UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING & INFORMATICS

PROJECT REPORT

On

Integrating Health Management Information Systems for Patient Referrals: A Case study of Kenyatta Referral Hospital and the Nairobi Metropolitan Hospitals

BY

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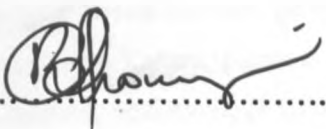
Science in Information Systems

DECLARATION

I, **Bernard Francis Mwangi Chogi** do declare that this piece of research project is entirely my own and where there's work or contributions of other individuals, it has been clearly acknowledged and also that to the best of my knowledge this research work has not been carried out before or previously presented to any other education institution in the world for similar purposes on any forum.

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I, **Prof. W. Okelo-Odongo**, do hereby certify that this project has been presented for examination with my approval as the University of Nairobi Supervisor.

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ABSTRACT

Successful implementation of patient care information systems (PCIS) in health care organizations is fundamental. In line with United Nations millennium development goal on improving healthcare, there is an urgent need to improve on our health care delivery services through the use of ICTs. However this process is faced with several challenges.

This study focused on the various challenges that inhibit the successful integration of Health Management Information systems between Kenyatta as a referral hospital and other referring hospitals around in the Nairobi metropolitan. The study was undertaken in recognition of the main challenges in the patients' referral process between a referral hospital and referring centers.

The research was a survey of nine (9) hospitals that refers patients to Kenyatta National Hospital in the Nairobi metropolitan area. The survey critically evaluated the challenges and motivations faced by hospitals towards successful implementation of electronic referral hospital systems. The study assessed the hospital's management/ administration, nature of the profession for medical/health workers and their attitudes, ICTs, technical capacity and capabilities required to support the electronic referral process in a hospital. Data was collected through the use of questionnaires from the health workers (Doctors, Nurses, Clinical officers etc), hospital administrators/management and the ICT staff in the hospitals. Interviews and observation were also used on selected doctors, hospital administrators and ICT staff to enhance objectivity.

The findings uncovered a range of issues, some of which are specifically related to ICT infrastructure in the hospitals, attitudes of the health workers towards information technology in the referral process, their professional and ethical considerations. Others were in regard to management support in the hospitals and the level of ICT literacy in the hospitals from all members of staff. It was evident that the benefits of the patients' e-referral are enormous.

The funding for the ICT infrastructure, the ICT literacy levels, health workers Attitudes and hospital's management are some of the major challenges that the hospitals have to contend with. Using the research findings, a framework was developed that, would help the hospitals and the government to analyze the implementation process of the electronic referral system in hospitals in a standardized approach in the exchange, management and integration of data that supports clinical patient care and the management, delivery and evaluation of healthcare services, as stipulated by HL7 mission statement of clinical interoperability.

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LIST OF ABBREVIATION

Abbreviations	Meaning
CSPP	Computer Systems Policy Project
ICT	Information and Communication Technologies
HL7	Health layer 7
HMIS	Health Management Information Systems
EHR	Electronic health record
eMAR	Electronic medication administration record
EMR	Electronic medical record
EPR	Electronic patient record
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE   INTRODUCTION

1.0   Overview

Policy makers and healthcare leaders are faced with the challenge of improving access and quality of healthcare services to the citizens and increasingly, they are looking towards information and communication Technologies (ICT) to play an important role in addressing some of these challenges. Developed countries have embraced the use of ICT in the hospitals and health clinics to provide services such as computerization of medical records, electronic scheduling for appointments, communication(Ouma,2008).The ICTs have a huge potential to improve healthcare quality, improve efficiency and reduce the cost (Kotz,D,et al 2009). In the words of Simba (2008), the ICT revolution has brought opportunities and challenges to developing countries in their efforts to strengthen the Health Management Information Systems (HMIS). Electronic Health (eHealth) in developed countries has rapidly evolved from the delivery of online medical content toward the adaptation of generic e-commerce solutions to the processing of health-related administrative transactions and the logistical support of clinical tasks (Adebola,2011).To ensure that the access to data be feasible, the systems within which data is stored must be capable of interoperation with those systems around them (Miller P, 2002)

As for developing countries, most of them have to deal with socio-economic challenges(Ouma,(2008).However in the wake of globalization, developing countries have no choice but to take advantage of the opportunities and face the challenges for the benefit of the citizens in a country. Tan (2009) points out that, hospitals and other health service organizations will face increasing pressures to move toward an e-health model, due to changing demographics, changing governments, a changing e-technology marketplace, and changing health care environments. Car et al(2008) notes that emerging e-Health systems have the potential to reduce errors and enhance patient safety by, amongst other things, improving the legibility of clinical communications, enabling shared access to health records, reducing reliance on human memory and prompting evidence-based prescribing.

The main challenge that ICT should help to overcome is to significantly improve the quality and success rate of healthcare delivery while decreasing costs to patients paying for the

service and improving the overall positive experiences of patients and hospital staff. Information and communication system (ICT) is a key enabler for this mission and vision to be realized for an efficient electronic referral system for the health service provision in Kenya. Electronic referral(e-referral) as a process is supported by the qualities of rapid, two-way information flow, interactivity and mobility with improved health action that stimulates and test the strategic programming skills and imagination of international health and development workers (digital pulse,2003).

According to Simba (2008) efforts to improve referral systems in low-income countries require that the primary and secondary level hospitals services be strengthened and increased so as to limit inappropriate use of national referral hospitals. Kenyatta National Hospital in Nairobi is the country's chief referral and teaching institution, with provincial and district hospitals which are in rural areas or urban centers of Kenya providing diagnostic services, inpatient and outpatient treatment, but they often lack adequate facilities, trained personnel, and medications.

1.1   Background of the Problem

In the Nairobi metropolitan area there are about 63 hospitals that provide in-patient services to the communities around and, often they refer some patients to Kenyatta National Hospital for complex medical cases attention. Kenyatta National Hospital is the major public referral facility in Kenya. As a referral hospital it has to fully complement the health services of pediatrics, general medicine, various branches of surgery and psychiatry in which the patients will often be referred from smaller hospitals for major operations, consultations with sub specialists and when sophisticated intensive care facilities are required. As a national referral facility, the hospital offers various specialized services as shown in appendix 2.The metropolitan the hospitals refer patients to Kenyatta National Hospital for one of the many specialized services. The metropolitan hospitals in Nairobi provide Primary health care to most of the Nairobi residents ensuring that the patients can access relevant quality services in a timely and reliable manner.

Most of the doctors in the metropolitan hospitals mainly use paper based referrals, through medical notes written in a referral paper. The referral Service is manually coordinated with the use of paper based documents or telephone messages; without much support of ICTs.

However, some of the metropolitan hospitals have ICT supported initiatives with an existing level information technology infrastructure and practices which are established to manage various autonomous hospitals in the metropolitan area of Nairobi. On the other hand Kenyatta National Hospital has used substantial resources to develop and acquire internal health management information systems (MIS) to support service delivery within the hospital. This investment already made by the institution (KNH) in service delivery coupled with an electronic patient referral system is likely to change the way health services are offered in Kenya.

1.2   Perspective of patient Referrals

It is worth noting that the developing world suffers inadequate health care and medical services. Lack of health care professionals and infrastructure contribute to this problem making it more and more difficult to deliver health care to people in and communities of the developing world, Wootton (2009). According to poll by Growth Survey Research Practice Fusion (2010), in all over the world approximately 22 million people are referred to another doctor by a physician each year, but only 16% of primary care providers use an electronic process to send patient records for referrals. In United states of America the referral patterns in primary care, providers are sharing patient information through; fax at 28 %,phone 20% , patient (19 %) and mail at 4 %.

1.3   Patient Referral process in Kenyan Hospitals

The current referral system is mainly paper based cards and referral letters (appendix 6), which are delivered by the patients, or in some cases through the use of telephone calls. This process encourages to queuing again in the casualty to get access to the medical staff in the referral facility (Kenyatta National hospitals) that will assign a registration number or retrieve the file from the registry, from where the patient is taken to the appropriate clinic for further diagnosis or tests. This process is flawed by inefficiencies that lead to long queues of patients waiting to be seen in the casualty department and then be sent to the referred clinics as shown in figure 1.1 leading to congestion due to constrained resources and to the worst loss of lives that possibly would be avoided.

Figure 1.1 **Current referral processes from a metropolitan hospital to Kenyatta national hospital**

Patients Bio data
Referal data
Diagnosis
X-ray information
Lab Results

Doctor refers a patient
using a printed/written letter

All referral information
presented to the doctor
incharge of casulty

Patients visits hospital

Doctor refers a patient to
Kenyatta Hospital through phone(s)
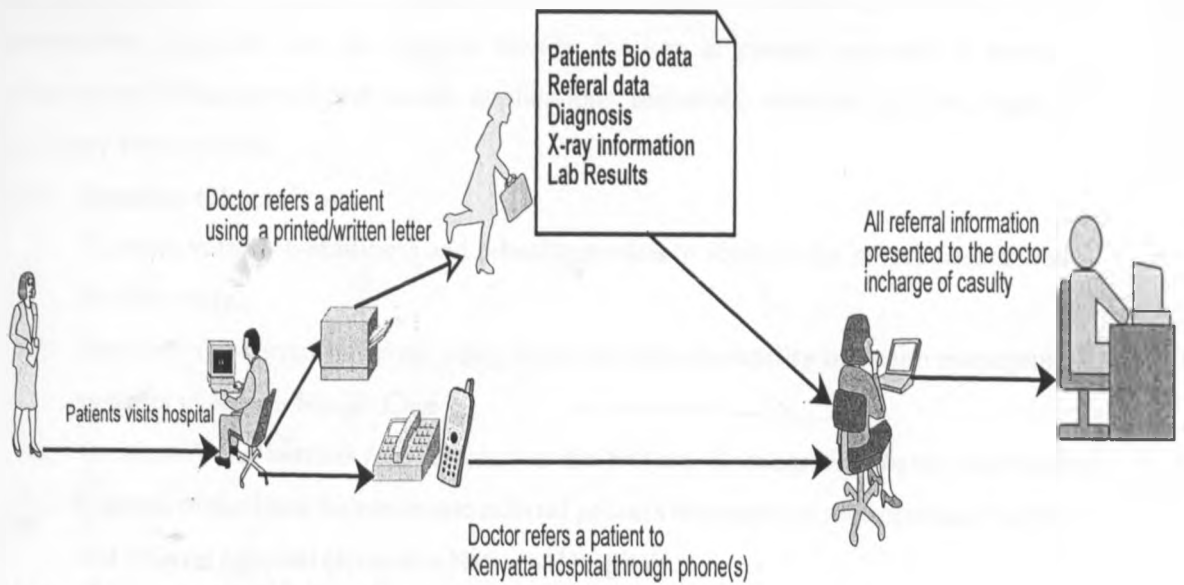
1.4 Research Problem Statement

Hospitals would like the patient referral process to be seamless, without interruptions or delays where the patients would receive timely and quality healthcare services during a referral.

Approximately 90% of doctors in Kenyan hospitals use a manual process (telephone/mobiles, fax, and paper cards) of exchanging clinical health information about patients during a referral process from one hospital to another for specialized/advanced healthcare services. As result the doctors in the referral hospital have just limited access to information about the referred patients. Indeed sometimes the doctors' restarts the diagnosis process all over again including conducting all the clinical tests which were conducted in the primary health care provider.

Consequently the doctors take more time to attend to a referred patient, increasing the time taken for decision-making about patients' treatment by the doctors in the referral facility, leading to congestion and straining of some resources and hence lower service delivery to the referred patients and to the worst it may lead to loss of lives. Due to this there is an urgent need to evaluate the current referral process to help us understand the challenges to improve the referral process.

1.5 Research Objectives

1.5.1 General Objective

The study seeks to establish opportunities and barriers of adopting e-Health in the metropolitan hospitals and the referral facility for use in patient referrals in terms of technological infrastructure and access, applications, resources, attitudes, policies, legal and regulatory environment

1.5.2 Specific Objectives

1. To asses various e-readiness and e-health models to identify the most suitable model for this study.
2. Establish the current level of integration and interoperability of health management systems in Kenya Health Care
3. To identify the barriers /challenges that inhibits use of integrated health information systems to facilitate an electronic referral process between the metropolitan hospitals and referral hospital (Kenyatta National Hospital).
4. To model a framework suitable for implementing eHealth for patient referral system in Kenya integrating metropolitan hospitals to the Kenyatta national hospital focusing on usability

1.6 Research Questions

The research questions sought to find out:-

5. Are the hospitals in the Nairobi metropolitan area e-Ready for eHealth and electronic referral system in terms of infrastructure, access, applications and services, legal and regulatory environment?
6. What are the hospitals' institutional and management characteristics that hinder integrated use of information systems in sharing the referral data/information between the referring health service provider and Kenyatta national hospital?
7. In which ways can sharing of the referral data/information between hospitals lead to a more patient oriented referral process in the provision of health care in Kenya?
8. What are the best professional practices, standards and ICT skills for medical staff and hospital administrative staff that may promote/accelerate effective use of the electronic referral systems in the patient referral process between the referral centre and the hospitals within the metropolis?

1.7 Justification / Significance of the Study

The contribution of this study will be of great help in advising hospital's management, policy makers and the academia on what to do to implement a good patient electronic referral between primary health care hospitals and the referral hospital informing on the resources, skills and attitudes required.

This study proposes a framework to support patient e-referrals for quality, effective and timely delivery of the relevant effective admission and referral data to Kenyatta hospital and consequently reducing the waiting time and congestion within the casualty and emergency department of Kenyatta National Hospital which would consequently reduce loss of lives in the casualty before admission.

1.7.1 Benefits of this Study

The exchange and Access to patient information on referral process has the potential to improve patient health care management with outcomes such as more appropriate investigations, treatments, better time management and reduced mortality. Prompt, reliable access to health information can improve the quality and efficiency of care, and even save lives (Diamond, et al 2005).

At the end of this project, a framework will be produced that facilitates exchange of significant relevant patient information from one hospital to another hospital for ease of referral. The electronic referral framework will provide an appropriate base for implementing of electronic referrals in hospitals for e-Health purposes, based on a good ICT infrastructure and best practices.

1.7.2 Specific benefits of the study

1. Provide empirical information on best professional practices and attitudes and cultures that may influence adoption and usage of the electronic referral systems.
2. The study will enable the various hospitals' management to get information on the benefits of integrating ICT in the referral process such as streamlining processes, reduced costs and better time management.
3. Identify the various challenges that may not favor successful implementation of e-referral systems in a Kenyan context

4. Provide a basis for various decision makers in the health institutions' management to prepare and allocate resources which can support the electronic referral implementation efforts

CHAPTER TWO   LITERATURE REVIEW

2.1   Introduction

The literature review stage will cover extensive readings on: Elements of health information systems, Conceptual framework-readiness countries on eHealth [models, comparison description of the most suitable model] in different parts of the world, Building blocks of electronic referral systems, case studies of existing referral systems, Existing /current referral status in Kenya and HL7 on support of electronic exchange of clinical data /documents

2.2   Definition of key terms

Confidentiality: the obligations o those who receive information to respect the privacy interests of those whom the data relates (Kotz,D,et al 2009).

E-Health   eHealth is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. It characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and

worldwide by using information and communication technology (Eysenbach.G, 2001)

EHR   An electronic health record / electronic patient record (EPR) is a systematic collection of electronic health information about individual patients or populations. It is a record in digital format that is capable of being shared across different health care settings, by being embedded in network-connected enterprise-wide information systems (wikipedia)

HL7   Health Level Seven is a standard that provides most of the protocols for the transmission of data among different applications, such as between a laboratory information system and an EHR, or between a physician office EHR and health information exchange organization (HIO).

E-Ready
Community   an 'e-ready' community is one that has high-speed access in a competitive market; with constant access and application of ICTs in schools, government offices, businesses, healthcare facilities and homes; user privacy and online security; and government policies which are "favorable to promoting connectedness and use of the Network.(**CSPP's guide** to E-Readiness)

E-Referral   It is the electronic transfer of care for a patient from one clinician to another using the health information exchange (Google)

Health Information (HIE) it's the mobilization of healthcare information

Health information
Privacy   An individual's right to control the acquisition, use or disclosure of his or her identifiable health data (Kotz,D,et al 2009).

ICT   **Information and communications technology** is a term often used as an extended synonym for information technology (IT) but more general stressing the role of unified communications and the integration of telecommunications (telephone lines and wireless

	signals), intelligent building management systems and audio-visual systems in modern information technology (Wikipedia)
Integration	Describes a moment in time where systems are interconnected to provide a solution delivery (NEHTA, 2007)
Interoperability	It is the ability of a system or a product to work with other systems or products without special effort on the part of the customer (Miller.P,2002).It is a necessary precondition to ensure longevity of integration in a changing IT and business environment. (NEHTA, 2007)
Security	The physical, technological or the administrative safeguards or tools to protect identifiable health data from unwarranted access or disclosure (Kotz,D,et al 2009).
Tele-Health	The delivery of health-related services and information via telecommunications technologies, over large and small distances, includes remote and rural areas.
Telemedicine	Provision of medical services from a distance, which includes diagnosis, treatment and prevention of diseases (Ouma, 2008)

2.3   ICTs and Healthcare Systems

Successful implementation of patient care information systems (PCIS) in health care organizations appears to be a difficult task due to various challenges during and after implementation(Berg, 2001).Healthcare ICT are complex, organizational technologies whose applications, uses, limitations and implications are not clear-cut nor are benefits from use assured. However there are convincing ideas about how to use IT in healthcare to improve cost, quality and access for promoting adoption and guiding successful implementation of e-healthcare systems. The ideas for ICT use are negotiated among a community of stakeholders that includes medical professionals, leaders of healthcare organizations, government and regulatory agencies, and ICT vendors and consultants. These interactions between a community and the processes determine the shape and outcomes of the healthcare ICT innovations. It is therefore critical to understand the social

construction and the interpretive processes through which healthcare ICT innovations are developed and communicated; to anticipating outcomes of ICT adoption and to inform policy makers (Davidson and Reardon.J, 2005).

The labor intensive, costly and inconvenient paper-based referral workflow process is a good candidate for the great need for automating the referral process in the healthcare. According to DeLone and McLean model(2003),good information quality, system quality and system service quality leads to enhanced user satisfaction that translates to various net benefits such as cost saving, time saving among others. In each country, national referral hospitals are at the apex of the health care system, providing sophisticated diagnostic, therapeutic, and rehabilitative services. As noted by Hook (2003), the healthcare referral system in Kenya is not functioning up to date resulting in excessive workload on the main national referral hospitals.

The electronic referral system provides collaboration between a referral facility and the referring hospitals. The process establishes Electronic Health Record (EHR) exchange of clinical data between the physicians practicing in the two establishments, enabling referrals and patient medical summaries to be made available to physicians in their EHR systems at the point of patients care during referrals. The electronic patient referral system is expected to provide the benefits as illustrated in figure 2.1 when adopted in a healthcare system. According to marina, J (2009), e-health contains 10e's (efficiency, enhancing, empowerment, encouragement, education, enabling, extending, ethics and equity).

Figure 2.1: Benefits of electronic referral systems to healthcare

Source: author 2011

Efficiency-eHealth should increase efficiency in health care, thereby decreasing costs, by avoiding duplicative or unnecessary diagnostic or therapeutic interventions, through enhanced communication possibilities between health care establishments, and through patient involvement.

Enhancing quality of healthcare- increasing efficiency involves not only reducing costs, but at the same time improving quality.

Evidence based - e-health interventions should be evidence based in a sense that their effectiveness and efficiency should not be assumed but proven by rigorous scientific evaluation.

Empowerment of consumers of eHealth and patients, by making the knowledge bases of medicine and personal electronic records accessible to consumers over the Internet, and opening new avenues for patient-centered medicine, and enables evidence-based patient choice.

Encouragement as a new relationship between the patient and health professional, towards a true partnership, where decisions are made in a shared manner.

Education of physicians through online sources (continuing medical education) and consumers (health education, tailored preventive information for consumers)

Enabling information exchange and communication in a standardized way between health care establishments.

Extending the scope of health care beyond its conventional boundaries, both in a geographical sense as well as in a conceptual sense. e-health enables consumers to easily obtain health services that range from simple advice to more complex interventions from

Ethics - e-health involves new forms of patient-physician interaction that poses new challenges and threats to ethical issues such as online professional practice, informed consent, privacy and equity issues.

Equity – challenged by the gap between the "haves" and "have-nots". People, who do not have the money, skills, and access to computers and networks, cannot use computers effectively. As a result, these patient populations (which would actually benefit the most from health information) are those who are the least likely to benefit from advances in information technology, unless political measures ensure equitable access for all. The digital divide currently runs between rural vs. urban populations, rich vs. poor, young vs. old, male vs. female people, and between neglected/rare vs. common diseases.

2.4   Diffusion of Innovation Theory in E-health

The electronic referral system is technologically mediated, Davidson and Reardon (2005) suggests that to effectively promote adoption and diffusion of an IT innovation, in healthcare an organization's vision must be distinctive and credible, suggesting that something relatively new is being proposed, and that the proposed innovation could conceivably solve the problems associated with the new technological innovation and be useful to the stakeholders(health workers, management and other hospital staff) .

Diffusion of innovation theory derives from communication theory, and describes the process by which an innovation is communicated through certain channels over time to Members of a social system. It seeks to explain how, why, and at what rate new ideas and

technology spread through cultures (wikipedia). According to Moulding N.T (1999) an innovation is defined as an idea, practice, or object which is perceived as new. Electronic referral process is relatively an innovation in many hospitals, which needs to be communicated between all the stakeholders (health workers, administrators and ICT staff).The adoption of an innovation undergoes four stages of stating with the knowledge phase which involves learning about the innovation, and then persuasion stage that involves the individual forming positive or negative attitudes about the innovation, individuals tests the acceptability of the innovation and finally the adoption or rejection of the innovation. As shown in figure below Figure 2.2

Figure 2.2 E-Referral adoption & implementation FIT between technology, individuals and tasks
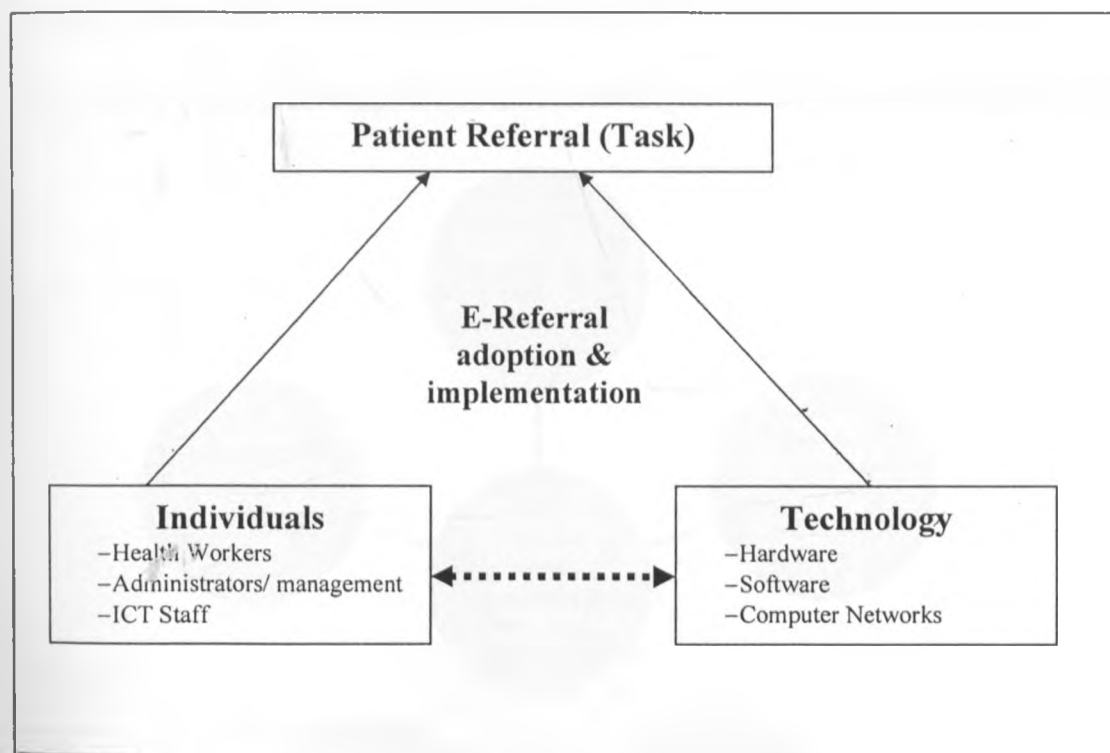
Source: Adapted from Ammenwerth.E, 2005

Davis et al (1989) defines perceived usefulness of a new technology as a subjective probability that using a specific application system will increase his/her job performance within an organization context. This usefulness is influenced by perceived ease of use and therefore the easier a technology is to use, the more useful the technology will be to a particular user. It is important to note that the usefulness of any technology will only be

measurable after being accepted and then adopted in any institution .Venkatesh et. al (2003) stated that user intentions to use an Information technology and subsequently influence the usage behavior. This theory holds acceptance and usage has four main constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) that are likely determinants of usage intention and behavior of a referral technology by the health workers in a hospital, hospital management or administrator and ICT staff. Therefore e-referral implementation must fit between patient referral task, technology and the people involved in the task as shown in figure 2.2

2.5   Conceptual Framework of Essential Research Concepts

Figure 2.3 shows a conceptual map for all the research concepts studied in this research, which includes the models of e-readiness in hospitals, electronic health, case studies of the e-referral system, building blocks of the e-referral systems and the e-referral standards

Figure 2.3 Conceptual maps for all the research elements for e-referral framework
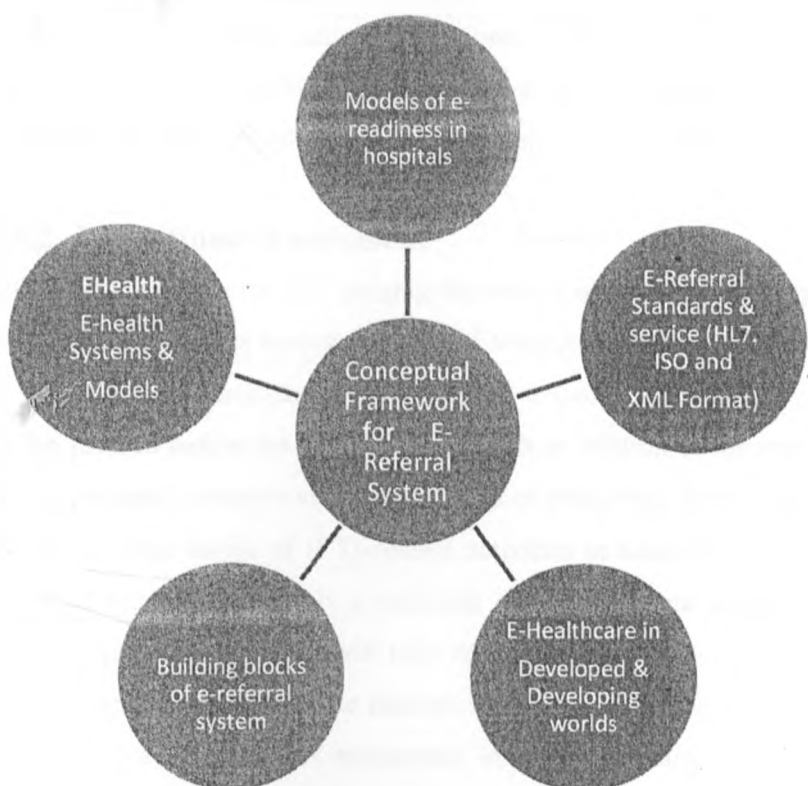
Source: author 2010

2.5.1. E- Readiness

E-readiness refers to the extent that a country or region is prepared for participation in the electronic world (Neilson, Brian 2002).ICT is a key weapon in the war against world poverty that when used properly, it offers a tremendous potential to empower people in developing countries to overcome development obstacles; to address the most important social problems they face; and to strengthen communities, democratic institutions, a free press, and local economies According to (Budhiraja et al 2006) Countries, organizations and communities must put efforts to prepare themselves to successfully meet the challenges of using the ICTs and maximize the opportunities that the information based economy offers in the modern digital world. Success at this age of information (information age) depends on how widely and well integrated ICTs are to a society's e-readiness is the degree in which a community /organization/country is qualified to participate in the networked world, which is measured by judging the relative advance of the important areas for the adoption of ICTs and their applications (Budhiraja et al 2006).The e-readiness process for a country, community or organization comprises four steps: First choosing an appropriate assessment tool based on a clear understanding of national goals for ICT integration, secondly conducting the e-readiness assessment, thirdly developing a detailed action plan that will move the country toward its objectives and finally Implementing the plan.

2.5.2. E-readiness Assessment

E-readiness assessment is a tool for judging the impact of ICT in a country, community or organization. The e-readiness assessment should Measures levels of ICTs penetration in the hospitals in regard to participation and service delivery activities, by collecting and analyzing the facts to define the level of e-readiness in relation to internationally accepted standards that presents a relative standing in terms of awareness, knowledge and capacities; identifying the various levels of ICTs-related activities in terms of technology in various service areas of the hospitals. This e-readiness assessments and e-strategies in hospitals needs to incorporate elements that will help enable a hospital to use ICT in provision of excellent healthcare services to all the patients towards achieving millennium development goals (MDGs).A good e-readiness assessment involves assessing the following elements (appendix 5):Physical access to ICT, appropriateness of ICT, affordability of ICT in the local context, ICT capacity and training, availability of locally relevant content and services, integration of ICT into peoples' lives, Socio-cultural factors that affect ICT use, legal and regulatory environment for ICT use, security and peoples' trust in ICT,

macroeconomic environment affecting ICT use and the government's role in driving e-readiness.

2.5.3. E-readiness assessment tools (Assessment Models)

These are e-readiness assessment models/tools that were developed to measure a country's or economy's e-readiness. The tools use varying definitions for e-readiness, different methods of measurement and the assessments with varying degrees of complexity and different outcomes. These tools make measurements by using questionnaires which use a set of direct questions about ICT and policy, Statistical methods that mathematically analyze ICT and policy data on the country, Best practices which incorporates experiences learned in comparisons with other countries and the historical analyses which uses unique political, economic, and social events to explain or forecast information technology usage in the country. The assessment tools (models) sued in e-readiness assessments provide both qualitative (historical analyses, best practices) and quantitative (questionnaires, statistical methods) assessments to e-readiness.

2.5.4. Comparison of the Models

Budhiraja (2006) notes that on the basis of the objective and focus of the study any of e-Readiness models, these models can be adapted or evolved based on the local needs. For the purposes of this study "Readiness Guide for Living in the Networked World" model was chosen, This model was developed by Computer Systems Policy Project (CSPP) as shown in appendix 5.The model was chosen because it focuses on the existing infrastructure measured: Infrastructure, Access, Applications and services, Economy and Enablers such as policy, privacy, security, ubiquity(CSPP).This model is ideal for measuring access, capacity and opportunity, which are very useful to investigate the e-readiness of the hospitals to grasp e-referral systems as an opportunity. The CSPP model satisfies the broad e-readiness indicators of Network access, Networked applications, Networked society, Networked economy and Network policy. It guides in the measuring the following categories: Infrastructure, Access, applications and services, Economy and enablers such as policy, privacy, security, ubiquity (Budhiraja, 2006).

2.5.5. Electronic health (e-Health)

The application and use of computer-based technologies in health care have undergone an evolutionary process. Advances in information, telecommunication, and network technologies have led to the emergence of a revolutionary new paradigm for health care that some refer to as e-health (Tan, 2008). Countries of the world have made, and are making major efforts to improve the delivery of appropriate health care at the right time and in the most effective and efficient way. Information systems and technology usually are at the heart of these efforts

According to WHO (2004) eHealth is the use of information and communication technologies locally and at a distance to presents a unique opportunity for the development of public health. Georgeff(2007)notes that there are two key characteristics of health care that should drive the type of Information and Communications Technology (ICT) .These are an acknowledgement that the fundamental business of health care is based on knowledge and secondly the need to be fully aware of the inherent complexity of health care composed as it is, of a large variety of highly autonomous, independent practitioners, all with their own systems and practices with potential benefits as shown in (figure 2.1).

2.6. Types of E-Health Solutions' environments

According to Microsoft (2009) eHealth is available in three distinct types of solutions which are in a chronological sequence as shown in figure 2.4.

Level 0 – Called Health 0 or the baseline or the legacy environment in which systems are essentially stand-alone applications, possibly quite old and often with paper-based inputs and interfaces. Nevertheless, they perform a vital function. There is often some small scale interoperability or integration based on location or by standardizing on a particular vendor's offerings. The scope of a business process is usually limited to the scope of a single application or two and the execution sequence of process steps is typically controlled by manual triggers and human interpretation of events and situations. Data is usually stored in isolated databases often in proprietary formats, which are hard to access and present semantic and synchronization problems.

Level 1 –"Health 1.0", in which strenuous attempts are made to "integrate" the legacy systems. This involves creating larger, more all-embracing applications that more comprehensively address specific functional areas and enable interoperability between

functional areas. Attempts are made to merge the isolated databases involving much effort to resolve semantic differences and implement a standards-based data exchange capability, these often foresee large, multi-terabyte databases that are difficult to secure and protect. Essentially these are B2B – business to business – approaches in which the patient or client is the subject of a transaction rather than the focus of a long-running process.

Level 2 –Health 2.0, where there is shift of focus of Health Information Systems from the provider to the consumer, shifting from a Business-to-Business (B2B) pattern to a Business-to-Consumer (B2C) pattern. In this case the consumers are the patients, healthcare professionals and administrators, starting to connect with virtual healthcare communities and turning to online sources of health information. This is achieved through patient, clinical and management portals, unified communication systems, mobile devices and facilities, and the provision of call center type services. The jump to Health 2.0 cannot happen overnight since there is a need to form a sound foundation which is a transition from Health 1.0

2.7. E-Health and E-Care Maturity Model

The evolution of eHealth and e-Care systems (Figure 2.4) moves from basic Internet presence and publishing of information; through development of new interaction channels and online transactions; to transformation of the underlying health processes. The evolution of information systems is often divided into four distinct phases that indicate the progression and maturity of electronic interactions between service providers, customers and consumers (Microsoft, 2009).

1. **Presence,** such as non-interactive Web sites where the main intent is to disseminate information.
2. **Interaction,** where limited online features are available, such as searching for information, sending e-mail messages, and possibly viewing data dynamically.

3. **Transaction,** where the user can take advantage of one or more services, perhaps making appointments, or renewing prescriptions for medication.

4. **Transformation,** where services become integrated, and expose portals tailored to specific sections of the community where the appropriate services combine and are orchestrated together. For example, when a patient makes an appointment with a

healthcare provider for a particular medical examination, the required scanning equipment is booked, specialist staff scheduled, laboratory time is reserved and the supervising clinician is alerted to oversee the process and counsel the patient.

Benefits
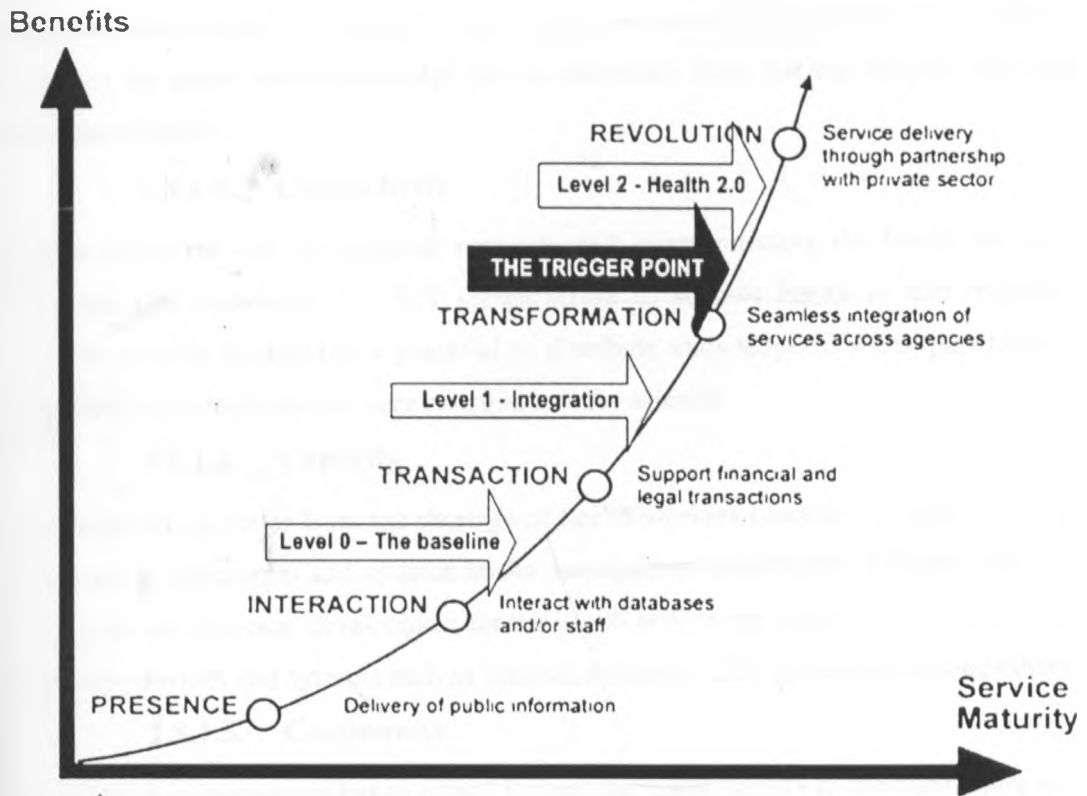
Figure 2.4: eHealth and E-Care Maturity Model (Source (Microsoft, 2009)

2.8. EHealth Analysis Model

An eHealth model is useful to inform the development process of eHealth in a country or hospital. The most common model for analysis of e-health in developing countries was proposed by Drury (2006) and referred to as the 5Cs model in which he argued that only when there is synergy between the various e-Health aspects of 5Cs that the full benefits of investing in eHealth can be realized. The 5Cs model evaluates context, content, capacity building, connectivity and community development as the analysis components.

2.8.1.1.   Context

EHealth can only be developed where there is a favorable environment to support the eHealth systems like electricity, availability of ICTs, continuous staff development (doctors,

ICT staff, Hospital administrators) a good support from the management and high quality management.

2.8.1.2. Content

This involves the process through which information gets to the health worker in the field in an appropriate format to support the worker when necessary. In the perspective of eHealth it improves the paper based knowledge into an electronic from that can support localization and customization.

2.8.1.3. Connectivity

This involves the use of computer networks and interconnecting the health facilities to distribute the knowledge. An ICT infrastructure to support health is also required. A wireless eHealth facility has a potential to distribute knowledge to wider population and therefore a mobile phone is a very essential tool for eHealth.

2.8.1.4. Capacity

The hospitals do suffer from the shortage of health workers (doctors, nurses) or may have no access to the current and updated health management information. EHealth can support continuous professional development for the health staff in the hospitals conveniently using electronic devices and systems such as internet, intranets, CDs, groupware among others.

2.8.1.5. Community

The eHealth infrastructure has to extend beyond the health facility to the community around the facility to ensure a wider source of information/knowledge and also a wider dissemination range for the available knowledge such as information on diseases outbreaks, or preventive measures. These components can be summarized as shown in figure 2.5

Figure 2.5 E-health development components

CONTEXT   CONTENT

COMMUNITY   CONNECTIVITY

CAPACITY

COMMITMENT
government & hospital
management
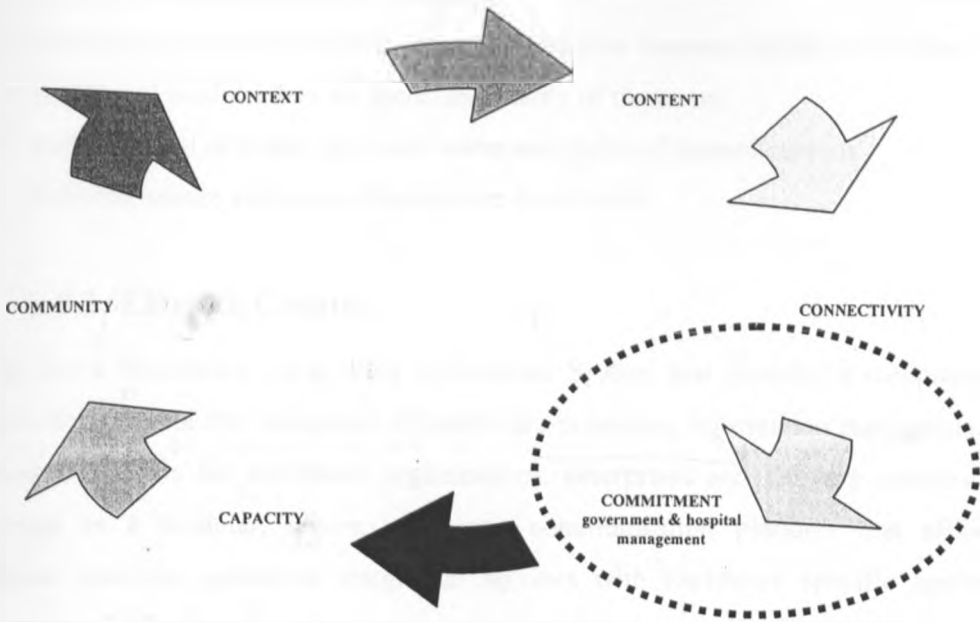
Source: Adapted from Drury 2006

2.9. E-Health Readiness

E-Health readiness refers to the preparedness of health-care institutions to implement programmes that involve use of Information and Communication Technology (ICT) in provision and management of health services. Level of readiness depends on a number of factors that lead to success or failure of eHealth programmes, and thus increase or decrease hope of achieving the desired results (Khoja.S, 2007).All over the world; countries have taken some steps forward toward eHealth.

2.9.1. E-Health project in Slovenia

Slovenia has embarked on an eHealth project called eZdravje (eHealth).It was started in September 2008 and expected to be completed by June 2015.This project is funded by European social fund, Budget of the Ministry of Health, other public funds and a total of over 67 million €.the expected benefits after completion of this project to Slovenians are:-

1. Increased confidence and independence through comprehensive security measures and access to their own data

21

2. Simplified procedures
3. Less time for administrative processes
4. Additional administrative data for communication between healthcare workers
5. Additional medical data for increased quality of treatment
6. Better control of health insurance status and rights of insured persons
7. Reliable, secure and open infrastructure for eHealth

2.9.2. EHealth Croatia

Croatia has a Healthcare Networking Information System that provides a comprehensive solution designed for the integration of healthcare processes, information management and business workflows for healthcare organizations, enterprises and delivery systems. It is developed as a modular, secure, and open communication platform that efficiently synergizes common enterprise integration services with healthcare specific application components. To date some 2400 primary healthcare teams in all 20 counties and in the City of Zagreb have been networked. The first phase was initiated 2005.

This eHealth solution allows e-prescription and e-referrals to be sent directly to pharmacies and labs / hospitals instead of carrying paper documents (printout). Retrieving and updating patient medical data (electronic healthcare record system). The solution also includes e-booking and e-reporting.

2.9.3. E-Health and implementation of Electronic Health Record in Denmark

The eHealth in Denmark is implemented using a system known as Medcom. The system supports the primary health sector with Standards for patient summary, lab results, e-Prescription among others. It provides standards for communication between hospitals in Denmark. The system also provides validation and certification of Health portal, E-record look up and an e-referral module.

The medcom is supported by A National Citizen Identifier that is used overall in Health care (public and private sector) as a key to identify individuals on matters of Health, tax, driving license, passport from birth to death. This project has brought about the following benefits for Denmark:-

- 50 minutes saved per day in GP practice
- Telephone call to hospitals reduced with 66%

- 2.3 € saved per message = 60 million per year
- 3.5 million Euro saved on using E-referrals
- Patient results obtained with no waiting time.

2.9.4. E-health in Australia

Australia, like the rest of the developed world is facing a looming crisis in its health care system from an unprecedented and simultaneous bulge in demand while there are worsening shortages in skilled workers needed to meet this demand. The vision of their health management system is:-

a)   **Engaging Consumers**

Patients are fully engaged in their own healthcare, supported by information and tools that enable informed consumer action and decision making, working hand-in hand with healthcare providers. Tools that support consumer engagement are well designed and customized to the diversity of consumers. These tools are integrated into the delivery of care, and are conveniently available outside healthcare settings as well

b)   **Transforming Care Delivery at the Point of Care**

Australian health care is high quality, patient centered, for a lifetime, and reflects a coordinated and collaborative approach. Complete, timely and relevant patient-focused information and clinical decision support tools are available as part of the provider's workflow at the point of care. High quality and efficient patient care is supported by the deployment and use of interoperable health IT and secure data exchange between and across all relevant stakeholders

c)   **Improving Population Health**

Electronic healthcare data and secure health information exchange are utilized to facilitate the flow of reliable health information among population health and clinical care systems to improve the health status of populations as a whole. Information is utilized to enhance healthcare experiences for individuals, eliminate health disparities, measure and improve healthcare quality and value, expand knowledge about effective improvements in care delivery and access, support public health surveillance, and assist researchers in developing evidence based advances in areas such as diagnostic testing, illness and injury treatment, and disease prevention.

d)   **Aligning Financial and Other Incentives**

Healthcare providers are rewarded appropriately for managing the health of patients in a holistic manner. Meaningful incentives help accelerate improvements in quality, safety, efficiency and effectiveness. Quality of care delivery and outcomes are the engines that power the payment of providers

e) Managing Privacy, Security and Confidentiality

In Australia's fully-enabled electronic information environment designed to engage consumers, transform care delivery and improve population health, consumers have confidence that their personal health information is private, secure and used with their consent in appropriate, beneficial ways. Technological developments have been adopted in harmony with policies and business rules that foster trust and transparency. Organizations that store, transmit or use personal health information have internal policies and procedures in place that protect the integrity, security and confidentiality of personal health information. Policies and procedures are monitored for compliance, and consumers are informed of existing remedies available to them if they are adversely affected by a breach of security. Consumers trust and rely upon the secure sharing of healthcare information as a critical component of high quality, safe and efficient healthcare.

f) Policy and Implementation

Policy development and implementation bodies, both government and private deliver clear and insightful leadership of eHealth programs within the health sector. They have a deep understanding of the cultural and operational complexities of the area and ensure that programs are appropriately structured and funded to be successful.

2.9.5. EHealth in Botswana

According to healthcare IT news (2010) A modern hospital recently opened in Botswana which is being referred to as a paperless hospital "without borders." The hospital is home to an advanced information technology department that supports electronic medical records and telemedicine capability with satellite connectivity. This hospital has set the pace for eHealth adoption and usage in Botswana

2.9.6. EHealth in Rwanda

Frasier, H. et al (2008) observes that Rwanda has six significant entities in health information technology to date which are OpenMRS that is an open-source Medical Records System that tracks patient-level data a TracPlus and TRACnet that is a monthly monitor of infectious diseases including HIV/AIDS, TB, and Malaria, a CAMERWA that is

a drug and medical supply management system, telemedicine which is an Information and communication technology (ICT) used to deliver health and healthcare services, information and education to geographically separate parties, a health Management Information Systems (HMIS) that integrate data collection processing, reporting, and use of the information for programmatic decision-making and finally an e-Learning system that use ICT in instruction of A2-level nurses for promotion to A1 status.

Despite the availability of many programs, there is limited interoperability between the various eHealth systems currently used in Rwanda such as OpenMRS, TRACnet, CAMERWA among others. The current forms of the HMIS modules are not integrated with each other. A planned HMIS overhaul is intended to fix many of these issues, when funds will be available .The Government of Rwanda would like the HMIS to be universally interoperable with current systems and require interoperability with HMIS as a criterion for future systems and modules.

Access to information at the clinic and national level exists though with little granularity. In some clinics, the implementation of electronic medical record systems enables clinicians to access comprehensive patient data efficiently.

In Rwanda Telemedicine efforts have been growing at the ground level. There is also an attempt to develop an e-Learning program that would facilitate nurse training and hopes to leverage its eHealth initiatives to build capacity broadly within its medical professionals.

2.9.7. E-health studies in Kenya

In the perspective of Ouma,et al,(2008) the use of Information Communication Technologies (ICT) within healthcare can make significant changes in the daily operations of hospitals particularly within the developing world. In Kenya various studies have been carried out to establish whether there is significant adoption of ICTs in the health care. In Nyanza a technology assessment of five hospitals has been conducted to find out how hospitals are embracing the use of ICT, seeking to establish the current structures in place in terms of technologies, equipments and communication media available within the rural areas and examined the challenges that exist which may not favor the implementation of eHealth solutions within the developing world. The study concluded that the major challenges were: lack of enough technologies in the hospitals to support eHealth, unreliability of the communication infrastructure available, inaccessibility of ICT technologies to most of the staff in the hospitals and lack of basic computer operation skills

as the main challenges that faces eHealth implementation in the rural areas. (Ouma,et al,(2008).From the literature reviewed, most of the studies conducted in Kenya reflects more on use of ICTs in supporting organizational structures and management in the hospitals particularly in the rural areas, with no explicit study on electronic patient referral process.

2.10. Referral process in Kenyan Health care System

In Kenya there are two national referral hospitals which are; Kenyatta National Hospital in Nairobi and Moi Referral and Teaching Hospital in Eldoret. The equivalent private referral hospitals are Nairobi Hospital and Aga Khan Hospital in Nairobi. The referral process in Kenya takes place as:-

1. Inter-hospital (Hospital to Hospital) referrals which involves

- Public to Public
- Private to Public
- Private to Private

2. Inter-facility such as Clinics in a Hospital e.g. from casualty to dental clinic.

The Inter-hospital (Hospital to Hospital) referrals are broadly categorized as emergency and non emergency referrals (routine referrals), with a referring facility and a receiving hospital, each of them having a particular responsibility. According to Chowdhury (2007) the health care facilities should ensure the following the referring and the referral hospitals must perform some activities as outlined:-

2.10.1. Referring Facility:

i. Identify the facility where the patient needs to be referred to

ii. Inform the patient/ next to kin regarding referral to another facility

iii. Contact the referring facility: Notify the doctor in the Emergency/casualty department regarding the patient's condition and get an approval to transfer

iv. For in-patient transfer / referral require the accepting hospital to have an available bed, and acceptance by a physician who has admitting privileges.

v. A designated hospital hotline shall be made accessible for the purpose of patient referral

vi. All inter-hospital transfers must be coordinated directly between the physicians in the referring facility and the accepting facility

vii. Prepare for the transfer: Ambulance, Equipments and Medications

viii. Qualified medical/paramedical personnel must be present in the ambulance when transferring the patient

ix. It is the responsibility of the referring physician to ensure continuity of care and patient safety during the transfer process

2.10.2. Receiving Facility

i. Accept the patient referral via telephone communication

ii. Arrangements must be made before the patient arrives

iii. The referred patient at the receiving facility must receive necessary management without any delay.

2.11. E-Health Systems Interoperability

E-health interoperability is a state of readiness to deal with new technologies, clinical practices and changes in policies, which is used to signify an overall capability of all participants to interoperate, spanning information, technical, and organizational perspectives. (NEHTA, 2007).

In reference to Miller's work (2002) organizations to be interoperable, they should actively be engaged in the ongoing process of ensuring that the systems, procedures and culture of an organization are managed in such a way as to maximize opportunities for exchange and re-use of information, whether internally or externally. He further identifies three types of interoperability as:-

◊ Functional interoperability/Technical Interoperability is the ability to exchange information which ensures that all the hardware and software component of networks and information system can physically communicate and transfer information successfully.

◊ Semantic Interoperability that refers to the ability to use the information that has been exchanged and the meaning of information to its human users, as opposed to the simple physical transfer of data. Semantic interoperability is tied directly to communities of practice, and to the negotiation of meaning that occurs within them.

◊ Political/Human Interoperability that consists of Inter-community Interoperability, Legal Interoperability and International Interoperability.

Interoperability contributes to enhanced healthcare delivery facilitating continuity of care and better decision making while delivering cost savings, undertaking five levels of maturity to capture the maturity of Practice. (NEHTA, 2007).

None, this is a level with no awareness of e-health interoperability issue nor processes to support it. It uses isolated system design, development, and procurement

Initial-There is an early awareness of e-health interoperability requirements and characteristics and perhaps some early e-health interoperability solutions adopted, typically localized within certain clinical or administrative domains (as these provide environments with limited complexity).

Managed-(under-development): An organization will begin accomplishing some interoperability goals, such as the adoption of specific e-health standards, while gaining an early shared understanding of data, services or internal processes, as well as initial governance established to ensure repetition of earlier successes.

Defined-An organization has defined a set of guidelines for the adoption of e-health for data, services and processes, according to the lessons learned from previous maturity levels. These are further augmented with explicit focus on policy and legal compliance. Governance is well defined and defined levels of organizational readiness for interoperability outcomes are established. Communication standards for interaction with internal and external partners are established as are the supporting organizational structures facilitating a shared understanding across technical and semantic issues.

Measured-An organization has established processes for appraising and measuring e-health interoperability. This can be done before the system is deployed such as through conformance and compliance activities or during the operation of the system, i.e. run-time monitoring.

Optimized-The organization has implemented processes to support continuous interoperability improvements, driven by feedback from monitored processes, with the aim of improving overall e-health interoperability capability.

2.12.   The E-Health Referral Systems

Referral is the communication, with the intention of initiating care transfer, from the provider making the referral to the receiver. The essential components of referral are the intent and facilitation of transferring patient care in whole or in part from one health care provider or organization to another provider or organization (Leslie et al, 2006). Therefore our e-referral refers to the electronic version of transmitting referral documents and information from the metropolitan hospitals to the referral facility (KNH).According to Barbara (2003) the most important building block to support electronic referral is the implementation of agreed common best practice by service providers and practitioners. Although called an e-referral system, it is acknowledged that referral is only one activity that can be undertaken electronically. Others include referral feedback, client information updates, client assessments, care plans; essentially any information that might need to be communicated about a client to enhance integrated service delivery will now be able to be communicated electronically, in a secure message or attachment according to heart improvement programme (HIP 2006), Paper based referrals are prone to illegibility, getting lost, and, when problems arise, arguments can occur about when and how the referral was made, which is a dangerous situation to the patient and the doctors.

2.13.   E-referral Status in Kenya

In the words of Veli (2002), one of the most challenging problems in the healthcare domain, is providing interoperability among healthcare information systems, which are scattered across many facilities, offices, labs, pharmacies and imaging centers(Diamond, et al 2005).A major set of obstacles to widespread health information exchange is technical.

In Kenya health system is extremely diverse and highly fragmented. In addition, the participants in the health system, which encompasses large hospital networks, individual doctors, labs, and others, that uses various types of computers and software to store patient information, or none at all, with some other information systems can't communicate with others because they lack standard ways of transporting and presenting information across the networks.

According to NeoTool (2007), the primary reason for the challenge of interfacing health care information systems is that as internal hospital teams or software vendors create new clinical applications, each application is developed without input or collaboration with other application development teams. This means that commercial development teams rarely

share proprietary data on how their applications are built, so it is difficult for other teams to build compatible applications.

2.14. Architectural framework for an e-referral system

2.14.1. E-referral system architecture

It consists of a referring side and the receiving side .each side has a user/client system that interfaces to the web based applications integrated by an intermediary system. The web services layer suppo t the transport of messages between the two hospitals as shown in figure 2.6

Figure 2.6   The architectural framework of an interoperable e-referral system
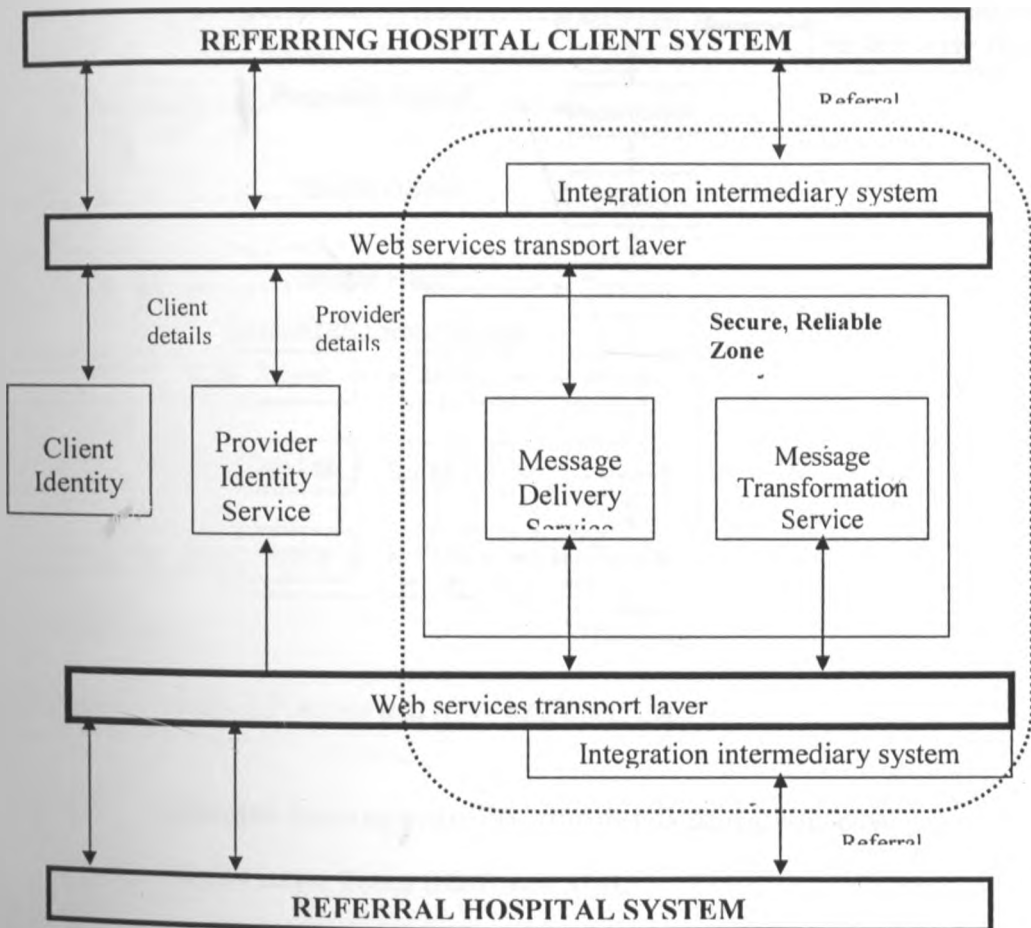
Source: adapted from Leslie Hugh et al, 2006

2.14.2. The web services layer services

The web services layer in the referral architecture figure 2.7 is supported by a standard protocol referred to as HL7 that is a top application layer of the Open Systems Interconnection (OSI) model, which has seven levels of requirements or specifications for a communications exchange. Each layer provides a service to the layer above it and extends the service provided by the layer below it. At the top, the highest layer is referred to as the application layer, which contains protocols designed to meet the communication requirements of specific applications, and mainly defining the interface to a service (Coulouris G, 2002).In this highest OSI application layer, the HL7 applies.

Figure 2.7 Message communication in a Network based on the OSI-OSI model
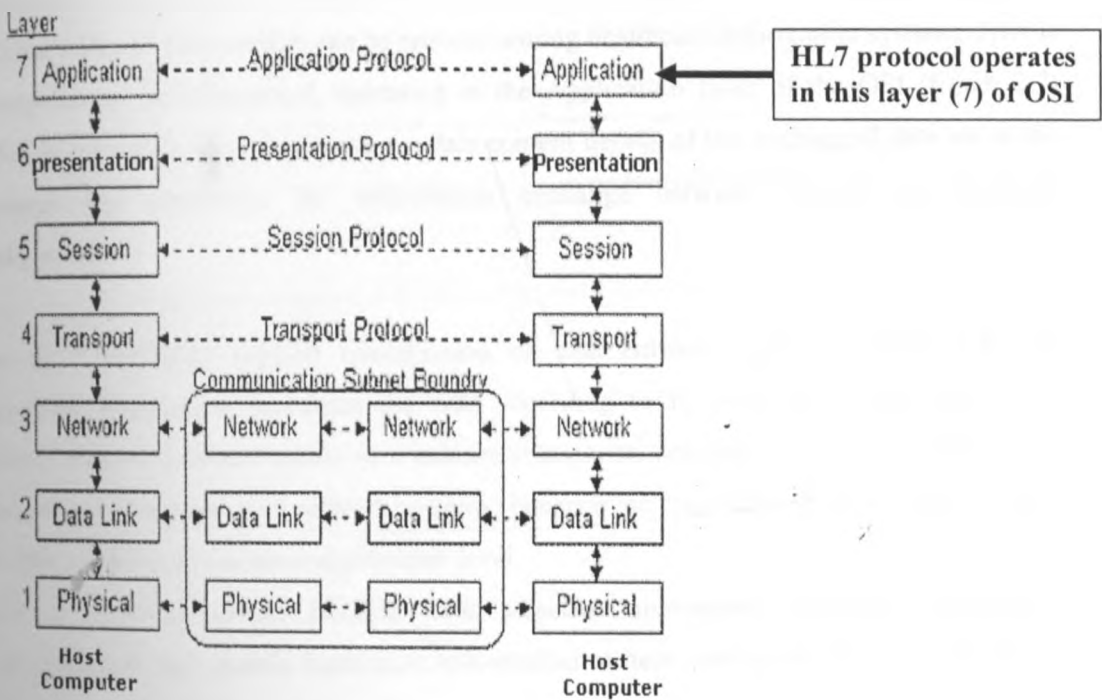
Adapted from: Duley CJ. Access and HDN Reference. 2000

2.15.   eHealth Interoperability standards and protocols

2.15.1. Health Layer Seven (HL7) and XML

HL7 represents is an ad hoc standards group formed to develop standards for exchange of health-care data between independent computer applications and also. the health care data messaging standard developed and adopted by the HL7 standards group(Healthinfo,2011).

HL7 group developed a model known as reference information models (RIM) that is used along with coding systems such as the Systematized Nomenclature of Medicine for clinical terminologies (SNOMED) and Logical Observation Identifiers Names and Codes (LOINC) to define medical concepts in the Clinical Document Architecture markup standard.

In order to ensure interoperability of the systems from various vendors the communication standards are necessary (Rudowski, 2004). The Health Level 7 (HL7) is developed by HL7 Standard organization which is one of American National Standards Institute (ANSI) accredited standards operating in the healthcare arena. The HL7's domain is clinical and administrative data. Its mission is set the standards for the exchange, management and integration of data that support clinical patient care and the management, delivery and evaluation of healthcare services so that the interoperability, compatibility, and quality of medical data and information can be ensured among healthcare information systems. HL7 is an application layer protocol, operating in the Application layer of the OSI (figure 2.7) which is primarily concerned with the data content details of the exchanged data set or the message and semantics for information exchange between clinical and business applications.

The HL7 standards support transmission of data between systems (figure 2.8). An individual application processes the data according to its purpose in that application. Content moves between points in a telecommunication network (such as the Internet, an intranet and other types of network systems) because the communication protocols moving the data conform to the same application level.

HL7 is used to create flexible, cost effective approaches, standards, guidelines, methodologies that enable healthcare information system interoperability and sharing of electronic health records. (Wikipedia).

Figure 2.8   several applications interconnected using HL7 protocols and standards

| Laboratory Application | Radiology Application | Pharmacy Application | Physician Application | Other Healthcare Applications |

HL7   HL7   HL7   HL7   HL7

System connecting Applications
within healthCare using HL7

API   Web Services   EDI

ERP   CRM   Finance   Other Business Applications
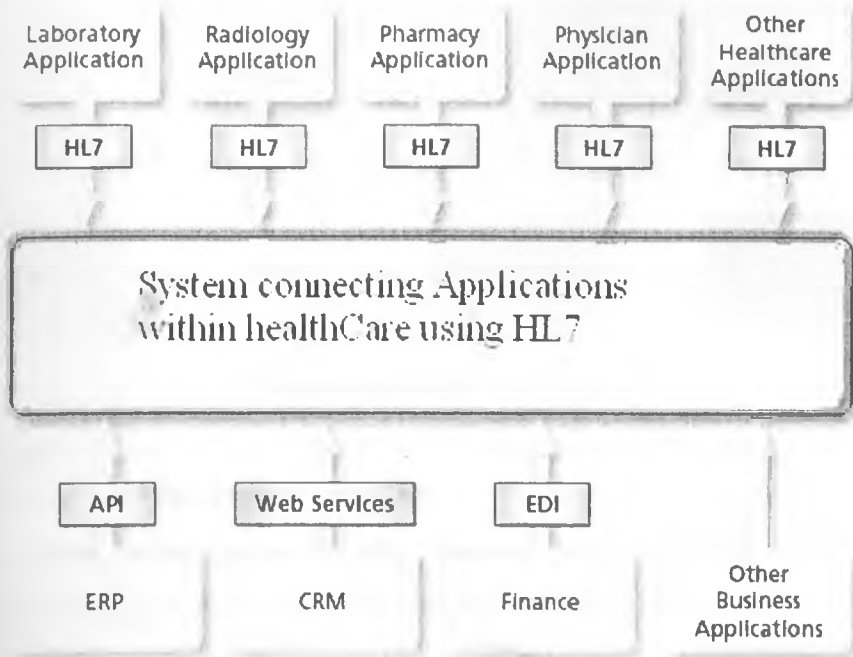
Source: Adapted from NEHTA, 2007

2.15.2. Reference Information Model (RMI)

RIM is a static model of health and healthcare information as viewed within the scope of HL7 standards development activities. Follows object oriented developmental methodology based on a UML model with the following classes as shown in figure 2.9:-

1. An Act represents any *action* that occurs and is documented throughout the process as health care is managed and provided

2. An Entity represents any physical thing and/or beings that are of interest to, and take part in health care

3. A Role describes the task that **Entities** play/provide as they participate in health care acts

4. Participation refers to an association between a Role and an Act

5. An Act relationship is the association between a pair of Acts

6. A Role link is the connection that may exist between two roles that expresses a dependency between those roles

Figure 2.9   RIM models classes
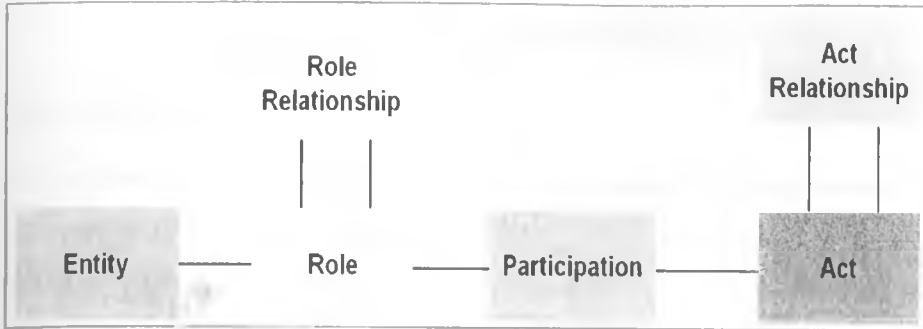
Source: Adapted from hl7.org

2.15.3. eXtensible Markup Language

HL7 uses   XML to encapsulate the HL7 message for   conducting   the information interchange and delivery in the system implementation.HL7 message is able to be encoded in eXtensible Markup Language(XML). These XML specified HL7 Standard (Chiu Ruey-Kei,2007) were formally approved by American national standards institute(ANSI)in July 2003 and has been used by healthcare industry since then. The HL7 Clinical Document Architecture (HL7 CDA) is an XML document markup standard that specifies the structure and semantics of clinical documents such as admission, discharge summary or progress note, for the purpose of exchange. The CDA (Dolin, et al., 2005) can be loaded within an HL7 message, so it is also known as HL7 CDA message, which is a defined and complete information object that can include text, images, sounds, and other multimedia data.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0   Introduction

Literature reviewed has revealed that there is a great interrelationship between eHealth, electronic health records and electronic referral. Electronic Health systems include applications of Information Communication Technologies to promote healthcare services support, delivery and education for health workers. The success of an eHealth system is very much dependent on the success of Electronic health record (EHR) systems, as EHR forms the core of any eHealth system. E-referral is the use of eHealth systems to facilitate the referral process and therefore eReadiness assessment is an essential requirement for the success of electronic referral in terms of adoption rate or acceptance.

Various e-readiness models were evaluated to find out the most appropriate model for the hospital e-readiness status. After a careful evaluation, CPP model (appendix 5) is adopted to look into the eReadiness of the hospitals to embrace electronic systems to manage the patient referral process in Kenya. The e-readiness was investigated by assessing eHealth readiness components for a hospital (Drury, 2006) which are context, content, connectivity, capacity, community. These were used to evaluate the technological institutional /management and clinical preparedness to adopt electronic referral system in the hospitals focusing on access, economy, infrastructure, applications and enabling environment (CSPP, 1988).To validate the study technological readiness; the economic readiness and the human resources readiness are investigated.

First of there was the need to investigate the technological readiness, about the available technological systems that are provided and the way they are used. The economic readiness examines the willingness of the hospitals to invest in eHealth since eHealth brings along large costs and the hospitals needs to be prepared to make the necessary investments in infrastructure but also foresees a degree of administration support.

The human readiness refers to the knowledge and the skills of the hospital staff (doctors, ICT staff and administrators) being the eHealth users, having necessary basic skills as well as feeling at ease with used technology.

To achieve the stated objectives and answer to the research questions, the following research methodology will be used:-

3.1   Assessment of the Existing Methodologies

Bridges.org (www.bridges.org) indicates that the starting point in the selection of the right assessment methodology is the Comparison of E-Readiness Assessment Models: Their comparability describes the various methodologies that are available and what they measure, including the tools' underlying goals and the assumptions which shape their outcomes (appendix 5). It's difficult to try combining all the different approaches to make a single assessment tool since different methodologies cover different situations and serve different purposes and an all-inclusive methodology would therefore leave out certain levels of detail or focus that is required in certain countries and not in others. As a result the computer systems project (CSPP) of 1998 was chosen because it fits in the 5Cs e-health development model of developing countries such as Kenya as shown in figure 2.5

3.2   Research Design

This research project is an academic research type whose main objective is to evaluate electronic readiness in the hospitals for electronic referral process between Nairobi metropolitan hospitals and Kenyatta National Hospital as a referral facility. The metropolitan area covers administrative Nairobi City and the immediate surrounding areas. Data was collected from the sampled hospitals targeting these hospitals staff: Doctors and other health workers, ICT staff and Hospital administrators or management by means of questionnaires and observation. The 5C's (context, content, connectivity, capacity and community) model was used to create the data collection instruments/questionnaire. The data from this study was analyzed using SPSS and Microsoft Excel.

3.2.1 Target Population

The target population for this research is staff members(doctors and health staff, administrative/management and ICT) of the sixty three (63) hospitals both public and private within the Nairobi metropolitan area that refer their patients to Kenyatta national hospital. Kenyatta National Hospital is the main referral hospital for the other hospitals from the metropolitan region from both the private and public hospitals.

3.2.2 Sample Estimation

The main goal of this analysis is to find the minimum sample size of hospitals required from a population of 63 hospitals in Nairobi which provides in-patient services as registered by the National Hospital Insurance Fund (NHIF). A margin of error (confidence interval) is maintained at 0.25 using a confidence level at 95% with a 50% accuracy percentage. A sample estimation calculator was use as shown in appendix 9.

$$SS = \frac{Z^2(p)*(1-p)}{c^2}$$

Where

SS is   the sample size

Z = Z value (e.g. 1.96 for 95% confidence level)

p = percentage of picking a choice, expressed as decimal, (0.5 used for sample size needed)

c = confidence interval, expressed as decimal (e.g. $0.04 = \pm 4$)

pop= population

$$SS = \frac{1.96^2(0.5)*(1-0.5)}{0.25^2}$$
$$SS = 15$$

For a finite population the new sample size corrected

$$SS = \frac{SS}{1 + \frac{SS - 1}{pop}}$$

$$SS = \frac{15}{1 + \frac{15 - 1}{63}}$$

$$SS \approx 13$$

Using this formula, sample size was 13 hospitals that were confidently estimated for this study within the Nairobi metropolitan area.

3.2.3 Sampling and the Focus group

Simple random and purposive sampling was used for this study. First the hospitals were to be involved in the study were randomly chosen using simple random sampling without replacement using pieces of paper with the name of the hospitals that were folded, and mixed in a basket, eleven (12) papers representing hospitals were drawn, and Kenyatta national hospital was Purposively selected as the main referral center, from the others in Nairobi that includes *Agha Khan* and *Nairobi* Hospitals which are high cost private hospitals. However *Agha Khan* and *Nairobi* hospitals were available in the basket as hospitals that may refer patients to *Kenyatta*. The hospital staffs were divided into three groups of doctors and health workers, hospital administrators and ICT staff and from the various strata's, non proportional purposive sampling was used due to the uneven/understaffing in most of the hospitals. The selected hospitals provided multiple case studies for this study.

3.3 Data Collection

3.3.1 E-Health Readiness Measurement Instruments

The study instruments were developed based on existing models assessing e-readiness of organizations. Questionnaires were developed based on the Computer systems project (CSPP) model of assessing e-readiness in the Nairobi metropolitan area hospitals both referring and referral hospitals. The CSPP model accommodated the six (6Cs) main components of the Drury's e-health analysis model which I modified. The developed questionnaires were used it to measure the eHealth readiness in the hospitals. Data was collected using questionnaires, interview and observation. In this study the questionnaires were distributed to the target group personally. Interviews were conducted to supplement the information collected through the questionnaires in this study, providing a more accurate impression of the actual situation. Observation was used to validate the data collected, making the research more objective.

3.3.2 Primary Data Sources

The main primary sources of data involved all data collected from the stakeholders in the referral process within selected hospitals in the Nairobi metropolitan area. Kenyatta national hospital provided the various requirements for the patient referral network for this study. The focus group consisted of health workers, practitioners and the health information users

in the hospitals within Nairobi metropolitan area. The target groups were Classified as(table 3.1):-

(i) **Kenyatta National Hospital**
- o ICT staff and support Service providers
- o Admitting Clinical workers in the casualty (Doctors, nurses)
- o Administrators/management

Table 3.1   Kenyatta National Hospital [referral facility]

Focus group	No.	Comments
ICT staff & support Service providers	3	
Hospital administrators/management	5	
Health workers(Doctors ,Nurses ,clinical officers	10	
Total	**18**	

(ii) **Metropolitan Hospitals**

From the selected hospitals, data was collected from the following:-
- o ICT staff
- o Doctors and health staff attending patients
- o Administrators/management staff

Table 3.2   Selected Government and private hospitals in the metropolitan area

Name of the hospital	Target population of hospital staff			Sample proportion of hospital staff			Sample size
	Health staff Estimates	Admin & mgt staff Estimates	ICT staff Estimates	Health staff (10%)	Admin staff	ICT staff	
Kenyatta National Hospital	>500	50	12	13	5	3	21
Mathari Hospital	50	4	1	5	1	1	7
Avenue Hospital	40	5	1	4	1	1	6
Mbagathi	40	5	1	4	1	1	6
Kihara Sub-District Hospital	20	3	1	2	1	1	4
Kikuyu Mission Hospital	50	3	1	5	1	1	7
Kiambu District Hospital	60	4	1	6	1	1	8
Huruma Nursing Home	20	2	1	2	1	1	4
Radent Hospital	20	2	1	2	1	1	4
Guru Nanak Hospital	40	3	1	4	1	1	6
Nazareth Mission Hospital	*50*	*6*	*1*	*5*	*1*	*1*	*7*
St Marys Hospital Langata	*50*	*4*	*1*	*5*	*1*	*1*	*7*
Marie Stopes	*30*	*1*	*1*	*3*	*1*	*1*	*5*
Totals	**1470**	**92**	**24**	**60**	**17**	**14**	**94**

3.3.3 Secondary Research Sources

Extensive secondary research was conducted on the exchange of clinical data/messages between the referring hospitals and the referral facility. Documents on ehealth and e-readiness were also reviewed. Various documents relating to manual health referrals from the Kenyatta national hospital (appendix 2),Central bureau of statistics in Kenya, Ministry of health, newspapers, journals, publications, magazines and other relevant publications were used to provide useful insights on the electronic health referral process.

3.3.4 Data Collection Techniques

3.3.4.1 Interviews

Interviews were conducted with the hospitals medical superintendent so as to gain access to the health facilities to distribute questionnaires. Oral discussions were held to justify the purpose of the study and why their hospital's staff should participate. After the interview some hospitals allowed me to administer the questionnaires while others were denied me the clearance to distribute the questionnaires. Informal individual discussions were also undertaken with other staff members of the hospitals both clinical and non clinical, which provided very useful insights to this study.

3.3.4.2 Questionnaires

Questionnaires were designed to investigate the e-readiness for electronic health for various health institutions to facilitate/inhibit successful integration of the electronic referral process in the hospitals and the perceived benefits that can be realized as a result of integration of the referral information systems between health facilities.

Due to the differences in orientation of the stakeholders involved in the implementation of a successful electronic referral process, three (3) different questionnaires were designed for each category of the respondent (health workers, Hospital Management/administrators and ICT personnel)working in each hospital (appendices [a],[b],[c]). The design of the questionnaires was simple to allow respondents answer questions correctly and easily irrespective of their ICT skills' level. Most of the questions required a simple 'tick box' response or yes/no answers. The questionnaires were distributed to the target population within the sampled hospitals.

3.3.4.3 Testing the reliability of the questionnaires

The designed sets of questionnaires were pre tested using respondents from the sampled hospitals to ensure that the questionnaires do measure what it is supposed to measure, words are well understood, respondents to interpret the questions in the same way, all response choices are appropriate, respondents correctly follow directions, a positive impression that motivates people to respond, how long it takes to complete filling in and finally test whether it collects the information required for the study. Three hospitals were selected *(Kenyatta,Kihara,Mathari and Kikuyu)*

3.3.4.4 Observation Documents Review and Analysis

Observation was used as a supportive and exploratory means of collecting data. During the process of distributing the questionnaires, various observations were made in regard to technology, management procedures, clinical procedures and ethical considerations among others. This was very useful to this study.

3.3.5 Research Permissions and Clearance

Due to the nature of the study relating to hospitals' ethical concerns and the degree of confidentiality/privacy required, relevant permission has to be sought from the relevant authorities relating to the study such as school of computing and informatics-University of Nairobi, Kenyatta national Hospital / University of Nairobi (KNH/UoN ERC), KNH scientific and research committees, ministry of health (appendix 8) and the consent by participants through interview (appendix 3)

CHAPTER FOUR

RESULTS, ANALYSIS & INTERPRETATIONS

4.0. Chapter Overview

This chapter presents the results, analysis and interpretations of findings focusing on: A
Kenyan context in which e-referral system is to operate (Context), adequate ICT

Infrastructure which supports access to ICT (Connectivity), An enabling environment which involves policies and strategies, access to information and knowledge (Content), human resources knowledge and skills (Capacity), eHealth systems and services, allocation of resources and money (Commitment) and the community to be supported by the e-referral system (community development).The results are broadly analyzed on the basis of public versus private

4.1. Introduction

Qualitative and quantitative methods of data analysis were applied. The responses from the questionnaires, observations and document review have been translated into raw scores, summary tables of frequencies and percentages. To achieve this, statistical software tools (SPSS) was used for analysis. Microsoft Excel was used to complement SPSS particularly in creating charts. Tabular presentations and charts have been used to represent the results and findings.

4.2. Survey Responses

The table above shows the response rate of this study. However three hospitals within the sample could not participate in the research due to internal policy challenges on research protocol in their institutions. The return rate for Kenyatta was low because of the very busy schedules by the doctors and other health staff as shown in table 4.1.

4.3. The Surveys Findings

Table 4.1 Summary of survey responses

Name of the hospital	Sample proportion of hospital staff			Respondents for each hospital per category			Total respondents
	Health staff Estimates (10%)	Admin & mgt staff Estimates	ICT staff Estimates	Health staff	Admin staff	ICT staff	
Kenyatta National Hospital	13	4	4	7 53.8%	2 50%	3 75%	12 57.1%
Mathari Hospital	5	2	2	3	1	1	
Avenue Hospital	4	2	2	3	1	2	
Mbagathi	4	2	2	5	1	1	
Kihara Sub-District Hospital	2	2	2	1	1	1	
Kikuyu Mission Hospital	5	2	2	3	1	2	
Kiambu District Hospital	6	2	2	4	1	1	
Huruma Nursing Home	3	1	1	3	1	1	
Radent Hospital	2	1	1	1	1	1	
Guru Nanak Hospital	4	2	2	2	1	1	
Nazareth Mission Hospital	5	2	2	0	0		0
St Marys Hospital Langata	5	2	2	0	0	0	0
Pumwani Maternity Hospital	3	2	2	0	0	0	0
			2	- 0	0	0	0
Totals	62	17	29	0	0	0	0

4.3.1. Hospital Classifications

Table 4.2 indicates that the hospitals under study were classified as public and private. The study involved a sample size of thirteen (13) hospitals both private and public within the Nairobi metropolitan area. However three hospitals did not allow their staff to participate in the study (one public and two private) the total that participated was public at 60% and private at 40%

Table 4.2 hospitals classifications

		Frequency	Percent (%)	Valid Percent (%)
Valid	Private	4	40.0	40.0
	Public	6	60.0	60.0
	Total	10	100.0	100.0

4.3.2. ICT staff qualifications in hospitals

The figure 4.1 shows that private hospitals had employed more ICT staff with lower qualifications than in public hospitals while public employed more degree graduate than private hospitals. This was due to cost cutting measures in the hospitals,

Figure 4.1   ICT personnel qualifications

Highest Academic/Professional ICT qualification
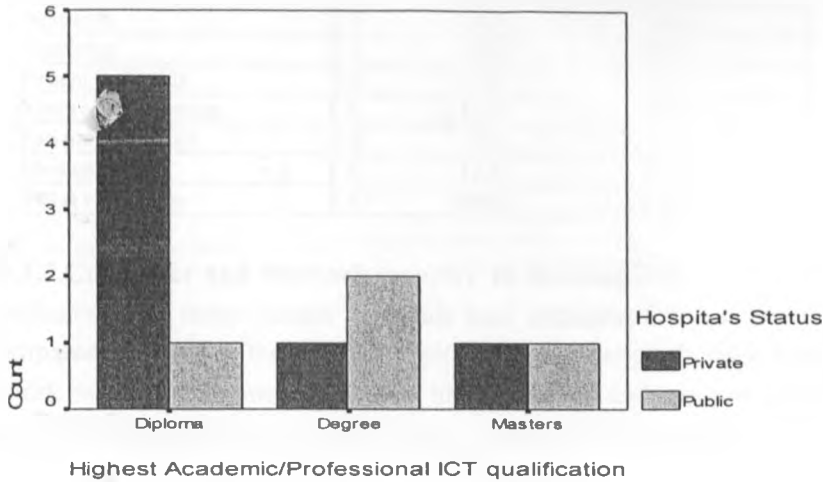
4.3.3. ICT INFRASTRUCTURE

4.3.3.1. Availability of ICT departments in hospitals

The table 4.3 shows that more hospitals both private and public had functional ICT departments in their hospitals. Only one respondent from a private hospital indicated that the services were outsourced externally. This point to the initial level of e-health maturity level in the hospitals.

Table 4.3   Is there an independent ICT dept in this hospital?

Count		Hospital's Status		Total
		Private	Public	
Is there an independent ICT dept in this hospital?	Yes, there's an independent functional ICT dept	3 (27%)	4 (36.4%)	7
	Yes, but exists under another dept	3 (27%)	0 (0.0%)	3
	No, ICt services are out sourced	1 (9.1%)	0 (0.0%)	1
Total		7	4	11

4.3.3.2. Hospitals' Automated functions

Table 4.4 shows that most of the respondents agreed that respective hospitals have a particular level of computerized tasks showing that there is an early awareness of e-health processes, and hence the level of e-health maturity is at the initial stages.

Hospital Function	Count	% of Responses	% of cases
Pharmacy	3	6.4	42.9
Accounting & Finance	3	6.4	42.9
Administration	6	12.8	85.7
Research	7	14.9	100.0
Teaching	6	12.8	85.7
Patient Referrals	6	12.8	85.7
Electronic Learning	6	12.8	85.7
Patient Discharge	4	8.5	57.1
Medical	6	12.8	85.7
Total responses	**47**	**100.0**	**671.4**

4.3.3.3.Computer and Network security in the hospitals

In table 4.5 indicates that more private hospitals had implemented a computer network (58.3%) as compared to 33% of the public hospitals. Public hospitals have both excellent and poor network security extremes as shown in figure 4.2, and we can generalize that private hospitals have a fair network security which can support e-health better than public hospitals.

Table 4.5 computer networks in the hospital

			Is there a computer network in this hospital?		
			Yes	No	Total
Hospital's Status	Private	Count	7		7
		Table %	58.3%		58.3%
	Public	Count	4	1	5
		Table %	33.3%	8.3%	41.7%
Total		Count	11	1	12
		Table %	91.7%	8.3%	100.0%

Figure 4.2   the network security
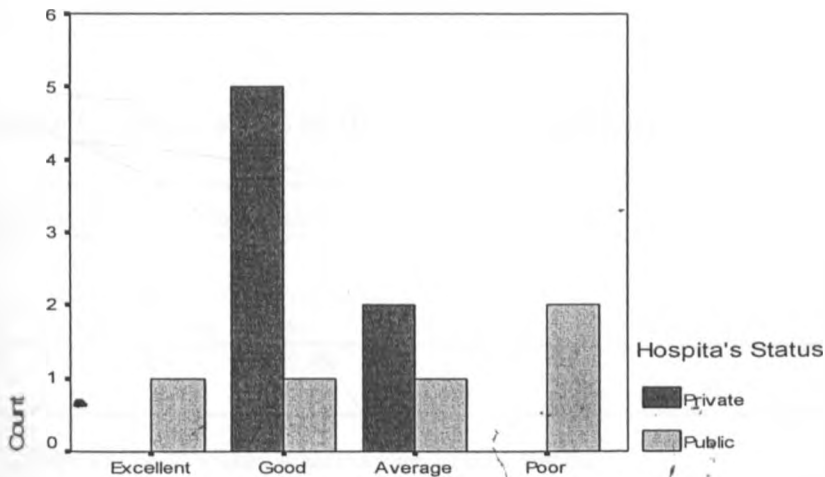
4.3.3.4.Internetworking and interoperability

Table 4.6 shows that 54.5% of the hospitals had some capability to provide data interoperability by having connectivity to the outside networks(internet) therefore more closer to the managed level of eHealth, while only 9.09% of the public hospitals had connectivity to the internet, therefore further away from being e-ready to adopt e-health services such as e-referral.

Table 4.6 Does this hospital have a link to wide area network outside an intranet?

Count		Hospital's Status		Total
		Private	Public	
Does this hospital have a link to wide area network outside an intranet?	No	0 0%	4 36.6%	4 36.6%
	Yes	6 54.5%	1 9.09%	7 63.4
Total		54.5%	5 45.5%	11 100%

4.3.3.5.Hospital's web services

Table 4.7 use of web services in hospitals

			Hospital's Status		Total
			Private	Public	
Does the website store any information about the hospital (hospital staff, patients, management)	Yes	Count	3	2	5
		Table %	37.5%	25.0%	62.5%
	No	Count	2	1	3
		Table %	25.0%	12.5%	37.5%
Total		Count Table %	5	3	8
			62.5%	37.5%	100.0%

Most of the hospitals both public and private had some web pages that they used to manage the hospitals administrative tasks as shown in table 4.7 at 37.5% for private 25% for the public hospitals with more information about hospitals is maintaining ministry of health and electronic health services website in Kenya, indicating a general level of awareness on e-health services and hence at the initial stage of e-health maturity.

4.3.3.6.Computer access by Health workers in the hospitals

Hospital's Status	Do you have access to a computer in this hospital?			
	Yes		No	
	Count	%	Count	%
Private	12	42.9%		
Public	16	57.1%	4	100.0%

Table 4.8a Health workers access to a computer in the hospitals

Table 4.8a shows that there more health workers had access to computers in private than in public health institutions, at 42.9% for private and 57.1% for the public hospitals. This indicates that the hospitals are still in their initial stages of developing adequate ICT infrastructure to enable the health workers effectively use the computers in their operations.

4.3.3.7.Health workers ICT usage experience in years

Years of Experience	Previous Computer Training	
	Count	%
1	4	33.3%
2	2	16.7%
4	2	16.7%
5	3	25.0%
10 and above	1	8.3%

Table 4.8b Health workers Skills and experience

As shown in table 4.8b above, most of the health worker respondents who had previous training on ICT had a working experience of about one year (33.3%) and only 8.3% had above 10 years ICT usage experience. This implies there is good access as shown in table 4.8 that is coupled with some training in ICT as shown in table 4.9

4.3.3.8.Computer access by hospital administrators/management

			Hospital's Status		Total
			Private	Public	
Have access to a computer and have Computer skills /training?	Yes				
		Table %	40.0%	40.0%	80.0%
	No				
		Table %		20.0	20.0%

Table 4.9 administrator's access to a computer in the hospital

Table 4.9 illustrates that most of the administrators at 40% for public and 40% for public have access to a computer and have got some ICT training, but 20% of administrators from the public hospitals have access to computers but has no ICT training. This implies that in terms of ICT literacy skills the private hospitals administrators are more e-ready than in the public hospital administrators and hence the public hospitals are less e-ready for e-health.

4.3.3.9.The level of computerization in the hospital

Table 4.10a in your own opinion what is the level of computerization/automation in this hospital?

		In your own opinion what is the level of computerization/automation in this hospital					
		Excellent	Good	Average	Poor	Very Poor	Total
Hospital's	Private	4	3	5	0	0	12

| Status | Public | 0 | 3 | 11 | 4 | 2 | 20 |
| Total | | 4 | 6 | 16 | 4 | 2 | 32 |

In table 4.10a opinions of the health workers presented shows that private hospitals have excellent ICT infrastructure and therefore more ready for e-health than public hospitals, and this implies that they have progressed a level entering to the managed level of e-health maturity. As table 4.10b shows that 9.7% of the respondents agreed that excellent infrastructure had a high positive impact on the action time on patients' referrals in their respective hospitals.

			Do you think your answer in (2.3) above has positive impact on the action time on patients' referrals in this hospital?			Total
			High Impact	Some Impact	No Impact	
In your own opinion what is the level of computerizatio n/automation in this hospital	Excellent	Count	3	1	0	4
		% of Total	9.7%	3.2%	.0%	12.9%
	Good	Count	2	2	2	6
		% of Total	6.5%	6.5%	6.5%	19.4%
	Average	Count	4	6	5	15
		% of Total	12.9%	19.4%	16.1%	48.4%
	Poor	Count	1	3	0	4
		% of Total	3.2%	9.7%	.0%	12.9%
	Very Poor	Count	1	1	0	2
		% of Total	3.2%	3.2%	.0%	6.5%
Total		Count	11	13	7	31
		% of Total	35.5%	41.9%	22.6%	100.0%

Table 4.10b   Impact of computerization on patients' referral action time

4.3.4. APPLICATIONS AND SERVICES
4.3.4.1. Need For Online Referral Services

Table 4.11 shows that over 60% of the health workers respondents agreed that introducing a new electronic referral system would make the hospital realize the benefits of timely admission, reduced congestion, reduced number of health workers for admission, provide efficient transfer of patients referral data, managing patients referrals, increase the speed of sharing of clinical data between doctors and also maintain a good relationship between the patients and the hospital staff. This indicates that most of the doctors have a positive attitude towards adoption of an electronic referral system in the hospital. This can make the ehealth adoption to be accelerated.

	Timely Patients admission and management	Reduced congestion during admissions and consultation	Reduced number of health workers required for referral process	Efficient transfer of patient's referral data from another hospital	Reduce costs and efforts in management of patient referrals	Increased speed of sharing of the clinical data between the doctors	Maintain a good working relationship between patients and the hospital staff
	%	%	%	%	%	%	%
Strongly Agree	38	38	14	54	32	64	32
Agree	62	45	45	39	50	25	46
Not sure	0	17	17	7	11	7	21
Disagree	0	0	21	0	7	4	0
Strongly Disagree	0	0	3	0	0	0	0
Total	100	100	100	100	100	100	100

Table 4.11   Perceived benefits from usage of an e-referral system by health workers

4.3.4.2. Application of ICTs in patients management

Figure 4.3a clearly shows that the health workers are in agreement that a new electronic referral system would enhance that patient-staff relationship and also reduce the congestion in the casualty area during admission of patients through automation of such processes.

Benefits on Patient management
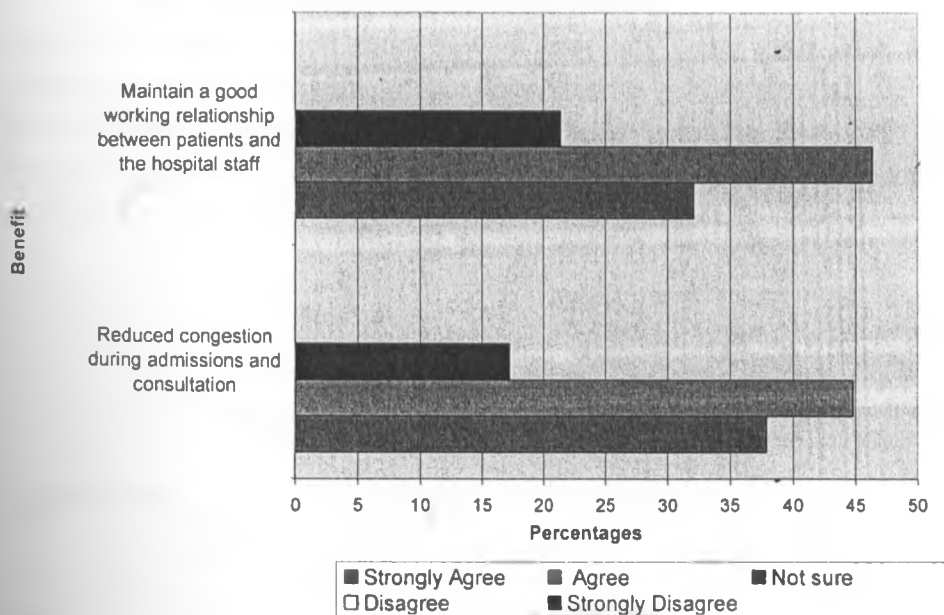
Figure 4.3a Benefits on patients' management

Figure 4.3b demonstrates that the electronic referral would significantly reduce the cost, time, efforts, and number of health workers who may be required in the referral process. This implies the patients' referral process would be streamlined and enhanced.
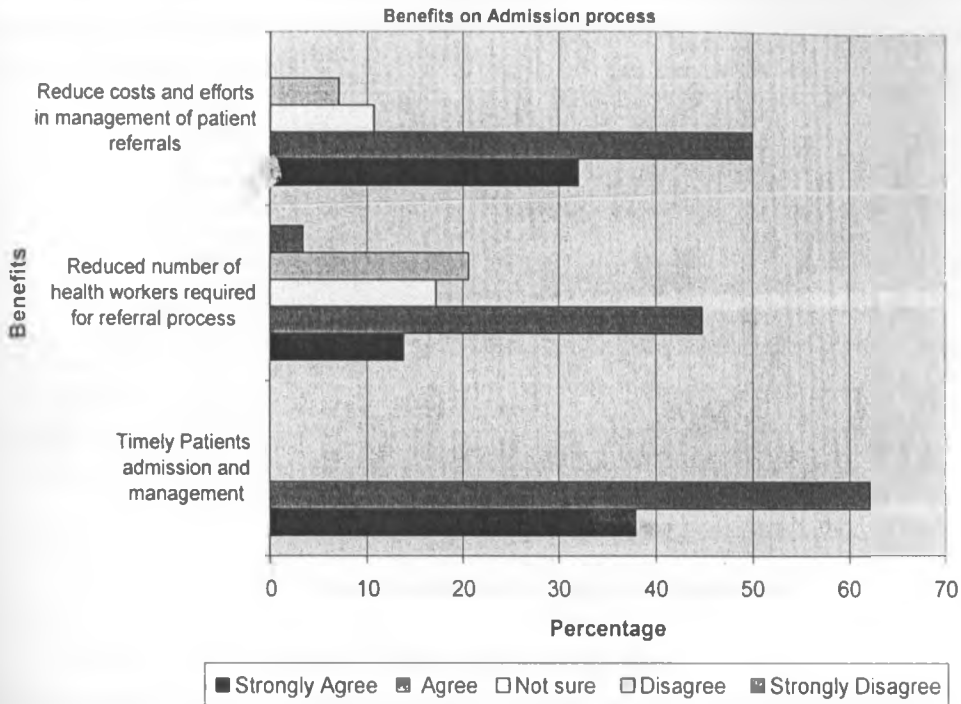
Figure 4.3b Benefits on patients' admission process

4.3.4.3. Application of ICTs in the hospital

Table 4.12 indicates that more private hospitals were using ICT applications to perform patients' management functions than in public hospital. It is also evident that the hospitals have a very low level of interoperability between them. It is also clear that most of the applications are localized clinical and administrative solutions and hence an early awareness of ehealth.

Hospital's Status		Capturing of patients information /data		Storage of patients information /data		Retrieval of the information /data of the patient captured		Analyzing the patient information /data stored		Transferring of patient information from one department to another		Receiving patient information referred from another hospital	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Private	Count	12		12		11	1	10	2	10	2	3	9
	Table %	38.7		38.7		35.5	3.2	32.3	6.5	32.3	6.5	9.7	29.0
Public	Count	8	11	7	12	6	13	5	14	2	17	2	17
	Table %	25.8	35.5	22.6	38.7	19.4	41.9	16.1	45.2	6.5	54.8	6.5	54.8

Table 4.12   Usage of ICTs in the hospital

4.3.4.4. Health workers s application of ICTs in hospitals

As table 4.13 indicates, most of the doctors both from public or private have used computers for research and online learning purposes, while very few of them have used ICTs to Share medical knowledge with other medical staff in other hospitals, Exchange/share patient referral information with other hospitals, online diagnosis of patients, and telemedicine operations. This indicates that the health workers are in the early stages of e-health readiness being only at the initial stage of progression.

Hospital's Status		Share medical knowledge with other medical staff in other hospitals?		Exchange/share patient referral information with other hospitals		Online diagnosis of patients		Research		Online surgical operations		Online Learning /Education	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Private	Count	7	4	2	10	2	10	8	4	1	11	10	2
	Table %	23.3	13.3	6.5	32.3	6.5	32.3	25.8	12.9	3.2	35.5	32.3	6.5
Public	Count	8	11	3	16	3	16	16	3		19	17	2
	Table %	26.7	36.7	9.7	51.6	9.7	51.6	51.6	9.7		61.3	54.8	6.5

Table 4.13health workers usage of ICT applications

4.3.5. ELECTRONIC HEALTH ENABLERS

This section provides more useful insights on the various enablers that support successful implementation of e-health in hospitals.

4.3.5.1. Technical enablers

Technical requirements are fundamental in enabling successful ehealth system in hospitals. However as shown in figure 4.4, more health workers' respondents agreed or strongly agreed that the hospitals lack computer networks, E-referral standards, necessary hardware, and data security .This is a slow down to the implementation of e-health in hospitals. This implies that lack of technical requirements is a major hindrance to e-referral implementation in hospitals.
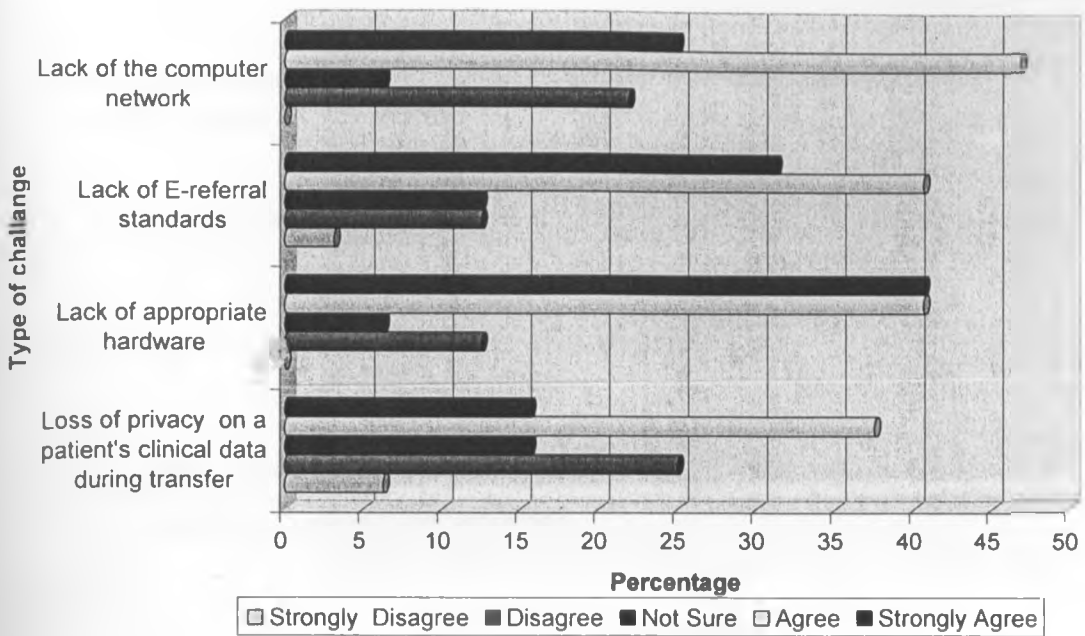
Figure 4.4   Technical challenges on e-referral system implementation

4.3.5.2.   Non Technical Enablers

Non technical enablers are also very critical in ensuring that a successful implementation of ehealth system is realized. Some of these enablers include ICT vendor support, Finances and adequate budgets for ehealth implementations, adequate ICT staff and appropriate skills for the e-health workers. Figure 4.5 shows that hospitals staff agreed/strongly that lack of these enablers in the hospitals greatly contributes to slow adoption process for e-health systems.
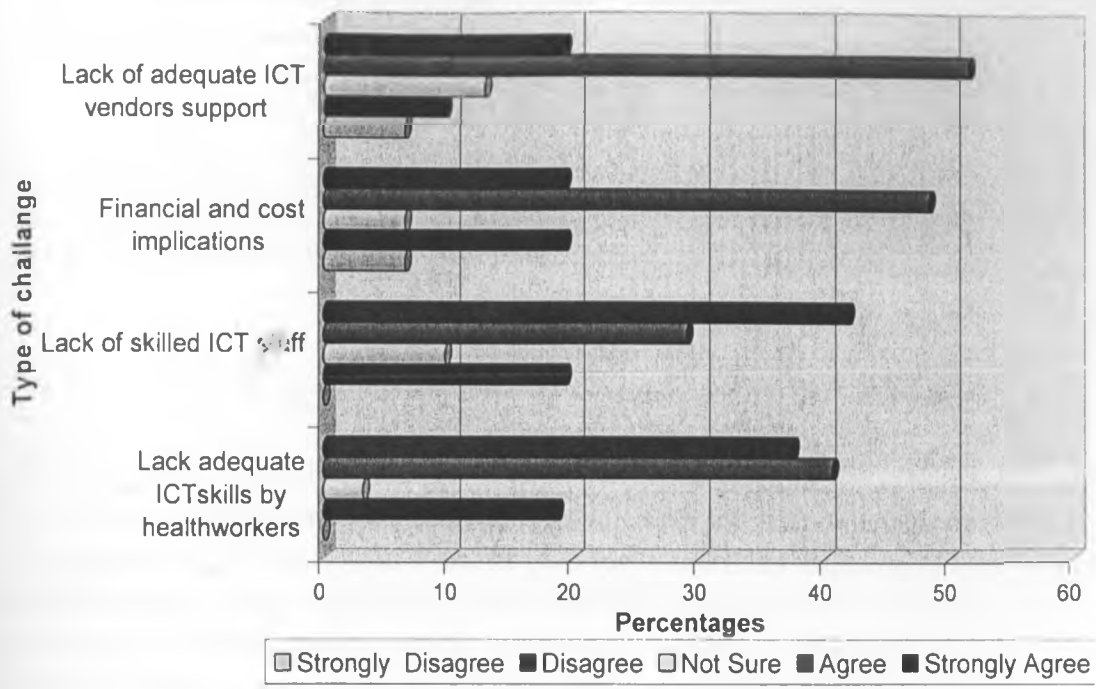
Figure 4.5　　　Technical challenges on e-referral system implementation

Figure 4.6 shows that inadequate legal infrastructure, high costs of user training, operational and maintenance costs of ICTs would highly impact on electronic referral implementation in the hospitals. This an implementation of the e-referral system must deal with the causes of systematic failure.
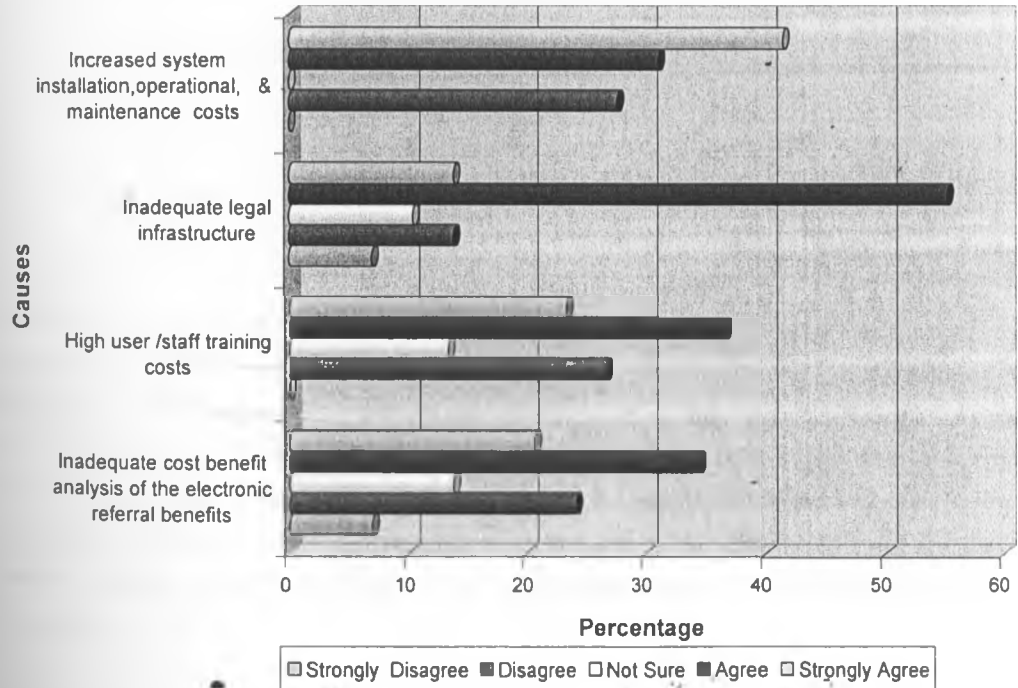
Figure 4.6 causes of systematic failure for e-referral implementation in hospitals

4.3.5.3. ICT planning and master plan implementation

		Do you think there was a proper planning for ICT implementation in this hospital?		Total
		Proper Planning	Ad-hoc planning	
Does this hospital have an ICT Master Plan supporting ICTs adoption, software licenses, upgrading, general maintenance etc?	Yes	4	2	6
	%	40.0%	20.0%	60.0%
	No	1	3	4
	%	10.0%	30.0%	40.0%
	Total	50%	50%	100%

Table 4.14   ICT planning and master plan implementation

The table 4.14 above illustrates the planning level of ICTs in the hospitals. 40% of the hospital management staff respondents indicated that hospitals which had proper planning for the ICTs also had a master plan for future ICTs implementation. 30% of all management staff respondents stated that the hospitals had no master plan and planning of ICTs is ad-hoc. This is slows down the process of ehealth and e-referral systems hospitals, because proper planning supports systems implementation.

4.3.5.4. Funding for the computers in the hospital

Hospital's Status		How were the computers and other ICT devices acquired in this hospital?		
		Hospital Funds & Donors	Hospital Funds only	Kenya Government
Private	Count	3	1	
	Table %	30.0	10.0	.
Public	Count	3	2	1
	Table %	30.0	20.0	10.0
	Total	**60%**	**30%**	**10%**

Table 4.15   Funding for Computers

The table 4.15 showed that in the private hospitals the main sources of the ICT equipment funds was through donations and the individual hospital's funds at 60%.Only 10% indicated that the government of Kenya was involved in providing the infrastructure. Private hospitals received no funding at all from the government. This implies that government funding as an enabler is necessary to supplement the available public-private partnership in supporting ICT investments in the health sector thereby greatly influence the implementation of e-referral systems in the hospitals.

4.3.5.5.   Training policy for employees on how to use ICT systems

Hospital's Status		Is there a training policy for employees in this hospital, that would facilitate skills development on employees on how to use ICT systems		Total
		Yes	No	
Private	Count	2	2	4
	% of Total	20.0%	20.0%	40.0%
Public	Count	1	5	6
	% of Total	10.0%	50.0%	60.0%
Total	Count	3	7	10
	% of Total	30.0%	70.0%	100.0%

Table 4.16   Employee training policy

Table 4.16 illustrates that 70% of the hospitals do not have a training policy that may guide new skills acquisition in the hospitals. Private hospitals were more equipped with a training policy (20%) better than in public hospitals which had only 10%.This can slow down the process of acquiring new skills on how to use a new e-referral system.

4.3.5.6.   Interoperability Challenges

Figure 4.7 shows the challenges hospital's ICT staff perceived as most challenging in the implementation of a successful e-referral system in the hospitals. The ICT staff felt that legal challenges were more (100%) in government hospitals than in private hospitals. Other perceived major challenges in public hospitals included resistance to change (75%), administrative, data security and ethical issues. This implies that private hospitals are more ready for e-referral than public ones, posing a challenge to interoperability for e-referral system implementation.
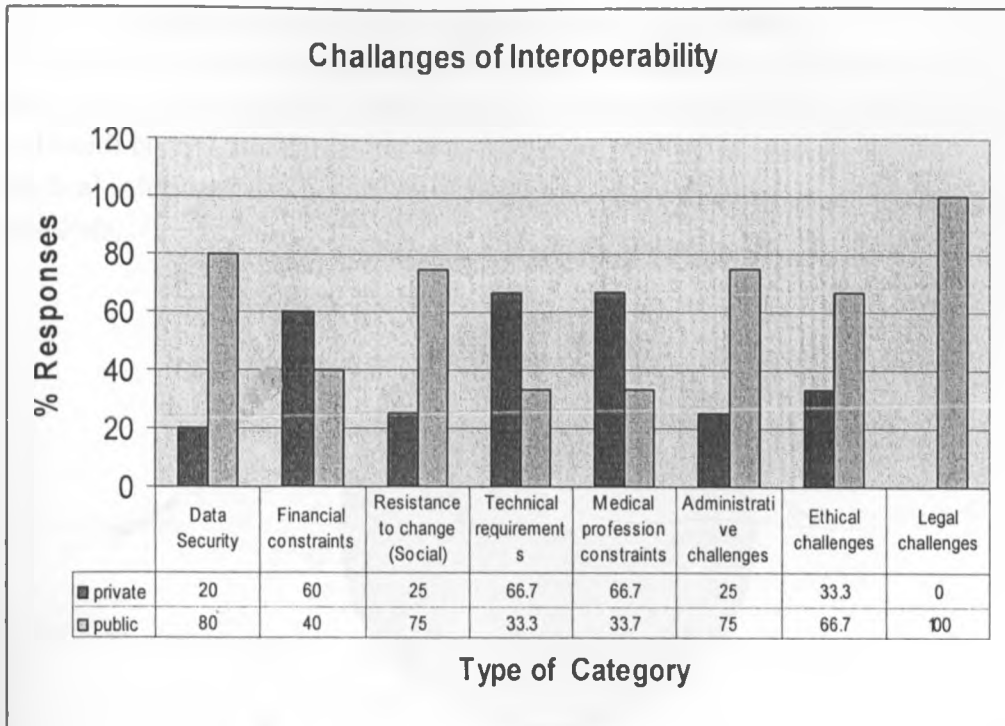
Figure 4.7Challenges of interoperability

4.3.5.7. IS security policy

The figure 4.8 shows that most of the hospitals do not have an IS Security policy in place. This indicates that the best practice of an institution adopting a security policy is not adhered to by majority of the health institutions, to enhance level of confidence in existing e-referral solutions since security is one of the ehealth enablers.
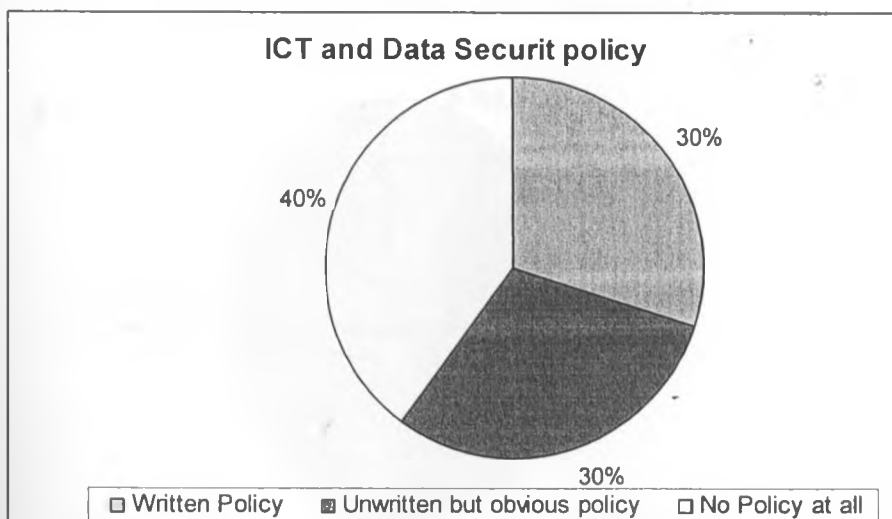
Figure 4.8 Data security policy

4.3.5.8. ehealth implementation standards (HL7 AND XML)

For successful ehealth implantation, good standards adoption is essential. Figure 4.9 shows that 75% of the ICT staff working in the metropolitan hospitals is not aware of Health layer 7 standards that is widely used for system interoperability for medical information. This can be a major hindrance to adoption of e-referral in most hospitals.
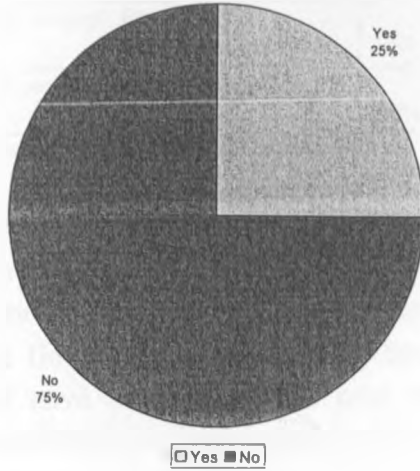
Figure 4.9   HL7 awareness

Figure 4.10 shows that the of all the ICT staff who responded to this question only 9.1% used a system in their hospitals that use XML standard whose main goals emphasize on simplicity, generality, and usability over the internet. This implies that for there to be interoperability for e-referral over the internet the other hospitals must embrace the use of XML standard, and hence increase usability of the internet for eHealth.
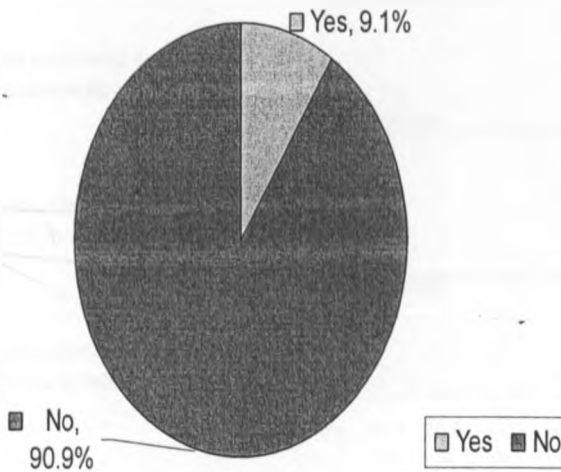
Figure 4.10 use of xml standard

4.3.5.9.   Management's perception on E-referral implementation

	Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
Hospital's Organizational structure that can support the e-referral system	20%	10%	20%	50%	0.0%
Need for investing in an electronic referral system in this hospital	10%	10%	10%	50%	20%
Implementation of the e-referral system fits in the hospital's strategic plan	0%	10%	30%	40%	20%
Cost reduction by using e-referral services instead of the current manual referral system?	0%	10%	0%	70%	10%

Table 4.16   Management perception on e-referral system implementation

The table 4.16 illustrates the perception of the hospital's management on implementation of e-referral system.50% of the respondents agree that the hospitals have the organizational structure to support the implementation of the e-referral system and streamline the flow of information in the hospital.70% of them believe that the e-referral would have a direct/indirect cost reduction. This is a major motivator towards implementation of the e-referral system, since they perceive it as having benefits if implemented.
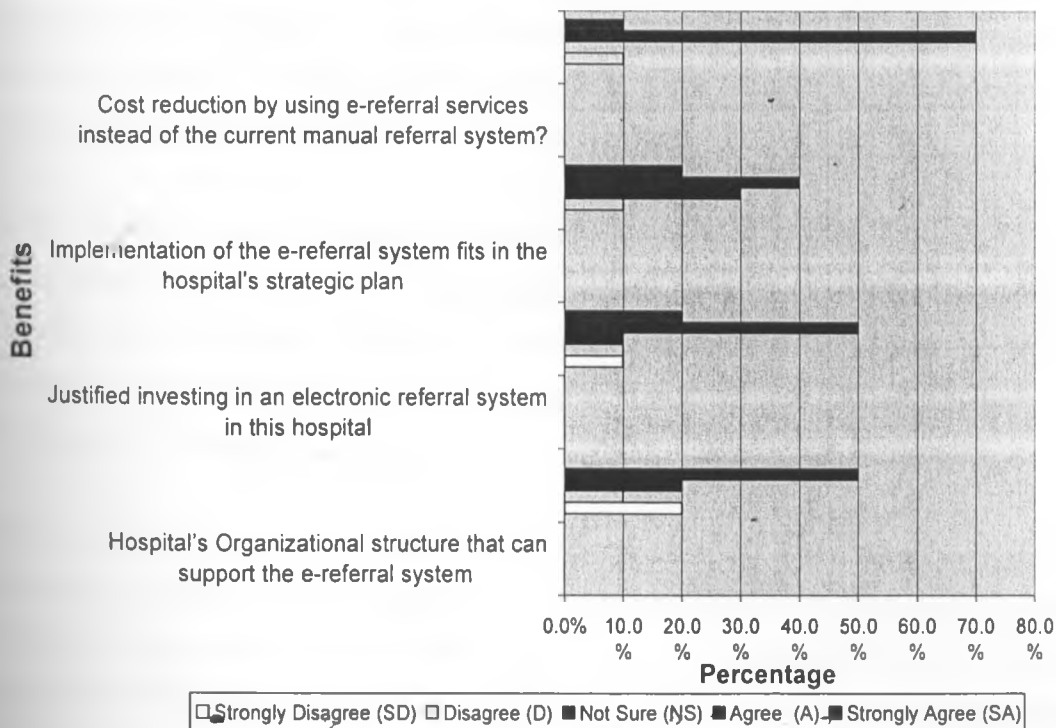
Figure 4.11 Management perceptions on implementation of e-referral

CHAPTER FIVE

E-REFERRAL IMPLEMENTATION FRAMEWORK

5.0   Introduction

The study has been used to develop a framework electronic referral system implementation that can be adopted while integrating the information systems to support the electronic referral process between the referral hospital (Kenyatta) and the metropolitan hospitals.

5.1   Implementation Framework

This framework builds on the substantive body of literature examining the guidelines for assessing electronic readiness of organizations and eHealth readiness. It draws on the key elements of Drury's (2006)5Cs of eHealth assessment and an addition of the sixth C of commitment to make 6Cs (figure 2.5) as observed during the study. This model is used to evaluate the three major pillars of en eHealth system implementation (technical requirements, management or administrators and health workers).These three pillars do influence the implementation of eHealth and e-care systems as demonstrated by Microsoft(2009) in figure 2.4. I believe that each of the eHealth implementation could be linked to practice to assist in guiding the efforts for a successful implementation of integrated health information systems for e-referral system.

In the framework shown in figure 5.1, the first step for implementation is the assessment of the electronic health readiness for the hospital focusing on context, content, connectivity capacity, community and commitment. These elements are used to evaluate the eHealth readiness of the health workers, hospital management and   the technical requirements for the hospital.

Effective health care management requires transparency of information on policies, regulations, and decisions affecting all the stakeholders, equitable and consistent policy relating to health; and therefore it affects greatly the rate at which the hospital technical requirements will be ready and directly support the direction health workers adopt in regard

to the e-referral system. The synergies of the management, technical requirements and health workers will highly influence the implementation of the e-referral system.

Step three involves the evolution of information systems electronic referral system in, with six distinct phases that it will undergo: emergence of e-referral systems, adoption of the referral system, adaptation of the e-referral to the actual referral tasks, acceptance of the e-referral systems in the hospital, rationalization of the e-referral process and finally diffusion of the electronic refe~ral system in the hospitals involved in the community, region or country into using the e-referral system.

In summary the framework shows the stages through which an e-referral will have to accomplish to mature: Commitment to (Ownership of the e-referral vision), Implementation of electronic health records, Implementation of electronic health systems, Implementation of electronic referral systems and Implementation of electronic referral services in all the hospitals.

I believe that this framework provides a comprehensive and applicable guide that may assist in the process of assessing, selecting and tools and strategies for electronic referral systems implementation.

Results & Milestones

The work of my project will most certainly wrap up the best practices to provide a sustainable framework to support the transfer of clinical documents across the referring hospitals within the country. Most importantly, regardless of the outcome of the prototype, the results of my project will have a significant impact on other students and interested people who are trying to use ICTs to enhance e-health systems in Kenya using the computer networks and appropriate standards of medical informatics such as,Health Level 7 (HL7), Clinic Data Architecture, and Digital Imaging and Communications in Medicine. **Chiu, Ruey-Kei** (2007) notes that the adoption of standards to develop information interchange system has been is an important issue to enhance the interoperability and compatibility in Health care industry. Different industries may have developed different standards for different purposes. Regardless of the purposes in adopting standards, they are aimed to improve the efficiency and effectiveness of system development, maintenance, and utilization.

Figure 5.1   Electronic Referral Implementation Frameworks

E-HEALTH READINESS ASSESSMENT AND ANALYSIS

- Context
- Content
- Connectivity
- Commitment
- Capacity building
- Community development

ASSESS
Infrastructure, Access, Enablers, Applications & Service

AFFECTS

Technical requirements
- Hardware & Software
- Interoperability
- Privacy and security
- ICT training
- E-health applications
- Standards

Hospital Management and administration
- Policies
- Planning
- Monitoring
- Directing
- Financing/funding

SUPPORTS

Health professionals
- Clinical Practices and procedures
- Clinical guidelines & documentation
- eHealth records
- Coding terminologies

INFLUENCES

PROGRESSIVE STAGES OF E-HEALTH IMPLEMENTATION

None
No awareness of e-health interoperability

Intial: Early awareness of ehealth interoperability requirements &characteristics; with localized clinical and administrative domains

Managed: - accomplishment of some interoperability goals such as adoption of specific e-health standards, data sharing and good governance

Defined: well defined guidelines for adoption of ehealth for data services and processes according to lessons learned from the previous levels

Measured: the hospitals have established processes for measuring e-health interoperability

Optimized: The hospitals have implemented processes to support continuous interoperability for patient referral process

CHAPTER SIX   DISCUSSION

6.0   Chapter Overview

From the findings of the study we focus our discussion on the existing ICTs in the hospitals secondly the perception of the administrators, health workers and ICT staff in regard to the various the benefits of using electronic patient referral systems and finally the challenges of implementing electronic referral systems in the hospitals.

6.1   Hospital's electronic readiness

Using the computer systems policy project(1998), the study results have shown that private hospitals are more e-ready than public hospitals in terms of infrastructure, access to ICTs, adoption and usage of applications and services, with a good level of enabling environment. Most of the public hospitals appear to be economically challenged more than private hospitals.

6.2   Ehealth Maturity Level

The study has clearly shown that all the hospitals are either in none and initial levels of maturity whereas Kenyatta may have started to accomplish some interoperability goals. Most of the private hospitals were in the initial stage where there is an early awareness of ehealth interoperability requirements, with solutions available for the hospitals clinical and administrative requirements. Study has also shown that some government is unaware of ehealth or lacks total capacity to initiate ehealth process.

6.3   Hospitals Existing ICT Infrastructure

The study revealed that for each hospital within the metropolitan area had at least one computer which may not necessarily be used for electronic referral purposes. This applied for both public and private hospitals. According to the e-health readiness models, computers alone may not be enough to support electronic referral system in a hospital. The study also revealed that the various hospitals that have management information systems do use it for internal hospital functions only and therefore no connectivity to the external world for the purposes of electronic health. Most of the hospitals used the existing infrastructure for the storage of the patient's data with little or no support to patient's referral processes.

Most of the existing ICT infrastructure also lacked appropriate referral standards, lack of appropriate security of data and appropriate software applications to support e-referral, and this contributed to the unsuitability of the electronic referral systems as at present in most of the metropolitan hospitals.

6.4   Perception of the Hospital staff on benefits of e-referral systems

Through the questionnaires analyzed the participants pointed out that there would be some benefits on implementing and using ICT technologies for electronic referrals between the metropolitan hospitals and the Kenyatta Referral Hospital. These benefits includes: Timely Patients admission and management, Reduced congestion during admissions and consultation, Reduced congestion during admissions and consultation, Reduced number of health workers required for referral process, Efficient transfer of patient's referral data from another hospital, Reduce costs and efforts in management of patient referrals, Increased speed of sharing of the clinical data between the referring and referral hospital, Increased speed of sharing of the clinical data between the doctors and Maintain a good working relationship between patients and the hospital staff.

6.5   Challenges of implementing e-referral systems in the hospitals

The questionnaires and interview sessions conducted coupled with observations made electronic health referral component has not been developed due to some inherent challenges that perpetually inhibit successful implementation of health information systems interoperability for the purposes of supporting electronic patient referrals.

6.5.1   Lack of adequate ICT skills and professionals

The study has revealed that the hospital administrators and health professionals lack the adequate skills in ICT which consequently impacts on their enthusiasm on adopting the referral process for patients. It was also evident that the ICT professionals were not adequate in the hospitals or they lacked adequate formal and professional education to implement and support e-referral systems in their respective hospitals, with an exception of Kenyatta which had enough ICT professional with adequate qualifications to support the infrastructure.

6.5.2   Technical Challenges

The respondents to the questionnaires echoed that there were several technical that were making the implementation of the electronic referral system difficult that include: lack of enough computer hardware in the hospitals, lack of the software resources, lack of broad band connectivity, security of the patients data while being stored or during the transmission process lack of referral standards since none of the respondents was aware of the HL7 health systems interoperability standard and also not using XML document standards.

6.5.3   Socio-Technical Challenges

Lack of HMIS interoperability is a major technical challenge that is constrained by data security, financial costs, resistance   by health workers on adoption of new ICT technologies for their daily operations due to change in technical requirements/skills, ethical considerations and legal infrastructure in relation to use, storage and

transmission of the patients data. This problem is aggravated by lack of adequate government policy of electronic sharing of patients' data in Kenya.

6.5.4 Administrative and Management Challenges

It was clear from the study results that most hospitals started computerization in an adhoc manner because they do not have a concrete master plan. This makes it difficult to manage the isolated data "silos" in these hospitals. The health workers felt that the hospital's management was not making electronic health a priority of the hospital. As a result there was poor funding of the ICT infrastructure resulting to inadequate access to the ICT infrastructure in the hospital or upgrading of the health workers skills. Lack of adequate ICT skills by the management also influenced their attitudes towards electronic health implementation budget, coupled with lack of quantifiable cost benefit analysis of such E-health investments.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

This research achieved the intended objectives, which were to identify the various challenges that inhibit integration of health information systems between hospitals to facilitate an electronic referral process, the factors which are likely to motivate hospitals to adopt electronic referral processes and also to model a framework for electronic patient referral system focusing on sustainability and usability.

Substantiated analysis has shown that the process of integration of e-health systems between hospitals requires interplay of technical ICT groups, health workers staff and the hospitals management, which sometimes may hold conflicting orientations and ideologies which can slow down the eHealth readiness and consequently having an implication on the wider inter-operability of the referral system. Most of the hospitals have not embarked on the use of ICTs in managing the patient referral process due to challenges as a result of administrative, technical and health profession practices within the hospitals. However the study also revealed that there are some factors that motivate or facilitate(motivators/facilitators) hospitals to adopt and implement the eHealth systems, perceived by the stakeholders as the benefits that the hospitals are likely to attain after adopting an electronic referral system to manage the patients' referral process in the hospitals.

The survey findings suggest that implementation of a patient e-referral system in the hospitals must take keen consideration on the eHealth readiness of the hospital in terms of ICT access, ICT infrastructure, ICT Applications and services, Economic environment and other enablers such as policy, privacy, security. It was evident from the study that private hospitals were more eHealth ready than public hospitals.

It was established that the ICT experience of the users(health workers and administrators) determined greatly their attitude towards implementation an electronic referral system for patients, that is the higher the experience on ICT usage, the lower the resistance while the lower the ICT usage experience the higher the resistance. The improvement of ICT literacy for all the user groups enhances the acceptance of the e-

referral systems in the hospitals. The technical quality of the ICT staff in the hospitals is a major factor towards determining the degree of the ICT usage level in the hospital. A well coordinated effort of health workers, hospital administrators and the ICT staff is important in the e-referral system implementation and enhances its success and usability. EHealth systems interoperability will have the best implementation chances if all the hospitals participating in the patient referral process are e-ready.

The findings have clearly demonstrated that the commitment of the electronic referral stakeholders is important and hence this information was used to modify the Drury's(2006) model of 5 Cs to a new one with 6Cs (context, content, connectivity, capacity building, community development and commitment for the purposes of assessing the eHealth readiness in the hospitals.

Some limitations/challenges were encountered in undertaking this research project. Lack of enough funds impeded or hindered the research to the extent that large samples of say all more hospitals within the metropolitan could not be covered. Transport costs to and from the hospitals, research application fees in different hospitals was a challenge. Also some hospitals particularly Mission Hospitals were reluctant to be involved in the study while other respondents were hesitant in responding to the questionnaires. The research protocol for this study involved several parties in a sequence, which made it very difficult.

It is highly recommend that the integration of e-referral systems should strongly consider the motivations of the e-referral implementation pillars (technical infrastructure, hospital's administration/management and healthcare staff characteristics and attitudes) and also develop strategies to confront the various challenges that may associated with such groups. The application of this recommendation would minimize the emergence of destructive conflicts and consolidate the synergies of the different stakeholders in accelerating the adoption and implementation of eHealth systems that would enhance integration of hospitals for the purposes of managing eHealth processes such as patient e-referral. Education, training and ongoing technical support is crucial. Such training is not solely about how to work with an e referral system, but also about increasing appreciation of anticipated benefits

and limitations of the e-referral system as well as how to use emerging eHealth technologies to greatest advantage.

The study recommends the adoption and use of the electronic referral implementation framework in the planning of eHealth systems in hospitals, so as to enhance successful implementation, usability and acceptability of the e-referral systems in Kenya.

Further research should look at the legal and regulatory environments specific to eHealth in reference to Kenya and electronic exchanging/transfer of patients data between hospitals and how this influenced by the attitudes of health workers in accepting electronic referral systems. Research should also evaluate the government's commitment toward eHealth in Kenya

Limitations of the study

There are various limitations to this study. These were: Issues related to the security and confidentiality of patients/ clinical data. Also the study was small covering only the Nairobi metropolitan area due constrained. Thirdly due to the self selecting bias as a result of having to solicit volunteers within the hospitals as opposed to selecting a more representative sample and finally,the process of obtaining research protocol was too long and hence affecting the research duration

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APPENDICES

Appendix 1: Nairobi metropolitan hospitals accredited by NHIF to provide inpatient services

1.	NAME OF THE HOPSITAL	ADDRESS	BED CAPAPCITY	LOCATION	NHIF CLASSIFICA TION
2.	MATHARI MENTAL HOSPITAL	40663 NAIROBI	1138	NAIROBI	A
3.	PUMWANI HOSPITAL MANAGEMENT BOARD	30108 NAIROBI	350	NAIROBI	A
4.	MBAGATHI DISTRICT HOSPITAL	20725 NAIROBI	250	NAIROBI	A
5.	KAMITI HOSPITAL	40061 NAIROBI	195	WESTLANDS	A
6.	NATIONAL SPINAL INJURY HOSPITAL	20906 NAIROBI	30	NAIROBI	A
7.	KIAMBU HOSPITAL		200	KIAMBU	A
8.	KIHARA SUB DISTRICT HOSPITAL		100	KIAMBU	A
9.	NGONG HILLS HOSPITAL	572 NGONG	40	NAIROBI	B
10.	DIVINE WORD PARISH HEALTH CENTER	304 NAIROBI	32	NAIROBI	B
11	HURUMA NURSING & MATERNITY HOME	72934 NAIROBI	26	IND. AREA	B
12.	BLESSED LOUIS PALAZZOLO HEALTH CENTER	656 NAIROBI	24	WESTLANDS	B
13.	MARIA MAT & NURSING HOME	34736 NAIROBI	20	IND AREA	B
14.	MARURA NURSING HOME	75520 NAIROBI	13	NAIROBI	B
15.	NAIROBI HOSPITAL NAIROBI	30026 NAIROBI	220	NAIROBI	C
16.	H H AGAKHAN HOSPITAL (NAIROBI)	30270 NAIROBI	165	WESTLANDS	C
17.	MASABA HOSPITAL	53648 NAIROBI	156	NAIROBI	C
18.	MATER MISERICORDIAE HOSPITAL NAIROBI	30325 NAIROBI	135	IND AREA	C
19.	S S LEAGUE M P SHAH HOSPITAL NAIROBI	14497 NAIROBI	108	WESTLANDS	C
20.	KAREN HOSPITAL LTD	74240 NAIROBI	102	NAIROBI	C
21	GURU NANAK RAMGARHIA SIKH HOSPITAL	33071 NAIROBI	85	WESTLANDS	C
22.	GERTRUDES GARDEN CHILDREN'S HOSPITAL NBI	42325 NAIROBI	72	WESTLANDS	C
23.	NAIROBI WEST HOSPITAL	43375 NAIROBI	66	IND. AREA	C
24.	ST. JAMES HOSPITAL	46024 NAIROBI	63	IND. AREA	C
25.	AVENUE HOSPITAL LTD	45280 NAIROBI	60	WESTLANDS	C
26.	PARKROAD NURSING HOME (NAIROBI)	19850 NAIROBI	57	NAIROBI	C
27.	LIONS SIGHT FIRST EYE HOSPITAL	66576 NAIROBI	52	WESTLANDS	C
28.	MAGADI SODA COMPANY HOSPITAL MAGADI	10 MAGADI	50	NAIROBI	C
29.	NAIROBI WOMEN'S HOSPITAL	10552 NAIROBI	50	NAIROBI	C
30.	EDELVALE TRUST JAMAA H$M HOSPITAL	17153 NAIROBI	46	IND. AREA	C
31.	ST.FRANCIS COMMUNITY HOSPITAL	62676 NAIROBI	46	NAIROBI	C
32.	KAYOLE HOSPITAL	67617 NAIROBI	40	IND. AREA	C
33.	NAIROBI EQUATOR HOSPITAL	44995 NAIROBI	40	IND. AREA	C
34.	COPTIC CHURCH NURSING	21570 NAIROBI	37	NAIROBI	C
35.	METROPOLITAN HOSPITAL	33080 NAIROBI	35	IND. AREA	C
36	LANGATA HOSPITAL	934 NAIROBI	30	NAIROBI	C
37.	SAMARITAN MEDICAL SERVICES	212 DANDORA	30	NAIROBI	C
38.	SINAI MT.HOSPITAL	52874 NAIROBI	30	NAIROBI	C
39.	MIDHILL MATERNITY & NURSING HOME	21138 NAIROBI	28	NAIROBI	C
40.	MARIA IMMACULATE HOSPITAL	57216 NAIROBI	28	WESTLANDS	C
41.	KILIMANJARO NURSING & MATERNITY HOME	43920 NAIROBI	26	NAIROBI	C

42.	MATASIA HEALTH CLINIC	185 KISERIAN	23	NAIROBI	C
43.	MOTHER & CHILD HOSPITAL	12658 NAIROBI	23	NAIROBI	C
44.	MARIAKANI COTTAGE HOSPITAL	12535 NAIROBI	21	IND. AREA	C
45.	CITY NURSING HOME NAIROBI	14591 NAIROBI	20	NAIROBI	C
46.	RADENT HOSPITAL	48234 NAIROBI	20	WESTLANDS	C
47.	FAMILY CARE MED. CENTRE & MAT. HOME	30581 NAIROBI	19	IND. AREA	C
48	MARIE STOPES KENYA LIMITED	59328 NAIROBI	19	NAIROBI	C
49.	MELCHIZEDEK HOSPITAL	20085 NAIROBI	19	NAIROBI	C
50.	MADINA NURSING HOME	78370 NAIROBI	18	NAIROBI	C
51.	KASARANI NURSING & MAT. HOME	31524 NAIROBI	18	WESTLANDS	C
52.	EMMAUS INNERCORE NURS NG HOME	78123 NAIROBI	16	IND AREA	C
53.	OLIVE TREE HOSPITAL	19739 NAIROBI	16	IND AREA	C
54.	NAIROBI SOUTH MEDICAL CENTRE	74079 NAIROBI	15	IND AREA	C
55.	DORKCARE NURSING HOME LTD	33541 NAIROBI	15	NAIROBI	C
56.	CHIROMO LANE MEDICAL CENTRE	73749 NAIROBI	15	WESTLANDS	C
57.	EDIANA NURSING HOME	56270 NAIROBI	15	WESTLANDS	C
58	ST ANNES MATERNITY HOME - NAIROBI	54337 NAIROBI	13	IND. AREA	C
59.	UMOJA HOSPITAL	76480 NAIROBI	13	IND. AREA	C
60.	MENELIK MEDICAL CENTER	55164 NAIROBI	13	NAIROBI	C
61.	SOUTH 'B' HOSPITAL	49255 NAIROBI	12	IND. AREA	C
62.	NGUMBA CENTER AND LABORATORY SERVICES	412 RUARAKA	12	NAIROBI	C
63.	UNIVERSITY OF NAIROBI HEALTH SERVICES	30194 NAIROBI	12	NAIROBI	C
64	ST. JOHN'S HOSPITAL LTD	51754 NAIROBI	12	WESTLANDS	C

Source: NHIF

Appendix 2   A List of Departments In Kenyatta National Hospital

1. Laboratory, human pathology and Mausoleum services
2. Medical specialties e.g. Diabetes, lung diseases, heart diseases, skin and mental health
3. Medicine and Poisons Information Management
4. Nutrition and patient support
5. Obstetrics and Gynaecology including VVF/RVF repair and reproductive health
6. Occupational Therapy
7. Paediatric including new born care
8. Pharmaceutical services
9. Radiotherapy and cancer treatment
10. Rehabilitative medicine, Physiotherapy, Occupational therapy
11. Critical care ICU, HDU, Renal, Burns (Reconstructive surgery)
12. HIV/AIDS Comprehensive Care Services
13. Surgical orthopedic, cardiothoracic, neuro, pediatric, plastic, ENT, eye, dental and maxillofacial.

Source : www.knh.or.ke

Appendix 3   Interview Consent Form

UNIVERSITY OF NAIROBI
SCHOOL OF COMPUTING & INFORMATICS
Challenges of Integrating Health Management Information Systems for patient Referrals:
Case study of Kenyatta referral hospital and Nairobi metropolitan hospitals

Interviewer
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fchogi@yahoo.com

Supervisor:
Prof. Okelo-Odongo
School of Computing and Informatics,
University of Nairobi
P.O. Box 30197; Tel-020-444919, 446543/4

I am a master's student at University of Nairobi, School of computing and informatics, and i am conducting interviews for my master Project. I am studying the challenges of integrating health information systems between a referral hospital and other hospitals that refer patients for the purposes of exchanging referral information

During this study, you will be asked to answer some questions related to the confidentiality of clinical data, ICT literacy and usage levels in the institution .This interview was designed to be approximately a half hour in length. However, please feel free to expand on the topic or talk about related ideas. Also, if there are any questions you would rather not answer or that you do not feel comfortable answering, please say so and we will stop the interview or move on to the next question, whichever you prefer.

All the information will be kept confidential. I will keep the data in a secure place. Only I and the faculty supervisor mentioned above will have access to this information. Upon completion of this project, all data will be destroyed or stored in a secure location.

Participant's/Interviewee's Agreement:

I am aware that my participation in this interview is voluntary. I understand the intent and purpose of this research. If, for any reason, at any time, I wish to stop the interview, I may do so without having to give an explanation.

The researcher has reviewed the individual and social benefits and risks of this project with me .I am aware the data will be used in a MSc.Project that will be publicly available at the University of Nairobi, Library. I have the right to review, comment on, and/or withdraw information prior to the MSc. Project's submission. The data gathered in this study are confidential with respect to my personal identity unless I specify otherwise. If I have any questions about this study, i am free to contact the student researcher or the faculty adviser (contact information given above). If i have any questions about my rights as a research participant, I am free to contact the chair of Kenyatta National Hospital/University of Nairobi-Ethics & Research Committee at Kenyatta hospital or the supervisor specified above.

I have been offered a copy of this consent form that I may keep for my own reference.

I have read the above form and, with the understanding that I can withdraw at any time and for whatever reason, I consent to participate in today's interview.

_____   _____

Participant's signature   Date

_____

Interviewer's signature

The selected units were:-

1) *Kenyatta National Hospital (referral Hospital)   (public)*
2) *Mathare Mental Hospital   (public)*
3) *Avenue Hospital (private)*
4) *Mbagathi District Hospital (public)*
5) *Kihara Sub District Hospital (public)*
6) *Kikuyu Mission Hospital (private)*
7) *Kiambu District Hospital (public)*
8) *Huruma Nursing Home and Maternity(private)*
9) *Radent Hospital(private)*

Appendix 5:   Models Comparison

Model	Author	Date
E Commerce Readiness Assessment Guide	Asian Pacific Economic Cooperation (EAPEC) Electronic Commerce Steering Group	2000
Readiness for the Networked World	Center for International Development (CID) at Harvard University and IBM.	
Cross National Analysis of Internet Development.	Crenshaw, E. M. and K.K Robinson. Ohio State University Department of Sociology.	1999
Readiness Guide for Living in the Networked World	**Computer Systems Policy Project (CSPP)**	1998
E Readiness Rankings	The economist Intelligence Unit and Pyramid Research	2002
E Readiness Rankings	The Economist Intelligence Unit and Pyramid Research	2001
Global diffusion of the Internet: Questionnaire	The mosaic group	1998
Global Technology	Howard A. Rubin and Metric	2002

Description	Focus
Gauges a country's readiness for ecommerce though 6 categories, 100 multiple choice questions detailed questionnaire. No overall scoring. Countries are recommended to work on areas with less than optimal answers.	Basic infrastructure and technology; Access to necessary services, Level and type of use of the Internet, Promotion and facilitation activities, Skills and human resources, Positioning for the digital economy.
Rates communities along 4 progressive stages of development in 19 indices. Based in communities self-estimation. No prescription for improvement.	Access, Learning, society Economy, Policy.
Statistical metrics and hypothesized model of technology development state the probable relationships between 10 variables. Provides narrative explanation of how the factors are likely to shape technology development.	Level of technological development, political openness/democracy, mass education, presence of a sizeable service sector, tale density, foreign investments, ethnic homogeneity sect oral inequality population density quantity of exports.
Rates community's along 4 progressive stages of development in 5 categories. Based in a 23 question questionnaire.	**Infrastructure, Access, Applications and services, Economy, Enablers (policy, privacy, security).**
Tallies scores across 6 categories, five of which include a total of 29 indicators. Combines business environment rankings (70 Separate indicators) with connectivity scores. Brief explanation of the results and the changes since last ranking.	Connectivity and technology infrastructure (25%), Business environment (20%), consumer and business adoption (20%) Social and cultural infrastructure (15%), Legal and policy environment (15%), Supporting services (5%).
Tallies scores across 6 categories, five of which include a total of 29 indicators. Combines business environment rankings (70 separate indicators) with connectivity scores. Provides brief account of the results and changes since last ranking.	Connectivity (30%), business environment (20%), E commerce consumer and business adoption (20%), Legal and regulatory environment (15%) Supporting e services (10%), Social and cultural infrastructure (5%).
Indicates stages of Internet growth and usage through combination of statistics, narrative description and comparison. Focus on 6 Internet statistics.	Pervasiveness, Geographic dispersion, Sect oral absorption, Connectivity infrastructure, Organizational infrastructure, Sophistication of use.
Qualitative statistics on country's technological	Knowledge jobs, Globalization, Economic dynamism

Information Society Index	World Rimes /IDC	2002
Knowledge Assessment Matrix	World Bank	
Risk E business: Seizing the opportunity of Global E Readiness	McConnell international and World Information Technology and Services Alliance (WITSA)	2001
Ready? Net. Go! Partnerships Leading the global Economy	McConnell International and World Information Technology and services Alliance	2001
E Readiness and E needs Assessment	Country Development Gateway Projects, world bank development Gateway	n/a
Global Diffusion of the Internet: Case Studies	The Mosaic group	1998
Internet Country Case study	International Telecommunications union (ITU)	n/a
Country ICT Surveys	Swedish International Development Coordination Agency SIDA	n/a
Information Communications Technology Country Assessment	United States Agency for International Development (USAID)	n/a

Interview and Survey based Reports

sophistication strength using 25 indicators in 5 categories. Ranking graphs.	and competition, Transformation to a digital economy, Technological innovation capacity.
Statistical ranking based on 23 indicators in 5 categories. Only the list of rankings.	Computer infrastructure, Internet infrastructure, Social infrastructure.
Online statistical assessment using 61 indicators in 5 categories. Default scorecards and optional measurements. Only values and graphs.	Performance, Economic Incentive and Institutional Regime, Education and Human Resources, Innovation system, Information Infrastructure.
Rates countries in five categories on a scale of 1 to 3. Provides extensive analysis and recommendations.	Connectivity, E leadership, Information Security, Human capital, E Business climate, Public private partnership.
Rates Countries in five categories on a scale of 1 to 3 Provides extensive analysis and recommendations	Connectivity, E leadership, Information Security, Human capital, E Business climate, Public private partnership.
Basic country assessments with a modified version of CID's methodology. Carried by CDG local teams.	19 categories focusing in technology infrastructure pervasiveness of technology, regulatory policy and business environment.
Indicates states of Internet growth and usage through combination of statistics, narrative description and comparison. Focuses on 6 Internet statistics.	Pervasiveness, Geographic dispersion, Sect oral absorption, Connectivity infrastructure, Organizational infrastructure, Sophistication of use.
Detailed case studies of ICT in the target country. Includes statistical ranking based on Mosaic's methodology, and recommendations.	Back ground, Telecommunications, Internet, Applications.
Detailed case studies focusing on the c sector though 5 main categories. Provides recommendations to improve ICT usage.	ICT policy process, Connectivity and access, Human resources, Structure of ICT sector and major users, Major areas fir development opportunities.
Detailed case studies of countries using a 5 categories framework. Provided detailed action plans for countries to pursue in the future.	Pipes (access), Public sector (Government policies, e government), Private sector (usage) People (training), Existing development programs.

Model	Author	Date
Negotiating the Net Model	Center for International Development and Conflict Management (CIDCM)	2001
International Survey of E Commerce	World Information Technology and Services Alliance (WITSA)	2000

Description	Focus
Based on interviews with key actors in a set of institutions. Describes the processes and outcomes of negotiations between key players over the phases of development identifying major contentious issues likely to the main problematic in the future.	Background and history, Key players in Internet development, Internet development and ICT policy over time, Negotiation between players in developing the country's Internet
Report based in a survey to technology companies on their experience with e barriers and asking for recommendations. Provides charts and narrative accounts of the answers. Only general conclusions, no country by country assessment.	How ready are world markets for electronic commerce? Economic factors, Regulatory environments.

REFERRAL FORM

NAME OF THE HOSPITAL

Medical Record
Patients Name......................................
Date of Birth......................................
Gender..
Nationality..
Residence..
Contact:-
Tel......................................

Referral Date ....

Referred to specialty ....

Referring clinic/hospital................................

Hospital Medical Record No................................

☐ Emergency

☐ Urgent

☐ Routine

REASON FOR REFERRAL (*Please include all copies of all pertinent investigators, and patient to bring X-rays, relevant test results to the appointment).*

SUMMARY OF PRESENTATION

- History
- Physical examination
- Investigations

Provisional Diagnosis

Recommendations

Medications (*Patient to bring all medications to the appointment*)

Referring Doctor Stamp..Signature.........................

Referral.................•..................Telephone.........................Fax.........................

Address..

Appendix 7: Research Questionnaires
   a) Doctors
   b) ICT staff
   c) Administrators

Appendix 7(a)   Health Workers Questionnaire

To be filled by Health Workers (Doctor, Clinical Officer/Nurse etc)
Questionnaire number ..../.........../..........

My name is **Bernard.F.M Chogi**, a student at the University of Nairobi, School of Computing and Informatics. I am taking a Master of Science degree in Information Systems and carrying out a research project entitled *" Challenges of integrating health management information Systems for patients' referral: Case study of KNH as a referral Hospital and Nairobi Metropolitan Hospitals".*
The objective this research is to assist me to model a framework for integrating metropolitan hospitals to KNH focusing on usability and efficiency. The information asked in this questionnaire will be used to develop the framework
The research is purely academic, confidential and will be solely used for that purpose. Your details or data provided will not be passed to any third party without prior permission. I wish to communicate information about this survey results to you, should you be interested. Please attach your email address or any other contact if you wish to receive information.
Please take a moment of your time and answer the following on electronic health services and ICT in this hospital. I will appreciate very much your honest and critical response to this questionnaire. Please put a checkmark in the appropriate box where provided, or follow any instructions provided on filling this questionnaire

SECTION A   GENERAL INFROMATION

This section collects general information about the hospital and the respondent

1.1   Name of the respondent (optional)...

1.2   Designation..Department.........................

1.3   Telephone/Mobile (optional).....................Email Contact (Optional) ....

1.4   Hospital's Name ....

1.5   What is the status of the hospital?   Private ☐   Public ☐

1.6   In your department, what is the average number of referred patients made or referral patients received per day in this hospital?

   1-2 ☐   2-4 ☐   4-6 ☐   6-8 ☐   8-10 ☐   Over 10

SECTION B   CONTEXT

This section investigates the Kenyan context in which the eHealth can be developed, considering the economic background (poverty, technological orientation, infrastructure, among others)

2.1   a)   Do you have access to a computer in the hospital?   Yes☐   No☐

   b)   If yes do you have any skills/training in using computer applications?   Yes☐   No☐

   c)   If yes indicate the number of years ....

   d)   Using the definitions given below indicate the corresponding level of your expertise in the use of computer applications and operations

Definitions

"No capability   can not operate a computer or use any application
"Fair   being able to operate basic computer functions and Word processing application
"Good   being able to operate at least three MS Office applications (MS Word, Excel and PowerPoint)
"Very Good   All of the above skills used for patient management activities with a regular use of e-mail and Internet resources
"Excellent   All of the above including use of e-mail, Internet surfing and searching; use of ICT in patient management activities in the hospital including referral and discharge services;

   ☐ Excellent   ☐ Very Good   ☐ Good   ☐ Fair   ☐ No Capability

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2.2   In your own opinion has the answer (2.1d) above impacted on usage of health management information systems in this hospital?

[ ] High Impact   [ ] Some Impact   [ ] No Impact   [ ] Do Not Know

2.3   In your own opinion what is the level of computerization/automation in this hospital

Definition

Very poor   No computers and ICT equipments available

Poor   Computers available, No application software and networks

Average   Computers available, application software available **but** Working as standalone

Good   well-networked computers and applications shared within the hospital (intranet)

Excellent A good intranet, connected to the internet, security and interoperability features

Excellent [ ]   Good   [ ]   Average   [ ]   Poor   [ ]   Very Poor [ ]

2.4   Do you think your answer in (2.3) above has positive impact on the action time on patients' referrals in this hospital?

[ ] High Impact [ ] Some Impact   [ ] No Impact   [ ] Do Not Know

2.5   What is the current method of handling referral process in this hospital

[ ] Manual   [ ] Electronic

2.6   If the answer in **(2.5)** above is manual, do you think the following **benefits /drivers** may motivate this hospital to introduce an electronic referral system to transform the manual referral process

	Benefits /Drivers	Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
i)	Patients to receive timely admission and management					
ii)	Reduced congestion in the casualty during admissions and consultation					
iii)	Reduced number of health workers required to manage the casualty department					
iv)	Efficient transfer of patient's referral data from another hospital					
v)	Reduce costs and efforts in management of patient referrals					
vi)	Increased speed in sharing of the clinical data between the doctors					
vii)	Maintain a good working relationship between patients and the hospital staff					

2.7   What is your opinion on whether the following Challenges may hinder successful implementation of an electronic referral system in this hospital:-

	Challenge	Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
i)	Loss of privacy on a patient's clinical data during transfer					
ii)	Unavailability of network resources during referral process					
iii	Lack of appropriate e-referral software application(s) in the hospital					
iv	Lack of appropriate hardware to support E-referral process					
v)	Lack of standards to support E-referral in the hospital					
vi	Lack of the computer network infrastructure to support the E-referral process.					
vi	Lack of the necessary ICT skills by the hospital staff					
vi	Lack of adequate ICT staff to support the e-referral					

		Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
	process					
ix)	Financial and cost implications on an E-referral system					
x)	Lack of adequate ICT vendors support on sustainable e- referral system					

2.8   Are there any other barriers that you would think may hinder implementation and the usage of an electronic referral system in this hospital? List them.

_____

2.9   In your opinion, do you think failure of most hospitals to have internal clinical data management systems may contribute to failure of an integrated referral system for different hospitals?

Strongly Disagree [ ]   Disagree ☐   Not Sure ☐   Agree ☐   Strongly Agree [ ]

2.10   What is your opinion on these factors that this hospital may experience, which may **negatively** affect implementation of electronic patient referral system and integration of the health information management information systems for healthcare in Kenyan hospitals?

No		Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
a)	**Resistance from both the patients and hospital staff towards using and integration on health management information systems to manage the referral process in this hospital may be due to:**					
i)	Security and sensitivity of clinical data/information:-					
ii)	Lack of Trust on the security of the E-referral system on patient data transfer					
iii)	Loss of jobs and other work related uncertainties					
iv)	Electronic referral operational difficulties as a new technology					
v)	Fear of change from manual to electronic referral system					
vi)	Associated financial costs of the system					
b)	**Systematic failure of the management to support the e-referral due to:**					
i)	Inadequate cost benefit analysis and quantification of the electronic referral benefits					
ii)	High user /staff training costs					
iii)	Inadequate legal infrastructure					
iv)	Increased electronic system operational installation & maintenance costs					
c)	**The low acceptability of electronically referred clinical information due to:-**					
i)	Difficulties of understanding the doctors Coding of clinical data for referral					
ii)	Differences in technologies, techniques & diagnosis applied by doctors in different hospitals					
iii)	Difficulties of coding images e.g. X-rays and lab test results for e-Referral					

SECTION C   **CONTENT**

This section investigates usage, provision and access to reliable health information for health workers in Kenya, in the correct format, at the right place and time.

3.1   In your opinion state whether each of the following referral process activities/tasks in this hospital is supported by the current ICT system?

         i)   Capturing of patients information /data   Yes ☐   No ☐

         ii)   Storage of patients information /data   Yes ☐   No ☐

         iii)   Retrieval of the information /data of the patient captured   Yes ☐   No ☐

         iv)   Analyzing the patient information /data stored   Yes ☐   No ☐

         v)   Transferring of patient information from one department to another   Yes ☐   No ☐

         vi)   Receiving patient information referred from another hospital   Yes ☐   No ☐

3.2   As a medical officer (doctor /clinical officer/nurse) state whether you have ever used an ICT system to:-

     i)   Share medical knowledge with other medical staff in other hospitals?   Yes []
          No []

     ii)   Exchange/share patient referral information with other hospitals.   Yes []
          No []

     iii)   Online diagnosis of patients   Yes []
          No []

     iv)   Research   Yes []
          No []

     v)   Online surgical operations   Yes []
          No []

     vi)   Online Learning /Education   Yes []
          No []

3.3   What do you mainly use for scheduling reminders about patients' appointment *(tick appropriately)*
     Diary   [] Computer Calendar [] Mobile Phone [] Others (Specify)...........................

3.4   How would you rate the contribution of this hospital's management towards improving your ICT skills
     Excellent []   Good   []   Average   []   Poor   []   Very Poor []

3.5   In your own view what would you consider as the rating of the confidentiality and security level of patients' records, in this hospital?

[] Excellent   [] Very Good   [] Good   [] Fair   []   No Capability

3.6   To what extent do you agree that medical staff should sign for confidentiality, agreeing to adhere to strict privacy policies and procedures for ensuring the confidentiality and security of patients' data in this hospital?

Strongly Disagree []   Disagree []   Not Sure []   Agree   []   Strongly Agree []

3.7   The table below shows **Techniques used in ensuring patients' data security and privacy. Select** all those techniques which can be used to safeguard Security and privacy of patients' data in this hospital

(Tick (√) where used, (x) where not used and (u) where not aware

Security & Privacy Techniques	Yes, it is used	No, it is not (Not Used)	I am Not aware
i) Understanding the principles and practice of data protection			
ii) The use of passwords and user names for electronic patients records			
iii) Medical Data records protection by legislation			
iv) Use of information rights software tools			
v) Use of the medical profession jargon to present the patient's data			
vi) Strictness on requests to access records by patients or their families			
vii) Individual doctors/clinicians responsibility with respect to data protection	/		
viii) Use of use of data encryption within the hospital network and outside			
ix) Restrict sending of patient data electronically via Email, Internet, fax			
x) Controlled permission to use patient data for research purposes			

3.8   In your opinion which of the above techniques in question (**3.7**) would you consider very critical in providing the highest level of security and confidentiality to the patient's records in this hospital.

_____

3.9   When referring a patient to another doctor/hospital/department, how do you ensure security and privacy of the patient's data during the transfer?

_____

SECTION D   CONNECTIVITY

This section investigates the current connectivity infrastructure in terms of hardware, software and the connectivity level of the hospital necessary to support an e-referral system

4.1   To have a good Electronic patient referral system, there is need for computers, internet access and telecommunication links between the hospitals, which may **NOT** always be available in all the hospitals.
Strongly Disagree []   Disagree []   Not Sure []   Agree   []   Strongly Agree []

4.2   In your own opinion, would an electronic referral system for patients make the work of a doctor/clinical officer/nurse (health workers) simpler or difficult?

☐ Very Difficult   ☐ Difficult   ☐ No Change ☐Easy   ☐Very Easy

SECTION E   CAPACITY BUILDING

This section investigates the options of improving the skills of existing staff in the hospitals, at low cost and as close to their place of work as possible, ensuring a continuous professional development

5.1   Is there a training policy for employees that would facilitate skills development in ICT ,for health staff working in this hospital ?   Yes ☐   No ☐

5.2   If the answer in **5.1** is **yes** is there a set budget for staff training on new skills such as ICT.

Yes ☐   No ☐

5.3   Are there options of advancing ICT literacy using electronic learning method when in the hospital?

Yes ☐   No ☐

SECTION F   COMMUNITY DEVELOPMENT

This investigates how capacity of the health workers extends outside the hospital, to involve the larger community and community based workers, to address the issues healthcare and enable dissemination of information.

6.1   In your own opinion, would an electronic referral system for patients enhance service delivery to the patients referred from the metropolitan hospitals and also in the referral hospital

Strongly Disagree ☐   Disagree ☐   Not Sure ☐   Agree   ☐   Strongly Agree ☐

SECTION G   COMMITMENT

This section investigates the available support from the hospital, management and other departments in the implementation of an electronic referral system.

7.1   Do you think that the hospital prioritizes the use of ICTs towards health care delivery in this hospital?

Strongly Disagree ☐   Disagree ☐   Not Sure ☐   Agree   ☐   Strongly Agree ☐

7.2   Select ALL the possible activities that the hospital is committed to:-

Staff capacity development   ☐ Replacement of ICT components   ☐ Procurement of new ICT equipments   ☐Maintenance of the ICT department   ☐

Any other *(specify)*..

Appendix 7(b)   Management /Administrative Staff Questionnaire

To be filled by hospital management or administrators ONLY
Questionnaire Number ..../................/.............../..............

My name is **Bernard.F.M Chogi**, a student at the University of Nairobi, School of Computing and Informatics. I am taking a Master of Science degree in Information Systems and carrying out a research project entitled " *Challenges of integrating health management information Systems for patients' referral: Case study of KNH as a referral Hospital and Nairobi Metropolitan Hospitals*".

The objective this research is to assist me to model a framework for integrating metropolitan hospitals to KNH focusing on usability and efficiency. The information asked in this questionnaire will be used to develop the framework

The research is purely academic, confidential and will be solely used for that purpose. Your details or data provided will not be passed to any third party without prior permission. I wish to communicate information about this survey results to you, should you be interested. Please attach your email address or any other contact if you wish to receive information.

Please take a moment of your time and answer the following on electronic health services and ICT in this hospital. I will appreciate very much your honest and critical response to this questionnaire. Please put a checkmark in the appropriate box where provided, or follow any instructions provided on filling this questionnaire

SECTION A   GENERAL INFORMATION

This section collects general information about the hospital and the respondent

Part One   The Respondent
1.1   Name of the respondent *(Optional)*...Designation........................
1.2   Department...Telephone/Mobile *(Optional)*.......................
1.3   Email Contact *(Optional)*..
Part Two: The Hospital
2.1   Hospital's Name .... District..............................
2.2   What is the status of the hospital?   Private ☐   Public ☐

SECTION B   CONTEXT

This section investigates the Kenyan context in which the eHealth can be developed, considering the economic background (poverty, technological orientation, infrastructure, among others)

3.1   a)   Do you have access to a computer in this hospital?
                              Yes ☐   No ☐
        b)
                    d)   If the answer in 3.1(a) is **yes**, do you have Computer skills /training?
                              Yes ☐   No ☐
                    .)   If **yes** how many years ....

                    (c) Do you think there was a proper planning for ICT implementation in this hospital?
☐ Proper planning   ☐   Ad-hoc(unplanned)
3.2   Does this hospital have an ICT Master Plan supporting ICTs adoption , software licenses, upgrading, general maintenance etc   Yes ☐   No ☐

3.3   (a) Do you have department in this hospital responsible for ICT activities (ICT Department)?
                              Yes   ☐   No   ☐
        (b)   If the answer to 3.3(a) is **yes**, do you think this ICT department is effective in promoting and enhancing usability ICTs in this hospital?
Disagree Strongly ☐ Disagree Somehow ☐ Not Applicable ☐ Agree ☐ Agree Strongly☐

        c)   How were the computers and other ICTs acquired in this hospital?
Donations only ☐   Hospital funds & Donors ☐ Hospital funds only ☐ Kenya Government ☐
        d)   Do you think the cost of implementing a functional ICT system to support e-referral would have an economic impact (cost implication) on the patients seeking referral services?
Very High Impact ☐   High Impact ☐   Low Impact ☐   No Impact ☐   I Don't Know ☐

e) In your own assessment, do you think this hospital has the necessary resources to allow implementation of an electronic (ICT) referral system?

Ready With Enough Resources ☐   Ready with Some Resources   ☐

Ready With No Resources   ☐   Not Ready At All   ☐

3.4   In your opinion, is there a proper planning for ICTs implementation in this hospital?

☐ Systematic ICT planning   ☐   Ad-hoc ICT (unplanned)

3.5   Does this hospital have an ICT Master Plan supporting ICTs adoption , software licenses, upgrading, general maintenance etc   Yes ☐   No ☐

3.6   What non-ICT resources may be required to support eReferral implementation in this hospital for optimal usability by the eHealth staff *(Select all that applies)*

Skilled ICT staff   ☐   Financial /Funds   ☐   ICT Procedures☐

3.7   Are there other major challenges that you think can hinder implementation of an e-referral system in this hospital *(list them)*.

i) _____

ii) _____

iii) _____

3.8   For each of the above challenges (if any) in question 3.7, state what you think should be done to overcome them.

i) _____

ii) _____

SECTION C   CONTENT

This section investigates usage, provision and access to reliable health information for health workers in Kenya, in the correct format, at the right place and time.

4.1   As an administrator or a member of the management staff, do you use a computer to perform the tasks below win this hospital?

i.	Data entry	Yes ☐	☐	No
ii.	Accounts & financial management	Yes ☐	☐	No
iii.	Internet browsing and sending e-mails	Yes ☐	☐	No
iv.	Typing official documents	Yes ☐	☐	No
v.	Entertainment (music, video etc)	Yes ☐	☐	No
vi.	Online Learning & Education	Yes ☐	☐	No
vii.	Any other *(Specify)*			

SECTION D   CONNECTIVITY

This section investigates the current connectivity infrastructure in terms of hardware, software and the connectivity level of the hospital necessary to support an e-referral system

5.1   Do you think the nature of the current ICT implementation in this hospital has impacted on ICT usability within this hospital?

Disagree Strongly ☐ Disagree Somehow ☐ Not Applicable ☐ Agree ☐ Agree Strongly ☐

5.2   What ICT resources do you think may be required to support an ICT infrastructure that will support adequate usability of ICTs in this hospital?   *(Select all that applies)*.

Computers ☐   Software ☐   Internet & Computer Networks ☐   All of them ☐

SECTION E   CAPACITY BUILDING

This section investigates the options of improving the skills of existing staff in the hospitals, at low cost and as close to their place of work as possible, ensuring a continuous professional development

6.1   Is there a training policy for employees in this hospital, that would facilitate skills development on employees on how to use a systems   Yes ☐   No ☐

Briefly explain your answer

6.2   If the answer in **6.1** is **yes** is there a set budget for staff training on new ICT skills
Yes []   No []
6.3   Is there an option of advancing ICT literacy using electronic learning method?
Yes []   No []

SECTION F   COMMUNITY DEVELOPMENT

This investigates how capacity of the health workers extends outside the hospital, to involve the larger community and community based workers, to address the issues healthcare and enable dissemination of information.

7.1   **Definitions**
        "**0**   No significance of this benefit to this hospital
        "**1**   Very low value to this hospital that is negligible
        "**2**   Some value that may only be to admissions /casualty
        "**3**   Moderate significance that will have an impact in more than one department
        "**4**   High significance that will impact all the departments handling referral process
        "**5**   Very high significance to the entire referral process within the hospital
        "**6**   I have no idea about any these benefits

Below are some of the efficiency benefits that may result from the usage of the electronic referral system to in the transfer of health information from referring centers to the referral facility. For each of them, indicate a **score (0-6)** above that you think would represent the value for using the electronic referral systems. In this hospital and other stakeholders

7.2   Do you think there is a need to share the e-referral network infrastructure with the public around the hospital?
Yes []   No []

	Benefit	Sore (0-6)
1.	Speed of Service delivery	
2.	High quality of patient (customer)Service	
3.	Simplified and streamlined referral process	
4.	Provision of quality service to targeted departments	

SECTION   G   COMMITMENT

This section investigates the available support from the hospital, management and other departments in the implementation of an electronic referral system.

For each of the following questions, select an appropriate by ticking

No		Strongly Disagree (SD)	Disagree (D)	Not Sure (NS)	Agree (A)	Strongly Agree (SA)
8.1	Do you think this hospital has an Organizational structure that can support the e-referral project in this hospital?					
8.2	Do you attach any importance to investing in an electronic referral system to support the referral process and streamline flow of information in this hospital?					
8.3	Do you think that the implementation of the e-referral system in this hospital would be in line with the strategic planning of this hospital?			-		
8.4	In your own opinion do you think there would be a reduction of direct or indirect costs by getting e-referral services instead of the current manual referral process?					
8.5	Do you think there is a systematic support of the ICT usage in this hospital from:-					
i)	Top management					
ii)	Administrators and hospital managers					

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iii)	Doctors and other Hospital medical staff					
iv)	Hospital Support staff					

8.6   Considering the many requirements and priorities for a hospital's budget, what would be the priority of this hospital committing itself to the new e-referral system project?

Very High Priority [] High Priority [] Average [] Low Priority [] Very Low Priority[]

8.7   Considering the costs and benefits of a new electronic referral system, to what extent do you think the system would be commercially viable / feasible for this hospital?

Very viable [] viable [] Low viability [] No Viability [] I don't know []

Appendix 7(c)   ICT staff Questionnaire

This questionnaire is to be filled by ICT staff only
Questionnaire number........./.........../..........

My name is **Bernard.F.M Chogi**, a student at the University of Nairobi, School of Computing and Informatics. I am taking a Master of Science degree in Information Systems and carrying out a research project entitled " Challenges of integrating health management Systems for patients' referral: Case study of KNH as a referral Hospital and Nairobi Metropolitan Hospitals".

The objective the research is to assist me to model a framework for integrating metropolitan hospitals to KNH focusing on usability and efficiency. The information asked for in this questionnaire will be used to develop the framework and provided require. ents to develop a prototype system to demonstrate the usability of the electronic referral system

The research is purely academic, confidential and will be solely used for that purpose. Your details or data provided will not be passed to any third party without prior permission. I wish to communicate information about the survey results to you should you be interested. Please attach your email address or any other contact if you wish to receive information in this way.

I would like you to take a few moments of your time to answer the following questions regarding ICT infrastructure in this hospital. I will appreciate very much your honest and critical response to this questionnaire. Please put a checkmark in the appropriate box where provided, or follow any instructions provided on filling the questionnaire

Part One: General Information
Name of the respondent *(optional)*.....................................Designation........................
Department...Telephone/Mobile (optional).......................
Email Contact *(Optional)* ....
Hospital's Name ....
What is the status of the hospital?   Private ☐   Public ☐

Part Two   ICT function in the hospital
1.7   Please indicate your highest academic/professional ICT qualification.
          Certificate ☐   Diploma ☐   Degree ☐ Masters ☐   Others
          (Specify).............................

1.8   Is there an independent ICT department in this hospital or ICT operates under another department? *Select*
          :-
                    Yes, there exists an independent functional ICT department   ☐
                    Yes, the ICT function exists under another department   ☐
                    No, ICT functions are outsourced from external service providers   ☐
1.9   If the answer to 2.3 above is **yes**, approximately how many members of staff are in the ICT department?
Below 5 ☐   6-10 ☐   11-15 ☐   16-20 ☐   Over 20 ☐

1.10   Please indicate whether the following major hospital functions are computerized /automated
                    Pharmacy   Yes   ☐   No ☐
                    Accounting and Finance   Yes   ☐   No ☐
                    Administration   Yes   ☐   -   No ☐
                    Research   Yes   ☐   No ☐
                    Teaching   Yes   ☐   No ☐
                    Referrals   Yes   ☐   No ☐
                    Education /Online learning   Yes   ☐   No ☐
                    Discharge   Yes   ☐   No ☐
                    Medical   Yes   ☐   No ☐

Part Three   ICT Infrastructure (Hardware)

3.1   Approximately how many functional computer units are in this hospital

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Below 20 [ ]   21-40 [ ]   41-60 [ ]   61-80 [ ]   81-100 [ ]   Over 100 [ ]

3.2   Apart from computers, Indicate whether the following ICT hardware components are available in this hospital and their use:-

ICT Hardware Components	Yes	No	Functional Use
Personal Digital Assistants (PDA)			
Pagers			
Faxes			
Scanners (document/image scanners)			
Document Printers			

3.3   What is the average age of the computers in this hospital (in years)?

Below 1 [ ]   ·2 [ ]   3-4   [ ]   5-6   [ ]   Over 6   [ ]

3.4   How many computer servers are available in this hospital's computer system..........................

3.5   Is there a computer hardware maintenance schedule?   Yes [ ]   No [ ]

3.6   If the answer in **3.5** above is **yes**, indicate whether the maintenance is in-house or outsourced..

In-House [ ]   Out-sourced [ ]

3.7   If the answer in **3.6** above is outsourced, indicate whether the maintenance of the hardware devices based on contracts or it is on "*need basis*"

Contract [ ]   *Need Basis* [ ]

3.8   In case of power failure what alternative source of power is available to run the ICT infrastructure within the hospital? _____

Part Four   **ICT Infrastructure (Software)**

4.1   Complete the following table by indicating whether it is available and its function

Type of software Applications	Yes	No	Function /use
Word processors			
Spreadsheets			
Data base management system			
Web browser			
Health management information system			
Financial management systems			
Others (specify)			

4.2   Does this hospital use open source software programs to support its function(s)? Briefly explain

_____

_____

Part Five   **ICT Infrastructure (Network & Internet)**

5.1   Is there a computer network infrastructure in this hospital?

Yes, computer network exists [ ]   No, computers operate as standalone   [ ]

5.2   If the answer in **5.1** above is **yes**, are all the operational computers in this hospital networked?

Excellent in all departments [ ] some departments are networked   [ ]   Not aware [ ]

5.3   If your answers to question 5.2 is **excellent**, can all the departments be able to share data in this hospital?

Excellent [ ]   sometimes   [ ]   No sharing [ ]   Not aware [ ]

5.4   What is the type of network connection available in this hospital?

Wireless networking [ ]   fixed networking   [ ]

5.5   How would you rate the network service availability in this hospital?

Excellent [ ]   ●Good [ ] Average [ ]   Poor [ ]   No connection [ ]

5.6   Does this hospital have a link to wide area network outside an intranet?

Yes [ ]   No [ ]

5.7   If the answer to 5.6 above is yes, is the network connected to the internet?

Yes [ ]   No [ ]

5.8   Doe the hospital have any fiber optic cable connection point?

Yes []   No [ ]

5.9   Give details of the Internet connection arrangement in this hospital with the (Internet Service Provider) and indicate speed/bandwidth where applicable. *(Please check all that apply)*

	Internet service	Band width				
i)	Dial up	_____	Yes []		No []	
ii)	Dedicated Dial up	_____	Yes []		No []	
iii)	Leased line	_____	Yes []		No []	
iv)	Wireless	_____	Yes []		No []	

Part Six   Web & Internet Services

6.1   Does the hospital have website?

              Yes [ ]   No   []

6.2   If the answer to 8.1 above is yes, state whether the web content is managed from within the department or by external service providers?

              Internal service providers   []   External service providers []

6.3   Does the website store any knowledge(information) about the hospital (hospital staff, patients, management e.t.c)

              Yes   []   No   []

6.4   Is the web site used to perform the following tasks in this hospital?   *Select all that applies*

              i)   Discharge Process management   []

              ii)   Financial transactions   []

              iii)   Hospital Planning & administration   []

              iv)   Communication (mails, memos etc)   []

              v)   Patients Admission   []

              vi)   Patients Referral   []

              vii)   Procurement services   []

              viii) Staff recruitment services   []

              ix)   Education/online learning   []

Part Seven   Security of Data

7.1   Which of the following methods is used to store medical records stored in this hospital?

              Physical Files & folders []   Computer Files   []   Both   []

7.2   If files are stored as computer files, indicate whether there is a back up schedule?

              Yearly   []   Quarterly []   Monthly []   Weekly []   Daily []   No Back Ups []

7.3   The table below shows **Techniques used in ensuring patients' data security and privacy. Select** all those techniques which can be used to safeguard Security and privacy of patients' data in this hospital.

                                                      (Tick appropriately where applicable)

Security & Privacy Techniques	Yes, it is used	No, it is not (Not Used)	I am Not aware
xi) Understanding the principles and practice of data protection			
xii) The use of passwords and user names for electronic patients records			
xiii) Medical Data records protection by legislation			
xiv) Use of information rights software tools			
xv) Use of the medical jargon to code patient data			
xvi) Strictness on requests to access records by patients or their families			
xvii) Individual doctors/clinicians responsibility with respect to data protection			
xviii) Use of use of data encryption within the hospital network and outside			
xix) Restrict sending of patient data electronically via Email, Internet, fax			
xx) Controlled permission to use patient data for research purposes			

7.4   In your opinion which of the above techniques in question (7.3) you would consider very critical or provides the highest level of security and confidentiality to the patient's records in this hospital. *Briefly explain.*

Part Eight   Network and Internet Security

8.1   How would you rate network system security design conformance to the medical standards on privacy and confidentiality of patients data

Excellent ☐   Good ☐ Average   ☐   Poor ☐   No conformity ☐

8.2   Is there an information system security policy in place to guide the network security in this hospital?

A written policy   ☐   Unwritten but Obvious policy   ☐   No policy at all ☐

8.3   Is there a system/mechanism for detecting and protecting the   hospital Intranet intrusion by unauthorized people?   Yes   ☐   No   ☐

8.4   If the answer to **8.3** is yes, state and explain the mechanism used to ensure secure electronic activities

8.5   In your own opinion, now would you rate the network security infrastructure in this hospital towards addressing the security of the hospitals data/information

Excellent ☐   Good ☐ Average ☐   Poor ☐ Very poor ☐

Part Nine   Network Interoperability

7.3   Does this hospital connect to any other hospital's intranet within Kenya or elsewhere in the world?

Yes   ☐   No   ☐

7.4   If the answer to **9.1** is **yes** ,select the major operations that are performed through the interconnected network   *(Select all that applies)*

        i.   Online Patients Referrals   ☐
        ii.   Sharing clinical data   ☐
        iii. Online surgical procedures   ☐
        iv.   Research   ☐
        v.   Staff development   ☐
        vi.   Knowledge sharing   ☐
        vii. General correspondence   ☐
        viii. Online Diagnosis   ☐

7.5   Please indicate the protocols that are of use in regard to the hospital's network interoperability

  i.   SNMP (Simple Network Management Protocol) for network interoperability   ☐
  ii. SQL (Standard Query Language) for database access   ☐
  iii. OLE (Object Linking and Embedding), an RPC for application interoperability   ☐
  iv. CORBA (Common Object Request Broken Architecture), an RPC locator for application interoperability   ☐
  v.   TCP/IP, IPX/SPX (Transmission Control Protocol / Internet Protocol), (Internet Packet Exchange / Sequenced Packed Exchange) for heterogeneous communications.   ☐

7.6   Are you aware of HL7 *(health Layer Seven)* standard?

Yes   ☐   No   ☐

7.7   If the answer is **9.3** yes ,in your opinion state whether the HL7 can have an impact on interoperability of the health management information systems

High impact ☐   Some Impact   ☐   No Impact ☐   Not Aware   ☐

7.8   Do you use **any** systems based on the use of metadata standards like **XML** etc?

Yes   ☐   No   ☐

7.9   In your opinion, what are the possible **challenges** that this hospital is likely to face as a result of inter-operability   *(Select all that applies)*

        i.   Data Security   ☐
        ii.   Financial constraints   ☐
        iii. resistance to change (Social) ☐
        iv.   Technical requirements   ☐
        v.   Medical   profession constraints   ☐
        vi.   Administrative challenges   ☐
        vii. Ethical challenges   ☐
        viii. Legal challenges   ☐

ix. Others *(Specify)*...

Part Ten Institutional Support on ICT Department

10.1 Is the ICT department integrated in the institutional budgeting/plan?

        Yes   ☐   No   ☐

10.2 If the answer is yes, does the budget cater for the following :-

    i. ICT Staff capacity development   ☐

    ii. Replacement of ICT components   ☐

    iii. Procurement of new ICT equipments ☐

    iv. Maintenance of the ICT department ☐

    v. Any other *(specify)*...

10.3 What are the major challenges as an ICT department that limit the full potential of the department

_____

_____

10.4 Suggest possible solutions to overcome the above challenges

_____

_____

Appendix 8: Research permission letter to the ministry of health

Chogi ,B.F Mwangi
School of Computing and Informatics
University of Nairobi

29th March, 2010

Director of Medical Services
Ministry of Health
Nairobi.

Dear Sir/Madam,

SUB: RESEARCH PERMISSION

I kindly do write this letter to your office as a formal request for the permission to conduct a research for MSc Information Systems Research project; in the public and private hospitals within the Nairobi metropolitan area that uses the referral facilities of Kenyatta National Hospital, by referring patients for advanced/specialized treatment.

The main aim of this study is to establish the challenges that may hinder/or hinders successful implementation of electronic referral system to allow sharing of referral data between Kenyatta National Hospital as a referral center and the referring hospitals in the Nairobi metropolitan. The study will focus on current the ICT infrastructure in the hospital, the usage of the infrastructure by doctors and medical staff in supporting the referral process, and the management view of an electronic referral process in a hospital. During this study, neither nor clinical samples are required.

The study findings will provide requirements for developing a framework to support integration of the isolated hospitals' referral systems with the referral center (KNH) for the purposes of enhancing the referral process. The output of the study is expected to improve productivity within hospitals through the management of the referral process, ensuring that the flow of tasks that manage a referral process are better, faster, easier, and more effective.

In view of this, any assistance that will be extended to this study to make it a success will be highly appreciated. A copy of the final research findings will be availed when the study is completed. I can be reached on 07227815800 or 0254-020-2228067.

Yours faithfully,

Chogi, Bernard F. Mwangi
P56/P/7827/2002
SCI-University of Nairobi

cc. Prof Okelo-Odongo
Director, School of Computing and Informatics,
University of Nairobi

MINISTRY OF MEDICAL SERVICES
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Telephone: Nairobi 2717077   Fax:2715239

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Ref: No: MMS/ADM/3/8/ VOL 1   26th April 2010

Chogi Bernard F. Mwangi
P56/P/7827/2002
School of Computing and Informatics
SCI – University of Nairobi

Dear Mr. Bernard,

## REF: RESEARCH PERMISSION IN THE NAIROBI METROPOLITAN HOSPITALS

We are in receipt of your letter Ref. No. P56/P/7827/2002 dated 6th April, 2010 in relation to the above subject.

You are hereby given authority to conduct the said research on challenges of integrating Health Management Information system for patient referrals: Case study of Kenyatta Referral Hospital and Nairobi Metropolitan Hospitals.

Also note that you are expected to give this office a copy of your research findings.

DR. FRANCIS M. KIMANI
DIRECTOR OF MEDICAL SERVICES

Kenyatta National Hospital
Hospital Rd. along, Ngong Rd.
P.O. Box 20723-00202, Nairobi.
Tel: 2726300-9   Fax: 2725272
Telegrams: "MEDSUP", Nairobi.
Email: knhadmin@knh.or.ke
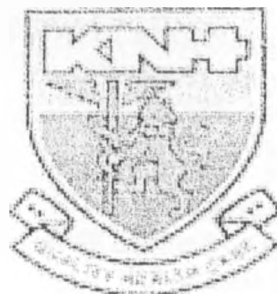
Date: 25th January 2010

Chogi, B.F Mwangi
P56/P/7827/2002
School Of Computing & Informatics
University of Nairobi.

RE: APPLICATION TO CONDUCT RESEARCH

The KNH Scientific Research Committee on its meeting held on 22nd January 2010 in the
Committee Room reviewed and approved your request to collect data for your research
on   Challenges of Integrating Health Management Information Systems for Patient
Referrals: Case study of Kenyatta referral hospital and Nairobi metropolitan
hospitals

You are required to carry out your research within the period stipulated in the proposal. It
is recommended the findings be published after the report is reviewed by the KNH
Research Committee.

DR. NJOROGE WAITHAKA
  COORDINATOR, KNH SCIENTIFIC RESEARCH COMMITTEE

cc

The Chief Executive Officer
The Deputy Director (CS)
Deputy Director (A&F)

Ref: KNH-ERC/ A/321   15th October 2009

Mr. Chogi B. F. Mwangi
P56/7827/2002
School of Computing and Informatics
University of Nairobi

Dear Bernard

RESEARCH PROPOSAL: "CHALLENGES OF INTEGRATING HEALTH MANAGEMENT INFORMATION SYSTEM FOR PATIENTS REFERRALS: CASE STUDY OF KENYATTA REFERRAL HOSPITAL AND NAIROBI METROPOLITAN HOSPTIALS"   **(P209/7/2009)**

This is to inform you that the Kenyatta National Hospital/UON Ethics and Research Committee has reviewed and **approved** your above revised research proposal for the period 15th October 2009 - 14th October 2010.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimen must also be obtained from KNH-ERC for each batch.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

DR. L. MUCHIRI
AG SECRETARY, KNH/UON-ERC

c.c.   Prof. K.M. Bhatt, Chairperson, KNH/UON-ERC
          The Deputy Director CS, KNH
          Supervisor: Prof.Okelo-Odongo

APPENDIX 9

DOCTOR- PATIENT RATIO IN AFRICA

DOCTOR- PATIENT RATIO IN AFRICA
(By Country, 2006)

Country	Doctor-patient ratio (per 100,000 people)

Country	Ratio	Country	Ratio
Seychelles	151	Zambia	12
Tunisia	134	Guinea-Bissau	12
Libya	129	Mauritania	11
Algeria	113	Gambia	11
Mauritius	106	Guinea	11
South Africa	77	Congo (Democratic Republic)	11
Egypt	54	Central African Republic	8
Morocco	51	Mali	8
Gabon	49	Angola	8
Sao Tome and Principe	49	Uganda	8
Botswana	40	Burkina Faso	6
Equatorial Guinea	30	Senegal	6
Namibia	30	Papua New Guinea	5
Gabon	29	Lesotho	5
Madagascar	29	Eritrea	5
Nigeria	28	Rwanda	5
Sudan	22	Togo	4
(Republic of) Congo	20	Benin	4
Cameroon	19	Chad	4
Djibouti	18	Mozambique	3
Swaziland	16	Burundi	3
Zimbabwe	16	Ethiopia	3
Comoros	15	Sierra Leone	3
Ghana	15	Niger	3
Kenya	*14*	Tanzania	2
Cote d' Ivoire	12	Malawi	2

WHO global standard pegged at 1:5,000

Determine Sample Size

Confidence Level: ⊙95% ○99%

Confidence Interval: 24.41

Population: 63

[Calculate]   [Clear]

Sample size needed: 13

Find Confidence Interval

Confidence Level: ⊙95% ○99%

Sample Size: 13

Population: 63

Percentage: 50

[Calculate]   [Clear]