IMPLEMENTATION OF ELECTRONIC MEDICAL RECORDS IN KENYAN PUBLIC HOSPITALS: CHALLENGES AND OPPORTUNITIES

BY

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DECLARATION

I confirm that this thesis is my original work and has not been presented in any other university. The thesis has been complemented by referenced works duly acknowledged. Where text, data, graphics, pictures or tables have been borrowed from other works- including the internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

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DEDICATION

This work is dedicated to my mother Naomi Njoki for her continued support and encouragement and my late father Christopher Wamae whose immense efforts to educate us continue to inspire me to date.

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TABLE OF CONTENTS

		Page
TITLE ……		i
DECLARATION ……		ii
DEDICATION ……..		iii
ACKNOWLEDGEMENTS ……..		iv
TABLE OF CONTENTS ……..		v
TABLES ……		xii
FIGURES ……..…….		xiii
ACRONYMS ……...		xv
ABSTRACT …….		xvi
CHAPTER ONE: INTRODUCTION AND BACKGROUND OF THE STUDY …….		**1**
1.1	Introduction ……..	1
1.2	Background to the Study …….	1
1.3	Statement of the Problem ……	10
1.4	Purpose of the study……..……..	13
	1.4.1 Specific Objectives ……..	13
1.5	Research Questions ……	14
1.6	Significance of the Study ……	14

1.7 Limitations and delimitations…. ……..…….. 15

1.8 Assumptions of the Study …… 16

1.9 Theoretical and Conceptual Framework …….. 16

1.9.1 Theoretical Framework …… 16

1.9.2 Conceptual Framework …….. 20

CHAPTER TWO: REVIEW OF RELATED LITERATURE …. 22

2.1 Introduction ……. 22

2.2 Strategies for EMR Implementation …… 23

2.3 Strategic Steps for EMR Implementation ……. 23

2.4 Strategic Models for EMR Implementation …… 26

2.5 EMR Implementation Trends ……. 27

2.5.1 EMR Implementation Lessons from Other Parts of the World …… 27

2.5.2 EMR Implementation in Africa …….. 30

2.5.3 EMR in Developing Countries ……..… 31

2.5.4 General EMRs in Kenya…….. 33

2.5.5 Donor Supported HIV EMRs in Kenya…… 33

2.5.6 Other area of service/disease specific EMRs In Kenya…….. ……. 34

2.6 Impact of EMR on Healthcare …… 35

2.7 Opportunities for EMR …… 38

2.7.1 EMR Potential in Care Structuring and Follow-ups …… 41
2.7.2 EMR Potential in Clinical Decision Support ……. 42
2.7.3 EMR Potential in Clinical Quality Assurance and Monitoring …… 43
2.7.4 EMR Potential for Online Health Care …… 45
2.7.5 EMR Potential for Automatic Data Capture and Integration With Medical Devices …… 47
2.8 The Challenge of EMR Implementation …… 49
2.8.1 Challenges of EMR Funding …… 51
2.8.2 Electronic Medical Record Systems Reliability …… 54
2.8.3 EMR Challenges in privacy and security…….. 56
2.8.4 EMR planning, design and architecture…… 59
2.9 Infrastructure for Electronic Medical Records Management … 61
2.9.1 Technologies for EMR Implementation …… 61
2.9.2 EMR system Selection and Vendors Issues …… 62
2.9.3 Stages of Selection…… 63
2.10 Conclusion ……. 65

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY…… 68

3.1 Introduction …… 68

3.2	Research Design and Locale……..	68
3.2.1	Variables ……	69
3.2.2	Location of the Study and Reasons for Selection …….	71
3.3	Target Population ……	72
3.4	Sampling Techniques and Sample Size …….	73
3.4.1	Sample apportionment by Hospital …….	75
3.4.2	Sample apportionment by Staff Category ……...	75
3.5	Research Instruments ……	77
3.5.1	Questionnaire for Doctors …….	77
3.5.2	Questionnaire for Nurses ……..	78
3.5.3	Questionnaire for Health Information Staff …….	78
3.5.4	Questionnaire for Strategic Managers ……..	78
3.5.5	Document Searches Checklist …….	79
3.5.6	Pilot Study ……	79
3.5.7	Validity ……	81
3.5.8	Reliability …….	81
3.6	Data Collection Techniques ……..	82
3.6.1	Logistical and Ethical Considerations ……	83
3.7	Data Analysis ……	84

CHAPTER FOUR: PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION …… 86

4.1 Introduction …….. 86

4.2 Response Rate …….. 86

4.3 Existing ERMs and Hospitals Background Information …. 88

4.3.1 Existing EMR Modules …… 90

4.3.2 Technologies and Equipment provided for Information Capture and management …… 92

4.4 EMR Implementation Methodology …… 93

4.4.1 EMR Pre-Implementation Strategies Issues …….. 94

4.4.2 EMR Funding Planning …… 95

4.4.3 User Involvement Strategies …… 97

4.4.4 Information Management Strategic Issues …… 98

4.5 EMR Implementation …… 101

4.5.1 Actual User Involvement …… 101

4.5.2 User Involvement in Selection of EMR Technology … 103

4.5.3 User Involvement in EMR Testing, Piloting and Training …….. 104

4.5.4 Data Capture Methods Being Used …… 105

4.5.5 EMR Coverage of Doctors Processes of Documentation…… 106

4.5.6 EMR Coverage of Nurses processes …… 108

4.5.7 EMR Coverage of health Records and Information Management Processes …… 109

4.6 EMR Post Implementation Stage …… 112

4.6.1 EMR Impact on Health Information Services …… 112

4.6.2 EMR Impact on Doctors processes …… 113

4.6.3 EMR Impact on Nursing Processes …….. 114

4.7 EMR opportunities and Challenges …… 116

4.7.1 Recommended Way Forward …… 116

4.7.2 Usability of EMR ……. 117

4.7.3 EMRs Ability to Provide Clinical Information to Doctors.. 118

4.7.4 EMRs Ability to provide Nursing Care Information …… 119

4.7.5 EMRs Ability to provide Administrative Statistics and Support For Records Management ……. 121

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS …… 123

5.1 Introduction …… 123

5.2 Summary …… 123

5.3 Conclusions …… 125

5.4 Recommendations …….. 127

5.4.1 Policy Recommendations …… 127

5.4.2 Recommendations for Further Research …… 128

6. References---------- 129

7. Appendices---------- 141

TABLES

Table 1.1	EMR Status in US Hospitals ……..	7
Table 3.1	Distribution of Staff in the Selected Hospitals ……	73
Table 3.2	Sample appointment by Hospital …….	75
Table 3.3	Sample by Staff Categories ……	76
Table 3.4	Pre-Testing Questionnaires Distribution, Completion Rate and Response ……	80
Table 4.1	Health Facility Level, Size and General Workload …	89

FIGURES

Fig. 1.1	A Model of Five Stages in the Innovation Decision Process …….	19
Fig. 1.2	Conceptual Framework …….	21
Fig. 4.1	Overall Response Rate …… ……	87
Fig. 4.2	Users Categorization of the Existing Medical Records systems ……	90
Fig. 4.3	Existing EMR Modules ……	91
Fig. 4.4	Techniques Provided for Information Capture and Management ……	93
Fig. 4.5	Availability of Vital Strategic Documents ……	95
Fig. 4.6	Strategic Management Response on EMR Funding Strategies …….	96
Fig. 4.7	Strategic Managers Responses on User Involvement Strategies ……	98
Fig. 4.8	Percentage of Strategic Managers Considering Information Strategic ……	100
Fig. 4.9	Actual User Involvement in EMR Planning and Resource Mobilisation ……	102
Fig. 4.10	User Involvement in Choice of EMR Technology..	103
Fig. 4.11	Users Involvement I Piloting, Training and Testing of EMR ……..	104
Fig. 4.12	Methods of EMR Data Capture ……	105
Fig. 4.13	EMR Coverage of Doctors Processes ……..	107

Fig. 4.14	EMR Coverage of Nursing Processes……	109
Fig. 4.15	EMR Coverage of Health Records and Information Management Process……..	111
Fig. 4.16	HRIOs Ratings on EMR performance on Health Information Management ……	113
Fig. 4.17	Doctors Ratings on Performance …….	114
Fig. 4.18	EMR Impact on Nursing Processes …….	115
Fig. 4.19	Recommended Way Forward for Existing EMRs ……	116
Fig. 4.20	Usability of the Installed EMRS……	117
Fig. 4.21	EMRs Ability to Provide Clinical Information …….	119
Fig. 4.22	EMR Ability to provide Vital Care Information ……..	120
Fig. 4.23	EMRs Ability to Provide Statistics and Support for Records Management function ……	122

ACRONYMS

AHRQ - Agency for Health Research and Quality

AMRS - Ampath Medical Records Systems

CPOE - Computerized Physician Order Entry

DHHS - Department Health and Human Services

EMAR - Electronic medication administration record

EMR - Electronic Medical Records

ESRA - Electronic Signatures and Records Act

FBO - Faith Based Organization

HIV - Human Immuno-defficiency Virus

ICT - Information Communication Technology

ISP - Internet Service Provider

IT - Information technology

KNH - Kenyatta National Hospital

NGO - Non Governmental Organizations

PACS - Picture Archiving and Communications System

RFID - Radio frequency identification

ABSTRACT

An Electronic Medical Record (EMR), a computer system composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, and pharmacy module has become a growing subject of debate in the world today. While EMRs hold great promise, few studies have been conducted on their implementation and outcome. Despite the fact that Kenya has made tremendous steps in Information Communication Technology (ICT) as demonstrated by the growing number of telephone lines, Internet Service Providers (ISPs), the number of Internet users, broadcasting stations, mobile phones and the growing competition by mobile service providers, and development of National EMR standards, there has been no noticeable penetration of ICT in public hospitals. To unearth the issues surrounding implementation of EMR in Kenyan Public hospitals, this study aimed at exposing technical and socio-economic challenges during pre-implementation, implementation, and post-implementation stages in Kenya. It also examined opportunities for EMR which can be utilized to improve healthcare. Towards this end, the study employed a descriptive approach to systematically study and describe the existing medical records management systems, the available electronic infrastructure, attitudes towards EMR and the expected EMR by-products. Structured and unstructured inquiry methods were used to collect quantitative and qualitative data from a sample of 685 (Strategic Managers, Doctors, Nurses and Health records and Information Officers) drawn from Moi Teaching and Referral Hospital, Kenyatta National Hospital, Rift Valley, Embu and Nyeri Provincial General Hospitals, Naivasha District hospital and Thika, Level 5 Hospital, and Meru Level 5 Hopital. Data was analyzed to determine the respondents' view on the procedures that were followed during EMR implementation, the existing EMR functionalities, user satisfaction with EMR output, and to look for EMR implementation trends and patterns. The key findings of the research included low consideration of financial strategies for EMR funding and sustainability, low utilization of existing national EMR standards, a disconnect between strategic managers and EMR users especially in the area of user involvement, Low EMR impact on healthcare services, and low reliability of EMR as evidence, maintenance of authentic records and lack of other records management functions such as appraisal, disposal and permanent retention of records among others. Based on the findings, the study recommends more sensitization on National EMR standards at both strategic and users level to ensure EMR quality, appropriate involvement of users and all stakeholders in all stages of implementation to enhance requirements analysis, ownership of system and utilization. The study also recommends before and after studies in health facilities implementing EMRs in order to ensure early corrective measures and control of the implementation process.

CHAPTER ONE

INTRODUCTION AND CONTEXT OF THE STUDY

1.1 Introduction

This chapter introduces the Electronic Medical Records (EMR) concept and explains the properties of an ideal EMR. It sheds some light on EMR implementation processes and provides a general view of EMR implementation trends in various parts of the world. The chapter also presents the efforts being made by Kenya government in the planning and implementation of Computer based systems in the health sector. A statement of the problem, objectives of the research, theoretical framework, and significance of the study are also presented.

1.2 Background to the study

The value of medical records in health care delivery has been recognized for a long time. Their relevance to patient care and health administration was first documented by Florence Nightingale in 1873 in her book entitled ‘‘Notes on a hospital’’. Mann (2003) asserts that an ideal medical record should be the primary repository of all information regarding patient care, providing decision-support, and be a tool for supporting and maintaining ancillary health care activities such as administration, medical legal support, quality assurance, research and epidemiology. Himmelstein (2005) claims that since 1960, the idea of EMR

continues to be viewed as a system for automating and reorganizing patients' records.

Various definitions of EMR exist in today's information age. Electronic Medical Record is a digital collection of a patient's medical history, including diagnosed conditions, prescribed medications, vital signs, immunizations, lab results, and personal details like age and weight (Lorenzi, Kouroubali, Detmer, & Bloomrosen, 2009). The Agency for Healthcare Research and Quality (AHRQ) describes EMR as a set of databases that contains information derived from varied clinical service delivery processes, including laboratory data, pharmacy data, patient registration data, radiology data, surgical procedures, clinic and inpatient notes, preventive care delivery, emergency department visits, and billing information. EMR is viewed as an enabling technology that allows health professionals to pursue more powerful quality improvement programs than is possible with manual records (Miller & Sim, 2004). According Roland (2001) in his evaluation of New York Electronic Signatures and Records Act, EMR just like any other electronic record is information created, stored, generated, received, or communicated by electronic means in a form that a person can perceive and which can be accurately reproduced. The data in the EMR is the legal record of what happened to the patient during their encounter at the health facility (Analytics, 2006). Although the need for EMR has greatly been felt as Heidenreich (2008) claims, Information Communication

Technology (ICT), the main avenue for EMR implementation, has not achieved the same degree of penetration in healthcare as witnessed in other sectors such as finance, transport, manufacturing and retail industries. As health facilities endeavour to achieve quality and cost effective health care, a growing demand for reliable medical records systems is being experienced in various parts of the world. Nowadays, the healthcare industry is in the midst of an exciting technology transformation which has triggered the urge for widespread adoption of ICT to improve efficiency, productivity and boost revenue (Sappington, 2009). Implementation of EMR is a cross cutting issue between records management and Information Communication Technology.

According to ISO 15489: 2001 standard, records management is the field of management responsible for the efficient and systematic control of the creation, receipt, maintenance, use and disposition of records, including the processes for capturing and maintaining evidence of and information about business activities and transactions in the form of records. On the other hand, ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form. The technology is employed for implementation of Electronic Records Management Systems, the environment within which EMR is operated and is composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy, and

clinical documentation applications. The environment supports the patient's EMR across inpatient and outpatient environments, and is used by healthcare practitioners to document, monitor, and manage health care delivery within a health facility.

According to Lorenzi et al (2009), the process of EMR implementation entails decision, selection, pre-implementation, implementation and post implementation. Lorenzi et al opine that implementation experience depends on a variety of factors including the technology, training, leadership, the change management process, and the individual character of the healthcare practice environment. The process requires a careful assessment of the practice readiness for EMR, conducting a cost benefit analysis, developing a master plan on how to handle paper records, training, system selection, and continued quality improvement (Sappington, 2009). Implementation of EMR varies greatly from country to country and a similar variation is observed in EMRs for different medical specialties. As interest in electronic medical record systems increases, the need to cost-justify these systems is becoming more important (Kotecha & Birtwhistle, 2008). Most countries in Europe and America are increasingly using EMRs for patient care, hospital administration and quality management (Williams & Boren, 2008). Evidence from previous studies indicates that national penetration of EMRs may have reached over 90% in primary care practices in European countries, but has been limited to 17%

of physician office practices in the USA (Jha, 2009). Hoerbst (2010), opines that implementation of EMR needs to be approached with a lot of caution. He further advises that because EMR users demand functionalities that would benefit them, they should be appropriately involved in EMR implementation and workflow change processes. This is deemed necessary as EMR introduces new unfamiliar computer systems and a significant modification of workflow.

Implementation of EMR is a topical subject of discussion in the global circles. Some people hold the opinion that the technology is still under test and should be handled cautiously (Boonstra & Broekhuis, 2010). Evidence from a study in Canada on emergency EMR indicates that physicians believe that the system improves the quality of care and would not like to go back to paper even after experiencing delays in emergency service delivery (Claret et al., 2012). In another study conducted on EMR in Germany and Australia, there was a positive attitude towards EMR but providers felt that despite strong media discussion and support, the system had information deficits and other issues on data security (Hoerbst et. al, 2009). At global level, Heidenrich (2008), observes that the EMRs being implemented vary widely in purpose nomenclature. EMR brands such as Human Immunal-defficiency Virus EMR, specialized surgery EMR, paediatric EMR, psychiatry, private practitioner, ambulatory and emergency are now common in the market. Various initiatives are being taken to streamline electronic records

implementation and management. In the USA, the advisory Committee for the Co-ordination of Information Systems has established a technical panel on Electronic Records management to develop guidelines for implementation of electronic records management systems. Various models for evaluating EMR implementation such as the Analytics 2006 seven stage model, distributed model, and National model among others have been developed. In the Analytics multi-stage model, Stage-0 is a situation where some clinical automation may be present, but not covering laboratory, pharmacy, and radiology. Stage-7 is a paperless EMR environment where clinical information can be readily shared via electronic transactions or exchange of electronic records with all entities within a regional health network such as other hospitals, ambulatory clinics, sub acute environments, employers, payers and patients. In this stage Health Care Organizations are able to support the true electronic health records as envisioned in some of models advocating for a paperless environment. Such models not only help in the determination of implementation of phases but have become valuable tools in gauging the levels of EMR penetration in the health sector. Majority of US hospitals are in the early stages of EMR transformation (Analytics, 2006). Most of the hospitals in the US are in stage 2 while none of the hospitals has achieved a paperless environment (see Table 1.1).

Table1.1: EMR status in US Hospitals

EMR STAGE	***STAGE DESCRIPTION***	***% OF US HOSPITALS AT THE STAGE***
Stage 7	Paperless environment with fully function EMR that is able to integrate with other national health systems	0%
Stage 6	Computerized structured physician documentation, clinical decision support systems covering all clinical activities, and picture archiving systems for radiology	0.1%
Stage 5	Closed loop medication in at least one patient care area with a fully functional EMR for the area	0.5%
Stage 4	Computerized investigations order and entry systems are in place and integrated with nursing and clinical data repository and is enabling second level clinical decision support	19%
Stage 3	Automated documentation of vital signs, care plan, nursing, and administration of drugs. Radiology services are electronically accessible by other clinical department	8.1%
Stage 2	Automated clinical data repository, clinical decision support inference engine available	49.7%
Stage 1	Diagnostic systems-Laboratory, radiology and pharmacy systems are installed	20.5%
Stage 0	Laboratory, radiology and pharmacy not automated	19.3%

Source: HIMSS Analytics Database (2006)

A report from the 2008 HIMSS Global Enterprise Task Force (GETF) on EMR implementation, indicates that although intermittent efforts to realize successful EMR have been reported, challenges on funding, governance, standardization, interoperability, and communication continues to affect implementation in most countries.

In the last 20 years, Kenya has made tremendous steps in ICT. According to the Kenya National ICT Master Plan (2013/14-2017/18), Kenya has witnessed significant growth in the ICT sector as demonstrated by the number of telephone lines, Internet Service Providers (ISPs), the number of Internet users, broadcasting stations, mobile phones and the growing competition by mobile service providers. While some sectors like banking, academic institutions, and insurance, among others, continue to apply ICT, no noticeable penetration of ICT has been witnessed in public hospitals.

The Kenya national health care system comprise the public health system with major players including the Ministry of Health and associated parastatal organizations, and the private sectors which includes private for profit, Non-Governmental Organizations, and Faith based Organization facilities. About 60% of the healthcare facilities are owned by the Government and are organized into a six-level management structure. At the lowest level are the dispensaries followed

by health centres, sub- district hospitals, district, provincial, and national hospitals at the apex. In a recent health information system policy by the Kenya Ministry of Health, some of the challenges currently being encountered by health institutions include inadequate capacities of Health Information System (HIS) staff, unskilled personnel handling data, lack of systems integration, many parallel data collection systems, and poor coordination.

Despite the rapid growth of ICT in Kenya, EMR penetration in public hospitals has been low. A recent research on the Current Status of E-Health in Kenya and Emerging Global Research Trends indicates that adoption of e-Health in Kenya is at its infancy. However, there has been innovative applications of e-Health in the management of treatment for HIV patients (Juma et al 2012). Currently, a number of donor supported HIV programmes are running HIV EMRs in some public facilities like Kenyatta National Hospital, Moi Teaching and Referral Hospital, Lumumba Clinic Kisumu and Migori among others. Other hospitals such as Nakuru Provincial General Hospital and Naivasha have introduced some automated systems. The rest of the public hospitals are still struggling with the problems of paper based patients records and have not been able to provide information for monitoring health goals and empowering communities and individuals with timely and understandable information on health. However, Kenya has put in place key policies and developed important strategies to enable

the uptake of e-Health. These include the Standards and Guidelines for Electronic Medical Records in Kenya, Strategic Plan for Health Information Systems, Kenya ICT policy, among others. Although there is notable progress in HIV-Specific EMRs, general hospital-wide EMRs for all disease conditions are yet to be introduced in the Kenyan public hospitals.

1.3 Statement of the Problem

Studies on implementation and impact of EMRs are relatively few, mostly retrospective, without controls, with most data from informants' self-reports and often from surveys. Many of the limited studies are of a few US Health Systems which have developed EMRs suited to their needs over a number of years, which makes the experience less generalizable (Ovretveit et al, 2007). Computerization of medical practices is an on-going reality. With increasing fiscal constraints, mixed feeling about EMR and a greater demand by all stakeholders for demonstrated value, its implementation is becoming a tricky affair. To meet users demands, it is important to ensure that EMR implementations are successful. Dealing with EMR chances of failure, stalling, and withdrawal by healthcare providers as indicated by Keshavjee et al (2006) in their findings on EMR implementations in Ontario is a major challenge.

Just like in other parts of the world, EMR adoption in Kenya is low. In hospitals with some level of automation like Moi Teaching Referral Hospital, the EMR layer only covers HIV therapy and in most cases, the implementation is heavily controlled by donors or is implemented as a specific disease monitoring tool and hence not serving the universal needs of EMR. Implementation of HIS, the wider system for EMR as acknowledged in the National Health System Strategic Plan (2009-2014) is an expensive affair. The estimated cost of implementing the Ministry of Health HIS plan, in which EMR is subsystem is Kshs 1.9 Billion meaning that the country must move forward from an informed point. Considering the cost involved and the mixed feelings surrounding implementation of EMR's, Kenya needs to approach the adoption with caution and certainty to ensure that no losses are incurred.

Although Electronic Medical Record advocates argue that EMR leads to reduced errors and reduced costs, many reports suggest otherwise (Sidorov, 2006). Sidorov further argues that EMR sometimes may lead to higher billings and declines in provider productivity with no change in provider-to-patient ratios. Evidence from other researches indicates that Error reduction is inconsistent and has yet to be linked to savings or malpractice premiums. As interest in patient-centeredness, shared decision making, teaming, group visits, open access, and accountability grows, new knowledge is being generated on how to make their implementation

more successful (Keshavjee et al, 2006). For EMR to have a direct impact on immediate patient care needs, a good infrastructure must be put in place. The minimum clinical data set and the EMR functionality must also be agreed upon. To understand the EMRs being used in the selected hospitals, there is need to explore their strengths and weaknesses in order to determine the extent to which they are benefiting the institutions.

While hospitals are raring to implement EMR across the globe, numerous frameworks have been developed. Some of the frameworks have been found to be suitable by users while others have totally landed users into problems. Majority of the frameworks focus on the phased methods of EMR in terms of clinical data modules, communication modules, speedy retrieval and processing and reporting of clinical statistics. Viewed from this dimension, the frameworks are only providing for the general computerization and are not clear on records management issues such as legal aspects, authentication, disposal and permanent retention. As Healthcare Information and Management Systems Society (HIMSS) asserts, electronic medical records must be stored legally as they can be challenged as hearsay and deemed invalid. From a medical records stand point, these are sensitive issues that make medical records unique and need to be probed further to ensure that reliable and trustworthy EMR is implemented. To achieve acceptable EMR for public hospitals, Kenya must look for local EMR solutions as what is

applicable in other countries should not be assumed to be suitable. In this regard, the study seeks to examine the strategies being applied by Kenyan public hospitals in the implementation of their EMR projects with main emphasis on the activities being carried out, the challenges, and opportunities of EMR systems in healthcare service delivery.

1.4 Purpose of the study

To evaluate EMR pre-implementation, implementation and post-implementation stages in the selected public hospitals with a view to determine the challenges being faced and the existing EMR opportunities.

1.4.1 Specific objectives

1. To establish the strategies being adopted in EMR implementation.
2. To find out the impact of the existing EMRs on health care delivery services.
3. To determine the existing opportunities for EMR integration.
4. To determine the challenges that hospitals face in EMR implementation.
5. To find out the impact of the existing health information policies on EMR implementation

1.5 Research Questions

To adequately probe the EMRs implementation challenges and the existing opportunities in the selected hospitals, the research sought to answer the following questions.

1. How are the hospitals implementing EMR.
2. What is the impact of EMR on healthcare.
3. What challenges do hospitals face in EMR implementation.
4. To what extent are the hospitals adhering to the existing EMR standards and information policies.
5. Are there opportunities for EMR continuity in the selected public hospitals

1.6 Significance of the study

This research focused on the challenges being encountered in EMR implementation, the existing EMRs performance gaps, existing potential in the facilities and appropriate models for implementation among others. Its findings are expected to benefit hospitals intending to implement EMR, healthcare planners, EMR system vendors, and systems consultants.

Considering the growing needs of EMR systems in public hospitals and the evident efforts being made by the Government of Kenya in EMR implementation, this research is expected to serve as an eye opener to both National and County Governments, and other stakeholders in the health sector by providing general knowledge on EMR implementation. EMR systems just like other electronic records management systems are relatively new ventures with limited research. This research explored a rarely researched area and is expected to contribute new knowledge on EMR implementation for a growing economy like Kenya.

1.7 Limitations and Delimitations

The study only covered doctors, nurses, strategic managers and health information officers as they are the ones who deal with medical records more frequently and hence considered appropriate respondents. Due to the large number of public health facilities and their wide geographic distribution, only a selected number of facilities were involved in this research. The selection criteria was based on availability of EMR in the facilities, representation in terms of geographic region, Government of Kenya facility level classification, and also their similarity in types of clinical services.

1.8 Assumptions of the Study

The assumptions made in this research were that the health facilities are using a phased approach in EMR implementation and that the hospitals have put in place the relevant structures for management of EMR projects. It was felt that with such an approach, users would be in a better position to provide reliable data as the data tools were structured in the same flow.

1.9 Theoretical and Conceptual Framework

1.9.1 Theoretical framework

A theory is a set of assumptions, propositions, or accepted facts that attempts to provide a rational explanation of cause-and-effect relationships among a group of observed phenomenon (Camp, 2001). This research applied Rogers' diffusion of innovation theory in the determination of EMR implementation variables, their cause effect relationship and other implementation issues related to EMR adoption. Diffusion of innovation**s** theory seeks to explain how, why, and at what rate new ideas and technology spread through cultures. According to Stuart (2000), Diffusion theory has been used for over 30 years as a theoretical framework for research in disciplines such as political science, communication, economics, technology, education, and in the health sector. Evidence from previous health

researches indicates use of the theory for EMR studies in developed countries (Tucker, 2009).

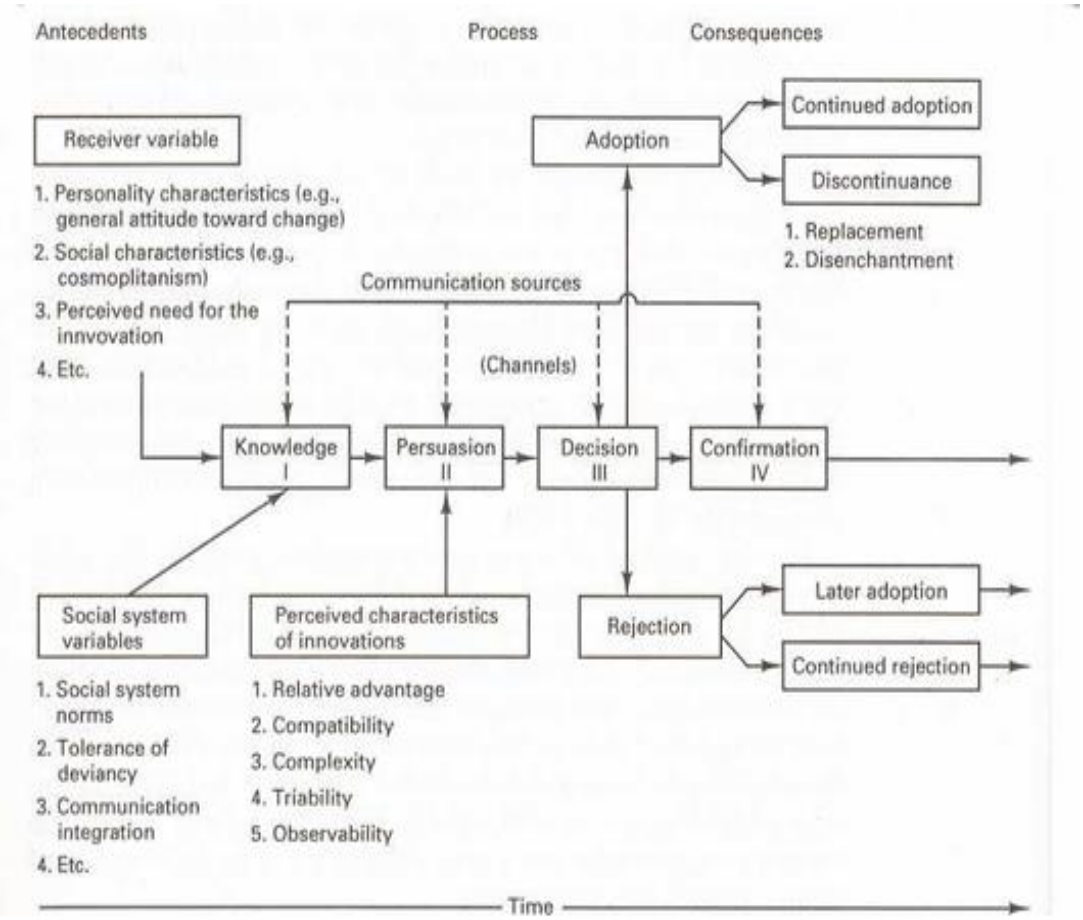
Sahin (2006) in his review of Rogers' theory states that because of the theory's popularity and extensive use in innovative technology research, Rogers used the words innovation and technology interchangeably. Rogers (2003) looks at technology in terms of hardware and software as well as a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. The hardware component is the tool that embodies the technology in the form of a material or physical object while software is the information base for the tool. Rogers also observes that since software as a technological innovation has a low level of observability, its rate of adoption is quite slow. Viewed from this perspective, EMR should be evaluated from both hardware and software stand point without forgetting its impact on health care as the basis for assessing the desired outcome.

Rogers also describes an innovation as idea, practice, or project that is perceived as new by an individual or other unit of adoption. He argues that when a new innovation is introduced, consequences such as the changes that occur in an individual or social system as a result new innovation may create uncertainty. He advises that to reduce uncertainty of adopting a new innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its

consequences. Advice such as this could be of great value in EMR implementation especially in the area of staff training and sensitization.

Diffusion theory recommends use of interpersonal channels of communication as they are more powerful in creating or changing strong attitudes held by an individual. This study coming at a stage when EMR adoption in Kenya is at its infancy and considering the mixed reaction of EMR performance from various parts of the world, benefitted from diffusion of innovation theory especially in probing social issues in the health care community such as EMR change process and technical issues affecting EMR adoption in Kenya. The theory five steps of innovation-decision process covering knowledge about the innovation being adopted; the persuasion step on approaches to convince users on the importance of the innovation; the decision step concerned with the individuals judgement on whether to accept the innovation or reject; implementation step at which the innovation is put into practice; and confirmation step at which the innovation acceptance level may vary from total rejection to acceptance with assured user support. EMR implementation as a process of introducing new technology can benefit greatly when viewed from diffusion theory perspective because both have linear steps (See Figure 1.1).

Figure 1.1: A Model of Five Stages in the Innovation-Decision Process



Source: Everett M. Rogers (2003)

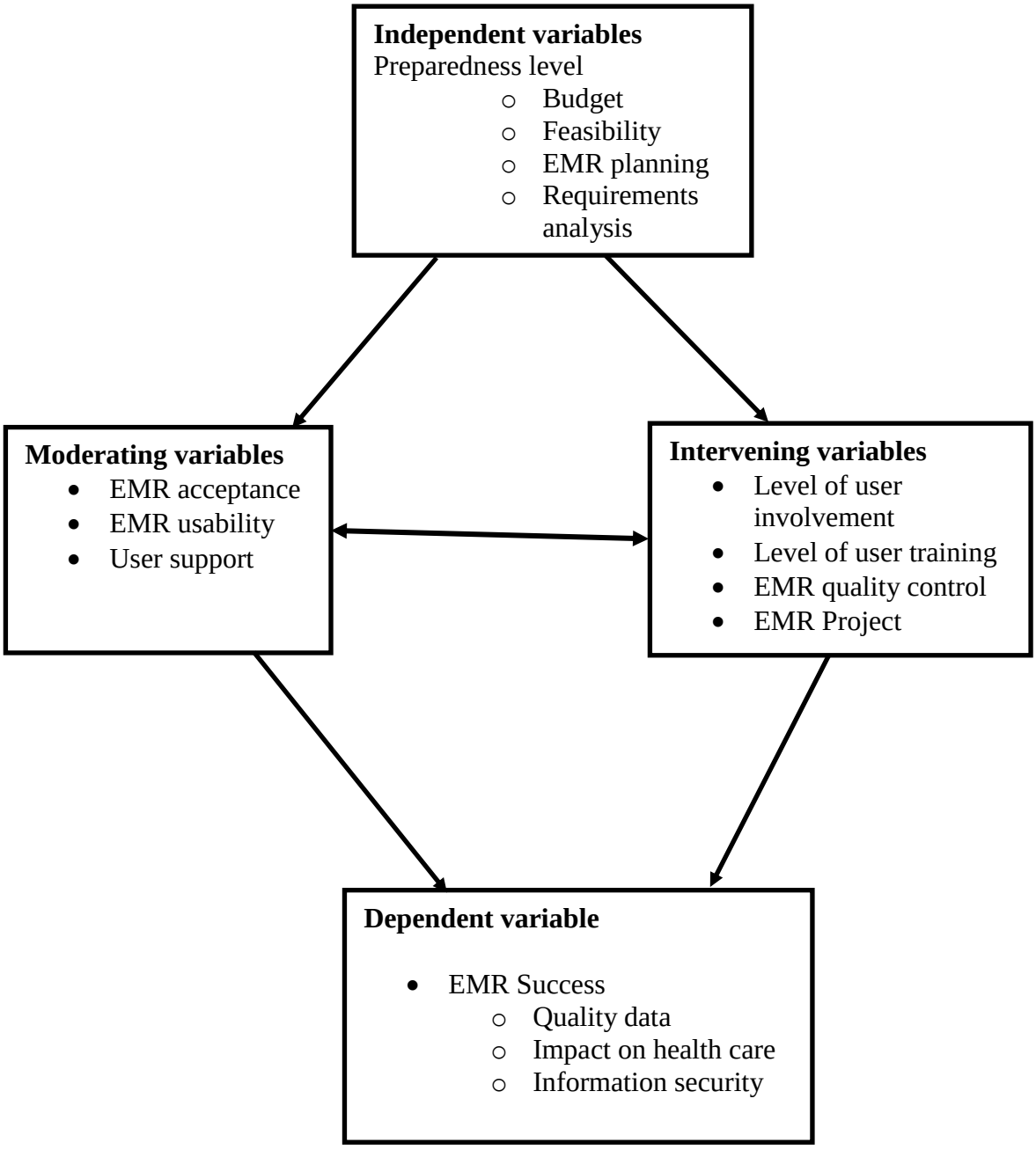
The relevance of this theory to the study was derived from its strength in its exhaustive coverage of issues surrounding diffusion of technology. Such issues as presented in the Five Stage Innovation-Decision Process model above provide a detailed see through picture of the linear activities involved in the

implementation process as depicted by EMR pre-implementation, implementation and post-implementation stages. These stages are the focus of this study.

1.9.2 Conceptual framework

The variables for this research were derived from the measurable characteristics of the three main stages of EMR implementation namely pre-implementation, implementation and post-implementation. This conceptual model applied diffusion of innovations approach in identifying and picking measurable variables for the study. The independent variables for this study covered the issues surrounding pre-implementation stage and are mainly touching on determinants for EMR preparedness such as budget, planning, ICT infrastructure, and availability of standards among others. Intervening variables were formulated from the issues surrounding implementation stage as it is intermediary and has a bearing on EMR outcome and post implementation. Some of the issues covered in this stage were utilization of existing standards, user involvement, project management, and EMR quality control. The dependent variable for this study was the expected EMR outcome which as Weed (1968) put it is to primarily support treatment and other secondary uses such as research and providing data for hospital management. A schematic representation of the research variables is provided in Figure 1.2 below

Figure 1.2: Conceptual Framework



Source: Researcher

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

Electronic Medical Records (EMR) are computerized record created in organizations that deliver health care, such as a hospital or physician's office (Smaltz and Eta, 2007). Electronic Medical Record is more than an electronic version of the paper-based record because a computer-based system is required for managing and delivering data required for patient care (Luo, 2006). Such a system should provide an integrated view of patient data, clinical decision support, clinician order entry, integrated communications support, and access to knowledge resources. The EMR should also interface with other systems, such as billing, pharmacy, radiology, scheduling, and practice management.

While it has been argued that EMRs hold great promise in some quarters, only a few studies have been conducted to measure the actual impact of using them to improve the quality, access or affordability of health care, particularly in developing countries (Alvarez, 2005). It is also felt that more work remains to be done to determine the right mix of ingredients for a workable, culturally appropriate EMR. Other questions of concern in healthcare are what should be built into the EMR (e.g., reports, patient summaries and analyses needed by local teams) and the appropriate level for EMR systems to be deployed at national, district or clinic

level. The main purpose of reviewing literature was to look at the challenges facing EMR implementation, the promises that it carries for healthcare, and EMR implementation practices and experience in various parts of the world. The issues are presented in main sections covering general EMR implementation concept, EMR pre-implementation phase issues, implementation phase, and post-implementation.

2.2 Strategies for EMR Implementation

Electronic medical records systems are continuing to evolve as a technology for use in medical practice. As experience with EMR implementations increases, new knowledge is gained on how to make their implementation more successful (Keshavjee et al, 2006). The importance of an EMR strategy as put by Pollack (2010) is to ensure that technology activities are properly aligned with the evolving needs and strategies of the health facilities. Such strategies, as outlined in the following section, are supposed to cover the entire EMR implementation process.

2.3 Strategic Steps for EMR Implementation

Implementation of EMR is a complex and costly affair that should be well planned and managed. The process as outlined in the Standards and Guidelines for Electronic Medical Records Systems in Kenya covers preparatory phase, implementation phase, transition and post implementation review. Keshvavjee

(2006) cautions health facilities to be careful in the pre-implementation phase as this is the stage at which seeds of success or failure are sown. Thorough planning at this stage is necessary because once an EMR implementation begins, it is very difficult and expensive to return to this phase and start again. The main pre-implementation issues are governance and address health facility reason for adopting EMR by laying the foundation on which EMR is built. Governance is concerned with mission, vision and top management's behaviours related to pre-implementation, implementation and post-implementation of the EMR. The activation of the activities identified and scheduled at the pre-implementation begin at implementation stage. The effectiveness and workability of a health facility preparedness initially determined at pre-implementation phase are tested at this stage. Some of the issues addressed at this stage include work flow re-designing, medical records privacy, training, user support, and feedback among others. Post implementation is concerned with technical and social dynamics necessary for positive continuity of the EMR.

Different implementation approaches have been applied in various parts of the world. The United States policy on Health IT recommends that anyone intending to venture in EMR should conduct a readiness assessment plan for implementation, wisely select or upgrade existing EMR to certified systems, train users, ensure achievement of meaningful use and continue quality improvement.

In the recent past, there has been an emerging trend of EMR implementation in various parts of the world. This has resulted from the realization that EMR is a critical ingredient for strengthening health care (Alvarez, 2005). The choice of system or technology to be implemented is influenced by medical, staffing and environmental factors. According to US Institute of Medicine, few studies have been conducted to measure the actual impact of using EMR to improve the quality, access or affordability of health care, particularly in developing countries. This implies that more work should be done to determine the right mix of ingredients for a workable EMR.

In the implementation of EMR, health facilities need to ensure that requirements for good records keeping are met. The issues to be addressed cover what should be captured as records in order to document the health care processes, procedures which capture the records, design of appropriate systems to manage reliable and authentic records, and formulation of a strategy to ensure that electronic records remain accessible and usable for as long as they are needed (Arden, 2006). The system should also be able to apply appropriate appraisal, scheduling and disposal procedures. Arden (2006) further argues that EMR success depends on management support. Support is needed at that level of the organization because the overall policy and strategy is set by managers. It is the same level at which

issues such as good record-keeping culture, Electronic records management procedure, and IT support are addressed.

2.4 Strategic Models for EMR Implementation.

Various models have been used by facilities implementing EMR in the world. The models vary from a database with a user interface deployed on a single computer for a patient registry or a clinical trial centre, to a hospital-wide EMR operated on a LAN, or a wide area network EMR especially those utilizing the internet (Anantraman, 2002). To adopt EMR effectively, HIMSS Analytics advocate for a model that identifies the levels of EMR capabilities ranging from the initial manual clinical data repository environment through a paperless EMR Environment (Analytics, 2006). The model has seven level stages of implementation where level zero is a situation with some clinical automation. Level two of the model propose automation of ancillary clinical systems such as pharmacy, laboratory and radiology. Level three introduces controlled medical vocabulary such as international classification of diseases and clinical decision support engine for rudimentary conflict checking. It also covers Clinical documentation (e.g. vital signs, flow sheets) nursing notes, care plan charting, and the electronic medication administration record (eMAR). Levels Four to six introduce Computerized Practitioner/Physician Order Entry (CPOE), identification technology, such as radio frequency identification (RFID integrated with CPOE and pharmacy to

maximize point of care patient safety processes for medication administration, fully structured physician documentation or charting templates, a full complement of radiology PACS systems that provide medical images to physicians through an intranet and displace all film-based images. Level seven is the desirable paperless EMR environment where clinical information can be readily shared via electronic transactions or exchange of electronic records with all entities within a regional health network (i.e., other hospitals, ambulatory clinics, sub-acute environments, employers, payers and patients). This stage allows the health facility to support the ideal EMR. The majority of US hospitals are in the early stages of EMR transformation. Currently 19 percent of US hospitals have not achieved level1 and are at Stage zero, 21 percent have achieved Stage one, 50 percent have achieved level two, approximately eight percent have achieved level three, approximately two percent have achieved level four, and less than one percent of hospitals have achieved level five and six (Analytics, 2006).

2.5 EMR Implementation Trends

2.5.1 EMR Implementation Lessons from other Parts of the World

Electronic Medical Records implementation experiences vary greatly as one move from country to country and from one EMR system to another. Various names such as ambulatory EMR, Diabetes management EMR, Primary care EMR, and HIV EMR have been used to identify the scope of EMRs **(**Varroud-Vial, 2011**).** The

value and importance of EMRs has been repeatedly demonstrated in Europe and USA. While there are now many successful implementation of EMRs in both hospital settings and ambulatory practices, widespread adoption and dissemination is the exception rather than the rule (Safran and Goldberg, 2000). Barriers to adoption are sometimes inherent in the design and sometimes related to organizational issues. Safran and Goldberg further states that although EMR is usually a self-contained applications designed to incrementally improve on some of the many problems with hand written records, it has been noted that mere introduction of EMR change workflow and seriously affects the performance of healthcare. It is also noted that EMRs that rely on scanned documents do not solve the problem of legibility.

Health services do not have a good history of cost effective implementation of health information technology systems (HIT), or of electronic medical records (EMR) which are at the center of such systems (Ovretveit et al 2007). Ovretveit further states that the potential for increasing safety and productivity is largely unrealized and that although many countries and services have policies for introducing EMRs, there is a wide gap between policy and practice. In the UK, an ambitious and well-funded policy for all NHS hospitals which was to have electronic patient records by 2005 did not succeed. By the year 2003 only 3% of

NHS hospitals had implemented the policy and by mid 2006 the EMR implementation date was estimated to be "2007 at the earliest". A recent USA review noted that most health care providers needed more information about how to implement IT successfully, as well as the limited research on this subject (Shekelle et al, 2006)

Evidence from existing literature reveals that EMRs have been applied in various specialties of healthcare in various parts of the world. In the USA, use of EMR as a clinical tool to decrease amputations in persons with diabetes has enabled clinicians capture and analyze data of their wound patients, review pertinent patient information, including digital wound photographs and measurements from hospital setting or remote locations. A report on evaluation of the wound management system indicated that the EMR contributed significantly to decreasing amputation rates in patients with diabetic lower extremity wounds (Maggi et al, 2010).

While some milestones have been achieved in the area of EMR performance, change management has continued to raise a lot of concerns. A study on attitudes and behaviors related to the introduction of electronic health records among Austrian and German citizens indicate a generally positive attitude towards the HER (Hoerbst, 2010). The study also showed that data protection is an issue for many citizens, and that despite strong media discussion, there are information

deficits with regard to the national HER initiatives. In another study on implementation and expansion of EMR for HIV care and treatment in Haiti, whose aim was to assess the system impact, it was concluded that there is real potential for EMRs in developing countries to improve clinical practice and make data available for efficient reporting, quality improvement and other population health uses(Matheson et al, 2012). It was also reported that although the system had achieved successes in terms of rolling out new functionality and expanding to new sites, more work was needed to improve perceptions of data quality and increase use of population data for accurate and timely reporting.

2.5.2 EMR Implementation in Africa

In Africa, countries such as Uganda, Kenya, and Malawi have implemented donor supported HIV EMR systems. Some of the systems like AMRS Kenya, employ offsite data capture and are mainly used for reporting of HIV data (Siika, 2005). A few EMRs like the one in use at Lilongwe Hospital Malawi are run over a local network and captures data at the point of service where nurses, physicians and pharmacists perform data entry such as medication orders using touch screens (Douglas, 2003). Considering the fact that most developing countries lack resources and robust healthcare infrastructures, health facilities need to ask the question whether appropriate technology and resources are available as they seek EMR solutions. The guiding principle is that technologies have a good chance to

be effective if they are appropriate to the needs, expectations and limitations of the surroundings in which they are applied. In other words, the selected solution should be in harmony with local standards and values and build on existing skills and techniques. A new technology will not be embedded in a sustainable manner into a health facility if the dependence on the developers of the solution is high and the available resources (financial as well as human) for maintenance are expensive and scarcely available (Victor, 2009).

To achieve a meaningful EMR, Rector et al (1991) advise that while many EMR derives from support for the use of aggregated data for research, audit, finance, or planning, health facilities should not shift focus from the primary purpose of medical record to support individual patient care as this is the only sound basis for an EMR model.

2.5.3 EMR in Developing Countries

A successful healthcare system in a developing country is expected to satisfy the needs of several stakeholders. Most importantly, systems must serve the patients, clinicians, researchers, funding agents, and the associated Ministry of Health (Wolfe et al, 2006). Developing countries continue to face challenges of disease burden such as HIV, non-communicable diseases and accidents. Millions of people

continue to die each year from HIV/AIDS related conditions. Mamlin et al (2006) claim that majority of infected persons (>95%) live in the developing world and that a worthy response to this pandemic will require coordinated, scalable, and flexible information systems.

Various initiatives are being taken in developing countries to prevent and control diseases. One such initiative is the implementation of OpenMRS, an open source infrastructure for the creation of medical record systems in developing countries (Mamlin et al, 2006). Produced and maintained collaboratively across multiple institutions, this framework consists of an open source data model, a set of core application functions, and a default implementation. The goal of this implementation is to provide the beginnings of an EMR that is suitable for all groups involved with healthcare in developing countries. OpenMRS like the one in collaboration between Moi Teaching Referral Hospital and The University of Indiana are now being implemented in Kenya. Mamlin et al (2006) state there is an immediate need for electronic medical record systems to help scale up HIV/AIDS prevention and treatment programs, reduce critical human errors, and support the research necessary to guide future efforts.

Although EMR systems have been shown to be feasible in developing countries, the problem of limited resources begs several questions (Choi et al, 2005). Choi's

concerns are on the ability of EMRs to contribute important benefits to healthcare projects, whether the use of information technology (IT) will be sustainable beyond a few well-funded pilot sites, the EMRs impact on patient care and the management of such health care organizations.

2.5.4 General EMRs in Kenya

According to the Kenya Ministry of Health task force report on the review of EMR systems (2011), EMR should enable the capture of demographic and clinical health information; foster clinical decision support; enable order entry and medication prescribing; increase data security and confidentiality; and enable exchange of electronic information between practitioners, facilities and providers. The report identifies over 28 different brand names of EMR in Kenya with varying functionalities and recommended for standardization of functionalities. Brand names such as Funsoft, Bomu, Care 2000, Trimed, Ehospital, among others are already in the market.

2.5.5 Donor supported HIV EMRs in Kenya

Most of the HIV EMRs such as AMPATH Medical Records System (AMRS), a collaboration between University of Indiana and Moi University Medical School are donor supported (Siika et al, 2005). This EMR is used by Moi Teaching and referral Hospital, District Hospitals and six rural health centres in western Kenya.

It supports comprehensive outpatient HIV/AIDS care. It's a hybrid EMR scenario where Demographic, clinical, and HIV risk data, diagnostic test results, and treatment information are recorded on paper encounter forms transported to a central data room where they are later hand entered into a central database that prints summary flow sheets and reminders for appropriate testing and treatment. There are separate modules for monitoring the Antenatal Clinic and Pharmacy. The EMR was designed with input from clinicians who understand the local community and constraints of providing care in resource poor settings. Currently, the EMR contains more than 30,000 visit records for more than 4000 patients.

According to Siika et al (2005), plans for future development include wireless connections, tablet computers, and migration to a Web-based platform to enhance data capture at the point of clinical service. The functional success at Mosoriot Health Centre is attributed to the USA partner eexperience with installing electronic medical record systems in the US (Hannan et al, 2001). This experience enabled the EMR to provide clinical data and meet the research missions of both the Mosoriot Health Center and Moi University.

2.5.6 Other area of service/disease specific EMRs in Africa

Other areas where Service specific or disease specific EMRs have been implemented in Africa include Zambia, Uganda, and Lilongwe. In Zambia

Electronic Perinatal Record System (ZEPRS) was implemented to record demographic characteristics, past medical and obstetric history, prenatal care, and delivery and newborn care for pregnant women across 25 facilities in the Lusaka public health sector (Chi et al, 2011). The system is used for capturing prenatal information such as syphilis screening, HIV screening, and delivery information. According to Chi et al (2011) the use of the EMR has enabled the facilities monitor the mothers and achieve a 98% rate of live births for mothers visiting their institutions. In Lilongwe Central Hospital, EMR is being used for a wide range of clinical problems in a paediatric department and has information for over 160,000 patients (Sood et al., 2008). Sood also states that other EMR partnership projects in the developing countries include: Partners in Health (PIH)-EMR, Peru; HIV-EMR system, Haiti; Careware, Uganda; PEPFAR project, Tanzania; National EMR, project Zambia.

2.6 Impact of EMR on healthcare

In the last 20 years different forms of EMRs with widely varied visions have been discussed, developed, and implemented in various parts of the world (Tavakoli et al, 2011). Tavakoli et al further state that a successful EMR should allow access to the patient record, 24 hours a day, prevention of medication error, ongoing education for healthcare professionals, timely and effective care, improved hospital revenue, reduced patient- turn -around time, and sharing of information

by authorized people. Evidence from existing literature indicates low availability of research findings on evaluation of EMR impact using the above parameters. A study by Ludwick and Doucette (2009) on adoption of EMR in primary care showed that quality of care, patient safety and provider/patient relations were not, positively or negatively, affected by EMR implementation. Lidwick and Doucette (2009) further advise that due limited research on EMR impact to patient care, privacy and reliability, adopters and other stakeholders should be cautious when implementing EMR systems. They observe that no studies were found that compared how provider-patient interactions are effected when providers used electronic health information systems as opposed to the paper equivalent.

In disease specific EMRs such as the French Group of Physicians , observational trials suggest that the use of EMRs improves the achievement of the recommended standards of diabetes care and intermediate outcomes (Varroud-Vial, 2011). Through the EMR, the physicians have been able to issue reminders to their patients, email them and monitor follow up. In France, the government initiative towards an Internet-based personal health record (PHR) provides an appropriate framework for implementing and sharing the information needed to improve diabetes care.

Despite benefits associated with the use of electronic health records (EHRs), one major barrier to adoption is the concern that EMRs may take longer for physicians to use than paper-based systems. In a study on this issue, a majority of survey respondents believed EMR use results in quality improvement, yet 30% reported that EMR documentation takes the same amount of time or less compared to the paper-based system meaning that EMR has not improved provider patient time (Pizziferri et al., 2005). Although evolution towards more computerization seems inescapable, it has introduced new problems of health facilities. In a longitudinal study to evaluate clinicians medical contact with EMR, the clinicians reported minimal satisfaction but refused to return to handwritten records (Claret et al, 2012).

In Emergency care, Handel & Hackman (2010) reports that the increasing presence of electronic medical records in health care presents interesting and unique challenges in the Emergency Department setting. They further observe that scant literature exists addressing the implementation of EMRs in this setting.

In developing countries Williams & Boren (2008) report that the potential of EMR systems to transform medical care practice has been recognised over the past decades, including the enhancement of healthcare delivery and facilitation of decision-making processes. Some benefits of an EMR system include accurate

medication lists, legible notes and prescriptions and immediately available charts. In spite of challenges facing the developing world such as lack of human expertise and financial resource, most studies have shown how feasible it could be with support from developed nations to design and implement an EMR system that fits into environment.

In the area of EMR integration with digital medical devices, Lee (2012), observes that due to the recent development of digitalized medical equipment, not only can doctors now check a patient's pulse without touching it directly, but the measured data can be computerized and stored into the database as the electronic obligation record. Thus, even if a patient cannot visit the hospital, proper medical treatment is available by analyzing the patient's medical history and diagnosis process in the remote area. Lee also advises that when a comprehensive medical testing centre is established, the quality of medical service is expected to be improved through EMR systems.

2.7 Opportunities for EMR

Information technology, as Tavakoli et al (2011) states offers many potential advantages over paper for the storage and retrieval of patients' data. The proponents of EMR predict that soon all patients records will be stored and viewed on computer. According to Safran & Goldberg (2000), a true EMR should allow

physicians and nurses to practice in a paperless environment. They further argue that the wide adoption of Internet technologies should allow truly distributed sharing of patient data across traditional organizational barriers. Viewed in this context, EMR as a representation of clinical documentation, should allow a collaborative environment that supports workflow, enables new care models and secure access to distributed health data.

As the world continues to embrace ICT, the society has matured to the information age - a time characterized by the ability of individuals to transfer information freely, and to have instant access to knowledge that would have been difficult or impossible to find previously (Ilie et al, 2009). Over the past decade, the political impetus for change in almost all western countries has become stronger and stronger as irrefutable evidence has increasingly shown that paper-based medical records systems are not delivering sufficiently safe, high quality, efficient and cost effective healthcare (Coiera, 2003). In the clinical arena, the demand for EMR is being driven by a growing sense of inevitability among physicians about clinical automation and generational change in which younger physicians who have grown with computers and the Internet want to practice medicine in a modern way (David, 2009).

Electronic medical record systems lie at the center of any computerized health information system. Without them other modern technologies such as decision support systems cannot be effectively integrated into routine clinical workflow. According to Analytics(2006), the paperless, interoperable, multi-provider, multi-specialty, multi-discipline computerized medical record, which has been a goal for many researchers, healthcare professionals, administrators and politicians in the last two decades, is becoming a reality in many western countries.

In addition to fixing some of the obvious shortcomings of the traditional paper chart such as speed of retrieval, loss of case notes, storage space, and illegibility, EMR offers features that written records simply can't match (Bordowitz et al , 2007). The electronic medical record enforces consistency. Every laboratory result, every radiology report, every progress note follows a standard format. When formats are standardized, incomplete or anomalous information stands out. Health care providers can spend less time figuring out what the report says and more time thinking about its meaning.

In the conventional medical record, clinic visit notes, lab results, and progress reports are entered in strict chronological order like the log book of a seagoing vessel. But medicine is non-linear and demands for access to patients notes from various perspectives (Lincoln, 1997). Patients often have multiple, unrelated medical conditions. By forcing everything into a linear narrative, the traditional

paper chart mixes everything up. The story of the patient's fight with heart disease is interrupted by notes from the podiatrist, the dietician and the dentist making it difficult for the clinician to sequence the notes in the preferred order. With EMR, the clinician can rearrange the information in any preferred order. He can move all the patient's electrocardiograms together to see how they have changed over the past year. He can even extract a single laboratory value, such as the patient's blood potassium level, and have the computer chart it over time.

2.7.1 EMR Potential in Care Structuring and Follow-up

Electronic medical records have proved to be very successful in providing a structure that helps doctors record their notes about patients, and view those notes subsequently in a manner that quickly gives them a good understanding of that patient history (Salmon et al, 1996). In this approach, each entry in the medical record is explicitly organized around the problem list, indicating which problems the note addresses, and summarizing of the medical plan in regards to the others. This approach to healthcare enables clinicians to deal with the itemized patients problem list and remove the problems from the list as they are resolved. Luo (2006) observes that with such an EMR, new patient problems should be added as they appear. Because of the flexibility of the electronic medical record, the problem oriented approach enables providers to effectively focus on the problem they are interested in a particular instance in the care of patients. The problem oriented

approach also enables quality assurance personnel to quickly determine whether each problem is receiving the attention that the standard of care requires.

2.7.2 EMR Potential in Clinical Decision Support

Adherence to clinical guidelines as Mikulich et al (2001) put it, is one way of ensuring quality in healthcare. They further argue that if clinical guidelines are to work, they must be actively implemented. The EMR strength in this area is seen in its potential to support decision making by providing information specific to decision steps outlined in clinical guidelines. When a medical record is organized in a standard way, the computer can begin to help in a limited way with the medical decision making process itself. The most important aspect of this is the ability of the computer to catch and flag human errors. Considering the large number of medications in common usage and the fact that most patients take several drugs simultaneously, physician are faced with challenges of keeping track of all the drug interactions. Such a challenge can be addressed by EMRs that provide patient's medications and an up-to-date database of adverse interactions (Fraser et al, 2006). In such a setting, when the doctor prescribes a new medication, the computer scans its database for interactions with any of the patient's existing medication. If an interaction is found, the computer flags the problem and notifies the doctor, emphasizing its point with a capsule review and bibliographic references. The

computer can catch misplaced decimal points and other errors that could result in a patient receiving a drug overdose.

Similarly, the computer system can be on the lookout for life-threatening results in the patient's laboratory test data (Safran et al, 1995). If routine blood chemistries detect a dangerously low potassium level, the system can raise an alert immediately rather than waiting for someone to notice the problem. Things can also be wired so that the computer will notice problems that arise from interactions between different parts of the medical record. For example, some medications are dangerous when used on patients with certain underlying medical conditions. The antibiotic gentamicin, for instance, should not be used in a patient with kidney disease, as it can damage the kidneys even further. If the computer sees a kidney disease listed on the patient's problem list, or detects anomalous laboratory values that are indicative of kidney disease, it will raise an automatic query for confirmation if a physician tries to prescribe the antibiotic.

2.7.3 EMR Potential in Clinical Quality Assurance and Monitoring

The potential of EMR in quality assurance has been noted in its ability to analyse data and provide indicators which can be used for evaluating quality of care improve coordination by making information electronically available at the point of care, especially if implemented well in a health facility (Varroud-Vial, 2011).

Quality assurance is an important aspect of healthcare in any setup. In an ideal situation, patients shouldn't receive expensive tests and medical procedures that they don't need since they don't improve the patient's life. EMR make quality assurance practical as the computer system is able to audits the patient's problem list, diagnoses, laboratory tests, medications, and procedure notes (Mamlin et al, 2006).

With EMRS, medication or procedure that doesn't seem to be justified by the patient's medical condition can be detected, and the system can request further information from the physician, or alert someone in the quality assurance department to investigate. The system can also detect physicians who order an unusually high number of lab tests or whose patients have an abnormally high rate of hospitalization. The system also ensures that the medical system applies a uniform and consistent high standard of care. For example, the standard of care at one institution might be that women with an abnormal pap smear are scheduled for a repeat pap smear after six months (Lincoln, 1997). If it is still abnormal at repeat time, they are scheduled for a cervical biopsy to investigate the possibility of a cancerous or precancerous condition. The electronic medical record allows the computer system to detect when a woman's pap smear results are abnormal and to set the wheels in motion. It notifies the clinician of the abnormal result and generates the standard letter to the patient. It schedules the repeat appointment, and

makes sure that the pap-smear is actually conducted. If the pap-smear is again abnormal, the computer system makes sure that the biopsy is scheduled and performed.

2.7.4 EMR Potential for Online Health Care

Health care is not, and never has been, delivered at a single geographic site (Bodenheimer, 2008). Patients will seek medical attention from healthcare providers of their choice, in different healthcare facilities and at different times. If they get sick enough to require hospitalization they will likely end up in a hospital affiliated with their health plan. Increasingly many routine lab tests and radiological procedures are now performed and interpreted by private commercial enterprises rather than by labs located within the hospital walls. By taking advantage of the network infrastructure, electronic medical records allow patient information to be shared among these sites efficiently and rapidly (Della, 1999).

An integrated medical record has other potential benefits. With paper records, the patient's medical history is never complete. Little bits and pieces of it are stashed away in file cabinets of all the hospitals and clinics the patient has ever visited. EMR offers the possibility of a centralized database that can hold the patient's entire medical history, from childhood pediatric visits to geriatric records (Hoch et al, 2003). EMR give health care providers remote access to the chart. Doctors can

check up on their patients from home, consult others in distant parts of the country, or follow their patients when they've been transferred to remote locations. This is a major boon to primary care doctors, who have long suffered the experience of being "cut out of the loop" when their patients were admitted to hospitals. Now personal physicians can actively participate in their patients' hospital management, reviewing the daily notes and treatment plan, and adding suggestions of their own to the chart. When radiologists are presented with particularly difficult cases, they can call in specialists for advice, transmitting the relevant X-rays and CT scan images across the Internet (Stormo et al, 2004).

Due to lack of universally agreed EMR standards, each hospital, Health Management Organisation, and clinic has built its own system. Incompatible systems make it difficult to effectively share patient information within an institution, let alone distribute it remotely. Although options such massive database conversion, reengineering of existing systems, and the installation of custom software and hardware throughout the consolidated institution appears to offer avenues for sorting this problem, the web offers the most appropriate solution out of this mess. With simple standards-based communications protocols (TCP/IP and HTTP), well-understood data conversion techniques (CGI scripts at the server side, Java and ActiveX at the client side), and a widely-available, easy-to-use client (the

browser), the World Wide Web is the natural platform for the electronic medical record of the future. It provides a nonproprietary data encryption and authentication techniques , allowing confidential information to remain that way, and a rich array of multimedia formats, allowing X-ray images, microscopic images, and even digitized heart sounds to be distributed.

2.7.5 EMR Potential for Automatic Data Capture and Integration with Medical Devices

Medical devices historically have been monolithic units developed, validated, and approved by regulatory authorities as stand-alone entities (King et al, 2009) Nowadays these devices are increasingly incorporating connectivity mechanisms that offer the potential to stream device data into electronic medical records, integrate information from multiple devices into single customizable displays, and coordinate the actions of groups of cooperating devices to automate clinical workflows(King et al, 2009). Medical device manufacturers in markets that have continued to resist creating connectivity solutions are facing increased pressure from healthcare providers adopting EMRs. Prospective EMR users prefer systems where they do not have to write down numbers read from medical device displays and then manually type them into the EMR as this is certainly not automation (Charles, 2007). Medical equipment connectivity whose aim is to create more provider-patient time is now a growing requirement for institutions implementing

EMR. Such equipment should have the ability to export data in a digital form to a centralized computer or server that aggregates data from various medical devices in the facility.

The benefits of automatic collection of data such as heart rate, blood pressure, respiration rate, oxygen saturation, blood glucose, etc. from acute care monitoring devices have become so obvious that all hospitals now require that their EMR provide interfacing capabilities to biomedical devices in order to ensure that key vital signs are stored in the Centralized Data Repository (CDR**)** to track patient progress over time. According to Vaz (2007), medical device integration is a critical and an often overlooked part of EMR planning. To be successful, any plan must take into account many more considerations beyond getting an HL7 feed into the EMR. Multiple stakeholders including nursing and clinical/biomedical engineering must be engaged. Putting together a successful long term plan requires negotiations across traditional hospital repository, and an in depth understanding of point-of-care workflows, medical device connectivity and device vendor offerings and product strategies. Vaz (2007) further argues that patient monitoring systems should be among the first to be integrated as EMR require at least basic patient vital sign collection. Integration with anesthesia devices is a must for facilities intending to capture anesthetic information.

Connecting to bedside medical devices and collecting data in your EMR is not as simple as it may seem. Device interface development is a specialized task that consumes resources and diverts attention away from core competencies. Industrial issues such as market share competition make obtaining device protocols difficult and sometimes impossible (Lesh et al, 2007). Incomplete connectivity results in frustration and decreased efficiency of the hospital. Some of the benefits of device integration include reduced documentation errors, reduced documentation time, clinical decision support, better patient care and more physician – patient contact time, improved overall hospital throughput and patient hospital-visit time. To arrive at these benefits, a well selected range of medical devices should be considered.

2.8 The Challenges of EMR Implementation

While information technology has brought many benefits to organizations, it has also introduced a number of challenges and difficulties (Laura, 2009). According to the Kenya National ICT Policy, the main challenge facing the nation is to harness the potential of ICTs for economic growth and poverty reduction. Specific challenges include lack of a comprehensive policy and regulatory framework, inadequate infrastructure, and insufficient skilled human resources. The direct operational challenges include technological obsolescence, technological dependence, increased risk of lost data and records, risks to reliability and

authenticity, loss of security and privacy, increased costs, decentralization of information, and the increased need for information technology specialists.

Managing electronic records as Mcleod and Hare (2005) claim is a complex undertaking because it involves the creation, capture and organization of electronic records, and providing ongoing access to them. No medical records manager today would deny that managing electronic records is the biggest challenge that they face. The challenge also confronts IT managers and developers because it depend on technology and strategic managers of the health facility because the information that medical records carry is a valuable and unique asset. This challenge affects the managers because they are responsible for implementing the policies and procedures to achieve the facility's goals. Considering the fact that all employees are involved in the facility data capture and that they rely on information for performing their daily tasks, it is expected that the challenge will also affect them as it is the norm today for each employee to have a PC on their desk to work with electronic information systems.

Although vendors are slowly improving EMR usability, it is generally felt that there no technology (for example, voice recognition, tablet computers, or mobile computing) that will dramatically simplify EMR usage (Robert and Ida, 2004).

Designing easy-to-use software for knowledge workers is a challenge that spans the software industry beyond health care.

2.8.1 Challenges of EMR Funding

Despite the benefits that come with EMR, its implementation is an expensive affair **(**Scott et al, 2005). Various technologies are needed for records capture, maintenance of records, communication and information processing. Because of rapid technological changes, individuals and organizations are quickly adopting emerging technologies in information management. Hardware and software have to be upgraded regularly to ensure continuity of access to records. Due to cost implications, health facility leaders and policy makers need to be aware of on-going hardware and software costs as well as costs of continual technical support for the EMR and constant staff orientation to use the system (Rantz et al, 2005).

The costs of hardware and software can be very high. Costs are incurred not only when acquiring technology in the first place but also, more importantly, when upgrading equipment and systems, which is essential in order to keep pace with changing technologies. For organizations, or countries, with limited resources to tackle other problems, this ongoing cost poses a serious challenge. For hospitals to stay financially viable Menachemi and Brooks (2006) advises when considering an

investment in new technology, or an expensive acquisition, healthcare leaders should conduct a cost benefit analysis to examine the financial impact.

When considering the acquisition of computer equipment or the implementation of an electronic records management system, most organizations focus on the initial budget requirements: hardware; software; licenses; supplies; and staff time to develop and install the equipment. But annual and unexpected costs also need to be considered, including: system maintenance fees; upgrades and repairs; and staff training. It has been argued that the cost of maintaining and administering computer systems can exceed seven times the cost of acquiring the equipment in the first place. The organization also has to consider the intangible costs of moving to a new working environment. Time and resources are required to comply with new regulations and legislation; to file, store, retrieve and access records; and to support office workers as they adjust to new technologies and methodologies. Because most organizations going through this transition are doing so by choice, these costs can be considered a part of the necessary learning curve involved with moving to the electronic working environment. There may be intangible savings as well, of course, including improved workflow, enhanced security and so on, that offset these costs.

As technology changes, records need to be migrated to new systems to ensure continuity of use and accessibility. Rapid changes in software applications and computer hardware have led to what is commonly referred to as technological obsolescence. As new innovations in computer technology appear, old systems become out of date and are no longer supported by the computer industry. Some examples of this obsolescence include Commodore 64 and WANG computers – first introduced in the 1970s and 1980s – which are no longer made or supported at all. Obsoleteness also affects storage media. In the late 80s, 8 inch, 5¼ inch and 3½ inch floppy disks were the latest technology then but are no longer found in the market even though they were the predominant storage devices for electronic records for decades. Technological obsolescence affects software as well. Many software programs that were once extremely popular are also now obsolete, including WordStar and early versions of Microsoft Word and Corel WordPerfect.

Some of these changes in technology are a consequence of changing economies and markets, while others resulted from advances and changes in software and hardware. The risk of technological obsolescence is further compounded by the harsh environmental conditions in which computer storage media are sometimes stored. Magnetic and optical media will deteriorate quickly when exposed to high temperatures, humidity and contaminants, often resulting in the partial or complete loss of electronic data. Overcoming technological obsolescence often requires

frequent and perhaps considerable investment in financial, human and technological resources. Conversely, a lack of committed resources will render any electronic records management strategy ineffective and unsustainable. If a health facility is going to commit to using Information Technologies, it needs to guarantee that it will provide the resources needed to maintain and upgrade those technologies indefinitely.

2.8.2 Electronic Medical Record Systems Reliability.

According to American Health Information Management Association (AHIMA), a medical record must be authentic to be trusted as evidence. A record is treated as authentic if it remains static, authoritative, unique and unaltered in its lifetime. Authenticity represents a medical records authorship action attributed to a specific individual or entity, acting at a particular time. Despite the many shortcomings of paper charts medical records, Lincoln (1997) argues that their reliability cannot be matched with EMR. They will withstand power outages, electrical storms, air conditioning failures, electromagnetic pulses, and, and many other issues of records management. . They are also completely impervious to programming errors, public enemy number one of the software world. An electronic medical record system needs to be at least as reliable as a paper system. Stein further opines that reliable EMR should not crash, hang, as such failures carries potentially life-threatening consequences.

Changes in information and computer systems require that information be migrated to new technologies if the information is to remain accessible over time. This process of migration can affect the authenticity and reliability of information, as the process itself can change the content or structure of the records (Keakopa et al, 2009). Unlike paper records, which can be moved, filed, refiled, copied and otherwise used and reused without change, electronic records need to be managed and preserved in such a way as to secure their authenticity as evidence.

Similarly, the way in which electronic records are created can limit their value as authentic records. For example, computerized electronic mail systems do not always capture accurate information about the author of the original email message. Further, as email messages are forwarded, copied, replied to, they may be edited or altered, and the integrity of the original message may be lost as the email communication progresses. To establish the uniqueness and integrity of a record in such a system, one has to know which system was used, who sent the message, who received it, and when it was sent, received, replied to, forwarded or otherwise acted upon. The email software may not have the ability to capture all this information, which is essential to understanding the structure, content and context of record.

When a physician signs a progress note, a medical order, or a prescription, her signature is a legal statement of responsibility (Pallavi, 2008). On the basis of this

signature, the pharmacy will fill the prescription, the therapist will begin a round of radiation therapy, or the patient will be led off to surgery. In a world where the only record kept of life and death decisions is in a malleable, easy to forge medium, it is critical to have a reliable substitute for the signature. Some institutions have addressed this issue by claiming that the secret login key assigned to their employees constitutes a legally binding signature. When a health care worker enters an order, note or diagnostic report, she signs it by entering her secret key.

Increasingly, healthcare organizations are swapping out their security tokens for an innovative authentication solution that leverages a device users already have – their phone – to enable strong security that is both user friendly and cost effective (Mike, 2010). The Upstate Medical University in Syracuse recently implemented phone-based authentication from Phone Factor to secure their growing base of remote users. The result: increased remote usage with less hassle for both the end users and the IT staff, which enables healthcare practitioners to focus on their number one priority – patient care.

2.8.3 EMR Challenges in Privacy and Security

The introduction of information technology into a system is widely understood to fundamentally change the nature of individual privacy because it enables collection and storage of data on a scale not possible using non-electronic methods. No matter

how sophisticated security systems become, people will always manage to defeat them. If by no other means, they may be able to exploit human weakness to subvert someone with legitimate access to the data **(**Mandl et al, 2001). One barrier that has been identified in the acceptance of health technologies such as EMRs is concern about privacy and security (Barrows and Clayton, 1996). Personal information captured in information systems, as opposed to systems existing before the widespread implementation of information technology such as paper-based filing systems, may be reproduced infinitely, transmitted instantaneously, used in ways formerly unimaginable, introducing new problems of privacy and security. Barrow and Clayton (1996) advises that EMRs should be carefully designed to preserve and protect patient privacy to at least the same level of non-information-technology-enabled systems as in paper based environments.

Privacy is the most troubling issue for the electronic medical record as they hold intimate and private information. The records can reveal a history of drug abuse, a venereal disease, or a life-threatening illness. Psychiatric notes reveal inner fantasies, sexual peccadilloes, crimes, or the crimes and abuses of family members. The information from genetic tests can reveal not only that a patient is susceptible for some disease, but that her children and other family members are susceptible as well. The rule that a physician must hold patient information in strict confidence is contoured by the efforts of medicine and law in response to emergent societal

issues (Rutberg, 1999). Unauthorized disclosure of medical records can cause terrible harm such as loss of insurance, job, or even marriage. There are numerous issues surrounding confidentiality. These are on why should we care about possible loss of privacy, the potential impacts when our privacy is breached, the data trails a person create in modern society, and the importance of the Internet, with its booming demand for online shopping and its free flow of information. Of concern are the steps individuals take to control access to data regarding their personal lives and thus protect their privacy. To protect privacy, a combination of governmental and private measures is necessary as new technologies become part of everyday life (Philip, 1998).

The introduction of information technologies has also affected the way governments and private organizations preserve and make available records in their custody. Computers allow organizations to create large and complex databases and make huge amounts of data available electronically. Databases containing personal financial and medical records, for instance, may be extremely useful to the individuals themselves. Without proper security protections, that information may also be accessed by others, threatening the privacy of the owners. People have an inherent right to privacy that can be violated, intentionally or by accident, in an electronic environment. For instance, the risk of identity theft is now very real in the electronic world. Identity theft has been a feature of financial markets for a long

time and has penetrated other sectors in the recent past (Schreft, 2007). Some unscrupulous individuals and research institutions compile and sell personal information about people; this information has been gathered, usually illegally, from electronic sources. This information may be used to gain access to medical legal documents.

All governments and organizations using computers to manage personal information have an obligation to ensure that the data and records in their care are well protected from theft, damage or loss. All necessary measures, from the use of passwords in the office to the creation of appropriate legislation for the jurisdiction as a whole, have to be put into effect to ensure that the information is secure. Security can pose its own problems, however. If, for example, only one person in the organization knows the passwords or access codes to computer systems, the absence of such a person can be disastrous when information and records are needed urgently.

2.8.4 EMR planning, Design, and Architecture.

A key problem with ERM is that records management principles has not been an integral component of information technology (IT) planning and systems design (Gilliland, 2005). When IT managers sit down to figure out what kinds of systems

they will need to manage agency information resources, they do not take records requirements into account. They are not habituated to think that the eventual automated retirement and disposition of data in IT systems is an IT planning and design function, as well as an integral part of program planning and design. IT personnel also do not understand the importance of separating information that constitute a record from non-record information, the importance of disposing of record materials in a prescribed manner and of destroying non-record materials.

Part of the problem is traceable to basic terminological misunderstandings; the words "record" and "archive" mean very different things in the IT environment and in the records environment (Patterson and Sprehe, 2002). Part of the problem is that the records management function has for too long been either omitted from information resources management or treated as an inconvenient afterthought; it has been seen as a "back room" administrative function rather than an IT systems and basic program function. Neither IT nor program planners have absorbed the basic business case for records management, namely, that no enterprise can conduct business without ready access to its important records. And today those records are born and live in electronic media.

2.9 Infrastructure for Electronic Medical Records Management

2.9.1 Technologies for EMR Implementation

In the three decades since the term "medical informatics" was first used, individuals working at the intersection of information technology (IT) and medicine have developed and evaluated computer applications aiming to improve health and health care (Hersh, 2004). The road to successful use of IT in medicine has not been easy, with examples of failures in both computer systems and networks. However, a variety of applications from the field of medical informatics have matured in recent years. HIT has the potential to enable a dramatic transformation in the delivery of health care, making it safer, more effective, and more efficient. Some organizations have already realized major gains through the implementation of multifunctional, interoperable HIT systems built around an EMR. However, widespread implementation of HIT has been limited by a lack of generalizable knowledge about what types of HIT and implementation methods will improve care and manage costs for specific health organizations. The reporting of HIT development and implementation requires fuller descriptions of both the intervention and the organizational/economic environment in which it is implemented (Shekelle, 2006). Electronic medical record systems rely on HIT for data capture, storage, processing, sharing of health information and data security. Technologies for information management activities such as Automatic

Identification and Data Capture (AIDC), Automatic Speech Recognition, Optical Character Recognition(OCR) among others are now emerging in the healthcare sector.

The delivery of excellent quality medical care demands that providers have the necessary information when they give care. To meet this need, Mcleod and Hare (2005) advises that the infrastructure for EMR should not viewed as technology only but as a combination of laws and policies, standards and practices, systems and technologies, and people, all supported by an effective management framework and leadership capable of continually aligning the infrastructure in support of the healthcare services in the facility.

2.9.2 EMR System Selection and Vendors Issues

Electronic records and the technologies that create and maintain them are increasingly numerous and important information resources in health facilities (Saffady et al, 2007). With the numerous EMR vendors in the market, selecting the right system can often be as intimidating as the implementation process (McDowell et al,2003). With so many systems having the same functions and features, it can be difficult to determine which most closely meets a practice's or facility's needs. Nor do most providers have the depth of understanding required to make that determination. Patricia Lohman, president and CEO of Outlook

Associates, Inc. as cited by Roop (2007) says that what happens in a lot of practices is that one person goes out and looks at a couple of demonstrations and makes the selection without really understanding the full impact the EMR will have on the practice, and that it is often the physician who makes the decision based on what they need from a clinical perspective without considering the administrative aspects. Carter, (2008) opines that smaller groups and facilities don't have the financial resources to hire the expertise to assist with the selection process, and many times find themselves at the mercy of the vendors' sales pitches.

2.93 Stages of selection

According to Office of the National Coordinator for Health Information Technology U.S. Department of Health and Human Services guidelines on implementation of EMR, selection should be based on the objective of the medical practice. The objective include the operational and financial improvements that the practice hopes to achieve by adopting an EMR. The guidelines stress the need of identifying a key staff member from each area of your practice to help conduct the selection process. The size of the selection team depends on the size of the practice but should include a physician, nurse, and office administrator. Carter (2001) advises that the team should comprise of knowledgeable staff on how actual processes are done. Some of the team may focus on order entry and others on

billing. The important objective is to talk it through to gain a clear understanding of expectations.

Carter (2008) further advises health facilities to define practice demographics to facilitate accurate hardware and workflow planning, review existing workflows and office processes, and to identify the areas to be automated with the EMR. The importance of a team as (Belden, Grayson, & Barnes, 2009) puts it is because the physician may not have any idea what happens at the front desk, but that front-desk encounter starts the record for the whole day meaning that if you don't start with how it's working now, you won't have a clear path, and you take a chance on avoiding some key handoffs and points along the process. To ensure that a good EMR is selected, there is need to clarify overall practice objectives along with growth and expansion plans to develop the general EMR system parameters for functionality and technology against which your selection team will evaluate each vendor system. The workflow analysis will help get you through the functional requirements, what you want the system to do. But at the same time you do that and walk it through the clinic, you should start to determine where you need printers set up, how many devices you need, and what type, says Adler, adding that this step is also where you should start evaluating security needs. The vendor selection will

involve an assessment of company history, review of business journals, system demonstration, and vendor site visit among others.

2.10 Conclusion

According to the reviewed literature, the growth of ICT based systems in health is slow and not comparable to what is happening in other sectors such as banking, education, trade and commerce among others. The literature indicates that EMRs have begun to penetrate health care in various parts of the world and that there is no universally agreed standards for EMR implementation. Although, the potentials of EMR systems have been identified, there is very limited research on their impact in healthcare in terms of the identified potential parameters. It was also observed that the EMRs being adopted have not taken into consideration, the requirement for medical records management such as maintenance of authentic records for evidence, compilation of medical statistics, medical records appraisal, disposal, archiving and adherence to the relevant laws and regulations in healthcare. Evidence from the reviewed literature indicates a gap in the identification of the challenges being encountered during the three stages of implementation forming the basis for this research.

From the literature, there is an agreement that the opportunities and challenges presented by EMR will not change, but health records professionals can take

advantage of the opportunities and mitigate the risks by the effective implementation of electronic records management programmes and the creation of reasonable and clear policies and procedures for creating and managing records in all media. Electronic technologies are a reality of life in the 21st century. They bring a range of benefits to governments, organisations and society, including improved communications, increased efficiency and greater accountability and transparency. Records professionals must not turn their back on the difficulties of implementing electronic records management programmes. Instead, they must use the opportunities presented by digital technologies to improve the framework for all records management. Toward this end, it is important to bear in mind that electronic records are entirely dependent upon technology. Rapid changes in technology require continuous review and modification of electronic records management strategies. Changes relating to technological obsolescence and dependency on new ones have complicated the long-term management and access to information. Currently, no single strategy exists to address and solve all electronic records management issues. Although preservation is an important aspect of EMR, the records are vulnerable to loss and destruction, making preservation both more difficult and more important. Generally the approach to electronic records management has been ad hoc or reactive. Health Records professionals need to approach EMR with a long-term vision and with an awareness of their responsibility to continue to upgrade their knowledge about electronic

records and current technologies. To close the identified gaps in the implementation process, this research is deemed necessary.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter provides details on the research design, variables used, the research methodology, the location of the study, the target population, sampling techniques, sample size, data collection techniques, data analysis and ethical issues.

3.2 Research design and Locale

Kothari (2003) describes research design as a blue print for the collection, measurement and analysis of data. Research design is therefore, used to structure the research, show how all of the major parts of the research project work together to address the central research question. This study applied a descriptive design which Kothari (2003), observes as appropriate for describing the characteristics of an individual or a group. Considering the fact that this study is about the EMR implementation in Kenyan public hospitals, a descriptive design was deemed necessary. The study employed four sets of structured questionnaires, aimed at gathering quantitative data from the study respondents namely strategic managers, doctors, nurses and health information officers. The researcher with the help of assistants ferried the questionnaire to the selected health facilities and obtained the relevant clearance to administer them to the respondents. The questionnaires were

structured in line with the aforementioned objectives of the study in order to enhance analysis.

3.2.1 Variables

The main variables for this study were derived from the EMR implementation stages. The independent variable was the EMR pre-implementation stage as it has a causal relationship with implementation, and post-implementation. Implementation stage was the intermediary variable while post-implementation was the dependent variable. In the pre-implementation stage, the study looked measurable aspects on health facilities level of preparedness such as budget, EMR requirements planning, availability of EMR master plans, and national EMR standards among others. To unearth the social, and economic issues affecting EMR pre-implementation, the research focused on the planning processes, source of funding, existing EMR knowledge in the subject hospitals and the perception of the hospital staff on implementation of EMR.

In the implementation stage, the study focused on the implementation of activities pre-determined in the previous stage such as user training, EMR utilization levels, user support, EMR technologies and usability among others. In the post-implementation stage the variables focused on the desirable EMR impact on healthcare and information management. In line with the objectives of the study, the impact of EMR implementation was measured in terms of its reliability for

clinical support, authentic documentation and reference for medical legal enquiries, source of health information for facility management, and research support.

The Analytics 2006 model of EMR implementation mentioned earlier in chapter one was applied in the research instruments as a measurement of automation levels in the respective hospitals. Challenges were evaluated by focusing on variables relating to obstacles being encountered in the respective institutions.

Research as Kumar (2005) put it, is a process of collecting, analyzing and interpreting information to answer questions. In this research, questions on EMR pre-implementation, implementation and post-implementation stages in public hospitals were raised with a view to determine their impact on healthcare, the challenges being met and the existing opportunities. According to Dawson (2002), accurate and reliable answers to research questions can only be achieved if the research is well controlled, rigorous, systematic, valid and verifiable, empirical and critical. In order to appropriately cover these issues, this research adopted the survey methodology. According to Pinsonneault and Kraemer (1993), the strength of the methodology is in its ability to produce standardized quantitative descriptions of some aspects of the study population, ease of data analysis to indicate relationships between variables or descriptive projections of predefined population. Pinsonneault and Kraemer (1993) further states that survey methodology is most

appropriate if the central questions of interest about the phenomena are on what is happening, and on how and why is it happening. Considering that the broad objective of this research was to evaluate EMR pre-implementation, implementation and post-implementation activities in the selected hospitals, a survey was considered appropriate.

3.2.2 Location of the Study and Reasons for Selection

The criteria for selection of hospitals was based on the Kenya Government Leveled classification of public health facilities and availability of EMR systems. In the classification, the lowest level is level 1 representing dispensaries and the highest is level 6 representing National teaching and referral hospitals. The study covered two level 6 hospitals namely Moi Teaching and Referral Hospital and Kenyatta National Hospital, five level 5 hospitals namely Nakuru provincial General Hospital, Embu Provincial General Hospital, Nyeri Provincial General Hospital, Thika Level 5 and Meru General Hospital. Naivasha District Hospital which is level 4 was also included. The general criteria for selecting the health facilities was availability of EMR. To ensure adequate representation of hospitals, the government facility classification was considered in the selection to enhance comparison. The national institutions were chosen because of their mandate in the health sector and availability of automated EMR systems. Level 5 hospitals were considered because of their intermediary level in the healthcare. The district

hospital was picked to represent the lower level facilities in the Government classification. The selected 8 institutions were representative because they are geographically distributed, controlled by the government and operate uniform medical records management systems.

3.3 Target Population

The study targeted a total of 5035 staff, comprising of strategic managers, doctors, nurses, and Health Information Officers distributed in the selected hospitals. Considering that doctors are the ones who guide treatment and care planning and that nurses are the ones who do round the clock monitoring of patients, it was felt that the two form a critical mass on implementation of EMR. Health information staff were considered significant in the study because of their role as custodians of medical records and health information management. Strategic managers as the hospital planners and decision makers were considered because of their leadership role in the EMR implementation projects. Strategic managers comprised of senior manager in offices such as the chief executive, deputy directors of clinical services, and heads of medical and surgical divisions. According to the Kenya Ministry of Medical Services Annual Operation Plan 2011/12, the targeted population is distributed as indicated in Table 3.1.

Table 3.1: Distribution of Staff in the Selected Hospitals

POPULATION STRATAS	MOI REFERRAL	NAKURU PGH	EMBU PGH	MERU G HOSP	NYERI PGH	NAIVASHA D HOSP.	THIKA LEVEL5	KNH	TOTAL
Doctors	**244**	**112**	**48**	**40**	**53**	**39**	**49**	**245**	**830**
Nurses	**748**	**428**	**234**	**208**	**271**	**183**	**238**	**1725**	**4035**
Health Information officers	**4**	**10**	**6**	**7**	**6**	**6**	**9**	**102**	**150**
Strategic Managers	**4**	**2**	**2**	**2**	**2**	**2**	**2**	**4**	**20**
TOTAL	**1000**	**552**	**290**	**257**	**332**	**230**	**298**	**2076**	**5035**

Source: Kenya Ministry of Medical Services Operation plan 2011/12

3.4 Sampling techniques and sample size determination

A Sample is a segment of the population selected to represent the population as a whole (Naign and Winn, 2006). Designing a sample calls for three decisions concerning who will be surveyed, how many people will be surveyed and how the sample will be chosen (Kumar, 2005). Considering that each of the selected hospital exist as a discrete entity, the hospitals were treated as the main stratas. Further stratification in the respective hospitals was done as per the staff category from which respondents were picked randomly. All the strategic managers were considered for this study due to their small number and significance on queries

relating to general facility information and EMR strategy. To ensure accurate representation, calculation of the sample size for the rest of the staff categories was based on Daniels (1999) formula. The formulas as (Kasiulevicius, Sapoka, & Filipaviciute, 2006) advises is suitable when dealing with a large population like the one stated in Table 3.1. A 99% confidence interval where the value of Z statistics is set at 2.58 and the error margin **d** at 0.05 was used t. According to Lwanga (1999), where the prevalence is not known, **P** is set at 0.5. Because the prevalence of EMR challenges is not known, a value of 0.5 was used. These values were applied in the following formula to derive the sample size.

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where

n=Sample size

Z=Z statistics for level of confidence = 2.58

P=Expected prevalence = 0.5

d = precision =0.05

Sample size=665

3.4.1 Sample Size Apportionment by Hospital

To ensure fair representation in the selected hospitals, the sample size of the 665 comprising of doctors, nurses and health information officers was apportioned in terms of the weights (% of total population) each hospital carries. The sample size for the hospitals is outlined in table 3.2.

Table 3.2: Sample apportionment by hospital

	MOI REFERRAL	NAKURU PGH	EMBU PGH	MERU G. HOSP	NYERI PGH	NAIVASHA D HOSP.	THIKA LEVEL5	KNH	TOTAL
% OF POPULATION	20%	11%	6%	5%	7%	5%	6%	41%	100%
SAMPLE PER HOSPITAL	132	73	38	34	44	30	39	275	665

Source: Researcher

3.4.2 Sample Apportionment by Staff Category

To determine the number to pick per staff category in each hospital, the sample was apportioned further in terms in terms of the weight (% of total population) each staff category carries. The sample size of each staff category including the strategic managers earlier mentioned in table 3.1 is outline in Table 3.3.

Table 3.3: Sample size by Staff Categories

RESPONDENT CATEGORY	% OF TOTAL POPULATION	SAMPLE BY STAFF CATEGORIES								TOTAL
		MOI REFERRAL	NAKURU PGH	EMBU PGH	MERU G HOSP	NYERI PGH	NAIVASHA D HOSP.	THIKA LEVEL5	KNH	
Doctors	17%	22	12	6	5	7	5	6	46	111
Nurses	80%	106	59	31	27	35	24	31	221	535
Health Information officers	3%	4	2	1	1	1	1	1	8	20
SUB TOTAL FOR THE SAMPLED CATEGORIES		132	73	38	34	44	30	39	275	665
Add strategic managers		4	2	2	2	2	2	2	4	20
TOTAL PER HOSPITAL		136	75	40	36	46	32	41	279	685

Source: Researcher

3.5 Research instruments

The study used four structured questionnaires targeted at strategic managers, doctors, nurses and health information officers (See appendix II-VI). The construction of the instruments was guided by the principle of ease of use rule in terms of clear questions, data analysis, language, and ease of completion. The questionnaires employed various scales on implementation issues to make easy for the respondents to score. The sequencing and subject of questions in the respective questionnaires was based on the research objectives. Due to the geographical distribution of the selected health facilities and the busy schedule of health workers, questionnaires were preferred because they are easy to administer and can be filled at respondent's convenience. The factors considered in the design of the respective tools are outlined below. A document search checklist was also used to gather general information about the facility from vital documents available in the hospitals.

3.5.1 Questionnaire for Doctors

The questionnaire (See appendix II) was used to collect data on doctors ICT skills, the challenges that they face in the capture of clinical data, clinical data manipulation, and clinical decisions support, and periodic reports required from the EMR system. The questionnaire also solicited for information on challenges

encountered with the current system and the root causes. The design of the questionnaire employed closed ended questions with tick boxes for ease of completion and data analysis.

3.5.2 Questionnaire for Nurses

The questionnaire (See appendix III) was used to collect data on nurses ICT skills level, challenges encountered in nursing decision support, periodic nursing reports, and general enquiries in patient treatment centres. The design of the questionnaire employed closed ended questions with tick boxes for ease of completion and data analysis,

3.5.3 Questionnaire for Health Information Staff

The questionnaire(See appendix IV) focused on the type of medical records system in place, challenges in user training, methods of data capture, querying and retrieval of information, records management issues such as authentication, retention and disposal and the root causes. To capture these issues, the questionnaire employed closed ended questions with tick boxes for ease on completion and analysis.

3.5.4 Questionnaire for Strategic Managers

This questionnaire(See appendix V) was used to gather data about the facility infrastructure in terms of staffing, outpatient and inpatient services, diagnostics

services, existing electronic information systems, modules available, availability of EMR strategies, EMR funding, institutional challenges and root causes. The aim of the sought data was highlight the challenges of EMR implementation from an institutional perspective and was used to related the rest of the data during analysis to make informed conclusions.

3.5.5 Document Searches Checklist.

The aim of searching documents was to gather background information about the institution. The review targeted strategic documents such as strategic plans, performance contracts, ICT master plans, and Standard operating procedures among others. A checklist (See appendix VI) was used to indicate the type of document reviewed, users, and purpose. The captured information was related with data from questionnaires to determine the level at which facility objectives were being met.

3.5.6 Pilot Study

Kothari (2004) advises that before using a questionnaire, a pilot study should be conducted to test the questionnaires. He states that piloting is the replica and the rehearsal of the main survey. It helps to bring out the weaknesses of the questionnaire and of the survey technique which helps to make improvements.

The overall aim of piloting was to ensure that the tools were able to consistently

capture same and reliable data from the respondents. To ensure reliability of the tools, piloting was done on 43 randomly selected staff drawn from Strategic managers, Doctors, Nurses and Health information Officers who have been using EMR system in Mbagathi District Hospital. Table 3.4 provides details of pre-testing questionnaire distribution and response rate.

Table 3.4: Pre-testing Questionnaires Distribution, Completion Rate and Response

Respondents category	**No of questionnaires distributed**	**No of questionnaires returned**	**% response**	**Average % completion rate**
Doctors	5	4	80	96
Nurses	30	27	90	93
Health information officers	4	4	100	100
Strategic Managers	4	4	100	98
Total	43	39	91	

Source: Researcher

This activity was conducted to check whether the questions were understood, the expected questionnaires completion level, and response rate as well as understanding the challenges that were likely to be encountered in the field.

3.5.7 Validity

Mugenda (1999) defines validity as the accuracy and meaningfulness of inferences which are based on the results. This is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. To ensure content validity, the questionnaires were sectionalized in terms of EMR pre-implementation, implementation and post-implementation stages. In each stage, the tools construct reliability was ensured through use of ratings on elementary implementation issues. Scale based questions was employed to eliminate bias in responses. Considering the returned pre-testing completion rate of between 93%-100% by the respondents, it was felt that the tool was appropriate for providing valid data for this research.

3.5.8 Reliability

Mugenda (1999) states that reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials. Inter-rater reliability was used in this study because it is one of the recommended method when the targeted data is nominal and discrete as is the case with this research. Inter-rater test method focusses on similarity of responses from two or more

informants. This test method was applied to assess the extent to which respondents were likely to provide similar responses as this would provide a measure of chances of getting consistent data. A 75% similarity of responses was achieved from the ratings provided by the 39 respondents involved in the pre-testing. This rate was considered appropriate for measuring reliability of the tools.

3.6 Data Collection Techniques

Both quantitative and qualitative data collection methods were employed for this study. Quantitative data was captured through use of the aforementioned structured questionnaires while qualitative data was obtained through document searching. To gain support and gather relevant information about the facilities, strategic managers were visited and supplied with questionnaires at their hospitals. Other information about the facilities was collected through review of selected institutional documents and observation. Informal interviews were also conducted with some of the respondents to gain an insight into the existing EMR system processes. The information drawn from these methods aided in the interpretation of the quantitative data. This step was conducted during the initial visit to the institutions.

Quantitative method was used because it relies on random sampling and structured data collection instruments which produce results that are easy to summarize,

compare, and generalize. This method facilitated capture of quantitative data for the measurable variables mentioned earlier in this research. Considering the geographic distribution of the health facilities being probed, questionnaires were distributed during planned site visits. To enhance follow-up, a questionnaire distribution register containing name of the respondent and contacts was maintained.

3.6.1 Logistical and Ethical Considerations

According to Berg (2012), concerns about research ethics revolve around various issues of harm, consent, privacy and the confidentiality of the data collected. He further argues that the fundamental tenets of ethical social scientific research is the notion of 'do no harm'. He cites such concerns as informed consent and implied consent, confidentiality and anonymity, protection for children and debriefing the subjects. Before embarking on field data collection, the mandatory clearance from National Council of Research Science and Technology was obtained(see appendix VII). As required by the council, a copy of this report will be deposited at the council headquarters. Clearance was also sought from the respective Ethical and Research Committees in the selected hospitals (See appendix X-X11). To avoid infringement of copyright, works by other authors in this research are credited

through citations. Other ethical issues such as, confidentiality of the gathered information, accountability for research funds and honesty were observed.

3.7 Data Analysis

Kombo (2006) explains that data analysis entails examining the data that have been collected in a survey or experiment and making deductions and inferences. It involves uncovering underlying structures, extracting important variables, detecting any anomalies and testing any underlying assumptions. Qualitative data such as the one captured with document checklist was read and interpreted in line with the objectives. The rest of the data was statistically analyzed. The aim of statistical analysis was to determine the respondents view on the respective study variables, to present the EMR implementation situation, to look for relationships and patterns among the study variables. The analysis adopted an exploratory approach with an aim of answering the research questions. Exploratory models for data analysis were formulated from the research questions to ensure that reliable outcomes were achieved. To enhance analysis, Microsoft excel package was employed for data cleaning, coding, statistical computations and measurements, and charting. Descriptive statistics such as frequency and percentage tables, pie

charts and bar graphs are used in this research to allow for easy interpretation, and conclusion of the findings.

CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

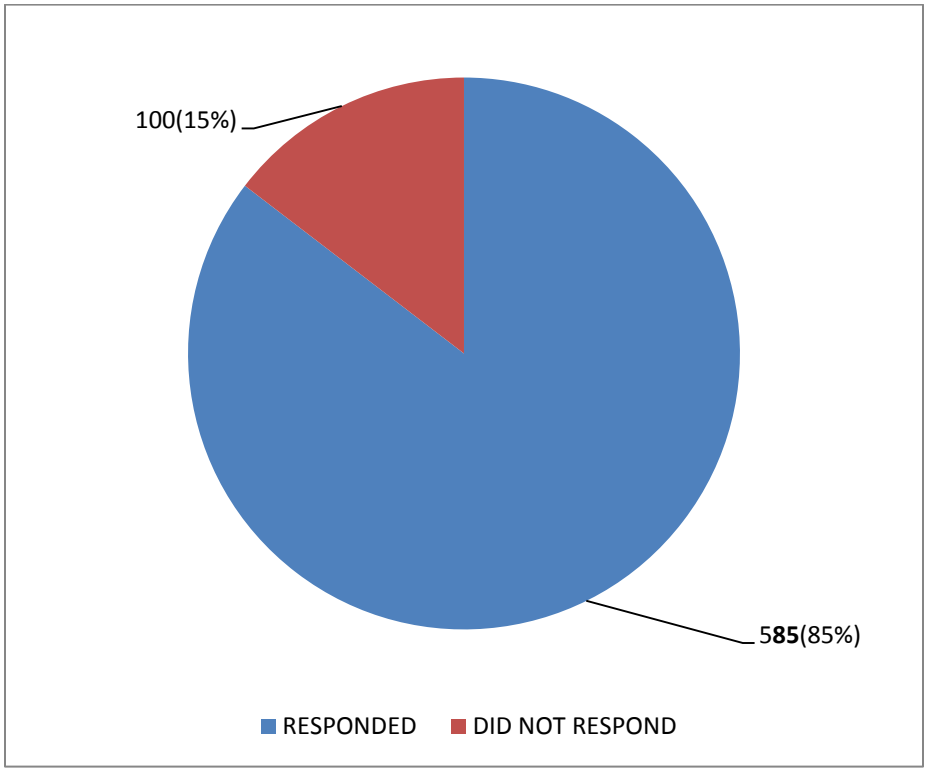
4.1 Introduction

This chapter presents the findings, interpretations and discussion in line with the objectives of the study. Analysis and interpretation of data is concentrated on EMR pre-implementation, implementation and post-implementation stages and zooms in into these stages by looking at the methodologies being applied, the impact of EMR, challenges being faced, existing opportunities, and the EMR ability to generate authentic medical records. Data is presented in form of charts and tables for ease of follow-up and understanding.

4.2 Response Rate

The response rate from each of the selected hospitals ranged between 68-100%. Out of the 8 selected public hospitals, one had a response of 100%, two returned a response of above92-99%, three were between 80-90% while two were between 68 -78%. The response for each staff category namely doctors, nurses, health information officers, and strategic managers was above 80%. The overall response rate in shown in Figure 4.1 below.

Figure 4.1: Overall Response Rate



Source: Research data

While we should not expect full response in studies where responding is voluntary, scholars utilizing questionnaires should aim for a high response rate (Baruch & Holtom, 2008). Baruch and Holton (2008) in their research on response rate covering more than 100,000 published researches with over 400,000 individual respondents, found an average response rate of 52.7% (Rogelberg & Stanton, 2008) which means the response rate for this research is within acceptable limits.

4.3 Existing EMRs and hospitals Background Information

A total of 20 strategic managers were purposefully selected to supply EMR background information on the selected health facilities. The information sought included facility classification, clinical service provided, number of staff, facilities workload in terms of inpatient and outpatient, EMR modules installed, technologies being used for data capture and management, and EMR funding. Two of the selected hospitals were National referral (level 6), five were provincial (level 5), while one was district (level 4) . The services provided in most of the hospitals were accident and emergencies, paediatric, consultants clinics, comprehensive care clinics for HIV patients, Obs/Gynae, medical and surgical. Only the two referral hospitals were providing Intensive Care, renal dialysis and Cancer treatment. The bed capacity in the selected hospitals ranged from 260 to 1800. This information was considered essential for reliable data analysis and interpretation especially on impact of EMR to healthcare services, and in the identification of the support being provided by the facility management. See table 4.1 for details

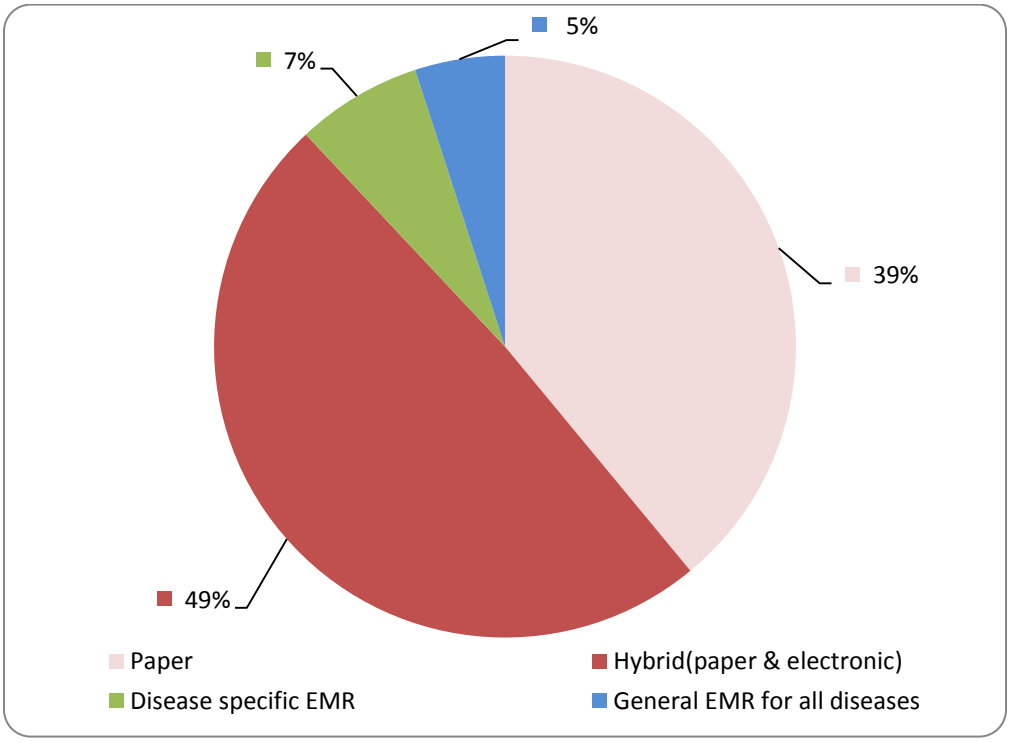
Table 4.1: Health facility level, size and general workload

HEALTH FACILITY NAME	FACILITY LEVEL	TOTAL NUMBER OF STAFF	TOTAL NUMBER OF BEDS	NUMBER OF OUTPATIENTS PER DAY	NUMBER OF ADMISSIONS PER DAY
KNH	6	4600	1800	2000	200
MTRH	6	3500	738	450	120
NAKURU PGH	5	860	476	380	40
NAIVASHA DISTRICT HOSP	4	250	280	250	30
THIKA LEVEL5	5	261	265	280	30
NYERI PGH	5	540	366	350	30
EMBU PGH	5	485	574	340	40
MERU LEVEL 5	5	370	325	100	20

Source: Research data

The medical records systems being used in all the selected hospitals, include hybrid (paper and electronic), paper only, disease specific, and general EMR. Fourty nine percent of the respondents comprising of doctors, nurses and health information officers confirmed combined use of paper and electronic systems. A significant number of respondents (39%) confirmed usage of paper alone in some areas of the facilities. Low utilization of disease specific and general EMR was reported. Figure 4.2 provide more details.

Figure 4.2: Users Categorization of the Existing Medical Records Systems



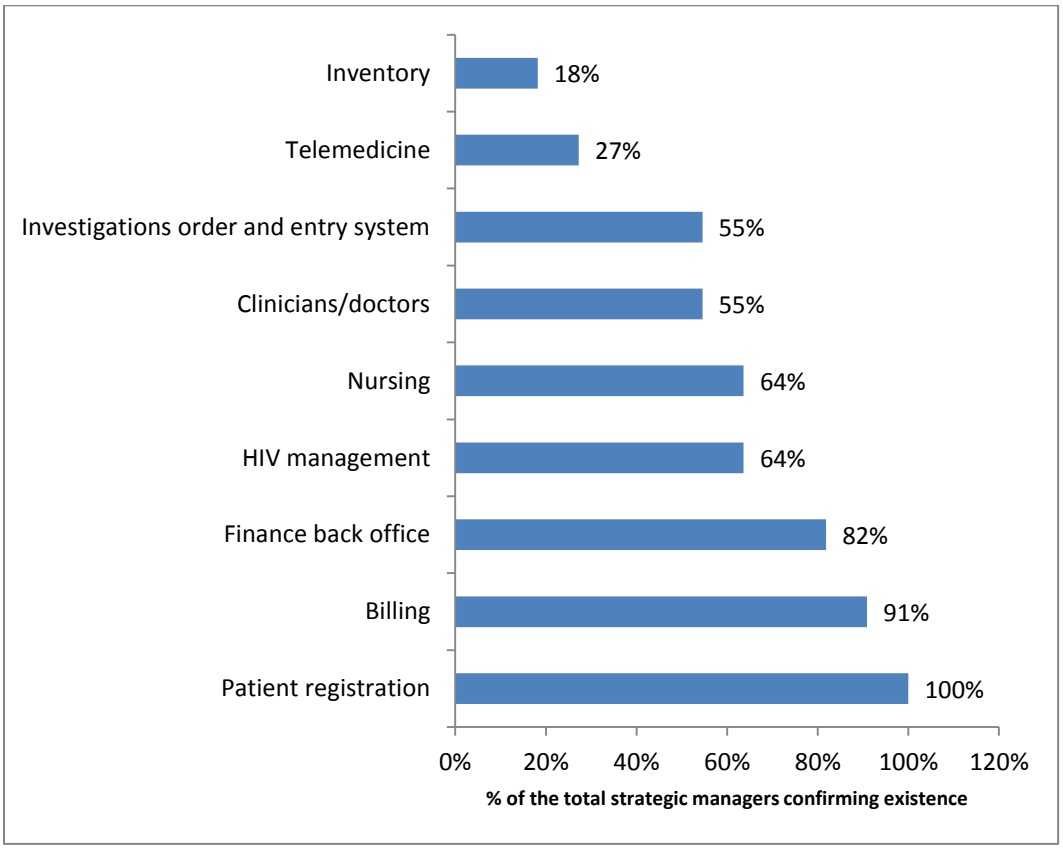
Source: Research data

4.3.1 Existing EMR Modules

Over 80% of the strategic managers confirmed existence of patient registration, billing and finance back office modules while slightly over 60% confirmed existence of HIV management and nursing modules. About 50% confirmed existence of Doctors and investigations order and entry modules while only about 20% confirmed existence of telemedicine and inventory module (see figure 4.3). This is an indication that most of the facilities are focusing more on patient

registration and bill capture while moderate attention has been given to immediate patient care needs and documentation of clinical data.

Figure 4.3: Existing EMR Modules

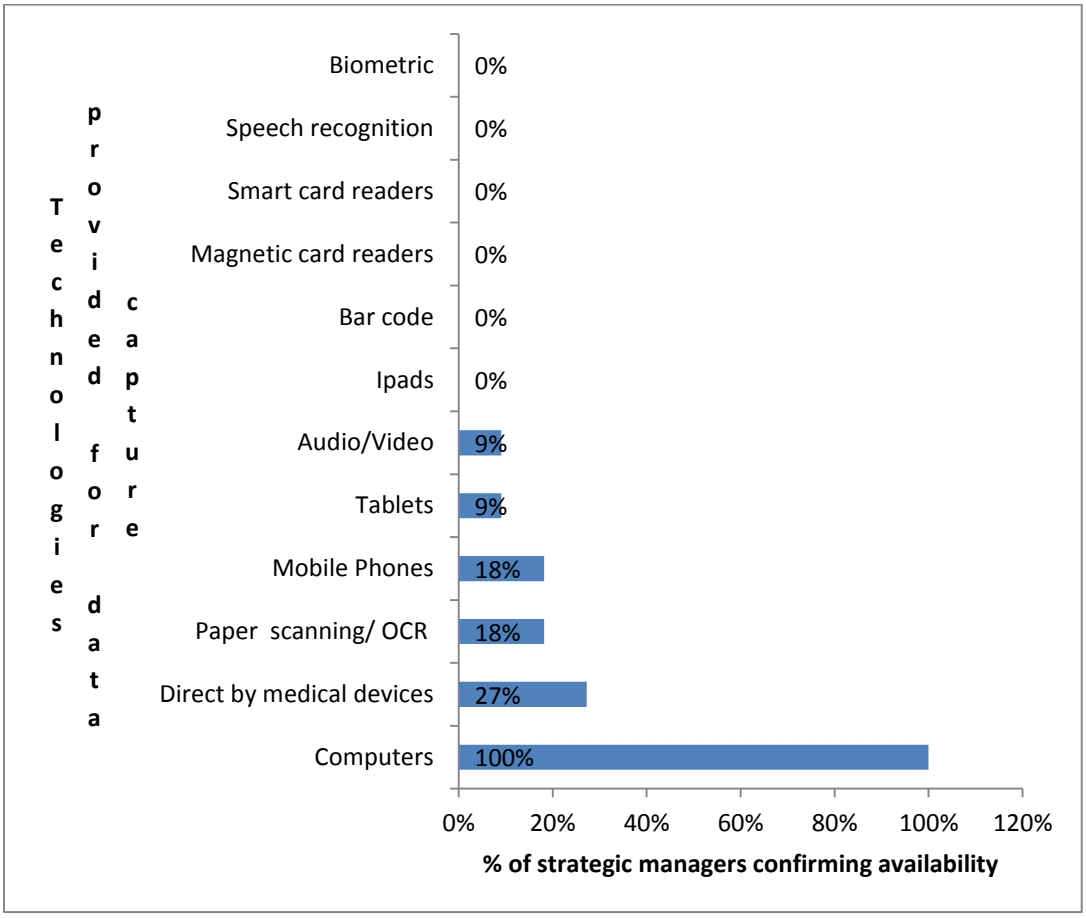


Source: Research data

4.3.2 Technologies and Equipment Provided for Information Management

Apart from computers, most of the modern digital technologies are rarely used in the hospitals. Low level of computer compatible medical devices was observed as indicated by the (27%) of strategic managers who confirmed direct data capture by medical devices. Only eighteen percent of the strategic managers confirmed use of paper scanning meaning that digitization of the existing paper medical records is yet to penetrate public hospitals. Technologies such as tablets, audio, video, ipads, bar code, magnetic readers, smart card readers and biometric have not been procured by the hospitals. This is likely to affect impact on ease of use of the existing EMR. The prevalence of the technologies is indicated in figure 4.4.

Figure 4.4: Technologies Provided for Information capture and management



Source: Research data

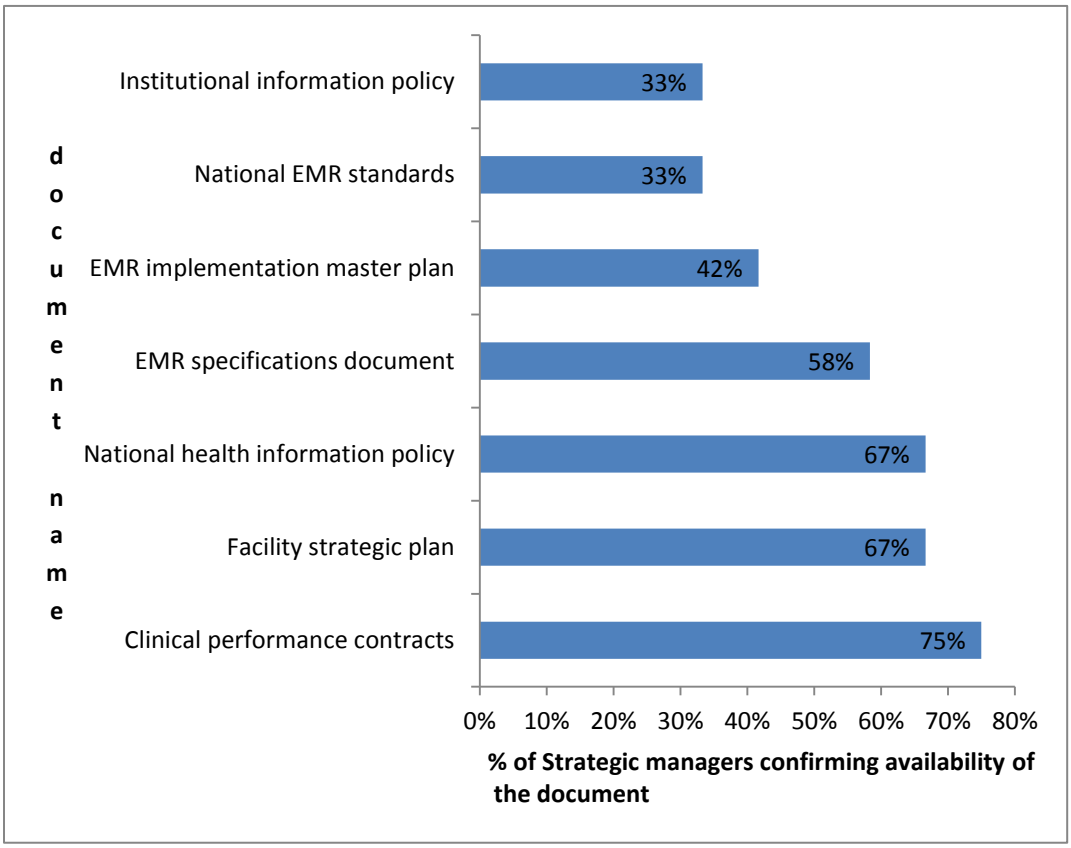
4.4 EMR implementation methodologies

In the area of implementation methodologies, the study focused on initial pre-implementation planning, availability of vital strategic document, funding, user involvement, and information management strategies. The findings are presented in the following sections.

4.4.1 EMR Pre-implementation Strategies and Planning.

The importance of an EMR strategy as put by Pollack (2010) is to ensure that technology activities are properly aligned with the evolving needs and strategies of the health facilities. To identify the strategic efforts being made by the facilities, this research sought to know whether there was existence of the tabulated strategic documents. Majority of the strategic managers in the selected facilities confirmed the existence of vital strategic documents. Existence of the National EMR standards and Institutional information policy were rated low at 33% meaning that the impact of the standards in EMR implementation is yet to be realised. See Figure 4.5 below

Figure 4.5: Availability of vital strategic documents



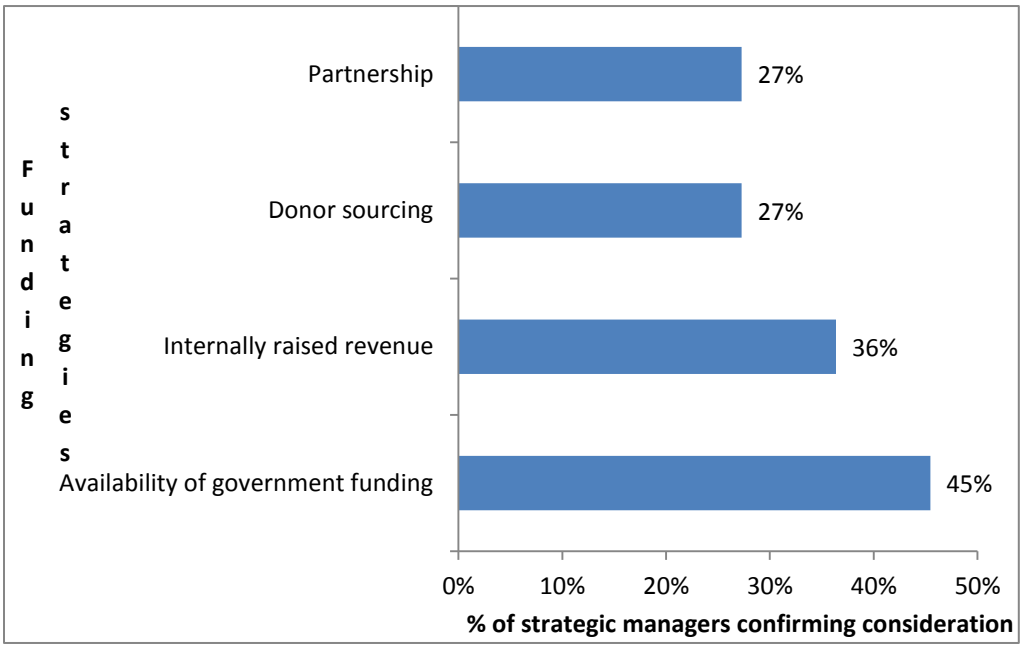
Source: Research data

4.4.2 EMR Funding Planning

According to the Ministry of Health strategic plan (2009-2014) EMR implementation is an expensive affair. Heidenreich (2008), reports that funding continues to be a problem in most countries due to the significant cost of implementing EMR. He further advices that facilities should have a multi-

dimensional strategy for EMR funding to ensure success. To probe funding strategies, this research focused on partnerships, donor sourcing, internal revenue and government funding. See Figure 4.6

Figure 4.6: Strategic Managers Response on EMR Funding Strategies



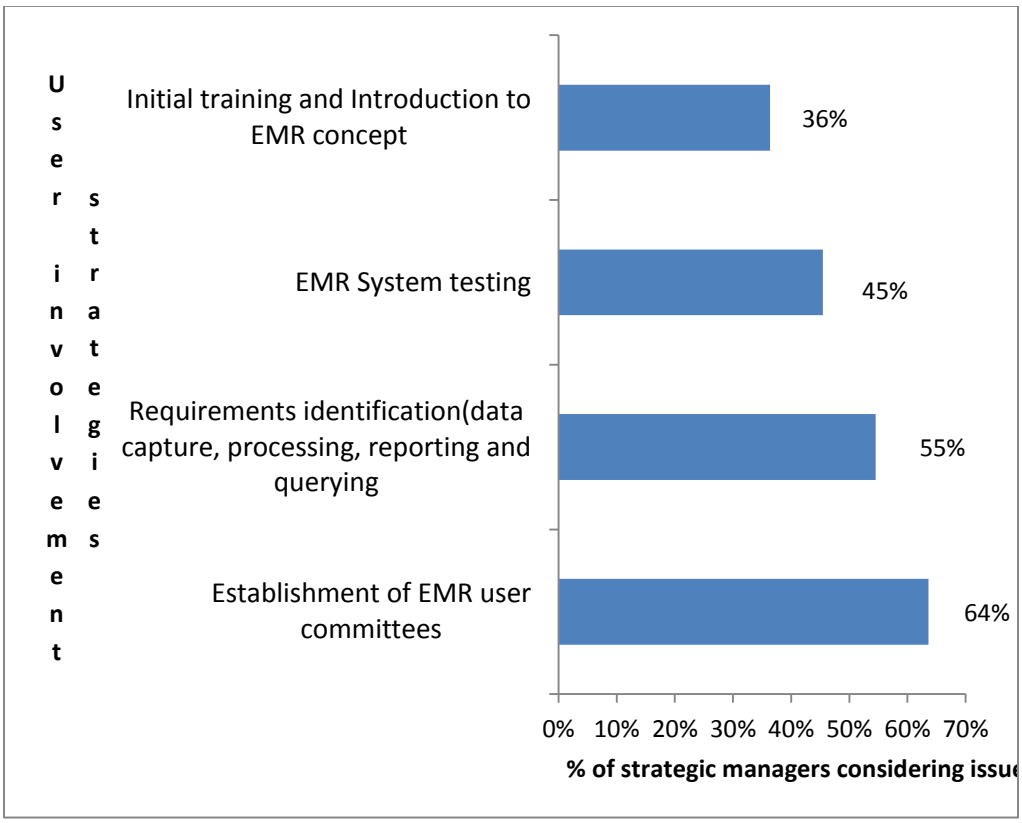
Source: Research data

Most of the strategic managers confirmed overreliance on government funds while less than 30% indicated lack of donor sourcing and partnership. Considering that funding remains one of the major constraint in healthcare, the trend seen in the public hospitals is likely to affect sustainability of the EMRs.

4.4.3 User involvement strategies

To gather data on whether strategic managers were considering user involvement strategies, the managers were asked to rate consideration of various involvement issues in a scale ranging from not considered, slightly considered to highly considered. The respondents who confirmed that they did not consider or slightly involved users were grouped together and termed as those who did not consider user involvement. The rest of the respondents are the ones who considered user involvement. Majority of the strategic managers (64%) confirmed establishment of user committees and user involvement in requirements identification. A small number of managers (36%) confirmed initial training of users and sensitization on EMR. This means that the majority of strategic managers (64%) are not considering training and sensitization of users on EMR and this is likely to impact on EMR acceptability and use. Only fourty five percent confirmed consideration of EMR testing which means that the existing EMRs were not adequately tested. See figure 4.7 for more details on user involvement strategies.

Figure 4.7: Strategic Managers Responses on User Involvement strategies



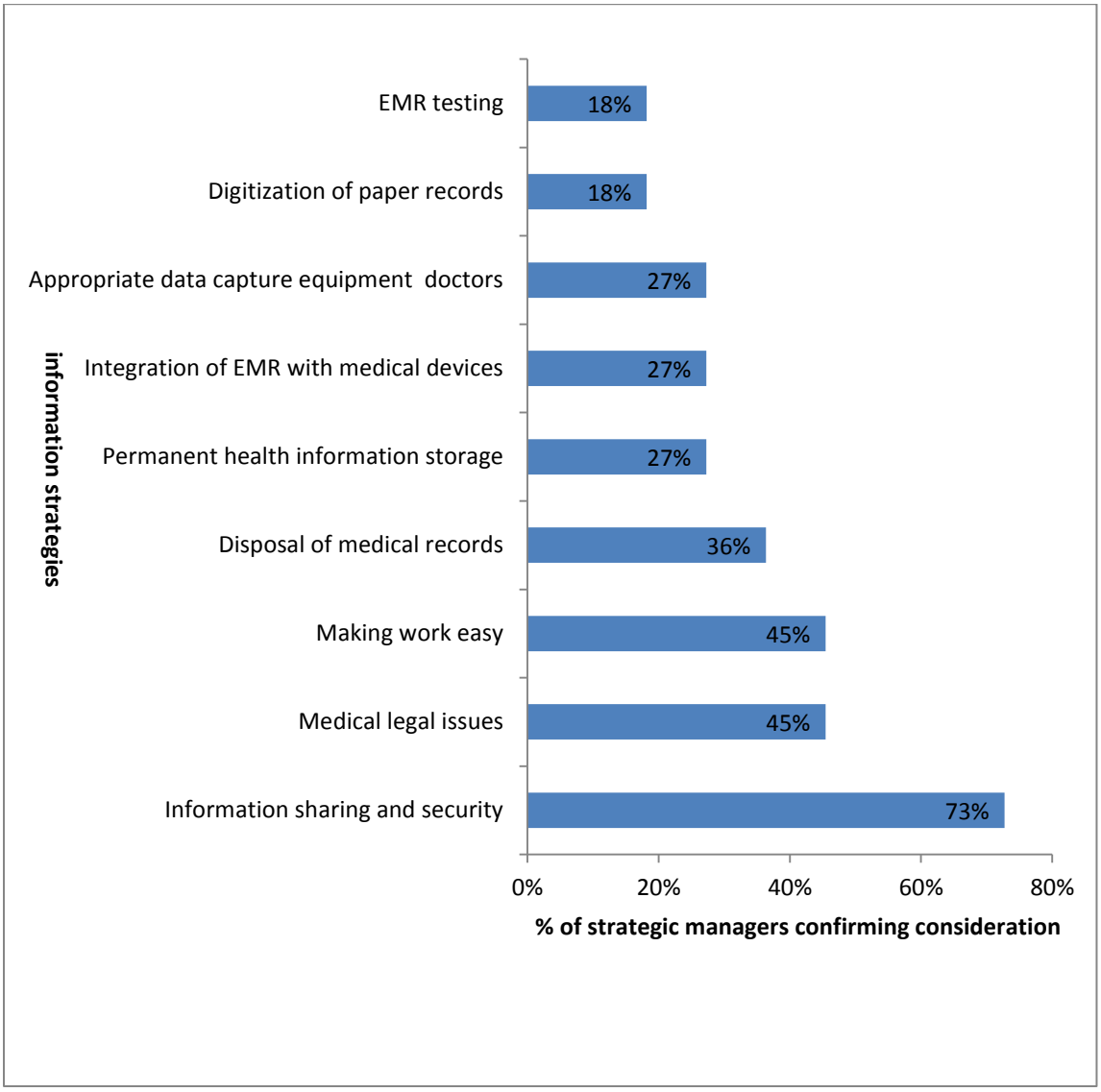
Source: Research data

4.4.4 Information Management Strategic Issues

Electronic Medical Record, as Luo (2006) affirms is more than an electronic version of the paper-based record because a computer-based system is required for managing and delivering data required for patient care. Such a system should provide an integrated view of patient data, clinical decision support, clinician order

entry, integrated communications support, and access to knowledge resources. Besides information sharing and access, American Health Information Management Association (AHIMA), advices that a medical record must be authentic to be trusted as evidence. To achieve this purpose a good records keeping as envisioned in the ministry of health strategic plan is mandatory. To gather data on information management, strategic managers were asked whether they considered the information strategies listed below during EMR planning. Majority of the strategic managers (73%) indicated consideration of information sharing and security in their responses. A significant number considered legal issues while disposal of medical records, permanent retention, and integration of EMR with medical devices received the lowest consideration (See figure 4.8). The low consideration of medical records management function implies low consideration of the EMRs as records management systems.

Figure 4.8: Percentage of Strategic Managers Considering Information Strategies



Source: Research data

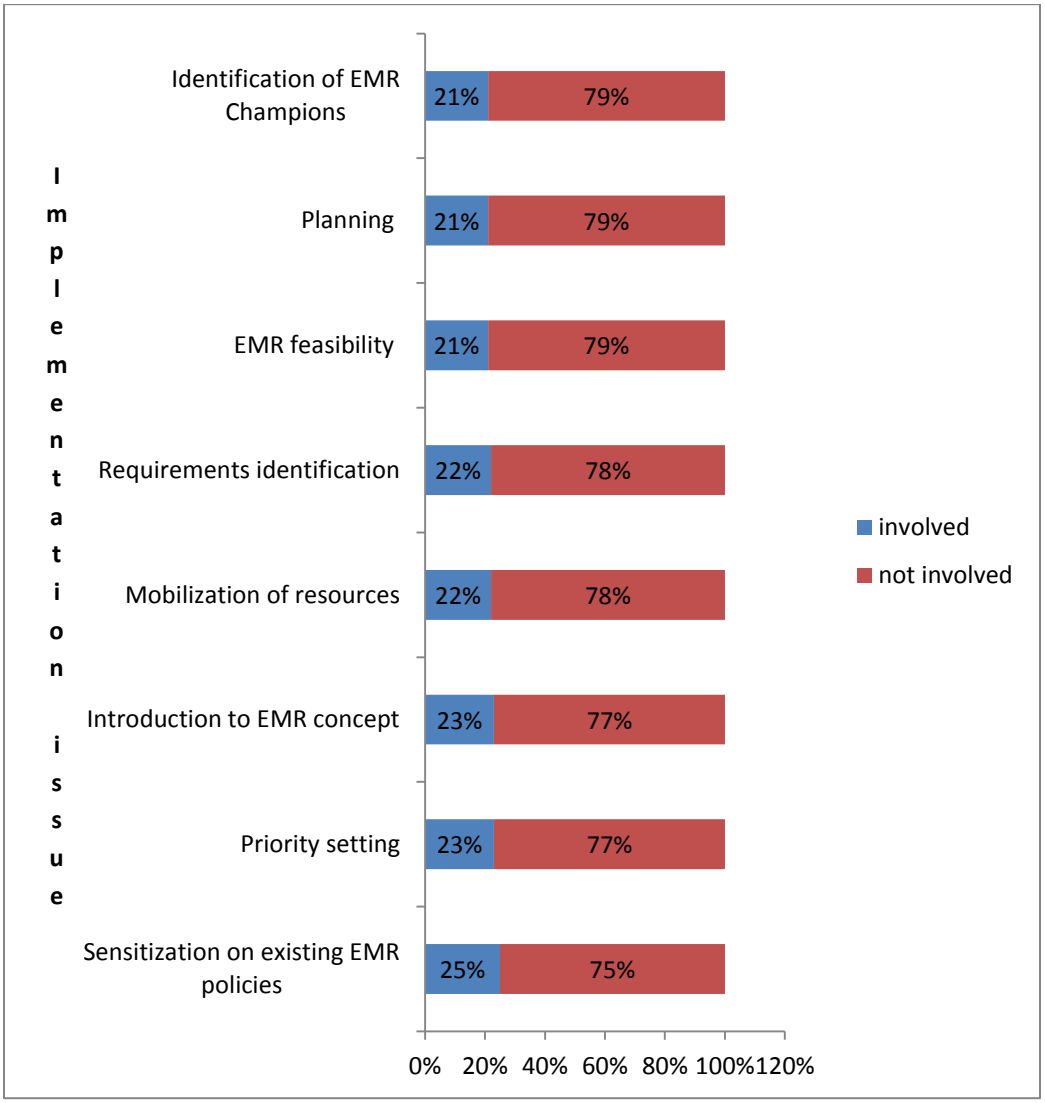
4.5 EMR Implementation

EMR implementation as Rogers (2003) puts it, is the stage at which the pre-planned activities are activated. Lorenzi et al (2009) opines that implementation experience depends on a variety of factors including the technology, training, leadership, the change management process, and the individual character of the healthcare practice environment. Successful implementation calls for intensive user involvement in all stages of implementation.

4.5.1 Actual User Involvement

To gauge the level of EMR user involvement in all the selected hospitals, doctors, nurses and health information officers were asked to indicate the level at which they were involved using a scale of involved, slightly involved, moderately involved and fully involved. The responses for not involved and slightly involved were combined together and treated as not involved while responses for moderately involved and fully involved were combined to mean involved. Over 75% of the565 users who responded on this issue indicated no involvement in the implementation process. Only about 20% of the users confirmed involvement. The low involvement reported by the actual EMR users indicate that the user involvement strategies by hospital management are either not effective or not implemented adequately (See figure 4.9).

Figure 4.9: Actual user Involvement in EMR Planning and Resource Mobilization



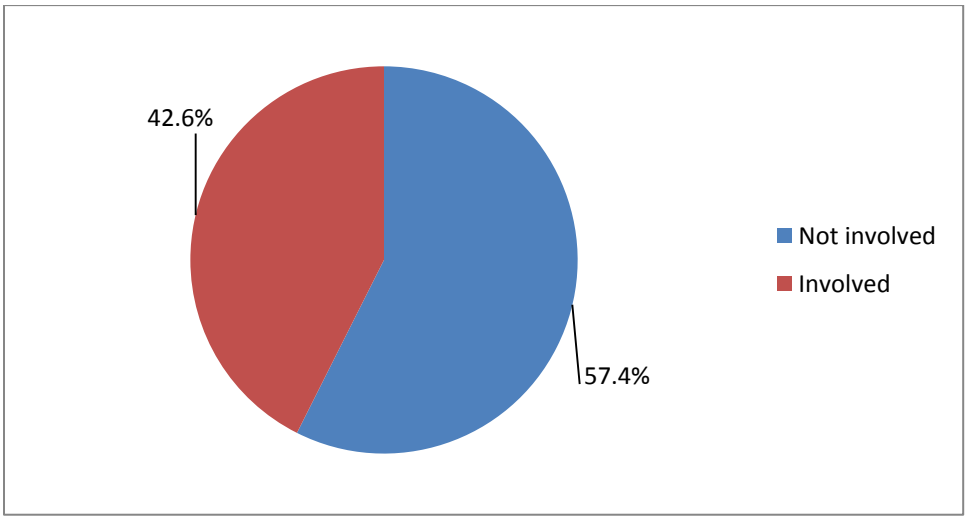
Source: Research data

Although strategic managers had confirmed having strategized for user involvement, from the EMR user perspective, involvement is largely lacking. Hoerbst (2010) advises that because EMR users demands for functionalities that would benefit them, they should be appropriately involved in EMR implementation and workflow change processes.

4.5.2 User involvement in selection of EMR technology

EMR technology covers treatment data capture, data processing, storage and retrieval, and dissemination. Such technology include automated data capture systems, software, networks and communication devices. On this issue, majority of the respondents (57.4%) indicated lack of involvement (See figure 4.10)

Figure 4.10: User Involvement in Choice of EMR Technology

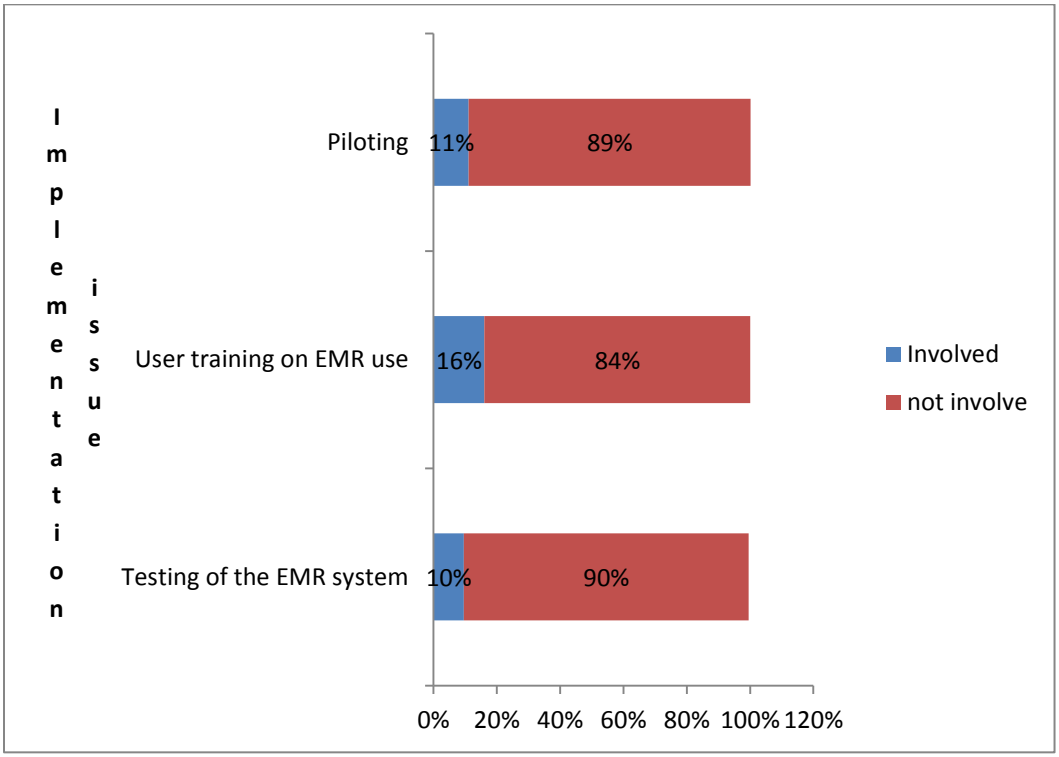


Source: Research data

4.5.3 User Involvement in EMR Testing, Piloting and Training

To gauge the level of involvement in this issue, the respondents were asked to indicate on a scale of not involved at all, slightly involved, moderately involved and fully involved. Responses for moderate and fully involved were interpretated as involved while the rest were combined to represent lack of involvement. Majority of the respondents indicated lack of involvement in piloting, user training on EMR use and testing while the percentage of those involved in the same issues ranged between 10-15% (See figure 4.11).

Figure 4.11: Users Involvement in Piloting, Training and Testing of EMR

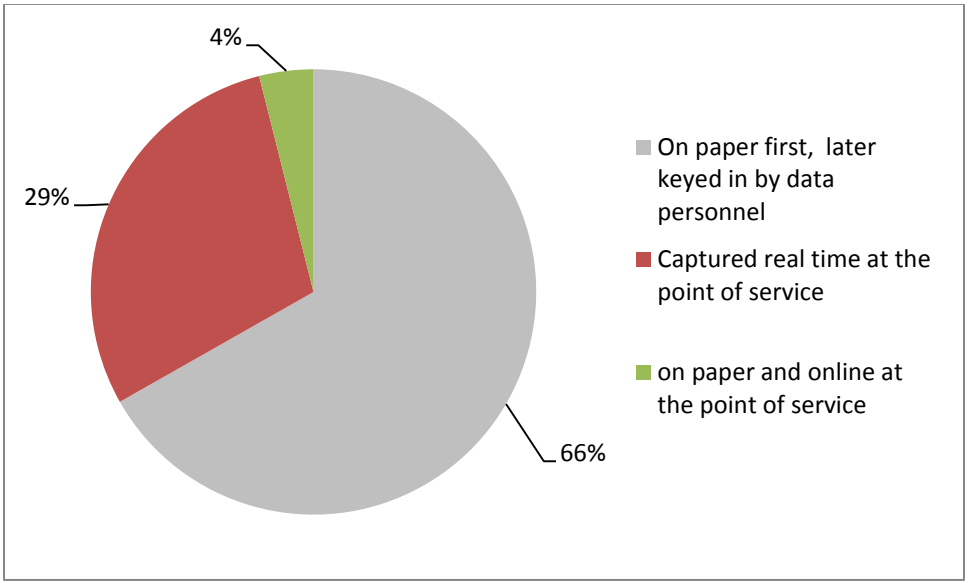


Source: Research data

4.5.4 Data Capture Methods Being Used

The data capture methods being used in the hospitals include capture on paper first and later transfer to computer system, real time electronic capture at the point of service, and on paper and online at the point of service. Majority of the respondents (66%) confirmed capture on paper first and transfer to electronic. Very little point of service data capture was reported. Lack of point of service data, is likely to contribute to lack of timely follow-up information especially when a patient revisit the hospital before the previous episode is captured. Figure 4.12 provide details

Figure 4.12: Methods of EMR Data Capture

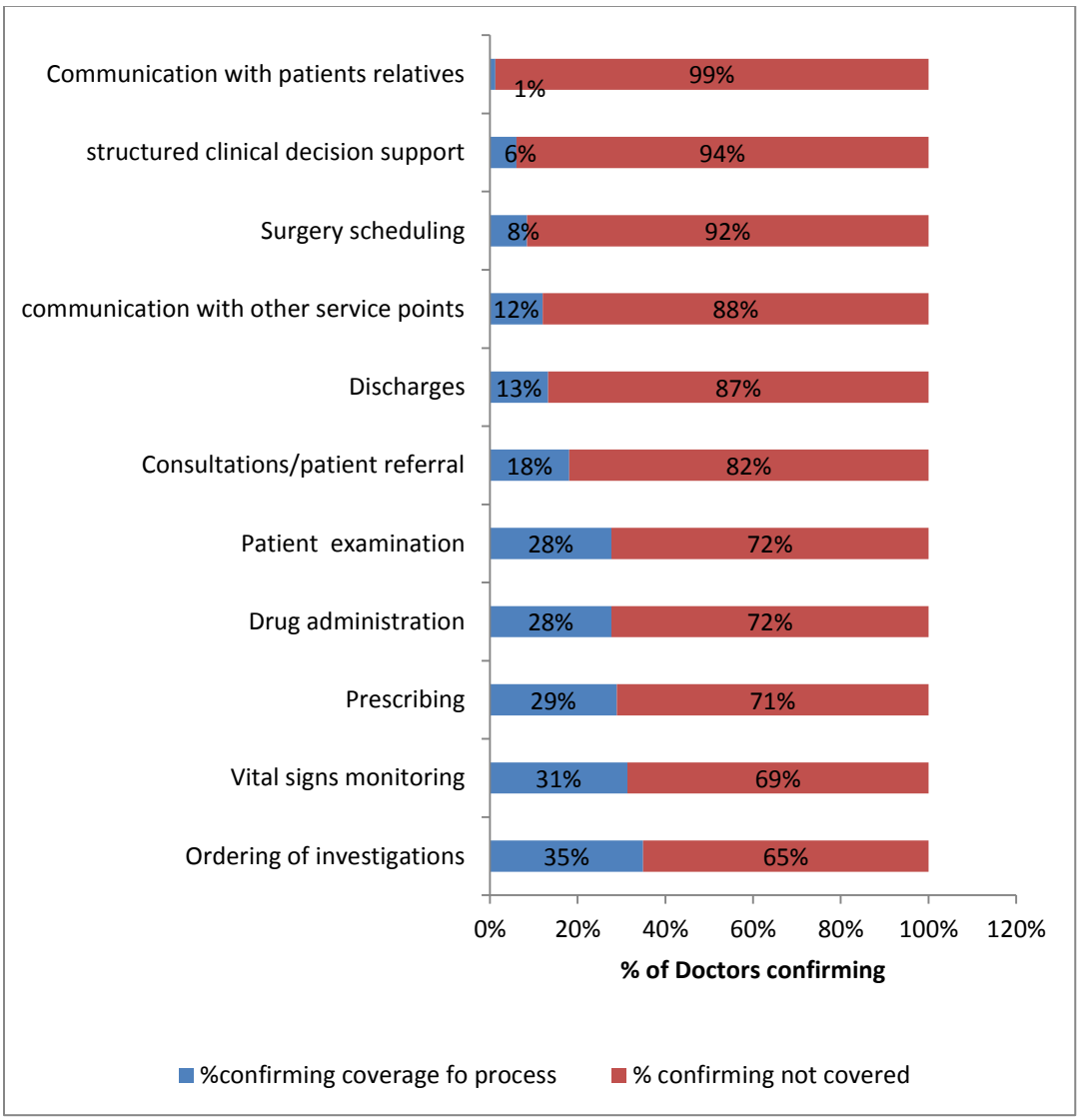


Source: Research data

4.5.5 EMR coverage of Doctors Processes and Documentation

To gauge the extent to which the implemented EMRs cover clinical processes performed by the doctors, doctors were asked to select automated clinical processes from a pre-prepared list. The list contained processes such as vital signs monitoring, patient examination, ordering of investigations, drug administration, and surgery scheduling among others. Over 70% indicated no coverage meaning that the uptake of EMR by medics is low (see figure 4.13). Keshavjee et al (2006) argues that for EMR to have a direct impact on immediate patient care needs, a minimum data set must be defined, system reminder methods for clinicians must be designed and agreed upon, and a good system infrastructure must be put in place. Such an approach is likely to impact positively on EMR uptake. The low uptake indicate a disconnect between installation of EMR modules earlier confirmed by strategic managers and actual usage by the targeted users.

Figure 4.13: EMR Coverage of doctors processes

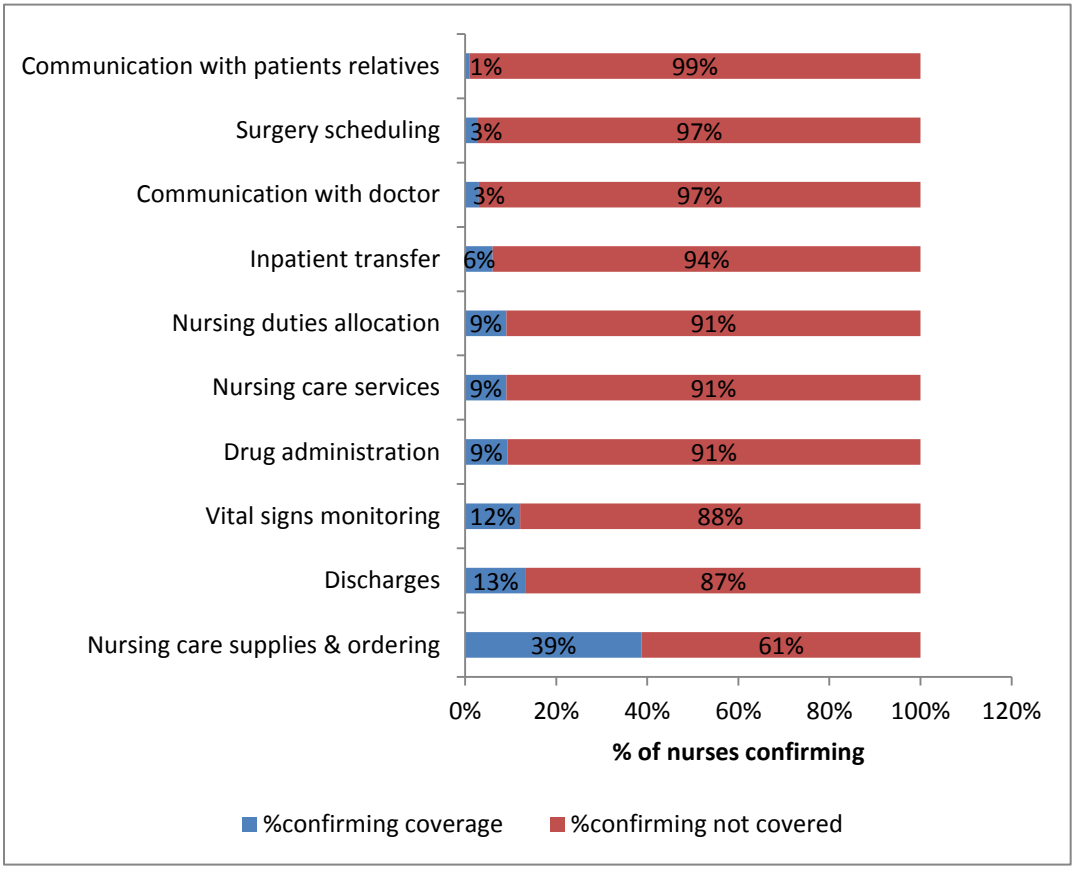


Source: Research data

4.5.6 EMR Coverage of Nurses Processes

To gauge the extent to which EMRs covered nursing processes, nurses were asked to select automated nursing processes from a pre-prepared list containing items such as vital signs, communication with doctor, inpatient transfer, nursing care services, and nursing duty allocation among others. Majority of the nurses catering for over 87% indicated no coverage meaning that EMR uptake is also low in nursing. A significant number of nurses indicated EMR ability to provide information on nursing supplies (See figure 4.14). The low coverage could be attributed to lack of user involvement reported earlier in this report

Figure 4.14: EMR coverage of nursing processes



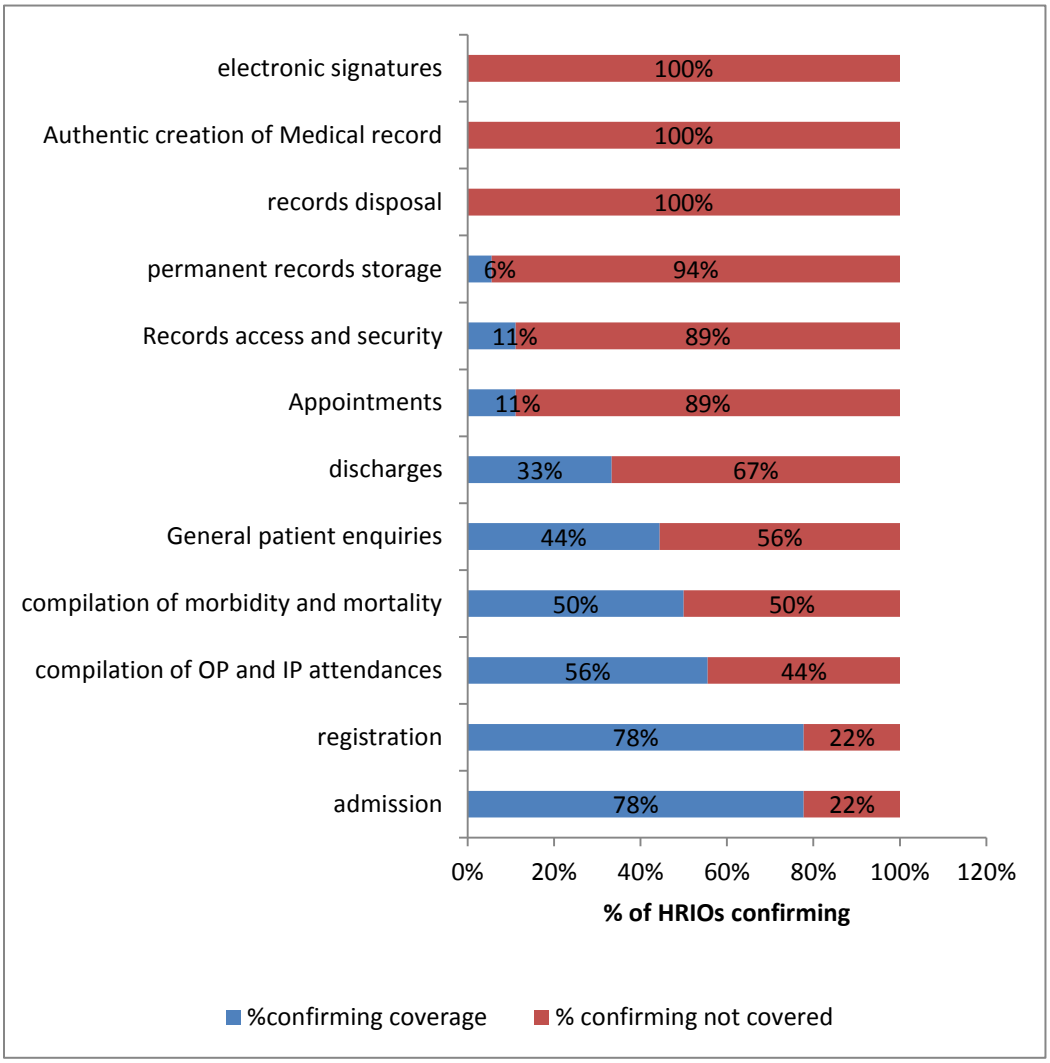
Source: Research data

4.5.7 EMR Coverage of health records and information management processes

According to Mann (2003), the importance of an EMR is seen in its ability to serve as the primary repository of all information regarding patient care, provide decision-support, and be a tool for supporting and maintaining ancillary health care activities such as administration, medical legal support, quality assurance, research

and epidemiology. To assess the extent to which the installed EMR covers health information management processes, the selected health information officers were asked to pick automated processes from a pre-prepared list of issues such as use of electronic signatures, authentic creation of medical records, records disposal, security, compilation of medical statistics, and appointment scheduling among others. About 50% confirmed coverage of patient registration and compilation of attendance statistics. Majority of the respondents ranging between 50-100% indicated no coverage of electronic signatures, authentic creation of medical records, permanent storage and disposal (See figure 4.15). Lack of coverage in this area implies that the existing EMR cannot provide reliable medical legal evidence.

Figure 4.15: EMR coverage of Health Records and Information Management Processes



Source: Researcher data

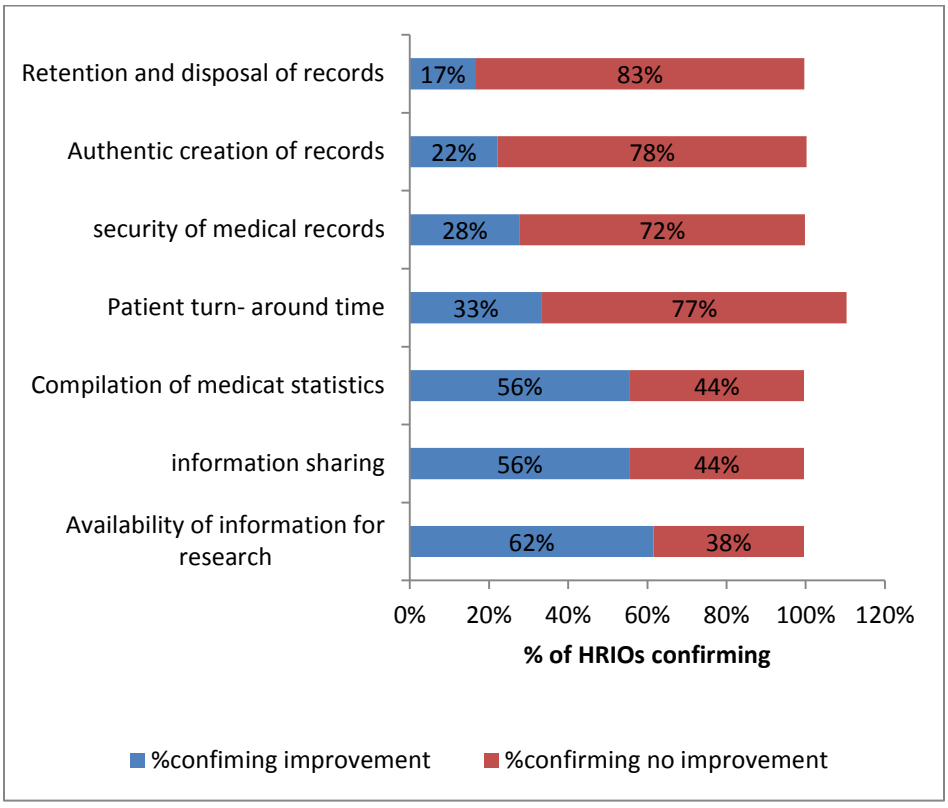
4.6 EMR Post Implementation Stage

In post-implementation, the study focused on EMR impact on health information services, doctors processes, and nursing processes. The findings in this area are presented in the following sections.

4.6.1 EMR Impact on Health Information Services

To gauge the impact of EMR on health information services, 18 health information officers distributed in the selected hospitals were asked to confirm whether they have noted improvement in various areas of information management. Most of the HIOs catering for 56% of this category reported improvement in information sharing, compilation and reporting of medical statistics, and availability of information for research. Other areas of information management such as retention and disposal of medical records, authenticity of medical records, security and turn-around time for patients were rated below 28% meaning that EMR has not impacted well in the areas. The details on ratings are provided in figure 4.16 below.

Figure 4.16: HRIOs Ratings on EMR Performance on Health Information Management



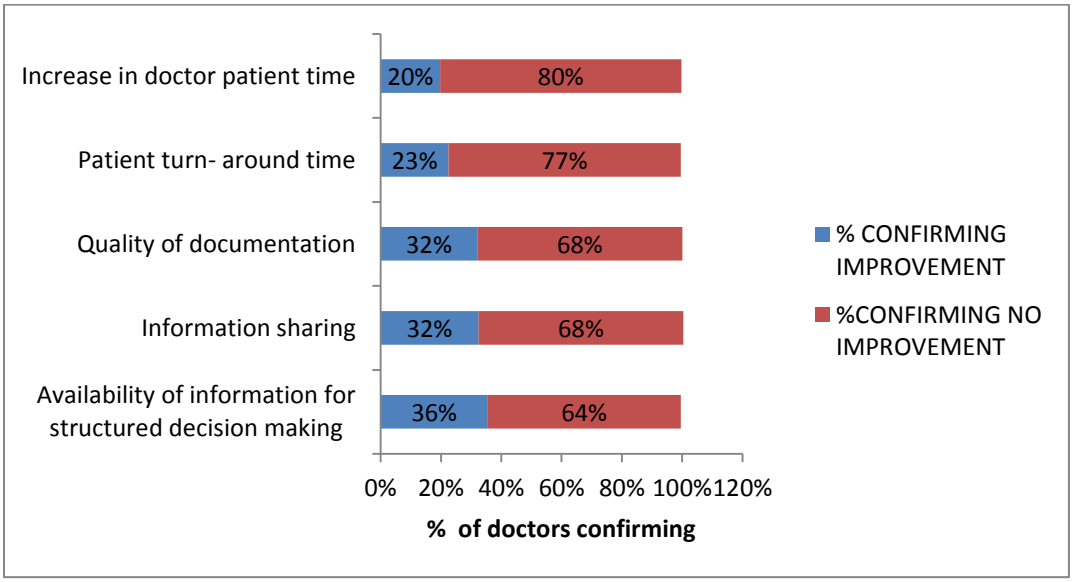
Source: Research data

4.6.2 EMR Impact on Doctors Processes

To gauge the impact of EMR on doctors' processes, doctors were asked to rate the EMR performance in terms of increase in doctor patient time, patient turn - around time, quality of documentation, information sharing with other health professional,

and availability of information for decision support in patient care. Out of the 83 doctors who responded on these issues, only a small percentage ranging between 20-36% indicated improvement. Majority of the doctors (over 64%) reported that use of EMR had not improved the issues enumerated above (See figure 4.17).

Figure 4.17: Doctors Ratings on EMR Performance



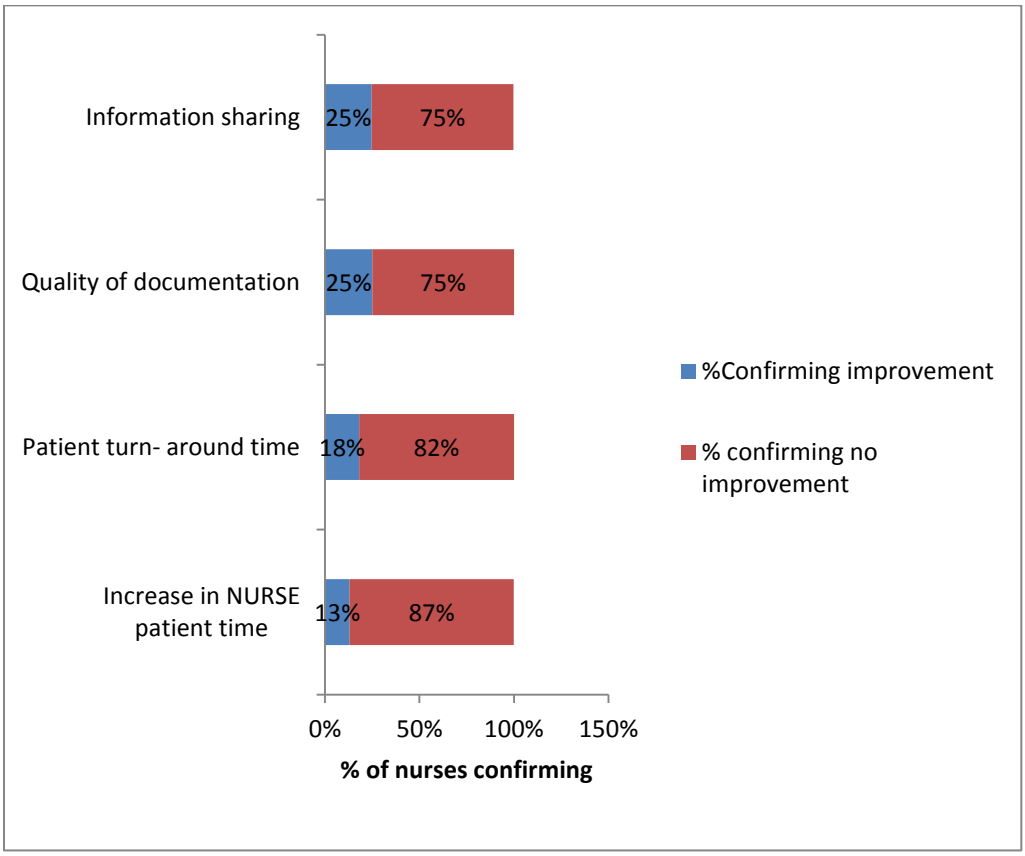
Source: Research data

4.6.3 EMR impact on Nursing processes

The performance of EMR on nursing processes was rated in terms of information sharing with other health professionals, quality of documentation, patient turn-around time in nursing services, and increase in nurse patient time. The ratings on

these issues were between13-25% meaning that majority of the nurses (over 70%) have not noted any improvement(see figure 4.18).

Figure 4.18: EMR Impact on Nursing Processes



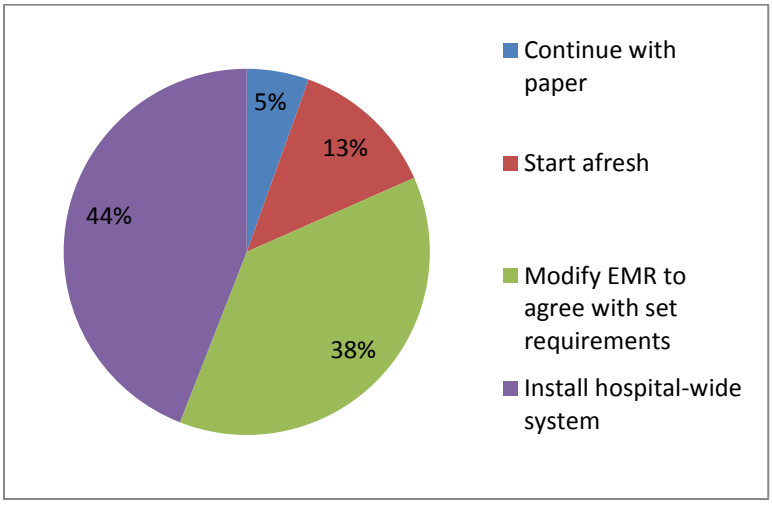
Source: Research data

4.7 EMR Opportunities and Challenges

4.7.1 Recommended Way Forward

In the determination of opportunities for EMR continuity in the selected hospitals, the respondents were asked to recommend the way forward in terms of installation of Hospital wide EMR, modification of the existing EMR, starting the implementation process afresh, and continue with paper. Fourty four (44%) of the 566 EMR users who responded to this issue wanted a hospital wide EMR system while 38% felt that the existing EMR should be modified to agree with their requirements meaning that the EMR agenda in public hospitals has a future. An insignificant number of the respondents (5%) felt that the hospitals should continue with paper (see figure 4.19 for details)

Figure 4.19: Recommended Way Forward for Existing EMRs.

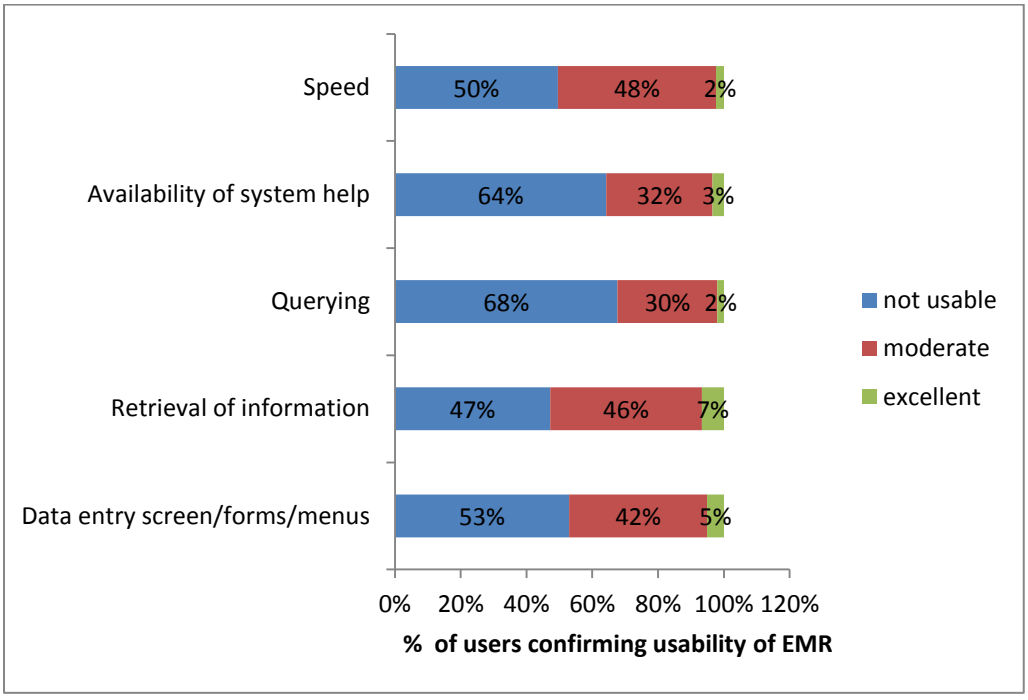


Source: Research data

4.7.2 Usability of EMR

To determine whether there were usability challenges, all the respondents, doctors, nurses, and health records and information officers were asked to comment on EMR speed, systems help, querying, retrieval of information and screens. The responses were rated on a scale of not usable, moderately usable and excellent. Majority of the respondents representing over 64% were not happy with usability of EMR while the rest returned moderate and excellent usability of EMRs (See figure 4.20). The low EMR usability could be attributed to inadequate user training and involvement. This means that more work needs to be done to improve usability of the existing EMRs.

Figure 4.20: Usability of the installed EMRs

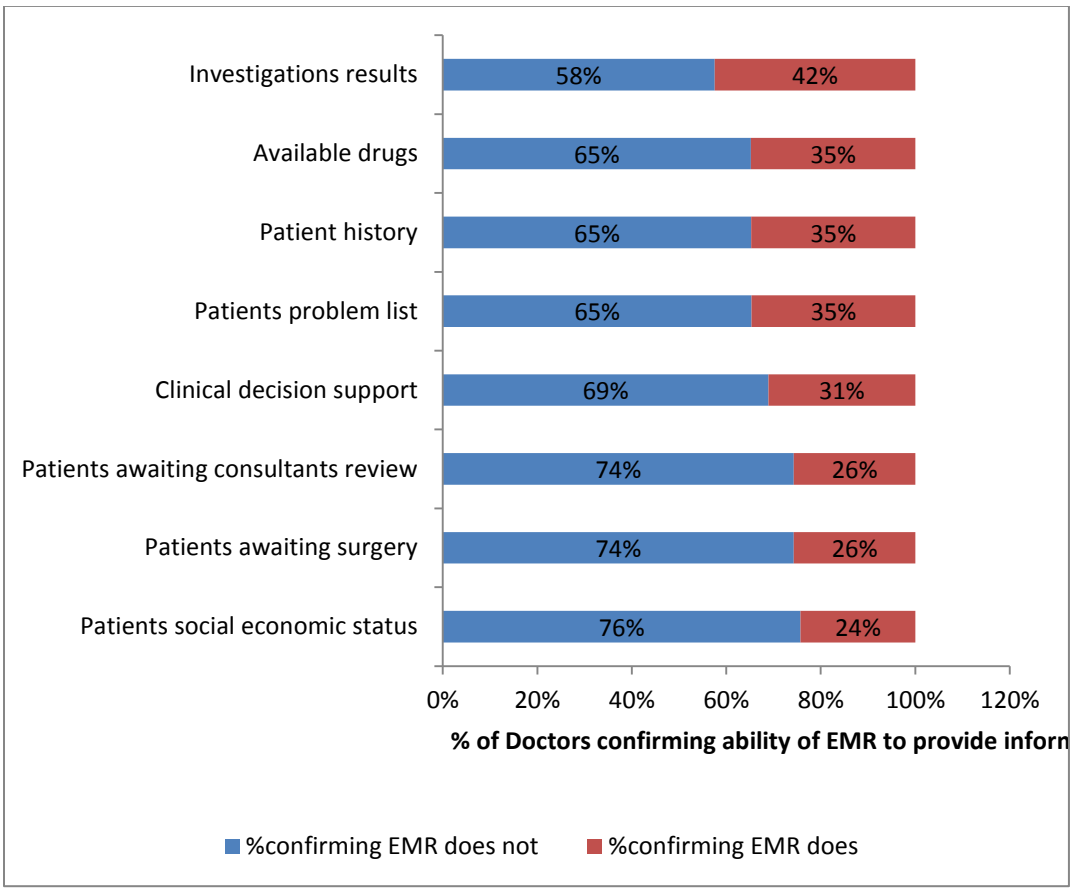


Source: Research data

4.7.3 EMR ability to Provide Clinical Information to Doctors

According to Safran & Goldberg (2000) EMR carries a great potential in healthcare. As a representation of clinical documentation, EMR should allow a collaborative environment that supports workflow, enables new care models and secure access to distributed health data. To assess the challenges that doctors face in this area, doctors were asked to rate the EMRs ability to provide clinical information in on a scale of not applicable, rare, moderate, and extensively. The information items included for selection were investigation results, patients problem list, clinical decision support, available drugs and patient history among others. Majority of the doctors catering for about 70% indicated that EMR does not appropriately provide clinical information meaning that EMR reliability for patient treatment is yet to be realised (See figure 4.21).

Figure 4.21: EMRs Ability to Provide Clinical Information



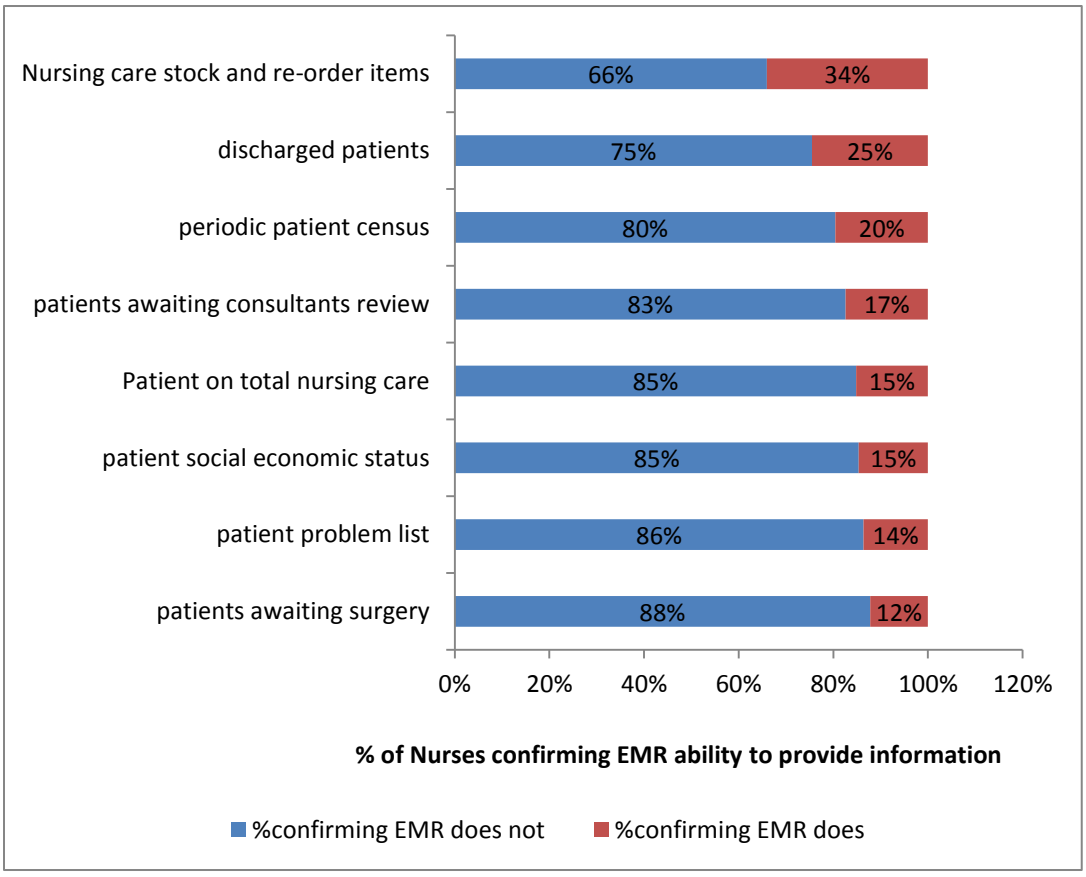
Source: Research data

4.7.4 EMRs Ability to Provide Nursing Care Information

To assess the challenges that nurses face in this area, nurses were asked to rate the EMRs ability to provide vital nursing care information on a scale of rare, moderate and extensively. Responses on rare were treated as inability to provide while the

rest were combined to represent able to provide nursing care information. The information items rated were patients on total nursing care, patient census, discharged patients, and patients awaiting consultants review among others. Majority of the nurses catering for over 80% indicated low reliability of EMR as a source of vital nursing care information. This indicates that the potential of EMR as a source of information is yet to be realized (See figure 4.22).

Figure 4.22: EMR Ability to Provide Vital Nursing Care Information

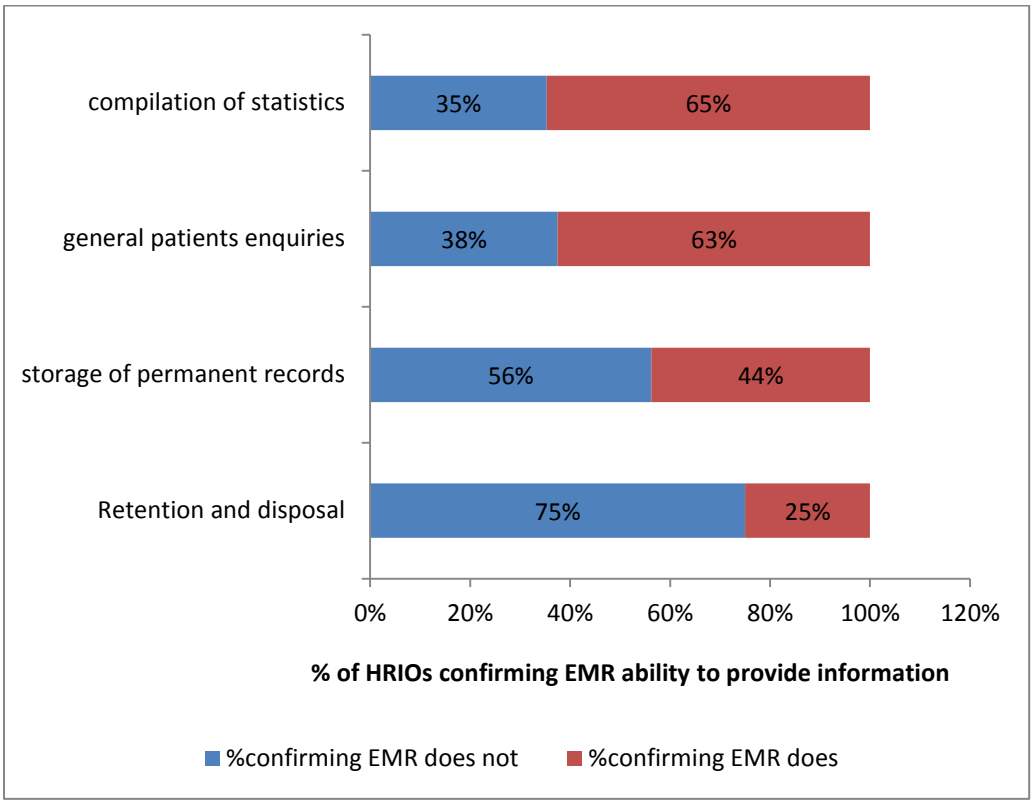


Source: Research data

4.7.5 EMRs Ability to Provide Aministrative Statistics and Support for Records Management

Apart from the primary purpose of supporting treatment and follow-up, medical records irrespective of form are also expected to serve as sources of health administrative statistics for hospital planning and management. Another important use of the medical records is providing authentic evidence to assist in determination of medical legal cases as well as responding to other official enquiries on patient treatment. To identify the challenges faced by health information managers in this area, they were asked to rate the extent to which EMR assist in compiling administrative statistics, general patient enquiries, and records storage and disposal. Over 65% confirmed EMRs ability to compile statistics and support for general enquiries while EMRs ability to store and dispose medical records was rated low by majority of the respondents (See figure 4.23). This means that the potential of EMR as a records management system is yet to be realised.

Figure 4.23: EMRs Ability to Provide Statistics and Support for Records Management Function



Source: Research data

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section provides a summary of the findings in terms of the challenges being encountered within the various stages of EMR implementation. Conclusions on challenges and opportunities for EMR are also presented in chapter. The chapter closes with recommendations for further research and on EMR implementation policy.

5.2 Summary

The efforts being made in the implementation of EMR in Kenyan public hospitals is encouraging. Although there exist various challenges in the operationalization of the EMR systems, feedback from healthcare providers indicated an unstoppable will to move on with EMRs. The challenges and opportunities are summarized below.

In the area of EMR implementation practices, the study noted challenges concerning the planning of activities from pre-implementation, implementation and post-implementation stages. In the planning stage, the key challenges included lack of master plan for EMR, overreliance on limited government funding and low exploration of alternative funding methods for EMR sustainability, low awareness on the existing National EMR standards, lack of information policy at the facility

level, and a disconnect between initial planning by strategic managers and actual activation of the activities. Such a disconnect indicates a gap in user involvement and is likely to negatively impact on the process. These challenges are likely to affect evaluation and monitoring of the EMR implementation process.

Despite confirmation by strategic managers that users were being involved, the actual responses from EMR users indicated user involvement gaps in the EMR preparatory stages, choice of technology for medical data capture and analysis, EMR sensitization, testing and piloting. Such gaps are likely to affect EMR ownership and acceptability levels.

As earlier stated, successful EMR should allow access to the patient record 24 hours a day, prevent medication error by providing decision support, support ongoing education for healthcare professionals, timely and effective care, improved hospital revenue, reduced patient-turn-around time, and sharing of information by authorized people. This potential has not been realized in Kenyan public hospitals. Some of the challenges contributing to this include concurrent operation of manual, hybrid and electronic medical records system meaning that one has to rely on all for patient care and follow-up. Feedback from the respondents indicated no improvement in doctor patient time, nurse patient time, and patient- turn- around time. Feedback from doctors and nurses indicated EMRs inability to provide

information for use during their day to day operations. Lack of such information indicates a gap in the maximization of EMR systems information management opportunities in the hospitals.

The general usability of EMR for querying, availability of system help, and it speed received low ratings from the users. However, user interface screens, and retrieval of information were acceptable by a significant number of users. Although the strategic managers had confirmed installation of clinicians modules, the EMRs coverage of doctors processes, such as monitoring of vital signs, prescription, drug administration was rated low. A similar case was noted with nursing where EMR coverage of nursing processes was also rated low. Feedback from health records and information officers indicated that the EMRs do not cover records management functions such as authentic creation of medical records, electronic signatures, retention and disposal of medical records. These gaps indicate a challenge in the identification of EMR requirements in the respective hospital functional areas.

5.3 Conclusions

Kenyan Public Hospitals face many challenges that are unique to the healthcare providers working there. The importance of the existing electronic medical record systems have at least been recognized despite the challenges being encountered. Appropriate EMR planning, user engagement, monitoring and evaluation of the implementation process will be the first step in making EMR systems workable.

Such plans if well activated at implementation stage will eliminate the problems arising from low user involvement, disconnect between strategic managers and users. Appropriate implementation of EMR plans will also help in ironing out issues surrounding EMR requirements identification, selection of EMR system and technologies, testing and alignment of the system with healthcare goals such as reduction of turn-around time, decision support, improvement of healthcare, creation of reliable and authentic medical records as well as provision for hospital clinical and administrative statistics. Determination of EMR requirements should be guided by the general medical records primary functions of supporting direct patient care and communication and the secondary functions of medico-legal record for clinical audit and research, resource allocation, epidemiology, service planning and , Performance monitoring.

To ensure EMR sustainability, public hospitals may need to build on the existing EMR modules which have already been shown to work, then add only relevant modules to the system depending on their priorities. The hospitals should identify the most appropriate technology for their EMR due to funding challenges or where possible explore other sources of EMR funding. The experiences of these hospitals are an important asset in the determination of the way forward in the EMR journey. More monitoring and sensitization is needed to ensure utilization of the existing National EMR standards by public hospitals.

5.4 Recommendations

Based on the findings of this research, the following are the recommended corrective measure which can contribute to effective implementation of EMRs in public hospitals and thus realize the full potential of EMR in healthcare

5.4.1 Policy Recommendations

I. Adherence to National EMR standards on minimum functional requirements by the hospitals should be enhanced through sensitization at both strategic and operational levels.

II. To achieve the desired EMR outcomes, ownership, and appropriate utilisation, users should be involved in all stages from the preparatory stages of requirements identification, systems design, testing, choice of technology, and implementation.

III. To ensure the privacy of patients, EMRs implementation should adhere to the relevant laws and regulations on disclosure of health information.

IV. For the EMRs to generate authentic and reliable legal medical records, the hospitals should ensure that the EMRs conform to the records management standards on maintenance of documents as evidence.

V. All EMR stakeholders (clinicians, nurses, health information officers, administrators and ICT staff) needs to come together to strategize the inclusion of electronic medical records retention and disposal schedule in

the EMR systems for control of retention for temporary and permanent medical records.

VI. The overall design of EMR should lay more emphasis on improvement of healthcare services. The systems should focus on support for patient treatment and follow-up as well as information for hospital administration and quality monitoring.

5.4.2 Recommendations for further research

I. To ensure EMR cost effectiveness, early corrective and control measures, and realisation of a positive impact on healthcare, a before and after study is recommended in hospitals intending to implement EMR system in Kenya.

II. More research work is needed in the area of EMR system usability, efficiency and acceptability in order to measure accurately the extent to which these systems impact on clinicians patient time.

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APPENDIX I: INTRODUCTORY LETTER TO HEALTH WORKERS

Peter W. Wamae
P. O. Box 10304-00400
Nairobi

Date_____
_

To_____

Name of Health facility_____

RE: COMPLETION OF QUESTIONNAIRE

I am a Ph.D student in the Kenyatta University Department of Health Systems Management and Informatics conducting a research entitled "**Implementation of Electronic Medical Records in Kenya: Challenges and opportunities**". The main objective of the research is to find out the challenges being encountered during **EMR pre-implementation, implementation and post-implementation stages in public hospitals, their impact on healthcare delivery and the existing operational gaps that can be filled by EMR.**Considering the fact that implementation of EMR, in public hospitals is at its initial stages, it is expected that this research will serve as an eye opener especially in the area of challenges, priority areas, existing potential and appropriate models for implementation among others. This research will contribute new knowledge especially on EMR implementation for a growing economy like Kenya.

This research is a mandatory requirement for the award of Phd and your participation will be highly appreciated. Kindly complete the attached questionnaire and return it to the undersigned in two weeks. Your feedback will be treated with utmost confidentiality. For any clarification, do not hesitate to contact me on **mobile no 0722794553** or through my **e-mail: wamaemesh@yahoo.com.**

PETER W. WAMAE

APPENDIX II
QUESTIONNAIRE FOR DOCTORS

SECTION 1: EXISTING EMR FEATURES

1. Please **tick (√)** the type(s) of medical record systems being used in the list below.

i)	Paper	( )
ii)	Hybrid(Paper and electronic)	( )
iii)	Electronic(disease specific e.g. HIV	( )
iv)	Electronic (for all diseases/conditions)	( )
v)	None	( )

2. Please **tick (√)** the computerized clinical processes in the following list.

i)	Vital signs monitoring	( )
ii)	Patient examination	( )
iii)	Ordering of investigations	( )
iv)	Drug administration	( )
v)	Prescribing	( )
vi)	Consultations/patient referral	( )
vii)	Surgery scheduling	( )
viii)	Communication with other service points	( )
ix)	Discharges	( )
x)	Communication with patients relatives	( )
xi)	Structured clinical decision support	( )

Others specify_____

xii) Please **tick(√)** in the list below the medical forms that are computerized in the hospital

i)	Registration	( )
ii)	Doctors Notes	( )
iii)	Nursing notes	( )
iv)	Lab	( )
v)	X-ray	( )
vi)	Prescription	( )
vii)	Vital sign	( )
viii)	Case summary	( )

ix) Patient Charge sheets ( )
x) Partograph ( )
xi) Baby Score ( )
xii) Blood matching ( )

SECTION2: INVOLVEMENT IN THE PRE-IMPLEMENTATION STAGE

xiii) Circle the answer that best indicate the extent to which doctors were involved in each of the following pre-implementation stages

	Not involved		slightly involved		moderate		Fully
EMR feasibility	0	1	2	3	4	5	6
Planning	0	1	2	3	4	5	6
Identification of EMR Champions	0	1	2	3	4	5	6
Introduction to EMR concept	0	1	2	3	4	5	6
Requirements identification	0	1	2	3	4	5	6
Priority setting	0	1	2	3	4	5	6
Mobilization of resources	0	1	2	3	4	5	6
Sensitization on existing EMR policies	0	1	2	3	4	5	6

SECTION 3: IMPLEMENTATION

xiv) Tick in the following list the methods that best represent how patient data is entered.

i) Captured on paper first and entered later by data personnel
ii) Captured real time at the point of service by doctor
iii) Captured both on paper and online at the point of service by doctor

xv) Using the scale provided, please circle the answer that best indicates the use of each of the following technologies for patient identification and data capture.

	N/A	Rare		Moderate		Extensively	
Bar code	0	1	2	3	4	5	6
Magnetic card readers	0	1	2	3	4	5	6

Smart card readers	0	1	2	3	4	5	6
Speech recognition	0	1	2	3	4	5	6
Biometric	0	1	2	3	4	5	6

xvi) Using the scale provided, circle the answer that best indicate the use of each of the following technologies for healthcare data capture.

	N/A	Rare		Moderate			Extensively
Paper scanning/ OCR	0	1	2	3	4	5	6
Tablets	0	1	2	3	4	5	6
Ipads	0	1	2	3	4	5	6
Mobile Phones	0	1	2	3	4	5	6
Audio/Video Capture	0	1	2	3	4	5	6
Direct by medical devices	0	1	2	3	4	5	6
Computers	0	1	2	3	4	5	6

xvii) Using the scale provided below, circle the answer that best indicate the extent to which doctors were involved in choosing the technology for health data capture, processing, storage and retrieval.

Not at all Very much

0 1 2 3 4 5 6 7

xviii) Circle the answer that best indicate the extent to which doctors were involved in each of the following implementation issues

	Not at all	slightly		moderated		fully
Purchase and distribution of Computers	0	1	2	3	4	5	6
Testing of the EMR system	0	1	2	3	4	5	6
User training on EMR use	0	1	2	3	4	5	6
Piloting	0	1	2	3	4	5	6
Selecting method of implementation	0	1	2	3	4	5	6

SECTION 4: USER PERCEPTIONS ON POST-IMPLEMENTATION ISSUES, IMPACT ON PATIENT CARE AND WAY FORWARD

xix) Circle the answer that best indicate the extent to which EMR has impacted on each of the following healthcare areas

	Not improved		Slightly	Better		Greatly improved
Patient turn- around time	0	1	2	3	4	5	6
Increase in doctor patient time	0	1	2	3	4	5	6
Quality of documentation	0	1	2	3	4	5	6
Information sharing	0	1	2	3	4	5	6
Availability of information For structured clinical decision	0	1	2	3	4	5	6

xx) Circle the answer that best indicate the extent to which EMR support is provided in each of the following areas.

	Not at all				Extensively		
Availability of technicians	0	1	2	3	4	5	6
EMR modifications	0	1	2	3	4	5	6
When system is down	0	1	2	3	4	5	6
Continuity training	0	1	2	3	4	5	6

xxi) Please tick what you would recommend for the way forward in the list below

i) Continue with paper
ii) Modify EMR to agree with set requirements
iii) Start afresh
iv) Install hospital-wide system

SECTION 5: USER SATISFACTION WITH EMR OUTPUT

xxii) Please **circle** the answer that best indicate the extent to which the EMR provide each of the following patient care information.

	N/A	Rare		moderate		Extensively	
Investigations results	0	1	2	3	4	5	6
Patients problem list	0	1	2	3	4	5	6
Clinical decision support	0	1	2	3	4	5	6

Available drugs	0	1	2	3	4	5	6
Patients awaiting surgery	0	1	2	3	4	5	6
Patients social economic status	0	1	2	3	4	5	6
Patients awaiting consultants review	0	1	2	3	4	5	6
Patient history	0	1	2	3	4	5	6

xxiii) Please circle the answer that best indicate the level of user friendliness of the EMR in each of the following areas.

	Not Usable			moderate			Excellent
Data entry screen/forms/menus	0	1	2	3	4	5	6
Retrieval of information	0	1	2	3	4	5	6
Querying	0	1	2	3	4	5	6
Availability of system help	0	1	2	3	4	5	6
Speed	0	1	2	3	4	5	6

xxiv) Using the scale below circle the answer that best indicate the extent to which medical record is computerized in your hospital.

Not at all Very much

0 1 2 3 4 5 6 7

THANK YOU FOR TAKING YOUR TIME TO FILL THIS QUESTIONNAIRE

APPENDIX III

QUESTIONNAIRE FOR NURSES

SECTION 1: EXISTING EMR FEATURES

xxv) Please **tick (√)** the type(s) of medical record systems being used in the list below.

i)	Paper	( )
ii)	Hybrid(Paper and electronic)	( )
iii)	Electronic(disease specific e.g. HIV)	( )
iv)	Electronic(for all diseases/conditions)	( )
v)	None	( )

xxvi) Please **tick (√)** the computerized nursing care processes in the following list.

i)	Vital signs monitoring	( )
ii)	Nursing care services	( )
iii)	Nursing duties allocation	( )
iv)	Drug administration	( )
v)	Nursing care supplies & ordering	( )
vi)	Inpatient transfer	( )
vii)	Surgery scheduling	( )
viii)	Communication with doctor	( )
ix)	Discharges	( )
x)	Communication with patients relatives	( )

Others specify_____ _____

xxvii) Please **tick(√)** in the list below the medical forms that are computerized in the hospital

i)	Registration	( )
ii)	Doctors Notes	( )
iii)	Nursing notes	( )
iv)	Lab	( )
v)	X-ray	( )
vi)	Prescription	( )
vii)	Vital sign	( )

viii)	Case summary	( )
ix)	Patient Charge sheets	( )
x)	Partograph	( )
xi)	Baby Score	( )
xii)	Blood matching	( )

SECTION2: INVOLVEMENT IN THE PRE-IMPLEMENTATION STAGE

xxviii) Circle the answer that best indicate the extent to which nurses were involved in each of the following pre-implementation stages

	Not involved		slightly		moderate		fully involved
EMR feasibility	0	1	2	3	4	5	6
Planning	0	1	2	3	4	5	6
Identification of EMR Champions	0	1	2	3	4	5	6
Introduction to EMR concept	0	1	2	3	4	5	6
Requirements identification	0	1	2	3	4	5	6
Priority setting	0	1	2	3	4	5	6
Mobilization of resources	0	1	2	3	4	5	6
Sensitization on existing EMR policies	0	1	2	3	4	5	6

SECTION 3: IMPLEMENTATION

xxix) Tick in the following list the methods that best represent how patient data is entered.

i) Captured on paper first and entered later by data personnel
ii) Captured real time at the point of service by nurses

xxx) Using the scale provided, please circle the answer that best indicates the use of each of the following technologies for patient identification and data capture.

	N/A		Rare		Moderate		Extensively
Bar code	0	1	2	3	4	5	6
Magnetic card readers	0	1	2	3	4	5	6
Smart card readers	0	1	2	3	4	5	6

Speech recognition	0	1	2	3	4	5	6
Biometric	0	1	2	3	4	5	6

xxxi) Using the scale provided, circle the answer that best indicate the use of each of the following technologies for healthcare data capture.

	N/A	Rare		Moderate			Extensively
Paper scanning/ OCR	0	1	2	3	4	5	6
Tablets	0	1	2	3	4	5	6
Ipads	0	1	2	3	4	5	6
Mobile Phones	0	1	2	3	4	5	6
Audio/Video Capture	0	1	2	3	4	5	6
Direct by medical devices	0	1	2	3	4	5	6
Computers	0	1	2	3	4	5	6

xxxii) Use the provided circle the answer that best indicate the extent to which you were involved in choosing the technology for health data capture, processing, storage and retrieval.

Not at all						Very much	
0	1	2	3	4	5	6	7

xxxiii) Circle the answer that best indicate the extent to which nurses were involved in each of the following implementation issues

	Not at all		slightly	moderate		fully
Purchase and distribution of Computers	0	1	2	3	4	5	6
Testing of the EMR system	0	1	2	3	4	5	6
User training on EMR use	0	1	2	3	4	5	6
Piloting	0	1	2	3	4	5	6
Selecting method of implementation	0	1	2	3	4	5	6

SECTION 4: USER PERCEPTIONS ON POST-IMPLEMENTATION ISSUES, IMPACT ON PATIENT CARE AND WAY FORWARD

xxxiv) Circle the answer that best indicate the extent to which EMR has impacted on each of the following healthcare areas

	Not improved			Slightly Better			Greatly improved
Patient turn- around time	0	1	2	3	4	5	6
Increase in nurse patient time	0	1	2	3	4	5	6
Quality of documentation	0	1	2	3	4	5	6
Information sharing	0	1	2	3	4	5	6

xxxv) Circle the answer that best indicate the extent to which EMR support is provided in each of the following areas.

	Not at all					extensively	
Availability of technicians	0	1	2	3	4	5	6
EMR modifications	0	1	2	3	4	5	6
When system is down	0	1	2	3	4	5	6
Continuity training	0	1	2	3	4	5	6

SECTION 5: USER SATISFACTION WITH EMR OUTPUT

xxxvi) Please **circle** the answer that best indicate the extent to which the EMR provide each of the following nursing care information.

	N/A	Rare		moderate		Extensively	
Patients on total nursing care	0	1	2	3	4	5	6
Patients problem list	0	1	2	3	4	5	6
Periodic patient census	0	1	2	3	4	5	6
Discharged patients	0	1	2	3	4	5	6
Patients awaiting surgery	0	1	2	3	4	5	6
Patients social economic status	0	1	2	3	4	5	6
Patients awaiting consultants review	0	1	2	3	4	5	6
Nursing care stock and re-order Items	0	1	2	3	4	5	6

xxxvii) Please circle the answer that best indicate the level of user friendliness of the EMR in each of the following areas.

	Not Usable			moderate			Excellent
Data entry screen/forms/menus	0	1	2	3	4	5	6
Retrieval of information	0	1	2	3	4	5	6
Querying	0	1	2	3	4	5	6
Availability of system help	0	1	2	3	4	5	6
Speed	0	1	2	3	4	5	6

xxxviii) Using the scale below circle the answer that best indicate the extent to which medical record is computerized in your hospital.

Not at all					Very much		
0	1	2	3	4	5	6	7

THANK YOU FOR TAKING YOUR TIME TO FILL THIS QUESTIONNAIRE

APPENDIX IV
QUESTIONNAIRE FOR HEALTH INFORMATION OFFICERS

SECTION 1: EXISTING EMR FEATURES

xxxix) Please **tick (√)** the type(s) of medical record systems being used in the list below.

i) Paper
ii) Hybrid(Paper and electronic)
iii) Electronic(disease specific e.g HIV)
iv) Electronic(for all diseases/conditions)
v) None

xl) Please **tick (√)** the computerized medical records management processes in the following list.

i) General patients enquiries
ii) Registration
iii) Appointments
iv) Admission
v) Electronic signatures
vi) Records access and security
vii) Records disposal
viii) Permanent records storage
ix) Discharges
x) Compilation of morbidity and mortality
xi) Compilation of OP and IP attendances
xii) Authentic creation and maintenance medical record

Others specify_____

xli) Please **tick(√)** in the list below the medical forms that are computerized in the hospital

i) Registration
ii) Doctors Notes
iii) Nursing notes
iv) Lab
v) X-ray

vi) Prescription
vii) Vital sign
viii) Case summary
ix) Patient Charge sheets
x) Partograph
xi) Baby Score
xii) Blood matching

SECTION 2: INVOLVEMENT IN THE PRE-IMPLEMENTATION STAGE

xlii) Circle the answer that best indicate the extent to which health information officers were involved in each of the following pre-implementation stages

	Not involved		slightly		moderate		Fully involved
EMR feasibility	0	1	2	3	4	5	6
Planning	0	1	2	3	4	5	6
Identification of EMR Champions	0	1	2	3	4	5	6
Introduction to EMR concept	0	1	2	3	4	5	6
Requirements identification	0	1	2	3	4	5	6
Priority setting	0	1	2	3	4	5	6
Mobilization of resources	0	1	2	3	4	5	6
Sensitization on existing EMR policies	0	1	2	3	4	5	6

SECTION 3: IMPLEMENTATION

xliii) Tick in the following list the methods that best represent how patient data is entered.

i) Captured on paper first and entered later by data personnel
ii) Captured real time at the point of service
iii) Captured both on paper and online at the point of service

xliv) Using the scale provided, please circle the answer that best indicates the use of each of the following technologies for patient identification and data capture.

	N/A	Rare		Moderate		Extensively	
Bar code	0	1	2	3	4	5	6
Magnetic card readers	0	1	2	3	4	5	6
Smart card readers	0	1	2	3	4	5	6
Speech recognition	0	1	2	3	4	5	6
Biometric	0	1	2	3	4	5	6

xlv) Using the scale provided, circle the answer that best indicate the use of each of the following technologies for healthcare data capture.

	N/A	Rare	Moderate		Extensively		
Paper scanning/ OCR	0	1	2	3	4	5	6
Tablets	0	1	2	3	4	5	6
Ipads	0	1	2	3	4	5	6
Mobile Phones	0	1	2	3	4	5	6
Audio/Video Capture	0	1	2	3	4	5	6
Direct by medical devices	0	1	2	3	4	5	6
Computers	0	1	2	3	4	5	6

xlvi) Using the scale provided below, circle the answer that best indicate the extent to which health information officers were involved in choosing the technology for health data capture, processing, storage and retrieval.

Not at all Very much

0 1 2 3 4 5 6 7

xlvii) Circle the answer that best indicate the extent to which health information officers were involved in each of the following implementation issues

	Not at all	slightly	moderate	fully			
Purchase and distribution of Computers	0	1	2	3	4	5	6
Testing of the EMR system	0	1	2	3	4	5	6
User training on EMR use	0	1	2	3	4	5	6
Piloting	0	1	2	3	4	5	6
Selecting method of implementation	0	1	2	3	4	5	6

SECTION 4: USER PERCEPTIONS ON POST-IMPLEMENTATION ISSUES, IMPACT ON PATIENT CARE AND WAY FORWARD

xlviii) Circle the answer that best indicate the extent to which EMR has impacted on each of the following healthcare areas

	Not improved		Slightly		Better		Greatly improved
Patient turn- around time	0	1	2	3	4	5	6
Retention and disposal of Record	0	1	2	3	4	5	6
Authentic creation of records	0	1	2	3	4	5	6
Information sharing	0	1	2	3	4	5	6
Security of medical record	0	1	2	3	4	5	6
Compilation of medical statistics	0	1	2	3	4	5	6
Availability of information for research	0	1	2	3	4	5	6

xlix) Circle the answer that best indicate the extent to which EMR support is provided in each of the following areas.

	Not at all					extensively	
Availability of technicians	0	1	2	3	4	5	6
EMR modifications	0	1	2	3	4	5	6
When system is down	0	1	2	3	4	5	6
Continuity training	0	1	2	3	4	5	6

l) Please tick what you would recommend for the way forward in the list below

i) Continue with paper
ii) Modify EMR to agree with set requirements
iii) Start afresh
iv) Install hospital-wide system
v) Improve statistical reporting
vi) Improve on authenticity of EMR (eg electronic signatures)
vii) improve on security of EMR

SECTION 5: USER SATISFACTION WITH EMR OUTPUT

li) Please **circle** the answer that best indicate the extent to which the EMR provide each of the following records management services.

	N/A	Rare	moderate		Extensively		
Retention and disposal	0	1	2	3	4	5	6
Storage of permanent records	0	1	2	3	4	5	6
Compilation of statistics	0	1	2	3	4	5	6
General patient enquiries	0	1	2	3	4	5	6

lii) Please circle the answer that best indicate the level of user friendliness of the EMR in each of the following areas.

	Not Usable		moderate				Excellent
Data entry screen/forms/menus	0	1	2	3	4	5	6
Retrieval of information	0	1	2	3	4	5	6
Querying	0	1	2	3	4	5	6
Availability of system help	0	1	2	3	4	5	6
Speed	0	1	2	3	4	5	6

liii) Using the scale below circle the answer that best indicate the extent to which medical record is computerized in your hospital.

Not at all Very much

0 1 2 3 4 5 6 7

THANK YOU FOR TAKING YOUR TIME TO FILL THIS QUESTIONNAIRE

APPENDIX V

QUESTIONNAIRE FOR STRATEGIC MANAGERS
SECTION 1: GENERAL FACILITY INFORMATION

1. Tick (√) your hospitals classification level in the list below

i) Level 1
ii) Level 2
iii) Level 3
iv) Level 4
v) Level 5
vi) Level 6

2. Please fill in the following infrastructure details

Total no of staff_____ No of beds_____ No of theatre rooms_____
No of Out-patients per day No of admissions per day_____

3. Tick (√) the services offered in your facility in the list provided below

(a) Out Patient

i) Adult emergency services
ii) Paediatric emergency services
iii) Consultant clinics
iv) Comprehensive HIV Care Clinic

(b)Inpatient services

i. Obs/Gynae
ii. Paediatrics
iii. Medical
iv. Surgical

(c) Specialized services

i) Intensive care unit
ii) Renal dialysis
iii) New born ICU
iv) Cancer treatment

(d) Diagnostic services

i) Ordinary lab tests

ii) Specialized lab tests
iii) Ordinary X-rays
iv) Specialized X-rays
v) Endoscopy

Others specify_____

SECTION 2: COMPUTER BASED SYSTEMS AVAILABLE IN THE HEALTH FACILITY

4. Please tick (√) the system or systems already installed in the list provided below

i) Patient registration
ii) Clinicians/doctors system
iii) Nursing system
iv) Medical Investigations ordering and reporting
v) HIV care system
vi) Billing system
vii) Telemedicine system
viii) Inventory
ix) Finance back office

SECTION 3: EMR-STRATEGY

5. Please tick(√) whether each of the following documents is available in your facility or not

	Available	Not available
Facility strategic plan	__	__
Clinical performance contracts	__	__
EMR implementation master plan	__	__
EMR specifications document	__	__
National EMR standards	__	__
National health information policy	__	__
Institutional information policy	__	__

6. Using the scale provided below, circle the answer that best represent the extent to which strategic consideration in EMR planning was taken in each of the following areas

	Not at all		Slight		Extensively
	0	1	2	3	4
(a) Funding					
Availability of government funding	0	1	2	3	4

Internally raised revenue	0	1	2	3	4
Donor sourcing	0	1	2	3	4
Partnership	0	1	2	3	4
(b) Information management					
Information sharing and security	0	1	2	3	4
Medical legal issues	0	1	2	3	4
Permanent health information storage	0	1	2	3	4
Disposal of medical records	0	1	2	3	4
Digitization of paper records	0	1	2	3	4
Integration of EMR with medical devices	0	1	2	3	4
Making work easy	0	1	2	3	4
Appropriate data capture equipment for doctors	0	1	2	3	4
EMR testing	0	1	2	3	4
(c) *User involvement*					
Initial training and Introduction to EMR concept	0	1	2	3	4
Establishment of EMR user committees	0	1	2	3	4
Requirements identification(data capture, Processing, reporting, querrying etc)	0	1	2	3	4
Choosing technology for data capture, Processing, reporting, querying etc)	0	1	2	3	4
EMR procurement	0	1	2	3	4
EMR System testing	0	1	2	3	4

7. Using the scale provided below, circle the answer that best represent the extent to which the EMR system vendors adhere to recommended EMR standards

Not at all		Slightly		moderate		Extensively	
0	1	2	3	4	5	6	7

SECTION 4: IMPLEMENTATION

8. Tick in the following list the methods that best represent how patient data is entered.

i) Captured on paper first and entered later by data personnel

ii) Captured real time at the point of service

9. Using the scale provided, please circle the answer that best indicates the use of each of the following technologies for patient identification and data capture.

N/A Rare	Moderate				Extensively		
Bar code	0	1	2	3	4	5	6
Magnetic card readers	0	1	2	3	4	5	6
Smart card readers	0	1	2	3	4	5	6
Speech recognition	0	1	2	3	4	5	6
Biometric	0	1	2	3	4	5	6

10. Using the scale provided, circle the answer that best indicate the use of each of the following technologies for healthcare data capture.

	N/A	Rare	Moderate		Extensively		
Paper scanning/ OCR	0	1	2	3	4	5	6
Tablets	0	1	2	3	4	5	6
Ipads	0	1	2	3	4	5	6
Mobile Phones	0	1	2	3	4	5	6
Audio/Video Capture	0	1	2	3	4	5	6
Direct by medical devices	0	1	2	3	4	5	6
Computers	0	1	2	3	4	5	6

11. Using the scale provided, circle the answer that best represent the extent to which each one of the following affect implementation of EMR in your facility

	Not at all		slightly		moderate		Extensively	
	0	1	2	3	4	5	6	7
Budget	0	1	2	3	4	5	6	7
Technical capacity	0	1	2	3	4	5	6	7
User training	0	1	2	3	4	5	6	7
Medical legal aspect of patient data	0	1	2	3	4	5	6	7
Existing ICT policy	0	1	2	3	4	5	6	7
Techno-phobia	0	1	2	3	4	5	6	7
Politics	0	1	2	3	4	5	6	7
Fear of the unknown	0	1	2	3	4	5	6	7

SECTION 5: SATISFACTION WITH EMR OUTPUT

12 .Please **circle** the answer that best indicate the extent to which the EMR provide each of the following management information.

	N/A	Rare	moderate		Extensively		
Hospital workload summaries	0	1	2	3	4	5	6
Hospital clinical performance indicators	0	1	2	3	4	5	6
Discharged patients	0	1	2	3	4	5	6
Workflow data	0	1	2	3	4	5	6

12. Using the scale below circle the answer that best indicate the extent to which the hospital is computerized.

Not at all Very much

0 1 2 3 4 5 6 7

THANK YOU FOR TAKING YOUR TIME TO FILL THIS QUESTIONNAIRE

APPENDIX VI: DOCUMENT REVIEW FORM

DOCUMENT NAME	USERS	PURPOSE

APPENDIX VII: RESEARCH AUTHORISATION FROM NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Approved at Kilt Mgae

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

4th November, 2013

NACOSTI/P/13/6509/188

Peter Wahome Wamae
Kenyatta University
P.O.Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Implementation of electronic medical records in Keyan Public Hospitals: Challenges and opportunities,"*** I am pleased to inform you that you have been authorized to undertake research in **Selected Counties** for a period ending **12th February, 2013.**

You are advised to report to **the County Commissioners and the County Directors of Education, Selected Counties** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

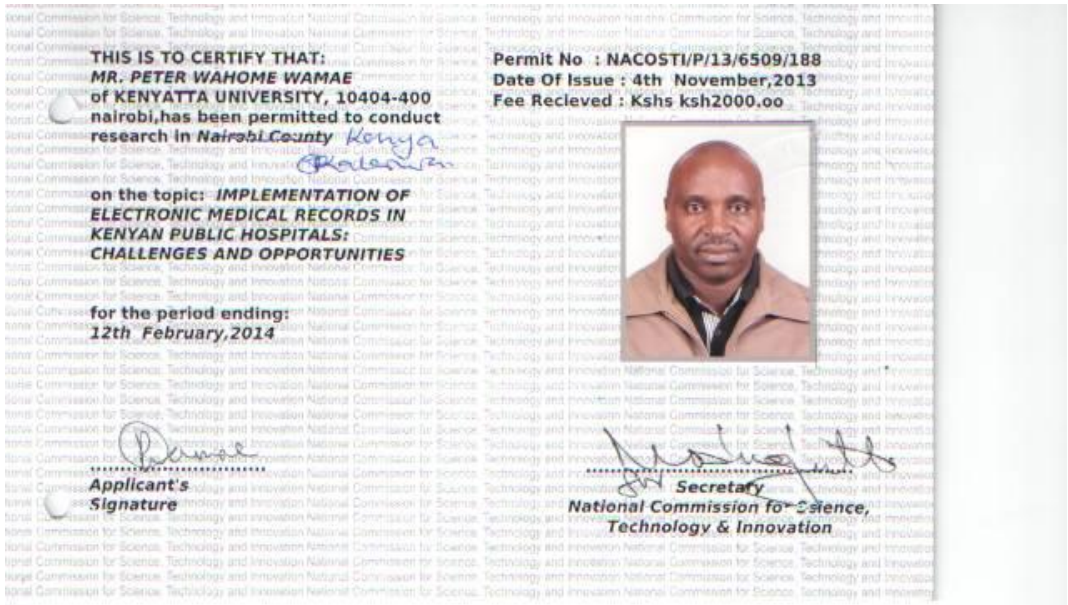
DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COMMISSION SECRETARY
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Copy to:

The County Commissioners
The County Directors of Education
Selected Counties.

National Commission for Science, Technology and Innovation is ISO 2008: 9001 Certified

APPENDIX VIII: REASEARCH PERMIT



THIS IS TO CERTIFY THAT:
MR. PETER WAHOME WAMAE
of KENYATTA UNIVERSITY, 10404-400
nairobi,has been permitted to conduct
research in *Nairobi County* Kenya

on the topic: *IMPLEMENTATION OF ELECTRONIC MEDICAL RECORDS IN KENYAN PUBLIC HOSPITALS: CHALLENGES AND OPPORTUNITIES*

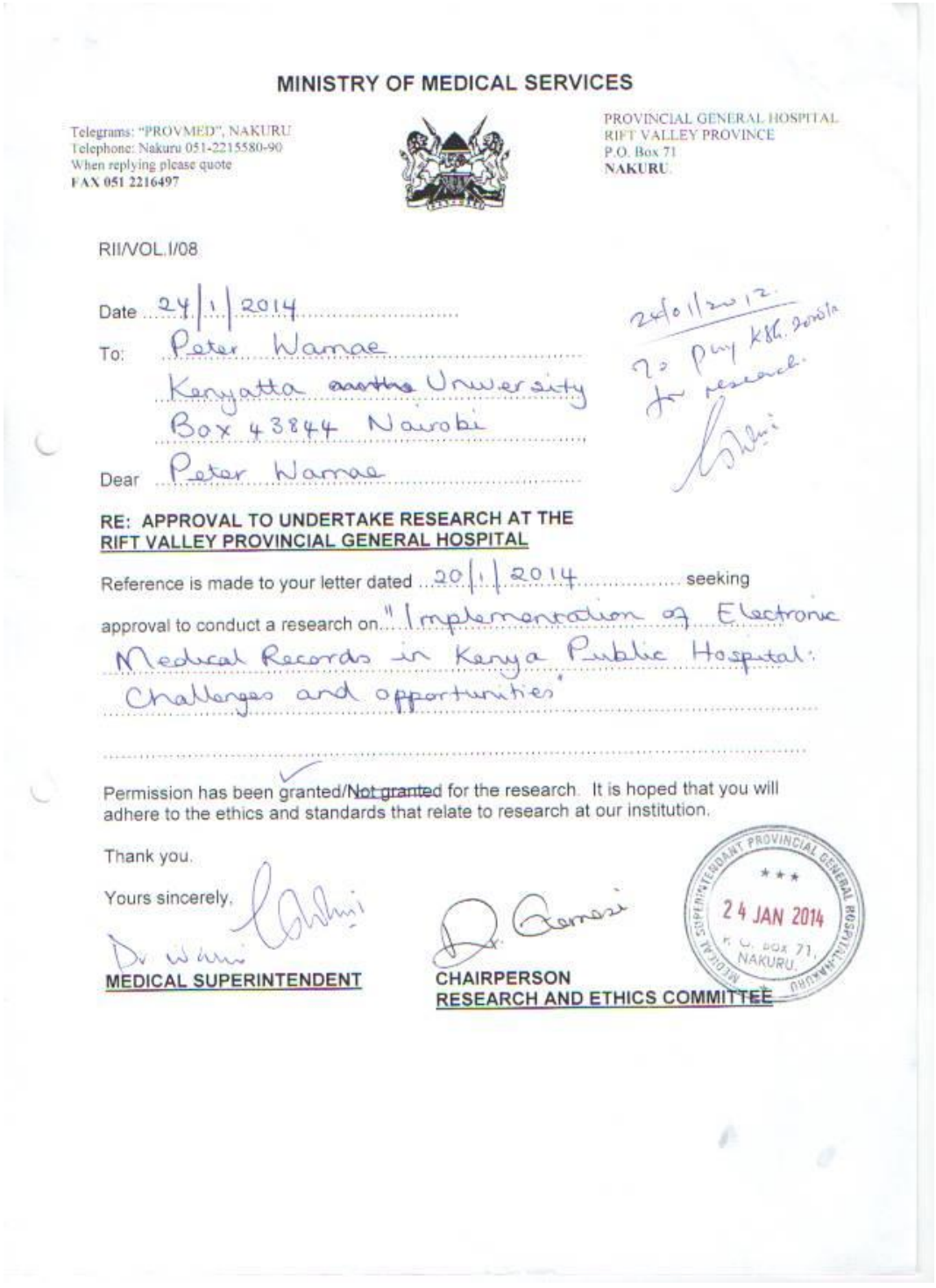
for the period ending:
12th February,2014

Permit No : NACOSTI/P/13/6509/188
Date Of Issue : 4th November,2013
Fee Recieved : Kshs ksh2000.oo

Applicant's Signature

Secretary
National Commission for Science, Technology & Innovation

APPENDIX IX: APPROVAL BY PROVINCIAL GENERAL HOSPITAL NAKURU RESARCH AND ETHIC COMMITTEE



MINISTRY OF MEDICAL SERVICES

Telegrams: "PROVMED", NAKURU
Telephone: Nakuru 051-2215580-90
When replying please quote
FAX 051 2216497

PROVINCIAL GENERAL HOSPITAL
RIFT VALLEY PROVINCE
P.O. Box 71
NAKURU

RII/VOL.I/08

Date 24/1/2014

24/01/2014.
2 pay KSh. 2000/=
for research.

To: Peter Wamae
Kenyatta ~~university~~ University
Box 43844 Nairobi

Dear Peter Wamae

RE: APPROVAL TO UNDERTAKE RESEARCH AT THE RIFT VALLEY PROVINCIAL GENERAL HOSPITAL

Reference is made to your letter dated 20/1/2014 seeking approval to conduct a research on "Implementation of Electronic Medical Records in Kenya Public Hospital: Challenges and opportunities"

Permission has been granted/~~Not granted~~ for the research. It is hoped that you will adhere to the ethics and standards that relate to research at our institution.

Thank you.

Yours sincerely.

Dr Wanni
MEDICAL SUPERINTENDENT

CHAIRPERSON
RESEARCH AND ETHICS COMMITTEE

MEDICAL SUPERINTENDANT PROVINCIAL GENERAL HOSPITAL NAKURU
24 JAN 2014
P. O. BOX 71, NAKURU

APPENDIX X: PERMISSION TO COLLECT DATA BY MERU LEVEL FIVE HOSPITAL

MINISTRY OF HEALTH

Telegrams: "MEDICAL" Meru
Telephone: Meru 064-32370/1
Fax: 31242
Email: hospitalmeru@yahoo.com
When replying should be to:
Medical Superintendent

MERU LEVEL FIVE HOSPITAL
P.O. BOX 8 – 60200
MERU

Ref: MRU/MED/G/R.14/11

Date: 28th February 2014

Peter Wahome Wamae
Kenyatta University
P.O. Box 43844-00100
NAIROBI

RE: PERMISSION TO COLLECT RESEARCH DATA

Following your request to collect data in Meru Level Five Hospital for your research on implementation of Electronic Medical Records in Kenyan Public Hospital; challenges and opportunities; I am pleased to inform you that you have been permitted.

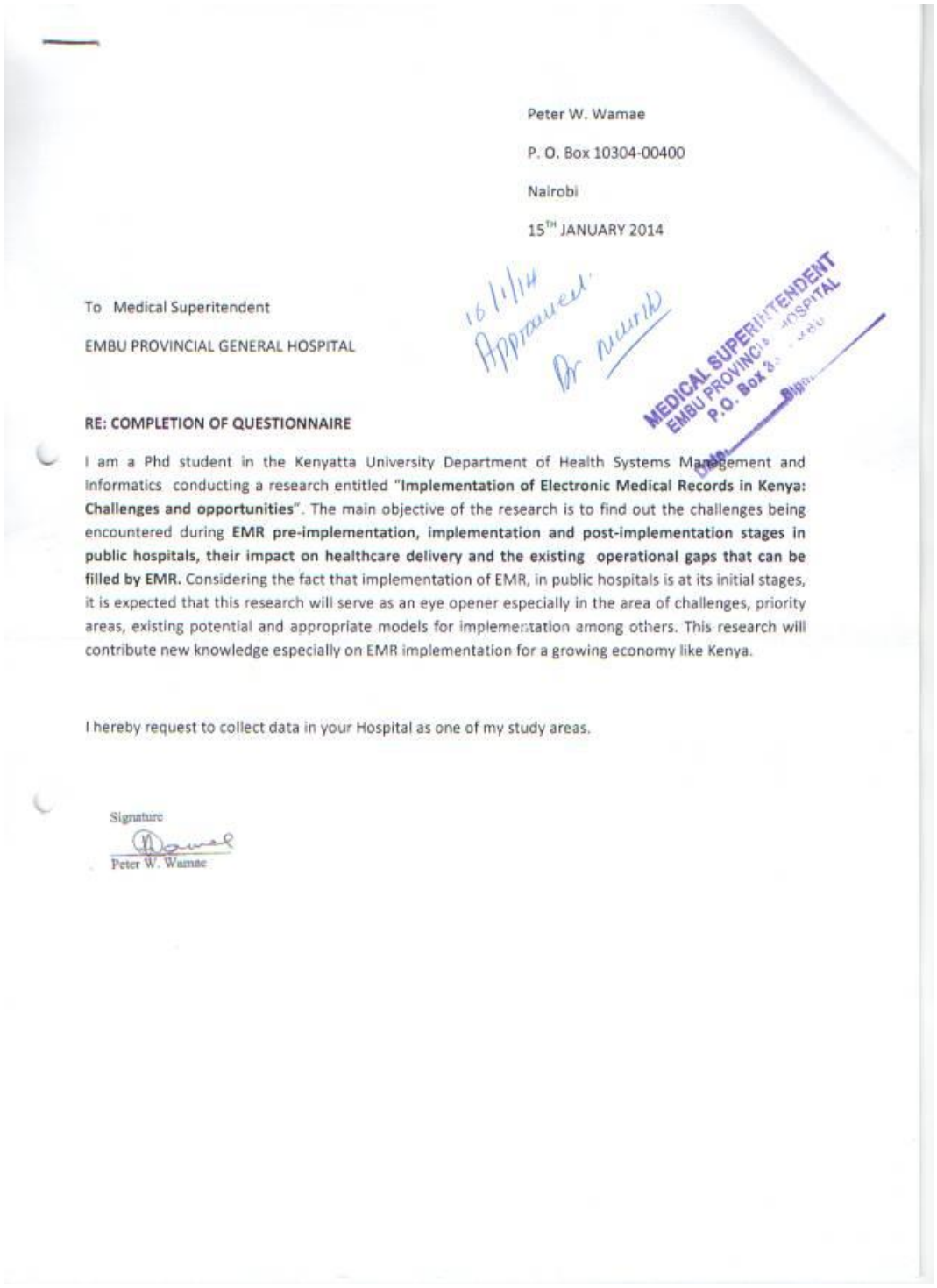
NB: On completion of the research, you are expected to submit one hard copy and soft copy of the research report / thesis to the hospital.

Thank you.

MEDICAL SUPERITENDENT
MERU DISTRICT HOSPITAL
P.O. BOX 8 – 60200
MERU

Irene K. Muthee
Nursing Officer In-charge
For: Medical Superintendent
Meru Level Five Hospital

APPENDIX XI: APPROVAL FOR DATA COLLECTION BY EMBU PROVINCIAL HOAPITAL



Peter W. Wamae

P. O. Box 10304-00400

Nairobi

15TH JANUARY 2014

16/1/14 Approved Dr Nduru

MEDICAL SUPERINTENDENT EMBU PROVINCIAL HOSPITAL P.O. Box 3...

To Medical Superitendent

EMBU PROVINCIAL GENERAL HOSPITAL

RE: COMPLETION OF QUESTIONNAIRE

I am a Phd student in the Kenyatta University Department of Health Systems Management and Informatics conducting a research entitled "**Implementation of Electronic Medical Records in Kenya: Challenges and opportunities**". The main objective of the research is to find out the challenges being encountered during **EMR pre-implementation, implementation and post-implementation stages in public hospitals, their impact on healthcare delivery and the existing operational gaps that can be filled by EMR.** Considering the fact that implementation of EMR, in public hospitals is at its initial stages, it is expected that this research will serve as an eye opener especially in the area of challenges, priority areas, existing potential and appropriate models for implementation among others. This research will contribute new knowledge especially on EMR implementation for a growing economy like Kenya.

I hereby request to collect data in your Hospital as one of my study areas.

Signature

Peter W. Wamae

APPENDIX XII: APPROVAL BY MOI TEACHING AND REFERRAL HOSPITAL RESEARCH AND ETHICS COMMITTEE

MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4
Fax: 61749
Email: director@mtrh.or.ke

P. O. Box 3
ELDORET

Ref: ELD/MTRH/R.6/VOL.II/2008

15 January 2014

Peter Wahome Wamae;
Kenyatta University,
P.O BOX 43844-00100,
NAIROBI-KENYA.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:

"Implementation of Electronic Medical Records in Kenya Public Hospitals: Challenges and Opportunities".

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

15/01/2014

DR. JOHN KIBOSIA
DIRECTOR
MOI TEACHING AND REFERRAL HOSPITAL.

CC - Deputy Director (CS)
- Chief Nurse
- HOD, HRISM