choosing among five traditions**. Thousand Oaks, CA: SAGE Publications.

D.J. Fryauff, Purnomo, M.A. Sutamihardja, I.R. Elyazar, I. Susanti, Krisin, B. Subianto and H. Marwoto.(2000), **Performance of the Optimal assay for detection and identification of malaria infections in asymptomatic residents of Irian Jaya**, Indonesia, Am. J. Trop. Med. Hyg. **63:** 139–145.

Delacollette, C., van der Stuyft ,P., and Molima. K (1996), **Using community health**

workers for malaria control: experience in Zaire, Bull. World Health Organization 74 (4): 423–430.

Egwang T. (2007),**Over diagnosis and over treatment in Zambia.** Aids Map/Malaria. May 23, 2007.

Font F., Alonso González M., Nathan R., Kimario J., Lwilla F., Ascaso C., Tanner M., Menéndez C., and Alonso P.L., (2001). "**Diagnostic accuracy and case management of clinical malaria in the primary health services of a rural area in south-eastern Tanzania**," Tropical Medicine and International health 6 (6), 423–428

Gagné RM, Briggs LJ, and Wager WW (1992), **Principles of instructional design**. 4th edition. Fort Worth, TX: Harcourt Brace Javonovich College Publishers.

Glaser, A.L. and Corbin, J. (1990), **Basics of Qualitative Research: Grounded Theory Procedures and Techniques**. Newbury Park: Sage.

Glaser, B.C. (1978), **Theoretical Sensitivity. Mill Valley** California: The Sociology Press.

Glaser, B.C. and Strauss, A. (1967), **The Discovery of Grounded Theory**. New York: Aldine Publishing.

Greenwood B.M, (1999),**The syndromic approach to malaria diagnosis. Draft position paper prepared for informal consultation on malaria diagnostics at the turn of the century**. Geneva, WHO, (WHO/CDS/IC/WP 99.2).

Guthmann J.P., Ruiz A., Protto G., Kiguli J., Bonte L., and Legros D., (2002), **Validity, reliability and easy of use in the field of five rapid tests for the diagnosis of plasmodium falciparum malaria in Uganda**, 2002; 96: 254-257.

Hamer D.H. (2007), **Improved diagnostic testing and malaria treatment practices in Zambia**. Aids map resources Africa Medical tests. JAMA 297: 2227-2231, 2007).

Hanscheid T. (1999), **Diagnosis of malaria: a review of alternatives to conventional microscopy**. Clinical Laboratory Haematology 21, 235–245.

Harvey S. A., Jennings L., Chinyama M., Masaninga F., Mulholland K. and Bell D. R., (2008), **Improving community health worker use of malaria rapid diagnostic tests in Zambia: Package instructions, job aid and job aid-plus-training**, WHO Lusaka, Zambia, Malaria journal 2008, 7:160doi:10.1186/1475-2875-7-160.

Kain K.C., Harrington M.A., Tennyson S. and Keystone J.S. (1998), **Imported malaria: prospective analysis of problems in diagnosis and management**. Clinical Infectious Disease **27,** 142–149.

Keiser J. and Utzinger J., (2004), "**Urbanization in sub-Saharan Africa and implication for malaria control.**" American Journal of Tropical Medicine and Hygiene 71 (Suppl 2): 118-27.

Kidane,G., and Morrow, R.H. (2000), **Teaching mothers to provide home treatment of malaria in Tigray**, Ethiopia: a randomized trial, Lancet 356 (2000) (9229), pp. 550–555.

Knebel E., Lundahl, S., Edward-Raj, A and Abdullah, H. (2000), **The Use of Manual Job Aids by Health Care Providers: What Do We Know?** Quality Assurance Project, Bethesda, MD.

Luxemburger C., Nosten F. and Kyle D.E (1998), **Clinical features cannot predict a diagnosis of malaria or differentiate the infecting species in children living in an area of low transmission**. Transactions of the Royal Society of Tropical Medicine and Hygiene 92, 45–49.

Malaria Foundation International (1998), **Background Information on Malaria**. 14 May 1998. UK Department for International Development.

Mayxay M., Newton P.N. and Yeung S, (2004), **Short communication: an assessment of the use of malaria rapid tests by village health volunteers in rural Laos**. Trop. Med. Int Health 2004; 9:325–9.

Medecins Sans Frontieres experience (2003), Artemisinin **Combination Therapy. ACT NOW** – MSF 2003.

Miley K.K., O'Melia M., and DuBois B.L.,(2007). **Generalist social work practice: An empowering approach** .Boston: Allyn & Bacon.

MoH (2004), **Guidelines for the Diagnosis and Treatment of malaria in Zambia. Together let us Roll Back Malaria**, Lusaka Zambia.

MoH (2005a), **A Road Map for Impact on malaria in Zambia**, 6- year Strategic Plan 2006-2011, A rapid Scale up of malaria Control Interventions for Impact in Zambia, Lusaka. Zambia.

MoH (2005b), **National Health Strategic Plan 2006-2011**, Lusaka Zambia, MoH.

MoH 2006c), Annual **Health Statistical Bulletin**, Lusaka Zambia, MoH.

MoH (2006a), **Annual Report**, Lusaka, Zambia, MOH.

MoH (2006b) **Zambia National Health Accounts 1999- 2002,** Lusaka, Zambia, MoH.

MoH (2007), **Integrated Management of Child Illness**, Lusaka, Zambia, MoH.

MoH (2008), **Zambia Demographic Health Survey**, Lusaka, Zambia, MoH.

MoH (2009a), **Eastern Province Ministry of Health Annual Report for 2008**. Chipata, Zambia, MoH.

MoH (2009b), **Health Management Information System,** Chipata, Zambia, MoH.

MoH (2009c), **Integrated Technical Guidelines for frontline health workers**, Lusaka Zambia, MoH.

Moody, A. (2002), **Rapid diagnostic tests for malaria parasites**. Clin. Microbiol. Rev. 15:66-78.

Moonasar D., Goga AE., Frean J., Kruger P and Chandramohan D., (2007), **An exploratory study of factors that affect the performance and usage of rapid diagnostic tests for malaria in the Limpopo Province**, South Africa. Licensee BioMed Central Ltd.

Nabarro D. N. and Tayler E. M. (1998). **"The "Roll Back Malaria" campaign**." Science **280**: 2067-8.

National Malaria Control Center (2007a), **Action Plan**, Lusaka Zambia, MoH.

National Malaria Control Center (2007b), **Annual report**, Lusaka Zambia, MoH.

O'Dempsey, T. J., and McArdle, T. F., (1993). "**Overlap in the clinical features of pneumonia and malaria in African children.**" Transactions of the Royal Society of Tropical Medicine and Hygiene **87**: 662-5.

Olumese P. and Global Antimalarial Drug Policy Database (2006). http://www.who.int/malaria/treatmentpolicies.htlm. **Antimalaria treatment policies for P.falciparum and P. vivax by country.** WHO Africa and Eastern Mediterranian region June2006 Update.

Patton, M. Q. (1990), **Qualitative Evaluation and Research Methods** (2nd ed.) Newbury Park, CA: Sage Publications, Inc.

Rennie W., Phetsouvanh R., Lupisan S., VansavethV., Hongvanthong B., Phompida S., Alday P., Fulache M., Lumagui R., Jorgensen P., Bell D and Harvey S., (2007). **Minimising human error in malaria diagnosis.**Trans R Soc Trop Med Hyg. 101(1): 9-18.

Reyburn H. and Ruanda J. (2006),"**The contribution of microscopy to targeting antimalarial treatment in a low transmission area of Tanzania.**" Malaria Journal **20;** 4-10.

Sachs J. and Malaney P. (2002), **The economic and social burden of malaria**. Nature 415: 680–685.

Samuel D., Shillcutt Chantal M., Morel Paul G., Coleman Anne J. and Mills Catherine A, (2008), **Cost-Effectiveness of Malaria Diagnosis in Sub-Saharan Africa: The Role of Rapid Diagnostic Tests in Rural Settings with High Plasmodium falciparum transmission,** Keppel Street, London WC1E 7HT, UK

Shiff C.J., Minjas J.N. and Premji Z. (1994) **The Parasight®-F test: a. simple rapid manual dipstick test to detect Plasmodium Falciparum infection**. Parasitology Today **10**, 494–495.

Singh N. and Nagpal A.C., (2004), **Performance of Optimal dipstick test for management of severe and complicated malaria cases in a tertiary hospital**, Central India. 2004; 48:364-365.

Singh N. and Saxena A. (2005), **Usefulness of rapid on site Plasmodium falciparum diagnosis in forest migrants and among indigenous population at site of their occupation activities in central India**. 2005; 72: 26-29.

Singh N., Mishra A., Shukla M., and Bharti P, (2005), **Diagnostic and prognostic utility of an inexpensive rapid on site malaria diagnostic test (ParaHIT f) among ethnic tribal population in areas of high, low or no transmission in central India**, Malaria research centre (ICMR) RMRCT campus.

Snow R.W., Trape J.F. and Marsh K. (2001), "**The past, present and future of childhood malaria mortality in Africa**". Trends Parasitol, **17**:593-597.

The Quality Assurance Project (QAP) and the World Health Organization (WHO) (2006). **How to use a malaria rapid diagnostic test (RDT): A guide for training CHWs and other health workers**. Bethesda, MD, and Geneva.

UNICEF (2007), **malaria diagnosis: a guide for selecting rapid diagnostic test (RDTs) kits** - 1st edition October 2007.

WHO (1993), **A global strategy for malaria control**. Geneva: 1-40.

WHO (1999), **Integrated Management of Child Illness Information Package**. Geneva. WHO/CHS/CAH/98.1.

WHO (2000a), **African Summit on Roll Back Malaria**. Abuja Nigeria WHO/CDS/RBM/2000.17. WHO, Geneva.

WHO (2000b), **New Perspectives: Malaria Diagnosis. Report of a joint WHO/USAID informal consultation, 25–27 October 1999**. WHO/CDS/RBM/2000. 14 and WHO/MAL/2000. 1091. WHO, Geneva.

WHO (2003a), **The Africa Malaria Report 2003**. Geneva, UNICEF and World Health Organization: 120.

WHO (2003b), **Malaria rapid diagnosis, making it work: Informal consultation on field trials and quality assurance on malaria rapid diagnostic tests**. Manila, RS/2003/GE/05(PHL): 61.

WHO (2004a), **Sources and prices of selected products for the prevention, diagnosis, and treatment of malaria,** Geneva. http://www.who.int/medicines/organization/par/ipc/AmalBro5.pdf: 70.

WHO (2004b), **Focus on the use of rapid diagnostic tests in areas of high transmission**, report of a WHO technical consultation, 25-26 October 2004.

WHO (2004c), **The Use of Malaria Rapid Diagnostic Tests**. Manila: World Health Organization - Regional Office for the Western Pacific.

WHO (2008), **World Malaria Report 2008, Global Malaria Programme**, Geneva. http://www.who.int/malaria

APPENDICES

APPENDIX I

INFORMATION SHEET

UTILIZATION OF MALARIA RAPID DIAGNOSTIC TESTS IN CHIPATA DISTRICT HEALTH CENTRES.

INTRODUCTION

I am Mutinta Siatwinda Malama; a student of masters in public health from university of Zambia kindly requesting for your participation in the research study stated above. Before you decide whether or not to participate in this study, I would like to explain to you the purpose of the study, any risks or benefits and what is expected of you. Your participation in this study is entirely voluntary. If you decline to participate, no sanctions or privileges will be taken away from you (Miley et al., 2007). If you agree to participate, you will be asked to sign the consent in the presence of someone. Agreement to participate will not result in any immediate benefits.

PURPOSE OF STUDY

To determine factors associated with under utilization of malaria rapid Diagnostic Tests in Chipata District health centres. The study will assist to obtain information on problems health workers experience in utilizing malaria rapid diagnostic tests. The results of this study are also expected to influence future training programmes and policy formulation and implementation with regards to RDT utilization.

PROCEDURE

This study involves a face to face interview with the researcher that will ask you questions using a semi-structured questionnaire. After you have signed the consent form. I will ask you questions on utilization of malaria RDTs and your responses will be recorded on the questionnaire. The interviews may be recorded if you would be willing. Checklists will be

used on health workers to validate responses from the interview schedule. You will also be given a chance to make suggestions on how RDT utilization can be improved to ensure adequate utilization. The interview will take about 30 minutes.

RISKS AND DISCOMFORTS

There are no risks or harm involved in this study though part of your time will be utilised to answer some questions. However, the researcher will endeavour to minimise any immediate and subsequent potential discomforts as a result of participating in this research. If you decide to take part in the study, you will be asked if the researcher could ask you some of the questions on malaria RDT tool, particularly about your experiences and observations. Your name will not be on any tape or paper or report if you agree to have the interview recorded and after the interview is typed, the tape will be kept under lock and will be destroyed three years after the study. However, if you feel uncomfortable or decide to decline to take part or stop everything, you have to do so voluntarily. The researcher who would be responsible for the study is not a member of any health management or regulatory board and that your participation will not have any harm in any way.

BENEFITS:

Noting the many steps the ministry of health and local government are taking to reduce malaria infection, the study will make considerable contribution in public health by enhancing strategic planning. There is however no guaranteed direct benefits to you immediately on account of this research, but guidelines will be given on how Malaria rapid diagnostic tests can be adequately utilized.

CONFIDENTIALITY:

Your research records and any information you will give will be confidential to the extent permitted by law. You will be identified by a number and personal information will not be released without your written permission except when required by law. The ministry of health, the University of Zambia Research ethics Committee or the School of Medicine may review your records again but this will be done with confidentiality.

INFORMED CONSENT FORM

The purpose of this study has been explained to me and I understand the purpose, the benefits, risks and discomforts and confidentiality of the study. I further understand that:

If I agree to take part in this study, I can withdraw any time without any sanctions and that taking part is purely voluntary.

I.....agree to take part in this study.

Signed ..... Date ..... (Participant)

Witness's name ..... sign .....

PERSONS TO CONTACT FOR PROBLEMS AND QUESTIONS

1 Mutinta S Malama, University of Zambia Dept of community medicine, box 50110, Lusaka.

Cell: 0966246543

2. Professor K.S Baboo, University of Zambia Dept of Community medicine, box 50110, Lusaka, Zambia.

3. The Chair Person, Research Ethics Committee, University of Zambia, P.O box 50110, Lusaka. Telephone: 256067.

Telephone. 260 (6) 221098
Reply Please Quote

Fax: 260 (6) 221298
Nr.: C.D.3/6/2/10/1

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
DISTRICT HEALTH OFFICE
EASTERN PROVINCE
P.O. BOX 511205

22nd December, 2009

Mrs Mutinta Siatwinda Malama
University of Zambia
School of Medicine
P. O. Box 50110
LUSAKA

Dear Madam,

REF: PERMISSION TO COLLECT DATA YOURSELF

Reference is made to your request letter dated 20th December, 2009 in which you are requesting for permission to collect data for your research project from our health facilities.

I am happy to inform you that permission has been granted for you to interview our health staff and also review our mediacal records for the purpose of your research.

By copy of this letter the In Charges of the selected rural holath centers have been informed.

Yours faitnfully,

Dr P. M. Zulu
District Medical Officer
CHIPATA DISTRICT

Cc Rural Health Center Incharges - Chipata District

APPENDIX II

APPENDIX III- Schedule for Field work activities

Task to be performed	Responsible person	2009									2010					
		APR	MAY	JUN	JUL	AUG	SEP	NOV	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Literature review	Researcher															
Proposal development	Researcher															
Presentation to graduate studies	Researcher															
Approval by REC	Researcher															
Data collection	Researcher															
Data analysis	Researcher															
Report writing	Researcher															
Submission of draft report	Researcher															
Submission of final report	Researcher															
Dissemination of results	Researcher															

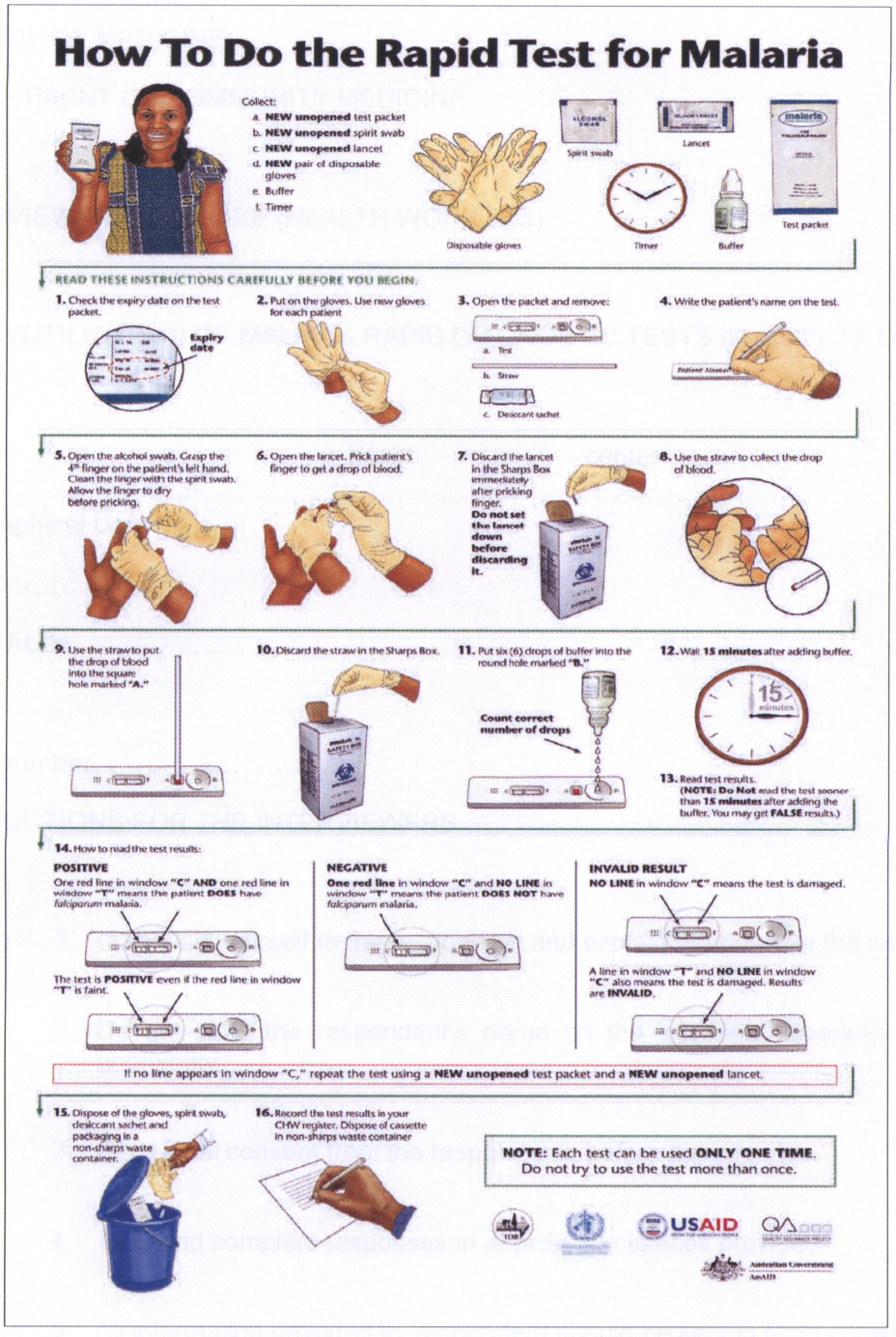
APPENDIX 1V

BUDGET FOR THE STUDY

ACTIVITY	Rate	Days	Number of People	Total Cost (ZMK)	USD$
Consent to perform research				**500,000**	
Pilot study					
Stationery	100,000	2	1	**200,000**	
Researcher's transport to site	200,000	2	1	**400,000**	
Research assistants fees	500,000	5	1	**2,500,000**	
Data Collection					
Stationery	1,000,000	2	1	**2,000,000**	
Researcher's transport to site	200,000	8	1	**1,600 000,000**	
Research assistants fees	200,000	10	1	**2,000,000**	
Data Analysis/Literature support	300,000	5	1	**1,500,000**	
Data Entry	200,000	5	1	**1,000,000**	
Binding Report	500,000	2	1	**1,000,000**	
Grand Total				**13,700,000**	

APPENDIX V

Sample Job Aid *(Specific job aids are available for different products.)*



APPENDIX VI

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

INTERVIEW QUETIONAIRE (HEALTH WORKERS)

TOPIC: UTILIZATION OF MALARIA RAPID DIAGNOSTIC TESTS IN CHIPATA DISTRICT

Name of health centre.....

.....

Geographical Unit :

Urban.....

Peri - Urban.....

Rural .....

Serial number.....

INSTRUCTIONS FOR THE INTERVIEWERS

1. Introduce yourself to the respondent and explain the purpose the interview.
2. Do not write the respondent's name on the interview schedule to ensure anonymity
3. Get verbal consent from the respondents before the interview
4. Tick and complete responses in appropriate spaces provided
5. All information provided by respondent should be kept in strict confidence.
6. Allow respondents to ask questions at the end of the interview

SECTION A: DEMOGRAGHIC DATA

1. Sex

Male	Female

2. How old are you? ☐

3. Number of months of experience in RDT program

1-2 months	3- 4 months	5- 6 months	Above 7 months

4. Period of service in government in years ☐

5. What is your Profession?

Doctor	Nurse	Clinical officer	Environmental H.Tech.	Others specify

SECTION B: GUIDELINES

Guidelines

6. What diagnostic procedure do you use to confirm malaria?

Microscopy ☐

RDT ☐

7. If you do use RDT, what guidelines do you use to utilize malaria RDTs?

	Yes	No
1. RDT job aid guidelines		
2. RDT Integrated Technical Guidelines (ITG) guidelines		
3. RDT Integrated Management of Child Illness (IMCI) guidelines		

8. Depending on the response above, what problems are you facing in using those guidelines?

.....
.....
.....
.....

You said you use MRDT job aid guidelines, please show them to me Available ☐
Not available ☐

You said you use IMCI guidelines, please show them to me Available ☐
Not available ☐

You said you use ITG guidelines please show them to me Available ☐
Not available ☐

SECTION C: SERVICE[9] FACTORS

RDT utilization services

9 Are staffing levels adequate to meet the daily MRDT loads and tasks? Yes ☐ No ☐

1o. To what extent do the numbers fulfill the establishment needs?

Very much	Much	Average	Little	Very little

11 What is the average number of MRDTS that you are able to do per day in this health centre?

12 On average how many health workers perform RDTs on a daily basis? ☐

13. How would you rate the level of utilization of malaria RDTs?

Low ☐

High ☐

14. Depending on your response, what do you think contribute to such levels of RDT utilization?

Inadequate guidelines Yes No ☐

Inadequate staffing levels Yes No ☐

Negative attitudes Yes No ☐

☐

[9] What service factors are associated with low utilization of RDT?

Inadequate RDT training Yes No

Inadequate RDT knowledge Yes No

Inadequate supervision Yes No

15. To what extent do you agree that RDTs are performed according to the MRDT guidelines?

Strongly agree	Agree	Disagree	Strongly disagree

16. To what extent, do you stick to the MRDT guidelines?

Always	Sometimes	Rarely	Never

RDT coverage

17. What is the coverage like of RDT?

High	Medium	Low

18. Have u been trained in RDT utilization? Yes No

19. To what extent do you think the training you received is adequate to grant you the required skill?

Very adequate	Adequate	Just average	Inadequate	Very inadequate

20. Are trained staffs readily available to perform MRDT

yes	no

21. To what extent does trained staff availability affect MRDT utilization?

Very much	much	Just average	Very little	Very little

22. What is the extent of MRDT trained staff attrition in the period 1st June to 1st December 2009?

Very high (three or more staff left)	medium (two staff left)	Low (one staff left)	Very low (none left)

23. To what extent does the attrition of trained staff affect your operations?

Very much	much	Less	Not sure

24. How often are you supervised when utilizing the RDT?

Twice in 1st quarter	Twice in 2nd quarter	Not at all
Once in 1st quarter	Once in 2nd quarter	Not at all

25. To what extent is sensitization of RDT for health workers adequate?

Very adequate	Adequate	Inadequate	Very inadequate

SECTION D: OPERATIONAL FACTORS[10]

Knowledge

26. What do you think is the use of malaria RDTs?

RDTs are a way to test whether a person with malaria like symptoms has malaria ☐

27. Why are RDTs important for malaria control?

They are more accurate than presumptive diagnosis and can be used close to the famil ☐

RDTs give result in about 15 minutes, so patient with malaria can begin treatment right awa ☐

Most people can learn to use RDTs in just a few hours. ☐

28. What are limitations for RDT?

RDTs cannot test how many parasites are present in the blood. ☐

The parasite antigens can remain in the blood for at least 2 weeks after the parasite have been killed by drugs and this can give a false positive result. ☐

Total for knowledge..... ☐

[10] What operational factors are associated with low RDT utilization?

Acceptability (attitude)

29. What do you consider to do an RDT?

Malaria symptoms – fever, headache, joint pains, flue like symptoms, vomiting, nause

30. Depending on your experience what actions do you take following positive RDT results?

If the test result is positive, treat the person for malaria according to the national guideline

31. Depending on your experience what actions do you take following negative RDT results?

If the test result is negative, follow the national guidelines for management of febrile patients who have a negative test result.

32. To what extent do you accept MRDT as a reliable tool?

Very much	much	Less	Not sure

Total for acceptability .....

33. Depending on the above responses, what measures have been instituted to improve utilization rate of RDTs?

.....

.....

.....

34. In your opinion how best can these factors (above) get addressed to increase utilization of RDT?

The end!

Thank you very much for your participation.

APPENDIX VII

FACILITY RECORD CHECKLIST

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

TOPIC: UTILIZATION OF MALARIA RAPID DIAGNOSTIC TESTS IN CHIPATA DISTRICT

DATE.....

PLACE OF INTERVIEW.....

NAME OF INTERVIEWER.....

NAME OF FACILITY.....

INSTRUCTIONS FOR THE INTERVIEWERS

1. Introduce yourself to the health authority and explain the purpose of the facility audit.
2. Get verbal consent from the health authority before the audit.
3. Tick the observations in appropriate spaces provided.
4. All the observation notes should be kept in strict confidence.
5. Thank the health authority at the end of the audit.

RECORD CHECKLIST

ITEM	DESCRIPTION	TOTALS
1	Number of RDTs done	
2	Number of RDT positives	
3	Number of RDT negatives	
4	Number of prescribed anti malarials	

APPENDIX VIII

PARTICIPANT OBSERVATION GUIDE

THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

DEPARTMENT OF COMMUNITY MEDICINE

TOPIC: UTILIZATION OF MALARIA RAPID DIAGNOSTIC TESTS IN CHIPATA DISTRICT.

DATE.....

PLACE OF INTERVIEW.....

NAME OF INTERVIEWER.....

NAME OF FACILITY.....

INSTRUCTIONS FOR THE INTERVIEWERS

1. Introduce yourself to the health authority and explain the purpose of the facility audit.
2. Get verbal consent from the health authority before the audit.
3. Tick the observations in appropriate spaces provided.
4. All the observation notes should be kept in strict confidence.
5. Thank the health authority at the end of the audit.

OBSERVATION GUIDE

NO.	ITEM	PRESENT (1)	ABSENT (0)	COMMENTS
	Performing RDT			
1.	Only trained health workers perform RDT			
2.	Adequate preparation for the test (5 to 10 minutes)			
3.	Correct timing of reading			
4	Correct interpretation of results			
5	Observed mistakes less than 3 steps (16 steps in all)			
6	Able to do test			
7	If result is negative			
8	If result is negative and no any other cause			