PHYSICIANS USE OF ELECTRONIC HEALTH RECORDS SYSTEMS AND PERFORMANCE IN HOSPITALS WITHIN NAIROBI COUNTY, KENYA

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION (MBA), SCHOOL OF BUSINESS,

UNIVERSITY OF NAIROBI

NOVEMBER, 2016

DECLARATION

This research project is my original work and has not been presented for any academic award in any other institution of learning.

Signed …… Date. ……..

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This research project has been submitted with my approval as the University Supervisor.

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DEDICATION

I wish to dedicate this work to my parents Zachary and Naomi. They accorded me immeasurable support and encouragement throughout the period of the study. It is through their cooperation and understanding that this work has been accomplished.

ACKNOWLEDGEMENT

Several people contributed to the success of this study and in a special way I would like to acknowledge them.

First I want to thank my family and friends for their never ending support, patience and encouragement during the period of the study.

Special thanks to my supervisor Mr. Joel Lelei for his unwavering and tireless support and guidance. I would also like to thank Mr. Denis Ekanusu and Mr. Justin Maranga for their input, review and invaluable comments in making this a success.

I acknowledge the support of all doctors who participated in this study and a special thank you goes to each of you.

Most of all I thank God, because this study is a success because of his blessings.

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ABSTRACT

This research was carried out within hospitals in Nairobi County to investigate the use of electronic health records systems by physicians and how their use relates to performance. The study also looked at establishing the drivers towards use of these systems, the extent at which they use these systems, challenges encountered while using them, and finally establishing the relationship between usage and physician performance. This study used the descriptive survey design. The population for this study were physicians working in hospitals within the Nairobi County that use electronic systems to manage their health records. Ten hospitals were identified and considered for the study. Printed paper questionnaires were used to collect the data. Demographic characteristics were analyzed using frequencies and percentages. Drivers towards usage of EHRs, extent of usage and challenges were analyzed by use of means and standard deviations. Regression analysis was carried out to establish the use of these systems and how they relate to performance of physicians. The study found the respondents rated that the greatest driver towards usage of electronic health records systems was the need for accomplishing tasks more easily and efficiently to a very large extent. On the extent of usage of EHRs, the study found that the feature rated as used every time was to enter daily notes. On challenges with the use of EHRs, the study found the physicians rated lack of clinical reminders and the lack for drug allergy alerts as a challenge to a large extent. The findings from the regression analysis reveal that the usage of the health information and reporting module of the EHR was significantly associated with improvement in the number of patients seen, collaboration with other physicians on a patient, and the efficiency experienced in which they complete tasks. The security and confidentiality module, was found to have a significant association with improvement in the number of patients seen and the efficiency experienced in which they complete tasks. Finally, the study recommends continuous training on the use of EHRs, more importantly on its advanced features. It also recommends that studies be carried out to assess how the use of reporting and use of security features relates to performance.

CHAPTER 1: INTRODUCTION

1.1 Background

Many countries have acknowledged the importance of Information Communication Technology (ICT) in provision of healthcare services to improve patient safety, efficiency and quality. Kenya has acknowledged this and has set pace in establishing initiatives to achieve this noble goal.

Electronic Health Records Systems (EHRs) are part of the larger health management information systems having several roles including serving as an intermediary between various healthcare facilities (Hendy *et al.*, 2005). They are an extensive record of a patient's health data resulting from visits in a healthcare facility. The records contain patient demographics, their progress, and medication history. Adoption of these systems automates the inefficient paper-based systems, thereby streamlining the workflow of the physician and thus improving the efficiency and effectiveness with which they provide care for the patient. They can generate complete records of patients' visits, produce evidence for clinical outcomes for management decision support (Hillestad *et al.*, 2005). They are increasingly being deployed in healthcare facilities to achieve improvements in safety and care of patients, but there remains a challenge to this, they must be used by physicians effectively. EHRs hold promise in the improvement, efficiency and quality of care for patients, however, in terms of information technology, they are still decades behind other industries.

Health costs have spiraled upwards putting financial pressure to employers, governments and individuals as they continue to increase faster than incomes. Use of these systems can result in cost reductions gained through the reduction of duplicate services, improved decision making with the provision of timely and relevant information, reduced medical errors, patient confidentiality, and more reliable prescribing (Hoffman, *et al.*, 2008).Unfortunately most physicians are poorly equipped with the tools to address this as most lack the essential information systems to keep up with the latest medical interventions to respond to various challenges posed in the provision of care.

Kenya has embarked on a mission to develop its electronic health management systems with the aim of migrating paper-based records to the electronic form of records management. The Ministry of Health (MoH) is putting efforts geared towards standardization of EHR systems in

healthcare settings under their control. This effort culminated in a document on standards and guidelines for electronic health records systems (Ministry of Health Report, 2011).

According to the Ministry of Health Report (2011), government run healthcare facilities have poor ICT making it difficult for adoption, and even though potential benefits for adoption and effective use of EHRs are known, documentation of its use and physicians' performance in healthcare settings in Kenya is limited.

1.1.1 Electronic Health Records Systems

Hillestad *et al.* (2005) define electronic health records (EHRs) as systems that organize and store medical records in electronic form. Unfortunately, most healthcare settings still rely on paper-based records, making it difficult to coordinate care for the patient and perform routine quality measurements, thereby leading to increase in medical errors. The use of EHRs provides the opportunity to improve medical decision making thus reducing medical errors, they also promote care coordination amongst healthcare professionals on patients in assessing problems, and also linking to other disparate systems for easy accessibility and accumulation of medical data. Paper-based records have certain shortcomings: expensive to maintain, easily destroyed, difficult to analyze, lack of security and confidentiality; and also their negative impact to environmental resources. According to Tang (2006), there are benefits to using EHRs which include secure health records, faster access of patient records and real time interaction with pharmacies and other specialists thereby reducing medical errors. Keying of data into the EHR is mostly recorded by various health care professionals and support staff ensuring a patient's health information and records are complete, accurate and secured.

The healthcare setting has complex processes according to Martin (2004), which extends from an individual presenting a health concern to a healthcare provider and continues through diagnosis, treatment and follow-up. Achieving efficiency of these processes is neither low-cost nor easy. These systems have the potential to improve health outcomes of patients through enhanced disease management, decision support and increased levels of preventive care (Bates *et al.*, 2003). They are continuously being improved upon to increase efficiency in management of information to ensure the right information is at hand in support of making better clinical decisions.

In a study done by Zandieh *et al* (2008) looking at challenges of implementing electronic health records versus paper-based systems, found that transitioning from a paper-based to an electronic system can be challenging. They also note that paper-based systems are plagued with inefficiencies such as the need for large physical storage space, time-consuming retrieval methods, loss or damage to contents in a patient's file, unauthorized access, and medical errors caused by ineligible handwriting of physicians. Such inefficiencies affect performance, and as inherent as they are, can be minimized with the adoption of an EHR.

Ochieng and Herselman (2008) conducted a local study on eHealth in rural areas and found that infrastructural factors that includes availability of computer, internet, and ICT skills are important drivers towards the adoption of electronic health records system. Sahay and Walsham (2006) add that, training of physicians in ICT boosts their confidence in using these systems and hence improving on their performance. This also means the roles of physicians would have to be reengineered to effectively accommodate the technology as a result of the disruptive change in the workplace by the introduction of EHR systems. It is this phase that McIntyre (2008) notes that physicians will experience low patient encounters.

Despite the challenges coupled with high EHR systems implementation and continuous maintenance costs being high, the costs are likely to decrease over time, and adoption rates will likely improve, leading to overall improvement of healthcare management. The Ministry of Health has also noted of several initiatives that are geared towards reporting of healthcare information with the use of the District Health Information System (DHIS) and other electronic medical record systems. This study therefore seeks to investigate the use of these systems by physicians working within hospitals in Nairobi County.

1.1.2 Physician Performance in Hospitals

In the USA, the Health Information Technology and Clinical Health Act (HITECH) was enacted under the Obama administration to promote the meaningful use of these systems in achieving efficiency in healthcare (Blumenthal, 2010). As a result of this, a tool was developed by the American National Committee for Quality Assurance (NCQA) to measure the performance of care (www.ncqa.org). The Health Effectiveness and Data Information Set (HEDIS) tool was developed for the purpose of providing consumers reliable ways of comparing various healthcare plans.

There are circumstances where physicians are encountered with limited information with which to make clinical decisions and this has a danger to the safety of the patient (Kaelber *et al.*, 2007). This leads to duplication of services such as laboratory testing and prescription of drugs (Frisse *et al.*, 2007). Without the use of these systems, searching for missing information on patients has an impact on the scarce administrative resources spent on this task causing unnecessary delays in care and thereby having a negative impact on the efficiency of the physician (Smith *et al.*, 2005). These systems have the capability of exchanging information between providers through Health Information Exchange (HIE). This solution allows timely and useful clinical information at the point of care, thereby aiding the physicians' clinical decision process with the aim of improving patient outcomes (Shapiro, 2007), thus leading to decreased costs, and reduction of medical errors as a result of the improved decision process (Kaelber *et al.*, 2007). Physicians that make meaningful use of EHRs are likely to improve on their performance and that of the health facility.

The Ministry of Health Report (2011) key output from the review process on electronic health records was to recommend some criteria for monitoring their usage. They acknowledge from their findings that implementing of EHRs is different from its' meaningful use, and that well used EHRs results in improvement of clinical care and as such the evaluation of their usage can take the form of either quantitative or qualitative depending on indicators set.

1.1.3 Hospitals in Nairobi County

The World Health Organization (WHO) recognizes the importance of the role played by healthcare institutions such as hospitals since they host various cadres of medical personnel, and the fact that they are also equipped with inpatient and ambulatory facilities that offer various medical services around the clock (www.who.int); they are also a source of essential information for medical research and education since a lot of data is collected on health related conditions arising from disease and injuries.

There is a popular dictum that "health is wealth" and it's in order to say that the wealth of a nation can be measured by the health status of its citizens. According to the World Bank (2005), amongst the drivers to a poor economic performance of a country is attributable to ill-health and low life expectancy. In other words, health is a fundamental driver for economic growth and development, therefore a high percentage of the Gross Domestic Product (GDP) is apportioned

for public healthcare by developed nations since they believe health is a great driver for economic growth. A better healthcare should not wait for the economy to improve but ensures that measures are put in place to reduce the high burden of disease, thereby increasing life expectancy leading to creation of a healthier and richer economy. Therefore, hospitals are valuable and should be well equipped to offer essential health services for individuals seeking medical attention for an improved health outcome.

Nairobi County has a population of approximately four million residents and happens to be the capital city of Kenya. According to the Ministry of Health list of health facilities (2008), there are 170 registered health facilities in Nairobi County composed of private and government owned health facilities which include referral hospitals, district hospitals and health centres. Physicians work in hospitals and are the backbone of the healthcare industry, they perform routine diagnosis of patient's problems and prescribe the required treatment, and management of their conditions (www.who.int). With the advancements in ICTs, they are more than ever required to adopt information systems to manage their practices.

According to Devaraj (2003), looking at performance impacts of information technology, noted that emergent technologies like electronic health records (EHRs) has brought the demand for physicians who will have to strike a balance between their responsibilities and attaining the more of the expected benefits of EHRs, but for this to happen, there has to be a change in the mindset of physicians and their settings in order for the systems to support productivity and quality healthcare. Devaraj (2003) finally concludes that the success of any ICT system is the actual use and subsequent realization of derived benefits, and as such their limited use undermines the attainment of perceived benefits of productivity and high-quality care.

The World Health Organization (WHO) states that physicians are responsible for taking medical histories and performing physical examination to determine a possible diagnosis which is key expertise in medical practice based on both knowledge and judgement, and also that it's a core requirement for management and treatment of various medical conditions. They also provide continuous care for the patient in a collaborative effort with their healthcare team while in hospital and also manage any complexity and risk in situations that are often times uncertain and changing. As these responsibilities are enormous, there are solutions that can help manage these processes. Electronic health records systems are part of a health information management

systems that help with organization of patients' health records required for medical history in support of clinical care through clinical decision support.

1.2 Research Problem

Despite the benefits derived by EHRs to a healthcare setting, there have been barriers to successful adoption of these systems. A study done by Miller (2004) looking at adoption of EHRs by physicians, reveal that although their rate of adoption has been on the increase, the actual uptake has been relatively slow. Among the notable reason cited was the availability of a large number of systems offered by vendors proving difficult to identify which would satisfy and meet the needs of their facility. There was also a justifiable concern which is also shared by Audet et al (2003), about the stability of many of these companies offering these solutions in regards to availability of adequate technical support. Bostrom *et al.* (2006), also puts other aspects such as the quality of graphical user interface design, system features and perceived functionality, privacy, patient safety, finances, staff anxiety and efficiency as an influence to successful implementation of these system. Though it is perceived there is a successful return on investment (Wang et al, 2003) by practices that have adopted an EHR; this remains to be felt or seen.

Locally, Kimani and Namusonge (2015) did a study on factors affecting the utilization of health information technology projects in Nairobi County, and found that some of the determinants influencing the utilization of these systems, include age of the user, presence of computers, engagement of the user during the implementation phase, relevant training with follow-up, proper and routine maintenance of systems. These concerns are also shared in a review done by the Ministry of Health (2011) that led to a document on standards for EHR Systems, which highlights challenges such as users not aware of capabilities of their EHR, differences in knowledge and extent of use amongst users, lack of ICT skills, lack of technical support and vendor volatility as issues faced by healthcare institutions that have adopted an EHR. It is due to such challenges that have led hospitals for been slow in adopting these systems. The Ministry of Health (2011) review also recommends that there should be a defined benchmark for recurrent measurements of effects of EHR systems through designing specific indicators to capture how the systems are used for the purpose of ensuring they have an impact on healthcare.

The studies so far highlighted the challenges with the adoption of EHRs in hospitals, therefore, this study need arose with the following questions: What are the drivers towards usage of electronic health records systems by physicians? What is the extent of use of electronic health records systems by physicians? What is the relationship between usage and physician performance?

1.3 Objectives of the Study

The general objective of the study was to investigate the physician use of electronic health records system and performance in hospitals specifically to:

(i) Establish drivers towards use of electronic health records systems by physicians in Nairobi County.

(ii) Establish the extent of use of electronic health records systems by physicians in Nairobi County.

(iii) Establish the challenges physicians encounter when using electronic health records in Nairobi County

(iv) Establish the relationship between usage and physician performance in Nairobi County.

1.4 Importance of the Study

Physicians may have access to all the latest equipment at their disposal, but when timely information determines improved patients' outcomes, there's need to be equally prepared with the correct and necessary information, as this has an impact on their performance. Electronic Health Records Systems are tools if properly utilized will not only add value to the physician but will somewhat improve on their performance. Physicians are often the prospective end-users; therefore, they heavily impact how successful a prospective EHR will be used. The findings of this study highlights challenges they face in their usage leaning towards their performance.

Since Electronic Health Records Systems are a data collection system they store a vast amounts of information, thereby making this study important for physicians to appreciate the importance of properly maintained electronic health records since they can facilitate planning, care and

management of patients, they can also be viewed as part of a larger data set for further medical research and how best to introduce medical interventions that can help change health outcomes.

This study is of importance to the Ministry of Health having launched its eHealth Strategy for 2011-2017, which additionally, is a step forward in achieving its core objective of provision of high quality healthcare for its citizenry. This study is also important to future researchers of EHRs, the contribution to the literature on electronic health records adoption and performance of physicians will form a basis upon which other studies will be done, and subsequently help create research gaps and opportunities to contribute to the existing literature.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter critically assess various researches that have covered different aspects of electronic health records and physician performance. The review looks at the drivers towards use of these systems, challenges experienced, and the relationship between usage of EHRs and physician performance. The chapter also introduces the theoretical foundation and conceptual framework.

2.2 Theoretical Foundation

This section examines the theories behind the study, namely the Diffusion of Innovations (DOI) theory, the Technology Acceptance Model (TAM) and the Theory of Interpersonal Behavior (TIB) to provide the theoretical framework due to their extensive use in studies related to adoption of an innovation (Rogers, 2003). TAM has some limitations when it comes to healthcare professionals according to Yarbrough and Smith (2007), and an integrated model approach with TAM as the base and other constructs from DOI and TIB have been used to explain use of innovative technology systems such as EHRs by physicians and the impact it has on their performance. TIB incorporated the professional norm (Gagnon *et al.*, 2006) construct due to the complexity associated with the healthcare professional behavior.

2.2.1 The Diffusion of Innovations Theory

This theory recognizes changes in social settings as they occur as a result of a newly introduced innovation (Rogers, 2003), and critically assess which social characteristics have an impact in an individual's acceptance or rejection of the innovation.

Bowler *et al.*, (2006) explain that a physicians' interpersonal interaction in a social setting has an influence on the use of an innovation, and by interacting with other physicians through social calls and general consultations it can prove important in explaining behavior. The innovation diffusion theory is hereby used to identify with its two perceptions, that of perceived usefulness and perceived ease of use.

2.2.2 The Technology Acceptance Model

The Technology Acceptance Model (TAM) is a derivation of two theories: The Theory of Reasoned Action (TRA) and the Diffusion of Innovations Theory (DOI) (Davis, 1989 & Lee *et*

al, 2003). According to Ajzen (1973), TRA assumes that attitude towards something is derived from beliefs, which then has a bearing on behavioral intention, which leads to actual use. Here, use, refers to how the user interacts with the technology by measuring frequency of use, and duration. Likewise, the diffusion of innovation theory according to Rogers (1995) has five elements contributing to a new behavior that will each partly determine whether diffusion of a new activity will occur: relative advantage of the innovation, complexity in its use, compatibility, trialability, and observability of results.

The complexity element is broken and renamed as perceived ease of use and perceived usefulness. The perceived usefulness which is hereby defined as the degree to which a person believes using a particular information system such as an EHR would contribute accomplishing work important to the individual while perceived ease of use is defined as the degree to which an individual believes little or no effort will be expended in using the system (Venkatesh, *et al.*, 2003). According to Davis (1989) and Chismar *et al.* (2003), both constructs are influenced by human and social factors which will indirectly determine technology acceptance. This model also combines demonstrability of results construct from Rogers' Diffusion of Innovations theory and the computer self-efficacy construct which is a user's perception of their capacity to use the EHR.

TAM is applicable to this study as it reliably predicts and interpret physicians' acceptance and use of an innovation and has been confirmed to be applicable to management of health information technology (Venkatesh and Davis, 2000).

2.2.3 The Theory of Interpersonal Behavior

This theory integrates the social and personal normative dimensions. The socio-cultural setting of the physicians and their peers acts as a conduit for socializing and consultations related to their responsibilities which is important and can help explain behavior (Bowler *et al.*, 2006), which has an impact on performance. However, TAM is focused on individual psychological level of acceptance paying less attention to the social context surrounding the user (Sykes *et al.*, 2009), though prior research indicates that social networks can influence technology acceptance (Eckhardt *et al.*, 2009).

2.3 Drivers of Electronic Health Systems

This section describes the characteristics of physicians and drivers towards usage of EHRs. Characteristics such as age, gender, years in practice, and the relationship with the health system have roles in predicting attitudes towards usage of EHRs. Gabbay (2004) and Coleman (1966) note that physician's social network, its culture and peers also have an influence on the way new technology is adopted; this socio-cultural aspect was noted as having an effect on adoption of EHRs.

A study by Hogan and Palmer (2005), found that most medical training do not train future physicians in the use of EHRs. Training future physicians on EHRs, and to rely on them for their decision-support can improve on their performance of healthcare provision. Therefore, its' of utmost importance that all forms medical training should include the use of EHRs and ICT skills. Ochieng and Hasoi (2005) in their study seeking to establish the drivers towards use of electronic health records also noted that ICT training among physicians was found to be a key requirement for greater adoption. Thus, there is a need to impart ICT skills amongst physicians as part of their medical training, as this most probably will lead to adoption of EHRs. Physicians with ICT skills relate better with the benefits accruing from their usage when engaging in their responsibilities as it boosts their confidence level (Sahay & Walsham, 2006). Those physicians that lack ICT skills spend more time trying to understand the innards of an electronic health system (Hogan & Palmer, 2005).

Muathe, Wawire and Ofafa (2003), in their study focusing on ICT solutions that have been adopted in the Kenyan health sector noted that the quality of the information and communication systems is a determinant in their usage. The Internet according to Qureshi et al (2013) is vital for a sustainable ICT solution targeted at the health sector this is because physicians are able to share medical consultations with other physicians online through applications such telemedicine. Infrastructural concerns more specifically cost of equipment like computers, high implementation and maintenance costs, the learning effort, loss of productivity (Simon *et al.*, 2007) are a hindrance to the adoption of eHealth solutions as noted by a study conducted by Ouma and Herselman (2008). Confidentiality of electronic health data was also noted to be a concern by physicians.

Provision of financial incentives towards the gainful use of computerized records by physicians (HITECH, 2009) would accelerate the usage. Low provision in funding towards the health sector according to Omary et al (2010) impacts on success, as this poses difficulties in allocating funds for ICT resources required for implementation and sustainability of electronic health records systems. Larger health institutions receive better funding than smaller one and there is a positive correlation with the size of the health institution (Zhu et al, 2003).

2.4 Usage of Electronic Health Records Systems by Physicians

Many physicians view and use EHRs as the electronic format of the paper version, only more legible, and hence not using or aware of the advanced features which could further enhance their performance and that of the healthcare facility (Hafner, 2014). This has an impact on the quality of the data when advanced usage of the EHR is called for. Unfortunately, most physicians still store medical records on paper resulting in uncoordinated care and non-reduction of medical errors (Bates et al, 2003). The importance of data quality is that less time is spent cleaning, making it reliable and more appreciated when it can be used to generate meaningful reports. Possibly with proper training of the advanced features and continuous education, maybe then EHRs will go a long way into supporting the quality of data and maximization of its use.

Advanced features also include effective connectivity amongst systems to avoid redundant tests and to improve coordination amongst physicians in provision of healthcare. There are factors that hinder the use of these advanced features such as challenges on how to use an EHR, lack of confidence, having a backlog of documents needing to be scanned resulting in incomplete records, variability in usage amongst users creating frustration where some were not using the EHR fully (Friedberg *et al.*, 2009). Factors that motivated continued usage as noted by Friedberg *et al.* (2009) was identification of providing efficient care to patients as a priority, and confidence in the use of ICTs and that of the EHR system.

Electronic Health Records Systems have key modules composed of the clinical documentation module, testing and imaging results module, computerized provider order entry module, clinical decision support module, health information reporting module, security module and the inter-exchange of information module. Many current EHRs have these modules and it is likely that more functionality will be added with time. The modules have the ability to assist the physician make decisions based on evidence provided by accurate data, and this can only be possible with

the use of EHRs than paper charts. The following sub-section describes in brief these modules which are desirable in any EHR system.

2.4.1 Clinical Documentation Module

This module of the electronic health records is used for accessing key information of patients i.e. their medication list, notes, discharge summaries, problem lists, physician notes, medication list, etc. This is the most comprehensive and advanced module in most EHRs. The module is used to create an account for a new patient by capturing their demographic details and health information, and this is recognized as a bare minimum requirement for an EHRs.

2.4.2 Testing and Imaging Results Module

According to a study by Tang (1999), 25% of the time paper charts of patients are missing from their files, and even when they are available, approximately 13.6% of the consultations have specifics missing (Smith *et al.*, 2005). This causes re-ordering of tests because results are missing, but with EHRs, physicians would not have to do a manual search for these results, thus saving time and money and preventing redundancy thereby improving care coordination. This module allows a physician to create, view and also obtain laboratory reports, radiologic reports and images, consultant reports, diagnostic results as well as other reports.

2.4.3 Computerized Provider Order Entry Module

The module allows physicians to make orders for laboratory and radiologic tests, order for refills and medications for patients, consultant request, nursing orders, etc. It has the prescription order entry which is important in reducing prescription errors and severe drug events (Shekelle *et al.*, 2006). This in turn causes a reduction of treatment costs while maintaining quality of care, thereby reduction in the workload by eliminating of unnecessary transcription as noted by the Ministry of Health (2011).

2.4.4 Clinical Decision Support Module

This module of the electronic health records allows the clinicians to view medical guidelines, reminders, alerts on allergy to medication, alerts on drug-laboratory interactions, medication dosage support, etc. The module also allows clinicians make correct clinical decisions thus improving overall quality of care by provision of alerts and reminders.

2.4.5 Health Information and Reporting

Reporting is a key feature for any EHR to be useful, and utilization of well-organized and correctly entered data is of utmost importance to the creation of meaningful reports for key stakeholders for purposes of planning and management in the delivery of quality services. Thus, there is a need for longitudinal records from which reports can be generated over time. Depending on the report, EHRs can highlight the performance of the institution as a whole or the physicians' productivity in terms of patients seen per hour and referral patterns.

2.4.6 Security and Confidentiality

Electronic health records systems implementations come with questions about confidentiality and security of health data as to who is authorized to access patients' data and how is the data protected from theft. Confidentiality, integrity and availability are the three fundamental security goals of electronic health records systems (Hass, 2011). Safety measures built in these systems include access control mechanisms like the use of passwords, encryption of data, and an audit trail that records who accessed certain information and what changes were made. The Ministry of Health report (2011) mentions security and confidentiality should be a key feature for electronic health records systems in the protection of sensitive health records.

2.4.7 Electronic Information Exchange

Availability of inter-exchange of health information allows physicians to access and share vital information on patients with other physicians through electronic means, thereby improving outcomes and reduce costs of healthcare. Without this, patients would have their records sent to other providers physically or they would carry their files with them to other healthcare providers but with electronic health records system there is sharing of information on past history, current medications which can be jointly viewed during consultations. This avoids unnecessary readmissions, medical errors and duplication of tests. This is a core requirement according to the Ministry of Health (2011) report, which also acknowledges that there should be existence of interoperability between diverse systems sharing health information in a timely manner.

2.5 Challenges with The Use of Electronic Health Records

Physicians' initial challenge of adopting an electronic health records systems is at the implementation phase which is attributed to high costs, loss of productivity, and choice of EHR, as well as uncertainty about whether the systems would meet their needs, and if they would be a worthy investment (Simon SR, *et al.*, 2007).

According to Hafner (2014), the present generation of EHRs are yet to mature since most are a transposition of paper charts to an electronic format and do not support clinical decision support; have poor connectivity to other relevant data sources thereby creating frustration for physicians having to struggle switching between nonintegrated systems which will then have an impact on their performance and also a risk to the patients' health. If some of the features of the EHR are found to be difficult and not intuitive enough, those features will not be used as much or not used at all. Campbell et al (2007) note that the quality of data affect how physicians use the system since it limits the use of advanced features which are critical to support patient care. Unintended consequences might occur when the EHR is expected to execute essential critical functions but is unable due to the poor quality of the data.

Miller and Sim (2004) argue that perceived complexity of the system leads to non-use of these systems. When physicians encounter numerous options and heavy use of navigational aids, they normally perceive this as not as user-friendly and will find it a challenge to allocate time and effort to master them. Though, its' upon them to master how to use the EHR system adequately and efficiently. Some physicians lack basic ICT skills like good typing skills, lack of technical support, lack of training or view ICT as being complicated (Boonstra & Broekhuis 2010).

According to Boonstra (2010), management support as well as technical support is crucial to the way the EHR systems are used and consequently influences the rate of usage by physicians. Meinert (2005) observes that other cadre of staff will be influenced into the use, by the rate at which physicians use the systems. Further to this, Boonstra (2010), alludes that the ability of the EHR to be customizable is important to the increase usage of the system. Halbesleben (2008), notes that, with any system, whenever there is a perceived limitation, workarounds are developed by users to counter that limitation usually brought about by a workflow problem. Physicians will at some point face the difficulty of choosing between giving critical or emergency care to a patient and consulting patient records in the EHR.

On training, Mark (2013) notes that there are those that trained on EHR years ago when the system was first installed and most might have attended minimal sessions but there are also those that joined the facility when the EHR had been implemented and had to learn through trial and error, this has consequences to the quality of data. The author also captures complaints from physicians such as interoperability between systems and spending a lot of time with data entry, interference with face-to-face patient care having to choose between the patient and the computer thereby lengthening overall work hours as some of the reasons why they do not use these systems. The same is shared by the Ministry of Health report (2011) that highlighted key challenges in the adoption of EHRs: disparate systems in use, lack of information interchange amongst users, lack of ability to create tailored reports and lack of infrastructure.

2.6 Relationship Between Usage of EHRs and Physician Performance

According to Lansky (2002), improved quality healthcare results in better patient outcomes and this has a bearing on the physicians' performance. To measure performance there has to be a set of technical specifications that detail how to calculate it for some important indicator such as quality. Currently, there has been no agreed standards to measure physician performance but what comes out from the literature is that some physicians have been known to provide high quality care and be inefficient or vice versa. While there are those that show poor performance on both quality and efficiency, as well as those who do well on both. The objective of measuring their performance is to comprehend their position in terms of performance, and then initiate support mechanisms that will drive substantive performance in their provision of quality and efficient healthcare.

The Commonwealth Fund (2008), states that better management of patients leads to reduction of their medical costs as this alleviates redundant tests and procedures that are avoidable, since quality of care is a concern of the health care delivery system, therefore the goal of measuring performance is to improve patient care and reduction of costs. According to Leung *et al.* (2003), physicians spend most of their time providing care to patients and it is their hope that EHRs could increase this patient-interaction and improve on care and outcomes. For this to happen, routine documentation of clinical data is essential as this translates into better patient care. Therefore, in evaluating performance of physician activities, several studies have taken time used in documentation as the primary outcome and direct patient care as secondary outcome (Allan *et*

al., 2000). Though, increase in documentation time has been cited as one of the barriers to a successful implementation of an EHR.

2.7 Conceptual Framework

The conceptual framework presents the relationships between the variables used in the study. The independent variables were: clinical documentation module, testing and imaging results module, computerized provider order entry module, decision support module while the dependent variable is the physician performance.

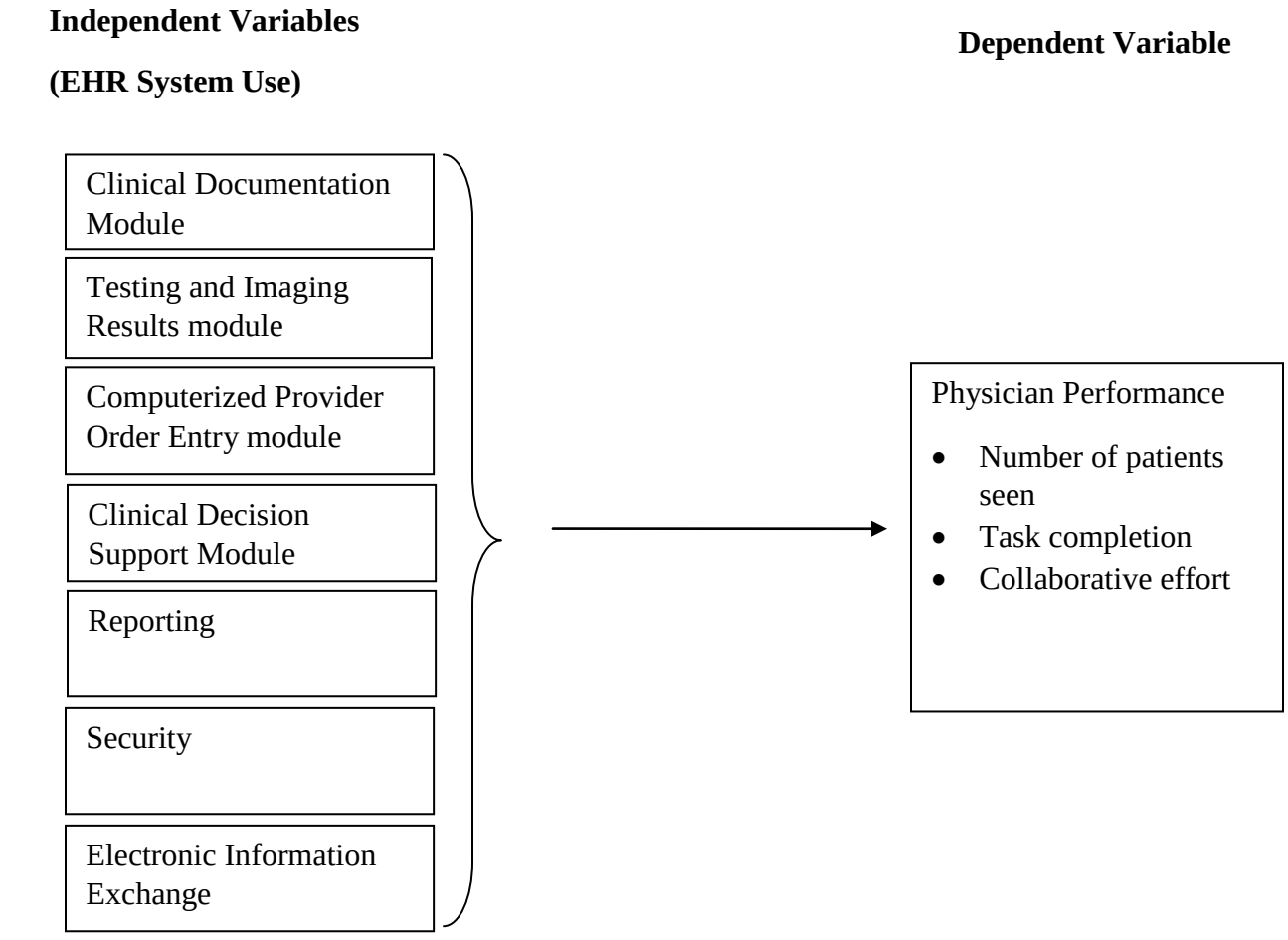

Figure 1: EHR Systems Usage and Physician Performance

2.8 Summary of the Literature Review

This chapter has presented the relevant literature touching on physician performance with the use of electronic health records systems. The literature reveals that the drivers towards usage are dependent on the demographic characteristics of the user, concern on the security and confidentiality of health data, availability of funds for implementation and sustainability of an electronic health records system, and quality of ICT systems also as a determinant in their usage. It is further revealed that factors that motivated continued usage was identification of providing efficient care to patients as a priority, and confidence in the use of ICTs and that of the EHR system. The review has highlighted that among the challenges facing the use of EHRs among physicians are lack of training, lack of timely technical support, poor quality data, unfriendly interfaces and lack of basic ICT skills. It also highlights that the initial challenge of adopting an electronic health records systems is at the implementation phase which is attributed to high costs, loss of productivity, and choice of EHR system. Other notable challenges are management support as well as technical support which is crucial to the way the EHR systems are used and which consequently influences the rate of usage. To this end, it is also observed that other cadre of staff will be influenced into the use, by the rate at which physicians use the systems. The review also reveals that training future physicians on electronic health records systems to rely on them for their decision-support can improve on their performance of healthcare provision.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The chapter introduced the research design, population under study, method used for sampling, technique for collection and analysis of the data.

3.2 Research Design

This was a descriptive survey study. Polit and Hungler (1999) describe the purpose of descriptive research as studies that observe, describe and document aspects of a situation. Within the realm of descriptive studies, descriptive statistics tell what is, while inferential statistics try to infer results obtained from the sample to the population from which the sample was selected. The physicians under study were the focus of this descriptive research whose aim was to assess the adoption of electronic health records systems and their performance.

3.3 Study Population

The population for this study were physicians working in hospitals within the Nairobi County that have adopted an electronic health records systems.

3.4 Sampling

Ten selected hospitals that have adopted an electronic health records system had been identified for the study, and grouped into Faith Based Hospitals, Government Hospitals, Specialized Hospitals and Private Hospitals. A total of 15 respondents were selected at random from each hospital. Thus, a total of 150 respondents were targeted for the study.

3.5 Data Collection Method

A questionnaire was used to collect the primary data for the study, which was dropped and later picked from the respondent after they had filled it.

The questionnaire was divided into five sections, section A through Section E. Section A captured the demographic characteristics of the physician; Section B captured drivers towards usage of electronic health records systems. Section C captured the extent of usage of EHRs. Section D captured the challenges with the use of EHRs while Section E captured the performance indicators of the physicians.

3.6 Data Analysis

The primary data collected was checked for completeness, entered, cleaned and analyzed by the use of Statistical Package for Social Sciences version 20. Demographic data was analyzed using frequencies and presented by use of frequencies and percentages. Drivers towards usage of EHRs, extent of usage and challenges was analyzed by use of means and standard deviations. Regression analysis was used to determine the relationship between physician usage and performance of electronic health records.

The following regression model was used to identify factors associated with the variables.

Model:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

$$Y_2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

$$Y_3 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

Where,

For Model

$\boldsymbol{Y_1}$= Number of patients seen

$\boldsymbol{Y_2}$= Task completion

$\boldsymbol{Y_3}$= Collaborative effort

$\boldsymbol{X_1}$ = Clinical Documentation Module

$\boldsymbol{X_2}$ = Testing and Imaging Results module

$\boldsymbol{X_3}$ = Computerized Provider Order Entry module

$\boldsymbol{X_4}$ = Clinical Decision Support Module

$\boldsymbol{X_5}$ = Reporting

$\boldsymbol{X_6}$ = Security

$\boldsymbol{X_7}$ = Electronic Information Exchange

$\boldsymbol{\beta_0}$ = Constant

$\boldsymbol{\varepsilon}$ = Error

CHAPTER 4: RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

The findings of the study are presented in this chapter. The specific objective of the study was to investigate the relationship between usage of electronic health records systems and physician performance within selected hospitals in Nairobi County. A total of 150 questionnaires were dropped and only 136 were picked, giving a response rate of 91%. Physicians working in those selected hospitals were the respondents.

4.2 Demographic Information

This section presents the demographic information of the respondents including: gender, specialty, age bracket, years in practice, type of hospital, prior EHR systems use, computer sophistication, name of EHR system in use, year of adoption and duration of use of the EHR in the hospital.

4.2.1 Distribution of the Respondents by Gender

The respondents were asked to specify their gender and the findings are as shown by Table 4.2.1.

Table 4.2.1 Distribution of Respondents by Gender

	Frequency	Percentage
Male	76	55.9
Female	60	44.1
Total	**136**	**100.0**

The Table 4.2.1 presents the gender distribution of the respondents, the study found that 55.9% were male while 44.1% were female.

4.2.2 Distribution of Respondents by Specialty

The respondents were asked to specify their specialty and the findings are as shown by the Table 4.2.2.

Table 4.2.2: Distribution of Respondents by Specialty

	Frequency	Percentage
General practitioners	109	80.1
Specialists	27	19.9
Total	**136**	**100.0**

On the distribution of the respondents by specialty, the study found that 80.1% of the respondents were general practitioners while 19.9% were specialists as presented by Table 4.2.2.

4.2.3 Distribution of Respondents by Age Bracket

The respondents were asked to specify their age bracket and the findings are as shown by the Table 4.2.3.

Table 4.2.3: Distribution of Respondents by Age Bracket

	Frequency	Percentage
26 – 30	33	24.3
31 – 35	44	32.4
36 – 40	27	19.9
41 – 45	14	10.3
46 – 50	8	5.9
51 – 55	5	3.7
56 – 60	3	2.2
60 +	2	1.5
Total	**136**	**100.0**

On the distribution of the respondents by age bracket, the study found that 32.4% of the respondents interviewed were between 31-35 years, 24.3% were between 26-30 years, 19.9% were between 36-40 years, 10.3% were between 41-45 years, 5.9% were between 46-50 years, 3.7% were between 51-55 years, 2.2% were between 56-60 years while 1.5% were 60 years and above. The findings are as presented in Table 4.2.3.

4.2.4 Distribution of Respondents by Years in Practice

The respondents were asked to indicate the number of years in practice and the findings are as shown by the Table 4.2.4.

Table 4.2.4: Distribution of Respondents by Years in Practice

	Frequency	Percentage
Less than 5 years	13	9.6
5 – 10	62	45.6
11 – 15	33	24.3
15 +	28	20.6
Total	**136**	**100.0**

The Table 4.2.4 presents the distribution of respondents by years in practice of the physicians. The study found that 45.6% of the respondents had been in practice for a duration of between 5-10 years, 24.3% of the respondents had practiced between 11-15 years, and 20.6% of the respondents had practiced above 15 years while 9.6% of the respondents had less than 5 years of practice.

4.2.5 Distribution of Respondents by Type of Hospital

The respondents were asked to identify the type of hospital they are working with and the findings are as shown by Table 4.2.5.

Table 4.2.5: Distribution of Respondents by Type of Hospital

	Frequency	Percentage
Faith based	16	11.8
Government	52	38.2
Specialized	6	4.4
Private	62	45.6
Total	**136**	**100.0**

The study found that 45.6% of the respondents were from private hospitals, 38.2% of the respondents were from government hospitals, 11.8% were from faith based hospitals while 4.4% of the respondents were from specialized hospitals as shown by Table 4.2.5.

4.2.6 Distribution of Respondents by Prior EHR System Use

The respondents were asked to indicate if they have had prior use of an EHR system and the findings are as shown by the Table 4.2.6.

Table 4.2.6: Distribution of Respondents by Prior EHR System Use

	Frequency	Percentage
Yes	106	77.9
No	30	22.1
Total	**136**	**100.0**

The study found that 77.9% of the respondents had prior EHR use, while 22.1% had no prior EHR use as presented by Table 4.2.6.

4.2.7 Distribution of Respondents by Computer Sophistication

The respondents were asked to indicate their level of computer sophistication and the findings are as shown by the Table 4.2.7.

Table 4.2.7: Distribution of Respondents by Computer Sophistication

	Frequency	Percentage
Novice	1	0.7
Technician	10	7.4
General	124	91.2
Advanced	1	0.7
Total	**136**	**100.0**

The study found that 91.2% of the respondents had general computer expertise, 7.4% of the respondents had technician expertise while the novice and the advanced expertise were each at 0.7% of the respondents respectively as shown by Table 4.2.7.

4.2.8 Distribution of Respondents by Type of EHR System in Use

The respondents were asked to specify the type of EHR system they use and the findings are as shown by the Table 4.2.8.

Table 4.2.8: Distribution of Respondents by Type of EHR system in use

	Frequency	Percentage
Boss	4	2.9
Care	19	14.0
Collabmed	8	5.9
Funsoft	54	39.7
Kranium	33	24.3
Med Access EMR	3	2.2
Meditech	6	4.4
Pacs	4	2.9
Proprietary (in house developed)	5	3.7
Total	**136**	**100.0**

The study found that 39.7% of the respondents use Funsoft, 24.3% use Kranium, 14.0% use Care, 5.9% use Collabmed, 4.4% use Meditech, 3.7% use a proprietary system (in-house developed) EHR, 2.9% use Boss, 2.9% use Pacs, while 2.2% of the respondents use Med Access EMR as shown on Table 4.2.8.

4.2.9 Distribution of Respondents by Year of Adoption of Current EHR System

The respondents were asked to specify the year of adoption of their current EHR system and the findings are as shown by the Table 4.2.9.

Table 4.2.9: Distribution of Respondents by Year of Adoption of Current EHR System

	Frequency	Percentage
2009	13	9.6
2010	19	14.0
2011	9	6.6
2012	49	36.0
2013	27	19.9
2014	16	11.8
2015	3	2.2
Total	**136**	**100.0**

The study found that 36.0% of the respondents had adopted their EHR in the year 2012, 19.9% in year 2013, 14.0% in year 2010, 11.8% in year 2014, 9.6% in year 2009, 6.6% in year 2011 while 2.2% of the respondents had adopted their EHR in year 2015 as shown by Table 4.2.9.

4.2.10 Distribution of Respondents by Length of Usage of EHR

The respondents were asked to specify their length of use of the EHR system and the findings are as shown by the Table 4.2.10.

Table 4.2.10: Distribution of respondents by Length of Usage of EHR

	Frequency	Percentage
1	8	5.9
2	27	19.9
3	45	33.1
4	40	29.4
5	8	5.9
6	6	4.4
7	2	1.5
Total	**136**	**100.0**

The study found that 33.1% of the respondents had used their current EHR for 3 years, 29.4% for 4 years, 19.9% for 2 years, 5.9% for 1 year, 5.9% for 5 years, 4.4% for 6 years while 1.5% for 7 years as shown by Table 4.2.10.

4.3 The Drivers Towards Usage of Electronic Health Records by Physicians

This section looked at the respondents rating of the drivers that motivated them towards usage of electronic health records systems on a five point ordered Likert scale of 1 to 5 where 'No extent' was represented by 1, 'Little extent' by 2, 'Moderate' by 3, 'Large extent' by 4 and 'Very large extent' by 5. A mean score of less than 1.5 represented 'No extent', 1.5 to < 2.5 represented 'Little extent', 2.5 to < 3.5 represented 'Moderate', 3.5 to < 4.5 represented 'Large extent' and a mean score of 4.5 to 5.0 represented 'Very large extent'. A standard deviation of > 1 in the mean scores was interpreted as an indication of differences in the responses.

Table 4.3.1: Drivers towards Usage of Electronic Health Records by Physicians

	Num.	Mean	Standard deviation
Top management support	136	4.22	0.948
Need for patient safety	136	3.89	0.795
Need for quality of care	136	4.41	0.551
Need for improved clinical documentation	136	4.46	0.569
Need for improved decision making	136	3.92	0.531
Need for health information exchange with fellow physicians	136	3.95	0.692
Need for accomplishing tasks more easily and efficiently	136	4.59	0.564
Need for security and confidentiality of records	136	3.82	0.818
Need for migration from inefficient paper-based to electronic system	136	4.24	0.755
Ease of use	136	3.75	0.541
Fits workflow	136	3.61	0.623
Need for generating various types of reports on demand	136	4.02	0.412
Need for better referral of patients	136	3.43	0.685
Need for better testing and results management for patients	136	3.75	0.728
Need for a better and efficient ordering of tests for patients	136	4.00	0.632

The findings on Table 4.3.1 shows that the respondents to a very large extent their need for accomplishing tasks more easily and efficiently (mean score 4.59). To a large extent the respondents noted the need for improved clinical documentation (mean score 4.46), followed by the need for quality of care (mean score 4.41), need for migration from inefficient paper-based to electronic system (mean score 4.24), top management support (mean score 4.22), need for generating various types of reports on demand (mean score 4.02), need for a better and efficient ordering of tests for patients, need for health information exchange with fellow physicians (mean score 3.95), need for improved decision making (mean score 3.92), need for patient safety (mean 3.89), need for security and confidentiality of records (mean 3.82), ease of use (mean score 3.75), need for a better testing and results management for patients (mean score 3.75), fits workflow (mean score 3.61), and the need for better referral of patients (mean score 3.43).

4.4 Extent of Usage of Electronic Health Records Systems by Physicians

This section looked at the respondents extent of use of the modules found in an electronic health records systems, namely the clinical documentation, testing and imaging results, computerized provider order entry, clinical decision support, health information and reporting, security and confidentiality, and the exchange of electronic information found within the electronic health records systems by rating on a five point ordered Likert scale of 1 to 5 where 'Never' was represented by 1, 'Almost never' by 2, 'Occasionally/Sometimes' by 3, 'Almost all the time' by 4 and 'Every time' by 5. A mean score of less than 1.5 represented 'Never', 1.5 to < 2.5 represented 'Almost never', 2.5 to < 3.5 represented 'Occasionally/Sometimes', 3.5 to < 4.5 represented 'Almost all the time' and a mean score of 4.5 to 5.0 represented 'Every time'. A standard deviation of > 1 in the mean scores was interpreted as an indication of differences in the responses.

4.4.1 Clinical Documentation

Analysis of responses on the extent of use clinical documentation by the respondents is as shown on Table 4.4.1.

Table 4.4.1: Clinical Documentation

Clinical Documentation	Num.	Mean	Standard deviation
Create and maintain patient-related medical problem list	136	3.16	1.212
Seek out specific information from patients records	136	4.01	0.812
Enter daily notes	136	4.28	0.717
Write prescription	136	3.26	1.229
Write sick-leave notes	136	2.40	0.810
Give written general medical information to patients	136	2.83	1.008
Collect patient info for discharge reports	136	3.97	0.996
Identify patient-specific allergies	136	3.04	1.025
Register codes for diagnosis or performed procedures	136	3.04	1.043

On clinical documentation module, the features used almost all the time were to enter daily notes (mean score 4.28), followed by seeking out specific information from patients' records (mean score 4.01), collect patient info for discharge reports (mean score 3.97). There was an indication of differences in the use of EHRs by physicians on writing prescriptions (mean score 3.26), creating and maintaining patient-related medical problem list (mean score 3.16), identifying patient-specific allergies (mean score 3.04), registering codes for diagnosis or performed procedures (mean score 3.04) and giving written general medical information to patients (mean score 2.83). The findings also show that they almost never used the feature of writing sick-leave notes (mean score 2.40).

4.4.2 Testing and Imaging Results

Analysis of responses on extent of use of the testing and imaging module by the respondents is as shown on Table 4.4.2.

Table 4.4.2: Testing and Imaging Results

Testing and Imaging Results.	**Num.**	**Mean**	**Standard deviation**
Follow results of investigations and tests	136	3.88	0.682
Obtain the results from the new test or investigation	136	3.82	0.827
Obtain results from clinical biochemical laboratory analyses	136	3.91	0.839
Obtain results from X-ray, ultrasound or CT investigations	136	3.76	0.856
Obtain the results from other supplementary investigations	136	3.70	0.855

The results presented in Table 4.4.2 show that almost all the time physicians would obtain results from clinical biochemical laboratory analyses (mean score 3.91), followed by following the results of a particular test or investigation over time (mean score 3.88), obtain the results from the new test or investigation (mean score 3.82), obtain results from X-ray, ultrasound or CT investigations (mean score 3.76) and lastly obtain the results from other supplementary investigations (mean score 3.70) .

4.4.3 Computerized Provider Order Entry

Analysis of responses on extent of use of the computerized provider order entry module by the respondents is as shown on Table 4.4.3.

Table 4.4.3: Computerized Provider Order Entry

Computerized Provider Order Entry	**Num.**	**Mean**	**Standard deviation**
Order clinical biochemical laboratory analyses	136	3.70	0.846
Order X-ray, ultrasound or CT investigations	136	3.54	0.860
Order other supplementary investigations	136	3.40	0.819
Order treatment for patients directly	136	3.71	0.842

The computerized provider order entry module feature that was used almost all the time was to order treatment for patients directly (mean score 3.71) followed closely by ordering of clinical

biochemical laboratory analyses (mean score 3.70), order X-ray, ultrasound or CT investigations (mean score 3.54), and lastly, order other supplementary investigations as shown on Table 4.4.3.

4.4.4 Clinical Decision Support

Analysis of responses on extent of use of the clinical decision support module by the respondents is as shown on Table 4.4.4.

Table 4.4.4: Clinical Decision Support

Clinical Decision Support	Num.	Mean	Standard deviation
Receive drug interaction alerts when writing prescriptions	136	2.36	0.916
Receive drug-allergy alerts when writing prescriptions	136	2.23	0.911
Highlight of laboratory results that are out of acceptable range	136	3.33	0.689
Obtain information on investigation or treatment procedures	136	2.90	0.698
Seek answers to questions concerning medical knowledge	136	3.02	0.638

On the clinical decision support module, the features that were used occasionally/sometimes were to highlight laboratory results that are out of acceptable range (mean score 3.33), to answer questions concerning general medical knowledge (mean score 3.02), and to obtain information on investigation or treatment procedures (mean score 2.90). The other features almost never used were receiving of alerts from drug interaction when writing prescriptions (mean score 2.36), and to receive drug-allergy alerts when writing prescriptions (mean score 2.23).

4.4.5 Health Information and Reporting

Analysis of responses on extent of use of the health information and reporting module by the respondents is as shown on Table 4.4.5.

Table 4.4.5: Health Information and Reporting

Health Information and Reporting	Num.	Mean	Standard deviation
Produce reports on specific type of patients	136	3.49	0.750
Collect patient information for various medical declarations	136	3.51	0.919
Generating health statistics	136	4.18	0.893

On reporting of health information, generating health statistics was used almost all the time (mean score 4.18), collecting patient information for various medical declaration (mean score 3.51). Producing reports on specific types of patients was used occasionally/sometimes (mean score 3.49).

4.4.6 Security and Confidentiality

Analysis of responses on extent of use of the security and confidentiality module by the respondents is as shown on Table 4.4.6.

Table 4.4.6: Security and Confidentiality

Security and Confidentiality	Num.	Mean	Standard deviation
Use passwords to protect access to patients records	136	4.71	0.654
Use encryption on patient data when exchanging health information	136	3.48	1.199
Review audit trails of records on who accessed certain information and what changes were made	136	3.57	0.891

On security and confidentiality, the study found the use of passwords to protect access to patients' records was used every time (mean score 4.71). To review audit trails of records on who accessed certain information and what changes were made (mean score 3.57) was used almost all the time. There was an indication of differences in the use encryption on patient data when exchanging health information (mean score 3.48) as shown by Table 4.4.7.

4.4.7 Exchange of Electronic Information

Analysis of responses on extent of use of the exchange of electronic information module by the respondents is as shown on Table 4.4.7.

Table 4.4.7: Exchange of Electronic Information

Exchange of Electronic Information	Num.	Mean	Standard deviation
Referral of patients to other specialists	136	3.31	0.962
Sharing of patients' information on past history, current medications that can be jointly viewed during consultations.	136	3.49	0.807

On exchange of electronic information, the study found that respondents occasionally/sometimes shared patients' information on past history, current medication that can be jointly viewed during consultations (mean score 3.49) and referral of patients to other specialists (mean score 3.31).

4.5 Challenges with The Use of Electronic Health Records Systems

This section looked at the respondents' challenges with the use of electronic health records systems on their ability to provide high-quality patient care, clinical decision support, promotion of care coordination, configuration and customization of modules, technical support and training, and infrastructure and security rating on a five point ordered Likert scale of 1 to 5 where 'No extent' was represented by 1, 'Little extent' by 2, 'Moderate' by 3, 'Large extent' by 4 and 'Very large extent' by 5. A mean score of less than 1.5 represented 'No extent', 1.5 to < 2.5 represented 'Little extent', 2.5 to < 3.5 represented 'Moderate', 3.5 to < 4.5 represented 'Large extent' and a mean score of 4.5 to 5.0 represented 'Very large extent'. A standard deviation of > 1 in the mean scores was interpreted as an indication of differences in the responses.

4.5.1 Ability for Provision of High-Quality Patient Care

Analysis of responses on challenges with the use of the electronic health records on their ability to provide high-quality patient care by the respondents is as shown on Table 4.5.1.

Table 4.5.1: Ability for Provision of High-Quality Patient Care

Ability for Provision of high-quality patient care	Num.	Mean	Standard deviation
Loss of productivity caused by too much time spent on documentation	136	2.29	0.851
Difficult to use i.e. heavy use of navigation, less intuitive, not user-friendly	136	2.42	0.715
Varying levels of usage amongst users resulting to incomplete records	136	2.38	1.174
Does not fit seamlessly with the workflow needs of the hospital	136	3.04	1.046
Lack of accurate records i.e. correct record, correct patient and correct documentation	136	2.10	0.926

The notable challenge on physicians' ability to provide high-quality patient care to a little extent was the difficulty in using the system (mean score 2.42), loss of productivity caused by too much time spent on documentation (mean score 2.29) and lack of accurate records (mean score 2.10). The Table 4.5.1 also shows that there was in an indication of differences for varying levels of usage amongst users resulting to incomplete records (mean 2.38) and their indication that it does not fit seamlessly with the workflow needs of the hospital (mean 3.04).

4.5.2 Clinical Decision Support

Analysis of responses on challenges with the use of the electronic health records system clinical decision support by the respondents is as shown on Table 4.5.2.

Table 4.5.2: Clinical Decision Support

Clinical Decision support	Num.	Mean	Standard deviation
Lacks ability to update information on clinical guidelines	136	3.54	1.161
Lacks clinical reminders	136	3.29	0.967
Lacks drug allergy alerts, drug-laboratory interaction alerts	136	3.21	0.962

On clinical decision support the challenge the physicians noted was the systems lack of clinical reminders (mean score 3.29) and the lack for drug allergy alerts, drug-laboratory interaction alerts (mean 3.21) to a moderate level while there was indication of differences on the challenge in the system lacking the ability to update information on clinical guidelines (mean score (mean score 3.54).

4.5.3 Does Not Promote Care Coordination

Analysis of responses on challenges with the use of the electronic health records system on promotion of care coordination by the respondents is as shown on Table 4.5.3.

Table 4.5.3: Does Not Promote Care Coordination

Does not promote care coordination	Num.	Mean	Standard deviation
Lacks interoperability with other systems i.e. pharmacy, laboratory	136	1.76	0.828
Does not automatically track referrals, consultations, labs and orders	136	2.23	0.788
Inability to delegate some tasks to support staff	136	2.63	1.161
Lack of connectivity to other physician for coordinated care	136	2.14	0.920

On promotion of care coordination, the study found the respondents challenge that the system does not automatically track referrals, consultations, labs and orders (mean score 2.23), and the

lack of connectivity to other physician for coordinated care (mean score 2.14), systems lack of interoperability with other systems (mean score 1.76) to a little extent. There was indication of differences on the challenge of the inability to delegate some task to support staff (mean score 2.63).

4.5.4 Does Not Offer Configuration and Customization of Modules

Analysis of responses on challenges with the use of the electronic health records system on configuration and customization of modules by the respondents is as shown on Table 4.5.4.

Table 4.5.4: Does Not Offer Configuration and Customization of Modules

Does not offer configuration and customization of modules	Num.	Mean	Standard deviation
Lacks customization of interface to suit the needs of physician	136	2.27	1.014
Lack of useful presentation format	136	1.99	0.878
Inability to generate defined reports	136	1.61	0.862

On the configuration and customization of modules the study found the lack of useful presentation format (mean sore 1.99) and inability to generate defined reports (mean score 1.61) as a challenge to a little extent. There was an indication of differences in respondents' challenge on the lack of customization of interface to suit the needs of physician (mean score 2.27)

4.5.5 Technical Support and Training

Analysis of responses on challenges with the use of the electronic health records system on technical support and training by the respondents is as shown on Table 4.5.5.

Table 4.5.5: Technical Support and Training

Technical support and training	Num.	Mean	Standard deviation
Lack of continuous training to effectively use of EHR	136	3.15	1.067
Lack of technical support	136	3.00	0.903
Lack of ICT skills to properly use the system	136	2.17	0.857

On technical support and training, the study found that lack of technical support (mean score 3.00) as a challenge to a moderate extent. The lack of ICT skills to properly use the system (mean score 2.17) was a challenge to a little extent. There was an indication of differences on the challenge for lack continuous training to effectively use of EHRs (mean score 3.15).

4.5.6 Infrastructure and Security

Analysis of responses on challenges with the use of the electronic health records system on infrastructure and security by the respondents is as shown on Table 4.5.3.

Table 4.5.6: Infrastructure and Security

Infrastructure and Security	Num.	Mean	Standard deviation
Lack of enough computers and supporting equipment	136	1.82	0.842
Lack of fast computers for speed of data access	136	3.00	1.217
Poor network connectivity hampering access of records	136	3.07	1.266
Lack of proper maintenance of ICT systems	136	2.80	1.222
Lack of proper security and confidentiality of records	136	2.88	1.177

On infrastructure and security, the study found that lack of enough computer and supporting equipment (mean score 1.82) was a challenge to a little extent. There was an indication of differences on the challenge of poor network connectivity hampering access of records (mean score 3.07), lack of fast computers for speed of data access (mean score 3.00), lack of proper

security and confidentiality of records (mean score 2.88) and lack of proper maintenance of ICT systems (mean score 2.80).

4.6 Relationship Between Usage of EHRs and Physician Performance

This section looked at the respondents' performance improvement with the use of electronic health records systems and number of patients seen, collaboration with other physicians, and the ability to complete a task quickly and accurately on an ordered categorical rating scale of 1 to 5 where 'Less than 20%' improvement was represented by 1, '21-30%' improvement by 2, '31-40%' improvement by 3, '40-50% improvement' by 4 and 'Above 50%' improvement by 5

4.6.1 Improvement in Number of Patients Seen

Analysis of responses on relationship between use of electronic health records systems and physician performance on improvement in the number of patients seen by the respondents is as shown on Table 4.6.1.

Table 4.6.1: Improvement in Number of Patients Seen

	Frequency	Percentage
Less than 20%	41	30.1
21 – 30%	34	25.0
31 – 40%	32	23.5
41 – 50%	3	2.2
Above 50%	26	19.1
Total	**136**	**100.0**

The study found that 30.1% of the respondents had noted improvement in the number of patients seen by less than 20%, 25.0% of the respondents between 21-30%, 23.5% of the respondents between 31-40%, 19.1% of the respondents above 50% while 2.2% of the respondents between 41-50%.

4.6.2 Collaboration with Other Physicians

Analysis of responses on relationship between use of electronic health records systems and physician performance on collaboration with other physicians by the respondents is as shown on Table 4.6.2.

Table 4.6.2: Collaboration with Other Physicians

	Frequency	Percentage
Less than 20%	63	46.3
21 – 30%	20	14.7
31 – 40%	41	30.1
41 – 50%	9	6.6
Above 50%	3	2.2
Total	**136**	**100.0**

The study found that 46.3% of the respondents had experienced improvement in collaborating with other physicians on a patient in assessing problems by less than 20%, 30.1% of the respondents had experienced improvement of between 30-40%, 14.7% of the respondents between 21-30%, 6.6% of the respondents 41-50% while 2.2% of the respondents had experienced improvement of above 50%.

4.6.3 Ability to Complete Tasks

Analysis of responses on relationship between use of electronic health records systems and physician performance on ability to complete tasks by the respondents is as shown on Table 4.6.3.

Table 4.6.3: Ability to Complete Tasks

	Frequency	Percentage
Less than 20%	21	15.4
21 – 30%	45	33.1
31 – 40%	34	25.0
41 – 50%	10	7.4
Above 50%	26	19.1
Total	**136**	**100.0**

The study found that 33.1% of the respondents had noted their ability to complete a task quickly and accurately improved by 21-30%, 25.0% of the respondents had experienced improvement of between 31-40%, 19.1% of the respondents above 50%, 15.4% of the respondents experienced improvements of less than 20%, while 7.4% of the respondents had experienced improvement of 41-50%.

4.6.4 Effects on The Use of EHRs

This section looked at the respondents' effects on the use of electronic health records systems. This was tested on a five point ordered Likert scale of 1 to 5 where 'Strongly disagree' was represented by 1, 'Disagree' by 2, 'Neither agree nor disagree' by 3, 'Agree' by 4 and 'Strongly agree' by 5. A mean score of less than 1.5 represented 'Strongly disagree', 1.5 to < 2.5 represented 'Disagree', 2.5 to < 3.5 represented 'Neither agree nor disagree', 3.5 to < 4.5 represented 'Agree' and a mean score of 4.5 to 5.0 represented 'Strongly agree'. A standard deviation of > 1 in the mean scores was interpreted as an indication of differences in the responses

Table 4.6.4: Effects on The Use of EHRs

Statements	Num.	Mean	Standard deviation
The use of EHRs has improved management of patients records thus improving health care provided to the patient	136	4.07	0.896
The use of EHRs has made it easier to view and obtain laboratory tests and reports	136	4.16	0.752
The use of EHRs in ordering for all types of tests, prescribe medications has become easier	136	4.13	0.811
The use of EHRs has improved on clinical decision process of drug allergy and interaction alerts	136	3.60	0.754
The use of EHRs has made it easy to create and review various types of reports thus improving the services provided.	136	4.19	0.830
The use of EHRs has improved on the security and confidentiality of patients records.	136	4.01	0.812
The use of EHRs has made it easy to exchange patients' records with other physicians through electronic means.	136	3.80	0.436

The findings on Table 4.6.4 show that the respondents agreed with the statements that the use of EHRs has made it easy to create and review various types of reports thus improving the services provided (mean score 4.19), the use of EHRs has made it easier to view and obtain laboratory tests and reports (mean score 4.16), the use of EHRs in ordering for all types of tests, prescribe medications has become easier (mean score 4.13), the use of EHRs has improved management of patients records thus improving health care provided to the patient (mean score 4.07), the use of EHRs has improved on the security and confidentiality of patients records (mean score 4.01), the use of EHRs has made it easy to exchange patients' records with other physicians through electronic means (mean score 3.80), and the use of EHRs has improved on clinical decision process of drug allergy and interaction alerts (mean score 3.60).

4.7 Regression Analysis

A cumulative odds ordinal logistic regression with proportional odds was used to determine the effect of clinical documentation, testing and imaging results, computerized provider order entry, clinical decision support, health information and reporting, security and confidentiality, and exchange of electronic information, on the belief that the number of patients seen has improved, collaboration with other physicians on a patient in assessing problems has improved, and that the ability to complete a task quickly and accurately has improved.

The regression models presented below were used to test on the relationship between the variables of the study:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

$$Y_2 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

$$Y_3 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

Where,

For Model

$\boldsymbol{Y_1}$= Number of patients seen

$\boldsymbol{Y_2}$= Collaborative effort

$\boldsymbol{Y_3}$= Task completion

$\boldsymbol{X_1}$ = Clinical Documentation

$\boldsymbol{X_2}$ = Testing and Imaging Results

$\boldsymbol{X_3}$ = Computerized Provider Order Entry

$\boldsymbol{X_4}$ = Clinical Decision Support

$\boldsymbol{X_5}$ = Reporting

$\boldsymbol{X_6}$ = Security

$\boldsymbol{X_7}$ = Electronic Information Exchange

$\boldsymbol{\beta_0}$ = Constant

$\boldsymbol{\varepsilon}$ = Error

For the first model, the proportional odds assumption was met, with the assessment of a full likelihood ratio test which compared the fitted model to a model with varying location parameters, χ^2 (21) = 20.318, p = .501. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data, χ^2 (265) = 224.709, p = .965, but most cells were sparse with zero frequencies in 73.6% of cells. However, the final model statistically significantly predicted the dependent variable over and above the intercept-only model, χ^2 (7) = 75.270, p < .001.

4.7.1 Parameter Estimates for Number of Patients Seen

Analysis of the parameter estimates for the number of patients seen has improved with the extent of use of the modules of the electronic health records systems by the respondents is as shown on Table 4.7.1.

Table 4.7.1: Parameter Estimates for Number of Patients Seen

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	[num_of_patient=1]	-2.560	2.2447	-6.960	1.839	1.301	1	.254	.077	.001	6.291
	[num_of_patient=2]	-.887	2.2281	-5.254	3.480	.159	1	.691	.412	.005	32.459
	[num_of_patient=3]	.642	2.2231	-3.715	4.999	.083	1	.773	1.900	.024	148.242
	[num_of_patient=4]	.808	2.2233	-3.550	5.166	.132	1	.716	2.243	.029	175.149
Clinical Documentation		-2.299	.5998	-3.475	-1.124	14.693	1	.000	.100	.031	.325
Testing and Imaging		-.436	.3598	-1.141	.270	1.465	1	.226	.647	.320	1.309
Comp. Provider Order Entry		-.930	.4483	-1.808	-.051	4.300	1	.038	.395	.164	.950
Clinical Decision Support		.969	.7382	-.478	2.416	1.722	1	.189	2.635	.620	11.197
Reporting		1.204	.3727	.473	1.934	10.430	1	.001	3.332	1.605	6.917
Security		.827	.3600	.121	1.533	5.278	1	.022	2.287	1.129	4.631
Elec. Info. Exchange		.265	.3939	-.507	1.037	.454	1	.500	1.304	.603	2.822
(Scale)		1[a]									

Dependent Variable: The number of patients seen has improved by

Model: (Threshold), Clinical Documentation, Testing and Imaging, Computerized Provider Order Entry, Clinical Decision Support, Reporting, Security, Electronic Information Exchange

a. Fixed at the displayed value.

The Table 4.7.1 reveals that an increase of one unit in reporting was associated with an increase in the odds of considering the number of patients has improved, with an odds ratio of 3.332, 95% CI [1.605, 6.917], Wald χ^2 (1) = 10.430, p = .001. The use of the reports module of the electronic health records has a statistically significant effect on the prediction of whether the number of patients seen has improved. The odds of being in the higher category of the dependent variable i.e. the number of patients seen has improved is 3.3 times for those using the reporting module than those not using it. This finding is in consistent with Hillestad *et al*. (2005) who note that reporting is useful for purposes of supporting evidence-based decision support, management and outcomes report. Depending on the report, EHRs can highlight the performance of the institution as a whole or the physicians' productivity in terms of patients seen per hour and referral patterns.

The Table 4.7.1 also reveals that an increase of one unit in security was associated with an increase in the odds of considering the number of patients has improved, with an odds ratio of 2.287, 95% CI [1.129, 4.631], Wald χ^2 (1) = 5.278, p = .022. The use of the security and confidentiality module of the electronic health records system has a statistically significant effect on the prediction of whether the number of patients seen has improved. The odds of being in the higher category of the dependent variable i.e. the number of patients seen has improved is 2.3 times for those using the security and confidentiality module than those not using it. According to Hass (2011), confidentiality, integrity and availability are the three fundamental security goals of electronic health records systems.

For the second regression model, the proportional odds assumption was not met by the assessment of a full likelihood ratio test comparing the fit of the proportional odds location model to a model with varying location parameters, χ^2 (21) = 118.294, p < .001. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data, χ^2 (265) = 229.133, p = .946, but most cells were sparse with zero frequencies in 75.9% of cells. However, the final model statistically significantly predicted the dependent variable over and above the intercept-only model, χ^2 (7) = 56.799, p < .001.

4.7.2 Parameter Estimates for Collaboration with Other Physicians

Analysis of the parameter estimates for collaboration with other physicians has improved with the extent of use of the modules of the electronic health records systems by the respondents is as shown on Table 4.7.2.

Table 4.7.2: Parameter Estimates for Collaboration with Other Physicians

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	[collaboration=1]	-.349	2.3625	-4.980	4.281	.022	1	.883	.705	.007	72.337
	[collaboration=2]	.575	2.3621	-4.055	5.204	.059	1	.808	1.776	.017	182.044
	[collaboration=3]	3.147	2.3682	-1.494	7.789	1.766	1	.184	23.273	.224	2413.514
	[collaboration=4]	4.625	2.4123	-.103	9.353	3.676	1	.055	101.976	.902	11530.111
Clinical Documentation		-1.404	.6064	-2.593	-.216	5.363	1	.021	.246	.075	.806
Testing and Imaging		.149	.3665	-.569	.867	.165	1	.684	1.161	.566	2.381
Comp. Provider Order Entry		-.208	.4537	-1.097	.681	.210	1	.646	.812	.334	1.976
Clinical Decision Support		-.537	.7792	-2.064	.991	.474	1	.491	.585	.127	2.693
Reporting		1.096	.3813	.348	1.843	8.257	1	.004	2.991	1.417	6.316
Security		.147	.3650	-.568	.862	.162	1	.687	1.158	.566	2.368
Elec. Info. Exchange		.469	.4036	-.322	1.259	1.348	1	.246	1.598	.724	3.524
(Scale)		1[a]									

Dependent Variable: Collaboration with other physicians on a patient in assessing problems, making diagnoses, determining therapeutic options, and communicating care plans has improved
Model: (Threshold), Clinical Documentation, Testing and Imaging, Computerized Provider Order Entry, Clinical Decision Support, Reporting, Security, Electronic Information Exchange

a. Fixed at the displayed value.

The Table 4.7.2 reveals that an increase of one unit in reporting was associated with an increase in the odds of considering that collaborating with other physicians has improved, with an odds ratio of 2.991, 95% CI [1.417, 6.316], Wald χ^2 (1) = 8.257, p = .004. The use of the reports module of the electronic health records has a statistically significant effect on the prediction of whether collaborating with other physicians has improved. The odds of being in the higher

category of the dependent variable i.e. collaboration with other physicians has improved is 2.9 times for those using the reporting module than those not using it.

For the third regression model, the proportional odds assumption was not met by the assessment of a full likelihood ratio test comparing the fit of the proportional odds location model to a model with varying location parameters, χ^2 (21) = 35.341, p = .026. The deviance goodness-of-fit test indicated that the model was a good fit to the observed data, χ^2 (265) = 229.133, p = .946, but most cells were sparse with zero frequencies in 77.7% of cells. However, the final model statistically significantly predicted the dependent variable over and above the intercept-only model, χ^2 (7) = 136.550, p < .001.

4.7.3 Parameter Estimates for Task Completion

Analysis of the parameter estimates for task completion has improved with the extent of use of the modules of the electronic health records systems by the respondents is as shown on Table 4.7.3.

Table 4.7.3: Parameter Estimates for Task Completion

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	[task_comp=1]	6.509	2.721	1.18	11.84	5.724	1	.017	671.45	3.243	139004.30
	[task_comp=2]	9.157	2.805	3.66	14.66	10.658	1	.001	9485.1	38.86	2315457.2
	[task_comp=3]	11.372	2.837	5.81	16.93	16.066	1	.000	86855.3	334.0	22584275.7
	[task_comp=4]	12.436	2.859	6.83	18.04	18.919	1	.000	251623.1	927.1	68290491.1
Clinical Documentation		-3.472	.7096	-4.86	-2.08	23.944	1	.000	.03	.008	.12
Testing and Imaging		.736	.381	-.01	1.48	3.729	1	.053	2.087	.989	4.40
Comp. Provider Order Entry		.386	.446	-.49	1.26	.751	1	.386	1.472	.614	3.52
Clinical Decision Support		.568	.789	-.98	2.11	.517	1	.472	1.764	.376	8.28
Reporting		2.552	.441	1.69	3.42	33.469	1	.000	12.83	5.405	30.45
Security		1.071	.386	.32	1.83	7.707	1	.006	2.92	1.370	6.22
Elec. Info. Exchange		.501	.399	-.28	1.29	1.572	1	.210	1.65	.754	3.61
(Scale)		1[a]									

Dependent Variable: The ability to complete a task quickly and accurately has improved by
Model: (Threshold), Clinical Documentation, Testing and Imaging, Computerized Provider Order Entry,

Clinical Decision Support, Reporting, Security, Electronic Information Exchange

a. Fixed at the displayed value.

Table 4.7.3 reveals that an increase of one unit in reporting was associated with an increase in the odds of considering the ability to complete a task quickly and accurately has improved, with an odds ratio of 12.830, 95% CI [5.405, 30.457], Wald χ^2 (1) = 33.469, $p < .001$. The use of the reports module of the electronic health records has a statistically significant effect on the prediction of whether the ability to complete a task quickly and accurately has improved. The odds of being in the higher category of the dependent variable i.e. the ability to complete a task quickly and accurately has improved is 12.8 times for those using the reporting module than those not using it.

The table also reveals that an increase of one unit in security was associated with an increase in the odds of considering the ability to complete a task quickly and accurately has improved, with an odds ratio of 2.920, 95% CI [1.370, 6.221], Wald χ^2 (1) = 7.707, $p = .006$. The use of the security and confidentiality module of the electronic health records system has a statistically significant effect on the prediction of whether the ability to complete a task quickly and accurately has improved. The odds of being in the higher category of the dependent variable i.e. the ability to complete a task quickly and accurately has improved is 2.9 times for those using the security and confidentiality module than those not using it.

CHAPTER 5: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

5.1 Introduction

This chapter presents the summary of the study, conclusion and recommendation.

5.2 Summary of Findings

The purpose of this study was to investigate the relationship between usage of electronic health records systems and performance of physicians in hospitals within the Nairobi County. The study was guided by the following objectives: to establish the drivers for usage of electronic health records by physicians, establish the extent of usage of electronic health records by physicians, to determine the key challenges physicians encounter when using electronic health records, and to establish the relationship between usage and physician performance.

On the drivers towards usage of electronic health records systems, the study found that the respondents rated to a very large extent the need for accomplishing tasks more easily and efficiently. This is consistent with the findings of Friedberg *et al*. (2009) on factors of continued usage of EHRs, that provision of efficient care to patients was a priority. The respondents also rated to a large extent the need for improved clinical documentation, need for quality of care, need for migration from inefficient paper-based to electronic system, top management support, need for generating various types of reports on demand, need for a better and efficient ordering of tests for patients, need for health information exchange with fellow physicians, need for improved decision making, need for patient safety, need for security and confidentiality of records, ease of use, need for a better testing and results management for patients, fits workflow , and the need for better referral of patients in that order. The high ratings on the drivers is in alignment with Rogers Diffusion of Innovation Theory that identifies with its two technology perceptions: perceived usefulness and perceived ease of use. This is also in consistent with the Theory of Reasoned Action (TRA) which is used to derive the Technology Acceptance Model (TAM). TRA assumes that attitude towards something is derived from beliefs which then has a bearing on behavioral intention which then leads to actual use. Here, use, refers to how the user interacts with the technology by measuring frequency of use, and duration.

On the extent of use of the electronic health records system features, the study found that the features used every time was the use of passwords to protect access to patients' records. The respondents almost all the time used the system to enter daily notes, seek out specific information from patients' records, obtain results from clinical biochemical laboratory analyses, follow results of investigations and tests, obtain the results from the new test or investigation, obtain results from X-ray, ultrasound or CT investigations, order treatment for patients directly, obtain the results from other supplementary investigations, review audit trails of records on who accessed certain information and what changes were made, order X-ray, ultrasound or CT investigations, collect patient information for various medical declarations in that order. There was moderate usage on features that produce reports on specific type of patients, sharing of patients' information on past history, current medications that can be jointly viewed during consultation, order other supplementary investigations, highlight of laboratory results that are out of acceptable range, referral of patients to other specialists, seek answers to questions concerning medical knowledge, obtain information on investigation or treatment procedures, write sick-leave notes, receive drug-allergy alerts when writing prescriptions in that order. There was difference on the use of encryption on patient data when exchanging health information, write prescription, create and maintain patient-related medical problem list, identify patient-specific allergies, register codes for diagnosis or performed procedures, and to give written general medical information to patients.

On the challenges, the respondents were moderate on the systems lack of clinical reminders, lack of drug allergy alerts, drug-laboratory interaction alerts, and lack of technical support. The respondents were to a little extent in the following order, found the system difficulty to use, experienced loss of productivity caused by too much time spent on documentation, system does not automatically track referrals, consultations, labs and orders, lack of ICT skills to properly use the system, lack of connectivity to other physician for coordinated care, lack of accurate records i.e. correct record, correct patient and correct documentation, lack of useful presentation format, lack of enough computers and supporting equipment, lacks interoperability with other systems i.e. pharmacy, laboratory, and inability to generate defined reports. There were differences on the systems lack of ability to update information on clinical guidelines, lack of continuous training to effectively use of EHR, poor network connectivity hampering access of records, does not fit seamlessly with the workflow needs of the hospital, lack of fast computers for speed of data

access, lack of proper security and confidentiality of records, lack of proper maintenance of ICT systems, inability to delegate some tasks to support staff, varying levels of usage amongst users resulting to incomplete records, and lack of customization of interface to suit the needs of physician. The findings from the regression analysis reveal that health information and reporting, security and confidentiality were significantly associated with the improvement in the number of patients seen. On collaboration with other physicians on a patient in assessing problems, the regression analysis reveals that there was a significant association with health information reporting. The study also reveals that the ability to complete a task quickly and accurately was also significantly associated with health information and reporting, and the security and confidentiality modules of the electronic health records system.

5.3 Limitations of The Study

This study was limited to physicians working in hospitals that have adopted an electronic health records systems, but there are other professional support staff and other cadre of health workers like the nurses who were never interviewed but used the systems extensively. The study also did not look at physicians working in solo practice setting.

5.4 Conclusions

The study concluded that the extent of use of electronic health records systems influences the performance of physicians. The health information and reporting module was found to be associated with all the three measures: improvement on the number of patients seen, collaboration with other physicians on a patient, and the ability to complete a task quickly and accurately. Perhaps this was due to target marketing where the hospitals want to offer its renowned services to a targeted set of patients or perhaps its' a requirement from the Ministry of Health on reporting requirements. The security and confidentiality module was found to be associated with two measures: improvement on the number of patients seen and the ability to complete a task quickly and accurately. There is perhaps due to the use of electronic health records systems more than reliance on paper-based records to access patients' records. The clinical documentation module was associated with collaboration with other physicians on a patient. This could perhaps be due to a doctor referring a patient to a specialist and proper documentation on treatment including procedures done should be well documented.

5.5 Recommendations

The study recommends continuous training on the use of EHRs, more importantly on the advanced features of these systems since it was found out that there were differences in the way the physicians used the EHRs on writing prescriptions, creating and maintaining patient-related medical problems list, identifying patient-specific allergies, registering codes for diagnosis or performed procedures and giving written general medical information to patients. It was also found that the physicians occasionally used the EHRs to obtain information on investigation or treatment procedures. On the clinical decision support module, the challenge the physicians noted to a large extent was the systems lack of clinical reminders and the lack for drug allergy alerts, drug-laboratory interaction alerts while there were differences of opinion in the systems lacking the ability to update information on clinical guidelines. There is a possibility these features were available but they were not aware of them since there was also an indication of mixed opinion on lack of continuous training to effectively use the systems. Top management of hospitals should encourage optimal use of these systems since the study found mixed opinion indicated by physicians for varying levels of usage amongst users resulting to incomplete records and their indication that it does not fit seamlessly with the workflow needs of the hospital. This perhaps can be to some extent be associated with the mixed opinion noted in respondents' challenge on the lack of customization of interface to suit the needs of physician. The study also found that there was also mixed opinion of the systems inability to delegate some task to other support staff. Management should also to some extent invest in infrastructure since the study found that there were mixed opinion on challenges facing physicians of poor network connectivity hampering access of records, lack of fast computers for speed of data access, lack of proper security and confidentiality of records and lack of proper maintenance of ICT systems.

5.6 Recommendations for Further Research

The study recommends that studies be carried out to assess the use of the health information and reporting module of the electronic health records systems in relation to the performance of the physicians and also the use of the security and confidentiality module of the electronic health records systems in relation to the performance of the physician.

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QUESTIONNAIRE

SECTION A: DEMOGRAPHIC CHARACTERISTICS

1. Gender: [ ] Male [ ] Female
2. Specialty: [ ] General Practitioner [ ] Specialist
3. Age group (years) [ ] 25 or less [ ] 26 – 30 [ ] 31 – 35 [ ] 36 – 40 [ ] 41 – 45 [ ] 46 – 50 [ ] 51 – 55 [ ]56 – 60 [ ] 61+
4. Years in practice: [ ] Less than 5 years [ ] 5 – 10 years [ ] 11 – 15 years [ ] 15 years +
5. Type of Hospital: [ ] Faith Based [ ] Government [ ] Specialized [ ] Private
6. Prior electronic health records systems use? [ ] Yes [ ] No
7. Computer Sophistication

   [ ] Novice (beginner with limited skills and privileges)

   [ ] Technician (advanced beginner but without significant expertise)

   [ ] General (Starting to become well rounded)

   [ ] Advanced (Experienced – Completed formal training e.g. Computer Science)

   [ ] Extra (Seasoned – Completed advanced training medicine and e.g. informatics)
8. Name of the electronic health records system in use: _____
9. Year of adoption of current EHR system: _____
10. How long have you used this EHR system? _____

SECTION B: DRIVERS TOWARDS USAGE OF ELECTRONIC HEALTH RECORDS BY PHYSICIANS

To which extent did each of the following drivers motivate you to adopt electronic health records? Indicate using the scale:

1: No extent 2: Little extent 3: Moderate 4: Large extent 5: Very large extent

		1	2	3	4	5
1	Top management support					
2	Need for patient safety					
3	Need for quality of care					
4	Need for improved clinical documentation					
5	Need for improved decision making					
6	Need for health information exchange with fellow physicians					
7	Need for accomplishing tasks more easily and efficiently					
8	Need for security and confidentiality of records					
9	Need for migration from inefficient paper-based to electronic system					
10	Ease of use					
11	Fits workflow					
12	Need for generating various types of reports on demand					
13	Need for better referral of patients					
14	Need for better testing and results management for patients					
15	Need for a better and efficient ordering of tests for patients					

SECTION C: EXTENT OF USAGE OF ELECTRONIC HEALTH RECORDS BY PHYSICIANS

How often do you use the electronic health records to assist you with the following tasks? Indicate using the scale:

1: Never 2: Almost never 3: Occasionally/Sometimes 4: Almost all the time

5: Every time

A	Clinical Documentation	1	2	3	4	5
1	Create and maintain patient-related medical problem list					
2	Seek out specific information from patients records					
3	Enter daily notes					

4	Write prescription					
5	Write sick-leave notes					
6	Give written general medical information to patients					
7	Collect patient info for discharge reports					
8	Identify patient-specific allergies					
9	Register codes for diagnosis or performed procedures					
B	**Testing and Imaging Results**.	**1**	**2**	**3**	**4**	**5**
1	Follow the results of a particular test or investigation over time					
2	Obtain the results from the new test or investigation					
3	Obtain results from clinical biochemical laboratory analyses					
4	Obtain results from X-ray, ultrasound or CT investigations					
5	Obtain the results from other supplementary investigations					
C	**Computerized Provider Order Entry**	**1**	**2**	**3**	**4**	**5**
1	Order clinical biochemical laboratory analyses					
2	Order X-ray, ultrasound or CT investigations					
3	Order other supplementary investigations					
4	Order treatment directly (e.g. medicines, operations etc.)					
D	**Clinical Decision Support**	**1**	**2**	**3**	**4**	**5**
1	Receive drug interaction alerts when writing prescriptions					
2	Receive drug-allergy alerts when writing prescriptions					
3	Highlight of test results that are out of normal range					
4	Obtain information on investigation or treatment procedures					
5	Answer questions concerning general medical knowledge (e.g. concerning treatment, symptoms, complications etc.)					
E	**Health Information and Reporting**	**1**	**2**	**3**	**4**	**5**
1	Produce data reviews for specific patient groups, e.g. complication rate, diagnoses					
2	Collect patient information for various medical declarations					
3	Generating health statistics					
F	**Security and Confidentiality**	**1**	**2**	**3**	**4**	**5**

1	Use passwords to protect access to patients records					
2	Use encryption on patient data when exchanging health information					
3	Review audit trails of records on who accessed certain information and what changes were made					
G	**Exchange of Electronic Information**	**1**	**2**	**3**	**4**	**5**
1	Refer the patient to other departments or specialists					
2	Sharing of patients' information on past history, current medications that can be jointly viewed during consultations.					

SECTION D: CHALLENGES WITH THE USE OF ELECTRONIC HEALTH RECORDS

Extent to which you face each of the following challenges in relation with the use of electronic health records. Indicate using the following scale:

1: No extent 2: Little extent 3: Moderate 4: Large extent 5: Very large extent

A	**Physicians ability to provide high-quality patient care**	**1**	**2**	**3**	**4**	**5**
	Loss of productivity caused by too much time spent on documentation					
	Difficult to use i.e. heavy use of navigation, less intuitive, not user-friendly					
	Varying levels of usage amongst users resulting to incomplete records					
	Does not fit seamlessly with the workflow needs of the hospital					
	Lack of accurate records i.e. correct record, correct patient and correct documentation					
B	**Clinical decision support**	**1**	**2**	**3**	**4**	**5**
	Lacks ability to update information on clinical guidelines					
	Lacks clinical reminders					
	Lacks drug allergy alerts, drug-laboratory interaction alerts					
C	**Does not promote care coordination**	**1**	**2**	**3**	**4**	**5**

	Lacks interoperability with other systems i.e. pharmacy, laboratory					
	Does not automatically track referrals, consultations, labs and orders					
	Inability to delegate some tasks to support staff					
	Lack of connectivity to other physician for coordinated care					
D	**Does not offer configuration and customization of modules**	**1**	**2**	**3**	**4**	**5**
	Lacks customization of interface to suit the needs of physician					
	Lack of useful presentation format					
	Inability to generate defined reports					
E	**Technical support and Training**					
	Lack of continuous training to effectively use of EHR					
	Lack of technical support					
	Lack of ICT skills to properly use the system					
F	**Infrastructure and Security**					
	Lack of enough computers and supporting equipment					
	Lack of fast computers for speed of data access					
	Poor network connectivity hampering access of records					
	Lack of proper maintenance of ICT systems					
	Lack of proper security and confidentiality of records					

SECTION E: RELATIONSHIP BETWEEN USAGE OF EHRS AND PHYSICIAN PERFORMANCE

1. The number of patients seen has improved by

   [ ] Less than 20% [ ] 21 – 30% [ ] 31 – 40% [ ] 41 – 50% [ ] Above 50%

2. Collaboration with other physicians on a patient in assessing problems, making diagnoses, determining therapeutic options, and communicating care plans has improved by

   [ ] Less than 20% [ ] 21 – 30% [ ] 31 – 40% [ ] 41 – 50% [ ] Above 50%

3. The ability to complete a task quickly and accurately has improved by

   [ ] Less than 20% [ ] 21 – 30% [ ] 31 – 40% [ ] 41 – 50% [ ] Above 50%

The following are statements on the effects of the use of EHRs. Please indicate the level of agreement with each of the statement as relating to your use of EHRs. Indicate using the following scale:

1: Strongly disagree 2: Disagree 3: Neither Agree nor disagree 4: Agree

5: Strongly agree

	Statements	**1**	**2**	**3**	**4**	**5**
	The use of EHRs has improved management of patients records thus improving health care provided to the patient					
	The use of EHRs has made it easier to view and obtain laboratory tests and reports					
	The use of EHRs in ordering for all types of tests, prescribe medications has become easier					
	The use of EHRs has improved on clinical decision process of drug allergy and interaction alerts					
	The use of EHRs has made it easy to create and review various types of reports thus improving the services provided.					
	The use of EHRs has improved on the security and confidentiality of patients records.					
	The use of EHRs has made it easy to exchange patients' records with other physicians through electronic means.					