INFLUENCE OF HEALTH INFORMATION SYSTEMS ON MEDICAL DIAGNOSIS OF MALARIA FOR EFFECTIVE TREATMENT: A CASE OF HOSPITALS IN MERU TOWN, KENYA

BY

ABRAHAM KABUI KAHUTHIA

A RESEARCH REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ARTS DEGREE IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2016

DECLARATION

Declaration by the Student:

This research report is my own original work and it has not been presented before in any other university.

Signature: _____Date:_____

Abraham Kabui Kahuthia

Reg. No: L50/73319/2014

Declaration by the Supervisors:

This research report has been submitted with our permission and assent as University of Nairobi supervisors.

Signature: _____Date: _____

Dr. Peter Keiyoro

Senior Lecturer, School of Continuing and Distance Education,

Department of Educational Studies,

University of Nairobi

Signature: _____Date: _____

Dr. Josephine Ngunjiri,

Lecturer, School of Continuing and Distance Education,

University of Nairobi

DEDICATION

I dedicate this project report to my parents Rev. Eustace Kahuthia and Mrs. Evelyn Kahuthia for their advice, moral and financial support as well as my brothers Paul Nyaga and Victor Mureithi. I also reserve special thanks to Florence Ngina for her constant support and encouragement. God bless you.

ACKNOWLEDGEMENT

I reserve special gratitude to my supervisors Dr. Peter Keiyoro and Dr. Josephine Ngunjiri for their careful guidance and wise counsel throughout the process. I am thankful to the staff of University of Nairobi Meru Extra-Mural center for their exemplary services. I would also like to recognize my fellow classmates for the experiences we have shared during the course of our studies as well as the respondents who made data collection possible.

ABSTRACT

Information systems are being embraced as tools of better service delivery, efficiency and accountability in many sectors including healthcare. Medical diagnostic reports are crucial in treatment and prognosis of diseases, thus the importance of precise and accurate medical data. Various interventions and measures have been undertaken globally in the fight against malaria with notable gains, including Kenya. The introduction of rapid diagnostic testing kits for malaria in Kenya presents a novel way of testing. However, the problem lies in translation of the malaria results done through rapid diagnostic tests to accurate data due to transcription errors as well as medical biases. Inaccurate medical data negatively impacts health interventions and policy. Therefore this study sought to investigate the influence of health information systems on medical diagnosis of malaria for effective treatment in, Meru town, Imenti North constituency, Meru County. The research design was of descriptive survey research design .This was because the design was useful since it collected data from members of the population in order to determine the current status without manipulating the variables. The study consisted of a population of 30 respondents from the Karen Hospital, Aga khan Hospital, Grace Park Hospital and Meru teaching and referral hospital in Meru town .The respondents and interviewees consisted of medical officers, laboratory technologists, pharmaceutical technologists, clinical officers, nurses, radiographers, physiotherapists, accountants and hospital administrators. Quantitative data was analyzed using the SPSS version 21 and tabulated into frequency tables and percentages. This study employed correlation coefficient inferential statistics to bring out the relationship between the dependent and independent variables. Qualitative data was analyzed by organizing according to the research questions and objectives. It was implied in the study that availability of a hospital information system influenced the ease of access and management of patient data; the forms of registration were varied, attributed to difference in scope of hospital clientele. The higher the scope of hospital clientele, the more integrated the system was. The level of integration decreased with lower hospital clientele base. The study established that a reliable and effective network influenced the quality of service rendered by the hospital information system. Hospital information systems improved accessibility of medical records as well as enabled tracking and use of health data by medical personnel. Hospital information systems influenced decision making in treatment of malaria through shortened treatment times. Based on the findings, the study suggested that older users should be encouraged to utilize the system through specialized training programmes; standardization of hospital information systems to enhance quality of health service delivery and improved resource allocation for realization of the full potential of hospital information systems. The study suggested further research how levels of competence of information technology influences use of hospital information systems; investigation of how health information system integration influences quality of medical data and further studies on the contribution of hospital information systems on disease surveillance.

TABLE OF CONTENTS

DECLARATION II

DEDICATION III

ACKNOWLEDGEMENT IV

ABSTRACT V

TABLE OF CONTENTS VI

LIST OF ABBREVAITIONS AND ACRONYMS IX

LIST OF TABLES X

LIST OF FIGURES XI

CHAPTER ONE: INTRODUCTION 1

1.1 Background of the Study 1

1.2 Statement of the Problem 5

1.3 Purpose of the Study 7

1.4 Objectives of the Study 7

1.5 Research Questions 7

1.6 Significance of the Study 8

1.7 Limitations of the Study 8

1.8 Delimitations of the Study 8

1.9 Assumptions of the Study 9

1.10 Definition of Significant Terms 9

1.11 Organization of the Study 10

CHAPTER TWO: LITERITURE REVIEW 11

2.1 Introduction 11

2.2 Medical diagnosis of Malaria and Health Information Systems 11

2.3 Key attributes of Health information systems 15

2.4 Availability of health systems and disease diagnosis 15
2.5 Quality Hospital systems for disease diagnosis 17
2.6 Monitoring and evaluation of hospital systems and disease diagnosis 19
2.7 Hospital systems and decision making in disease diagnosis 21
2.8 Theoretical Framework 22
2.9 Conceptual Framework 23
2.9.1 Research Gap 25
CHAPTER THREE: RESEARCH METHODOLOGY 27
3.1 Introduction 27
3.2 Research Design 27
3.3 Target Population 28
3.4 Sampling techniques and sample size 28
3.5 Method of Data Collection 29
3.6 Validity of research instruments 29
3.7 Reliability of research instruments 29
3.7 Data Collection Procedure 30
3.8 Data Analysis 30
3.9 Ethical considerations 31
3.9.1 Operationalization of variables 32
CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION 35
4.1 Introduction 35
4.2 Response Rate of Instruments 35
4.3 Demographic characteristics of the respondents 35
4.4 Availability of health systems and disease diagnosis 38
4.5 Quality hospital systems for disease diagnosis 40

4.6 Monitoring and evaluation of hospital systems and disease diagnosis 43

4.7 Hospital systems and decision making in disease diagnosis..... 46

CHAPTER FIVE: SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS..... 47

5.1 Introduction..... 47

5.2 Summary of the findings..... 47

5.2.1 Availability of hospital information systems and medical diagnosis of malaria..47

5.2.2 Quality of hospital information system and medical diagnosis of malaria……...48

5.2.3 Monitoring and Evaluation function of hospital information systems…….48

5.2.4 Influence of hospital information system on decision making……..……48

5.3 Discussion of findings…….47

5.4 Conclusions..... 50

5.5 Recommendations..... 49

5.6 Suggestions for further study..... 51

REFERENCES 53

APPENDICES 60

Appendix A: Transmittal Letter..... 60

Appendix B: Research Questionnaire for Medical personnel 61

Appendix C: Interview Schedule for Medical Personnel 67

Appendix D: Meru County disaggregated data on Malaria..... 69

LIST OF ABBREVAITIONS AND ACRONYMS

EMR	Electronic Medical Records
EHR	Electronic Health Record
HIS	Health Information Systems
HISP	Health Information System Program
HMIS	Hospital Management Information Systems
ICT	Information Computer Technology
IT	Information Technology
MDGs	Millennium Development Goals
PCISs	Patient Care Information Systems
RDT	Rapid Diagnostic Test
SPSS	Statistical Package for Social Sciences
TB	Tuberculosis
USA	United States of America
WHO	World Health Organization

LIST OF TABLES page

Table 2.1: Comments on research gap……26
Table 3.1: Population sample……..30
Table 4.1: Gender of respondents……...33
Table 4.2: Marital status……35
Table 4.3: Age category……37
Table 4.4: Respondents and hospital departments……37
Table 4.5: Forms of registration……38
Table 4.6: Accessibility and timeliness……..38
Table 4.7: Privacy and Confidentiality……..39
Table 4.8: Accurate and updated EMR……....40
Table 4.9: Movement within Hospital departments……..40
Table 5.0: Reasons for 'NO' response……...41
Table 5.1: Ability to serve patients promptly and fast……..41
Table 5.2: Delays in service delivery……....42
Table 5.3: Duration of delays if 'YES'……..42
Table 5.4: Monitoring and evaluation……43
Table 5.5: Tracking of patient health status……...43
Table 5.6: Patient data design……44
Table 5.7: Importance of malaria testing……...44
Table 5.8: Accuracy in malaria tests reporting……..45
Table 5.9: Accuracy of malaria results……..45
Table 6.0: Hospital systems and decision making……....46

LIST OF FIGURES

Page

Figure 1: Conceptual Framework……...25

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

According to World Health Organization, the health information systems provide the underpinnings for decision making and have four key functions: data generation, compilation, analysis and synthesis, communication and use. The health information system collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision-making (Health Metrics Network Framework and Standards for Country Health Information Systems, Geneva, World Health Organization, WHO,(2008).

Health information is health care data that have been organized into a meaningful format. The information may refer to organized data collected about an individual patient, or the summary of information about that patient's entire experience with his or her health care provider. Health information can also be the aggregate information about all patients that have attended or been admitted to a hospital, or attended a health center, outlying clinic or a community immunization or health screening program. Health information, therefore, can encompass the organization of a limitless array and combination of possible data items ,Davis and LaCour (2002). Data may be defined as a representation of facts or concepts or instructions in a formalized manner, suitable for communication, interpretation or processing by manual or electronic means. An element of data is an item, idea, concept or raw fact Abdelhak *et al,* (1996).

In much of the literature on patient safety, patient care information systems (PCISs) are lauded as one of the core building blocks for a safer health care system (Committee on Quality of Health Care in America, 2001).

Health information management professionals plan information systems, develop health policy, and identify current and future information needs. In addition, they may apply the science of informatics to the collection, storage, analysis, use, and transmission of information to meet legal, professional, ethical and administrative records-keeping requirements of health care delivery .They work with clinical, epidemiological, demographic, financial, reference, and coded healthcare data (WHO, 2010).The World Health Organization (WHO) stated that the proper collection, management and use of information within healthcare systems will determine the system's effectiveness in detecting health problems, defining priorities, identifying innovative solutions and allocating resources to improve health outcomes LaTour *et al*,(2010).

Winter *et al*, (2003) and Haux *et al*, (2004), defined Hospital information system as a subsystem of a hospital, which comprises all information processing actions as well as the associated human or technical actors in their respective information processing role. Health systems consist of all activities whose purpose is to promote, restore or maintain health. This includes, but is not limited to, the preventive, curative and palliative health services provided by a health care system Chetley *et al.*, (2006).

The concept of patient care can be defined as the creation of more value for patients through the removal of all none value added steps or actions, Victoria, Kannan, (2008). The current administrative emphasis on the management of frequently used resources, cost control, the effectiveness of patient care, and improved quality and responsibility, reinforces the importance of optimal patient care. An important precondition of optimal patient care is that patient information is completely and accurately recorded and accessible Ammenwerth, Kutscha *et al*, (2001). Undoubtedly, if a patient's medical records are used as a means of communication between health care providers; these records will function as unique tools for planning, coordinating and organizing patient care Nilmini , Steve (2008).

The rapid introduction of Information Systems (IS) in all aspects of society has left little time to consider the impacts or develop policies to take maximum advantage of these systems. Most organizations, including hospitals either use or are planning to implement IS in some capacity. The progressive growth of Information Technology (IT) has led hospital administrators to recognize IT as a powerful tool to enhance their organization's productivity James, Parag *et al*., (1996). Many hospitals around the world are in the process of moving away from paper-based health information and implementing electronic health information to support patient care.

In Africa, high levels of communicable and parasitic disease are being matched by growing rates of chronic conditions. Although the communicable diseases; malaria, tuberculosis, and above all HIV/AIDS are the best known, it is the chronic conditions such as obesity and heart disease that are looming as the greater threat and are expected to overtake communicable diseases as Africa's biggest health challenge by 2030 (Health care Africa Report, 2012).In the countries of Tanzania, Mali, Zambia and Uganda information systems are being introduced in hospitals in the form of health management information systems. But with a lack of relevant research done in these countries about the introduction of technologies like information systems there is not much to go by Nichole Archangel (2007).

The continent's continuing struggle with communicable diseases such as HIV/AIDS and Tuberculosis (TB), parasitic diseases and poor primary and obstetric care has been a major factor in stalling the development and the extension of healthcare services in African countries at even the most basic level. Undoubtedly, a unified global effort by governments and multilateral organizations has been hugely successful in recent years at bringing down mortality rates linked to these biggest killers. Deaths linked to malaria have fallen by 33 percent since 2000 World Malaria Report (2011). Yet, in a 2010 report, the WHO noted that overall progress towards meeting these Millennium Development Goals (MDGs) had been less than impressive. Just six countries were deemed on track to reduce under five mortality by two thirds during the time specified, with 16 having made

no progress; only 13 countries had maternal mortality rates of fewer than 550 deaths per 100,000 live births, while 31 countries had rates of 550 deaths or higher WHO, (2010).

The implementation of routine health information systems in developing countries is widely seen as critical for improving the quality of health services, Lippeveld, Sauerborn, *et al* (2000). By providing the management of the health sector with timely and accurate data, for instance, resources can be allocated more effectively and epidemics can be monitored and appropriately addressed. In order to address the health system of an entire country it becomes imperative to standardize the processes of data production and collection at the various levels of the health sector.

By standardizing the data set to be collected, all sorts of statistical analyses between facilities, districts, and provinces become possible. Although standardization is necessary to harmonize and integrate the information, the actual implementation of a standard at the local level often demands flexibility and adaptation, Hanseth, Monteiro, *et al* (1996); Rolland, Monteiro, (2002); Timmermans ,Berg (1997).In South Africa the Health Information System Program (HISP) addresses this challenge by means of a particular standardization and implementation strategy: the creation of a hierarchy of standards to allow flexibility, and particular attention to build "local capacity" Braa , Hedberg (2002); Shaw, (2002).

Kenya's Vision 2030 aims at transforming the country from its current status into a newly industrializing middle income country providing a high quality of life to all its citizens by the year 2030.The vision is anchored by three pillars namely Economic, Social and Political pillars. Each pillar has defined objectives to be achieved by 2030, strategies and projects to be implemented in the first 5 year phase. The projects are diverse covering all social and economic sectors and are widely dispersed to cover the whole country Njuguna, Kamau, *et al* (2008). Under the social pillar, the health sector is underpinned as a critical area to achieving a just, equitable social development in a clean and secure environment. One of the flagship projects under the health sector aims to revitalize the efficacy of the hospital management information system by improving data tools used

and reporting methods, spearheaded by the government of Kenya, under the ministry of health.

To this effect, the study seeks to assess the influence of hospital Information systems on medical diagnosis of Malaria for effective treatment in Meru town, North Imenti Constituency, Meru County. The broad objective of this study is to determine the influence of hospital information systems on medical diagnosis. This study will provide the authorities with an insight into best practices and policy formulation in regard to quality assurance in provision of medical services in the County among other projects related to improving health services.

1.2 Statement of the Problem

Until recently, conventional diagnosis of malaria has relied upon either clinical diagnosis or microscopic examination of peripheral blood smears ,Wongsrichanalai , Barcus *et. al.,* (2007). These diagnostic methods required trained staff, expensive and fragile equipment, and, in the case of microscopy, an electricity supply. These requirements and the intrinsic potential for human or technical error have been shown to result in patients who do not have clinical malaria being diagnosed as positive and prescribed anti-malarials, hence risk of drug resistance. According to world health organization, resistance to Artemisinin based combination therapy (ACT) is described as increase in parasite clearance time, as evidenced by approximately 10 per cent of cases with parasites detectable on day 3 after treatment with an ACT (suspected resistance) or treatment failure after treatment with an oral artemisinin based monotherapy with adequate antimalarial blood concentration, as evidenced by the persistence of parasites for 7 days, or the presence of parasites at day 3 and recrudescence within 28 to 42 days (confirmed resistance) WHO, (2014).

The problem of misdiagnosis, over and under treatment of malaria provided the impetus for the development of a more reliable, field suitable, and cost effective diagnostic tool Moody (2002); Shillcutt , Morel *et al,* (2008). In 2010 the WHO recommended that all suspected cases of malaria be confirmed with a diagnostic test prior to treatment ,WHO, (2011) .Based on the detection of Plasmodium antigens in a small drop of the patient's

blood, these tests are easy to use , requiring only minimal training of health workers. The reliability and accuracy of rapid diagnostic tests, even in extremely challenging, remote settings where infrastructures may be broken, health care systems weak and education poor, have made them a staple in malaria control programs and the first choice malaria diagnosis tool, especially when microscopy is not possible, or suitable ,WHO, (2013).

Centre for disease control and prevention (CDC) say that in Kenya has an estimated 6.7 million new clinical cases and 4000 deaths each year CDC, (2015). Malaria is also estimated to cause 20 per cent of all deaths of children under five years, ministry of health, (2006). On October 4th, 2012 malaria rapid diagnostic test kits (RDT) were nationally launched, marking another milestone in the fight against malaria in Kenya. The launch was expected to scale up the diagnosis of malaria using RDTs nationally and promote medical diagnosis reporting of malaria. The number of aggregated confirmed outpatient malaria cases country wide was observed to sharply increase from around 3.5 in April–May to above 4.5 cases per 1000 person in June 2013, malaria surveillance bulletin (2013).

Kenya has more than 39 million inhabitants with 36 per cent of the population living in high transmission areas, 40 per cent in low transmission areas, and 24 percent in malaria-free zones, world malaria report, (2009). Between April to June 2013 the malaria report indicated that in Meru County had 25,452 out- patients treated for malaria and 63,691 out-patients confirmed malaria cases; in both instances there were more cases tested than the number of suspected malaria cases , malaria surveillance bulletin, (2013).

According to Meru county health data between January to June 2015, in Imenti North Constituency 961 cases, approximately 1.1 per cent confirmed malaria cases were reported for over and under 5 years and 14 cases, approximately 0.7 per cent confirmed cases in pregnant women. Rapid diagnostic testing accounted for approximately 23 per cent of positive malaria tests whereas blood smear tests accounted for approximately 3.53 per cent of reported cases for both over and under five years. Whilst it has been shown that the accuracy of RDTs is comparable to that of expert microscopy, Marx , Pewsner *et al,* (2005); Ochola, Vounatsou *et al,*(2006) patient pressure and treatment expectations despite negative test results as compared to what both patients and health providers were

used to seeing when only symptoms were used for diagnosis, has brought about inconsistencies in reporting of malaria diagnosis.

It is in this context that this study sought to investigate the influence of health information systems on medical diagnosis of malaria for effective treatment in Meru town, North Imenti constituency, Meru County, Kenya.

1.3 Purpose of the Study

The purpose of the study was to investigate the influence of health Information systems on medical diagnosis of malaria for effective treatment.

1.4 Objectives of the Study

The study was guided by the following research objectives:

1. How availability of hospital information systems influence medical diagnosis of malaria for effective treatment.
2. How quality of hospital information systems influence medical diagnosis of malaria for effective treatment.
3. To determine the influence of monitoring and evaluation on hospital information systems for medical diagnosis of malaria for effective treatment.
4. To find out the influence of hospital information systems on decision making for medical diagnosis of malaria for effective treatment.

1.5 Research Questions

1. How does availability of hospital information systems influence medical diagnosis of malaria for effective treatment?
2. How does quality of hospital information systems influence medical diagnosis of malaria for effective treatment?
3. How does monitoring and evaluation in hospital information systems influence medical diagnosis of malaria for effective treatment?
4. What is the influence of hospital information systems on decision making for medical diagnosis of malaria for effective treatment?

1.6 Significance of the Study

It was expected that the study would add to the body of knowledge of scholars in the field of hospital management for provision of quality in their services and programmes. The study would also be useful to the Ministry of Health at County and national level, who ought to use the findings to objectively assess the quality of medical diagnostic reports. It was also expected that the findings of the study be used to identify and address challenges that are facing hospital institutions in provision of quality health services and outcomes within Meru town, North Imenti Constituency, Meru County. The study also sought to offer useful recommendation and measures in articulation of the health projects under the social pillar of the Kenya vision 2030.

1.7 Limitations of the Study

According to Best and Kahn (1989) limitations are conditions beyond the jurisdiction of the researcher that may place boundaries on the conclusions of the study and their application to other situations. This study was confined by the attitude of the respondents which may influence the legitimacy of the responses. This was because the respondents were tempted to give socially conventional answers to please the researcher. To counteract this limitation, the researcher ensured that the appropriate explanation was given so that the limitation of attitudes towards responding to questionnaires was reduced. Confidentiality was guaranteed to the respondents by researcher. This was expected to improve respondents' cooperation and response rates.

1.8 Delimitations of the Study

According to Mugenda and Mugenda (2003) delimitations are boundaries of the study.

This study focused on private and public hospitals within Meru town. The respondents were the medical personnel of Karen, Grace Park, Aga Khan and Meru teaching and referral hospitals. The study focused on influence of hospital information systems on medical diagnosis of malaria for effective treatment.

1.9 Assumptions of the Study

Assumptions are facts presumed to be true but have not been verified ,Orodho, (2003).The assumptions of this study were that all hospitals in the study possessed some form of health information system in running hospital business and that respondents were honest in their responses and feedback.

1.10 Definition of Significant Terms

Health systems -The organization of people, institutions and resources that deliver healthcare services to meet the health needs of the target populations

Health information System -Health information systems refers to any system that captures, stores, manages or transmits information related to the health of individuals or the activities of organizations that work within the health sector.

Hospital Management Information system - Is an element of health informatics that focuses mainly on the administrative needs of hospitals. In many implementations, it is a comprehensive integrated information system designed to manage all aspects of a hospital's operations such as medical, administrative, financial, legal issues and the corresponding processing of services

Millennium Development Goals (MDGs) - are the world's time- bound and quantified targets for addressing extreme poverty in its many dimensions-income poverty, hunger, disease, lack of adequate shelter and exclusion while gender equality, education and environmental sustainability

Information Technology - According to the small business encyclopedia, it is a term that encompasses all forms of technology used creates, store, exchange and utilize information in its various forms including business data, conversations, still images, motion pictures and multimedia presentations.

1.11 Organization of the Study

The study is organized into five chapters. Chapter One focused on Background of the study, Statement of the Problem, Purpose of the Study, Objectives of the Study, Research Questions, Significance of the Study, Limitation of the study, Delimitations of the study, Assumptions of the study, and Definitions of Significant Terms and organization of the study.

Chapter Two captured literature review done on the basis of key study variables. Also outlined in the chapter is the theoretical framework, conceptual framework and summary of the literature review.

Chapter Three covered research methodology. This chapter outlined the methodology that is used in the study. The following topics were discussed; research design, target population, sampling procedure, methods of data collection, validity and reliability, operational definition of variables, and methods of data analysis.

Chapter Four focuses on data analysis, presentation and interpretation. In Chapter Five of the study, there is a summary of findings, discussion, conclusion and recommendations.

CHAPTER TWO
LITERITURE REVIEW

2.1 Introduction

This chapter entails a review from other studies that have been carried out globally on influence of hospital Information systems on medical diagnosis of malaria. This review will focus on a prism of key study variables; availability; quality; monitoring and evaluation; decision making on influence of health information systems on medical diagnosis of malaria for effective treatment in Meru town, North Imenti Constituency, Meru County. Also featured in this section are the theoretical and conceptual frameworks of the study as well as the research gap.

2.2 Medical diagnosis of malaria and Health Information Systems

Malaria is caused by *Plasmodium* parasites. The parasites are spread to people through the bites of infected *Anopheles* mosquitoes, called "malaria vectors", which bite mainly between dusk and dawn. Malaria is a life threatening disease caused by parasites that are transmitted to people through the bites of infected mosquitoes. According to the latest estimates by WHO released in December 2014, there were about 198 million cases of malaria in 2013 (with an uncertainty range of 124 million to 283 million) and an estimated 584000 deaths (with an uncertainty range of 367000 to 755000).

Malaria mortality rates have fallen by 47 per cent globally since 2000 and by 54 per cent in the WHO African Region (WHO, 2014). When it comes to surveillance, the tracking progress is a major challenge to malaria control. In 2012, malaria surveillance systems detected only around 14 per cent of the estimated global number of cases. Stronger malaria surveillance systems are urgently needed to enable a timely and effective malaria response in endemic regions, to prevent outbreaks and resurgences, to track progress, and to hold governments and the global malaria community accountable (UN, 2014).

Haux (2006) described systems that process data and provides information and knowledge in healthcare environments as health information systems. He further suggests that hospital information systems are just an instance of health information systems, in which a hospital is the healthcare environment as well as healthcare institution. The aim of health information systems is to contribute to a high quality, efficient patient care. The word ‘system’ implies a connected whole or organized process Abouzahr, (2005). A

hospital information system is the socio- technical sub-system of a hospital, which comprises all information processing as well as associated human or technical actors in their respective information processing roles ,Haux, Winter *et.al,* (2004)

Smith (1997) says that 'healthcare is undergoing a paradigm shift, moving from industrial age medicine to information age healthcare'. This paradigm shift is shaping healthcare systems Haux *et. al*, (2006) and transforming the healthcare-patient relationship,Ball, (2001). From the late 1980's, technology was developed in order to make the delivery of more tailored services and products at lower prices possible. During this period, healthcare organizations were shifting towards an integrated care. A trend towards open systems and object technologies has already been emerging during the 1990's; institutional mergers and networks have made new concepts mandatory ,Kuhn , Guise (2001).

In the United States of America (USA), the merger of hospitals and individual practices into large integrated healthcare networks has been described as a dominant trend ,Teich, (1998), while in Europe has been described as a decentralized network of healthcare delivery institutions that slowly replaces hospitals as centers of care delivery ,Iakovidis, (1998). As predicted, the hospital information system of earlier decades which was mainly administrative functionality had become much more focused on the clinical perspective and the patient record, while becoming more open in a technological as well as an organizational sense. It is now understood that data, not systems is what counts Tuttle, (1999). Moreover, the critical issue is people, not technology, and technology is the enabler, not the driver Ball, (1999).

In regard to terms used to expound on the concept of health information systems, Conrick, (2006) says that health informatics tools include computers as well as clinical guidelines, formal medical terminologies, information and communication systems. He further says that the emphasis is on clinical and biomedical applications with added possibility of the integrated clinical components either among themselves or to more administrative type health information systems. Goldschmidt, (2005) says that health

information technology is the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and the use of healthcare information, data and knowledge for communication and decision making.

Protti *et.al.,* (2009), says that Electronic Medical Records (EMR) reside at the heart of any health information systems. An electronic medical record is a medical record in a digital format, whereas Electronic Health Record (EHR) refers to an individual patient's medical record in a digital format. Protti *et. al.,* (2009) further says that electronic health record systems coordinate the storage and retrieval of individual records with the aid of computers, which are usually accessed on a computer, often through a computer network. One of the most interesting aspects of health information systems is how to manage the relationship between healthcare providers and patients. Fostering good relationship with customer (patient) will retain them and attract them to become loyal customers, create greater mutual understanding, trust and satisfaction. In addition, a good relationship will encourage patient's involvement in decision making ,Richard , Ronald (2008).

The use of Information computer technology (ICT) in health care has grown in the same pattern as compared to the larger industry landscape. The use of web technology, database management systems, and network infrastructure are part of the ICT initiative that will affect healthcare practice and administration. An observable trend is the gradual adoption of e-health systems towards the use of EMR. The systems move patient information from paper to electronic format so that they can be easily and effectively managed Ilias, (1998).

Haux (2006) summarized the milestone of development for HIS were considered important: (1) the shift from paper- based to computer based processing and storage , as well as the increase of data in healthcare settings ; (2) the shift form institution centered departmental and later, hospital information systems towards regional and global HIS ; (3) the inclusion of patients and health consumers as HIS users, besides health care professionals and administrators; (4) the use of HIS data not only for patient care and

administrative purposes, but also for healthcare planning as well as clinical and epidemiological research; (5) the shift from focusing mainly on technical HIS problems to those of change management as well as of strategic information management; (6) the shift from mainly alpha-numerical data in HIS to images and how and now also to data on a molecular level; (7) the steady increase of new technologies to be included, now starting to include ubiquitous computer environments and sensor based technologies for health monitoring.

Kihuba *et al*., (2014) , says that hospital management information systems (HMIS) is a key component of national health information systems (HIS), and actions required of hospital management to support information generation in Kenya are articulated in specific policy documents. Kihuba *et al.*, (2014), conducted an evaluation of core functions of data generation and reporting within hospitals in Kenya to facilitate interpretation of national reports and to provide guidance on key areas requiring improvement to support data use in decision making. The findings indicated that HMIS did not deliver quality data due to significant constraints that exist in data quality assurance, supervisory support, data infrastructure in respect to information and communications technology application, human resources, financial resources, and integration.

Richard and Diane (1996), say that since the advent of HIS development, many high-level managers and health care planners have strived to detect factors that influence the quality of patient care. It is a common belief that the quality of health care is enhanced through information collected and accessed through HIS. Information and HIS quality are linked with the support of effective, timely and appropriate care services, reduction of health risk; efficiently streamlining clinical and administrative tasks such as communicating with patients, their families and other healthcare professionals; monitoring patient awareness; and achieving strategic planning and community health management goals.

However, information itself is not valuable; its value is derived from the changes that it influences in decision making, so information quality is defined as data that are fit for use by data consumers. Health care environments are increasingly dependent on information and the volume of the data collected, stored and used has greatly increased, while computer dependence has also increased. This information is more operational and complex than previous information as the volume of healthcare data has grown exponentially over the last decade. Larger and more complex data are not necessarily better data. The most important issue in this field is the use of high-quality information to improve patient care. Thus, health information can be most effective when the data is high in quality. Delone and Mclean (2003), successful model of information system shows that information quality and system quality affect organizational services. Haslina, Sharifa, (2005); William, Ephraim (2003), say that researchers have indicated that information quality consists of particular attributes, such as completeness, accuracy and relevance.

2.3 Key attributes of Health information systems

Hospital Information systems encompass a wide array of functions that fall under the scope of Information systems. This study examines the following attributes of health information systems; Availability, Quality, Monitoring and Evaluation, decision making.

2.4 Availability of health systems and disease diagnosis

Matthew (2009) says that planning is a process that translates strategic goals and priorities into realistic and flexible plans and programs; monitors the implementation of plans to ensure that key results are achieved. This is done through preparing and budgets and maximizing resources to address strategic issues and priorities; establishment and implementation methods for tracking progress which include deliverables, deadlines, checkpoints to ensure targets are met; anticipation of immediate an future obstacles and opportunities and development of plans to address them/ work around them; working smart by simplifying and improving processes, emphasizing activities that add value, and eliminating inefficiencies and tasks that add little value; achieving results that have a clear, positive impact.

According to Abdelhak (2006), if a health care facility or ministry of health is serious about data quality, a plan needs to be developed aimed at improving and maintaining the quality of data and the information generated from that data. To develop quality plan, several structural components needs to be in place. They can be categorized as commitment of top level management to support the program, which would involve the appointment of a quality coordinator with adequate clerical support; staff responsible for quality control should be involved and deal with quality reports properly by reading and acting upon recommendations in a timely manner (Schofield, 1994); a specific member should be assigned to audit aspects of documentation contained in the patient's medical/health record; identify important aspects of data collection such as accuracy and validity, reliability, completeness and timeliness; determine indicators of data quality for each documentation component; set a threshold by determining an acceptable error rate; develop an organized method of collecting data according to quality indicators previously developed; asses actions taken to improve documentation and communicate the results of the review/audit to those affected Abdelhak,(2006)

In South Africa, as part of the reconstruction and development program (Africa National Congress, 1994b), an effort was launched in the country for the restructuring of the health sector in all provinces. This effort included the creation of a unified health information system (ANC, 1994a). The Health Information System program (HISP) initiative addressed the challenge in the Western Cape Province by defining an essential data set (EDS) of indicators and by developing a district health information software (DHIS) to support data collection, aggregation and analysis at the district level. Eventually, the HISP initiative scaled up to the national level and the standardization process was carried out in the other provinces in a coordinated manner Braa, Hedberg (2002); Braa *et al*, (2004).

Standardization of the data set to be collected, all sorts of statistical analyses between facilities, districts and provinces become possible. Although standardization is necessary to harmonize and integrate the information, the actual implementation of a standard at the local level often demands flexibility and adaptation Hanseth *et.al* (1996); Rolland, Monteiro (2002); Timmermans, Berg (1997). The study sought to establish whether

availability of health systems as an attribute influences medical diagnosis of malaria in Meru town, North Imenti Constituency, Meru County.

2.5 Quality hospital systems for disease diagnosis

In India, Centre for Technologies and Public Health was piloting a nurse managed, physician supervised, technology enabled comprehensive primary healthcare delivery model in rural Thanjavur in Tamil Nadu Johar, (2010). An insight into this initiative shows that a HIS may comprise of various modules tailored to the health institution's needs and requirements. These modules interrelate simultaneously to give a holistic output.

Rajana, Kapila (2011), say that HMIS features fall under the following categories: Demographic section; which allows the management of information about the recipient, their respective households , from states all the way to villages, outpatient; perhaps the most used sub-system in primary healthcare setting, module provides interfaces to provision healthcare providers, Supply chain management; pharmacists who receive supplies (drugs and consumables) from external suppliers and then dispatch them to the clinics and diagnostic centers, nurses-practitioners and diagnostic technicians, who manage inventories.

In Kenya, the Health policy framework paper ((1994 - 2010), implementation plans (1996), HMIS Needs assessment report (2003) and the National Health Sector Strategic Plan II (NHSSPII) 2005 – 2010 (Reversing the current trends) outlined areas that require urgent attention in matters of health systems management and coordination. Provision of integrated data collection and reporting tools, improvement of data flow mechanisms, support of districts in supportive supervision, providing clear policy guidelines on HIS and improvement of feedback mechanisms at all levels were found to be key steps in piloting a health system . The Kenyan government in collaboration with stakeholders formulated the health information systems and health management information system strategic plan 2009-2014 to guide the interventions needed to strengthen the national health information system and have sufficient capacity to serve all identified health stakeholders (Ministry of health, 2008;2009)

Recognizing the inadequacies of the file transfer protocol system (FTP) used which include major lag time between data reported and received, lack of an in built data error checking mechanism thus inadequate levels of data accuracy, over reliance of wireless modems which experienced low bandwidths, data files were infected with viruses from source computers, data was rejected by main server and master file not updated ,Ministry of health, (2009). The shift to the district health information system-2 (DHIS2) commenced in 2010, following successful customization to suite the Kenyan context, was rolled out as a pilot phase in 8 provinces between March and December 2011. The DHIS2 was installed on a central server using the "cloud" based computing infrastructure where users were expected to access the system via the internet both for data entry and information use purpose Manya *et. al*, (2012)

Kenyan health facilities like other developing countries suffer infrastructural problems such as inadequate access to computers, internet connectivity, and telephone and electricity services. Some of the challenges that faced the deployment of the web-based DHIS2 include varied levels of internet connectivity as well as access to electricity and mobile telephony thus difficult to implement direct data entry by health facilities till the infrastructure at these levels in enhanced, user capacity to use DHIS2 effectively was challenged because of the limited availability of skilled ICT work force in the health sector, project was heavily donor funded, there is need to find ways to blend private and public resources in ways that would be sustainable, the onset of devolved counties slowed down the rollout of training to users which was necessary to ensure ease of system use. Moreover the new structures at the counties meant that some of the DHIS2 district champions had their roles redefined slowing down use even further Manya *et.al*, (2012)

Lack of HIS policy guidelines and clear responsibilities of health workers at all levels, weak linkages and data sharing, inadequate feedback at all levels, inadequate capacity building in data management, inadequate health information scientists, lack of standard operating guidelines, inadequate infrastructure i.e. email, computers services and databases, inadequate use of HIS for planning and allocating resources, inadequate

allocation of resources to support HIS activities, lack of integration in implementing some activities in various health facility assessments, incomplete data for various indicators and lack of integrated standardized data collection and reporting tools are the areas that need support to strengthen HIS implementation in Kenya ,Health Information Systems Assessment in Kenya,(2008) . The study sought to investigate whether quality of hospital information systems influences the medical diagnosis of malaria in Meru town, North Imenti Constituency, Meru County.

.

2.6 Monitoring and evaluation of hospital systems and disease diagnosis

The importance of sound empirical evidence for informed policy making decision and the monitoring of progress towards achieving health system goals and human resources for health (HRH) in particular are widely recognized, Dussault (1999). The WHO framework on health system performance assessment is based on the concept of health action and encapsulates any set of activities whose primary intent is to maintain or improve population health, enhance the system's responsiveness to the expectations of the population, and assure fairness of financial contributions to the system. To achieve these main goals, four functions are performed by health systems: financing, stewardship, service provision and resource generation, WHO (2000).

Ethiopia is in the process of implementing a multi-sectored plan for accelerated and sustained development to end poverty, with specific goals relating to health. Along with other 188 countries, the country signed the declaration to achieve the Millennium Development Goals (MDGs), including the goals related to health, by 2015. Ethiopia also signed additional conventions with the United Nations (UN) and WHO for monitoring and reporting the progress towards goals within the health sector and for eradication, elimination, control and surveillance of specific diseases (Federal Ministry of Health, Ethiopia, 2010).

Friedmann , Wyatt (1997) say that enormous investment has gone into computerized hospital information systems worldwide. The estimated costs of each large hospital are about 50 million dollars, yet the overall benefits and costs of HIS have rarely been

assessed. When systems are evaluated, about three quarters are considered to have failed, Wilcocks , Lester (1993) and there is no evidence that they improve the productivity of health professionals, Gibbs (1997). To generate information that is useful to decision makers, evaluations of HIS need to be multidimensional, covering many areas beyond technical functionality, Kaplan (1988).

In South Africa's Limpopo province, the failure of implementation of the HIS program can be attributed to some the following factors: failure to take into account the healthcare cultures, that is the IS initially increased the workload of staff, whereas they received insufficient education before the system was introduced, under estimation of the complexity of the healthcare process; most interactions between care givers and patients happen in the context of apprehension, anxiety and time pressure. Any additional activities not considered essential to alleviate the patient concerns would be unwelcome Peter *et .al* (2003).

The United Kingdom has had its share of HIS failures, Audit commission (1995), National audit office (1994) errors will continue to be replicated unless the unique nature of health information systems is recognized and properly designed evaluation is built into all contracts/agreements from the beginning of implementation.

In letter dated 21st of August, 2014, the Ministry of health through the chief health officer Meru County stated " laboratory services forms an essential component of the health services, hence requiring constant update and strengthening for improving testing services, epidemiological surveillance, research and other related activities. All laboratories within the county need to expand in support of scaling up disease prevention and control. However, most laboratories operate within limited capacity. The Stepwise Laboratory improvement towards Accreditation (SLIPTA) process and the increasing burden of priority diseases such as HIV, Tuberculosis and Malaria continues to challenge the weak existing systems. Public health programmers have encountered challenges linked to the lack of reliable laboratory support disease diagnosis and patient care and management. This calls for quality assurance activities, documents and record

management, organization and personnel, facility and safety among others" (Ref:MRU/MED/GEN/C.50)

The study therefore sought to establish whether monitoring and evaluation as an attribute of health information system has any influence on medical diagnosis of malaria in Meru town, North Imenti Constituency, Meru County.

2.7 Hospital systems and decision making in disease diagnosis

The decision making attribute of health information systems remains a critical component in providing timely and precise patient care. David *et. al* (2003) carried out a study at Brigham and Women's' hospital, a 720 bed tertiary care hospital. The hospital has an integrated hospital information system, accessed via networked desktop personal computers, that provides clinical, administrative, and financial functions. In the study, they intimated that decision support delivered using information systems, ideally with the electronic medical record as the platform, would finally provide decision makers with tools making it possible to achieve large gains in performance, narrow gaps between knowledge and practice, and improve safety Bates *et. al* (2001), Middleton *et. al*, (1997). Delivering outstanding medical care requires providing care that is both high-quality and safe. However, while the knowledge base regarding effective medical therapies continues to improve, the practice of medicine continues to lag behind, and errors are distressingly frequent, Institute of Medicine (2001). The costs of medical care continue to rise, and society is no longer willing to give the medical profession a blank check. An early consequence of rising costs was the increasing penetration of managed care, which has attempted to minimize the provision of unnecessary care, while providing the care that is important. However, even in most managed care situations, many unnecessary things get done, while other effective interventions do not get carried out in part because the number of potentially beneficial things to accomplish is so large that physicians cannot effectively keep track of them all. Information systems represent a critical and underused tool for managing utilization and improving both efficiency and quality, Institute of Medicine (2001).

David *et. al* (2003) in their study conclude that decision support provided using information systems represents a powerful tool for improving clinical care and patient

outcomes, and are hopeful that these thoughts will be useful to others building such systems. Implementation of computerized decision support through electronic medical records will be the key to actually accomplishing this. However, much remains to be learned about how to best influence physician behavior using decision support especially around implementing complex guidelines and this is likely to become an increasingly important area of research as we struggle to provide higher quality care at lower cost David *et al* (2003). Health systems achievements in developing countries pales in comparison to the level in developed countries. Developing countries still lag behind in the shift from paper based to a computerized system of health care delivery. Policy formulation on HIS is in its nascent stage, facilitation; funding, training and sensitization efforts are to be accelerated if HIS benefits are to be realized. The study therefore sought to find out whether decision making plays a role on influence of hospital information system on medical diagnosis of malaria in Meru town, North Imenti Constituency, Meru County.

2.8 Theoretical Framework

Mikko Nenonen (2002) divides HIS into two parts with the 'topographic map' approach, which are: the clinical part and an administrative/statistical part. The difference between the two is the way data are used. In clinical work they are linked to a real patient either via a name or a unique personal identifier. Decisions concerning this patient are made based on this information; thus there is a high demand for data accuracy and correctness. In the administrative/statistical part of the system, data are separated from the patient and are no longer used for decision making concerning individual patients. The demand in this case for absolute correctness in each individual case is not so high. Instead, the usefulness of the data at this level is highly dependent on definitions, comparable use of codes and the data from this system may not be in any case traced back to the patient again. This principle is also the key to the data security of an HIS.

In his review Tuomi, (1999) discusses several theories and models of data hierarchy and in particular presents what he calls the 'conventional view on the knowledge hierarchy'.

For HIS needs, the levels data – information – knowledge – wisdom seem to be sufficient to describe the system. It starts with data, it is then refined into information and then into knowledge. Thus the hierarchy may be seen both bottom-up as well as top-down. A conclusion from Tuomi's studies might be expressed as follows: people communicate only at the data level. They also store only data, not information and wisdom, Mikko (2003).

Cybernetics theory is explained as a trans-disciplinary approach to regulatory systems, their structures, constraints and possibilities (Muller, Albert, 2000). Louis Couffignal, one of the pioneers of cybernetics in 1956 characterized cybernetics as "the art of ensuring efficacy of action". A more recent definition has been proposed by Louis Kaufmann, president of the American Society of Cybernetics as the study of systems and processes that interact with themselves and produce themselves from themselves (CYBCON discussion group 20 September, 2007).

In the context of the study, cybernetics theory is elaborated in the rapid introduction of Information Systems (IS) in all aspects of society has left little time to consider the impacts or develop policies to take maximum advantage of these systems. Most organizations, including hospitals either use or are planning to implement IS in some capacity. The progressive growth of Information Technology (IT) has led hospital administrators to recognize IT as a powerful tool to enhance their organization's productivity (James, Parag, & David, 1996). Cybernetics theory can be applied to this study in that health information systems are structured with defined levels of refinement, health data is synthesized, analyzed and interpreted in an efficient manner to be used in decision making in patient care.

2.9 Conceptual Framework

A conceptual framework is a graphical or diagrammatical representation of the relationship between variables in the study whose purpose is to assist the reader see the proposed relationship. It is a graphical or visual representation that is used to describe the phenomenon under study (Jwan, 2010).

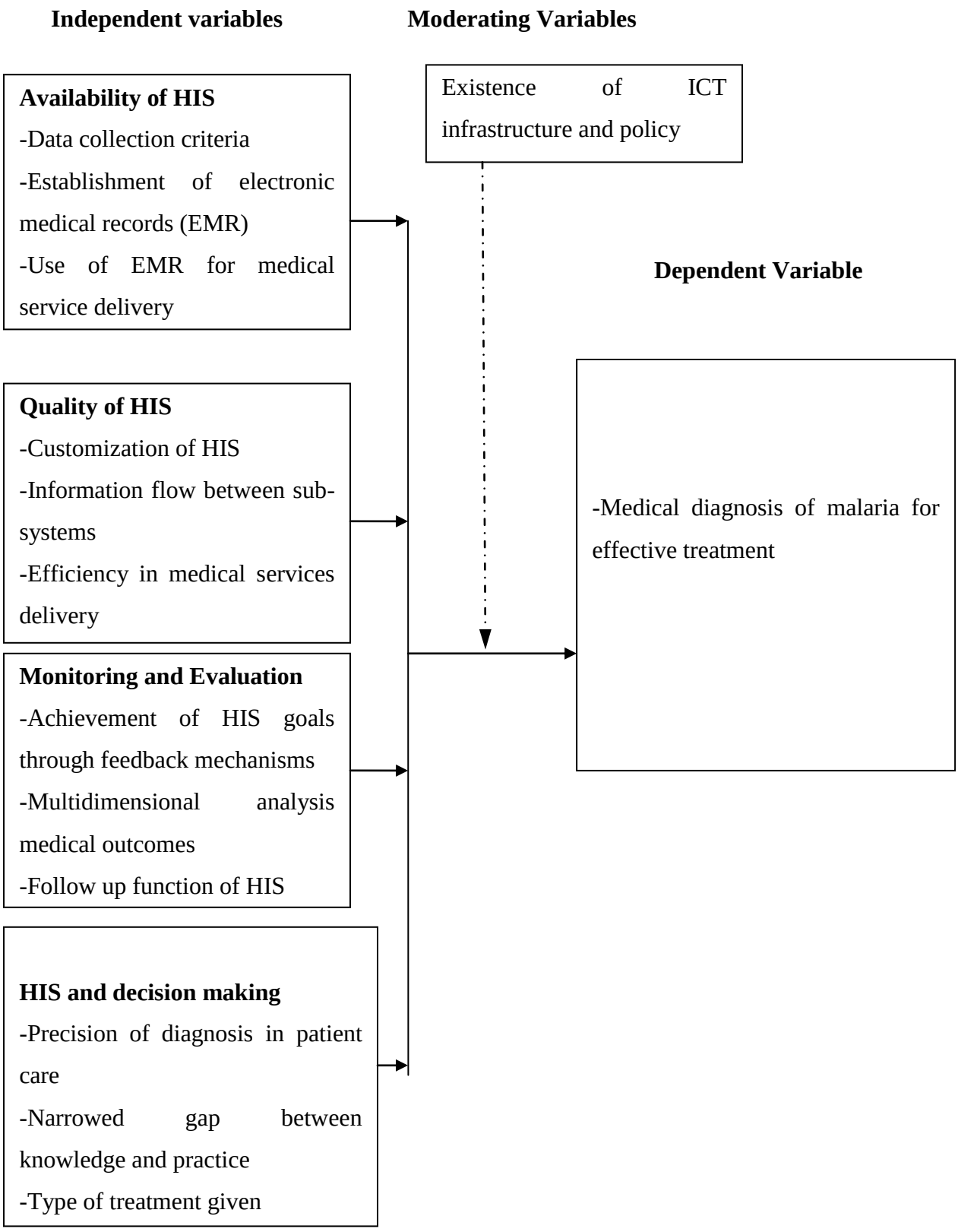

Figure 1: Conceptual Framework

Figure 1: shows the relationship between the dependent and independent variables that may show the influence of hospital information systems on medical diagnosis of malaria for effective treatment.

2.9.1 Research Gap

Reviewed literature revealed that there was little effort to look at the influence of health information systems on medical diagnosis of malaria for effective treatment. This study therefore sought to find and recommend measures of mitigating the shortcomings for medical diagnosis of malaria for effective treatment in Meru town, North Imenti constituency, Meru County, Kenya. The shortcomings included;

Table 2.1: Comments on research gap

Author	**Comment**
Kihuba *et.al,* (2014)	Study revealed that hospital information systems did not deliver quality data due to significant constraints that exist in data quality assurance, supervisory support, data infrastructure in respect to information and communication technology application, human resources, finance resource and integration
Manya *et.al*,(2012)	Introduction of the web based hospital information system DHIS2 in Kenya encountered challenges of lack of skilled ICT workforce in health sector, heavily donor funded thus sustainability challenges, the new county system slowed down training initiatives of the DHIS2 district champions, having their roles redefined
Hospital information system assessment Kenya, (2008)	Lack of Hospital information system policy guidelines and clear responsibilities of health workers at all levels, weak linkages of data sharing, inadequate feedback at all levels, capacity building in data management, health information scientists, lack of standard operating guidelines, inadequate infrastructure, incomplete data for various indicators and lack of integrated standardized data

	collection and reporting tools are some of the areas that need support to strengthen HIS implementation in Kenya
Peter *et.al* (2003)	In South Africa's Limpopo province, the failure of implementation of the Health information system program was attributed to among other factors failure to take into account the healthcare culture, underestimation of the complexity of the healthcare process.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter set out various stages and phases that followed in completing the study. It involved a blueprint for the collection, measurement and analysis of data. This section was an overall scheme, plan or structure conceived to aid the researcher in answering the raised research questions. In this stage, most decisions about how research was executed and how respondents were approached were addressed, as well as when, where and how the research was conducted. Therefore in this section the research identified the procedures and techniques that were used in the collection, processing and analysis of data. Specifically the following subsections were included; research design, target population, sample design, data collection instruments, data collection procedures, data validity and reliability, and finally data analysis.

3.2 Research Design

Kothari (2004) defines research design as the arrangement of the conditions for collections and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. Kothari (2006) says descriptive research is used to obtain information concerning the current status of the phenomena to describe "what exists" with respect to variable to conditions in a situation.

In this study, a descriptive survey research design was adopted. According to Mugenda and Mugenda (2003), a survey is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables. Survey research is considered as the best method available to social scientists and other educators who are interested in collecting original data for purposes of describing a population which is too large to observe directly. This research design was therefore considered appropriate in studying influence of hospital information systems on medical diagnosis of malaria for effective treatment in Meru town, North Imenti constituency, Meru County.

3.3 Target Population

Target population as defined by Cooper (2010), is a universal set of the study of all members of real or hypothetical set of people, events or objects to which an investigator wishes to generalize the result. The target population for this study comprised of 30 respondents from the Karen Hospital, Aga khan Hospital, Grace Park Hospital and Meru teaching and referral hospital in Meru town. The respondents and interviewees consisted of medical officers, laboratory technologists, pharmaceutical technologists, clinical officers, nurses, radiographers, physiotherapists, accountants and hospital administrators.

3.4 Sampling techniques and sample size

According to Mugenda and Mugenda (2003) a sample is a smaller group procedurally selected from the population to represent it. In this case, due to the limited number of respondents the sample population was the same as the target population and was used in the study. The study was of descriptive research design. Therefore, the total number of respondents in this study was 30 and was drawn from all cadres of respondents, the population was regarded homogeneous. The sampling technique to be employed was stratified random sampling. According to Thomas and Nelson (1996) random sampling leads to selection of a sample that could be inferred back to the larger population.

Table 3.1: Population Sample

Category	Population sample
Doctors	6
Clinical Officers	4
Nurses	5
Accountants	4
Physiotherapists	2
Laboratory technologists	4
Radiographers	2
Pharmacists	3
Administrators	2
Total	**30**

3.5 Method of Data Collection

The study collected both primary and secondary data. Primary data was gathered using structured questionnaires where the respondents were issued with the questionnaires. Questionnaires were preferred because according to Cox (2004), they are effective data collection instruments that allow respondents to give much of their opinions in regard to the research problem. According to Festing (2007) the information that will be obtained from questionnaires will be free from bias and researchers' influence and thus accurate and valid data will be gathered. In this study, both questionnaire and interview schedule were used for purposes of obtaining data from the respondents, with questionnaire and interview schedule used to collect data from the hospital personnel. The questionnaire items comprised of both closed- ended and open- ended questions that gave the advantage of collecting both qualitative and quantitative information.

3.6 Validity of research instruments

According to Cooper, *et al* (2003) validity is a characteristic of measurement concerned with the extent to which a test measure what the researcher actually wishes to measure and that the differences found in the measuring tool reflects the true differences among participants drawn from the population. Any questions found to have been interpreted differently were rephrased so that they could have the same meaning to all respondents. Views given by the respondents were analyzed and used to improve the questionnaires before actual collection of data was done.

3.7 Reliability of research instruments

Reliability is concerned with estimates of the degree to which a measurement is free of random or unstable error. The reliability of the instrument was tested during piloting. The pilot survey tested whether the design of questions was logical, clear and easily understood; whether the stated responses were exhaustive and how long it would take to complete the questionnaire. All questions were then divided into two equal halves taking the odd numbered items against the even numbered items and split half correlation coefficient was calculated using the formula:

$$R = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X^2)][N\sum Y^2 - (\sum Y)^2]}}$$

Where; x = scores on 1st half

y = scores on 2nd half

$\sum x$ = sum of x

$\sum y$ = sum of y

$\sum y^2$ = sum of y^2

$\sum x^2$ = sum of x^2

$\sum xy$ = sum of product of x and y

N = total number of scores

R = coefficient correlation

The obtained coefficient index was 0.70. Salvin, (1984) noted that reliabilities of 0.70 are usually considered reasonable.

3.7 Data Collection Procedure

The researcher sought permission from the Kenyatta Hospital Ethics and Research Committee as well as the National Commission for Science Technology and Innovation (NACOSTI) through University of Nairobi. The questionnaires were checked for the results of the pilot study done to correct any ambiguities. Primary data was then collected by using structured questionnaires and structured interview guide. The interviews were also conducted by the researcher personally at a time convenient to the respondents.

3.8 Data Analysis

Data analysis refers to the examination of data collected in a study and making deductions and references. It also involves uncovering the underlying structures, extracting important variables, detecting anomalies, scrutinizing the acquired information and testing underlying assumptions (Orodho, 2005). The raw data was assembled and tabulated in form of statistical tables to allow for further analysis. This facilitated the summation of items and detection of errors and omissions. Descriptive statistics was used

to analyze the data. This entails the use of measures of central tendency such as the mean, mode, median and measures of normal distribution. The Statistical Package for Social Sciences (SPSS) was used to aid the statistical analysis of the data. The results were presented in frequency tables; finally all data was stored in soft and hard copies.

3.9 Ethical Considerations

The researcher sought permission from the Kenyatta Hospital Ethics and Research Committee. The researcher also strictly adhered to all the rules regarding conducting a research. All participants were treated with respect as all humans are presumed to be free and responsible persons. It is the right and responsibility of every competent individual to advance his or her own welfare. Therefore this responsibility was exercised freely and voluntarily. Upholding individuals' rights to confidentiality and privacy is a central tenet was observed. The researcher was honest and portrayed a high level of integrity while conducting the study.

3.9.1: Operationalization of Variables

Objective	Variable	Indicators	Measurement Scale	Data Collection Method	Type of Analysis
How availability of hospital information systems influence medical diagnosis of malaria for effective treatment.	Availability of health systems and disease diagnosis	-Data collection criteria -Establishment of electronic medical records (EMR) -Use of EMR for medical service delivery	-Ordinal -Nominal -Ordinal	Self directed questionnaire	Inferential Statisitics
How quality of hospital information systems influence medical diagnosis of malaria for effective treatment.	Quality hospital systems for disease diagnosis	-Customization of HIS -Information flow between sub systems -Efficiency in medical services delivery	-Ordinal -Interval -Ordinal	Self directed questionnaire	Inferential statistics

To determine the influence of monitoring and evaluation on hospital information systems for medical diagnosis of malaria for effective treatment	Monitoring and evaluation of hospital information systems and disease diagnosis	-Achievement of HIS goals through feedback mechanisms Multidimensional analysis -Medical outcomes -Follow up function of HIS	-Ordinal -Ordinal -Ordinal -Ratio		Inferential statistics
To find out the influence of hospital information systems on decision making for medical diagnosis of malaria for effective treatment	Hospital systems and decision Making in disease diagnosis	Precision of diagnosis in patient care - Narrowed gap between knowledge and practice - Improved diagnostic outcomes	-Ratio -Interval -Ordinal	-Self directed questionnaire	Inferential statistics

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the findings of the study and the interpretation of the results of data analysis in relation to influence of hospital information systems on medical diagnosis of malaria for effective treatment. The findings were presented in the order of the study objectives and aimed at answering the following questions: how the availability of hospital information systems influence medical diagnosis of malaria, to what extent quality of hospital information systems influence medical diagnosis of malaria, how monitoring and evaluation in hospital information systems influence medical diagnosis of malaria and the extent to which hospital information systems influence decision making for medical diagnosis of malaria .

4.2 Response Rate of Instruments

The sample population was 30 respondents from the Karen Hospital, Aga khan Hospital, Grace Park Hospital and Meru teaching and referral hospital in Meru town. From the study all the 30 questionnaires were duly filled and returned, making a response rate of 100 per cent. According to Mugenda and Mugenda (2008), a response rate of 50 per cent is acceptable for analysis. A response rate of over half is good while over 70 per cent is very good (AAPOR, 2011). Chen (1996) argues that the larger the response rate, the smaller the non-response error. The response rate was considered excellent at 100 per cent and therefore it was sufficient for analysis.

4.3 Demographic characteristics of the respondents

Table 4.1 shows gender distribution of respondents

Table 4.1: Gender of the respondents

	Frequency	Percent	Cumulative Percent
Male	21	70.0	70.0
Female	9	30.0	100.0
Total	**30**	**100.0**	

The study collected demographic information of the participants in the study. This was necessary in order for the study to establish gender, age, marital status of the respondents who were medical personnel. The findings were summarized in Table 4.1. From the table, 70.0 per cent of the respondents were male while 30.0 per cent were female. Therefore, there was adequate gender representation in the study. The difference in percentages can be attributed to more flexibility in working shifts among male employees than female as well as the duty Rota arrangements in twenty four hour health facilities.

4.3.1 Marital status of respondents

Table 4.2 indicates marital status among respondents.

Table 4.2: Marital status

	Frequency	Percent	Cumulative Percent
Single	15	50.0	50.0
Married	14	46.7	96.7
Separated			100.0
	1	3.3	
Total	**30**	**100.0**	

The study sought to find the marital status of the respondent and the findings were presented in Table 4.2. From the figure, 50.0 per cent of the respondents single, 46.67 per cent were married while 3.33 per cent were separated. This shows that the exposure to use of health information systems among hospital personnel is well distributed among single and married respondents as well as literacy in use of information technology among two groups.

4.3.2 Age of medical personnel and use of hospital information systems

Table 4.3 shows the distribution of age among respondents.

Table 4.3: Age Category

	Frequency	Percent	Cumulative Percent
20-30 years	18	60.0	60.0
30-40 years	9	30.0	90.0
40-50 years	3	10.0	100.0
Total	**30**	**100.0**	

The research sought to find the age category of the respondents. From the findings summarized in Table 4.3, a majority 60.0 per cent of the respondents were between 20 to 30 years age category, 30.0 per cent were between 30 and 40 years old, and 10.0 per cent were between 40 and 50 years old.

4.3.3 The Hospital departments the respondents work in

Table 4.4 shows the various departments the respondents work in.

Table 4.4: Respondents and hospital departments

	Frequency	Percent	Cumulative Percent
Radiology	1	3.4	3.4
Nursing	2	6.9	10.3
Finance	2	6.9	17.2
Pharmacy	3	10.3	27.6
Medical	1	3.4	31.0
Laboratory	7	24.1	55.2
Outpatient department (OPD)	4	13.8	69.0
Pediatric	3	10.3	79.3
Reception	1	3.4	82.8
Administration	1	3.4	86.2
In Patient	1	3.4	89.7
Physiotherapy/Rehab	1	3.4	93.1
Obstetrics and Gynecology	1	3.4	96.6
Accidents and Emergency	1	3.4	100.0
Total	**29**	**100.0**	

The study sought to find the departments that the respondents worked in. From the findings summarized in Table 4.4, a majority 24.1 per cent were working in the laboratory department, 13.8 per cent were working in out-patient department, 10.3 per cent were working pharmacy, while another 10.3 per cent were working pediatric department, 6.9 per cent were working in nursing department, while another 6.9 per cent were working finance department, the other department each were represented at 3.4 per cent each.

4.4 Availability of health systems and disease diagnosis

Table 4.5 shows the distribution of patient registration.

Table 4.5: Forms of patient registration

	Frequency	Percent	Cumulative Percent
Insurance details	1	3.3	3.3
Cash payer details	11	36.7	40.0
Both (Insurance and Cash payer details)	18	60.0	100.0
Total	**30**	**100.0**	

The study sought to find out the different forms patient registration. From the findings presented in Table 4.5, 60.0 per cent of the respondents said both (Insurance and Cash Payer Details), 36.6 per cent said cash payer details and 3.33 per cent said insurance details.

4.3.2 Accessibility and timeliness of patient data.

Table 4.6 illustrates the views by respondents on accessibility and timeliness of patient data

Table 4.6: Accessibility and timeliness

	Frequency	Percent	Cumulative Percent
Neutral	4	13.3	13.3
Agree	15	50.0	63.3
Strongly agree	11	36.7	100.0
Total	**30**	**100.0**	

The researcher sought to establish the extent to which the respondent would agree that through the hospital information system, patient details are easily accessible and timely. The findings were summarized in Table 4.6. From the figure, a majority 50.0 per cent of the respondents agreed, 36.67 per cent strongly agreed while 13.33 per cent remained neutral on the statement that through the hospital information system, patient details are easily accessible and timely. According to Ilias (1998), the systems move patient information from paper to electronic format so that they can be easily and effectively managed.

4.3.3 Patient details retrieved from the hospital information system are private and confidential

Table 4.7 illustrates distribution responses on privacy and confidentiality of patient data

Table 4.7: Privacy and confidentiality

	Frequency	Percent	Cumulative Percent
Disagree	3	10.0	10.0
Neutral	4	13.3	23.3
Agree	14	46.7	70.0
Strongly agree	9	30.0	100.0
Total	**30**	**100.0**	

The study sought to find out the extent the respondents would agree with the statement that patient details retrieved from the hospital information system are private and confidential. From the findings summarized in Table 4.7, a majority 46.7 per cent agreed, 30.0 per cent strongly agreed, 13.3 per cent remained neutral while 10.0 per cent disagreed with the statement.

4.3.4 If the electronic medical records of patients provided are accurate and updated

Table 4.8 shows distribution of responses on the question of responses on EMR

Table 4.8: Accurate and updated EMR

	Frequency	Percent	Cumulative Percent
No	2	6.7	6.7
Yes	28	93.3	100.0
Total	**30**	**100.0**	

The researcher asked the respondents if the electronic medical records of patients provided by the hospital information system are accurate and updated. From the findings summarized in table 4.8, a bigger majority 93.33 per cent agreed while only 6.67 per cent did not. Haslina and Sharifa (2005) posit that information quality consists of particular attributes, such as completeness, accuracy and relevance.

4.5 Quality hospital systems for disease diagnosis

Table 4.9 illustrates the response to movement within hospital departments

Table 4.9: Movement within hospital departments

	Frequency	Percent	Cumulative Percent
No	9	30.0	30.0
Yes	21	70.0	100.0
Total	**30**	**100.0**	

Richard and Diane, (1996) say that larger and more complex data are not necessarily mean better data. The most important issue is the use of high-quality information to improve patient care. Thus, health information can be most effective when the data is high in quality. The researcher sought to find out whether the hospital information system enabled patients move swiftly within hospital departments. From the findings summarized in table 4.9, 70.0 per cent of the respondents agreed while 30.0 per cent did not.

Table 5.0 illustrates distribution for "No" response to the question of movement within hospital departments.

Table 5.0: Reasons for "No" as a response

	Frequency	Percent	Cumulative Percent
Some departments do not have computers or network	6	85.7	85.7
Sometimes there is delays caused by system breakdowns	1	14.3	100.0
Total	**7**	**100.0**	

Further, the researcher sought to find reasons for disagreeing that the hospital information system did not enable patients move swiftly within hospital departments. From the findings summarized in Table 5.0, 85.7 per cent said some of the departments did not have computers or were not networked, and 14.3 per cent of the respondents said sometimes there are delays caused by system breakdowns.

4.4.1 Able to serve patients promptly and fast as their details are readily available within all hospital departments

Table 5.1: Ability to serve patients promptly and fast

	Frequency	Percent	Cumulative Percent
Neutral	3	10.0	10.0
Agree	15	50.0	60.0
Strongly agree	12	40.0	100.0
Total	**30**	**100.0**	

The study sought to find out if patients were served promptly and fast as their details were readily available within all hospital departments. The findings presented in Table 5.1 show that 50.0 per cent agreed, 40.0 per cent strongly agreed and 10.0 per cent remained neutral. Furthermore, the study sought to find out if the system users were able

to acquire previous and current patient data promptly. All the respondents agreed that they were able to acquire previous and current patient data promptly.

4.4.2 Experience of delays in service delivery to patients due to slow network/down time of hospital system

Table 5.2 shows distribution of responses on network delays and downtime

Table 5.2: delays in service delivery due to slow network/down time

	Frequency	Percent	Cumulative Percent
No	3	10.0	10.0
Yes	27	90.0	100.0
Total	**30**	**100.0**	

The study sought to find out if the respondents had experienced delays in service delivery to patients due to slow network/down time of hospital system. The findings summarized in Table 5.2, shows that a larger majority 90.0 per cent agreed that they had experienced delays in service delivery due to slow network/down time of hospital system while only 10.0 per cent said they had not.

Table 5.3 shows distribution for a "yes" response

Table 5.3: Duration of delay if response is "yes"

	Frequency	Percent	Cumulative Percent
Less than 1 hour	13	46.4	46.4
up to 6 hours	10	35.7	82.1
Up to 12 hours	3	10.7	92.9
Up to 18 hours	1	3.6	96.4
More than 24 hours	1	3.6	100.0
Total	**28**	**100.0**	

The study further asked the respondents who said yes the duration of delay as result of slow network/down time of the hospital system. Their responses were summarized in Table 5.3. From the table, 46.4 per cent said less than 1 hour, 35.7 per cent said up to 6

hours, 10.7 per cent said up to 12 hours, 3.6 per cent said up to 18 hours, while another 3.6 per cent said more than 24 hours.

4.6 Monitoring and evaluation of hospital systems and disease diagnosis

Table 5.4 shows the distribution of response to question on monitoring and evauation by respondents

Table 5.4: Monitoring and evaluation

	Frequency	Percent	Cumulative Percent
Neutral	2	6.7	6.7
Agree	15	50.0	56.7
Strongly agree	13	43.3	100.0
Total	**30**	**100.0**	

The study sought to find out if through medical records in the hospital system, the doctors were able to review patients with previous visit results and follow up treatment. According to Protti *et al,* (2009) electronic health record systems coordinate the storage and retrieval of individual records with the aid of computers, which are usually accessed on a computer, often through a computer network.

The findings summarized in Table 5.4, show that 50.0 per cent of the respondent agreed, 43.33 per cent strongly agreed while 6.67 per cent remained neutral.

4.5.1: Tracking of patient health status

Table 5.5 elaborates the distribution of responses on the question of tracking health status of patients.

Table 5.5: Tracking of health status

	Frequency	Percent	Cumulative Percent
Neutral	1	3.3	3.3
Agree	14	46.7	50.0
Strongly agree	15	50.0	100.0
Total	**30**	**100.0**	

The research sought to find out if the through the hospital system, it was possible to continually track patient healthy status. The findings presented in table 5.5 shows that 50.0 per cent of the respondents strongly agreed, 46.67 per cent agreed while only 3.33 per cent remained neutral.

4.5.2 Patient data acquired on request from the hospital system well designed and easily understandable

Table 5.6 illustrates the distribution of responses to the question of customization of HIS

Table 5.6: Patient data design

	Frequency	Percent	Cumulative Percent
No	1	3.3	3.3
Yes	29	96.7	100.0
Total	**30**	**100.0**	

The researcher sought to establish if patient data acquired on request from the hospital system was well designed and easily understandable. From the findings summarized in Table 5.6 shows that a big majority 96.67 per cent of the respondents agreed while only 3.33 per cent of the respondents did not.

4.5.3 Malaria testing is important

Table 5.7 illustrates the response to question on importance on malaria testing

Table 5.7: Importance of malaria testing

	Frequency	Percent	Cumulative Percent
Neutral	3	10.0	10.0
Agree	8	26.7	36.7
Strongly agree	19	63.3	100.0
Total	**30**	**100.0**	

The study sought to find the opinion of the respondents on whether malaria testing was important. The responses were recorded and summarized in Table 5.7. From the figure, 63.33 per cent strongly agreed, 26.67 per cent agreed while 10.0 per cent remained neutral on whether malaria testing was important.

4.6.4 Accurate reporting of malaria tests for effective treatment

Table 5.8 illustrates distribution of response to accuracy of reporting of malaria test results for effective treatment

Table 5.8: Accuracy in malaria tests reporting

	Frequency	Percent	Cumulative Percent
Agree	4	13.3	13.3
Strongly agree	26	86.7	100.0
Total	**30**	**100.0**	

The study sought to find if accuracy of malaria testing was important. From the findings summarized in Table 5.8. From the figure, 86.67 per cent strongly agreed and 13.33per cent agreed that accurate testing of malaria was important.

4.6.5 With a hospital computerized system, it is possible to track and acquire accurate malaria test results

Table 5.9 shows the distribution to the question of use of HIS monitoring and evaluating malaria results data

Table 5.9: Accuracy of malaria results

	Frequency	Percent	Cumulative Percent
Disagree	3	10.3	10.3
Agree	11	37.9	48.3
Strongly agree	15	51.7	100.0
Total	**29**	**100.0**	

The study sought to find out if with a hospital computerized system, it was possible to track and acquire accurate malaria test results. The findings presented in Table 5.9 shows that 51.72 per cent strongly agreed, 37.93 per cent agreed while 10.34 per cent disagreed that with a hospital computerized system, it was possible to track and acquire accurate malaria test results.

4.7 Hospital systems and decision making in disease and treatment

Table 6.0 illustrates the response to the question of HIS in disease and treatment thereof

Table 6.0: Hospital systems and decision making

	Frequency	Percent	Cumulative Percent
No	2	6.9	6.9
Yes	27	93.1	100.0
Total	**29**	**100.0**	

The researcher sought to find out whether the hospital systems assists medical personnel arrive at critical decisions on patient management. The findings summarized in Table 6.0, show that 93.10 per cent of the respondents agreed while only 6.90 per cent did not. A majority of the respondent said that the hospital information system assisted the medical personnel in accurate recording and fast and easy retrieval of patient information and diagnosis. The finding confirm an explanation by Goldschmidt (2005) that, health information technology is the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and the use of healthcare information, data and knowledge for communication and decision making.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the major findings of the study as well as the conclusions made from them. The section also presents recommendations made by the researcher as well as suggestions for future studies related to the influence of health information systems on medical diagnosis of malaria for effective treatment.

5.2 Summary of the findings

The purpose of the study was to establish the influence of health information systems on medical diagnosis of malaria for effective treatment. Data was collected from 30 medical personnel via questionnaires. Descriptive analysis techniques were used in data analysis with the help of SPSS version 21. The findings of the study are summarized and arranged in line with the study variables.

5.2.1 Availability of hospital information systems and medical diagnosis of malaria

In this study, it was observed that all hospitals under investigation had some form of hospital information system with varied levels of usability and functioning. Abdelhak, (2006) says if a healthcare facility or ministry of health is serious about data quality, a plan needs to be developed aimed at improving and maintaining the quality of data and the information generated from the data. It was implied by the study that the forms of registration were varied, attributed to difference in scope of hospital clientele. The higher the scope of hospital clientele, the more integrated the system was. The level of integration decreases with lower hospital clientele base. From the study, it was seen that availability of hospital information systems influences the ease of access and management of patient data as well as aid in diagnosis and treatment of malaria.

5.2.2 Quality of hospital information systems and medical diagnosis of malaria

Delone and Mclean (2003), say information quality and system quality affect organizational services. From the study, 70 per cent of respondents agreed that hospital information systems enabled patients move swiftly within departments whereas 30 per cent disagreed. Of those who disagreed, 85.7 per cent said that some hospital departments lacked computers or internet whereas 14.3 per cent said that the delays were due to system crashes and internet downtime. Delays in service delivery due to slow network and downtime proved to be a general experience among most respondents at 90 per cent whereas 10 per cent did not experience the phenomena. This revealed that a reliable and effective network influenced the quality of service rendered by the hospital information system. For effective treatment of malaria, an efficient and reliable hospital information system is required, for prompt medical reports and effective treatment thereof as well as shortened treatment times.

5.2.3 Monitoring and evaluation function of hospital information systems

According to Meru county Ministry of health services letter (Ref:MRU/MED/GEN/C.50), laboratory services forms an essential component of the health services, hence requiring constant update and strengthening for improving testing services, epidemiological surveillance, research and other related activities. Haux (2006) describes health information systems as systems that process data and provide information and knowledge in healthcare environments. From the study, it was generally agreed that hospital information systems improved accessibility to medical records as well as enable tracking and use of data my medical personnel. Malaria diagnosis and treatment can be effectively tracked and the data used by relevant health stakeholders to mitigate spread of malaria, management and outcomes.

5.2.4 Influence of hospital information systems on decision making

Protti, *et. al* (2009), say one of the most interesting aspects of health information systems is how to manage the relationship between healthcare providers and patients. Fostering good relationship with patients will retain them and attract them, create greater mutual understanding, trust and satisfaction. Richard and Ronald (2008), say that a good

relationship will encourage patient involvement in decision making. From the study, it was seen that hospital information systems influenced decision making of medical personnel in patient care and treatment of malaria through shortened treatment times.

5.3 Discussion of findings

Protti *et.al* (2009) in their study noted that electronic medical records reside at the heart of any health information systems. Prompt retrieval of patient data and availability of the data in multiple departments in an efficient manner was seen as key in health service delivery. Electronic health record systems coordinate the storage and retrieval of individual records with the aid of computers, which are usually accessed on a computer, often through a computer network. Accurate data storage and retrieval is key in diagnosis and treatment of diseases in timely manner. From the study, availability of health information systems was seen as to have influenced the diagnosis and effective treatment of malaria in that access and treatment times were greatly reduced.

Kihuba *et al.*, (2014), conducted an evaluation of core functions of data generation and reporting within hospitals in Kenya to facilitate interpretation of national reports and to provide guidance on key areas requiring improvement to support data use in decision making. The findings indicated that HMIS did not deliver quality data due to significant constraints that exist in data quality assurance, supervisory support, data infrastructure in respect to information and communications technology application, human resources, financial resources, and integration. Similarly in the study, it was seen that levels of integration of health information systems varied, depended on patient numbers and hospital resources. Varied levels of integration in turn reflected on the quality of the health information system used. Hospitals that had more integrated systems had better functionality and usability than those without. Medical diagnosis of malaria was influenced in that efficiency and reliability of results for treatment depended on quality of health information system.

Dussault (1999) says that the importance of sound empirical evidence for informed policy making decision and the monitoring of progress towards achieving health system goals and human resources for health (HRH) in particular are widely recognized. Study

findings indicated that tracking of patient health status was made more efficient through health information systems. Reviews of patients with previous results were improved, and follow up of patient health status made more efficient. On a higher scale, data on disease trends, in specific malaria was generated in an efficient manner. Monitoring and evaluation of malaria disease trends influences health policy, diagnostic protocols and compilation of health surveillance records for reporting. However, from the findings it was seen that better standardization of hospital information systems was required, to better fulfill a set threshold of accuracy and precision of health data.

David *et al* (2003) in their study conclude that decision support provided using information systems represents a powerful tool for improving clinical care and patient care. Bates *et al* (2001), Middleton *et al*, (1997) intimated that decision support delivered using information systems, ideally with the electronic medical record as the platform, would finally provide decision makers with tools making it possible to achieve large gains in performance, narrow gaps between knowledge and practice, and improve safety. In the study, hospital information systems were seen as enabling tools for health practitioners to better implement patient care and management.

5.4 Conclusion

From the findings, it was concluded that availability of hospital information systems influenced ease of access to medical data on malaria. Quality of hospital information system had influence on efficiency and reliability of medical diagnosis of malaria. Monitoring and evaluation function of hospital information systems influenced the medical diagnosis of malaria through surveillance of patient health and follow up. Finally, hospital information systems influenced decision making of medical personnel on medical diagnosis of malaria through efficient patient care and shortened treatment times.

5.5 Recommendations

Based on the aforementioned study findings the following recommendations of the current situation on the use of hospital information systems on medical diagnosis of malaria for effective treatment, the following recommendations were suggested:

The researcher recommends the following in boosting utilization of hospital information systems; Age of the users influenced the use of health information systems. The older users should be encouraged to utilize the system through specialized training programmes tailored to increase interest and stimulate more usage to enhance the benefits of the system in medical diagnosis. The Ministry of health should spearhead these efforts.

Standardization of health information systems across the board would help enhance quality in health service delivery. An interlinked multi layered system that feeds from lower level accredited systems from both private and public health facilities would improve disease surveillance, reporting mechanisms at County and National levels as well as policy formulation on matters health. Strengthening of information technology departments in health institutions would help build capacity in order to reap maximum benefits from health information systems. Regular tailored seminars and trainings on usage and security protocols would help medical personnel own and enhance productivity of the system. Data from primary to tertiary level integrated health information systems should also be continually updated to enhance accuracy of medical data. This should be spearheaded by the Ministry of health and Ministry of information Communications and Technology.

Resource allocation is an important provision in realizing the full potential of health information systems. A fully integrated system would require adequate funding from government and non-governmental institutions as well as the private health sector in order to fast track implementation through private public partnerships. All stakeholders in the health sector must work together to realize nationwide integration of health information systems geared towards realization of the Kenya vision 2030 under the social pillar.

5.6 Suggestions for further study

The role played by hospital information systems on medical diagnosis is inevitable so more research should be conducted on the following; an assessment of how levels

of competence of information technology influences use of hospital information systems, Investigation of how health information system integration influences quality of medical data and further studies on the contribution of hospital information systems on disease surveillance.

REFERENCES

AAPOR (2011), *America Association for Public Opinion Research*, 111 Deer Lake Road, Suite 100, Deerfield USA.

Abdelhak M, Grostick S, Hankin MA, Jacobs E, (1996). *Health Information: Management of a Strategic Resource*. Philadelphia, WB Saunders Company

Ammenwerth, E., Kutscha, U., Kutscha, A., Mahler, C., Eichstadter, R., & Haux, R. (2001). *Nursing process documentation systems in clinical routine–prerequisites and experiences*. International Journal of Medical Informatics, 64(2), 187 – 200.

Ball M.J., Lillis J., (2001). E-health: *transforming the physician/patient relationship*, International Journal of Medical Informatics 61 (1) 1–10

Ball M.J, Peterson H, Douglas JV (1999) .*The computerized patient record*: a global view. MD Computation; 16: 40-6.

Braa, J., & Hedberg, C. (2002). *The struggle for district-based health information systems in South Africa*. The Information Society, 18, 113–127.

Best, J. W., & Kahn, J. V. (1992). *Research in Education*. New Dehli: Prentice Hall at India Private Limited.

Carla AbouZahr (2005), *Health information systems*: the foundations of public health. Pg 4-10, WHO Library Cataloguing in Publication Data ,ISBN 92 9061 050 6

Chen, H., "*Direction, magnitude and implications of nonresponse bias in mail surveys*,"Journal of the Marketing Research Society, 38(3), 1996, pp 267-276.

Chetley, A. (2006), *Improving health, connecting people*: the role of ICT in the health sectors of developing countries a framework paper. InfoDev.

Conrick, M. (2006). Health informatics: *Transforming healthcare with technology*. Thomson Social Science Press

Cooper, D.R , Schindler, P.S (2010), *Business Research Methods*, Tata McGraw-Hill, 8th Edition, New Delhi, India

Couffignal, Louis,(1958) "*Essai d'une définition générale de la cybernétique*", The First International Congress on Cybernetics, Namur, Belgium, June 26–29, Gauthier-Villars, Paris, pp. 46-54

Cox, T. Jr., (2004), the *Importance of malaria vaccination*, International Journal of Management Reviews, Vol. 2 No.4

David W. Bates, Gilad J. Kuperman, Samuel Wang, Tejal Gandhi, Anne Kittler, Lynn Volk, Cynthia Spurr, Ramin Khorasani, Milenko Tanasijevic, Blackford Middleton (2003), *ten Commandments for Effective Clinical Decision Support:* Making the Practice of Evidence-based Medicine a Reality. Retrieved from http://dx.doi.org/10.1197/jamia.M1370

Davis N, LaCour M. (2002). *Introduction to Information Technology*. Philadelphia, WB Saunders Company.

Dussault G (Ed.). (1999). *Analysis of human resources situation in health: why and how*? Paper prepared for Intercountry consulting on human resource development in the health field, *Cairo* 15–18 February.

Elesban Kihuba, David Gathara, Stephen Mwinga, Mercy Mulaku, Rose Kosgei Wycliffe Mogoa1, Rachel Nyamai , Mike English (2014), *Assessing the ability of health information systems in hospitals to support evidence-informed decisions in Kenya*, KEMRI-Wellcome Trust Research Programme, Global Health Action, 7: 24859

Festing A.B, & Hoy F. (2007), *Integrating corporate social policy into strategic management*, Journal of Business Strategy, 4(3).

Friedman C, Wyatt J (1997). *Evaluation methods in medical informatics*. New York: Springer-Verlag.

Gibbs, W. (1997). *Taking computers to task.* Science America*;* 278:64-71.

Goldschmidt, P.G. (2005). *HIT and MIS: Implications of health information technology and medical information systems*. Communications of the ACM, 48(10), 69-74.

Healthcare Africa report (2012), *the Economist Intelligence Unit*; 3-10.

Haslina, M., Sharifah, M. S. M. (2005). *Acceptance Model of Electronic Medical Record.* Journal of Advancing Information and Management Studies, 2(1), 75-92.

Hanseth, O., Monteiro, E., Hatling, M. (1996). *Developing information infrastructure: The tension between standardization and flexibility*. Science, Technology and Human Values, 21, 407–426.

Haux Reinhold, (2006). Health *information systems – past, present, future*, International Journal of Medical Informatics, 75, 268—281.

Ilias Iakovidis (1998), *Towards personal health record: current situation, obstacles and trends in implementation of electronic healthcare record in Europe*, International Journal of Medical Informatics, Volume 52, Issues 1-3, Pg 105-115, ISSN 1386-5056

James, A. R., Parag, C. P., David, J. P. (1996). *End-user perceptions of quality and information technology in health care*. Journal of High Technology Management Research, 7(2), 133-147.

Johar, Z. (2010,). *Provisioning Ophthalmic Care for Remote Rural Indian Populations.* Retrieved from The ICTPH Blog: http://ictph.org.in/blog/?p=248

Jwan, J. (2010). *Conducting Qualitative Research: Current Trends & Developments*: Moi University 5th Campus Wide Research Workshop.

Kaplan B. (1988) Development and acceptance of medical information systems: an historical overview. *J Health Human Resource Administration*; 11:9-29.

Kothari, C.R. (2006), *Research Methods*: Methods and techniques, 3rd Edition, New age international publishers

Kothari, C. R. (2004). *Research Methodology: Methods and Techniques* (2nd Ed.). New Delhi: New Age International limited

Krejcie, R.V., & Morgan, D.W., (1970). *Determining Sample Size for Research Activities*. Educational and Psychological Measurement.

Kuhn, K.A., Giuse D.A., (2001), *From Hospital Information systems to Health Information Systems*; Problems, Challenges, Perspectives, Method Information Med4/2001.

LaTour, Kathleen M., Maki, Shirley Eichenwald. (2010). *Health information management concepts, principles, and practice*. Chicago, Illinois: American Health Information Management Association

Lippeveld, T., Sauerborn, R., Bodart, C. (2000). *Design and implementation of health information systems*. Geneva: World Health Organization.

Manya A, Braa J, Øverland L, Titlestad O, Mumo J, Nzioka C, (2011). *National Roll out of District Health Information Software (DHIS 2) in Kenya* . Journal of Health informatics in developing countries, volume 8 (1), pg 41-50.

Marx A, Pewsner D, Egger M, Nüesch R, Bucher HC, Genton B, Hatz C, Jüni P (2005): Meta-analysis: accuracy of rapid tests for malaria in travelers returning from endemic areas. *Ann Intern Med 2005,* 142:836-846

Matthew R. Fairholm (2009), *Leadership and Organizational Strategy*, Political Science Department and W. O. Farber Center for Civic Leadership University of South Dakota, Vermillion, SD 57069

Malaria surveillance bulletin, 2013: 5th Edition

Message on World Malaria day (2014)*:* United Nations, New York 25th April

Middleton B, Renner K, Leavitt M (1997) *Ambulatory practice clinical information management: problems and prospects;* 11(4):97–112.

Ministry of Health. *Health Information System Policy*. Nairobi; 2008

Ministry of Health(2009). Division of Health Information Systems: *Terms of Reference for Software Acquisition*.

Ministry of Health (2009).. *Health Sector Strategic Plan for Health Information System* 2009-2014. Pg 4-6, Nairobi; Govt print.

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

Mugenda, O., Mugenda, A. (2003). *Research methods; Quantitative and Qualitative Approaches*. Nairobi: Act Press.

Mugenda, A. G. (2008). *Social science research; Theory and principles*. Nairobi. Arts Services.

Müller, Albert (2000). "*A Brief History of the BCL*". Österreichische Zeitschrift für Geschichtswissenschaften 11 (1): 9–30

Nenonen, M. and Pelanteri, S. (1999) Terveyskeskusten vuodeosastot 1998: Palvelujen käyttö ja tuottaminen: Stakes, Tilastoraportti 36/1999

Nicole Archangel (2007), *The Critical issues affecting the introduction of Health Management Information Systems in developing countries in Africa.*

Orodho, A. J. (2003). *Essential of educational and social sciences research method. Nairobi*: Masola Publishers.

Reducing the frequency of errors in medicine using information technology (2001) . *J American Medical Information Association*; 8:299–308

Ref:MRU/MED/GEN/C.50

Richard, L.S., and Ronald M.E. (2008). *Lessons from Theory & Research on Clinician-Patient Communication In: Karen G., Barbara K.R, K.Viswanth (eds.) "Health Behavior and Health Education;* Theory, Research, and Practice*"* 4th edition, (11) p 236-269 JOSSEY-BASS

Richard, Y. W., & Diane, M. S. (1996). Beyond Accuracy: What Data Quality Means to Data Consumers. *Management Information Systems*, 12(4), 5-34.

Rolland, K. H., Monteiro, E. (2002).*Balancing the local and the global in infrastructural information systems. The Information Society*, 18, 87–100 World Malaria Report, World Health Organization, Geneva.

Salvin, R. A. (1984). *Approaches to Social Research*. New York. Oxford University Press.

Shaw, V. (2002). *The development of an information system for district hospitals*. Proceedings of the 7th IFIP 9.4 Working Conference, Bangalore, India.

Shillcutt S, Morel C, Goodman C, Coleman P, Bell D, Whitty CJ, Mills A (2008): Cost-effectiveness of malaria diagnostic methods in sub-Saharan Africa in an era of combination therapy. *Bulletin World Health Organisation*, 86:101-110

Smith, R., (1997). *The future of healthcare systems*, BMJ314 1495–1496.

Teich JM. (1998).*Clinical information systems for integrated healthcare networks*. In: Chute CG (ed). Proc AMIA Symp; 19-28.

Thomas J.R, Nelson J.K., (Eds.). (1996). *Research methods in physical activity*. Human kinetics, America Medical Information Association.

Timmermans, S., & Berg, M. (1997). *Standardization in action: Achieving universalism and localization in medical protocols*. Social Studies of Science, 27, 273–305.

Tuomi, I. (1999) '*Data is more than knowledge: implications of the reversed knowledge Hierarchy for knowledge management and organizational memory'*, Journal of Management Information Systems, Vol. 16, No. 3, pp.103–117.

Tuttle M.S (1999). *Information technology outside health care: what does it matter to us*? J America Medical Information Association; 6: 354-60

Victoria, H., & Kannan, S. (Eds.). (2008). *Healthcare Information Systems* Vol. 1. United States of America: Information Science Reference.

Willcocks L, Lester S (1993). *Evaluating the feasibility of information technology, research.* Oxford Institute of Information Management. (Discussion paper DDP 93/1.)

William, H. D., & Ephraim, R. M. (2003). *The DeLone and McLean Model of Information Systems Success: A Ten-Year Update*. Management Information Systems 19(4), 9-30.

Winter, A., Ammenwerth, E., Brigl, B., Haux, R. (2004). *Strategic Information Management in Hospitals: an introduction to hospital information systems*. Springer

Wongsrichanalai C, Barcus MJ, Muth S, Sutamihardja A, Wernsdorfer WH (2007): *A review of malaria diagnostic tools: microscopy and rapid diagnostic test* (RDT) Am J Tropical Medicine, 77:119-127

World Health Organization, (2010), *"Towards Reaching the Health-Related Millennium Development Goals: Progress Report and the Way Forward",* Report of the Regional Director for Africa" p 23

World Health Organisation, (2011) *African Region Ministerial Consultation on Non-communicable Diseases, Brazzaville, Republic of Congo*, April 4th-6th 2011, p 6.

WHO (2014): *World Malaria Report*. Geneva: World Health Organization.

WHO (2013): *World Malaria Report.* Geneva: World Health Organization.

World Malaria Report(2009). Geneva: World Health Organization

World health report (2000): *health systems – improving performance.* Geneva

http://www.cdc.gov/malaria/malaria_worldwide/cdc_activities/kenya.html

APPENDICES

Appendix A: Transmittal Letter

University of Nairobi
College of Education and External Studies
School of Continuing and Education Distance
Department of Extra-Mural Studies
Meru Extra Mural Center
P.O. Box 3054-00200
Meru.

Dear Respondent,

RE: PERMISSION TO CARRY OUT RESEARCH

I am a post graduate student pursuing a Master of Arts degree in Project Planning and Management at the University of Nairobi.

I am carrying out a research on **"Influence of health information systems on medical diagnosis of malaria for effective treatment."** I wish to request you to assist me by filling in the questionnaire attached. The information you provide will remain confidential and will only be used for academic purpose.

Kindly give your honest and objective responses to the questions.

Yours faithfully

Abraham Kabui Kahuthia

L50/73319/2014

Appendix B: Research Questionnaire for Medical personnel

Section A: Demographic Information of Respondents

Please tick (√) the appropriate answer

1. What is your gender?
   a) Male [ ]
   b) Female [ ]

2. What is your marital status?
   a) Single [ ]
   b) Married [ ]
   c) Divorced [ ]
   d) Separated [ ]

3. In what age category do you fall under?
   a) Less than 20 years [ ]
   b) 20-30 [ ]
   c) 30-40 [ ]
   d) 40-50 [ ]
   e) Above 50 [ ]

4. What department of the hospital do you work in?

……

……

……

Section B: Research Questions

Availability of health systems and disease diagnosis

1. What form(s) of patient registration do you have?

a) Insurance details [ ] b) Cash payer details [ ]

a) Other (specify)

……

……

……

2. To what extent do you agree or disagree that through the hospital information system, patient details are easily accessible and timely.

a) Strongly agree [ ] b) Agree [ ]

c) Neutral [ ] d) disagree [ ]

e) Strongly disagree [ ]

3. To what extent do you agree or disagree that patient details retrieved from the hospital information system are private and confidential.

a) Strongly agree [ ] b) Agree [ ]

c) Neutral [ ] d) disagree [ ]

e) Strongly disagree [ ]

4. Are the electronic medical records of patients provided by the hospital information system accurate and updated?

a) Yes [ ] b) No [ ]

Section C: Quality hospital systems for disease diagnosis

1. i) Does the hospital information system enable patients move swiftly within hospital departments?

   a) Yes [ ] b) No [ ]

   ii) If no, state the reason(s)

.....

.....

……..

……

2. To what extent do you agree or disagree that you are able to serve patients promptly and fast as their details are readily available within all hospital departments.

   a) Strongly agree [ ] b) Agree [ ]
   c) Neutral [ ] d) disagree [ ]
   e) Strongly disagree [ ]

3. i) Are you able to acquire previous and current patient data promptly?

   a) Yes [ ] b) No [ ]

   ii) If no, state the reason(s)

   .....

   ……

   .....

   ……

   .

4. i) Have you experienced delays in service delivery to patients due to slow network/down time of hospital system?

a) Yes [ ] b) No [ ]

ii) If yes, how long?

a) Less than 1 hour [ ]
b) up to 6 hours [ ]
c) up to 12 hours [ ]
d) up to 18hours [ ]
e) More than 24 hours [ ]

Section D: Monitoring and evaluation of hospital systems and disease diagnosis

1. State the extent to which you agree or disagree that though your medical record in the Hospital system, the doctor is able to review patients with previous visit results and follow up treatment.

a) Strongly agree [ ] b) Agree [ ]
c) Neutral [ ] d) disagree [ ]
e) Strongly disagree [ ]

2. State the extent to which you agree or disagree that through the hospital system, it is possible to continually track patient health status

a) Strongly agree [ ] b) Agree [ ]
c) Neutral [ ] d) disagree [ ]
e) Strongly disagree [ ]

3. Is patient data acquired on request from the hospital system well designed and easily understandable?

a) Yes [ ] b) No [ ]

4. To what extent do you agree or disagree that malaria testing is important?

a) Strongly agree [ ] b) Agree [ ]
c) Neutral [ ] d) disagree [ ]
e) Strongly disagree [ ]

5. To what extent do you agree or disagree that **accurate** reporting of malaria tests is important for effective treatment?

a) Strongly agree [ ] b) Agree [ ]
c) Neutral [ ] d) disagree [ ]
e) Strongly disagree [ ]

6. To what extent do you agree or disagree that with a hospital computerized system, it is possible to track and acquire accurate malaria test results.

a) Strongly agree [ ] b) Agree [ ]

c) Neutral [ ] d) disagree [ ]

e) Strongly disagree [ ]

Section E: Hospital systems and decision making in disease diagnosis and treatment

1. Do you think hospital information systems assist medical personnel arrive at critical decisions on patient management?

a) Yes [ ] b) No [ ]

ii) Give reason(s) to answer above

.....

.....

……...

……

Thank you for your cooperation

Appendix C: Interview Schedule for Medical Personnel

1. What is your job description/ title/designation?
    a) Medical officer [ ]
    b) Clinical officer [ ]
    c) Laboratory technologist [ ]
    d) Pharmacists /technologists [ ]
    e) Radiographer [ ]
    f) Accountant [ ]
    g) Administrator [ ]
    h) physiotherapist
    i) Other (specify) _____

2. What is the name of the hospital information system used?

    .....

    ……

    ……..

3. Does the hospital information system provide sufficient, accurate, understandable and timely information?

    .....

    ……

    ……..

4. Does the hospital information system influence the quality of decision making on patient care?

    .....

    ……

    ……..

5.How is the usability of the information system in terms of menus and customization?

    .....

……

……..

6. Does the hospital information system have the ability to communicate and exchange data among departments?

.....

……

……..

7. Does the hospital information system provide complete and secure information?

.....

……

……..

8. Does the hospital information system reduce waiting time of serving patients?

.....

……

……..

9. Is the network speed of the hospital information system adequate for its normal operations?

.....

……

……..

10. Is there a dedicated ICT department that deals with technical issues arising from the hospital information systems functionality?

.....

……

……..

Thank you

Appendix D: Meru County disaggregated data on Malaria

Data elements	MOH 706_Malaria BS (5 years and above)						
Organization units / Periods	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	
Meru County	6 274	7 447	12 078	9 877	12 988	11 041	59 705
Buuri	1 826	2 829	3 073	2 122	2 779	2 261	14 890
Igembe Central							
Igembe North	827	101	404	1 196	945	772	4 245
Igembe South	271	41	24	695	1 235	1 283	3 549
Imenti Central	15	968	2 873	2 435	3 733	1 864	11 888
Imenti North	2 055	981	1 369	805		245	5 455
Imenti South	1 207	1 551	2 552	1 575	1 747	1 578	10 210
Tigania East	73	976	899	893	1 235	1 269	5 345
Tigania West			884	156	1 314	1 769	4 123
Total	12 548	14 894	24 156	19 754	25 976	22 082	119 410
MOH 706_Malaria BS (Under five years)							
Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15		
4 302	8 518	7 067	4 094	4 573	4 850	33 404	
1 499	866	792	665	1 060	1 444	6 326	
2 143	3 903	1 610	769	2 010	501	10 936	
8	9	1 469	333	4	140	1 963	
14	2 561	1 953	1 422	722	746	7 418	
604	184	431	389		72	1 680	
	578			115	1 015	1 708	
34	417	438	422	504	466	2 281	
		374	94	158	466	1 092	
8 604	17 036	14 134	8 188	9 146	9 700	66 808	
MOH 706_Malaria Rapid Diagnostic Tests							
Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15		
1 277	1 635	1 007	1 358	1 685	3 356	10 318	
19						19	
	578	410	561	1 207	378	3 134	
1 258	829	221	351		2 168	4 827	
	228	376	446	392	650	2 092	
				86	160	246	
2 554	3 270	2 014	2 716	3 370	6 712	20 636	
Confirmed Malaria							
Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15		

8 283	7 345	7 585	6 131	6 298	5 700	41 342
154	118	150	69	104	143	738
1 182	1 697	1 231	892	1 047	899	6 948
765	661	680	465	298	676	3 545
2 292	2 008	1 721	1 458	1 115	799	9 393
1 349	1 223	1 625	1 394	1 421	1 275	8 287
111	201	176	118	223	132	961
608	890	1 263	1 071	1 423	1 144	6 399
555	421	418	547	512	407	2 860
1 267	126	321	117	155	225	2 211
16 566	14 690	15 170	12 262	12 596	11 400	82 684
Malaria in pregnant woman						
Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	
245	144	156	134	170	147	996
	1		2	4	2	9
6	40	41	17	86	73	263
107	14	11	27	20	37	216
75	50	59	22	18	7	231
19	25	24	9	12	8	97
3	1	1	3	4	2	14
22	5	17	15	11	12	82
8	4	3	39	15	5	74
5	4				1	10
490	288	312	268	340	294	1 992

Source: County Health Records and Information Manager (CHRM), Ministry of Public Health, Meru County.