ASSESSING VALUE OF ELECTRONIC MEDICAL RECORDS SYSTEMS AT CARAES NDERA REFERRAL HOSPITAL IN RWANDA

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ASSESSING VALUE OF ELECTRONIC MEDICAL RECORDS SYSTEMS AT CARAES NDERA REFERRAL HOSPITAL IN RWANDA

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DECLARATION

I, Eric Ferdinand TWIZEYIMANA, hereby declare that this thesis contains no material which has been accepted for the award of any other degree, diploma or award in any university or other tertiary institution. To the best of my knowledge and belief, contains no material previously published by another person, except where due reference has been made. I consent for a copy of this thesis to be available for loan from the University Library and host department.

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Date…….

CERTIFICATION

This is to certify that this research work entitled "*Assessing value of Electronic Medical Records Systems at CARAES NDERA referral hospital in Rwanda*" is an original work, proposed and conducted by Eric Ferdinand TWIZEYIMANA as a result of his academic efforts, and was done under my supervision.

…….....

Mr. Jean Marie Vianney NTIBAZAMUSHOBORA

Date : November 21, 2016

DEDICATION

I dedicate this book to my Almighty God, his Son Jesus Christ and the Holy Spirit. Through God's Mercy and love, I have been able to accomplish what I could not. God proved supremacy and faithfulness to me through this work.

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Firstly, I thank my God Father, my Lord Jesus Christ and the Holy Spirit who always provide me all that I need: blessings whenever I am awake or asleep. I would like to express my sincere gratitude to my supervisor Mr. Jean Marie Vianney NTIBAZAMUSHOBORA for the support on my research. His guidance, comments and encouragement helped me in all the aspects of research and writing of this thesis.

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May God bless you all.

ABSTRACT

Background: EMR systems have been installed in Rwandan hospitals in the last few years. It has been hoped that their adoption can potentially transform the health care system from a mostly paper-based to one that utilizes clinical and other pieces of information to assist providers in delivering higher quality of care to their patients. Studies examining business value accrued from EMR usage have been widely done in other countries but not in Rwanda. This study set out to assess the value of Electronic Medical Records Systems at CARAES NDERA referral hospital in Rwanda. **Objective:** The overall objective of the study was to ascertain whether the integration of Electronic Medical Records Systems result in any tangible value in Ndera Hospital.

Method: In achieving this objective, a survey was carried out at the hospital. Both stratified and purposive sampling techniques were used mainly targeting knowledgeable people about the daily running of the hospital while using the EMR Systems in place. **Results:** It was observed that majority of the system establishment objectives have been achieved to date, revenues have increased, and the ROI is positive, support for the EMR is high both internally and externally from the vendor and that the EMR has resulted in improved workflows and processes especially when compared against the increased patient numbers and the p-value results about such affirmations.

Conclusion: While the systems still have some challenges with regard to functionality gaps, system output and extra training needs, overall, the results suggest that Ndera Hospital made a worthwhile investment in the EMR as the overall net system benefit seem positive. Since the initial adoption idea was based on how other systems users in other hospitals across the country were increasing their revenue collections, the resulting revenue increases are a clear indication that using EMR systems is positive across a wide range of assumptions. Hence, the magnitude of the return is sensitive to several key factors. Equally, these systems have provided the ground towards attaining this anticipated value. It is hoped that once this value is tracked over time, more improvement will be registered.

ACRONYMS AND ABBREVIATIONS

EHR: Electronic Health Records (EHR) Systems

EMR: Electronic Medical Records (EMRs)

HIV: Human Immunodeficiency Virus

IS: Information System

MOH: Ministry Of Health

NAHIT: National Alliance for Health Information Technology

NCD: Non-Communicable Diseases

OpenMRS: Open Medical Records System

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KEY TERMS DEFINITIONS

Electronic Medical Records (EMR): An Electronic Medical Record is an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization [34].

Electronic Health Record (EHR): An Electronic Health Record is an electronic version of a patient's medical history, that is maintained by the provider over time, and may include all of the key administrative clinical data relevant to that persons care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports The EHR automates access to information and has the potential to streamline the clinician's workflow. The EHR also has the ability to support other care-related activities directly or indirectly through various interfaces, including evidence-based decision support, quality management, and outcomes reporting [35].

CHAPTER ONE : INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

1.1.1 Background

Electronic Medical Records (EMRs) are computerized medical information systems that collect, store and display patient information [1]. Given the challenges in using paper based systems, organizations adopting electronic systems usually have an intent of replacing the existing paper based systems. While available literature offered different options on how the transition could be done [2], it falls short of giving direction on how an organization can measure the value of this replacement. Yet, many organizations perceived EMR as beneficial or useful, despite the lack of organized evidence [2].

Rwanda is in the process of integrating EMR systems in the health care services in lieu of leveraging the much-proclaimed value from these systems. In Rwanda, we have different categories of hospitals,

- faith-based with financial subsidy from Government,
- public hospital which purely rely on internally generated funds and some subsidy from the central Government, and
- private hospitals – without any Government hospitals.

Apart from private hospitals, faith-based and public hospitals are further categorized to district, provincial and referral levels. Given that these hospitals offer different services, their needs and administrative complexity are different. The strategies and timeline in adopting EMR as well as the value of EMR brought to these hospitals would be different. This study focused on assessing the value of EMRs in CARAES Ndera hospital which is a Referral Hospital specialized in the Neuropsychiatry.

1.1.2 About the Hospital

CARAES NDERA Neuropsychiatric Hospital is a referral hospital in Ndera Sector, Gasabo District, Kigali City; specialized for providing care to neuropsychiatric disorders. It has two branches - CARAES Butare Psychiatric Centre and ICYIZERE Psychotherapeutic Centre.

This hospital was established in 1968 by the Brothers of Charity, an international pontifical religious congregation, following the request by the government of Rwanda and the local Catholic Church to release the psychiatric patients from the prisons of the country. The first patients were admitted in the hospital in 1972.Their vision is to develop quality mental health services rooted in the social and cultural context of Rwanda.

Since August 1994, the hospital began providing treatments to people who were traumatized by the Rwandan Genocide. As of 2015, the hospital has 381 beds and has an average monthly census of 5,000 patients. As of 2015, Its scope of services includes taking care of mental patients and neurological cases referred by other health facilities. Assuring the technical supervision in mental health at the district hospital level with the collaboration of the Ministry of Health, training the health professionals in mental health, teaching the interns and health professionals about mental health as well as promoting the research in neurology and mental health are its core business interests.

1.2 Statement of the Problem

In Rwandan, there is no systematic approach to assess the impact of EMR on business performance of the hospital; thus, no objective means to inform hospital leadership or policy maker in the implementation of EMR. Most of the previous work done in this area had been based on IT investment [3] or focused on measuring the EMR benefit on driving data driven programs [4]; none was conducted in Rwanda. Measuring and communicating the business value of EMR systems remains one of the biggest challenges for most hospitals worldwide, especially those in the public domain [5].

1.3 Purpose of the study

The purpose of this study was to understand how EMR systems help to improve health facility administration. By understanding the business metrics which such system help manage, we were able to understand the cost benefit analysis of such systems. Secondly, by understanding the business process cycles that inform the satisfaction ratings, we were able to understand the user satisfaction of such systems especially in improving how things are done in the hospital. Thus, this has supported creation of new scientific knowledge which can result in undertaking of other studies across country in order to ascertain the national outlook in the adoption and usage of such systems.

1.4 Objective

The overall objective of the study was to ascertain whether the integration of Electronic Medical Records Systems results in any tangible value in Ndera Hospital.

1.4.1 Specific Objectives

The specific objectives of the study were to:

- To evaluate literature on system value measurement so as to obtain suitable value assessment parameters;
- To assess the value added by the implementation of EMR at Ndera hospital.

1.5 Research question

The research questions for this study is the following:

- How can the implementation of EMR add value to the hospital business function?

1.6 Value measurement Scope

This study sets to understand the value from the adoption of an EMR system in a specialized hospital in Rwanda. In particular, the net benefit which the hospital derives from using such a system. In this regard, measurement focused on two aspects:

- Primary business value: In measuring the primary business value, measurement concentrated on business metrics such as revenues, net income and may be return on assets. The other measurement option in this category extended to cost savings brought about by these systems.
- Business process value: In measuring the business process value, measurement dwelt on process cycles and their outputs so as to understand the net system benefits such as content, timeliness, ease of use, accuracy and format of the data from the EMR and how these create user benefit both in the short and long term.

1.7 Study Benefits

This study is envisaged to be beneficial to the hospital leadership and health care policy makers in Rwanda. By understanding the value from the use of EMR systems, hospital administrators will be in position to adopt strategies to align the input and impact in order to meet the needs of the hospital.

To the research community, this study helps in developing a practical system to measure attributable value in a resource constrained countries like Rwanda.

CHAPTER TWO : REVIEW OF RELATED WORK

2.1 Electronic Medical Record systems in Rwanda

NAHIT defines the Electronic medical record (EMR) systems as "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization". There has been some misconception in the past where the EMR has been understood as Electronic Health Records (EHR) Systems. EHRs go beyond the data collected in the provider's office and include more comprehensive patient history [6]. For example, EHRs are designed to contain and share information from all providers involved in a patient's care and can be created, managed, and consulted by authorized providers and staff from across more than one health care organization.

Since 2005, Rwanda, through its health sector, is moving from paper to digitized records [7]. While the vision is to move toward EHRs, the country is still far from EHR as even the EMR implementation has not yet permeated nationally.

While waiting for the country's long term strategic system direction [8], some hospitals have partially adopted some electronic systems within their business processes. OpenClinic and OpenMRS are the two most frequently used systems in Rwanda. Many hospital using OpenClinic have mainly included the system's patient registration and revenue collection capabilities. While the use of OpenMRS has been extended to manage HIV care as well as non-communicable diseases (NCDs) in some hospitals.

In Ndera hospital, OpenClinic (*Version 4.195.04*) is used to manage two interdependent processes: registration and revenue management. However, OpenMRS (*Version 1.6.7*) is also used for managing HIV related cases. Thus, this study assessed value on these dimensions.

2.2. The need to evaluate value created by EMR systems

The major goal of the medical record is to serve as a repository of the clinician's observations and analysis of the patient [9, 10, 11]. However, if this value has to be achieved, their implementation should be treated as a major change; led by implementers or change managers in medical practices [12]. It is anticipated that certain value, for example, increased consumer-directed care, new methods of organizing care delivery, and new approaches to financing, would

emerge. It is thus imperative to evaluate these value attributes as the EMR matures within its operational environment.

Alharthi *et al.*, [13] observe that continued evaluation of installed systems and feedback from users have positive results in supporting the product maturity within the operational environment. For instance, Pi-Jung [14] asserts that physician perceptions and attitudes associated with their perceived sense of control over EMR technology significantly influenced the decision to implement and use of EMR. Any hospital implementing an EMR system would want to maximize all the benefits that accrue from such a system. However, this maximization must be properly guided over time.

While some EMR systems are free, the majority are available commercially. Most sales vendors, naturally, created belief and promise high value of the merchandise [15]. However, they offer little insight on how this value can be leveraged to full capacity and continuously managed over time. It is thus incumbent on the consuming organization to focus on innovation that fosters the derivation of value from such systems so they can identify and respond to the threats and opportunities of the changing environment within which they operate; creating tangible organizational and social benefits [16].

In order to really understand what a project's value is to the organization, it is important to understand value identification, capturing, delivery and measurement, with the involvement of various stakeholders [17]. Thus, there is a need of mechanisms that can help to focus on identifying, measuring, and ensuring the value indicators achievable through the use of EMR systems within the health sector.

2.3 Value creation traces

Value creation is a central concept in the management and organization literature for both micro-level (individual, group) and macro-level (organization theory, strategic management) research [18]. Yet there is little consensus on what value creation is or on how it can be achieved and the mechanisms that allow the creator of value to capture the value [19]. It is important to understand whether this value is understood from individuals, an organization, or society. Several authors have emphasized that, in business terms, value is often determined by the customer, in the sense that the vendor sets a price and the customer decides if that price

represents value. However, when it comes to information systems, this perspective remains limiting. From an economic perspective, value creation theory revolves around calculations of the net present value of the future benefits associated with the investment [20]; introducing the element of cost of investment against targeted value.

When assessing the value derived from information systems such as the EMR, we need to understand the value parameters that are organizationally focused. The Information System Success model [21] illustrated below provides three areas of this assessment.

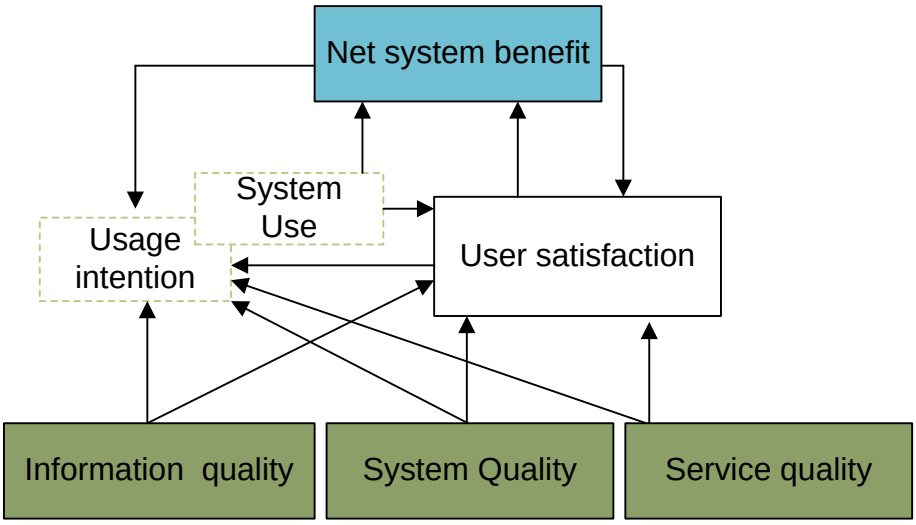

Figure 1: IS success model

In this model, net system benefit is seen as the prime element for measuring system value. In this case, information quality, system quality as well as service quality are considered essential when measuring net system benefit. When assessing net benefit from the system basing on information quality, it is important to understand the usage intention against user satisfaction. On the other hand, if this measurement is to be made based on system quality, this also has to be based on usage intention and user satisfaction. The same is true for service quality. However, we see that user satisfaction is impacted heavily by usage intention. At the same time, system use is a key element to consider when assessing user satisfaction. Hence, the net system benefit can only be holistically understood, if user satisfaction and system use are in perspective. With such considerations, it would thus result in refining user satisfaction parameters as well as usage intentions.

While we still have partial integration of EMR system in hospital processes, this assessment needed to understand which of the three net system benefit measuring yardsticks are important in understanding value of EMR systems in referral hospitals within Rwanda.

2.4 Value from EMR systems

While the business value for IT is an emerging area driven mainly by industry, available literature shows that within the health sector, EMRs have shown benefit for clinical, organizational, and societal outcomes [22]. There are many studies that describe the value that such systems are creating within the consuming organizations.

The widespread adoption of EMRs in the United States is transforming the practice of medicine from a paper-based cottage industry into an integrated health care delivery system [23] as it was also observed in some local health facilities. Over 90 percent of studies showed positive outcomes from EMR [24]. It is widely believed that increasing the use of EMR will increase efficiency and either decrease health care expenditures, increase quality, or ideally both [25].

Ideally an EMR is supportive in tracking data over time, identifying patients who are due for preventive visits and screenings, monitor how patients measure up to certain parameters, such as vaccinations and blood pressure readings as well as improving overall quality of care in a practice [5]. However, understanding whether the substantial investment in EMR has really been justified by improved patient outcomes or quality of care still remains an open question to many of these organizations.

If we are to measure value based on service, we may want to use user satisfaction measurement techniques such as the one described by Sebetci & Çetin [26]. If we adopt this, we shall be in position to assess Information Quality, System Quality, Service Quality, Social Impact and Facilitating Conditions constructs which are likely to have a significant and strong effect on Net Benefit in EMR systems. Hence, this empirical analysis on the value of partial implementation EMR systems can help the administrators to decide to what degree they should invest in the system.

2.5 Cost benefit analysis for EMR

Rubin [27] asserts that no business should initiate or prolong an IT system without a clear business reason for doing so; for it is only in the context of that business priority can the value of

a system be measured. A system may generate many kinds of value and deciding which value is the most important one to measure is necessary in order to ensure alignment with strategy. This will ensure that the system or initiative meets the business' expectations and also to clarify which metrics and perhaps which stakeholders are most important.

Thus, this evaluation must go through the following four steps:

- Making certain the business priority of the system one is investigating to ensure that it is clearly understood by all stakeholders and if there is more than one business priority these must then be ranked;
- Defining the value one is looking for, given the system's business priority;
- Selecting the metrics for measuring that value, and
- Starting the measuring.

Choi *et al* [28] observe that although EMR systems provide various benefits, there are both advantages and disadvantages regarding their cost-effectiveness. Usually, sources of benefits are mainly derived from health treatments to patients as compared to a counterfactual situation where they are treated with conventional therapies. It is thus important to understand the economic effects of EMR at all levels and by all intended stakeholders.

Some models have been devised in some studies to understand this pattern. For example, in understanding additional staffing needs within the hospital, Kevin *et al* [29] measure total patient wait and interaction times with staff, and estimate the additional staff required to maintain an increased patient load if medical scribes were to be introduced. Additionally, they calculate the average revenue per patient during the most recent 9 months of data so as to estimate the minimum increase in the number of patient visits needed to offset the additional staffing needs. On the other hand, Ding *et al* [30] introduce a decision analysis model to estimate the costs and benefits of NBS in an annual birth cohort of 86 600 infants based on projections of avoided infant deaths. The end result is to ascertain positive net economic benefit of such systems. Equally, Beresniaka *et al* [31] calculate potential benefits of using an EMR systems by specifically focusing on reduction in actual person–time and costs for performing a procedure in a clinical trial.

Business case for investing in health information technology must consider both financial and nonmonetized consequences. The financial aspect deals with the effect on the organization's

bottom line [32]. The above evaluations show that it is feasible to assess both the primary business value of the EMR and also its business process value in a hospital setting. While cost savings at any level can be counted as business value, other kinds of value are best thought of as secondary benefits that help create business value. Hence, executives who understand the level of investment involved with implementing an EMR system must thus focus significant attention on their potential return on investment. Equally, the users who use the system on the daily basis, must also provide the necessary feedback with regard to the value derived from using such systems.

2.6 The research gap

Despite the positive effects of EMR usage in medical practices, the adoption rate of such systems is still low and meets resistance from physicians [33]. EMR systems have the potential to transform the health care system from a mostly paper-based industry to one that utilizes clinical and other pieces of information to assist providers in delivering higher quality of care to their patients [32]. However, a lengthy, uneven adoption of non-standardized, non-interoperable EMR systems will only delay the chance to move closer to a transformed health care system.

We need mechanisms that can support us in understanding if the investment we are making through the use of EMR is worthwhile. The available studies on the benefit of EMR systems tend to evaluate only situations where the EMRs have been implemented in the entire hospital management. Such studies have been done in other countries but not in Rwanda. Additionally, in Rwanda we seem to have only partial implementations other than the full implementations. Hence, this study provides a basis for making such assessments and it is hoped that the results can be used to make further assessments when the full implementation of the EMR happens.

2.7 Assumptions around expected results

The studies reviewed in this section, offered a glimpse of the most pronounced benefits of EMR and the operational challenges it faces within its operational environment. As such, this finding resulted in an anticipation that the following assertions would be positive even within the target sample.

- Resistance to change in the way people work especially when new systems are in place
- Medical practitioners and clinicians finding it difficult to use the EMR system.

- Meaning of system value being relative based on who you ask
- EMR increasing efficiency

CHAPTER THREE : STUDY DESIGN

3.1 Measurement parameters

In bridging the research gap, this investigation considered two measurement parameters, that is, primary business value and business processes value measurement.

In measuring the primary business value, measurement concentrated on business metrics such as revenues, net income and return on investment. On the other hand, measuring the business process value dwelt on process cycles and their outputs so as to understand the net system benefits. Net system benefit hinged on content, timeliness, ease of use, accuracy and format of the data from the EMR and how these create user benefit both in the short and long term. This net assessment is summarized in the figure below.

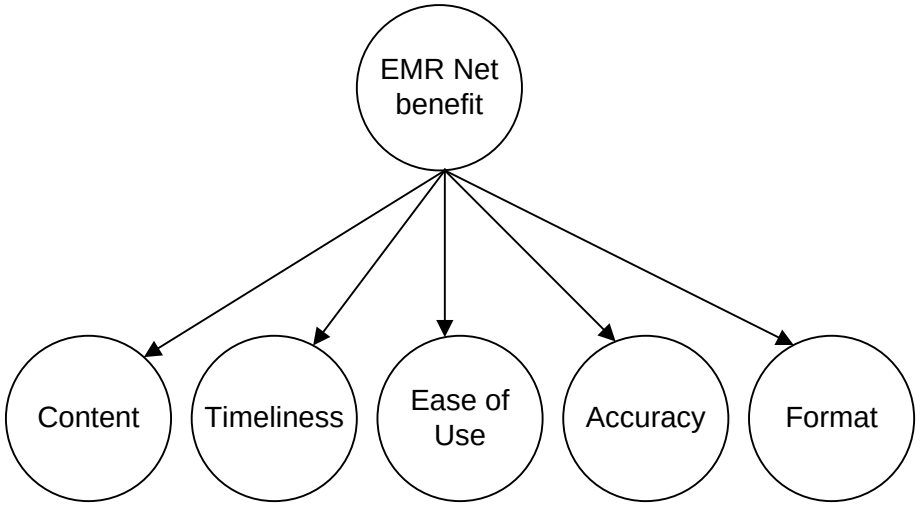

Figure 2: Parameters for measuring business process value

By assessing the content, we wanted to understand if the system provides the precise information the user needs, meets the user needs, provides reports that are required or if it provides sufficient information. With regard to timeliness, we wanted to understand if the user gets the information they need in time or if the system provides up-to-date information. For ease of use, we wanted to understand if the system is user friendly and easy to use. For accuracy, we wanted to ascertain if the users are satisfied with the accuracy of the system and if the system is accurate. For the

format, we wanted to ascertain if the output is presented in a useful format and if the output information is in a clear format.

3.2 Sample Selection and Size

The target sample population included practitioners, cashiers and administrative staff at Ndera Hospital who routinely use the EMR system. Other stakeholders with regard to EMR implementation decisions within the hospital were also included in the study. In total, 39 participants were sampled in this study.

Practitioners and cashiers are the ones that use the EMR on the day to day basis. Hence they had a fair understanding on how best the system is contributing to the improvement of the business functions within the hospital. On the other hand, hospital administrators and other stakeholders are at the tactical decision-making level. Hence, they had a clear understanding of cost of implementation and the business need that led to the adoption of the EMR in the hospital.

3.3 Data collection

Before data was collected, the Research Ethics Committee from the College of Medicine and Health Sciences at the University of Rwanda approved the study. The approval notice is in appendix. Verbal consent was obtained, and all participants were told that participation was strictly voluntary.

3.3.1 Study instruments

Since there were different stakeholders in this assessment, a mixture of data collection tools and study instruments were used. These include a Survey Questionnaire, an Interview Guide and a notebook for note taking. The survey instruments were designed to collect information to measure EMR systems content, timeliness, ease of use, accuracy and format. An Interview Guide was used to evaluate the primary business value.

Structured interviews were conducted with the respondents and this ensured that each interview is presented with exactly the same questions in the same order. With this approach, it was easy to test reliability and also shorten the time for data collection. The interview sessions were not recorded but rather, the researcher carried a small notebook where all answers were recorded as per the interview guide. In both assessments, all respondents were assured of anonymity.

3.3.2 Sampling Technique

Both stratified and purposive sampling techniques were used in the study. Stratified sampling technique was used to choose staff that deal with technology integration decisions. The purposive sampling procedure was used because it is convenient and time saving in selecting knowledgeable staff about value mapping of the system. Through the interview, the members were purposively selected depending on their ability to easily analyze and understand the problem of study. Also, a fair representation from each department and the stakeholders were considered when sampling.

In both techniques, group administered questionnaires were used and where additional clarity was required, an interview guide was used for those key respondents. The respondents were divided into two groups. The first group was for the staff that deal with technology integration in the hospital and these are the key stakeholders who determine the system primary business value.

The second category of respondents was for those that deal with the system on a day to day basis. A questionnaire was administered to the respondents in the group for the purpose of ensuring a high response rate. The researcher took the respondents through the set of questions on the questionnaire and then asked respondents to complete the questionnaire. In case there was clarity needed about the meaning of a question, the researcher provided this clarity. These were in form of questions or perceptions. In this case, the discussions that arose from such clarity augmented supplementary information that was useful for the study.

Aside interviews and the survey, thanks to the accountancy department of Ndera Hospital, document analysis was also used to ascertain certain value functions such as costs for purchasing and maintaining the EMR systems within Ndera hospital. In this case documents were interpreted to give voice and meaning around primary business value derivation.

3.4 Data analysis

Data was recorded thematically according to the research questions. Thereafter, it was interpreted and presented, using direct quotations with regard to the extent of the problem in comparison with the available data or information. For the purpose of analysis, the structured data in the questionnaires was matched according to the categories of the respondents. The frequencies of the various responses were tallied, and averages and rankings of discrete

responses were calculated. Descriptive research analysis was used for closed-ended questions that demanded discrete responses. The tool used to analyze data was Microsoft Excel 2016 MSO Version 16.0.7329.1017; 32-Bit.

3.5. Data presentation

After the data was collected, they were sorted, analyzed and presented according to the focus areas. Before the data was presented, it was inspected and edited to avoid distorting the message from the respondents. Anonymous quotations were extracted from questionnaires, actual interviews, casual discussions and open-ended questions, and observational descriptions were added. The tool used was Microsoft Excel 2016 MSO Version 16.0.7329.1017; 32-Bit.

3.6. Possible Risks

There were no foreseen risks that were envisaged for being part of this study. The questions used in the data collection tools were aimed at understanding the current state of EMR usage in the hospital. They were not meant to cause any emotional, physical injury or result in job loss. All answers were treated with utmost confidentiality.

3.7. Compensation for being in the study

There was no financial compensation set aside for subjects that participated in this study. This study was purely for academic purposes whose findings will help create new knowledge in system usage and adoption in hospitals. Hence, participation was voluntary.

CHAPTER FOUR : STUDY RESULTS

4.1 Overview

This chapter describes the results from assessing the primary business value and the business process value of the EMR implementation and usage in Ndera hospital. The results are tabulated based on the study objectives. Key observations are given along the analysis made. The first section of the result reports the findings from the business process value assessment while the second part reports on the findings from the primary value assessment.

4.2 Business process value assessment

4.2.1 Departments and staff categories sampled

In the survey, to ascertain the business process value of the EMR at Ndera hospital, a total of 39 hospital personnel was sampled from 8 departments as illustrated in the figure 3 below. This constituted the finance, administration, nursing, pharmacy, laboratory, physiotherapy, medical and reception departments.

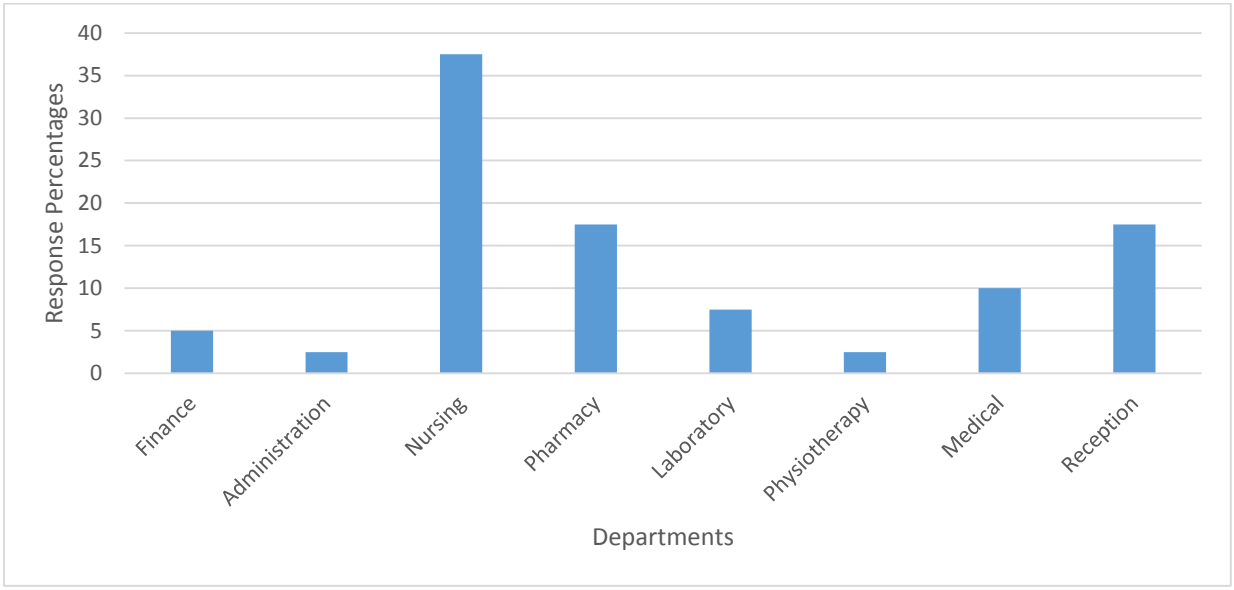

Figure 3: Sampled departments

5% of this sample was from the finance department, 2.5% from administration, 37.5% from nursing, 17.5 from pharmacy, 7.5% from laboratory, 2.5% from physiotherapy, 10% from medical and 17.5% from Reception. All these departments were important in this assessment since the EMR cuts across all of them. Therefore, the daily users of the EMR were deemed important in providing the required feedback with regard to the business process value of the EMR.

As illustrated in figure 4 below, from these departments, 2.6% were billing officers, 46.2 % were nurses, 7.7% were medical doctors, 20.5% percent receptionists, 2.6% percent cashiers and 20.5% from other categories.

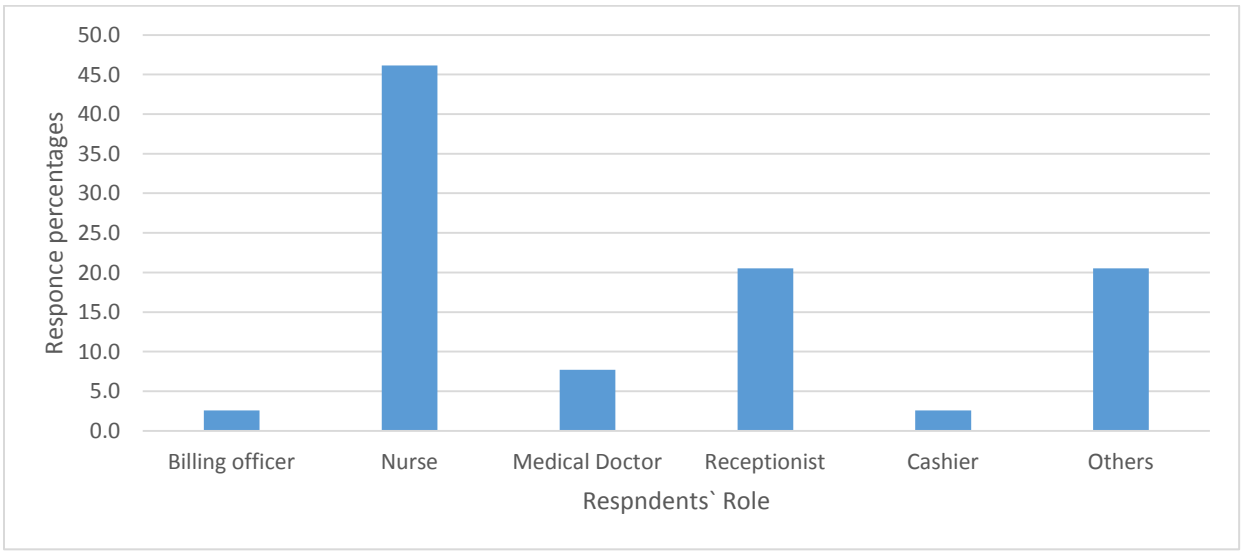

Figure 4: Staff categories

Nurses were the biggest number sampled because they form the biggest part of the personnel at Ndera hospital. Additionally, nurses are the ones that usually do data entry into the system at all serving points. Hence, their feedback on system business value was paramount. On the other hand, the cashiers and the billing officers deal with financial issues reported on by the EMR, as such ascertaining their feedback on the value of the EMR was important too.

4.2.2 Years of employment with the hospital

Understanding how change is registered over time, necessitated asking the number of years the employees have spent with the hospital. This information was helpful in ascertaining how those who worked with the hospital without the EMR can rate the improvement of the hospital

administration and operations after the introduction of the EMR. Figure 5 below illustrates the results from this assessment.

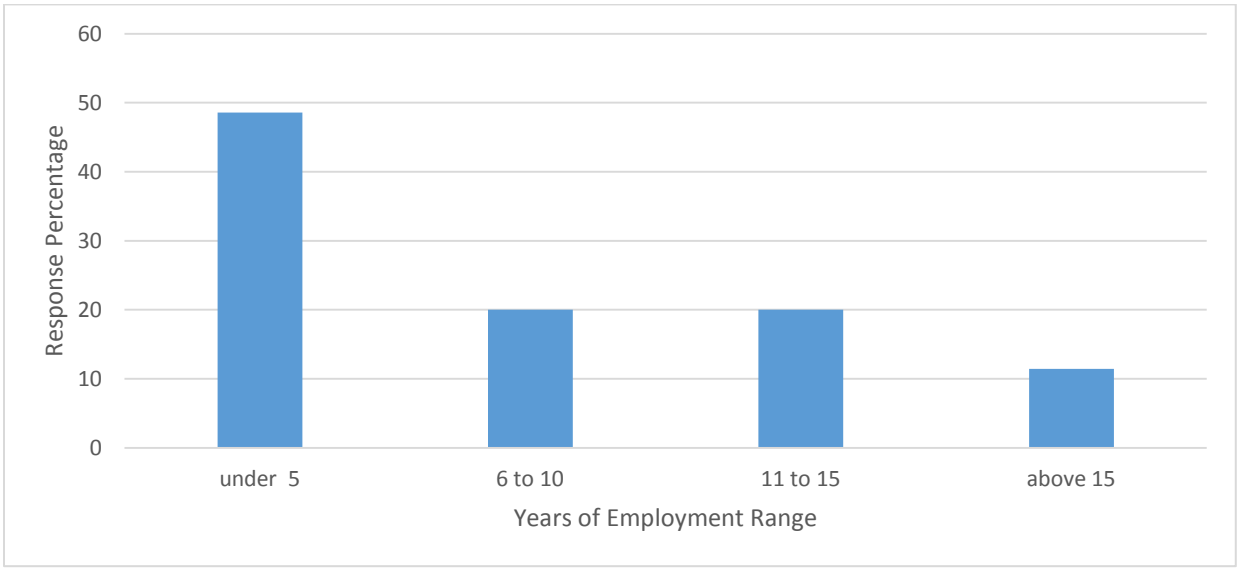

Figure 5: Years of Employment with Hospital

Out of the 39 personnel sampled, 49 % have spent only less than 5 years in the hospital. 20% have been with the hospital for 6 – 10 years, 20 % for 11 – 15 years, while 11% have been with the hospital for over 15 years. These results show that the biggest percentage sampled, that is, 69%, have been with the hospital for less than 10 years. Hence, with the introduction of the EMR in 2011, all these personnel have good knowledge of the system and its working abilities. The remaining 39% can thus give a comparative of the situation before and after system implementation as we measure system benefits over time.

4.2.3 EMR types used in the hospital

Different EMR systems tend to answer different business needs based on how they have been acquired or developed. In this study, it was important to ascertain the type of EMR in use within the hospital. It was observed that the hospital uses OpenClinic and OpenMRS in managing different business functions of the hospital.

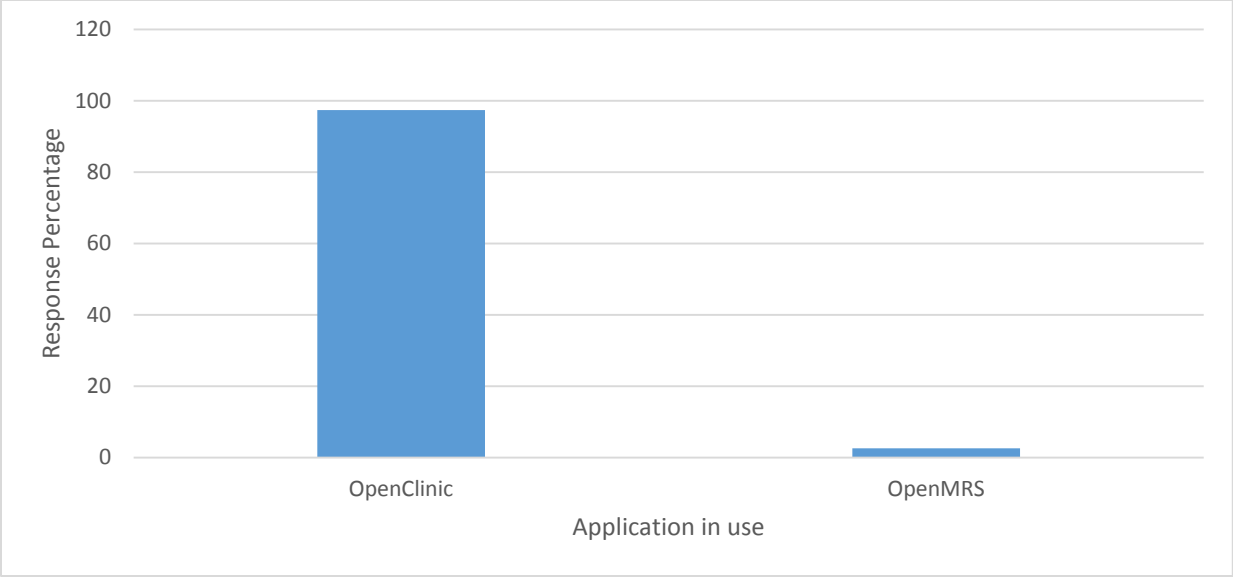

Figure 6: EMR applications in use

As illustrated in figure 6, OpenClinic is the widely used application in the hospital. 97% of the respondents sampled claimed to have used it while 3% of the respondents claim to have been working with OpenMRS. This implies that the biggest hospital functions are running on OpenClinic other than OpenMRS.

4.2.4 Business capabilities provided by the EMR

Any applications that drives a business process must hold functionality that solves business problems. In understanding this notion, the following areas were presented to the respondents;

The following results were obtained as illustrated in the table below.

Table 1: Business capabilities

Application Business Capability	Response %
Reducing office staff time spent looking for paper charts	78.4
Providing access to medical records anywhere any time	100
improving legibility of medical records	67.6
Accessing patient alerts based on criteria	35.1
Reducing filling time	62.2
Reducing time spent filling out forms	62.2
Improved reporting	81.1
Other	5.4

78.4% of the respondents felt that the EMR is supportive in reducing time that staff spent looking for paper charts. All the respondents felt that the EMR is supportive in providing access to medical records anytime and anywhere in the hospital. 67.6% of the respondents felt that the EMR is supportive in improving legibility of medical records. 35% felt that the EMR is supportive in accessing patient alerts based on criteria. 62.2% felt that the EMR supports reduction of filling time. 62.2% felt that the EMR reduces time spent filling out forms. 81.1% felt that it has resulted in improved reporting. 5.4% felt that there are additional business benefits that the EMR offers.

These results thus support the proposition in this research that an organization's ability to use IT to support its core competencies is dependent on application functional capabilities. With 67.6% of the respondents feeling that legibility of medical records is highly improved with the use of EMR, it is a good statistic. Equally, discovering that all the assertions scored over 60%, and reporting scoring 81.1%, this demonstrates that the value EMR is providing salient business capabilities. It is important to note that IT is not necessarily the driver of capabilities, but business capabilities are the primary driver of value [31]. IT is just an enabler of realizing this value. Hence, if the hospital can be able to get a better grasp on how these capabilities can be optimized in EMR so that they can be rated beyond 80%, these capabilities will thus be a major thrust in greatly improving efficiency in Ndera hospital.

4.2.5 Business Process value assertions

In assessing the respondents' opinion on the business process value assertions, a 5 Linkert scale was used. 1 represented strongly disagree, 2 represented disagree, 3 represented not sure, 4 represented agree and 5 represented strongly agree. In the analysis, 1 and 2 were considered as a general disagreement on the assertion while 4 and 5 were considered as general agreement on the assertion.

4.2.5.1 Business value with regard to support

Application support is a daunting task especially in resource constrained environments. The EMRs in use in Ndera hospital are not homegrown but rather imported into the environment. They are thus subject to continued support, which is externally sourced. In understanding this complexity, an assessment of how the EMR is supported both internally and externally was done. The following results were obtained as illustrated in the figure below.

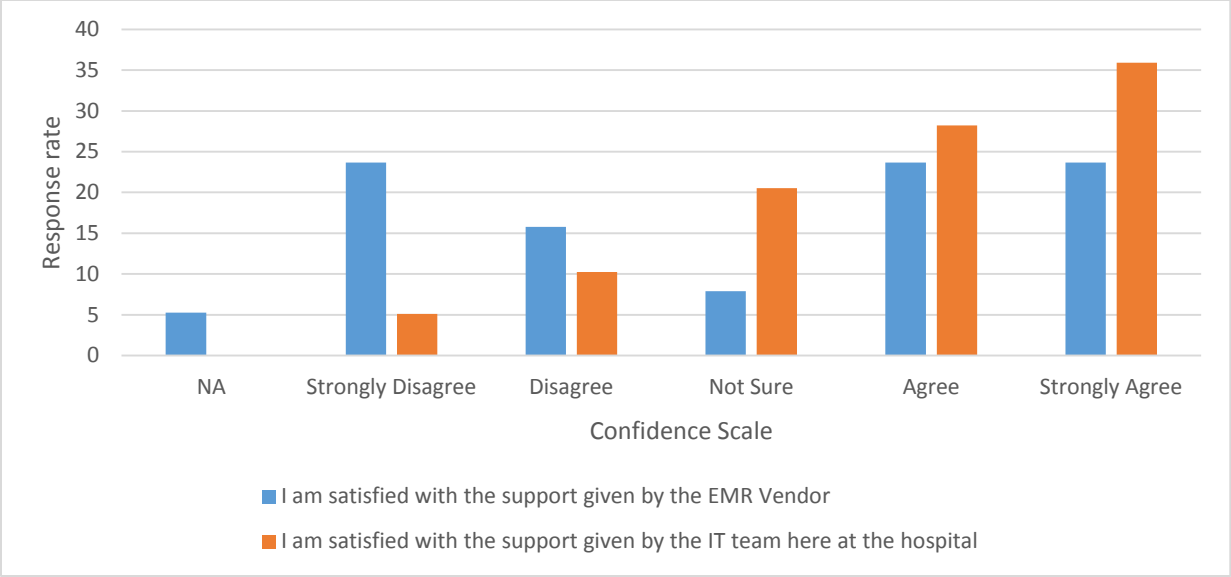

Figure 7: EMR Support

5% of the responds felt that the issue of support by the EMR vendor is not applicable when it comes to EMR evaluation or probably they did not have sufficient knowledge about the subject. Overall, 40% of the respondents felt that they are not satisfied with the support they get from the EMR vendor as well as the one given by the internal IT team. On the other hand, 30% were not sure of this support level. 48% of the respondents felt that there is sufficient vendor support while 64% felt that the support given by the internal IT team is sufficient.

4.2.5.2 Business value in terms of system output

In assessing business value in terms of system output, the following results were obtained as illustrated in figure 9 below.

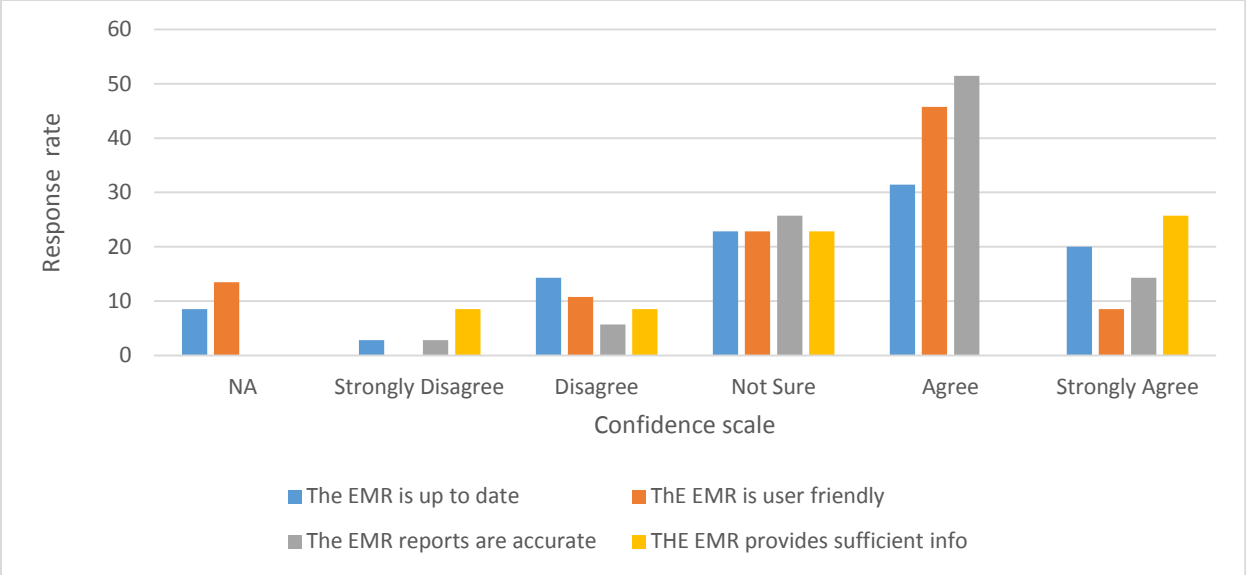

Figure 8: System output

9% found it inapplicable to comment on whether the EMR is up to date. 14% of the respondents also found it inapplicable to comment on whether the EMR is user friendly. They probably didn't understand well what was asked. On the other hand, 37% disagreed that the EMR is up to date. 34% disagreed that the EMR is user friendly. 32% disagreed that EMR reports are accurate. 32% disagreed that the EMR provides sufficient information. 23% were not sure if the EMR is up to date, 23% were not sure if the EMR is user friendly, 26% were not sure if the EMR reports are accurate and 23% were not sure if the EMR provides sufficient information that meet the needs. On the other hand, 51% felt that the EMR is up to date. 55% felt that the EMR is user friendly. 65% felt that the EMR reports are accurate. 27% felt that the EMR provides sufficient information that meets needs.

4.2.5.3 Business value in terms of processes and workflow

In assessing the value derived from the EMR in terms of improving processes and workflow, the following results were obtained as illustrated in figure 10 below.

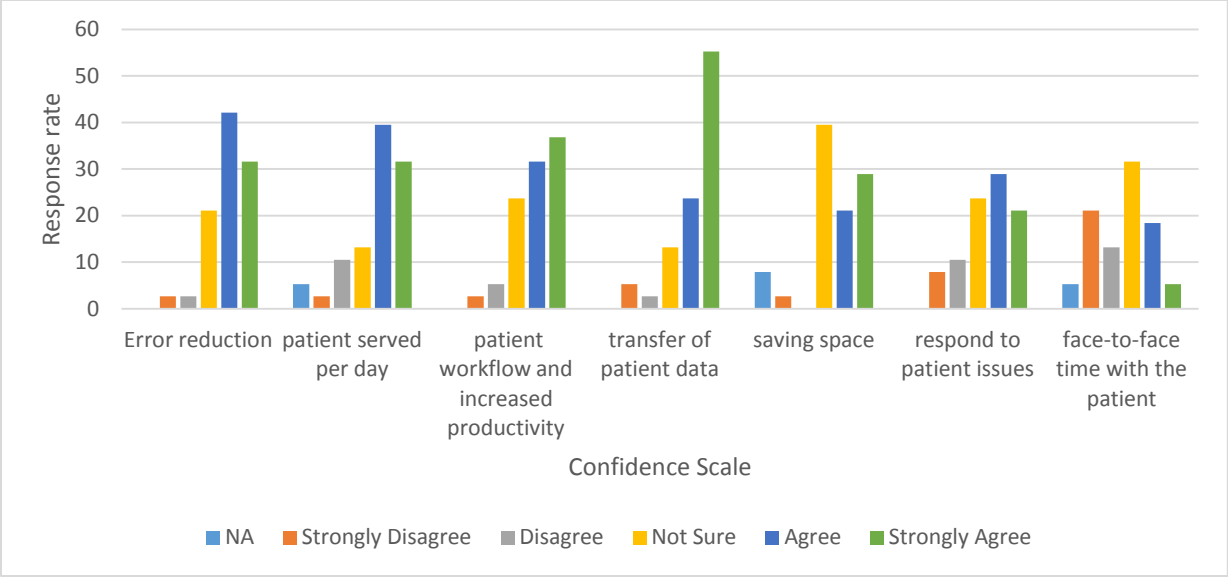

Figure 9: Workflow and process improvement

With regard to error reduction in entering data in the system, 6% did not believe that the EMR reduces errors, while 21% were not sure about this assertion. However, 74% believed that the EMR reduces errors. 5% of the respondents found it inapplicable to comment on the benefit of increased patient served per day due to the use of the EMR. With regard to the number of patients served per day, 14% felt that the EMR has not contributed to the increase in the number of patients handled per day. On the other hand, 24% were not sure of the EMR`s contribution in this regard. Otherwise, 71% felt that the increased number of patients served per day within the hospital has only been possible due to the EMR usage.

With regard to the EMR enhancing patient workflow and increased productivity, 8% disagreed with this notion, 24% were not sure. 69% felt that the EMR has contributed in enhancing patient workflow and improved productivity within the hospital. No respondents found this assertion inapplicable. With regard to improved quick transfer of patient data between departments, 8% disagreed with this EMR contribution. 13% of the respondents were not sure, yet 79% were confident that the EMR has contributed towards these patient movements.

With regard to saving space for storing patient records, 8% found it inapplicable, 3% disagreed yet 39% were not sure. On the other hand, 50% felt that there is contribution of the EMR in saving storage space of patient and hospital records. With regard to the EMR resulting in supporting the ability to respond to patient issues, 19% were in disagreement about this, yet 24%

were not sure. However, 50% felt that the EMR has contributed in supporting patient care greatly. For whether the EMR resulted in a clinician spending more face-to-face time with the patient, 5% found it inapplicable, 34% disagreed yet 32% were not sure. However, 23% felt that there is some contribution in this regard.

4.3 P-Value Calculations

In order to affirm the view that the EMR is well supported, provides good or expected outputs and that it has improved workflow and processes in the hospital, p-value calculations were done to establish the confidence levels. The assertions were categorized in terms of support, system output as well process and workflow improvement as summarized in the tables below.

Table 2: Summary of P-Value calculations

Category	Assertions	N	p Value
EMR Support	I am satisfied with the support given by the EMR Vendor	38	
	I am satisfied with the support given by the IT team here at the hospital	39	0.094
System Output	The EMR is up to date	35	
	ThE EMR is user friendly and presents data in the useful format	37	
	The EMR reports are accurate	35	
	THE EMR provides sufficient information that meet the needs	37	0.521
Process & Workflow improvement	The EMR resulted in reduction of errors with regard to patient care	38	
	The EMR resulted in increased number of patient served per day	39	
	The EMR enhanced patient workflow and increased productivity	38	
	The EMR improved a quick transfer of patient data between departments	38	
	The EMR resulted in saving space for storing patient records	38	
	The EMR resulted in our ability to respond to patient issues	35	
	The EMR resulted in a clinician spending more face-to-face time with the patient	36	0.001

Table 3: Assertion response percentages

Category	Assertions	Response %
EMR Support	I am satisfied with the support given by the EMR Vendor	95
	I am satisfied with the support given by the IT team here at the hospital	98
System Output	The EMR is up to date	88
	The EMR is user friendly and presents data in the useful format	93
	The EMR reports are accurate	88
	THE EMR provides sufficient information that meet the needs	93
Process & Workflow improvement	The EMR resulted in reduction of errors with regard to patient care	95
	The EMR resulted in increased number of patient served per day	98
	The EMR enhanced patient workflow and increased productivity	95
	The EMR improved a quick transfer of patient data between departments	95
	The EMR resulted in saving space for storing patient records	95
	The EMR resulted in our ability to respond to patient issues	88
	The EMR resulted in a clinician spending more face-to-face time with the patient	90

EMR support received an average response percentage of 96.5%. Measuring the satisfaction derived from system output received an average response percentage of 90.5%. Measuring satisfaction with regard to process and workflow improvement received a response percentage of 93.7%.

In confirming whether the EMR is supported well, both internally and externally, a p-value of 0.094 was obtained as illustrated in table 2 above. This confirmed the view that it is significant to assume that the EMR is well supported both internally and externally. Post application deployment always comes with different challenges which require a lot of hand holding especially to the non-technical users. Consequently, successful information system utilization can be measured by the effectiveness of IT to support an organization's strategies. For one to ensure that a business application like the EMR is effective in achieving its goal, it is imperative that it is well supported. The p-value obtained in this assessment further proves that the vendors have been responsive in addressing the hospital`s needs and that the IT team at the hospital has also been supportive to the users.

One of the key quality attribute of systems is the output it provides in terms of accuracy. In order to confirm whether the current EMRs in use provide the expected system output, a p-value was calculated on the response assertions as illustrated in table 2 above.

A p-value of 0.521 was obtained. This implies that there is still a low confidence level in terms of the quality of system output. Hence, the EMR is still average requiring fine tuning to ensure that it provides the required system outputs.

In affirming the view that the EMR has improved the process and workflow, a p-value computation was done as illustrated in table 2 above. A p-value of 0.001 was obtained. This implies that the EMR has improved the processes and patient workflow in the hospital significantly.

4.4 Key observations

4.4.1. Support of the EMR

The results described above show that the EMR is well supported especially when you consider 48% of the respondents agreeing that vendor support is sufficient and the 64% agreeing that the support given by the internal IT team is sufficient. The p-value obtained in the cross validation also further attests to this support level.

However, we cannot lose sight of the other respondents who felt that more needs to be done with regard to IT support as expressed from some of the user comments.

> *…"There are also associated problems with the network and the technicians of the EMR who are at time unavailable at the time when they are most needed"…*
>
> *..." It is affected by the network therefore the patients' records cannot be accessed at all the time."...*

It is important to note that offering top quality technical support is simply a matter of applying a blend of strong people and technical skills. Without the blend of these, perhaps, support would not be getting such a ratting. Thus, if these EMRs are constantly supported, the hospital will register increased productivity and resulting in the users enjoying their jobs thanks to an excellent IT support.

4.4.2 System output

Looking at the despondences from the assertions used to assess output of the EMR, the percentages in disagreement seem to highlight some issues that need to be addressed within the EMR. For instance, 37% do not find the EMR up to date, 34% do not find the EMR user friendly, 32% do not find the EMR reports to be accurate and 32% still found that the EMR does not provide sufficient information. The p-value obtained still further shows the low confidence level in this regard.

> *"…We need improvement of the EMR systems in order to satisfy our customers who are the patients in the hospital… If it is possible the vendor of OpenClinic could update and add some information needed in order to improve our activities…Some medical records must be saved and accessed to everyone in OpenClinic .."*
>
> *..The EMR can improve many activities for the hospital. For example, managing dispensing pharmacy because it manages pharmacy stock..*
>
> *There is more difficulty in using EMR according to users who don't have abilities or more information about the using of the EMR. …There is also a need for some updates needed within the system….*

However, not all respondents felt that way. The 51% who felt that the EMR is up to date, 55% who found the EMR user friendly and the 65% who found the EMR reports accurate, paint a different picture.

> *"……. It also permits to make analysis of works, statistics recorded about service and people who got the services. With such information, it is possible to make meaningful information.."*

Hence a need for further detailed study to understand the specifics of those particular areas that require improvement.

4.4.3 Processes and workflow

Patient flow within any hospital setting is an important attribute which the EMR must address. While the current EMR does not 100% address all the workflow and process needs as indicated by the 31% percentage of the respondents, it is credited in supporting this process to an acceptable level. The 69% respondents clearly demonstrate this. Equally, 79% who felt that the patient transfer between departments is now easy to manage, further shows that the EMR is supporting the improvement of productivity within the hospital. Given that all respondents did not miss answering this question, this shows that managing patient flow is a pertinent issue in the hospital. The p-value obtained of 0.00588 also further attests to this improvement.

> *.."The EMR is a system which is very important in this institution because it provides the users an opportunity to check, treat, manage and do anything you want concerning the institution in a short period of time through the data which the system keeps"....*

However, there are still some challenges with the system as highlighted by some users.

> *... "EMR seems to be a double work because nothing reduced, we are required to complete a patient file manually and also capture the same data in the system.".*.
>
> *.."it will be better if EMR connects Clinical medical results with openClinic system"*
>
> *.."The patients spend more time for waiting to be registered in the systems."...*
>
> *"all personnel of the hospital are not familiar with the EMR"*
>
> *"..the system should be available in all departments of the hospital"..*
>
> *..."The EMR is not yet enough to keep all records for the patient. So some patients are still spending more time"..*

Usually, workflow based solutions such as the EMR tend to save users from doing the same work that others have already done, or save them from postponing their own tasks while others finish theirs. Thus, capitalizing on such capabilities can provide greater benefit for the EMR.

4.5. Primary business value assessment

Investment in business applications such as the EMRs is aimed at driving increased productivity as well as performing business functions accurately. This assessment dimension was directed at measuring the primary business value by understanding revenue increments, net income and may be return on investment.

4.5.1 Target sample

In understanding this business metric, section heads, hospital directors as well as other personnel deemed important in providing this information were interviewed as illustrated in the figure below.

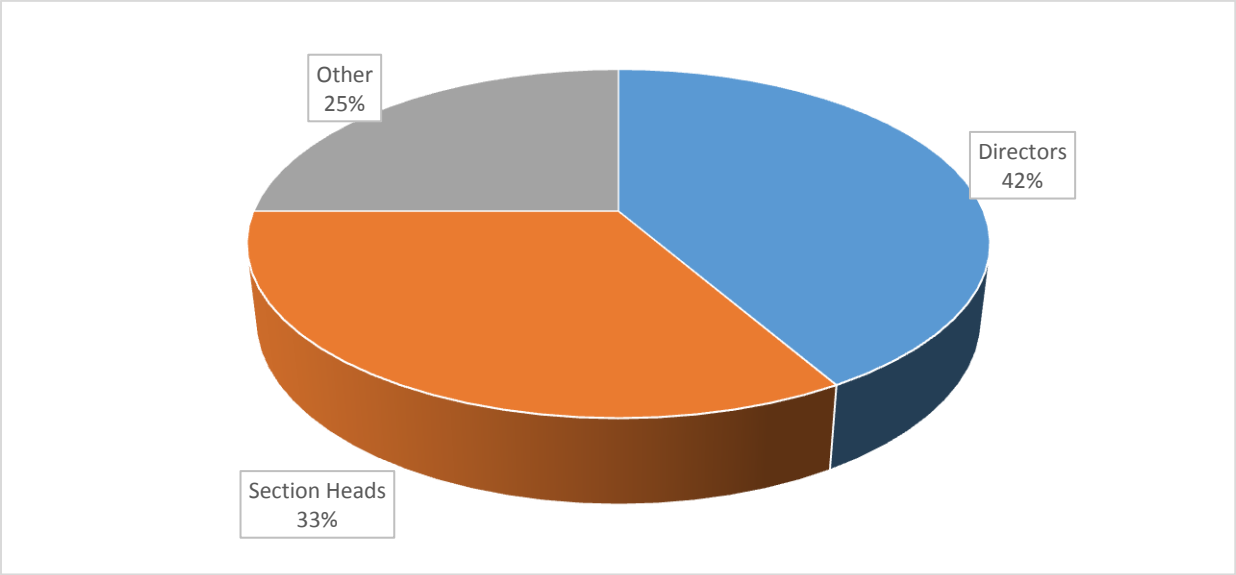

Figure 10: Sample with financial information

In total, 12 personnel were interviewed, 42% of which were directors as strategic decision makers at the hospital. 33% were section heads as important personnel in enforcing policy, budgeting as well as implementing strategic business directions. The 25% were other personnel knowledgeable with the financials of the hospital.

4.5.2 EMR adoption in this hospital

From the interviews, it was discovered that the EMR was established with the view of:

- Improving the service and overall quality of care given to patients,
- Increasing the financial performance,
- Improving the reporting process,
- Measuring up to other hospitals within the country which had already adopted such systems.

From the analysis, it was observed that proper technology acquisition strategies were not followed at the time as there was no document to prove otherwise. For instance, there was no feasibility study done to assess some technical and strategic questions as highlighted by some respondents.

> *…….there was no feasibility study because there was a clear improvement of the delivered services from other hospitals visited before our adoption of it…In other words, we were satisfied with what we saw from other hospitals in terms of system benefits….*
>
> *…..the vendors came to present about the good of adopting an EMR in a hospital like ours, giving clear examples of how it was helping them and the hospital management was convinced about it….*

In this case, there was no benefit measurement forecasted at the start of the project implementation. Hence, the business case for its adoption was never done. According, measuring of the system value can only be understood from the revenue improvements atop other soft benefits highlighted in the previous sections. It was not possible to assess initial projections at project inception and registered targets over time.

4.5.3 Financial benefit due to EMR adoption

It was hoped that by the introduction of the EMR, Ndera hospital would improve its revenue collections. The graph below illustrates how the revenue collection has improved prior and after the introduction of the EMR in Ndera hospital in 2011.

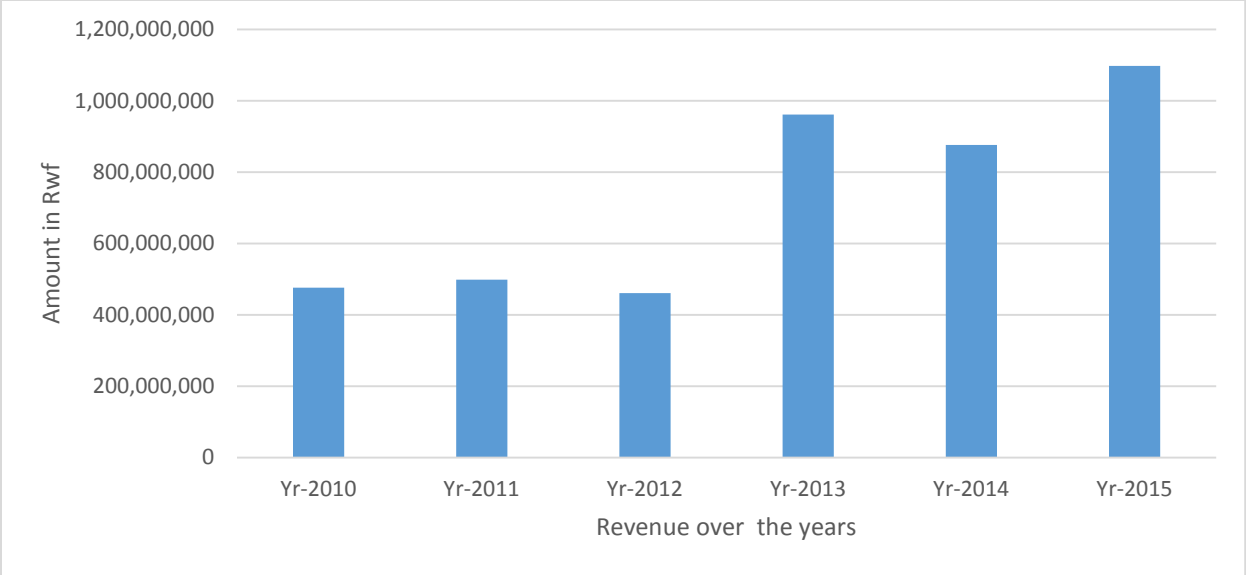

Figure 11: Revenue improvement

In 2010, the total annual revenue collection was 475,865,646 Rwf before the introduction of the EMR. When the EMR was introduced in 2011 to manage finances and other functions, a revenue increment of 22,495,067 Rwf was recorded. While the revenue in 2012 dropped due to the changes that were happening in the hospital in implementing the EMR, from 2013 to 2015, total annual revenue jumped to an average 765,886,846 Rwf per year. In 2014 the revenue also dropped due to an increase in unpaid bills from poor patients without insurances. When looking at the difference between revenue collections in 2015 and 2010, there is a revenue collection difference of 400,038,996 Rwf.

This improvement can further be correlated with the patient number improvements as illustrated in the graph below.

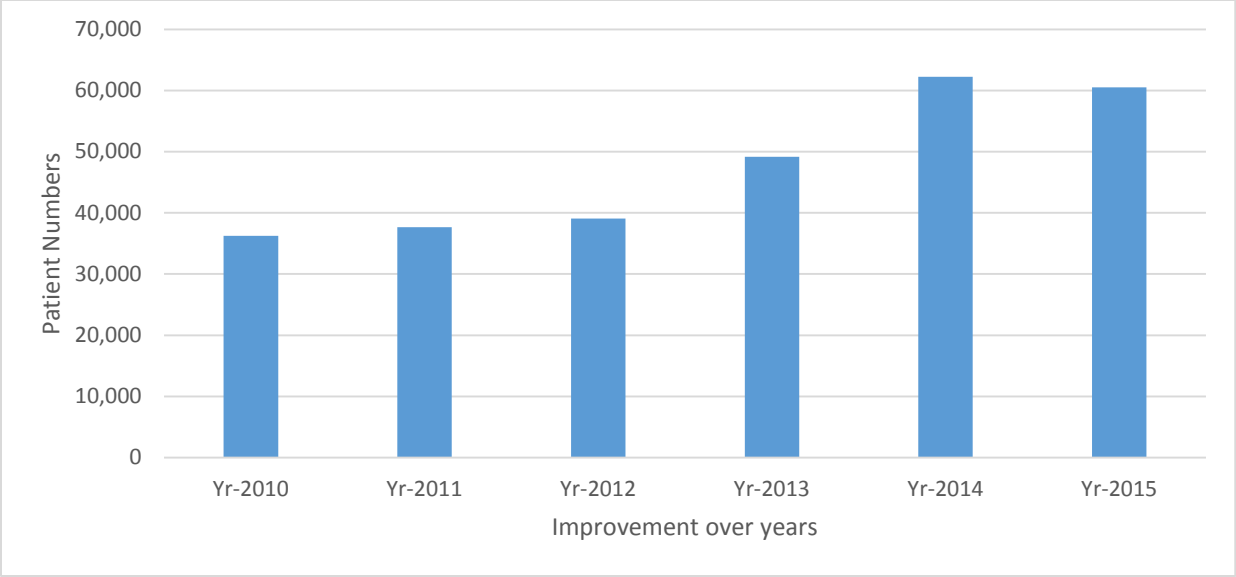

Figure 12: Patient numbers over the years

In 2010, a number of 36,261 patients was handled in the hospital. However, in 2011, an additional 1,383 patients were recorded. While the revenue dwindles in 2012, the patient numbers grew by 1,425 patients. In 2013 and 2014, the trend for increased patient numbers is vivid with additional 10,092 and 13,099 patients respectively. In 2015, the numbers dropped slightly by 1749 patients.

Hence, this improvement is significant to demonstrate that the 24,250 patients difference, when measured against 2010 and 2015 patient registrations, illustrates the benefit of increased productivity and work process improvements. Some of the response comments further attest to this.

> *…….we now have been able to register increases in finances thus being able to do other things that would not have be done without increase in finances…..*
>
> *…… we now see overall improvement in service delivery…….*
>
> *…….OpenClinic helps in improving the overall care of patients coming to Ndera hospital because, better Information gathered by this EMR means better health care to our patients…..*

> *…….Health care is a multidisciplinary team effort and shared information supports this effort. Patients, their families and providers all benefit when all team members can communicate with each other effectively and efficiently by the use of OpenClinic…..*

If this patient growth rate is maintained over the next five years, there is a high likelihood that even the revenues will double substantially.

4.6. Return on Investment

Both EMR systems used in Ndera Hospital are open source applications. Hence, they carry no base purchase costs. However, there are other costs which were analyzed. In understanding the Return On Investment(ROI) for investing in EMR in Ndera Hospital, an analysis of costs associated to the implementation of system were analyzed as provided in the table below.

Table 4: EMR associated costs (in Rwf)

Relevant costs	**2011 (Yr1)**	**2012 (Yr2)**	**2013(Y3)**	**2014(Y4)**	**2015(Y5)**
IT Team cost	17,411,528	18,137,008	18,892,800	19,680,000	20,500,000
Annual license	2,936,029	3,058,364	3,185,796	3,318,538	3,456,810
Infrastructure setup	15,000,000	0	0	0	0
Computer purchases	14,000,000	0	0	0	0
Totals	**49,347,557**	**21,195,372**	**22,078,596**	**22,998,538**	**23,956,810**

It is important to note that an inflation rate of 4% was assumed across the years. The costs above include the IT team costs which includes salaries, training, implementation, and ongoing maintenance and support. The other costs are annual licenses fees which are paid out to the vendor for continued feature change and system refinement, infrastructure setup and computer purchases. Infrastructure setup costs and computer purchases cost were only incurred during Year 1when the system was introduced. Hence, the investment costs were high in the first year.

However, in the subsequent years, these costs went down as only recurring costs were incurred as illustrated in the figure below.

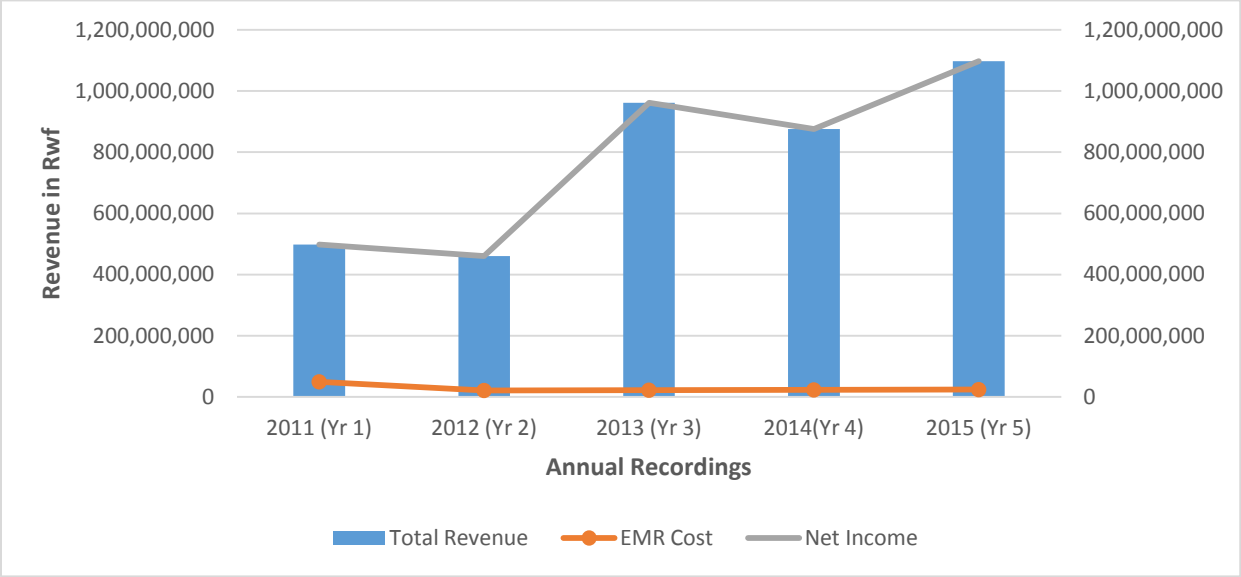

Figure 13: Revenue against cost analysis

When comparing costs against revenue collections over the years, the findings show that the costs have been kept at an average low of 22,557,329 Rwf per year, while the revenue is increasing. This has resulted in providing an average net income of 750,792,066 Rwf over the five years.

4.6.1 Calculating the Return on Investment

$$\text{ROI} = \frac{\text{Gain from investment} - \text{Cost of Investment}}{\text{Cost of investment}}$$

$$\frac{3{,}753{,}960{,}330 - 139{,}576{,}873}{139{,}576{,}873}$$

25.89528895%
Approximately 26%

The result from the ROI calculation demonstrates that the EMR investment has created a 26% increase in value for the investment. Hence it has been a worthwhile investment to the hospital.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Overview

In this chapter key conclusions are provided in relation to the study findings. Possible areas that require redress have also been provided as well as possible research grounds that further researches can explore in this regard.

5.2 Conclusion

The initial objectives of this study were to evaluate literature on system value measurement so as to obtain suitable value assessment parameters; assess the value added by the implementation of EMR at Ndera hospital; and provide guidelines which can be used for system value measurement in other hospitals in Rwanda. In achieving these objectives, both stratified and purposive sampling techniques were used in the study mainly targeting knowledgeable people about the daily running of the hospital while using the EMR Systems in place.

This study was grounded in the notion that despite other researches having based mainly on return on investment on IT initiatives, in Rwandan, no systematic approach to assessing the impact of EMR on business performance of the hospital has ever been done.

The study results observed in the previous chapter show that,

- Majority of the system establishment objectives have been achieved,
- Revenues have increased, and the ROI is positive,
- Support for the EMR is high both internally and externally from the vendor,
- The EMR has resulted in improved workflows and processes especially when compared against the increased patient numbers and the p-value results about such affirmations,

With this, it is worth concluding that both the primary business value assessment as well as the business process value are positive. Overall, it is worth suggesting that Ndera made a worthwhile investment in the EMR as the overall net system benefit seem positive. Since the initial adoption idea was based on how other systems users in other hospitals across the country were increasing their revenue collections, the resulting revenue increases are a clear indication that using EMR systems is positive across a wide range of assumptions. Hence, the magnitude of the return is sensitive to several key factors.

Equally, improving hospital business function takes into cognizance of different areas spanning service delivery, efficient administration as well as standardization. The EMR systems adopted in Ndera hospital have provided the ground towards attaining this anticipated value. It is hoped that once this value is tracked over time, more improvement will be registered.

While the results are positive, there are a number of other issues that need to be addressed in order to achieve the overall desired business need.

- **Ongoing review**: With the low p-value ratings on system outputs, the need for ongoing system review is imperative to assess those particular areas that need further refinement. This can only be achieved if full business analysis activity is carried out so as to ascertain the system gaps.
- **Existence of two EMR systems**: There are two EMR systems currently operational in Ndera Hospital. While OpenMRS is being used for HIV/AIDS related activities, OpenClinic is the widely used application across business functions. There is a need to review how both system can be integrated or adoption of one current system so as to minimize support constraints.
- **Training**: Most users expressed interest in further training on system functionality. It is hoped that this will result in increased productivity and system understanding.
- **Medical doctors' involvement**: Like most EMR assessment in other countries show about the low usage of EMR systems by physicians, Ndera also still has this challenge. Thus, there is a need to work at strategies of helping them use this product so as to increase productivity.
- **Installation in other branches of the hospital**: The system is not yet available in other two branches of Ndera hospital. There is thus a need to extend this capability to the rest of the branches so as to have a comprehensive view of system benefits.

5.3 Open research questions arising from the study

While this is an initial step in understanding the benefits of EMR system usage within Rwanda, there are other potential contexts which need clarity. It is hoped that further studies that will draw from this can help examine the following:

- Does the continuous review of system needs improve system understanding and overall usage over time or does it widen implementation cost without any immediate user benefits?
- How can economic value associated with the use of EMR system in Rwanda be associated with less tangible benefits such as higher quality of care, patient service, provider and employee satisfaction, and competitive advantage?

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Appendix – Data collection tools

APPENDIX I: Survey Questionnaire for the Study

Protocol title:

Assessing value of Electronic Medical Records Systems at CARAES NDERA referral hospital in Rwanda

PRINCIPAL INVESTIGATOR

Mr. Eric Ferdinand TWIZEYIMANA
Email: 86twizeyiman@cua.edu
Mob Telephone: +250 788 271 181
Address: Ndera – Gasabo – Kigali City

INTRODUCTION

This study aims at ascertaining whether the integration of Electronic Medical Records Systems (EMR) results in any tangible value in Ndera Hospital. We are interested in understanding the net system benefits such as content, timeliness, ease of use, accuracy and format of the data from the EMR and how this creates user benefit both in the short and long term.

DEMOGRAPHICS

Department: _____

Title (Nurse, Medical Doctor, Receptionist, etc.): _____

Years of Employment with Ndera Hospital: _____

EMR USE

1. Were you here before the introduction of the EMR?
   - ☐ Yes
   - ☐ No
2. Which EMR are you using in executing your daily activities in the Hospital?
   - ☐ OpenClinic
   - ☐ OpenMRS

3. The following business capabilities are currently supported by the EMR

   - ☐ Reducing office staff time spent looking for paper chats
   - ☐ Proving access to medical records anywhere any time
   - ☐ Improving legibility of medical records
   - ☐ Accessing patient alerts based on criteria
   - ☐ Reducing filing time
   - ☐ Reducing time spent filling out forms
   - ☐ Improved reporting
   - ☐ Other

   _____
   _____
   _____
   _____

EMR IMPACT ON NDERA HOSPITAL OPERATIONS

4. The EMR has:

		Disagree				Agree
Resulted in reduction of errors with regard to patient care	☐NA	☐1	☐2	☐3	☐4	☐5
Resulted in increased number of patients served per day	☐NA	☐	☐	☐	☐	☐
Enhanced patient workflow and increased productivity	☐NA	☐	☐	☐	☐	☐
Improved quick transfer patient data between departments	☐NA	☐	☐	☐	☐	☐
Resulted in saving space for storing patient records	☐NA	☐	☐	☐	☐	☐
Resulted in our ability to respond to patient issues	☐NA	☐	☐	☐	☐	☐
Resulted in a clinician spending more face-to-face time with the patient	☐NA	☐	☐	☐	☐	☐

5. Kindly indicate your satisfaction rating with regard to the support given.

		Disagree				Agree
I am satisfied with the support provided by the EMR vendor	☐NA	☐1	☐2	☐3	☐4	☐5
I am satisfied with the support given by the IT team here at the hospital	☐NA	☐	☐	☐	☐	☐

6. Do you agree on the following statements?

		Disagree				Agree
The EMR is up to date	☐NA	☐1	☐2	☐3	☐4	☐5
The EMR is user friendly and presents data in the useful format	☐NA	☐	☐	☐	☐	☐
The EMR reports are accurate	☐NA	☐	☐	☐	☐	☐
The EMR provides sufficient information that meet needs	☐NA	☐	☐	☐	☐	☐

7. Any other comments or remarks

_____
_____
_____
_____
_____
_____
_____

END

Thank you for accepting to participate in this study. At a later date, we are happy to share with you the findings of the study should you be interested. You can thus contact any of the principle investigators in this regard.

APPENDIX II: Interview guide for the Study

Protocol title:

Assessing value of Electronic Medical Records Systems at CARAES NDERA referral hospital in Rwanda

PRINCIPAL INVESTIGATOR

Mr. Eric Ferdinand TWIZEYIMANA

Email: 86twizeyiman@cua.edu

Mob Telephone: +250 788 271 181

Address: Ndera – Gasabo – Kigali City

INTRODUCTION

This study aims at ascertaining whether the integration of Electronic Medical Records Systems (EMR) results in any tangible value in Ndera Hospital. We are interested in understanding the business metrics such as revenues, net income and may be return on assets supported by the introduction of the EMR in Ndera hospital.

INTEVIEW QUESTIONS

1. I am a
    - Hospital Administrative personnel
    - Director
    - Other stakeholder: _____
2. Why was the EMR adopted in this hospital?
3. Was there any feasibility study done before the introduction of the EMR in the Hospital?
4. Do you believe to date it has helped solve the anticipated business needs prior to its purchase?
5. Roughly how many people use the EMR and which kind of categories?
6. Are there any gaps which have been created by the introduction of the EMR?
7. Has the EMR system allowed you to more effectively manage your staffs? If so how?
8. How would you want the EMR to support the efficient administration of the hospital?
9. What costs have you incurred for
    - Purchasing the EMR? _____
    - Annual licenses? _____

- Implementation:_____
- Support and Maintenance:_____
- Hardware:_____
- Any other Costs:_____

10. Do you believe there are cost savings that have been realized by the introduction of the EMR?
11. Do you believe the introduction of the EMR has helped improve your overall revenue collection and management?

REMARKS

_____

_____

_____

_____

_____

_____

_____

_____

END

Thank you for accepting to participate in this study. At a later date, we are happy to share with you the findings of the study should you be interested. You can thus contact any of the principle investigators in this regard.

APPENDIX III: Consent Form

a. Title of Study: Assessing value of Electronic Medical Records Systems at CARAES NDERA referral hospital in Rwanda

b. Principal Investigator: Eric Ferdinand TWIZEYIMANA, Email: 86twizeyiman@cua.edu, Mobile Telephone: +250 788 271 181, Address: Ndera – Gasabo – Kigali City.

c. Introduction

Dear Respondent,

This study aims at ascertaining whether the integration of Electronic Medical Records Systems (EMRs) results in any tangible value in Ndera Hospital. We are interested in understanding the business metrics such as revenues, net income and maybe return on assets supported by the introduction of the EMRs in Ndera hospital. It will take approximately 20 min of your time and refer me the next best alternative who could offer same information.

d. Confidentiality

The study is anonymous. We will not be collecting or retaining any information about your identity.

e. Right to Refuse or Withdraw

The decision to participate in this study is entirely voluntary. You may refuse to take part in this study at any time without affecting your relationship with the investigators of this study. You have the right not to answer any single question, as well as to withdraw completely from the interview at any point during the process; additionally, you have the right to request the interviewer not to use any of your interview material.

f. Right to Ask Questions and Report Concerns

You have the right to ask questions about this research study. Feel free to contact Eric Ferdinand TWIZEYIMANA, who is the Principal Investigator or Professor Kato J. NJUNWA, Chairperson of the Institutional Review Board or Prof Jean GAHUTU and Dr. Brenda KATEERA at the Secretariat of the Institutional Review Board.

g. Consent

Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

Name (print): Signature: Date: