A COMMUNICATION MODEL ON ELECTRONIC INTEGRATION OF PATIENTS' HEALTH INFORMATION AND RECORDS MANAGEMENT IN TERTIARY HOSPITALS

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Thesis submitted in fulfilment of the requirements for the Philosophiae Doctor in Health Sciences in the Faculty of Health Sciences at the Durban University of Technology

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Date : October 2022

Declaration

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

20 April 2023

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Signature of student Date

Approved for final submission

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Abstract

Background

Access to patient medical history information that is maintained by the provider over time, which may include all of the key administrative and clinical data relevant to people's care under a specific provider, such as demographics, progress notes, problems, medications, vital signs, immunizations, laboratory data, and radiology. Due to manual record keeping, reports may become cumbersome in retrieving and putting patients in difficult situations before they can access healthcare services, but they have been found to be easier and more reliable when integrated electronically.

Aim

The aim of the research was to develop a communication model for the electronic integration of hospital patient health information and records management, highlighting the flow of communication between members of the health team contributing to patient care in tertiary hospitals.

Methodology

A convergent parallel mixed methods approach was used to guide the study. 61 Health Information Management Professionals were used for the quantitative study using the questionnaire. 20 selected healthcare professionals across various disciplines who were managing patients with electronic health records were involved in the qualitative study, where they were asked to provide answers to online interview guide questions. Analysis of the quantitative data was done using frequency tables, percentages, one sample statistics test, a t-test and other statistical tests, while content analysis using the four stages was employed to analyse qualitative data.

Findings

Results from both quantitative and qualitative methods showed that staff proficiency in computer/software skills was rated highest for MS Word while the lowest was for MS Access. There was also significant proof that environmental support exists for the implementation of electronic health records (EHRs) in hospitals. EHRs offer numerous benefits that manual methods do not, such as a reduction in patients' waiting time, easy accessibility, faster ward rounds, enhanced confidentiality and a reduction in staff workload, to mention a few. Barriers to successful implementation and integration were also highlighted, including staff shortages, large numbers of patients, and a lack of information and communication technology navigation skills among workers. Poor staff attitudes towards EHR, a lack of necessary training, and inadequate funding had moreover been found to be the barriers to the electronic integration of patients' health information and records management.

Key words: Electronic health records, electronic integration, healthcare providers, information and communication technology, patients' information.

Dedication

This study is dedicated to my children.

Acknowledgements

I give glory to the Almighty God, my sustainer who made everything possible for me particularly in taking this programme. To Him alone is my thanks due, who am I to have received such grace and favour in my family? I appreciate God always on behalf of my supervisor, Professor Nokuthula Sibiya and my co-supervisor, Professor Olanrewaju Oladimeji whom God has given to me to guide me in this programme. I am grateful for their help, support, and commitment to ensure that I finish this programme. May you and your seeds never miss out on the mercy of God, you will continue to be relevant in your chosen fields.

What will I do without the help, drive and encouragement of my loving husband Dr /Eng. Ayodeji Akinyemi who was always on his toes to ensure that I pushed through to finish this programme. This has always been his attitude since my second-degree days. Your love and sacrifices are well appreciated.

To my children who missed me, especially during the time I had to go away to school: Ayomi, Ifetola, Oluwamolawa and Oluwamayode, thank you for your love and cooperation, I love you all.

I am super grateful to Dr Gill Hendry for her assistance in the analysis of my data. All your effort, right from structuring of objectives at the beginning of the thesis has shaped this work to this point, thanks so much Ma.

My special thanks also go to my parents, Pastor and Mrs Ayodeji for their support; to my siblings Seun, Dolapo, Tayo, Boluwatife, Tolorunju and my nieces, Damilola, Precious, Nifemi, Gloria, Favour and my nephew Victor Murewa and every other family member who had contributed in one way or the other to the success of this programme, thanks so much, I love you all. My thanks are incomplete without appreciating my in-law Mr Taiwo Ayinla for his help in the transcription process at the beginning. Also, to my sisters-in-law turned big mummies who took care of my children while I went away to school, Mrs Odetuyi Ibidun and Mrs Olukayode-Yakubu Abike, I love you so much.

Mrs. Pamela Oloo, I enjoyed every period of my stay there, and God will definitely repay your goodness to your children. I will not forget the assistance and support of the following people: Mr. Tolu, Mrs. Falade, Dr. Dada and his wife, all my respondents, my Pastor and his wife Prophet, Dr and Mrs Oluwatusin as well as Mr. Frank from Federal Poly Ado.

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Glossary of Terms

Electronic Health Record: Is a digitalised form of patients' health information containing all records about the patient from the point of initiation through his/her lifetime in the hospital. It contains family or personal history, medical history, warrant of treatment and end results, all in electronic form (Gunter and Terry 2005).

Information and Communication Technology: Is the use of a computer system and its accessories to transfer and communicate information (Ogunji 2013).

Paper-based records: Is the record of patients in paper format referred to as case notes (Abdulkadir, et al. 2010).

Electronic integration: This is the method of co-opting and incorporating an already existing paper-based record into an electronic format (Abdulkadir, *et al*. 2010).

Communication Model: Is the diagram of how information is transferred or communicated between members of a healthcare team in the hospital (Kapur 2020).

Records management: This involves all activities and procedures carried out on data repositories towards prolonging their life span and making them available for future use and reference (Marinic 2015).

List of Acronyms

Acronym	Full word/sentence
B.C.	Before Christ
DUT	Durban University of Technology
e-health	Electronic health
EHR	Electronic Health Record
EKSUTH	Ekiti State University Teaching Hospital
EMR	Electronic Medical Records
H/C	Health Centre
HIM	Health Information Management
HIMO	Health Information Management Officer
HIMT	Health Information Management Technician
HIV	Human Immunodeficiency Virus
ICT	Information and Communication Technology
IGR	Internally Generated Revenue
JTD	Joan Taiwo Daramola Memorial Hospital
PCV	Packed Cell Volume
SA	South Africa
TAM	Technology Acceptance/Adoption Model
UHC	Universal Health Coverage
UMF	Unfreeze-Move-Freeze
USA	United State of America
WHO	World Health Organization

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND TO THE STUDY

The need for actively bringing adequate health care and support for people to wherever they may be is part of the reason why electronic health record (EHR) is gaining popularity around the world. However, research studies show many healthcare users are yet to consent the technology, especially in developing countries due to reasons such as data security and the improper utilisation of available information and communication technologies (ICTs) in healthcare (Tuan-Vinh and Chien-Lung 2021). The purpose of collecting and storing patient information is to make it available for decision-making at a point of care, or for analysis and action for management and policy. It is critical to recognise that the majority of individual patients have more than one point of contact for care. They may have a primary general practitioner as well as a specialist. They may relocate from one location to another, including from one country to another. It is critical that their individual patient information is accessible at all points of care and analysis sites. To make this work, there must be standards for data representation and communication. Distributed health data networks have been proposed to improve the ability of institutions to collect and analyse data, resulting in improved effectiveness, safety, and quality of care.

Electronic integration of hospital patient health information entails converting existing paper-based patient health records into an electronic format that allows for interoperability between various Health Information Management (HIM) units within and across health institutions (Evelyn and Sebastian 2010). For many years, governments have been focusing on EHR and its adoption, particularly in primary care, which is critical in many countries. This is not the case in Saudi Arabia, where primary health care is still using paper-based records and only a small portion of the population is embracing information technology (Aljarullah, Crowder and Wills 2017).

In most developing countries, accumulated data from routine clinical practices is stored in paper records. This is so because of the perceived ease of handling by medical practitioners, lack of understanding or for treating more patients in a quicker time (Shan and Khan 2020). Medical clinics with inadequate resources, like those in lower-middle-income countries, currently rely on paper patient records because of the perceived ease of use, reliability, and because that is what financial and technical resources can sustain. Even though paper records have storage, access, and reporting challenges which would have been solved by EHR, the cost has made it seem unachievable for many, except if there is financial aid and provision of resources (Watson 2018).

Access to patient health information and the management of their records should not be confined to a unit, but rather should be managed with the use of a good software system. The information should be managed from any unit without necessarily going to a particular unit to retrieve the patient's health history. In many health institutions, when a patient requires other services away from where they are being managed, it becomes a matter of compulsion to carry the paper-based records around to allow for proper documentation. But when patient information is changed and incorporated into an electronic format, care providers will be able to access the documentation on the ground and add all new findings (Tom, Dean and Tod 2014). For example, a patient that needs to access care in about three different clinics in a day might be limited because of the need to be carrying the paper-based record around, whereas it can be accessed from various units with terminals networked together, making it easier for his/ her records to be accessed without stress and delay in as many places as he/she can get to in a day. This is not also limited or confined to within an institution, but even beyond, particularly for institutions that have annexes. The patient who was managed in a local annex should be able to expect his/her care being continued without any hindrances. All around the globe, a shift is being experienced from paper-based records to a friendlier and more easily accessible electronic based one. Apart from easier access, the confidentiality and security of patients' related data cannot be totally guaranteed in paper-based records. However, this can be brought under control in electronic

patients' health information and records management (José Luis, Inmaculalada and Pedro Ángel 2013). Government hospitals will need to have a software developer who will be able to develop software specific to their organisation in order to be able to meet their needs. Several computers, which will be networked together, and a stable or alternative source of power supply must be given greater consideration to make EHRs work out.

1.2 PROBLEM STATEMENT

Paper medical records were steadily kept in previous years but advancing technology in the 1960s and 1970s introduced the origins of a novel arrangement of hospital patient record keeping and documentation in the health information industry, while a significant leap in healthcare software development was seen in the 1980s and beyond. During this time, the introduction of computerised registration meant that, for the first time in most advanced countries, patients could benefit from a more efficient electronic check-in process. Today's healthcare providers are implementing functional health information systems with greater zeal than ever before. The industry has come a long way from keeping hard copies of health records to increasing and improving clinical documentation standards. However, the goal of fully functional electronic integration of patients' health information systems has yet to be realised. Traditional health care providers should be concerned not only with how to collect data, but also with how quickly and reliably they can process, analyse, and present the information to those who need it.

As much as we have several hospitals transitioning into electronic integration, there is still very low involvement in communication between and among health workers, and with their patients, as most of them carry out an electronic payment to monitor their funds (IGR) or even just capture the patients' identification data. Few HIM, nurses and doctors are attending to the patient through the EMR.

The model in picture for this thesis involves several other departments in the hospital, analysing how and whom they communicate with. A standard model should exist to allow for communicating patients' health information and records management electronically, either within a Hospital (Electronic Medical Record, EMR) or beyond the institution's geographical area. The communication involves the way a Health Information Department can communicate patient information and manage their records with the nurses for vital signs and doctors for consultation, how in turn a doctor can communicate investigations with Radiology department and Laboratory department without the patients carrying forms, be able to access drugs from the pharmacy without carrying prescription sheets around, communicate with wards for bed availability for admissions and possible connection with the Mortuary Department where patients' relatives can conveniently process the release of their corpse. At any point, each of the departments will be able to communicate with each other electronically, without necessarily going through a particular order.

1.3 AIM OF THE STUDY

The aim of the study was to develop a communication model for the electronic integration of hospital patient health information and records management, highlighting the flow of communication between members of the health team contributing to patient care in tertiary hospitals.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study were to:

- Assess the current paper-based methods of keeping medical records and how they are communicated/shared between personnel/departments.
- Assess the level of technological/computer skills of the personnel who handle medical records.
- Determine the ability of the environment to support the use of ICT.
- Determine the attitudes of the staff towards EHR.
- Identify perceived benefits and barriers to using ICT for medical record keeping and communicating patient health information.

- Identify protocol that will ensure that confidentiality of electronic medical records is maintained.
- Develop a template for storing and communicating medical records/patient information electronically between members of the health team.

1.5 RESEARCH QUESTIONS

- What system is currently used to keep medical records and how are they communicated between personnel/departments?
- What is the level of technological/computer skills of the personnel who handle medical records?
- Is the environment able to support the use of ICT?
- What is the attitude of the staff towards EHR?
- What benefits and barriers are there to using ICT for medical record keeping and communicating?
- What protocols can be put in place to ensure confidentiality of medical records?

1.6 SIGNIFICANCE OF THE STUDY

This research is important because it will allow us to gain access to the system that tertiary hospitals use to keep their records and how they are communicated between various departments. It will also provide information on the technological competencies of those handling patients' health information, the Hospital environment's ability to support this, and staff attitudes toward the use of EHR. Furthermore, potential barriers and benefits will be highlighted, and a model for tertiary hospitals to use for communicating Patient Health Information and Record Management, particularly in developing and underdeveloped countries, will be developed. This will assist all healthcare professionals in better understanding their communication workflow, make accessing healthcare easier for patients and their relatives as their information will be easier to retrieve to assist in better clinical care, assist in collation of hospital

statistics at a time without leaving any section out, and assist hospital management in proper decision making, particularly in adopting protocols for ensuring the confidentiality of patients' health records.

1.7 STRUCTURE OF THE THESIS

CHAPTER 1: Overview of the study.

CHAPTER 2: Literature review.

CHAPTER 3: Theoretical framework.

CHAPTER 4: Research design and methodology.

CHAPTER 5: Presentation of results for quantitative data.

CHAPTER 6: Presentation of results for qualitative data.

CHAPTER 7: Integration of the results from qualitative and quantitative data.

CHAPTER 8: Research outputs.

CHAPTER 9: Development of a communication model.

CHAPTER 10: Summary, limitations, recommendations and conclusion.

1.8 SUMMARY OF THE CHAPTER

Chapter 1 involves the introduction and background to the study under discussion, the problem that necessitated this study, its aim, the objectives of the study and the research questions raised by each objective. The significance of the study was also highlighted, after which the structure of the thesis is set out and the chapter summarised.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

As far as history is concerned, medical records are as old as medicine itself. One of the oldest recorded medical practices is the ancient Egyptian medicine which developed parts of the oldest form of health records. Ancient Egyptians used carvings, drawings and symbols (known as hieroglyphics) on the walls of tombs and temples to document the medical history of the deceased. The hieroglyphics provided information about the illnesses, treatments and operations performed during the life of the deceased (Al-Aswad, *et al.* 2013). However, the first more formal, medical record was developed in the fifth century B.C by Hippocrates who set two goals for medical records. The first goal was that a medical record should accurately reflect the course of the disease. The second goal was that a medical record should indicate the probable cause of the disease. These two goals are still valid and appropriate for medical records (Van and Musen 1997). Similarly, Galen of Pergamon, a Roman physician of Greek origin also made great contributions to anatomy and medicine and was known for documenting his observations about the care he provided to his patients (Nutton 1990).

In the 1890s, hospitals became more organised and began to keep records of patients' admissions and discharges. Massachusetts General Hospital records of admissions started in 1821. In the successive decades, many improvements in standards of professionalism were seen. The American College of Surgeons was formed in 1913 as an educational association for surgeons. The college sets high standards for surgical education and practice. These standards led the movement to maintain more comprehensive documentation of medical records. Later, standardisation was gradually replaced by accreditation (Guide 2003). Today, management of large amounts of patient information in medical practice makes the medical record the cornerstone of communication and documentation. This patient information was stored in the form of paper-based

medical record entirely until the early 1960s when the idea of electronic medical records was introduced (Blumenthal and Tavenner 2010).

Advocacy for the implementation of EHR has been seen in last two decades. Even today's paper-based medical record systems are widely practiced in health care settings. Meanwhile, health care organisations/providers have been improving the standard of records being created in the clinical settings. Most records of hospital patients established the details, names, addresses, family histories, complications, and outcomes of patient care. Hospital patient documentation has become widely popular since it is vital to the safety of both the patients and the health care providers. It can thereby be used worldwide after health care providers have recognised that they were better able to handle patients with accomplished and precise medical stories (Emeka and Lalit, A Systematic Review of Blockchain in Healthcare Frameworks, Prototypes and Implementations 2020).

In the past years, paper medical records were steadily kept and preserved, but the advancing technology of the '60s and '70s introduced the origins of a novel arrangement of hospital patient record keeping and documentation in the health information industry while a vast leap in healthcare software development was seen in '80s upwards (Shahid and Rizwan 2020). During this period, the advent of computerised registration meant patients were able to gain from a more efficient electronic check-in process for the first time ever in most advanced countries. The introduction of the master patient index (MPI), a database of patient information used in healthcare organisation in the United States of America was also a massive success. Yet, the applications still faced limitations at this point in time, as computers could not communicate with each other or be viewed by neighbouring departments. Current-day healthcare providers are implementing functional health information systems with more intensity than ever. The industry has come a long way from keeping hard copies of health records, to increasing and improving clinical documentation standards, but the ultimate goal of a fully functional health information system has yet to be realised (Loeffler and Suzanna 2014). Traditional health care providers have to

infer that they should not be concerned only with gathering data, but on how quickly and reliably they can process, analyse and present the information to those who require it, on any device. More research is necessary.

Many modifications have been made to the health information/record management system because of the introduction of electronic patient clinical information management. Gradually, paper-based records are being superseded by electronic method of records/data keeping. The small shelf/cabinet is being replaced by a portable computer system. Nevertheless, the purpose of EHRs is still in its infant stage in most African nations, although it is a little faster in developed countries. Research shows that on the basis of responses from 63.1% of hospitals surveyed, only 1.5% of US hospitals have a comprehensive electronic-records system (present in all clinical units), and an additional 7.6% have a basic system (present in at least one clinical unit). Computerised provider-order entry for medications has been implemented in only 17% of hospitals while larger hospitals, those located in urban areas, and teaching hospitals are more likely to have electronic-records systems (Ashish, *et al*. 2009). Research and innovation can give rise to the continued progress of health care that strengthens the relationship between patients and clinicians.

The data, timeliness and availability of comprehensive electronic-records systems will enable health providers to make better decisions about patients and provide better care for them. Relative to a decade ago, today more Americans buy airline tickets and check in for flights online, purchase goods on the Web, and even earn degrees online in such disciplines as nursing, law, and business, among others. Yet, despite these advances in our society, the majority of patients are given handwritten medication prescriptions, and very few patients are able to email their physician or even schedule an appointment to see a provider without speaking to a live receptionist (Nir and Taleah 2011). In the past health information managers used statistical research to improve the wellness care system. Some used a survey method to evaluate the hospital information system to improve the healthcare professions. Electronic application research was only applied in the area of patient drug information

management (Demian, Yesenia and José 2017), (Mohammed and Osama 2015). Electronic integration of patient data/medical records has not been incorporated in most of Africa's hospitals. Now, the virtual health industry must invest in and employ computational/electronic methods of patient health information/record management.

One of the main advantages of using computing systems in health care provision comes from its ability to provide health professionals with useful information for decision making. Thus, the system's primary aim is to incrementally increase the quality and efficiency of healthcare delivery. In order to accomplish these purposes, health information systems must fulfil interoperability standards, quality, security, scalability, reliability, timeliness, data storage and processing terms (Sandra , The Electronic Health Record and Its Contribution to Healthcare Information Systems Interoperability 2013). Better EHR integration can bring down the incidence of medical error by improving the accuracy and clarity of medical records. It can make health information more easily available, reduce the duplication of exams, reduce delays in treatment, and enable patients to be better informed and therefore make better decisions. The use of information technology in health has revolutionised and improved the delivery of health care services globally. It is applied in hospitals for the administration and management of patients, human resources, procurement, emergency fleet management, and much more (Khwima, Andrew and Benjamin 2017).

Various researchers have contributed to a body of knowledge based on their views and area of interest on EHR use. Boonstra *et al.* (2014) wrote that "EHR implementation initiatives tend to be driven by the promise of enhanced integration and availability of patient data, by the need to improve efficiency and cost effectiveness by changing the doctor-patient relationship toward one where care is shared by a team of health care professionals and/or by the need to deal with a more complex and rapidly changing environment". This research shows that EHR is worth implementing, bearing in mind that it has the power to impact on health care management particularly in the aspect of patient

information and records management (Boonstra, Versluis and Vos, Implementing Electronic Health Records in Hospitals:A Systematic Review 2014). The promise of enhanced integration and availability of patient data, offers hope for better collation and provision of patient data. Peng *et al* (2019) says “health data integration enables a collaborative utilisation of data across different systems. It not only provides a comprehensive view of a patient’s health but can also potentially cope with the challenges faced by the current health care system” (Peng, Goswami, & Bai, A Literature Review of Current Technologies on Health Data Integration for Patient-centred Health Records, 2019).

2.2 SOURCES OF LITERATURE REVIEWED

To collect studies for this review, a search strategy developed by the library of e-learning resources developed by the Durban University of Technology in South Africa was used. The search strategy made use of keyword terms in getting relevant information. Various search terms were used like ‘EHR', ‘paper-based record’, ‘electronic integration of patient information’, ‘global view on EHR' and so on. Using the above search strategy, the following databases contacted include:

- Elton B. Stephen Company (EBSCO) host Database.
- Elton B. Stephen Company (EBSCO) e-book.
- Institute of Electrical and Electronics Engineers (IEEE) Xplore.
- Cumulative Index of Nursing and Allied Health Literature (CINAHL) Complete.
- Health source – Nursing/Academic Edition.
- Health Information and Library Journals.
- Library, Information Science and Technology Abstract (LISTA).
- Sabinet African Journals.
- South African Medical Journal (SAMJ).
- South African Journal of Information Management.
- E-book Central.

2.3 CONSIDERATIONS FOR PUTTING EHR INTO ACTION

In putting EHR into action, there are four steps to consider. These include:

2.3.1 Research software and developers

It is important to consult firms or companies that have been in business for a longer period and have good customer reviews.

2.3.2 Education and training

There is a need for end users to fully understand the operation and application of EHR to be able to maximise the advantage for putting it into use. There is a need to identify smart and competent staff who use computers. This is the set of people that will be trained first who will in turn pass such training down to the remaining members of the health team. It is a known fact that people will want to resist change, preferring their old ways of doing things, but with training and retraining, people will adjust and adapt to it in time.

2.3.3 Optical character recognition and speech-to-text

There is no need for team members to be typing old patient records into the new EHR system. It is a waste of time when indeed one can use optical character recognition technology to scan in each record into the EHR, after which it is stored in digital format for easy access later. Another method is by starting the use of voice recognition (this is voice-driven EHR software) in which the computer recognises ones' speech at any rate to achieve higher rates of data input. This is much faster than having to type it in. It is one of the latest technologies for inputting data into EHR software. Speech-to-text systems now come with extensive medical vocabularies already built in, making the process of transforming the spoken word into digital files for use in the patients' chart much easier.

2.3.4 Set up permissions to control who has access to patients' information

Hospitals in time past have had control protocols in place to enable or deny access to paper-based patient's records e.g. locked rooms, locked filing cabinets and other measures to ensure that only authorised persons could see the confidential patients' information. But EHR systems allow you to designate who on your staff can look up information about patients as well as add new details or adjust information. The log can be checked by managers to see whose information, and what information is assessed and when. In making these changes, hospitals enable staff to work together with fewer errors, saving time and data, and making input and analysis easier, which in turn allows for the treatment of more patients, improves the quality of care and the organisation's financial health.

2.4 IMPORTANCE OF EHR

EHR is shaping the health care industry in that it can:

- **Minimize errors**

EHR eliminates the issue of illegible handwriting, misspelling, and different terminologies used by healthcare professionals when issuing handwritten documents, thereby standardising patient records across the board.

- **Maximize cost-efficiency**

With EHR, one can share information almost instantly with other professionals, thus speeding up patient care and ultimately saving time and money in health care professionals' pursuit of effectively treating patients. Since EHR stores complete medical records, medical data analysis free of error is also assured at lower cost.

- **Better coordination between healthcare providers**

When put into use, EHR allows for effective coordination and communication between physicians and hospital care providers. Important patient care information like medical history, allergies and previous treatments that have been provided by primary care physicians can be made available in hospitals in time, which will result in quality care for individuals seeking treatment (O'Connor 2014). The data saved in EHRs can be accessed over multiple locations concurrently and can also be shared with different partner organisations without difficulty. This enables concerned physicians to access data in order to provide better healthcare services for their patients.

- **Complete patient's health history**

In using EHR, there is opportunity to store organised, coded electronic patient information in one place to form a complete patient's health history without it being fragmented.

- **Monitored health output for quality health care**

EHR offers a Decision Support System (DSS) for monitoring health outputs towards improving health care quality.

- **Database of patients' information**

It also serves as a central database of information for patient documentation and billing, thereby helping to maintain quality and support delicate patient related decisions.

2.5 FACTORS AFFECTING THE ACCEPTANCE OF EHR

Several factors determine and affect peoples' acceptance of EHR, this includes:

2.5.1 Attitude toward EHR

This is an individual's positive or negative feelings about performing the target behaviour. In Technology Acceptance/Adoption Model (TAM), one's attitude toward using technology is a key determinant. In implementing EHR, effort must be concentrated on developing peoples' positive attitude towards its use.

2.5.2 Perceived usefulness

This is the extent to which peoples' beliefs that adopting a system like EHR will improve their job performance.

2.5.3 Perceived ease of use

This is individuals' belief that using the system will require less effort in its usage. According to TAM, perceived ease of use is a major factor of attitudes both toward the use of technology and its perceived usefulness (Mohammad, Fully Decentralized Multi-Party Consent Management for Secure Sharing of Patient Health Records 2020).

2.5.4 Social influence

An individual's peers and colleagues hold major sway over the adoption of a new practice. If an individual sees that people important to him/her are making use of the system, there is every likelihood that he/she will adopt it too. Example of people with social influence on healthcare teams' acceptance of EHR include colleagues, peers, and also top management.

2.5.5 Computer self-efficacy

One's ability to use the computer quite well determines one's efficacy. Members of healthcare teams who have high self-efficacy are going to embrace the use of EHR more quickly than their counterparts who do not. As the world advances technologically, it becomes a matter of compulsion for healthcare providers to be computer literate. This is because computer self-efficacy has become a

prerequisite for employment in many organisations. Thereafter, continuous on-the-job training programmes can be organised to update peoples' knowledge of computers prior to EHR implementation to increase its acceptance.

2.5.6 Perceived threat to physician autonomy

Venkatesh *et al.* (2012) was of the opinion that physicians are characterised by a high level of professional autonomy. Some physicians fear that using a particular system will reduce his or her control over the conditions, processes, procedures, or the content of his or her work. This, however, is far from the truth. Physicians may resist using an EHR because implementing it calls for substantial changes which they think could affect positions or power relations in the medical practice. But this should not affect their decision to adopt EHR (Venkatesh, Thong and Xu 2012) (Daher, Ong and Krisnan 2022).

2.5.7 Confidentiality concerns

It is a subject of general concern particularly for the developing world, that EHR could be accessed by unauthorised people. Some health care providers worry about protecting the confidentiality of patients' information (Li, *et al.* 2013). Having relevant policies and regulations and also informed consent from patients could help reassure those who fear risking confidentiality.

2.6 GLOBAL VIEW OF ELECTRONIC INTEGRATION OF PATIENTS HEALTH INFORMATION AND RECORDS MANAGEMENT

In healthcare settings, a record can be kept either in a paper-based form, or an electronic one or a combination of the two, which is known as a hybrid. Several organisations employ whichever method is suitable for them. However, paper-based records which make use of case notes contain various hard copy forms like patients' identification data; clinical sheets; nursing processing sheets; drug charts; temperature, pulse and respiration charts; laboratory and radiological reports and so on. The overall aim is to allow all information about a patient's health history to be seen. Currently, several hospitals, particularly in developed

and developing worlds are tending towards the keeping of electronic records. Hospitals that are already operating paper-based records can migrate either in phases or all at once. Whichever method is chosen, caution must be exercised so as not to cause a failure that will result to falling back to paper records. Getting information from paper-based records may involve:

- Abstracting data from case notes manually.
- Using computer data interfaces between existing systems.
- Converting paper forms to digital records.

An EHR is a computerised model of a paper-based record which combines data collected for the purpose of treating and diagnosing patients by physicians in hospitals. This allows for better accessibility and more efficient patient care. EHRs also allow for real-time communication between healthcare professionals, for example laboratories and experts. The increasing adoption of EHRs, rising incentives from federal government, and growing incidences of medication errors drive the growth of the market. However, concerns regarding data privacy and physician burnout hinder market growth. EHRs make patient data available instantly authorised health care professionals. Recently, there has been a shift in the way in which healthcare is being practiced globally. New models of healthcare service provision ideally comprise patients, doctors and machines working together, with few limitations imposed either by geography, or national or institutional restrictions (Townsend, Scott and Mars 2019).

Advanced world EHR:

- Improves clinical practices through public health monitoring. Entire populations of patients can now be reported and monitored through collecting and analysing patients' data to improve clinical outcomes. The combined information allows for a broader view of the health of the country's population, analysing identified patterns, while allowing healthcare givers to compare their care with that of their peers with the aim of improving it.
- Strengthens lines of communication between health care providers and public health officials by helping to make decisions about the improved

allocation of resources. It also plays an active role in controlling and avoiding big health issues through the provision of accurate and timely data provided by health officials so as to mobilise quick responses to threatening diseases if not able to avoid their occurrence in the first place (Sundermann, *et al*. 2018).

Electronic health (e-health) has also been recognised as one of the important components in successfully implementing Universal Health Coverage (UHC) by the World Health Organization (WHO), which emphasises that without the support of e-health, UHC cannot be achieved. The World Health Assembly substantiates this when it defines e-Health as the economical and safe use of ICT to back up health and health related fields in which health care services is included (Maimela, Mutshekwane and Basu 2019).

In the USA, switching to electronic-based record-keeping has received commendable support from policymakers embracing a national, interoperable health information system as a priority, thereby leading to having more than 90% of all US hospitals adopting the system and 86% of office-based physicians adopting EHR by 2017 (Reid, *et al.* 2020).

The hybrid way of keeping records involves the use of both paper-based and electronic record keeping simultaneously. This complicates workflows, making the system more expensive and it may also affect billing because of the various locations of information. Going with this method may make the transition takes longer, as health care providers have alternatives in paper documents used as a general medium of exchange.

2.7 CONTEXT OF ELECTRONIC INTEGRATION OF PATIENTS' HEALTH INFORMATION AND RECORDS MANAGEMENT IN AFRICA

According to Miniwatts Marketing Group 2019 on Internet users' statistics for Africa, the continent had a total population of one billion, three hundred and twenty million, thirty-eight thousand, seven hundred and sixteen (1 320 038

716) people (as at mid-2019), out of which Internet users constituted four million, five hundred and fourteen thousand, four hundred (4 514 400) making about 37.3% penetration of the African population, compared to the 60.8% of the rest of the world. Internet penetration in Africa has seen growth over the years, but despite this development, building data transmission links between the continent and the rest of the world is expensive, making it difficult to achieve the transfer of data to and from Africa, either for the purpose of storing it or consultation purposes. It is saddening to know that the problem of inadequate constant electricity supply has contributed to the failure of implementing and adopting EHR successfully (Odekunle, Odenkunle and Shankar 2017). Many hospitals in Africa do not have reliable electricity supply and thereby rely on alternative power supply from generators for their work. For example, in a Nigerian Tertiary Hospital, an EHR was not used for months because of the regular power outages (Mosweu, Luthuli and Mosweu 2019). The implication of this is that there is a need for steady electricity in many parts of Africa for EHR to work out.

2.8 CONTEXT OF ELECTRONIC INTEGRATION OF PATIENTS' HEALTH INFORMATION AND RECORDS MANAGEMENT IN SOUTH AFRICA

In South Africa, strategic issues highlighted in the 2012-2017 e-health strategy were; widely differing levels of e-health, maturity across and in provinces; a large number of disparate systems that has little or no interoperability and communication; several past initiatives which have not been realised due to inadequate planning/lack of steady sponsorship; management and/or its funding; and an un-encouraging degree of co-operation, collaboration and sharing across all the sectors. However, some progress has been made in certain areas like developing: a new e-health strategy, the National Health Normative Standards Framework for interoperability, and the Health Patient Registration System, with the provision of e-health infrastructure. However, this investment has not been supported by resultant efforts to build the capacity of healthcare personnel who are the main users of the system. Such personnel not only produce data through e-health, but also use the data for making

efficient and effective decisions at a grassroots level. This will necessitate training programmes which will be designed to cover the broad concept of implementing and adopting EHR for decision-making, particularly in the clinical setting (Maimela, Mutshekwane and Basu 2019). In May 2012, Discovery Health introduced an electronic medical record, Health ID, to private sector doctors. The application is the first of its type in South Africa which allows doctors, having gained electronic consent from the patient, to access to a patient's data, with the use of a tablet computer or web interface (Reid, *et al.* 2020).

The South African Department of Health recently embraced but has not yet fully rolled out an e-health strategy which was set to include EHRs, routine health management information, vital statistics registration, consumer health informatics, health knowledge management, m-health, and virtual healthcare.

2.9 TRANSITIONING FROM PAPER-BASED TO ELECTRONIC BASED

For hospitals that have already been operating manual/paper-based records, switching to electronic based records management may require a few steps to be able to access patients' information on the new system thus allowing for continuity of care. Where paper-based systems are still being used, scanned image technology is often used for the electronic transfer of the information. The transition from paper to electronic records has the potential to provide clinicians with relevant and necessary information about their patients' occupations, as well as possibilities for links to an array of clinical decision-support tools that could improve individual health care and safety. Some of the steps involved in making paper-based records available for electronic information management may include summarising the person's health history with full details of important health information. This can be scanned alongside other results of investigations that are not changing e.g., blood group and genotype unlike Packed Cell Volume (PCV) results that change. The scanned information can then be uploaded to cloud space for possible retrieval when the need arises.

The process can begin right from when patients present for consultations. Their case notes should be marked as soon as they are scanned to avoid confusion and repetition. A dedicated, trained staff member can be stationed in the library with a scanning machine and computer system to be attending to the case notes one after the other, giving preference to those that come for consultation before others are done. This process can continue till all patients have been captured electronically.

2.10 SUMMARY OF THE CHAPTER

This chapter has dealt extensively with reviewing literature about when documentation started of the development of EHRs. It looked at factors to consider when putting EHR into action, the importance of EHR, and factors affecting its acceptance. Furthermore, this chapter analysed various sources of literature reviewed for this thesis, the global view of electronic integration of patient health information and records managements, electronic integration of patients' information and records management in an African context and also reviewing the topic in the South African context. Thereafter, the chapter discussed a transition from paper-based to electronic based record before reaching the summary of the chapter.

CHAPTER 3: THEORETICAL FRAMEWORK

3.1 INTRODUCTION

Constant technological change simultaneously creates threats to established business models, while also offering opportunities for novel service offerings. Leading firms often seek to shape the evolution of technological applications to their own advantage (Bedatrayee, Priyanka and Rashmi 2020). With the advanced and dynamic growth of technologies, how fast consumers accept these technologies depends on several factors, such as availability of technology, convenience, consumers' need, and security (Yudi, *et al*. 2020). The phenomenon of electronic hospital patient data and information management should be universal in a healthcare system where new technologies and interventions are continually introduced to improve the health of individuals and populations. This electronic way of hospital information management innovation can be studied at four distinct levels: individual healthcare professionals; healthcare professional groups; healthcare organisations; and the larger healthcare system.

Several theoretical frameworks can be used to explore the adoption of electronic innovation at each of these levels. However, it is important to select theories according to a set of attributes, such as their predictive or explicative effectiveness and their ability to provide targets for intervention. The research will be tackled with three theories which are: Technology Adoption and Technology Acceptance (Mohammad, Fully Decentralized Multi-Party Consent Management for Secure Sharing of Patient Health Records. 2020) and the Unfreeze-Move-Freeze (UMF) transformational change management. These theories were combined to produce a new framework for EHR.

3.2 STAGES OF THE THEORETICAL FRAMEWORK INVOLVED IN INNOVATION ADOPTION

The stages of the theoretical framework involved in innovation adoption are as follows:

3.2.1 Knowledge stage

This is the first stage that involves gaining knowledge about the external variables involved in the technology. This includes obtaining information regarding the environmental, organisational, and personal needs of the technology. Individuals who already know that such technology exists but lack a full understanding will be orientated by fellow colleagues who are already using it, or by peer groups. Additional information can also be assessed via the Internet or through organised conferences and seminars. Before adopting a change, it is necessary to be well informed to avert conflicts and disagreement at the persuasion stage which will determine what happens eventually at the implementation stage (Frei-Landau, Muchnik-Rozanov and Avidov-Ungar 2022).

3.2.2 Persuasion stage

This is the stage at which one's interest is being developed towards the adoption of the innovation by continuous gathering of information; that which is unspoken and that which is obvious. It is a stage of inquisitiveness as one explores the benefits the innovation will bring and discovers the necessary skills. It is important for users to be able to see this innovation as being advantageous to them (Rush 2019) (Qian and Huang 2019).

3.2.3 Decision stage

This is the point at which one chooses from available options either to adopt the innovation with the hope that it will impact one's work and make one's work much easier or when one sticks to one's old method. Important decision making is done by small groups but should also carry along other participants so that

they will feel a sense of belonging in the decision process. However, the stage is a serious stage will involve the voice of and input of many people before the final decision is adopted (Reimers, *et al.* 2020).

3.2.4 Implementation stage

It is the stage whereby the actual system is put into use. There is a test to see if what the new method offers aligns with what is expected. Basically, there is need for a body to be set up to oversee the change process. It will be in charge of seeing how the financial and mental cost of the change process can be minimised without creating unnecessary difficulty for the user. At this point, ease of use is highly important (Ober and Kochmanska 2022).

3.2.5 Confirmation stage

This is the last stage involved in the innovation adoption changeover. Appraisal is done to see if the new technology meets the standard originally set. Its success will determine how comfortable people will be with the new method and prepared to let the old method go (Qian and Huang 2019).

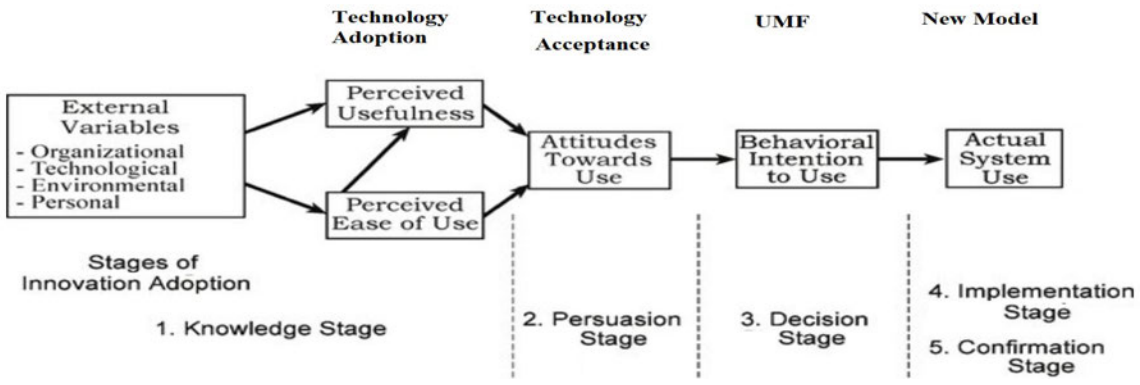


Figure 3.1: Theoretical framework depicting the connection between adoption, acceptance, and unfreeze-move-freeze transformation

3.3 APPLICATION AND INTERPRETATION OF TAM TO THE TOPIC

Using the TAM diagram, when a technology is introduced, the first stage has to do with assessment, that is assessing what is currently being used in the organisation. This includes technology, which is the probable tools and equipment environmental buildings, and personal aspects which involve evaluating health workers' knowledge of the use of EHR.

The unfreeze-move- freeze entails assessing the way the organisation's paper-based systems are being used, encouraging people to adopt the new system (move) and the final implementation of the adopted system before it is frozen back (Lai 2017) (Saghafian, Laumann and Skogstad 2021).

3.4 SUMMARY OF THE CHAPTER

Chapter 3 deals with a discussion of the theoretical framework beginning with its definition. This was followed by the theoretical framework diagram. Explanation was given on the stages involved in innovation adoption and lastly, there was explanation of the application and interpretation of the TAM model to the topic under discussion.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

This chapter discusses the design of the research process, its data collection procedure, and the methodology for gathering data; all tailored towards the achievement of the research objectives in the study.

4.2 RESEARCH DESIGN

Research design is an investigative plan with the intention of obtaining answers to research questions before commencing data collection. It sets out what data is required, how the data is collected and analysed and how it is going to provide answers for the research questions. These questions relate to qualitative, quantitative and mixed method design. This research work favours convergent parallels, mixed method research design, as shown in Figure 4.1. It is a design in which the researcher combines both the qualitative data and quantitative data to interpret it. In order to evaluate the communication model on electronic integration of hospital patients' health information and records management at tertiary hospitals, there is need to incorporate the use of both qualitative and quantitative method of data collection. This is needed in situations where either qualitative or quantitative data cannot provide sufficient results. There are basically three types of mixed methods design, namely, convergent parallel mixed methods, explanatory sequential mixed methods and exploratory sequential mixed methods. The study was guided by convergent parallel mixed methods, being a design in which qualitative and quantitative data collected at the same time were merged to provide a comprehensive analysis of the research problem (Creswell and Creswell, Research Design: Qualitative and Mixed Methods Approaches 2017). This is necessary as the results generated at the qualitative and quantitative level were joined at the point of interpretation to get more reliable and precise answers to the research questions.

4.3 RESEARCH PARADIGM

The research approach employed for the investigation carried out is shown in Figure 4.1. Here, both quantitative and qualitative data are collected and analysed, and both results are merged to provide understandings of the EHR integration to improve patient's health care.

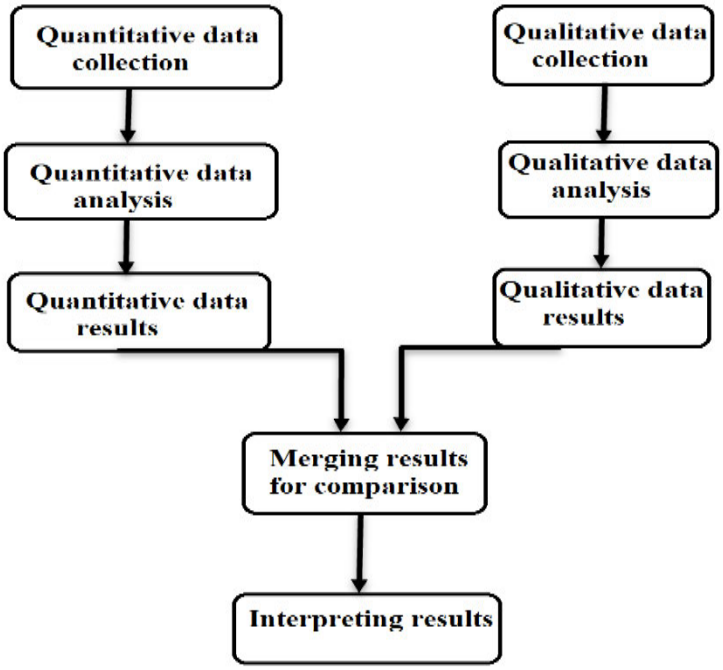
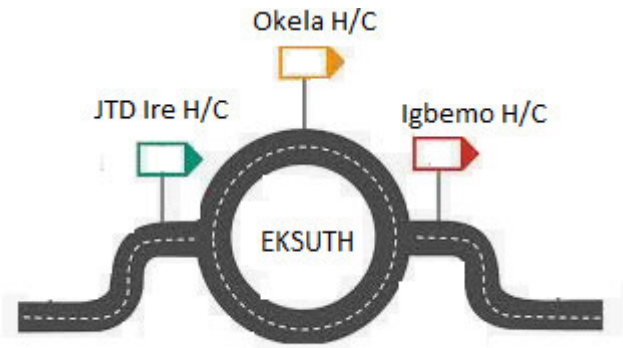


Figure 4.1: Diagram depicting the convergent parallels mixed method

4.4 SETTING

A research setting is a geographic area where the participants or group of people to be studied are located. Such a setting considers the structure, layout and organisation of the geographical area of the study (Majid 2018) (Casteel and Bridier 2021). The setting was the State-owned Teaching Hospital in Ekiti state in Nigeria, which consists of Ekiti State University Teaching Hospital (EKSUTH) main annex at Ado-Ekiti. The hospital has some outreach centres, which are: Okela Health Centre Ado-Ekiti, Joan Taiwo Daramola Memorial Hospital (JTDMH) Ire Centre and Igbemo Ekiti Health Centre. Within the main annex, there are about 18 different units where health care workers are working for each of their clinics. This excludes the other three outreach centres of the

hospital. Apart from private hospitals, the Ekiti State University Teaching Hospital is the only Tertiary Health Institution in the town; it therefore serves as a referral centre for all healthcare facilities within the state.



Source: Author designed.

Figure 4.2: Map of EKSUTH and its branches

4.5 SAMPLING PROCESS

A non-probabilistic purposive sampling method was used to analyse the characteristics of staff who are using an EMR to manage patients' health in EKSUTH. Purposive sampling is a sampling method using a snowball approach which involves referring individuals or groups of individuals who are mostly well-informed about an event, or skilled in an event of interest (Creswell and Plano Clark, Designing and Conducting Mixed Method Research 2011), (Nuryasin, *et al*. 2020). The sampling of the four hospitals in Ekiti State University Teaching Hospital (EKSUTH) in this study was achieved by using criterion sampling, which involves selecting cases that meet some predetermined criterion of importance (Crepon 2014). This method of sampling was chosen because the aim of the study is to develop a communication model of electronic integration of Hospital Patient Health Information and Records Management in tertiary hospitals. Health care team professionals play a key role in managing the patient's health. These professionals were selected to cover the clinics in the main annex of EKSUTH which guarantees that the various social, cultural, economic, and demographic characteristics of the entire staff in the hospital were captured. The main annex serves the entire state, taking referrals from all

other smaller healthcare facilities within both public and private hospitals. Each of the hospitals has a minimum GOPD, children, immunisation, and obstetric care to render across the four hospitals.

4.5.1 Sampling technique(s) and sample size

The research population for this study comprises 61 HIM Practitioners working in the main annex and 20 other healthcare providers. A total of 81 staff members was involved in the study. Members of staff (5) working in the outreach centres were exempted from the study. The staff members can be categorised into Health Information Management Officers (HIMO), Health Information Management Technicians (HIMT) in the departments and 20 other healthcare professionals. A randomly selected sample of 20 healthcare professional staff involved in the use of EMR was selected to participate in online interviews, while a total of 61 of HIM professionals also participated in the survey.

4.5.2 Inclusion criteria

- HIM professionals who had gone through basic training in Health records management.
- HIM professionals with a practicing licence.
- HIM professionals attending to patients with EMR in charge of all 18 units in the main annex.
- Health care professionals contributing to patients' care through the EMR.

4.5.3 Exclusion criteria

- Four administrative staff attached to the department were exempted from the study because they are not directly involved in attending to patients with EMR but only assist the professionals.
- HIM Professionals and other health care professionals working at the three selected outreach centres.

4.6 DATA COLLECTION PROCESS

Data collection is the methodical process of gathering and analysing specific information to proffer solutions to relevant questions and evaluate the results. It focuses on finding out all there is to a particular subject (Morgan and Harmon 2001). In this research, a mixed method approach of both questionnaire and interview was adopted and findings from these were used in the data analysis. This includes qualitative data collection (collection of data that involves numbers, or which need to be deduced through a mathematical calculation. The data can also be based on non-quantifiable elements like feelings or emotions e.g., open-ended questionnaires, semi-structured interviews). It also incorporates data that is quantitative in nature (which requires mathematical calculations to deduce certain numbers, e.g., the use of questionnaire with close-ended questions) to arrive at figures to be calculated mathematically (Creswell and Plano Clark, Designing and conducting mixed methods research electronic version 2013).

The data collection process also includes a review of organisational documents. Triangulation of the data facilitates comparison of the information collected and ensures the credibility of the study findings, and a deeper understanding of the research phenomenon (Fusch and Ness 2015)**.** Using a semi-structured interview technique facilitates the ability to diverge from predetermined questions, enabling the researcher to ask probing questions and the participant to elaborate beyond the initial response, thus, introducing information freely and rendering the collection of rich data (McIntosh and Morse 2015). Semi-structured interview techniques aid the researcher in successfully conducting the interview and contribute to the trustworthiness of the research findings (Kallio, *et al*. 2016). However, research participants may not always provide in-depth responses to the interview questions, (McIntosh and Morse 2015) and the process could result in time-consuming challenges for researchers (Kristensen and Ravn 2015).

A list of printed designed questionnaires was distributed by the researcher to the target population. Copies of the questionnaire were sent to each participant (61 HIM Professionals in charge of the 18 clinics) in their respective workplaces after which the researcher collected the completed questionnaire.

An observation checklist was also personally filled in by the researcher for each of the 18 clinics where patients were being attended to with the use of EMR. For the purpose of this study, a qualitative approach using four (4) key interview guides was adopted. After completing the interview sessions, a review of organisational documents, including EHR implementation policies and procedures to determine congruence of the data was carried out. Permission from the organisation before reviewing the documents was obtained. A member-checking validation tool to minimise bias and ensure the accurateness of the data collected was also utilised. Member-checking as a validation tool involves the researcher verifying the accuracy of the data collected with the participants.

4.7 PRE-TESTING OF THE DATA COLLECTION TOOLS

Pre-testing means running a data collection tool with a small test group before it is done for real, to assess whether the tool will yield the desired result (Hurst, *et al*. 2015). To determine the usefulness of such a measuring tool, it is necessary to run a pre-test before using it. Pretesting helps to determine the strengths and weaknesses of one survey as regards the format of the question, its wording, and its arrangement. In this study, the researcher carried out a pre-test of the questionnaire by selecting three professionals in the Federal Teaching Hospital Ido-Ekiti. These respondents were not part of the final study as it is outside the study area. Necessary adjustments were made in order to collect accurate data in the final study.

4.8 DATA ANALYSIS

This is the method of examining, purging, modifying, and modelling data in order to explore valuable information, advice, conclusions, and aid decision-making. The processes are stated below.

4.8.1 Qualitative data

A content analysis of the data collected from recorded face-to-face and semi-structured interviews of research participants using the four stages of analysis described by (Bengtsson 2016) was employed. First, a verbatim transcription of the interview recordings was made to facilitate immersion into the data. Then, the transcribed data was read to achieve familiarity and gain an understanding of the information presented by the participants. Reading through the transcribed data enables the researcher to gain a sense of the whole before identifying smaller units (Bengtsson 2016) (Gale, *et al.* 2013). It was important to gain familiarity with the interview using audio recordings, transcripts, and any other data collected; and to conduct a verbatim transcription of the audio recordings to facilitate immersion into the data. Cross-checking of the audio recordings and transcribed data for accuracy ensured the data collected adequately answered the research question. A pre-coding system matching the interview questions with the participants' responses was also carried out. Coding the data enables its classification and enables comparison of other aspects of the data set (Gale, *et al.* 2013). The data was then triangulated to ensure the credibility of the research findings. This was done by examining documents related to the EHR implementation process, such as organisational policies, procedures, and reports, as well as notes from the reflexive journal. Triangulation of the data using multiple methods to collect data can facilitate a deeper understanding of the research topic and supports the validity of the research findings (Carter, *et al*. 2014).

4.8.2 Quantitative data

Three methods of quantitative data (Total Unduplicated Reach and Frequency Analysis [TURF] analysis, Gap analysis and Text analysis) were combined to analyse the data collected. TURF is the methodology that assesses the channels, understanding and frequency with which patients communicate with doctors/health workers online or on the phone and are able to generate and have access to their basic health information without visiting the hospital. Gap analysis measures the difference between expected performance and actual performance. This analysis helps to measure the gaps in the performance of the health workers and what is required to bridge this gap. Text analysis is an advanced statistical method where intelligent tools fashion qualitative and open-ended data into easily understandable data. This method was used when the data collected was unstructured but needed to be brought into a structure that makes sense.

4.9 STATISTICAL TESTS

Appropriate statistical tests were used in analysing the questionnaire. These are:

4.9.1 Descriptive statistics

Descriptive statistics are the methods used in summarising data in a meaningful way by describing the relationship that exists between variables in a sample. For the purpose of this study, various descriptive statistics that were used include: Chi-square goodness-of-fit test, Wilcoxon signed rank test, Analysis of Variance, Mann Whitney U-test, Spearman's correlation, One Sample T-test and Independent Samples T-test.

4.9.2 Chi-square goodness-of-fit-test

This is a univariate test, used on a categorical variable to test whether any of the response options are selected significantly more/less often that the others. Under the null hypothesis, it is assumed that all responses are equally selected.

4.9.3 Wilcoxon signed ranks test

This is used in the comparison of the distribution of two variables. It is a non-parametric free test which can be used a) in place of a one-sample t-test b) in place of a paired t-test or c) for ordered categorical data where a numerical scale is inappropriate but where it is possible to rank the observations.

4.9.4 Analysis of Variance (ANOVA)

ANOVA is a test for several independent samples that compares two or more groups of cases in one variable. ANOVA is a statistical test for detecting differences in group means when there is one parametric dependent variable and one or more independent variables (Sawyer 2009).

4.9.5 Mann Whitney U test

This is a non-parametric equivalent to the independent samples t-test. It is used to test the null hypothesis that two samples come from the same population (i.e., have the same median) or, alternatively, if the observations in a sample tend to be larger than the other.

4.9.6 Spearman's correlation

Spearman's correlation is named after Charles Spearman. It is a non-parametric measure of the relation between variables using ranks to calculate the correlation. Spearman's correlations measure how ordinal variables or rank orders are related (Rebekic, *et al.* 2015).

4.9.7 One sample t-test

One sample t-test is a statistical procedure which is used for testing the mean value of a distribution, i.e., mean difference between the sample and the known value of the population mean. It is used to decide if the sample mean is different from the population mean. It tests whether a mean score is significantly different from a scalar value.

4.9.8 Independent samples t-test

This is a test used to compare the mean of two groups. Independent samples t-tests, which are usually called student's t-tests, are a test that compares two independent groups of cases.

4.10 TRUSTWORTHINESS AND RIGOUR OF THE STUDY

In this study, Lincoln and Guba's (1985, 1994) proposed criteria were used to ensure the trustworthiness and rigour of qualitative research findings, including credibility, transferability, confirmability, and dependability. Guba's (1981) model of four aspects of trustworthiness (Truth value, applicability, consistency, and neutrality) that are relevant to both quantitative and qualitative studies is very similar to the one by Lincoln and Guba (1985), except the principle of authenticity was not involved in Guba's model. The combination of the two involves: credibility, dependability, confirmability, transferability, and authenticity.

4.10.1 Credibility

Credibility is one of the most important factors in trustworthiness. It is defined as confidence in the believability of the data and its source, along with the interpretations of the findings (Shang and Luo 2021). In this study, credibility of data was obtained by prolonged engagement in collecting and analysing the data. Furthermore, variation was considered in selecting the participants, in order to access expertise information on the subject matter. Also, the supervisors checked the processes of interviewing, coding, grouping, and interpreting the findings.

4.10.2 Dependability

The dependability of a research project is the extent to which the study can be replicated and, in a situation of group research, whether all the members agree with what they see (Nyirenda, *et al*. 2020). To ensure dependability, the researcher gave data to observers who were not in the research team, but who

were familiar with the quantitative and qualitative studies to examine and confirm the data.

4.10.3 Confirmability

Confirmability is defined as neutrality in the interpretation of findings by the researcher (Nyirenda, *et al*. 2020). For confirmability, outside reviewers who were not part of the research reviewed the findings, interpretations, and conclusions of the study. Also, using suitable quotations in the findings can help confirmability (Guba and Lincoln 1994). A confirmability auditing was done to confirm the findings, interpretations and recommendations supported by data.

4.10.4 Transferability

Transferability refers to the applicability of the findings to other contexts, which is achievable through a detailed description of the context and assumptions of the study (Nyirenda, *et al*. 2020). For transferability, a clear description of the demographic characteristics of the participants and the study context was provided to enable the reader to make decisions about how to use the results. Data was collected and analysed in a way that it gave a sufficient understanding of the work to be done, comparable with other similar studies, and generalizable to the larger population. Researcher ensures that findings are true reflection of experiences and viewpoints and not just the perceptions of the researcher.

4.10.5 Authenticity

Authenticity refers to the lengths to which the researcher has been fair in showing realities. It implies that the research had been carried out and evaluated in a genuine and credible way and that it adds knowledge to the field. The process of having a perfectly consistent connection to oneself and others is what we refer to as authenticity (Dammann, *et al.* 2021). This study is novel in nature as it is intended to be a template for a communication model yet to be designed. Literatures reviews were carefully carried out to guard against plagiarism.

4.11 RIGOUR

Rigour refers to the extent to which the researcher worked to enhance the quality of the studies. In quantitative research, rigour is achieved through measurement of the validity and reliability (Hosseinnejad, *et al*. 2022). Rigour within the context of quantitative research refers to how well the research idea or project has been developed, how concise and objective the design and analytic techniques are and how meticulously the guidelines have been adhered to and applied to all decisions. When rigour in quantitative research is addressed, it appears to be largely from a medical perspective, with the concern being that experimental research and randomised controlled trials have design flaws and lack originality. It is evident that the traditional criteria of internal validity, external validity, and replicability are core to a rigorous quantitative study (Sumaya 2016).

4.11.1 RESEARCH RIGOUR

By looking at the validity and reliability of the methodologies employed for data collecting as well as its analysis, the quantitative phase of the study's research rigour was guaranteed. The study's validity and reliability allude to its dependability and focuses on the level of the work (Hosseinnejad, *et al*. 2022).

The study’s validity is concerned with the creation, choice and use of a data instrument. It also measures the extent to which a research tool gauges the questions accurately (Hosseinnejad, *et al*. 2022). In this study, the questionnaire's face, content, construct, and criterion validity were used to validate it. External validity means how far the findings of the study can be generalised, while internal validity is when a study's findings and results accurately represent the subjects being researched and there are no extraneous variables. Purposive sampling was used to choose the participants as a representative sample of the entire study population so that the findings could be generalised. In order to evaluate the questionnaire and make changes, a pre-test was carried out in a place outside the study area but with same characteristics. Face validity is when the instrument measures what it is

supposed to measure. To ensure this, the instrument was submitted to professionals for evaluation to make sure it reflected all the developed concepts. Content validity deals with assessing whether all aspects are covered in a range of meanings that are included in a concept, ensuring that all parts of the subject it aimed to measure are well covered. Construct validity is verifying relationship between variables, that is if the measurement matches the construct it wants to measure. The data collection tool was structured to obtain the required information and was developed based on the study's objectives. The researcher ensured that the tool appeared professional and uncomplicated for respondents to complete. Criterion validity deals with matching the method of measurement to the construct you want to measure. In other words, it is the extent to which a measure is related to its results. This is useful in the relation of a performance-based outcome to another situation, either in time past, currently or a future occurrence (Taherdoost 2016).

Reliability is the extent to which the measurement of a phenomenon brings a stable and a consistent result. It deals with repeatability (Taherdoost 2016). It is the accurateness and constancy of the information acquired by the study in association with the method used to measure the variables. The reliability of a study is important, but not sufficient until it is combined with an analysis of validity.

4.12 ETHICAL CONSIDERATIONS

Before the study commenced, the researcher received full ethics clearance from the Institutional Research Committee (IREC 197/21) (Appendix 1). Prior to data collection, the researcher was also granted gatekeeper permission from the HMP Department of Health Science (Appendices 2a and 2b). Participants were given letters of information, which provided the details of the study (Appendix 3a and 3b). Participants were thereafter requested to provide a written consent (Appendix 4).

Research participants need to be respected and protected against harm. There are various principles of ethics in research; this depends largely on the subject under consideration. For the purpose of this study, which involves human participants, the Belmont report produced by the National Commission in the United State was considered (Olajide 2019). These principles include the following: Respect for persons, Beneficence and Justice.

4.12.1 Respect for persons

Respect for persons refers to the ability of individuals to decide whether or not to participate in research without coercion or undue influence (Subramani and Biller-Andorno 2022). They should have the autonomy to decide whether to participate, not participate or to pull out of the research process without fear of being intimidated. This forms the basis for informed consent. This research gives respect to participants in this regard.

4.12.2 Beneficence

Beneficence is the ability of the researcher to protect the subject from physical, emotional or psychological harm through efficient management of the information and data provided by respecting the right to confidentiality and privacy, making sure that the subject is safe (Pandit 2021). The nature of the study, its importance and how it was going to be conducted was explained to the potential participants. The information about the purpose of the study, the process of data collection and analysis and how the results will be disseminated was discussed with the participants. Participants were afforded the opportunity to ask questions about the purpose of the study and the research process before they gave their written consent.

4.12.3 Justice

Justice refers to fair treatment and the right to privacy (Fleck 2021). To ensure that justice was maintained, sampling was inclusive and that those selected represented the diversity of the population. To ensure the right to privacy, data

collected was kept in a private place that could only be accessed by the researcher. Participants' details were not written in the research report; instead, codes were used.

4.13 SUMMARY OF THE CHAPTER

This chapter begins with an introduction to what research design and methodology is all about, which was followed by an explanation of the research design. The one used in this study was specifically mentioned as a mixed method design. The study was guided by convergent parallel mixed method design. A diagram of the research paradigm showing the points at which both qualitative and quantitative data meet was prepared. The setting of the case study was described and the sampling process for the study was highlighted. The sampling technique and sample size of the study was also given. Going further, a discussion of the criteria for inclusion and exclusion of samples for the study was laid out. The data collection process was explained and information on the pretesting of the data collection tool was provided. Data analysis was also discussed, highlighting the method used for analysing the qualitative and quantitative data collected and collated. Various statistical tests used in the analysis of data were outlined and discussed. Lincoln and Guba's criteria for qualitative research for trustworthiness and research rigour applied to the quantitative study were explained. Lastly, a discussion on the various ethical considerations involved in this research study was provided, and the principle of ethics as described by Belmont was mapped out.

CHAPTER 5: PRESENTATION OF RESULTS FOR QUANTITATIVE DATA

5.1 INTRODUCTION

This chapter discusses the analysis of the results from the quantitative data and also presents the findings of the results.

5.2 QUANTITATIVE RESULTS

The results from the analysis of the retrieved questionnaire are presented below.

SECTION A

5.2.1 Demographic data

Respondent 43 was removed from the study as she only gave demographical information which does not add any value to the study. A few others did not answer many more questions, but they have been retained for what they did contribute which brought the total to 60. Table 5.1 depicts the gender while Table 5.2 shows the age range of the respondents. The highest number of respondents were female (83.3%) while the number of males sat at 16.7%. Most respondents sat in the age range of 31-40 (41.7%) 30% of respondents were to be found in the age 20-30 bracket, while 25% of the respondents sat in the 41-50 age bracket and 3.3% to be found in the 51-60 age bracket with 3.3%, as depicted in Tables 5.1 and 5.2. Table 5.3 describes the length of service of the respondents, where respondents that have spent less than 10 years at work have the highest percentage of 61.7% and those who have worked for 10-20 years have 38.3%, as depicted by Table 5.3. The most senior title among respondents was Health Information Management Officer with 50%, while Health Information Management Technicians sat at is 40%. 1.7% were Doctors

1.7%, while 8.3% held other positions, as depicted in Table 5.4. Figure 5.1 depicts the combined charts of the gender and age of the respondents where it was shown that females were in the majority while the highest age range was between the ages of 31-40. Figure 5.2 shows the combined charts of the length of service and the job title of the respondents where it was shown that the highest number of respondents were those that have spent less than 10 years in service and Health Information Management Officers have the highest number of job titles.

Table 5.1: Respondents' gender by frequency and percentage

	Frequency	**Percentage**
Male	10	16.7
Female	50	83.3
Total	60	100.0

Table 5.2: Age range of the respondents

	Frequency	**Percentage**
20-30	18	30.0
31-40	25	41.7
41-50	15	25.0
51-60	2	3.3
Total	60	100.0

Table 5.3: Years of length of service of the respondents

	Frequency	**Percentage**
<10	37	61.7
10-20	23	38.3
Total	60	100.0

Table 5.4: Respondents' job title

	Frequency	Percentage
Health Information management officer	30	50.0
Health Information management technician	24	40.0
Doctor	1	1.7
Other	5	8.3
Total	60	100.0

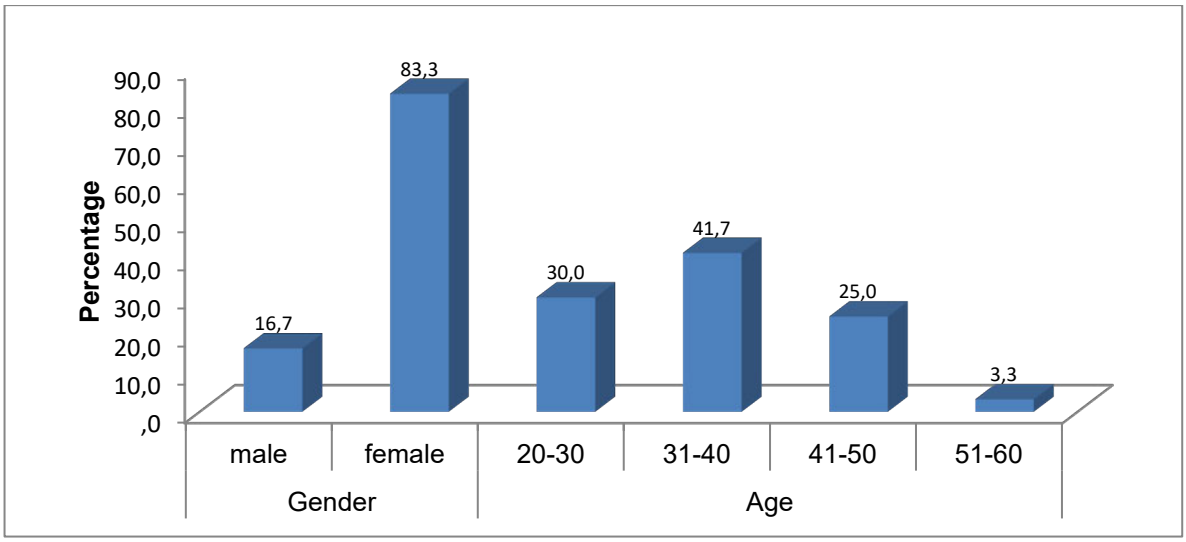


Figure 5.1: Chart of respondents' gender and age

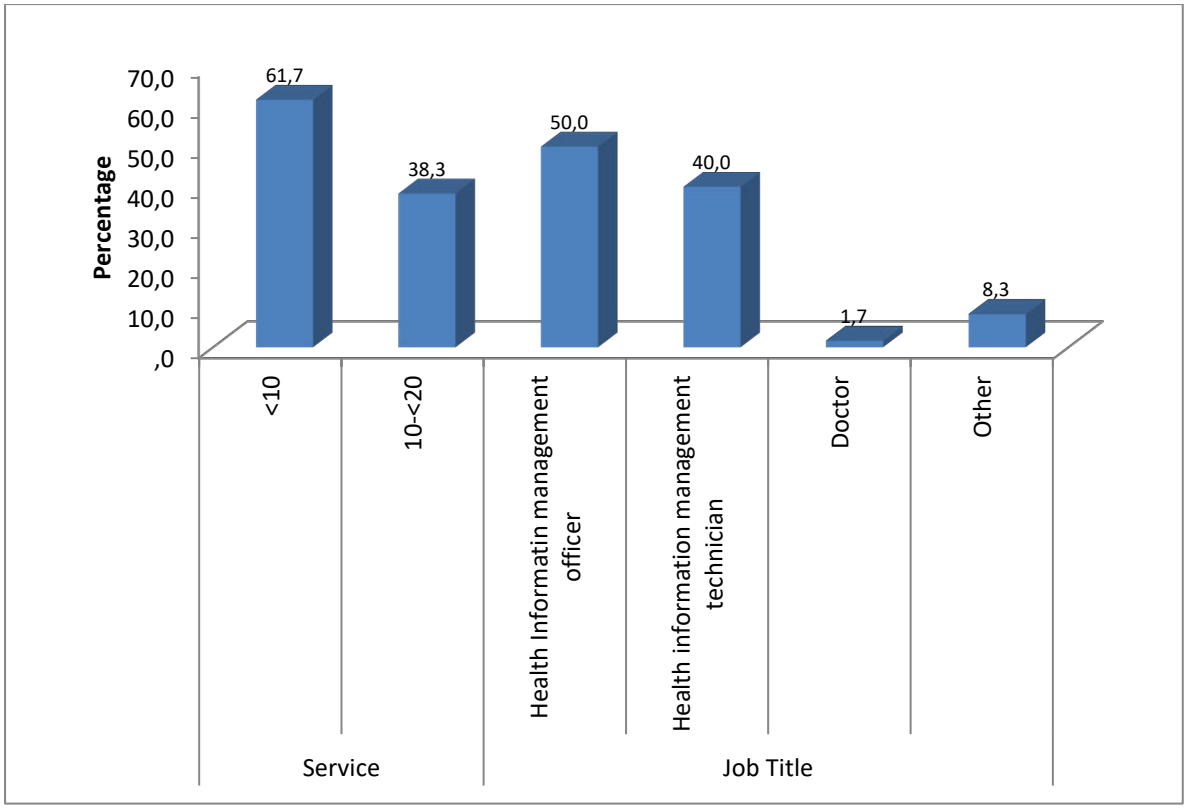


Figure 5.2: Chart of respondents' length of year in service and their job title

SECTION B

5.2.2 Electronic management of records

Respondents were asked to rate their level of efficiency (from 1 = Not at all efficient to 5 = extremely efficient) in the usage of computer/smartphone software/functions. The respondents' frequencies on skills in MS Excel were given in Table 5.5 where both Moderately Efficient and extremely efficient have the same highest percentage of 33.3%, efficient 15%, moderately not efficient 13.3% and not at all efficient with 3.3%. Table 5.6 depicts the respondents' level of skill in MS Word in frequency and percentage with extremely efficient having the highest percentage of 51.7%, moderately efficient 28%, efficient 10%, moderately not efficient 5% and not at all efficient with 3.3%. The respondents' level of skill in MS Access in frequency and percentage is provided in Table 5.7 with moderately efficient having the highest percentage of 30%, extremely efficient 26.7%, efficient 18.3%, moderately not efficient

8.35 and not all efficient 13.3%. The respondents' level of skill in email in frequency and percentage is given in Table 5.8 with extremely efficient having the highest percentage of 36.7%, moderately efficient with 31.7%, efficient 11.7%, moderately not efficient 8.3% and same percentage for not all efficient. The respondents' level of skill in WhatsApp in frequency and percentage are provided in Table 5.9 where extremely efficient has the highest percentage of 45%, while moderately efficient is 23.3%, efficient is 16.7%, moderately not efficient 5% and not at all efficient 6.7%. A one-sample t-test was applied to the results of efficiency in the usage of the computer/smartphone software/ functions and the summary is provided in Table 5.10. Since the mean deviation is greater than 3.5 in MS Excel, MS Word, Email, and WhatsApp, there is significant agreement that these skills exist. 81.6% of the respondents are efficient in the MS Excel skill, 90% are efficient in the use of MS Word, 75% are efficient in the skill usage of MS Access, 80.1% are efficient in the usage of Email and 85% are efficient in the usage of WhatsApp as depicted in Table 5.10 also. In SPSS, a p value given as .000 is very small and reported as p<.001; a p value of e.g. .017 is reported as p=.017. From Table 5.11, it is noted that efficiency in using each of these computer applications was rated significantly above the average rating of '3'. These respondents rated their efficiency highest for MS Word and lowest for MS Access. These items can be grouped according to 'communication and 'non-communication'. These groupings are tested for reliability using Cronbach's alpha. (An alpha >.7 indicates that a measure formed by combining items is reliable). They are summarised in Table 5.11. The composite variable/construct is formed by calculating the average of the items included in the construct. From Table 5.11, since the alpha across the two constructs is greater than .7, it shows that they are reliable. These composite measures were used to test if there is a significant difference in these 2 types of skill across demographic variables. No significant differences exist across gender, age, service or job title. Figure 5.3 shows the chart for respondents' efficiency levels on the computer/smartphone functions where the people that can use MS word have the highest mean deviation with 4.22 followed by people that can make use of it for WhatsApp with 3.98. The lowest were those that can use MS Access with a mean deviation of 3.5.

Table 5.5: Respondents' level of skill in MS Excel in frequency and percentage

	Frequency	Percent
1 Valid Not at all efficient	2	3.3
2 Moderately not efficient	8	13.3
3 Efficient	9	15.0
4 Moderately efficient	20	33.3
5 Extremely efficient	20	33.3
Missing System	1	1.7
Total	60	100.0

Table 5.6: Respondents' level of skill in MS Word in frequency and percentage

	Frequency	Percentage
Valid Not at all efficient	2	3.3
2	3	5.0
3	6	10.0
4	17	28.3
Extremely efficient	31	51.7
Missing System	1	1.7
Total	60	100.0

Table 5.7: Respondents' level of skill in MS Access in frequency and percentage

	Frequency	Percentage
Valid Not at all efficient	8	13.3
2	5	8.3
3	11	18.3
4	18	30.0
Extremely efficient	16	26.7
Missing System	2	3.3
Total	60	100.0

Table 5.8: Respondents' level of skill in email in frequency and percentage

	Frequency	Percentage
Valid Not at all efficient	5	8.3
2	5	8.3
3	7	11.7
4	19	31.7
Extremely efficient	22	36.7
Missing System	2	3.3
Total	60	100.0

Table 5.9: Respondents' level of skill in WhatsApp in frequency and percentage

	Frequency	Percentage
Valid Not at all efficient	4	6.7
2	3	5.0
3	10	16.7
4	14	23.3
Extremely efficient	27	45.0
Missing System	2	3.3
Total	60	100.0

Table 5.10: Respondents' level of efficiency in computer/smartphone software/functions after applying t-test

Item	Responses as frequency (%)					n	Mean (SD)	t	df	p-value
	Not at efficient 1	2	3	4	Extremely efficient 5					
MS Excel	2 (3.3)	8 (13.3)	9 (15.0)	20 (33.3)	20 (33.3)	59	3.81 (1.152)	5.425	58	<.001*
MS Word	2 (3.3)	3 (5.0)	6 (10.0)	17 (28.3)	31 (51.7)	59	4.22 (1.052)	8.914	58	<.001*
MS Access	8 (13.3)	5 (8.3)	11 (18.3)	18 (30.0)	16 (26.7)	58	3.50 (1.354)	2.812	57	.007*
Email	5 (8.3)	5 (8.3)	7 (11.7)	19 (31.7)	22 (36.7)	58	3.83 (1.272)	4.954	57	<.001*
WhatsApp	4 (6.7)	3 (5.0)	10 (16.7)	14 (23.3)	27 (45.0)	58	3.98 (1.221)	6.130	57	<.001*

* indicates significant at the 95% level

Table 5.11: Summary of the construct for reliability using Cronbach's Alpha

Construct	Label	Items included	Cronbach's alpha (Reliability)
MS applications	MSApp	5.1 – 5.3	.812
Communication	COMM	5.4- 5.5	.902

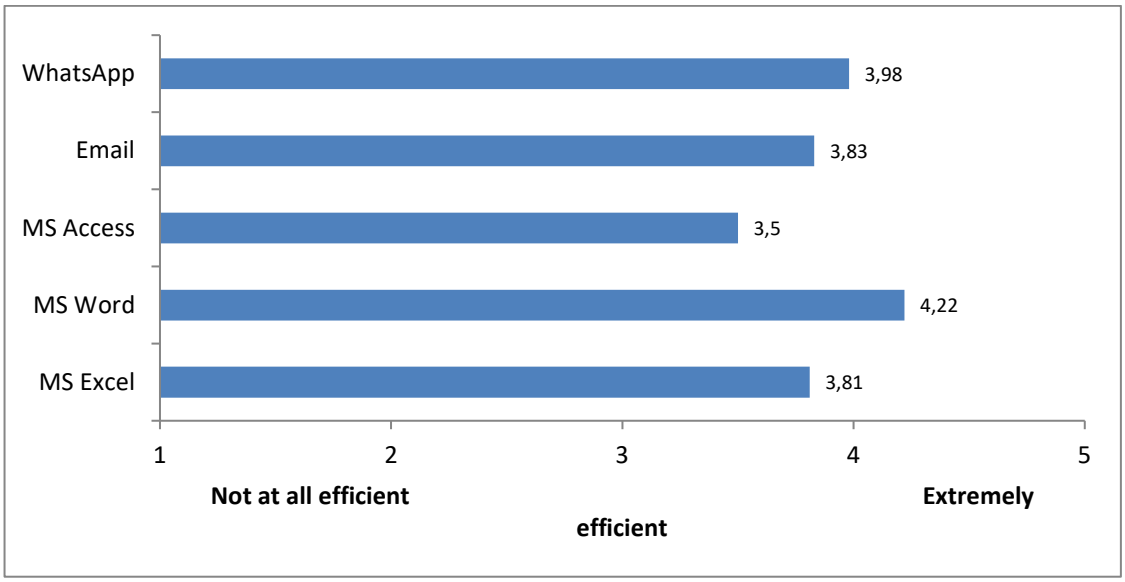


Figure 5.3: Chart of respondents' efficiency level on the computer/smartphone functions

5.2.3 Environmental support

Respondents were asked to indicate their level of agreement (from 1= strongly disagree to 6= strongly agree) that specific aspects of environmental support exist for effective usage of ICT. The same sort of analysis is done for this section – this time the average agreement score is tested against the central score of 3.5.

If significant, interpret as significant agreement if mean >3.5 and significant disagreement if mean <3.5. The respondents' frequencies on availability of reliable Internet as environmental support were given in Table 5.12 where agree has the highest percentage of 43.3%, strongly agree 38.3%, slightly disagree 11.7%, disagree 3.3% and same percentage were for those that chose strongly disagree. Table 5.13 depicts opinion on reliable power supply as environmental support, where strongly agree has the highest percentage of 46.7%, 40% had agree, 5% for slightly agree 1.7% for slightly disagree and 3.3% for strongly disagree. As depicted in Table 5.14, the highest percentage of 70% agree that there is availability of technical support at all stages for ICT usage, 18.3% strongly agree, 5% slightly agree and 1.7% strongly disagree. Table 5.15 shows the opinion on the availability of sufficient and reliable computers for ICT usage where agree has the highest percentage of 36.7%, strongly agree 35%, slightly agree 21.7% and strongly disagree with 5%. From Table 5.16 which shows the opinion of respondents on availability of backup power e.g. solar/inverter/generator for ICT usage, it was seen that the highest percentage were those that strongly agree having 53.3%, 38.3% agree, 5% slightly agree and 1.7% strongly disagree. Table 5.17 shows the summary opinion of the respondents on environmental support. Across all, there is significant agreement that all these environmental aspects exist to support the use of ICT since mean is greater than 3.5. 56% agree to reliable Internet connection while 4% disagree. 55% agree to reliable power supply while 3% disagree. 56% agree to availability of technical support at all stages while 1% disagree. 56% agree to sufficient and reliable computers while 3% disagree and 58% agree to back-up power e.g solar/inverter/generator while 1% disagree. From Figure 5.4 which shows the chart for the mean deviation of the agreement level of the respondents on availability of environmental support for ICT usage, the highest mean deviation was availability of back-up power e.g. solar/inverter/generator with 5.46 while the lowest was for sufficient and reliable computers with 4.93.

In order to get a single composite measure for this construct which is reliable, MS Access and WhatsApp were dropped in order to attain a reliable composite score. A reliable (alpha=.864) composite measure for environmental support was found by averaging agreement scores for items MS Excel, MS Word and Email. This variable (EnvSupp) is analysed for significant agreement/disagreement as well as for differences across demographics. From table 5.18, since mean is >3.5, we say that there is significant agreement that environmental support exists for the effective use of ICT. No significant differences were found across demographics.

Table 5.12: Respondents' opinion on availability of reliable Internet as part of environmental support for ICT usage

	Frequency	Percentage
Valid Strongly disagree	2	3.3
Disagree	2	3.3
Slightly disagree	7	11.7
Agree	26	43.3
Strongly agree	23	38.3
Total	60	100.0

Table 5.13: Respondents' opinion on availability of reliable power supply as environmental support for ICT usage

	Frequency	Percentage
Valid Strongly disagree	2	3.3
Slightly disagree	1	1.7
Slightly agree	3	5.0
Agree	24	40.0
Strongly agree	28	46.7
Total	58	96.7
Missing system	2	3.3
Total	60	100.0

Table 5.14: Respondents' opinion on the availability of technical support at all stages for ICT usage

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Slightly agree	3	5.0
Agree	42	70.0
Strongly agree	11	18.3
Missing system	3	5.0
Total	60	100.0

Table 5.15: Respondents' opinion on the availability of sufficient and reliable computers for ICT usage

	Frequency	Percentage
Valid Strongly disagree	3	5.0
Slightly agree	13	21.7
Agree	22	36.7
Strongly agree	21	35.0
Missing system	1	1.7
Total	60	100.0

Table 5.16: Respondents' opinion on the availability of backup power

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Slightly agree	3	5.0
Agree	23	38.3
Strongly agree	32	53.3
Missing system	1	1.7
Total	60	100.0

Table 5.17: Summary for the respondents' opinion on the environmental support for ICT usage

Item	Responses as frequencies (%)						n	Mean (SD)	t	df	P-value
	Strongly disagree	Disagree	Slightly	Slightly agree	Agree	Strongly agree					
Reliable Internet connection	2	2	-	7	26	23	60	5.03	10.204	59	<.001*
Reliable power supply	2	-	1	3	24	28	58	5.26	12.727	57	<.001*
Availability of technical support at all stages	1	-	-	3	42	11	57	5.07	16.273	56	<.001*
Sufficient & reliable computers	3	-	-	13	22	21	59	4.93	9.267	58	<.001*
Back-up power e.g. solar/ inverter/ generator	1	-	-	3	23	32	59	5.46	22.186	58	<.001*

* indicates significance at the 95% level

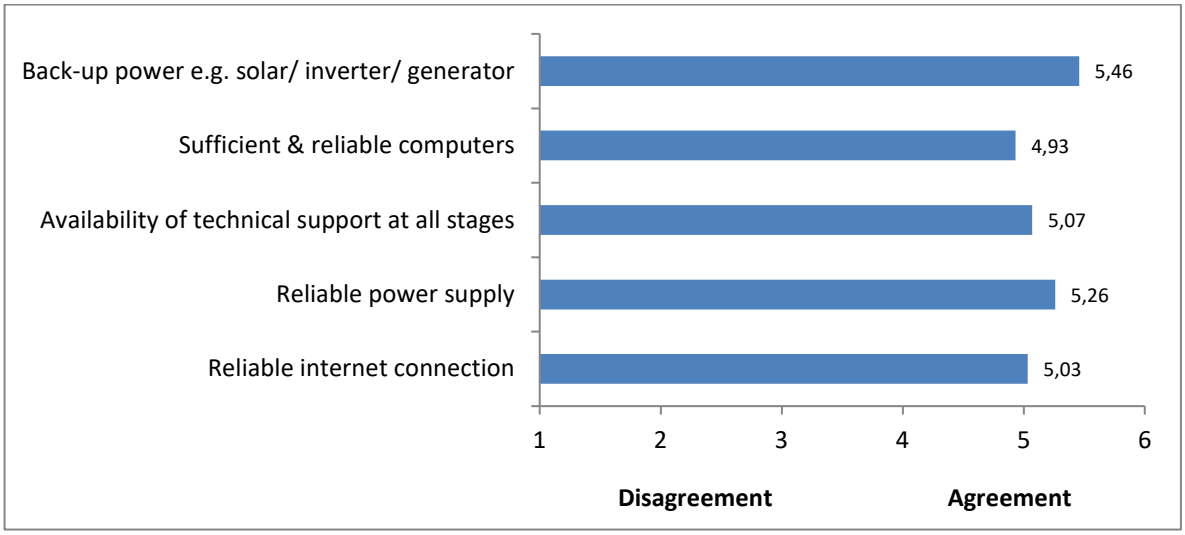


Figure 5.4: Chart for the mean deviation of the agreement level of the respondents on availability of environmental support for ICT usage

Table 5.18: Composite summary for environmental support

Construct	N	Mean (SD)	t	df	p-value
Environmental Support	60	5.07 (0.999)	12.188	59	<.001*

5.2.4 Attitudes to Moving to Electronic Record Keeping

Respondents were asked to indicate their level of agreement (from 1= strongly disagree to 6= strongly agree) that moving to electronic record keeping is a good development. As depicted in Table 5.19, 56.7% being the highest percentage strongly agree that moving to electronic record keeping is a good development, 26.7% agree, 3.3% slightly disagree and 5% strongly disagree. From Table 5.20, there is significant agreement that moving to EHR is a good development since the mean is >3.5. Then no significant differences were found across demographics.

Table 5.19: Respondents' opinion on moving to electronic record keeping

	Frequency	**Percentage**
Valid Strongly disagree	3	5.0
Slightly disagree	2	3.3
Agree	16	26.7
Strongly agree	34	56.7
Missing system	5	8.3
Total	60	100.0

Table 5.20: Summary for the respondents' opinion after applying one sample text

	n	Mean (SD)	t	df	P-value
Moving to electronic record keeping	55	5.33	10.858	54	.<.001

5.2.5 Modes of attending to patients electronically

Respondents were asked to indicate their mode of attending to patients, ranging from never to nearly always. As depicted in Table 5.21, 50% being the highest percentage said they often attend to patients through physical contact, 43.3% always/nearly always, 3.3% sometimes and 1.7% never attend to patients through physical contact. From Table 5.22, the highest percentage 48.3% said they sometimes attend to patients through telephones, 11.7% said they always/nearly always, 6.7% often, 15% rarely and the same percentage never attend to patients through telephones. From Table 5.23, the highest percentage of 53.3% said they never attend to patients through voice mails, 16.7% said rarely, 6.7% sometimes and 10% often attend to patients through voice mails. From Table 5.24, the highest percentage of 50% said they never attend to patients through emails, 16.7% said rarely, 6.7% sometimes, 11.7% often attend to patients through emails. 46.7% said they never, 16.7% rarely, 8.3% sometimes, 13.3% often and 5% always/nearly always attend to patients through Online/WhatsApp chatting/Zoom as depicted in Table 5.25. Table 5.26 shows that the highest percentage of 30% never, 25% rarely, 23.3% sometimes, 8.3% often and 3.3% always/nearly always attend to patients through letter.

Chi-square goodness-of-fit test was applied to test whether any response option is selected significantly more than others, As shown in Table 5.27, the minimum expected frequency for physical contact is 14.8, for telephone it is 11.6 as depicted in Table 5.28, for voice mails it is 13.0 as shown in Table 5.29,

for emails it is 12.8 as shown in Table 5.30, for online chatting/WhatsApp/Zoom it is 10.8 as shown in Table 5.31, for letters it is also 10.8 as shown in Table 5.32.

Test statistics was thereafter applied to it, the result is shown in Table 5.33. From Table 5.34, a significant 93.3% 'often' or 'always' communicate with patients face-to-face which forms the highest percentage. 18.4% uses telephone often or always while 10% use voice mail which is the lowest percentage. 48.3% sometimes use telephone, 53.3% never use voice mail, 50% never use email, 46.7% never use Online/WhatsApp chatting/Zoom and 78.3 'never' or 'rarely' or 'sometimes' uses letters to communicate with patients. No significant differences are found across gender or job title.

Spearman's correlation was applied to determine if there is a significant correlation between the frequency of these methods of communication and age or service. Results show that there is a moderate positive correlation between age and communicating via letters, rho = .464, p<.001. There is a moderate negative correlation between age and communicating via physical contact, rho = -.310, p=.017. Service is negatively correlated with communicating face-to-face, rho = -.259, p=.047; while it is positively correlated with communicating via voice mails (rho = .330, p=.017) and letter (rho = .402, p=.003).

Table 5.21: Respondents' opinion on attending to patients through physical contact

		Frequency	**Percentage**
Valid	Never	1	1.7
	Sometimes	2	3.3
	Often	30	50.0
	Always/Nearly always	26	43.3
Missing system		1	1.7
	Total	60	100.0

Table 5.22: Respondents' opinion on attending to patients through telephones

		Frequency	Percentage
Valid	Never	9	15.0
	Rarely	9	15.0
	Sometimes	29	48.3
	Often	4	6.7
	Always/Nearly always	7	11.7
	Missing system	2	3.3
	Total	60	100.0

Table 5.23: Respondents' opinion on attending to patients through voice mails

		Frequency	Percentage
Valid	Never	32	53.3
	Rarely	10	16.7
	Sometimes	4	6.7
	Often	6	10.0
Missing system		8	13.3
	Total	60	100.0

Table 5.24: Respondents' opinion on attending to patients through emails

		Frequency	Percentage
Valid	Never	30	50.0
	Rarely	10	16.7
	Sometimes	4	6.7
	Often	7	11.7
Missing system		9	15.0
	Total	60	100.0

Table 5.25: Respondents' opinion on attending to patients through Online/WhatsApp chatting/Zoom

	Frequency	Percentage
Never	28	46.7
Rarely	10	16.7
Sometimes	5	8.3
Often	8	13.3
Always/Nearly always	3	5.0
Missing system	6	10.0
Total	60	100.0

Table 5.26: Respondents' opinion on attending to patients through letters

	Frequency	Percentage
Never	18	30.0
Rarely	15	25.0
Sometimes	14	23.3
Often	5	8.3
Always/Nearly always	2	3.3
Missing system	6	10.0
Total	60	100.0

Table 5.27: Chi-square result for physical contact

	Observed N	Expected N	Residual
Never	1	14.8	-13.8
Sometimes	2	14.8	-12.8
Often	30	14.8	15.3
Always/ Nearly always	26	14.8	11.3
Total	59		

Table 5.28: Chi-square result for telephone

	Observed N	Expected N	Residual
Never	9	11.6	-2.6
Rarely	9	11.6	-2.6
Sometimes	29	11.6	17.4
Often	4	11.6	-7.6
Always/Nearly always	7	11.6	-4.6
Total	58		

Table 5.29: Chi-square result for voice mails

	Observed N	Expected N	Residual
Never	32	13.0	19.0
Rarely	10	13.0	-3.0
Sometimes	4	13.0	-9.0
Often	6	13.0	-7.0
Total	52		

Table 5.30: Chi- square result for emails

	Observed N	Expected N	Residual
Never	30	12.8	17.3
Rarely	10	12.8	-2.8
Sometimes	4	12.8	-8.8
Often	7	12.8	-5.8
Total	51		

Table 5.31: Chi-square result for Online/WhatsApp chatting/Zoom

	Observed N	Expected N	Residual
Never	28	10.8	17.2
Rarely	10	10.8	-.8
Sometimes	5	10.8	-5.8
Often	8	10.8	-2.8
Always/ Nearly always	3	10.8	-7.8
Total	54		

Table 5.32: Chi-square result for letters

	Observed N	Expected N	Residual
Never	18	10.8	7.2
Rarely	15	10.8	4.2
Sometimes	14	10.8	3.2
Often	5	10.8	-5.8
Always/ Nearly always	2	10.8	-8.8
Total	54		

Table 5.33: Result of test statistics applied on the mode of attending to patients

	8.1 Physical contact	8.2 Telephone	8.3 Voice mails	8.4 Emails	8.5 Online/WhatsApp chatting/Zoom	8.6 Letter
Chi-Square	48.186[a]	34.069[b]	38.462[c]	32.529[d]	36.926[e]	17.667[e]
Df	3	4	3	3	4	4
Asymp. Sig.	.000	.000	.000	.000	.000	.001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected frequency is 14.8.
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected frequency is 11.6.
c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected frequency is 13.0.
d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected frequency is 12.8.
e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected frequency is 10.8.

Table 5.34: Summary for mode of attending to patients with application of test statistics

Item	**Responses as frequencies (%)**					**X^2**	**df**	**p-value**
	Never	Rarely	Sometimes	Often	Always/ Nearly always			
Physical contact	1 (1.7)	-	2 (3.3)	***30 (50.0)***	***26 (43.3)***	48.186	3	<.001*
Telephone	9 (15.0)	9 (15.0)	29(48.3)	4 (6.7)	7 (11.7)	34.069	4	<.001*
Voice mails	32 (53.3)	10 (16.7)	4 (6.7)	6 (10.0)	-	38.462	3	<.001*
Emails	30 (50.0)	10 (16.7)	4 (6.7)	7 (11.7)	-	32.529	3	<.001*
Online/WhatsApp chatting/Zoom	28 (46.7)	10 (16.7)	5 (8.3)	8 (13.3)	3 (5.0)	36.926	4	<.001*
Letter	18 (30.0)	15 (25.0)	14 (23.3)	5 (8.3)	2 (3.3)	17.667	4	.001*

* indicates significance at the 95% level.

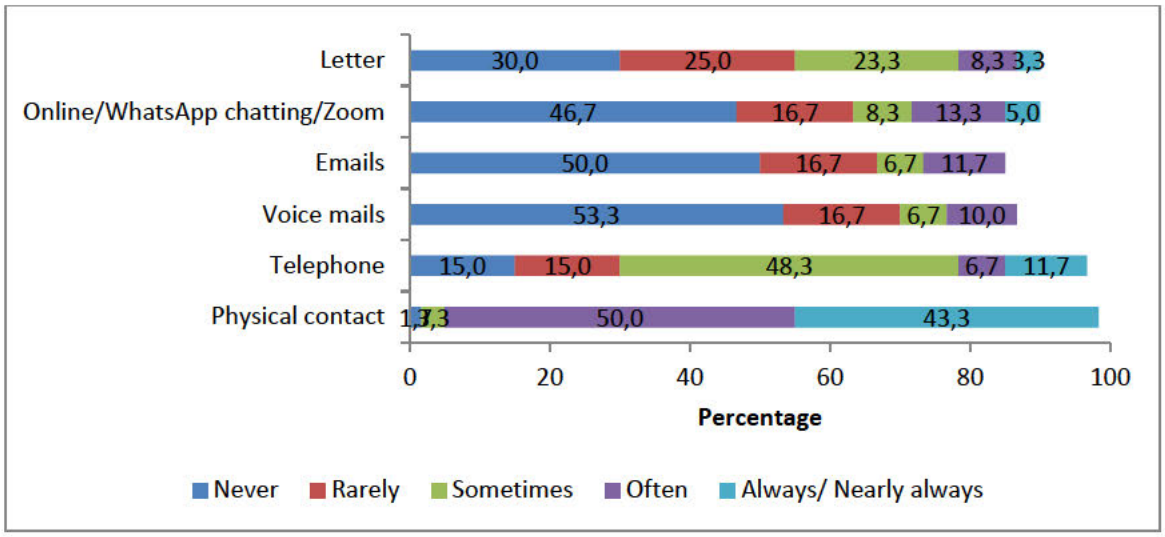


Figure 5.5: Chart for the percentage of respondents' opinion on mode of communication with patients

5.2.6 Benefits

Respondents were asked to indicate their agreement level on the benefit of Electronic Record keeping. From Table 5.35, 50% (which is the highest percentage) agree that integrating patients' records into an electronic system will reduce patients' waiting time, 36.7% strongly agree, 3.3% slightly agree and same percentage is for disagree and strongly disagree. From Table 5.36, the highest percentage (50%) strongly agree, 36.7% agree, 55 slightly agree, 1.7% slightly disagree and the same strongly agree that integrating patients' records into an electronic system will reduce medical errors e.g., wrong diagnosis, medication errors etc. Table 5.37 discusses a suggested longer time span for storage of patients' information as a benefit of integrating patients records into an electronic system, where 50% (being the highest percentage) strongly agree, 36.7% agree, 3.3% slightly agree and the same percentage slightly disagree, while 1.7% strongly disagree with the notion. Table 5.38 discusses enabling the quick and easy accessing of past medical records, thus ensuring prompt continuity of care as a benefit of integrating patients' records into an electronic system where 56.7% strongly agree, 33.3% agree, 3.3% slightly agree, 1.7% disagree and same percentage strongly disagree with this. As depicted in Table 5.39, while 43.3% strongly agree, 31.7% agree, 8.3% slightly

agree, 1.7% slightly disagree, 6.7% disagree and 3.3% strongly disagree that there is easy accessibility of patients' information from anywhere as a benefit of electronic integration of patients' records. 56.7% agree, 33.3% strongly agree, 5% slightly agree and 1.7% strongly disagree that there is easy accessibility to healthcare at any location due to accessibility of medical records as a benefit of integrating patients' records into electronic system as depicted in Table 5.40. From Table 5.41, 41.7% strongly agree, 40% agree, 10% slightly agree, 3.3% disagree and 1.7% strongly disagree that there are more efficient and faster ward rounds as a benefit of integrating patients' records into an electronic system. 46.7% agree, 43.3% strongly agree, 5.0% slightly agree, 1.7% slightly disagree and the same percentage strongly disagree that integrating patients' records into an electronic system will reduce staff workload as depicted in Table 5.42. 50% strongly agree, 35% agree. 3.3% slightly agree, 1.7% slightly agree, the same percentage disagree, while 3.3% strongly disagree that a reduction in the number of duplicated diagnostic tests ordered is a benefit of electronic integration of patients' records as depicted in Table 5.43. In Table 5.44, 43.3% strongly agree and same percentage agree, 5% slightly agree, 3.3% disagree and 1.7% strongly disagree that integrating patients' records into an electronic system will reduce loss of patients' information. It was depicted in Table 5.45 that 45% strongly agree and the same percentage agree, while the same 1.7% slightly agree, slightly disagree, disagree and strongly disagree that shareable patients' information across disciplines and specialties for quick decision-making is a benefit of electronic integration of patients' records.

From Table 5.46, the highest percentage of 51.7% agree, 25% strongly agree, 10% slightly agree, 8.3% slightly disagree and 1.7% strongly disagree that integration of patients' records into an electronic system will cause increased revenue and prompt claims reimbursement. Table 5.47 depicts the result of one sample statistic applied to the benefit, which was noted across each of the benefits as the mean deviation. From Table 5.48, the 12 items combine into a reliable (alpha = .946) composite measure for 'benefits. Analysis shows that there is significant agreement that integrating patients' records into an

electronic system will be beneficial. Since mean is greater than .3.5 as shown in Table 5.49, we say there is significant agreement that the benefit of electronic integration of records exists. There is no significant difference in BEN across demographics. Figure 5.6 shows the chart for the benefits of electronic integration using their mean where enabling the quick and easy access of past medical records has the highest mean of 5.43 and increased revenue and prompt claims reimbursement has the lowest mean of 4.91.

Table 5.35: Respondents' opinion on reduction in patients' waiting time as a benefit of integrating patients' records into electronic system

	Frequency	**Percentage**
Strongly disagree	2	3.3
Disagree	2	3.3
Slightly agree	2	3.3
Agree	30	50.0
Strongly agree	22	36.7
Missing system	2	3.3
Total	60	100.0

Table 5.36: Respondents' opinion on reduction in medical errors e.g., wrong diagnosis, medication errors etc. as a benefit of integrating patients' records into an electronic system

	Frequency	**Percentage**
Valid Strongly disagree	1	1.7
Slightly disagree	1	1.7
Slightly agree	3	5.0
Agree	22	36.7
Strongly agree	30	50.0
Missing system	3	5.0
Total	60	100.0

Table 5.37: Respondents' opinion on a longer time span for storage of patients' information as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Slightly disagree	2	3.3
Slightly agree	2	3.3
Agree	22	36.7
Strongly agree	30	50.0
Missing system	3	5.0
Total	60	100.0

Table 5.38: Respondents' opinion on enabling quick and easy access of past medical records thus ensuring prompt continuity of care as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Disagree	1	1.7
Slightly agree	2	3.3
Agree	20	33.3
Strongly agree	34	56.7
Missing system	2	3.3
Total	60	100.0

Table 5.39: Respondents' opinion on easy accessibility of patients' information from anywhere as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	2	3.3
Disagree	4	6.7
Slightly disagree	1	1.7
Slightly agree	5	8.3
Agree	19	31.7
Strongly agree	26	43.3
Missing system	3	5.0
Total	60	100.0

Table 5.40: Respondents' opinion on easy access to health care at any location due to the accessibility of medical records as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Slightly agree	3	5.0
Agree	34	56.7
Strongly agree	20	33.3
Missing System	2	3.3
Total	60	100.0

Table 5.41: Respondents' opinion on more efficient and faster ward rounds as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Disagree	2	3.3
Slightly agree	6	10.0
Agree	24	40.0
Strongly agree	25	41.7
Missing system	2	3.3
Total	60	100.0

Table 5.42: Respondents' opinion on reduction in staff workload as a benefit of integrating patients' records into an electronic system

	Frequency	**Percentage**
Valid Strongly disagree	1	1.7
Slightly Disagree	1	1.7
Slightly agree	3	5.0
Agree	28	46.7
Strongly agree	26	43.3
Missing system	1	1.7
Total	60	100.0

Table 5.43: Respondents' opinion on a reduction in number of duplicate diagnostic tests ordered as a benefit of integrating patients' records into an electronic system

	Frequency	**Percentage**
Valid Strongly disagree	2	3.3
Disagree	1	1.7
Slightly disagree	1	1.7
Slightly agree	2	3.3
Agree	21	35.0
Strongly agree	30	50.0
Missing system	3	5.0
Total	60	100.0

Table 5.44: Respondents' opinion on a reduction in loss of patients' information as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Disagree	2	3.3
Slightly agree	3	5.0
Agree	26	43.3
Strongly agree	26	43.3
Missing system	2	3.3
Total	60	100.0

Table 5.45: Respondents' opinion on shareable patients' information across disciplines & specialties for quick decision making as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Disagree	1	1.7
Slightly disagree	1	1.7
Slightly agree	1	1.7
Agree	27	45.0
Strongly agree	27	45.0
Missing system	2	3.3
Total	60	100.0

Table 5.46: Respondents' opinion on increased revenue and prompt claims reimbursement as a benefit of integrating patients' records into an electronic system

	Frequency	Percentage
Valid Strongly disagree	1	1.7
Slightly disagree	5	8.3
Slightly agree	6	10.0
Agree	31	51.7
Strongly agree	15	25.0
Missing system	2	3.3
Total	60	100.0

Table 5.47: Results of one sample statistic applied to the benefits of integrating patients' records into an electronic system

Benefits	N	Mean	Std. Deviation	Std. error mean
9.1 Patients' waiting time will be reduced	58	5.10	1.135	.149
9.2 Reduction in medical errors e.g. wrong diagnosis, medication errors etc.	57	5.37	.899	.119
9.3 Longer time span record of patients' information can be stored	57	5.35	.935	.124
9.4 Enable quick and easy access to past medical records thus ensuring prompt continuity of care	58	5.43	.939	.123
9.5 Patients' information is easily accessible from anywhere	57	4.98	1.356	.180
9.6 Access to health care at any location since medical records would be easily accessible	58	5.22	.796	.104
9.7 More efficient/faster ward rounds	58	5.16	1.056	.139
9.8 Reduction in staff workload	59	5.29	.872	.114
9.9 Reduction in number of duplicate diagnostic tests ordered	57	5.26	1.142	.151
9.10 Reduction in loss of patients' information	58	5.22	1.027	.135
9.11 Information can be shared across disciplines & specialties for quick decision-making.	58	5.29	.955	.125
9.12 Increased revenue and prompt claims reimbursement.	58	4.91	.996	.131

Table 5.48: Result of one sample test on the benefits

	Test value=3.5					
					95% Confidence interval of the difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
9.1 Patients' waiting time will be reduced	10.763	57	.000	1.603	1.31	1.90
9.2 Reduction in medical errors e.g. wrong diagnosis, medication errors etc.	15.690	56	.000	1.868	1.63	2.11
9.3 Longer time span record of patients' information can be stored	14.941	56	.000	1.851	1.60	2.10
9.4 Enable quick and easy access to past medical records thus ensuring prompt continuity of care	15.667	57	.000	1.931	1.68	2.18
9.5 Patients' information is easily accessible from anywhere	8.253	56	.000	1.482	1.12	1.84
9.6 Access to health care at any location since medical records would be easily accessible	16.503	57	.000	1.724	1.51	1.93
9.7 More efficient/faster ward rounds	11.933	57	.000	1.655	1.38	1.93
9.8 Reduction in staff workload	15.751	58	.000	1.788	1.56	2.02
9.9 Reduction in number of duplicate diagnostic tests ordered	11.655	56	.000	1.763	1.46	2.07
9.10 Reduction in loss of patients' information	12.789	57	.000	1.724	1.45	1.99
9.11 Information can be shared across disciplines & specialties for quick decision-making.	14.295	57	.000	1.793	1.54	2.04
9.12 Increased revenue and prompt claims reimbursement.	10.808	57	.000	1.414	1.15	1.68

Table 5.49: Summary of one sample statistic to the benefits

	N	Mean	Std. Deviation	Std. Error Mean
BEN	59	5.2109	.79306	.10325

Table 5.50: Summary of one sample test at 3.5 value to the benefit

	Test Value=3.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence interval of the Difference	
					Lower	Upper
BEN	16.571	58	.000	1.71094	1.5043	1.9176

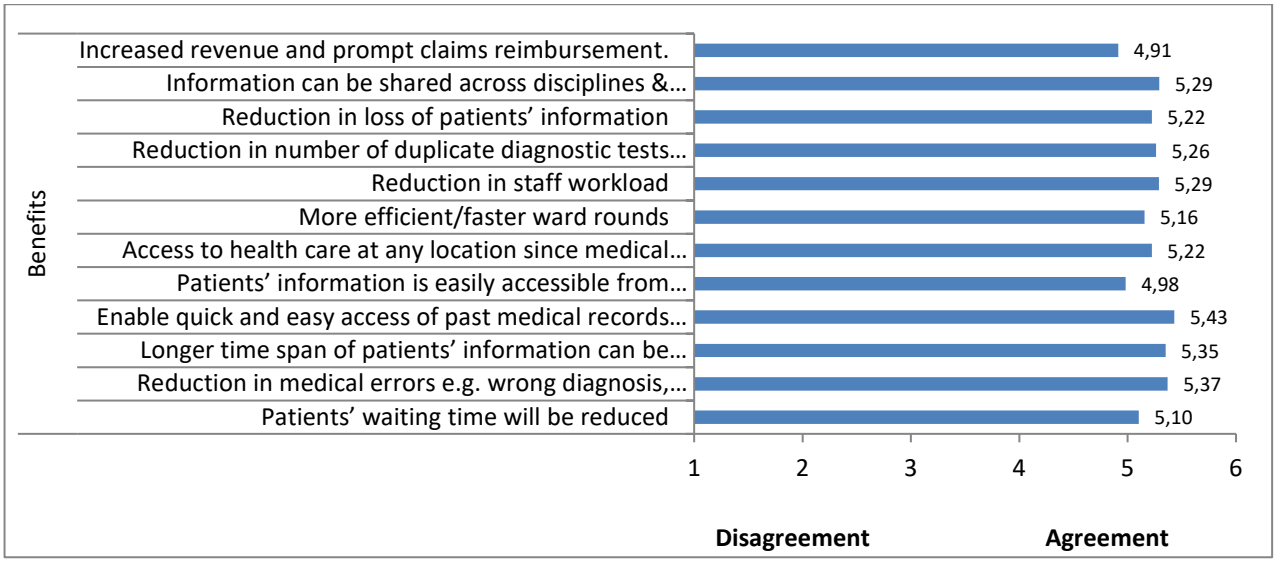


Figure 5.6: Charts for the respondents' opinion on benefits of electronic integration using the mean

5.2.7 Barriers to electronic integration of patients' health information and records management

Respondents were asked to indicate their level of agreement (from 1= strongly disagree to 6= strongly agree) that the following could be barriers to electronic integration of patients' health information and record management. It can be depicted from Table 5.51 that the highest percentage of 31.7% agree, same 21.7% strongly agree and agree, 10% slightly disagree, 11.75 disagree and 1.7% strongly disagree that staff shortages are a barrier to electronic integration of patients' health information and records management. Table 5.52 showed that highest percentage of 28.3% agree, 25% strongly agree, 11.7% slightly agree, 13.3% slightly disagree, 16.75 disagree and 1.7% strongly disagree that large numbers of patients is a barrier. The highest percentage of 48.3% agree while 13.3% strongly agree, 8.3% slightly agree, 5% slightly disagree, 21.7% disagree and 1.7% strongly disagree that lack of ICT navigation skills among staff is a barrier as depicted in Table 5.53. Table 5.54 shows that the same highest percentage of 26.7% both agree and disagree while 13.3% strongly agree, 21.7% slightly agree, 5% slightly disagree and the same percentage strongly disagree that poor staff attitudes towards electronic record keeping could be a barrier. Table 5.55 depicts that 41.7% being the highest percentage agree while 30% strongly agree, 10% slightly agree, 1.7% slightly disagree, 13.3% disagree and 1.7% strongly disagree that inadequate ongoing training for those who need it, is a barrier. 33.3% agree, 21.7% strongly agree, 1.7% slightly agree, 5% slightly disagree, 26.7% disagree and 5% strongly disagree that lack of availability of line thermal printers on an EHR network could be a barrier as depicted in Table 5.56. Table 5.57 depicts that the highest percentage of 28.3% agree, 25% strongly agree, 13.3% slightly agree, 5% slightly disagree, 13.3% disagree and same percentage strongly disagree that a lack/shortage of scanners for scanning previous records is a barrier. Table 5.58 depicts the response to a lack of needed funding as barrier where 53.3% agree, 15% strongly agree, 8.3 slightly agree, another 15% disagree and 6.7 strongly disagree. From Table 5.59, it is seen that same 33.3% strongly agree and agree (this being the highest percentage) while 3.3% slightly agree, 6.7%

slightly disagree, 18.3% disagree and 1.7% strongly disagree that concern about privacy and confidentiality may be a barrier. Table 5.60 depicts the result of one sample statistic applied to the barriers. From Table 5.61, it is noted that there is significant agreement to all but poor staff attitudes towards electronic record keeping (neither significant agreement nor significant disagreement). From Table 5.62, it is noted that 75.1% agreed that staff shortage is a barrier while 23.4% disagreed, 65% agreed that large number of patients can be a barrier while 31.7% disagreed. 69.9% agreed that lack of ICT navigation skills among staff can be a barrier, while 28.4% disagreed. 61.7% agreed that poor staff attitudes toward electronic record keeping can be a barrier, while 36.7% disagreed. 81.7% agreed that inadequate ongoing training for those who needs it can be a barrier while 16.7% disagreed. 56.7% agreed that a lack of availability of line thermal printers on an EHR network can be a barrier, while 36.7% disagreed. 66.6% agreed that a lack/shortage of scanners for scanning previous records can be a barrier, while 31.6% disagreed. 76.6% agreed that a lack of needed funding is a barrier, while 21.7% disagreed. 69.9% agreed that concern about privacy and confidentiality can be a barrier to electronic integration of patients' health information and records management, while 26.7% disagreed.

Factor analysis with promax rotation was used to determine latent factors present within these 9 items measuring barriers. A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .807 and a significant Bartlett's test indicate that successful and reliable extraction took place. Two factors were extracted which account for 72.21% of the variance in the data. Rotation converged in 3 iterations. The factor loadings are summarised in Table 5.63 while the factors are summarised in Table 5.64. A one sample t-test to test for significant agreement/disagreement was applied and was then used to test for differences across demographics. Table 5.66 also shows significant agreement that these barriers exist. There is no significant difference in the level of these barriers, they are considered equal statistically.

The Kruskal Wallis test followed by Mann-Whitney test on pairs showed that there are significant differences between respondents from different job categories in their agreement that Capacity and Ethics barriers exist, p=.001. In particular, HIM Technicians and 'other' job categories showed significantly more agreement than HIM Officers, p=.001 and p=.004 respectively. Analysis from an independent samples t-test revealed that those with <10 years' service agrees significantly more than those with 10 - <20 years' service that barriers concerning resources and skills exist, p=.035.

Table 5.51: Respondents' opinion on staff shortage as a barrier

		Frequency	Percentage
Valid	Strongly disagree	1	1.7
	Disagree	7	11.7
	Slightly disagree	6	10.0
	Slightly agree	13	21.7
	Agree	19	31.7
	Strongly agree	13	21.7
	Missing System	1	1.7
	Total	60	100.0

Table 5.52: Respondents' opinion on large numbers of patients as a barrier

		Frequency	Percentage
Valid	Strongly disagree	1	1.7
	Disagree	10	16.7
	Slightly disagree	8	13.3
	Slightly agree	7	11.7
	Agree	17	28.3
	Strongly agree	15	25.0
	Missing System	2	3.3
	Total	60	100.0

Table 5.53: Respondents' opinion on a lack of ICT navigation skills among staff as a barrier

		Frequency	Percentage
Valid	Strongly disagree	1	1.7
	Disagree	13	21.7
	Slightly disagree	3	5.0
	Slightly agree	5	8.3
	Agree	29	48.3
	Strongly agree	8	13.3
	Missing System	1	1.7
	Total	60	100.0

Table 5.54: Respondents' opinion on poor staff attitudes towards electronic record keeping as a barrier

		Frequency	Percentage
Valid	Strongly disagree	3	5.0
	Disagree	16	26.7
	Slightly disagree	3	5.0
	Slightly agree	13	21.7
	Agree	16	26.7
	Strongly agree	8	13.3
	Missing System	1	1.7
	Total	60	100.0

Table 5.55: Respondents' opinion on inadequate ongoing training for those who need it as a barrier

		Frequency	Percentage
Valid	Strongly disagree	1	1.7
	Disagree	8	13.3
	Slightly disagree	1	1.7
	Slightly agree	6	10.0
	Agree	25	41.7
	Strongly agree	18	30.0
	Missing System	1	1.7
	Total	60	100.0

Table 5.56: Respondents' opinion on lack of availability of line thermal printers on EHR network as a barrier

		Frequency	Percentage
Valid	Strongly disagree	3	5.0
	Disagree	16	26.7
	Slightly disagree	3	5.0
	Slightly agree	1	1.7
	Agree	20	33.3
	Strongly agree	13	21.7
	Missing System	4	6.7
	Total	60	100.0

Table 5. 57: Respondents' opinion on lack/shortage of scanners for scanning previous records as a barrier

		Frequency	Percentage
Valid	Strongly disagree	8	13.3
	Disagree	8	13.3
	Slightly disagree	3	5.0
	Slightly agree	8	13.3
	Agree	17	28.3
	Strongly agree	15	25.0
	Missing System	1	1.7
	Total	60	100.0

Table 5.58: Respondents' opinion on lack of needed funding as a barrier

	Frequency	**Percentage**
Valid Strongly disagree	4	6.7
Disagree	9	15.0
Slightly agree	5	8.3
Agree	32	53.3
Strongly agree	9	15.0
Missing System	1	1.7
Total	60	100.0

Table 5.59: Respondents' opinion on concern about privacy and confidentiality as a barrier

		Frequency	Percentage
Valid	Strongly disagree	1	1.7
	Disagree	11	18.3
	Slightly disagree	4	6.7
	Slightly agree	2	3.3
	Agree	20	33.3
	Strongly agree	20	33.3
	Missing System	2	3.3
	Total	60	100.0

Table 5.60: Results of one sample statistic applied to the barriers to electronic integration of patients' health information and records management

Barriers	N	Mean	Std. Deviation	Std. error mean
10.1 Staff shortages	59	4.37	1.351	.176
10.2 Large numbers of patients	58	4.28	1.508	.198
10.3 Lack of ICT navigation skills among the staff	59	4.22	1.451	.189
10.4 Poor staff attitudes towards electronic record keeping	59	3.80	1.551	.202
10.5 Inadequate ongoing training for those who need it	59	4.69	1.380	.180
10.6 Lack of availability of line thermal printers on EHR network	56	4.04	1.737	.232
10.7 Lack/shortage of scanners for scanning previous records	59	4.07	1.780	.232
10.8 Lack of needed funding	59	4.34	1.516	.197
10.9 Concerns about privacy and confidentiality	58	4.53	1.570	.206

Table 5. 61: Result of one sample test on the barriers

	Test value=3.5					
					95% Confidence interval of the difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
10.1 Staff shortages	4.964	58	.000	.873	.52	1.22
10.2 Large numbers of patients	3.919	57	.000	.776	.38	1.17
10.3 Lack of ICT navigation skills among the staff	3.813	58	.000	.720	.34	1.10
10.4 Poor staff attitudes towards electronic record keeping	1.469	58	.147	.297	-.11	.70
10.5 Inadequate ongoing training for those who need it	6.649	58	.000	1.195	.84	1.55
10.6 Lack of availability of line thermal printers on EHR network	2.308	55	.025	.536	.07	1.00
10.7 Lack/shortage of scanners for scanning previous records	2.450	58	.017	.568	.10	1.03
10.8 Lack of needed funding	4.252	58	.000	.839	.44	1.23
10.9 Concerns about privacy and confidentiality	5.019	57	.000	1.034	.62	1.45

Table 5.62: Summary table for the barriers

Item	Responses as frequencies (%)						n	Mean (SD)	t	df	P-value
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree					
10.1 Staff shortages	1 (1.7)	7 (11.7)	6 (10.0)	13 (21.7)	19 (31.7)	13 (21.7)	59	4.37 (1.351)	4.964	58	.000
10.2 Large numbers of patients	1 (1.7)	10 (16.7)	8 (13.3)	7 (11.7)	17 (28.3)	15 (25.0)	58	4.28 (1.508)	3.919	57	.000
10.3 Lack of ICT navigation skills among the staff	1 (1.7)	13 (21.7)	3 (5.0)	5 (8.3)	29 (48.3)	8 (13.3)	59	4.22 (1.451)	3.813	58	.000
10.4 Poor staff attitudes towards electronic record keeping	3 (5.0)	16 (26.7)	3(5.0)	13 (21.7)	16 (26.7)	8 (13.3)	59	3.80 (1.551)	1.469	58	.147
10.5 Inadequate ongoing training for those who need it	1 (1.7)	8 (13.3)	1 (1.7)	6 (10.0)	25 (41.7)	18 (30.0)	59	4.69 (1.380)	6.649	58	.000
10.6 Lack of availability of line thermal printers on EHR network	3 (5.0)	16 (26.7)	3 (5.0)	1 (1.7)	20 (33.3)	13 (21.7)	56	4.04 (1.737)	2.308	55	.025
10.7 Lack/shortage of scanners for scanning previous records	8 (13.3)	8 (13.3)	3 (5.0)	8 (13.3)	17 (28.3)	15 (25.0)	59	4.07 (1.780)	2.450	58	.017
10.8 Lack of needed funding	4 (6.7)	9 (15.0)	-	5 (8.3)	32 (53.3)	9 (15.0)	59	4.34 (1.516)	4.252	58	.000
10.9 Concern about privacy and confidentiality	1 (1.7)	11 (18.3)	4 (6.7)	2 (3.3)	20 (33.3)	20 (33.3)	58	4.53 (1.570)	5.019	57	.000

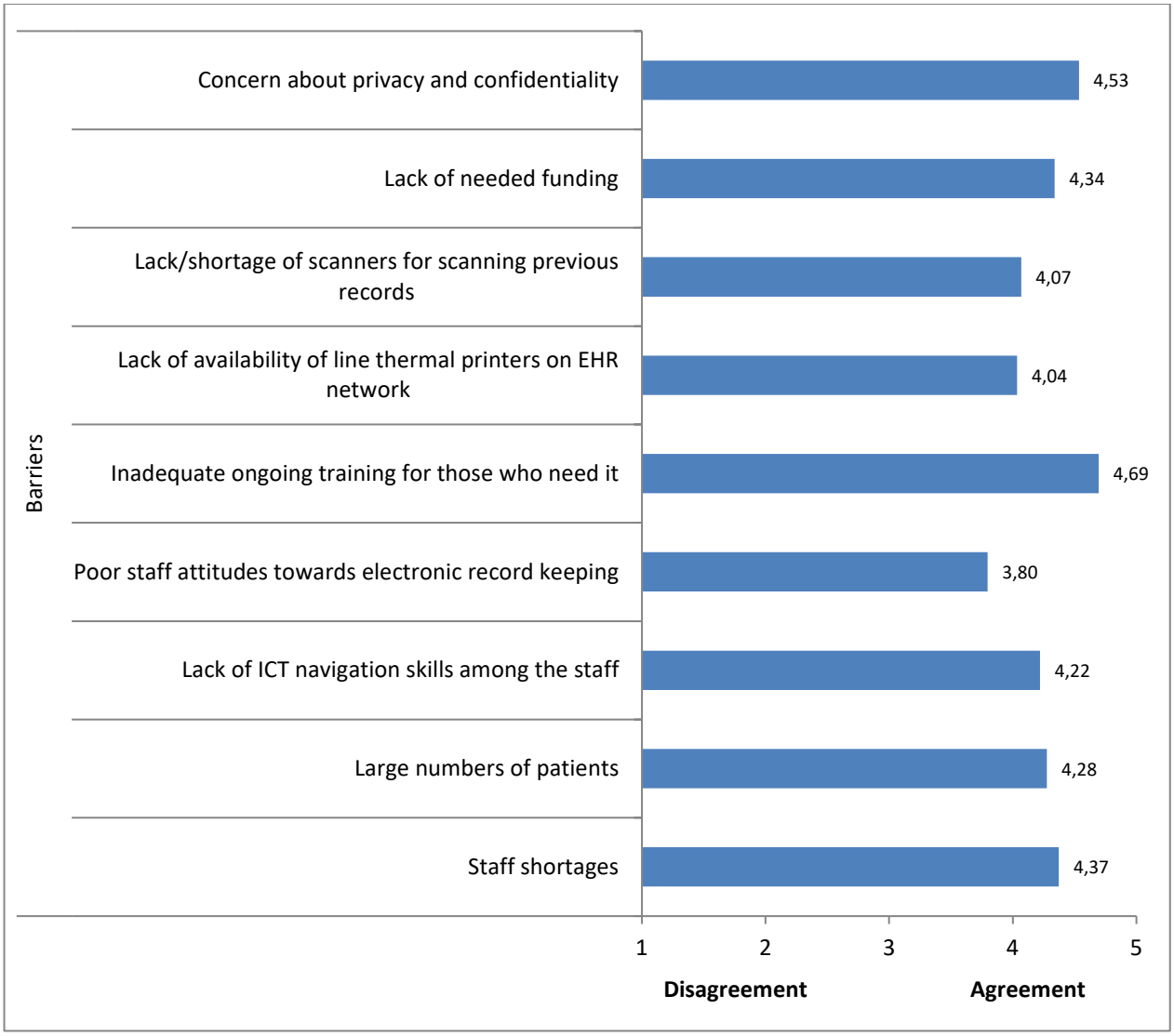


Figure 5.7: Charts for respondents' opinion on barriers to electronic integration of patients' health information and records management using the mean

Table 5.63: Factors loading result to the barriers

	Factor	
	1	2
10.8 Lack of needed funding	.943	
10.7 Lack/shortage of scanners for scanning previous records	.759	
10.4 Poor staff attitudes towards electronic record keeping	.719	
10.3 Lack of ICT navigation skills among the staff	.675	
10.6 Lack of availability of line thermal printers on EHR network	.663	
10.5 Inadequate ongoing training for those who need it	.526	
10.1 Staff shortages		.937
10.2 Large numbers of patients		.810
10.9 Concerns about privacy and confidentiality		.719

Table 5.64: Factor summary

Factor	**Construct**	**Items included**	**% Variance extracted**	**Reliability (Cronbach's alpha)**
1	Resources and skills	10.3 – 10.8	60.452	.920
2	Capacity and Ethics	10.1, 10.2, 10.9	11.753	.902

Table 5.65: Result of one sample statistic to barriers with resources and skills and capacity and ethics

	N	Mean	Std. Deviation	Std Error Mean
BAR_RS	59	4.1904	1.30261	.16958
BAR_CE	59	4.3927	1.34718	.17539

Table 5.66: Result for one sample test to the barriers at 3.5

	Test value=3.5					
					95% Confidence interval of the difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
BAR_RS	4.071	58	.000	.69040	.3509	1.0299
BAR_CE	5.090	58	.000	.89266	.5416	1.2437

5.3 SUMMARY OF THE CHAPTER

This chapter has displayed the result of the quantitative methods where the demographic information of respondents had been shown. It has also presented respondents' opinions on their skill level in IT usage, environmental support for ICT usage, staff attitudes towards moving to electronic record keeping, modes of attending to patients electronically, benefits of integrating patients' records and the barriers to successful integration.

CHAPTER 6: PRESENTATION OF RESULTS FOR QUALITATIVE DATA

6.1 INTRODUCTION

This chapter discusses the results of the online interview data which is the qualitative data and presents the findings of the results.

6.2 QUALITATIVE RESULTS

The result of the online interview questions retrieved through a Google account are presented below:

6.2.1 Demographic data

From Table 6.1 and Figure 6.1, it is noted that males are the highest respondents' having 60% of the total respondents. Also, from Table 6.2, it is observed that the highest respondents fell within the age range of 41-50 years. It was assumed that these respondents can provide an adequate analysis of the efficacy of switching to an electronic method of the hospital patients' record keeping since they are in their active age. From Table 6.3 and Figure 6.2, it is evident that respondents are selected across various disciplines in the hospital as each makes a significant contribution to patients' care management with electronic system. A hospital comprises multidisciplinary team members who work together towards delivering quality health services. The most respondents were consultants, making about 25% of the total respondents. From Table 6.4, it is observed that the most respondents were from medicine departments, followed by HIM, nursing, surgery, maternity and pharmacy, all having 10% each. Management of patients' health information and records management is not limited to a department but cuts across all departments. Also, respondents with years of service between 10-<15 years have the highest percentage of 35% as shown in Table 6.5 and Figure 6.3, meaning that they are within the

core active age of their service with a wealth of experience to manage their job well.

Table 6.1: Online respondents' gender

Gender	Number	Percentage
Male	12	60
Female	8	40
Total	20	100

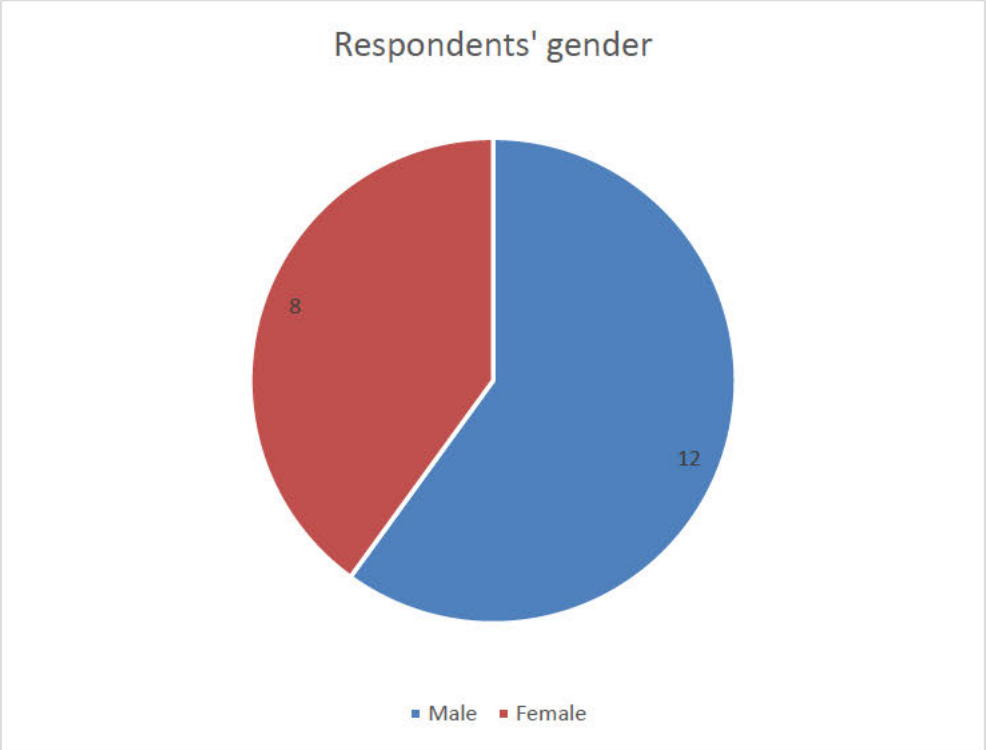


Figure 6.1: Pie chart of respondents' gender

Table 6.2: Online respondents' age

Age	Number	Percentage
Up to 30 years	3	15
31-40 years	5	25
41-50years	8	40
Over 50 years	4	20
Total	20	100

Table 6.3: Online respondents' job position

Position	Number	Percentage
Health Record Officer	2	10
Nurse	3	15
Doctor	3	15
Consultant	5	25
Physiotherapist	1	5
Medical Lab Scientist	1	5
Radiographers	1	5
Pharmacist	2	10
Dietician	1	5
Dentist	1	5
Total	20	100

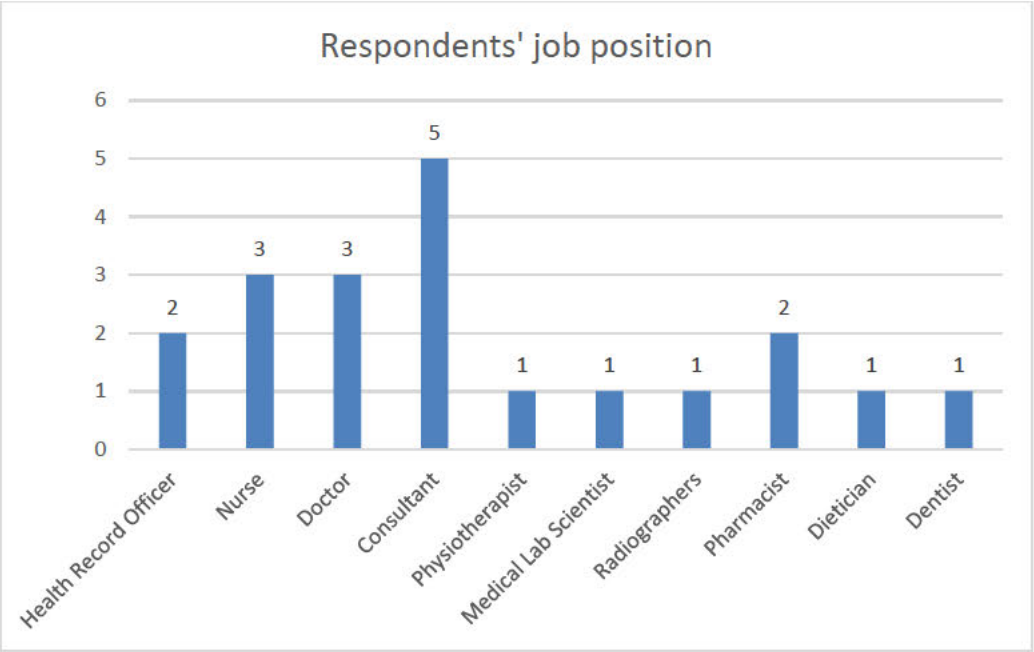


Figure 6.2: Charts for respondents' job position

Table 6.4: Online respondents' departments

Department	Number	Percentage
Health Information Management	2	10
Nursing	2	10
Medicine	4	20
Surgery	2	10
Dentistry	1	5
Paediatrics	1	5
Psychiatry	1	5
Maternity	2	10
Nutrition & Dietetics	1	5
Physiotherapy	1	5
Laboratory	1	5
Pharmacy	2	10
Total	20	100

Table 6.5: Online respondents' length of years in service

Length	Number	Percentage
5-<10 years	6	30
10-<15 years	7	35
15-<20 years	4	20
>20 years	3	15
Total	20	100

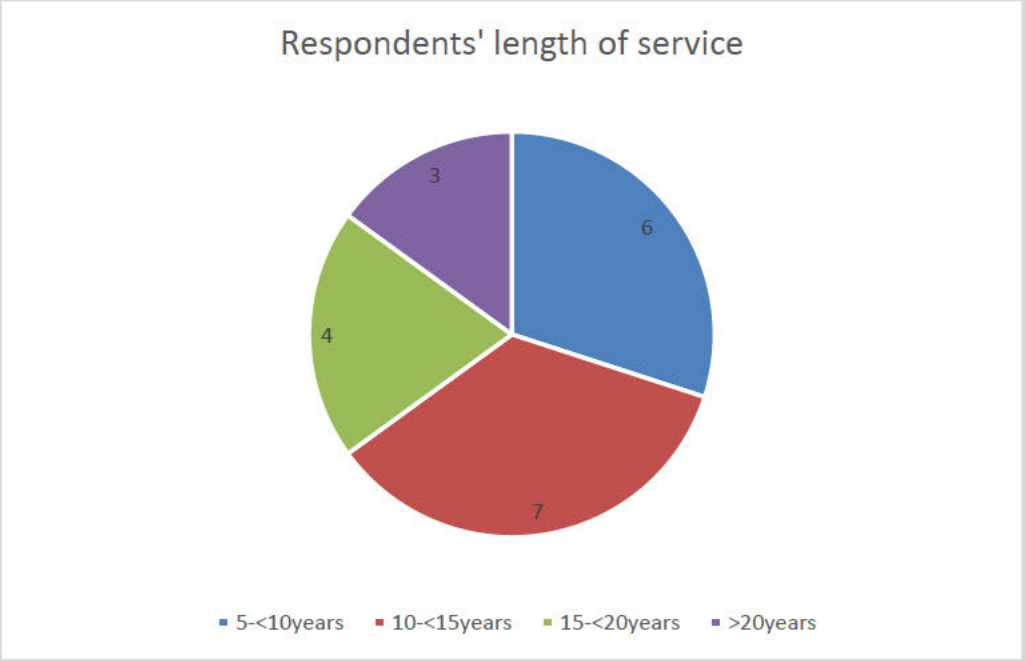


Figure 6.3: Pie-chart for online respondents' length of service

6.2.2 Interview questions

The following are the interview guides for administrators, clinical staff, decision makers, and office staff in a healthcare delivery system. The tool includes questions to gauge users' attitudes toward EHRs.

6.2.2.1 Respondents were asked how medical records are currently being kept in the institution

From Table 6.6, it is noted that the majority of the respondents (70%) confirmed that they combine the use of both electronic and manual methods for keeping medical records. 5% said they use manual, hence the need for emphasising electronic integration of patients' health information and records management, while 25% purely use electronic alone.

Table 6.6: Online respondents' opinion on ways medical records are being kept

	Number	Frequency
Manual	1	5
Electronic	5	25
Both	14	70
Total	20	100

6.2.2.2 Respondents were asked how medical records are being shared/communicated between personnel and departments

From Table 6.7, it is noted that while 30% of information is shared or communicated between personnel and departments through electronic means, the highest percentage (55%) uses both manual and electronic methods and 15% still uses manual alone. By implication, it means that some patients' information is still transferred through papers and case notes among healthcare personnel and across departments, hence, patients are still stressed moving up and down, and their waiting time is increased in accessing care from various departments in the hospital because of manual communication of information.

Table 6.7: Online respondents' opinion on how medical records were shared/communicated between personnel and departments

	Number	**Frequency**
Manual	3	15
Electronic	6	30
Both	11	55
Total	20	100

6.2.2.3 Respondents were asked if they encounter any problems with the chosen system

From Table 6.8, 80% confirmed that they encounter problems with the chosen system while the remaining 20% said no.

Table 6.8: Online respondents' opinion on encountering problems with chosen system

	Number	Percentage
Yes	16	80
No	4	20
Total	20	100

6.2.2.4 Respondents who answered yes, were asked to elaborate the problems encountered

Respondents highlighted various problems like: Poor network, non-user-friendly design, erratic power supply, locating folders could be huge problems when conducting research. Most case notes could not be traced, most entries are not well recorded, slow speed of Internet network, inability to communicate information from one department to another smoothly, login challenges, retrieval of investigation results, lack of adequate equipment, lack of proper

training and time taken. It was observed that some of the respondents highlighted more than one of the above-mentioned problems.

When the responses are analysed critically, it can be observed that some of the problems, like most case notes could not be traced, inability to communicate information from one department to another smoothly and retrieval of investigation results are likely to emanate from those still combining manual and electronic methods. Results and information sent electronically cannot be accessed by a department still operating on manual. Other problems specific to those using electronic can be resolved with continuous training, constant upgrading of the server and financial commitment on the part of the management in providing the hardware needed.

6.2.2.5 Respondents were asked how they will feel about changing from a paper-based to electronic system for record keeping

The highest percentage (60%) as shown in Table 6.9, agreed to the need to change from paper-based to electronic record keeping, which means that members of staff will be more relaxed, efficient, less burdened and fulfilled when using electronic. Some choose each of the feelings listed but the majority are likely to have picked ‘the all of the above’ rather than ticking each. Also, the 5% that picked none of the above might be due to people operating on paper-based records who do not have an idea of the experience of electronic record keeping.

Table 6.9: Online respondents' opinion on feelings about changing from paper-based to electronic methods of record keeping

	Number	Percentage
Relaxed	1	5
Efficient	3	15
Less burdened	2	10
Fulfilled	1	5
All of the above	12	60
None of the above	1	5
Total	20	100

6.2.2.6 Respondents were asked about any benefits of using ICT to keep records

From Table 6.10, 60% of the respondents confirmed that using ICT to keep records is beneficial as it will minimise workload, allow easy communication, reduce patients' waiting time and improve confidentiality. 10% believed that it will minimise workload, reduce patients' waiting time and improve confidentiality, while 5% said it will allow easy communication, whereas some others had summarised their own view into taking the option of all of the above. The other 5% that took none of the above might have done so based on their lack of knowledge and practicability of using EHR.

Table 6.10: Respondents' opinion on benefit of using ICT to keep records

	Number	**Percentage**
Minimised workload	2	10
Easy communication	1	5
Reduced patients' waiting time	2	10
Improved confidentiality	2	10
All of the above	12	60
None of the above	1	5
Total	20	100

6.2.2.7 Respondents were asked what barriers could prevent the successful transition to electronic record keeping

Barriers that could prevent a successful transition to electronic record keeping include lack of IT skills, inadequate equipment, poor Internet facility and unstable power supply as depicted in Table 6.11. The highest percentage of 60% said all the above while 15% said unstable power supply and 10% said lack of IT skills and inadequate equipment, the remaining 5% said its poor Internet facilities.

Table 6.11: Online respondents' opinion on barriers that could prevent successful transition to electronic record keeping

	Number	Percentage
Lack of IT skills	2	10
Inadequate equipment	2	10
Poor Internet facility	1	5
Unstable power supply	3	15
All of the above	12	60
None of the above	0	0
Total	20	100

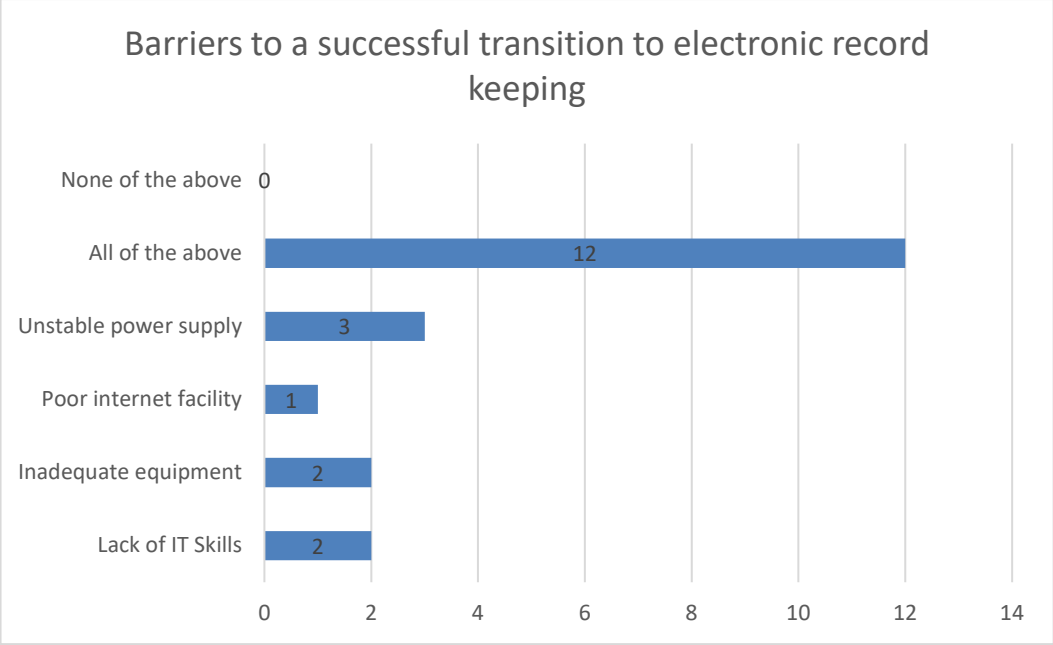


Figure 6.4: Chart for online response to the barriers to successful transition to electronic record keeping

6.2.2.8 Respondents were asked to suggest any protocol that could be put in place to ensure that confidentiality of medical records is maintained

Of the total respondents, 35% agreed that restricting users' access, providing an individual username and password, and frequent managerial review and checkmating of user's access are protocols that can be put in place to ensure that the confidentiality of medical records is maintained. Other significant percentages are of the opinion that using each of the protocols on their own can assist a great deal as depicted in Table 6.12.

Table 6.12: Online respondents' opinion on protocols to ensure confidentiality of medical records

	Number	Percentage
Restriction of user access	2	10
Individual username & password	6	30
Occasional change of password	1	5
Frequent managerial review & checkmating of user's access	4	20
All of the above	7	35
None of the above	0	0
Total	20	100

6.3 THEMES AND SUB-THEMES FROM THE INTERVIEW

The following are major themes from the study:

(i) Ways of keeping records currently in the hospital.

(ii) How records are being shared/communicated between personnel and departments.

(iii) Are problems encountered with the system?

(iv) Elaboration on problems encountered.

(v) Feeling about changing from paper-based to an electronic system for record keeping.

(vi) Benefits of using ICT to keep records.

(vii) Barriers to a successful transition to electronic record keeping.

(viii) Protocols to ensure that confidentiality of record is maintained.

Table 6.13: Overview of the themes and sub themes

Major themes	Sub-themes
1. Ways of keeping records currently in the hospital.	1.1. Manual. 1.2. Electronic. 1.3. Both.
2. How records are being shared/communicated between personnel and departments.	2.1. Manual. 2.2. Electronic. 2.3. Both.
3. Any problems encountered with the system?	3.1. Yes. 3.2. No.
4. Elaborate on problems encountered.	4.1. Poor network. 4.2. Non-user-friendly design. 4.3. Erratic power supply. 4.4. Locating folders could be a huge problem when conducting research. 4.5. Most case notes could not be traced. 4.6. Most entries are not well recorded. 4.7. Slow speed of Internet network. 4.8. Inability to communicate information from one department to another smoothly. 4.9. Login challenges. 4.10. Retrieval of investigation results. 4.11. Lack of adequate equipment. 4.12. Lack of proper training. 4.13. Time taken.
5. Feeling about changing from paper-based to an electronic system for record keeping.	5.1. Relaxed. 5.2. Efficient. 5.3. Less burdened. 5.4. Fulfilled.
6. Benefits of using ICT to keep records.	6.1. Minimized workload. 6.2. Easy communication. 6.3. Reduced patients' waiting time. 6.4. Improved confidentiality.
7. Barriers to successful transition to electronic record keeping.	7.1. Lack of IT skills. 7.2. Inadequate equipment. 7.3. Poor Internet facility. 7.4. Unstable power supply.
8. Protocols to ensure that confidentiality of record is maintained.	8.1. Restriction of access to users. 8.2. Individual username and password. 8.3. Frequent managerial review. 8.4. Checkmating of user's access.

6.4 SUMMARY OF THE CHAPTER

This chapter has discussed the opinion of the online respondents about interview questions designed to provide answers to the research questions previously outlined in the early chapters of this thesis. The chapter has also highlighted the themes and the sub themes.

CHAPTER 7: INTEGRATION OF RESULTS FROM QUANTITATIVE AND QUALITATIVE DATA

7.1 INTRODUCTION

This chapter discusses the integration of the results from both quantitative method and qualitative methods, after which the results were interpreted.

7.2 MERGING RESULTS FOR COMPARISON

Findings from the results of both qualitative and quantitative analyses shows that there were more female respondents in quantitative data while for qualitative there were more males. The highest respondents' age range was 31-40 years in quantitative while it was 41-50 years for qualitative. The highest percentage for respondents' length of years in service in quantitative fell within less than ten years (<10 years) while it is 10-<15 years in qualitative method. From both results, it is evident that rendering of healthcare services is not limited to a particular gender and that the respondents are people with experience who are within their active years in service. Management of patients' information is a team effort involving various disciplines within the hospital such as Health Information Management, Doctors, Nurses, Pharmacists, Laboratory scientists, physiotherapists etc. who all work together towards achieving better healthcare outcome for the patients. Healthcare workers have a lot of computer knowledge in management of patients' health information as seen under quantitative and qualitative results. The majority of the respondents confirmed that there was environmental support for EHRs. On attitudes to moving to EHRs, the majority of health care workers agreed it was a good development. Physical contact was found to be the highest mode of contact with patients.

EHRs have been found to be beneficial as a majority under quantitative results agreed that:

- It reduces patients' waiting time.

- Reduce medical errors.
- Assures a longer life span for patients' information storage.
- Enables quick and easy access of past medical records thus ensuring prompt continuity of care.
- Enables easy access to patients' information from anywhere.
- Enables easy access to health care at any location due to accessibility of medical records.
- Enables more efficient and faster ward rounds
- Reduces in staff workloads.
- Reduces the number of duplicate diagnostic tests ordered.
- Enables shareable patients' information across disciplines & specialties for quick decision-making.
- Reduces the loss of patients' information and
- Increases revenue and prompt claims reimbursement.

While under qualitative results a majority agreed that EHRs:

- Minimise workload.
- Allow easy communication.
- Reduce patients waiting time and
- Improve confidentiality.

From the above, there are positive opinions on the benefits that EHR brings to the performance of duties of healthcare workers in the hospital.

Obstacles or barriers to successful implementation of EHRs

The obstacles identified in both quantitative and qualitative are as follows:

Quantitative

- Staff shortages.
- Large numbers of patients.
- Lack of ICT navigation skills among staff.
- Poor staff attitudes towards electronic record keeping.
- Inadequate ongoing training for those who need it.
- Lack of availability of the thermal printers on EHR network.
- Lack/shortage of scanners for scanning previous records.

- Lack of needed funding.
- Concerns about privacy and confidentiality.

Qualitative

- Lack of IT Skills.
- Inadequate equipment.
- Poor internet facility.
- Unstable power supply.

In both quantitative and qualitative, ICT skills had been found to be a common factor identified in both methods as a barrier to EHR implementation. It is therefore important to make ICT literacy part of employment criteria for health workers. Lack of adequate equipment has also been found to be a barrier, as some of the equipment was mentioned under quantitative methods (eg lack of thermal printers and shortage/lack of scanners for scanning previous records under qualitative methods). Meanwhile, some of the problems highlighted by the online respondents as discussed in previous chapters are: Poor network, non-user friendly design, erratic power supply, locating folders when conducting research, badly recorded entries, slow speed of Internet network, inability to communicate information from one department to another smoothly, login challenges, retrieval of investigation results, lack of adequate equipment, lack of proper training and time taken were seen as barriers to be critically looked into.

Protocols that could be put in place to ensure confidentiality of records is maintained are highlighted as:

- Restriction of users' access.
- Individual username and password.
- Occasional change of password with frequent managerial review and checkmating of user's access.

There is a high response rate to agreement to concern towards confidentiality under the quantitative result, this is not unrelated but in conformity to the fact that respondents from qualitative data suggest protocols that can be put in

place to ensure confidentiality of records. This means the issue of confidentiality should not be taken with levity in the use of EHR since patients' information are been stored there.

7.3 INTERPRETATION OF RESULTS

Mixed method research allows meaningful integration of a whole result that is more than the sum of the individual qualitative or quantitative parts. Data integration can be (a) discussion about the data gotten from qualitative result and quantitative analysis separately. (b) Joint display of the result in the form of tables or figure visually. The types of joint displays we have are statistics by themes, side-by-side comparisons, innovative joint displays etc. Findings are connected to theoretical frameworks or recommendations with the use of innovative joint display as a type of joint display (Guetterman 2015). This research work went through the full convergent parallel mixed method and results from the two methods were itemised as seen in number 7.2 above.

7.4 SUMMARY OF THE CHAPTER

This chapter discussed the comparison from the findings of both quantitative and qualitative data and the results were interpreted.

CHAPTER 8: RESEARCH OUTPUTS

8.1 INTRODUCTION

This chapter discusses the papers that have been developed as outputs of this research work for publication purposes.

8.2 Paper 1

Topic: Communication model enhancement using electronic health record standard for tertiary hospitals.

Status: Published: 28 Apr. 2022 in the ***South African Journal of Information Management***

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Dates:

Received: 13 Oct. 2021

Accepted: 21 Jan. 2022

Published: 28 Apr. 2022

How to cite this article:
Akinyemi, O.R., Sibiya, M.N. & Oladimeji, O., 2022, 'Communication model enhancement using electronic health record standard for tertiary hospital', *South African Journal of Information Management* 24(1), a1472. https://doi.org/10.4102/sajim.v24i1.1472

Background: Communication of patient information in a healthcare setting in previous years was based on documented information on paper records carried from one location to another. However, with the introduction of electronic health records (EHRs), communications are now conducted electronically via installed and connected computer systems that are networked together. Inadequate communication of patients' information can deter patients' health and threaten their lives, putting them in unnecessary danger.

Objective: The objective of this study was to design a standard EHR template model of communication for tertiary hospitals that can be used in communicating patients' information between various departments involved in the management of patients without carrying papers around or tossing patients or their relatives up and down.

Method: The research adopts soft system methodology (SSM) with communication concepts from knowledge management, combining observations with various practical information to make a conclusion based on past experiences through a process of inductive reasoning,a communication model was developed that can be used as a template for hospitals to upgrade/integrate paper-based patient information management to electronic based in a bid to enhance patient care and information management.

Results: The developed communication template model has been designed to be adopted for use in a bid to manage patients' information electronically in all tertiary hospitals and other hospitals that may so desire its use.

Conclusion: It is observed from this article that communication in hospitals through EHR template is user friendly, safe and possible within the hospital and to outside facilities for effective paperless management of patients.

Keywords: communication model; patients' health information; electronic health records; the flow of information; data security; blockchain distributed information technology.

Introduction

It is important, if there is to be an improvement in the coordination of care amongst the providers of healthcare, to be able to adopt electronic health records (EHR) effectively (Buntin, Jain and Blumenthal 2010; Williams *et al.* 2017). Today's combined patient-

centred healthcare necessitates linked data to valid coding for proper billing and funding, documentation standards, nomenclatures inclusive, which are all important in order to enable EHRs retrieve and analyse data whilst in support of decision-making processes for healthcare workers (Hoyle 2019). An inadequate way of managing and communicating patients' health information can have dire consequences that can deter healthcare reform and threaten the safety of the patients. One key criterion for adopting EHR is adequate management of patients' information that can be communicated easily between healthcare workers and between hospitals (Alhuwail 2020; Buntin *et al.* 2010; Hoyle 2019).

Health records include documentation made by various healthcare professionals in electronic or paper format, including digital images, photos, ultrasound scans reflecting images of the foetus, computerised tests such as electroencephalogram (EEG), referral or consult letters and other health information. Previously, it was assumed that only doctors documented processes, but this is no longer the case, as it now includes documentation from other healthcare workers (Marinič 2015). When healthcare workers record their patients' information consistently, it ensures appropriate health monitoring, adequate planning and the right treatment. Paper-based health record management involves the use of paper records and other correspondences in the management of patients' health. These include case notes, paper prescriptions, laboratory investigation forms, radiology request form, referral letters, consult letters requesting the expert management of a certain consultant and their team, billing sheets and lots more.

EHR stores patients' data in digital format that can be safely transmitted and made available to several authorised users in the shortest possible time. It contains the past, current and possible future information aimed at providing a continuing effective and efficient integrated health service (Alsadi and Saleh 2019). This

involves the use of computer systems, networked together to manage patients' health information and render quality service delivery. Tertiary hospitals are the hospital at the third level of care designed for rendering highly specialised medical and surgical services and equipment for curative, rehabilitative, teaching service and many more. The tertiary health facility takes referral from other levels of care and can also refer to other service delivery hospitals (Flegel 2015). This study provides a designed standard EHR template model of communication for the tertiary hospital. It discusses the method of data transfer from one department to the other for the enhancement of patients' care.

Literature reviewed

In getting an effective communication model using EHR in the hospital setting, one has to bear in mind some concepts, which must be well taken care of. These include the concept of communication, network connectivity, hardware maintenance, human skills, security concept and application of distributed information technology (DIT) blockchain for EHR. Hence, a communication template model is designed to enhance data management amongst departments.

Communication concepts

Communication refers to the transfer of ideas and information from one person to another through a defined medium. An effective communication takes place when it brings the resulting feedback (Lunenburg 2010). When this concept is applied to health workers, it entails the flow of communication from the person at the lowest level to the highest regardless of their rank to provide healthcare services within the hospital. Services rendered in the hospital might be for preventive, curative and rehabilitative services: the reasons for which tertiary level of care is established.

Patients or their relatives visit the hospital for several reasons such as collection of medical certificates of fitness, general health checks and screening, treatment of certain ailments, admission in case of health emergencies, follow up for continuity of care, even to the point of collection of corpses by the deceased relatives. When

these types of services are sought in the hospital, particularly in this era of technology, there is a way information is being communicated between members of the health team electronically. This term involves the transfer of information from one person to another through a predefined medium, which should bring feedback before it can be termed effective. It can either be downward (from top person to lower person), upward (from lower person to top person), diagonal (amongst all departments, which may be in the form of vertical, horizontal, upward and downward, within the same workgroup and departments) or informal channel (flow of information either vertical or horizontal with persons at different levels all having direct relationships). Irrespective of the case the ultimate goal is the achievement of the purpose for which the message is being sent (Gurav 2020). Communication can also be understood as a process of transferring meaningful ideas or information from one person to another. In brief, communication is the transfer of information from the sender to the receiver, for a specific purpose. In a healthcare setting, communication occurs between patients, doctors, nurses, lab scientists, pharmacists, radiologists, health information management (HIM) professionals, billing, hospital management, health assistants and many others, but the intention of the message will determine its direction of flow.

Flowchart diagram ofcommunication

Sender (which may be the patient, healthcare giver, hospital management)

↓

Message (clear, unambiguous ideas, which may be request for drugs, information or investigation or care)

↓

Medium (EHR)

↓

Receiver (recipients whose service is required by the sender)

↓

Feedback (reaction to the sender). The process continues all along as depicted in Figure 1.

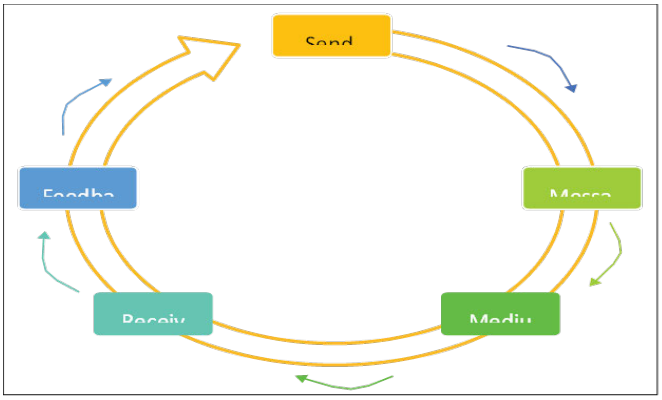


FIGURE 1: The flowchart diagram of communication.

Connectivity to network

For communication to effectively take place with EHR in a healthcare setting, there is a need for providing network connectivity. Computer devices such as laptops, desktops, tablet Personal Computers, and smartphones can communicate with each other over a variety of wireless technologies that are linked together using the Local Area Network (LAN) or wide area networks (WANs). A LAN is a network covering a small geographical area such as offices and homes and transmits data with a fast speed because of the distance the data is required to travel through. It can be owned and maintained by a hospital or an entity. Wide area network, on the other hand, is a network having an ability to cover large areas such as cities, countries and continents, for example, Internet (Sahoo *et al.* 2020). Several working computer systems and other devices are needed to be linked together through a wireless network or communication devices. For EHR to be effective, all the hospital departments must be connected together on a platform, which can be accessed by the workers without having a physical contact, and they are to respond to information immediately as soon as they receive it (Boonstra and Vos 2014).

Hardware maintenance

Several hardware devices involved in EHRs include the desktops or laptops, tablets, servers, routers, workstations, inverters (backup device), printers, scanners and host of others depending on whether the storage options are cloud based or use client-server system. These hardware devices require continuous maintenance to avoid spending exorbitant amounts of money on upgrading and replacement. This had been made easy through improved network protocols over the years (Campbell *et al.* 2014).

There is a need for the establishment of a technical support team who will be in charge of constant and continuous checking of all installed hardware and put-up practices and advice that can assist in the elongation of their lifespan.

A quality control team should also be constituted from amongst the hospital staff, who will move round to see the usage of this equipment and report any complaints to the technical support group for probable resolution. They are to ensure that the use of this technology (EHR) meets with the standard and specifications that had been spelled out. Figure 2 shows the flowchart for quality control towards achieving a quality EHR.

Subjective checks

This relates to pulling some randomly sampled units for inspection. It is important to check the way the end user works how they navigate through the system and whether there are any challenges. When this is performed in a few departments, the findings can then be generalised for the whole hospital.

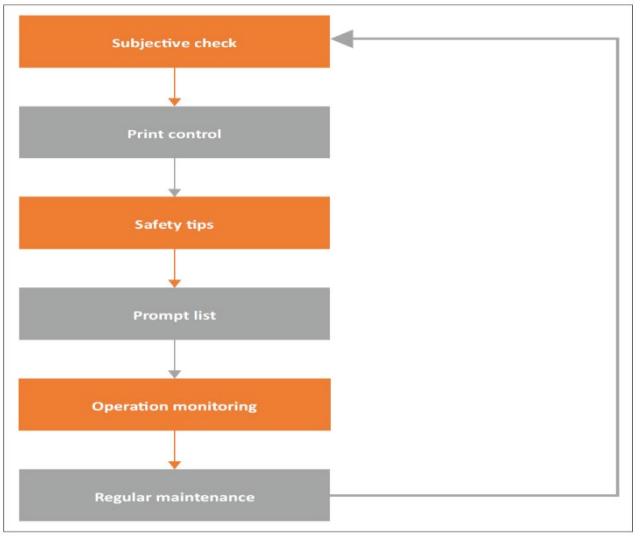


FIGURE 2: The flowchart diagram of quality control functions.

Print control

This is a setting to control the printing process to be carried out by the printer. The possibility of controlling the printing device of each user is assured from the setting of the print control. This is part of the checks that can be put in place by the quality control team.

Safety tips

Safety tips are guides to what should be done in a certain situation. In quality control, the safety tips should be made known to all so as to be able to alert the team when something abnormal happens. These tips involve specifying the quality standard, that is, the steps in the process. For example, an improvement is desired, probably regarding promptness in responding to patients' requests and a constant offer of training for staff. In addition, it allows the technology to take over one's activities instead of applying physical human efforts, thus people will maximally put the EHR into use. The need for constant upgrading of equipment when needed is another saving grace. It may even include replacing outdated systems or ones that constantly break down. With all these in place, the last result will be to report any problem to the quality control team.

Prompt list

This is a type of a predetermined list of risk categories that are documented, which may be likely to occur or form the basis of risks for end users. This will allow the team to gather ideas for resolving the risks.

Operation monitoring

Operation monitoring is the periodic review to ensure that operation plans are met, the safety, process, design, reliability and environmental limits are in effect, and if plans are being violated. It also describes the probable way of having an improved performance. These are part of the function to be carried out by the quality control team.

Regular maintenance

This involves physically checking on all the hardware and end users to ensure that things are in order and also to ensure that quality standards and requirements are being met.

Human skills

In an organisation, there is a need for human skills competency to ensure that quality services are delivered. Whilst implementing EHR, efforts should be concentrated on the information communication and technology (ICT) skill of the professional staff because a new technology will require training on how it is to be used. It is a must to be ICT compliant for those intending to come into the hospital as a new employee. Furthermore, an opportunity should be given to existing employees to update and upgrade their knowledge through short courses and seminars. Consequently, handling the communication process for patients seeking healthcare will not pose a challenge for them as they will be able to use the technology efficiently (Merhi 2015). Improving the technical skill of the staff is important to bridge the knowledge gap and encourage partnerships to share information within and outside the organisation. In the absence of adequate training

and education alongside in-service training programmes, resources on the ground may not be properly utilised (Smith 2003).

Software and data security

There is need to protect the data involved in EHR through a reliable and user-friendly software. The software to be used must be easy to understand without any ambiguity in its use. When security measures are in place, the level of threat and exposures to data will be reduced. Data security is about not allowing an unauthorised person to access, create or modify information that has been entrusted to someone. The threat to data security occurs when personal information is accessed, used or disclosed without proper consent of the given person. When patients' information is tampered with and falsified, healthcare givers will be paying unnecessary attention to patients' health, thinking that their health condition are not improving which may result to social, medical and legal implications (Aljedaani and Babar 2021). The patients' confidential information should be protected from unauthorised access. This can be achieved by using a strong data encryption and digital certificates along with a plan that can be followed. In the hospital, healthcare givers are bound to maintain the confidentiality of their patients' information, which is their ethical and legal duty. Privacy refers to an individual's right to control the access of their personal information (Han *et al.* 2012). Electronic health record software uses either cloud services or a virtual private server (VPS) for storing data. The EHR software has the ability to provide swift, remote and convenient access and data transfer. Nevertheless, some of its limitations make it susceptible to:

- the attacks of social engineers or hacking, which is one of the most common causes of data theft in the healthcare sector
- loss and leakage of data
- wrong configuration in the cloud (being one of the causes of data leakage)
- malicious people inside the hospital who can possibly leak out patient data with adequate access
- becoming a single point of failure, which is a problem that disallows the service provider's server from serving data, thereby preventing healthcare

providers from accessing critical EHR data.

This may also restrict the hospital to a particular vendor as the money involved in changing vendors may be high, although hospitals can be forced to avoid being locked in with a vendor with the use of vendor neutral archive (VNA): a solution that allows facilities to archive data from different healthcare information technology systems into a single, easily accessible and interoperable repository, without being locked-in to the vendors who provide these systems (Adamu, Hamza and Rosli 2020).

The Health Insurance Portability and Accountability Act can help with the provision of security mechanisms such as digital signatures, which is a way of providing rigorous methods for authenticating EHR users (Yu, Huang and Hou 2012). Individual users can also change their password often as a security measure to avoid unnecessary access into their accounts. However, the measures are summarised as follows:

- **Physical security:** This involves the use of practical access control, radio frequency identification device (RFID), and workstation protection such as the use of a fingerprint scanner.
- **Technical security:** These are access control, entity authentication, audit trails, encryption of data, firewall protection and checking of the virus.

These two measures can be combined to achieve protected patients' right and system against several threats (Adetoyi and Raji 2020).

Application of distributed information technology blockchain to electronic health records

Blockchain is a chain of blocks that are connected together, which continues to increase from the storage of information on the blocks. Its features include decentralisation, transparency of data with no third-party interference, security and privacy. This makes it a sensible option in the storage of patients' health information because of the fact that securing patients' information is now a major priority. It works in a way by allowing information distribution in a decentralised

manner and that such distributed information or data have a common ownership (Sarmah 2018; Velmovitsky, Bublitz and Morita 2021). This has been found to be a practicable solution in healthcare.

Distributed information technology is the means of sharing information amongst multiple systems in various locations over a network with the ability to store, record and exchange information across various locations as shown in Figure 3 (Gordon & Catalini, 2018).

A new addition to the database is carried out by one of the member nodes being sent by a user on the blockchain network suggesting that a new block is created. A block in the blockchain is used for storing information, and these blocks are distributed to all of the connected nodes in the network. That information placed inside a block is spread to all of the nodes in the network in an encrypted form to prevent it from public access. All the nodes in the network have a copy of the complete blockchain that helps them in the verification process with the use of a predetermined algorithm consensus mechanism. When a block containing the user information is communicated to other nodes, it is validated (to ensure that the sender is an authorised part of the network) and the new block is added in their own copy. This whole process of the block being added on the blockchain is performed by the nodes reaching a consensus where they decide which blocks are valid to be added on the blockchain and which are not. This completes the session (Shahnaz, Qamar and Khalid 2019). With blockchain, it is certain that even though it has its own flaws, patients' health information can be communicated safely and effectively without fear because it assures privacy and security of data as discussed.

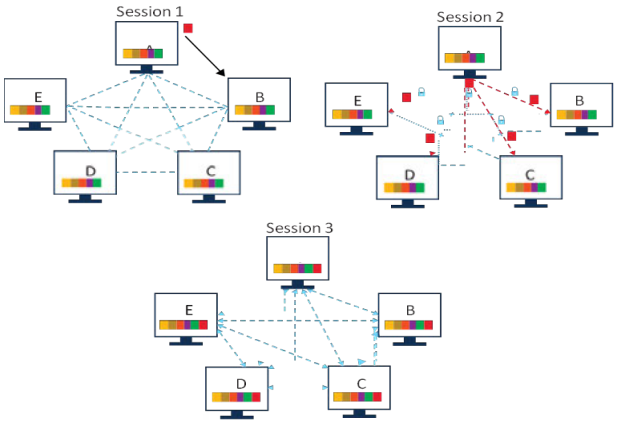


FIGURE 3: The use of distributed information technology blockchain in electronic health record.

Partial electronic medical record

The electronic medical record (EMR) contains patients' health data that is managed by a healthcare organisation, which contains health records and accumulated health data created by various patient encounters in the hospital setting arising from interoperability of several healthcare providers. The EMR cannot go beyond the clinical activities of the hospital (Anshari 2019).

Methodology

The methodology employed in this research investigation is inductive reasoning, which involves generation of observation on the communication pattern between the health workers and the patients for many years in handling paper-based patients' hospital information from one department to another. The pattern of communication of information is now created to a template that can be used as a standard method of information management between hospital health workers and patients to enhance hospital patients' care and wellbeing. The practical study over the years is now used to generalise the observation to hospitals that want to upgrade from paper-based to electronic-based information management as explained in Figure 4.

The methodology for the development of the model is justified by a soft system methodology (SSM). This is suitable as it describes a rich picture and a conceptual model. It involves different human activities each with their interest, beliefs and opinions. It involves several steps ranging from appreciating the problem situation, writing the problem situation, formulating root definitions, building of conceptual models, comparing models to real world, defining possible changes and recommending actions (Mehregan 2012).

The research adopts communication concepts from knowledge management, through a process of inductive reasoning. A communication model was developed that can be used as a template for hospitals to upgrade or integrate paper-based EHR.

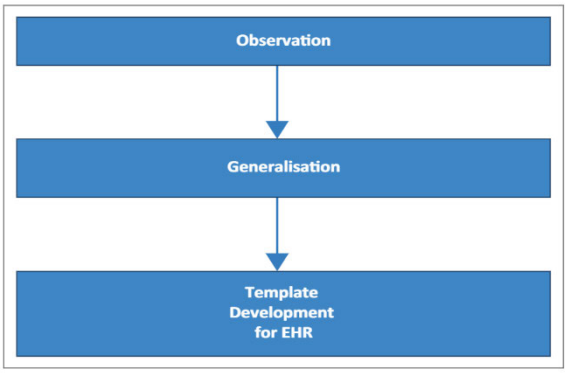


FIGURE 4: The flow of research method used for the study.

This EHR transfers patient information management in a bid to enhance patient care and information management. Inductive reasoning is a logical way of thinking that involves combining observations with various practical information to make a conclusion based on previous experiences. It involves observing facts and making conclusions based on these facts. An inductive reasoning approach makes it possible to directly reach conclusions via thorough reasoning, which involves recognising, selecting and acting on procedures. It is needed particularly when analysing a system that is not structured (Shin 2019). Various methods adopted by most hospitals are non-standard in managing the information of patients between various departments providing care to patients with EHR; this has required that the researcher develop a standard template model for communicating patients' information.

Considering the cost involved in setting up a standard EHR communication model, hospitals that are not financially buoyant can begin with the use of a Partial Electronic Medical Record (PEMR), which involves the use of computers and some paper work. They can start out with a minimum of eight workstations and practice the norms as if the whole hospital is covered as shown in Figure 5. The eight workstations must include one at outpatient department (OPD) in HIM office being the first point of contact, one with the nurse and one with the doctor, one at the radiology department, one with the billing/account department, one at the ward, one at the laboratory and the last one at the pharmacy. However, adopting PEMR is merely EMR, which comes with a lack of consistent evidence of improved healthcare quality. It requires carrying some papers and does not guarantee communication to outside the hospital facility.

However, other specialties and departments can be gradually incorporated till it is upgraded into a full EHR.

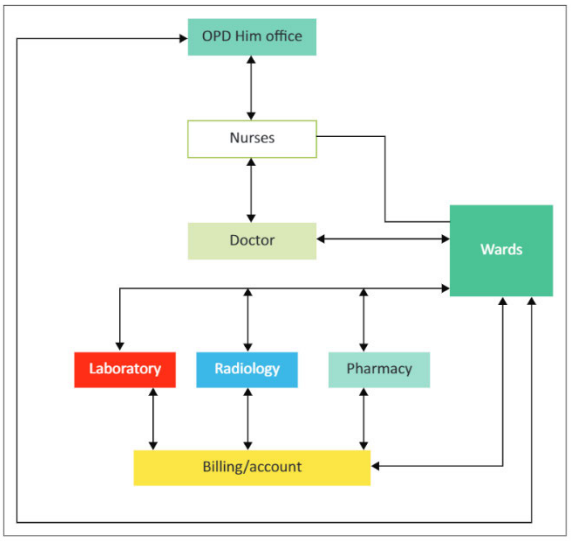


FIGURE 5: Connectivity of eight workstations using electronic health record.

Communication model template

This is the heart of the article as it shows the connectivity of various healthcare givers on an EHR platform. It demonstrates how they can manage their patients' information without running partial manual services or having the patients or their relatives run around in accessing a particular service or care. As shown in Figure 5, patients can come into the hospital either through referral or walk-in. They either come through the Outpatients department (otherwise referred to as OPD) or via the Accident and Emergency (A&E) department, depending on the case at the time of presentation. However, the requirements of outpatient services will depend on the age (either as adults or children) and/or specialty needed (be it obstetrics and gynaecological services), which may also be some specialised consultations. For both inpatients and outpatients, the outcome of management, will determine the next line of action either:

- to be admitted for more specialised and monitored care
- or released to go home
- or probable referral within the hospital for a special consultant.

These three conditions will fall within the purview of the communication template, which may not allow for the inclusion of specialised consultation to avoid cumbersomeness as they are all regarded as outpatient services. However, the way a patient's information is transferred can either be one way meaning that it is not expected to return to the sender or might be two way, meaning that the flow of information communication is supposed to bring back resulting feedback to the sender in order to allow for proper management of the patient.

Interfacing

Healthcare facilities often need to interact with each other to share patient information; however, they often utilise different EHR systems, which makes it difficult to share information. Furthermore, much of this communication happens via fax machine and long phone calls, which results in wastage of time and additional costs. Increased interoperability between EHR systems would make healthcare data universally shareable, thus facilitating patient care and allowing for seamless referrals and transitions between health providers. This article proposes a collaborative health record (CHR) scheme and cross-platform mental health app (CMHA) to facilitate cross-communication between health providers. The CHR is a centralised dashboard with a patient's story, notes and test results, managed by all the physicians and treating the patient whilst CMHA connects patients and caregivers. Every time the patient sees a doctor, the physician can add his or her report to the CHR and makes it viewable instead of getting documents faxed over from other clinics. It displays all the patient's information by opening the patient's longitudinal record, which will enable physicians to make more informed decisions about patient's health.

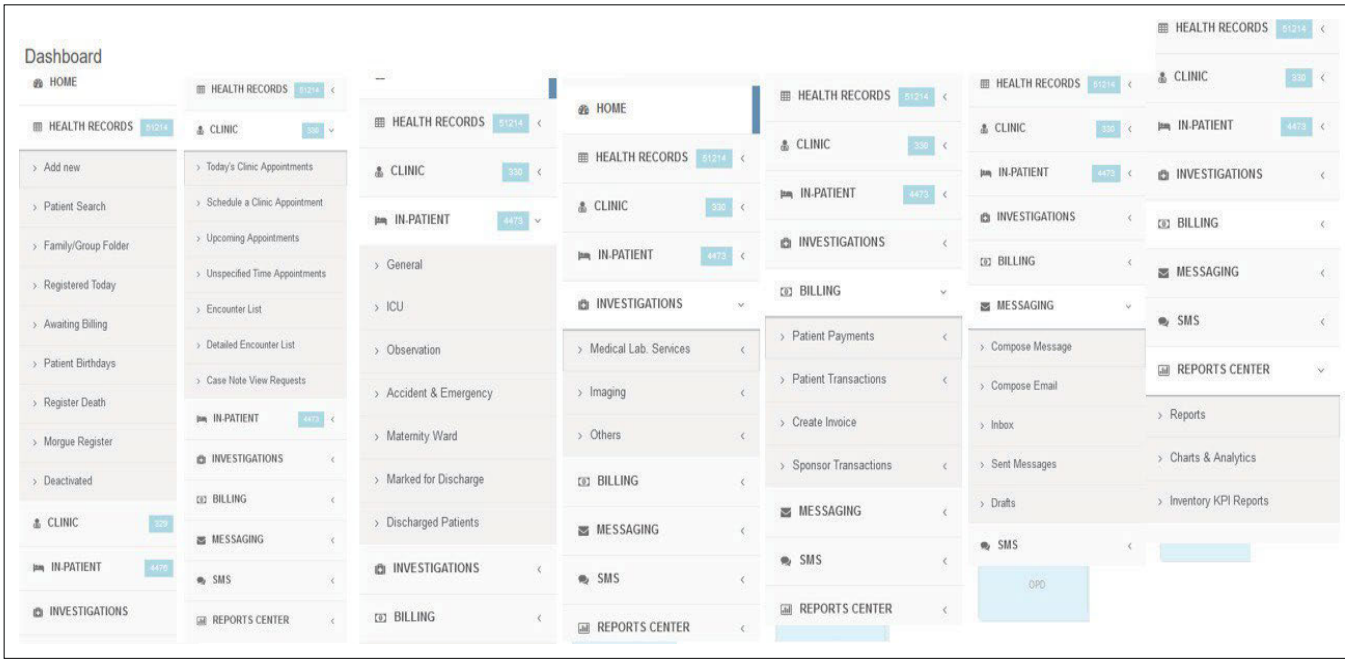


FIGURE 6: The screenshot dashboard of interface of various departments using Electronic Health Record.

A cross platform mental health app provides easy meeting schedule, engaging progress tracking graphs, smart reminders and notifications. The screenshot in Figure 6 shows the different interfaces from the dashboards of various departments ranging from health records, clinics, inpatients, investigations, billing, messaging, SMS and report centre. Each of these icons has a drop-down menu under which various input relating to it can be inputted through their interactions and findings from patients. This interface helps physicians not to lose focus on the patient currently being treated. Hence, it helps to maintain patient's records overview. This places the complete patient's history in a temporal framework and provides the physician with a detailed view of the patient's overall history. This user interface element is the main vehicle employed for navigation of the patient chart and for sustaining a physician's overview of the patient record. The proposed method provides physicians with a central access point for all records in a medical chart, irrespective of the combined source from where the events are initiated. In cases where the databases containing these records are under the control of one or more application vendors (possibly using different data formats), collaboration with the vendor(s) would be necessary. The vendors must make it possible to

authenticate the database against their data sources so that relevant data can be extracted and updated directly using the proposed interface without the physician having to start the vendor's application directly or at all. The interface also provides a way for the physician to implicitly interleave all the different sections of the patient chart and to navigate through them in time order. The proposed interface navigates automatically by pressing the Shift key whilst using the left and right arrow keys, each event is visited and displayed in time order, regardless of which section it is in. In fact, the EHR automatically goes from one section to another on behalf of the physician. This provides a temporal interleave of all the sections of the chart, which is not possible in a traditional paper chart. The system in its current form is in use in a real-world clinic.

Discussion of the template

The template shown in Figure 7 describes the proposed standard Electronic Health Record communication template for how patients move and/or communicate with health professionals within the hospital in a standard tertiary hospital. For example, patient Y who came as an emergency patient with a ruptured appendix will consult the HIM professionals in the emergency who will get his or her information documented and forward it to the nurses for vital signs to be noticed and documented. After this, the doctors attend to the patients and may require that an ultrasound scan be carried out, thereby sending a request to the Radiology Department via the EHR. At the same time, some required laboratory investigations can be sent to the lab via the platform after samples have been taken. Patients' relatives and hospital assistance take the samples to the laboratory without any hardcopy forms. Billing for the two investigations is done and sent to the Billing/accounts Department where payments are made and communicated back to the department from which services are being requested, which is carried out on the same platform. The result of the requested investigations is sent back to the consulting doctor to review and guide towards the right diagnosis and line of management. Thereafter, patients can be transferred to bed or sent to the theatre for surgical procedures before they are returned back to the wards. All the correspondence is carried out solely through the use of EHR. If there is any patient who dies whilst in theatre, the body can be sent to the mortuary after adequate

preparation, consultation and documentation has been acquired from the sender even to the recipient. After all treatment procedures, the patient can be discharged either to the home or mortuary as the case may be.

Patient X also came into the hospital as an outpatient. He or she will go through the HIM office too, documented and registered on the EHR platform before transmitting the information to the nurses for records of vital signs after which it is sent for a consultation with the doctor. If it is a patient requiring a medical certificate of fitness or medical report not just because the patient is sick, doctors can request investigations from the laboratory and Radiology Department. Billing/account people are contacted, and bills are settled and the results are sent back within a short turnaround time. After this, the doctor writes the report and connects with the management's administrative office for authorisation and stamping without necessarily having the patient moving around and the report can be printed for the patient. Alternately, a sick patient presenting at the OPD can be admitted for observation right there before his or her release home when the condition is satisfactory and stable. Pharmacy orders can be sent and drugs collected after due settling of funds for proper administration. Patients not requiring admission procedures can have their drugs picked up at the pharmacy and leave. However, some cases might require emergency action to be taken after due assessment. Thus their information is sent to the wards or A&E notifying them about the patient ahead and contacting the ambulance service for transporting the patient to hospital. At each point of admission, the kitchen service is contacted for meals, either a special diet or a general meal, in order to cater for the patient whilst in bed without putting the stress and burden of getting food on either the patients or their relatives.

Patients with mental health issues who try to escape from the hospital or violent patients' relatives trying to evade payments and abscond can be nabbed by connecting to the security office via the same EHR platform, notifying them to help salvage the situation.

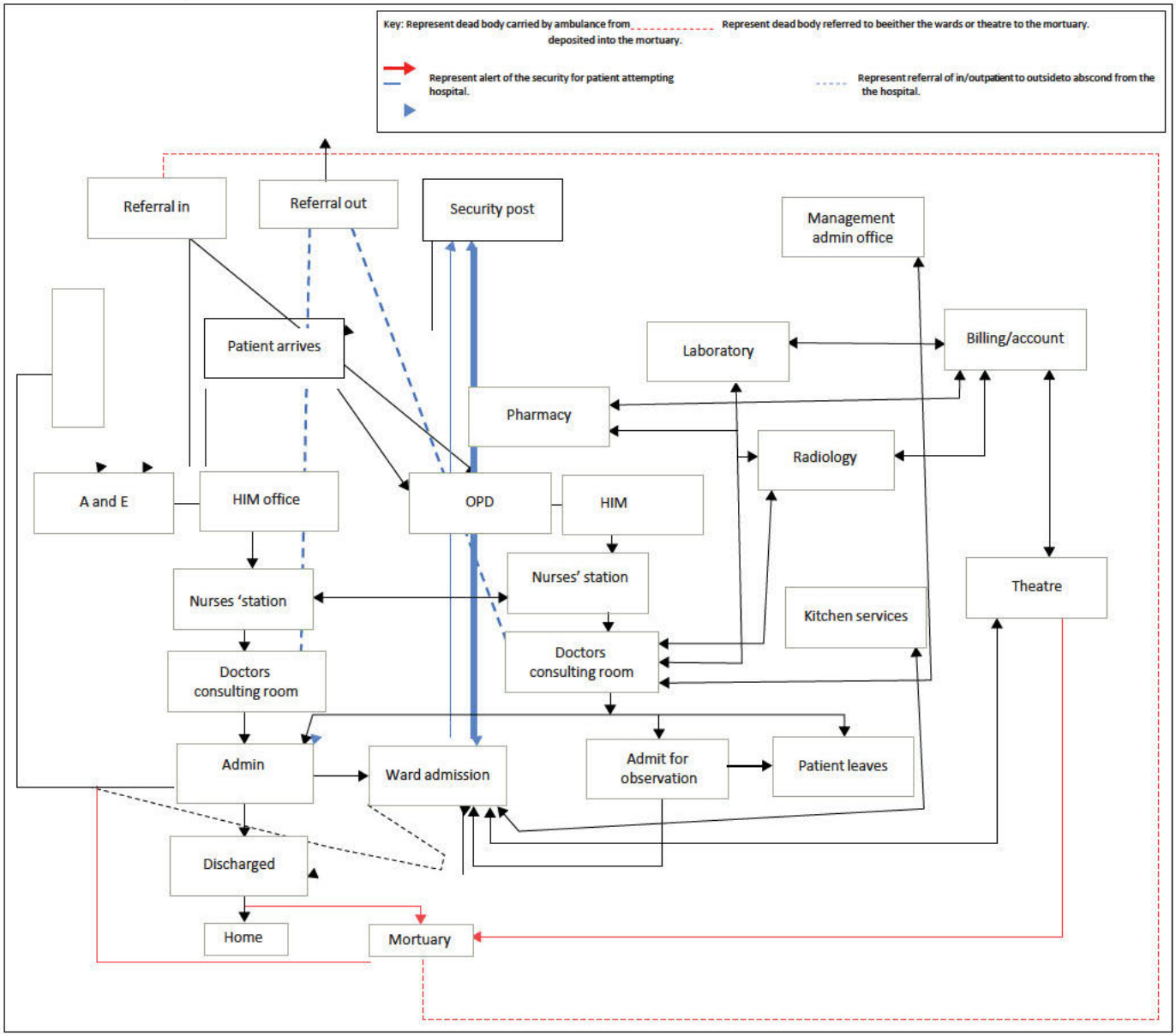


FIGURE 7: The proposed standard electronic health record communication template.

Also, patients can be referred to the hospital via the A&E Department or OPD, and doctors may at any point decide to refer a patient out of the hospital either as an inpatient or outpatient for better management. A corpse can also be transferred from outside the hospital into the mortuary after going through the necessary processes as shown in Figure 7.

The justification for the development of the proposed model for the hospital became necessary seeing the rate at which patients or their relatives suffer and are stressed in accessing care or services in the hospital; there is need for a system that will reduce their movement rates and at the same time, make it possible to get the intended care or services within the shortest time and also with reduced stress, hence the need for the introduction of the model. There is also need for standardisation in order for patients' information to be accessed from other healthcare facilities for better management of care and continuity of care through the use of EHR. With continuous use of the proposed model interface, whichever feedback is received is resolved and the system is also upgraded as required.

Conclusion

The importance of EHR is that at every point, communication is possible and made easy both within and outside the hospital for as many systems that align with the EHR system. By this, patients' health and their information can be well managed electronically without having paper records or a paper referral letter in our tertiary hospitals. As much work is made easier for both staff and patients with the use of EHR, other levels of care that require it can also adopt the method.

8.3 PAPER 2

Topic: Data management issues in electronic health records in Nigerian Hospitals.

Status: Under review in the ***Ethiopian Journal of Health Development*.**

Background: Data Management has to do with the process of inputting, storing, organising, maintaining and making available data that had been created for use. When it is done effectively, it allows hospitals or any other organisation to guard against data breaches and matters affecting the privacy of patients' information which can result in legal issues for the hospital. Data management issues in Electronic Health Records (EHR) are linked to issues relating to slack documentation, omissions and inadequate data that can make the availability of complete, reliable and efficient patient health information difficult. In EHR, challenges relating to proper and complete documentation are issues of concern. The use of Internet of Things (IoT) systems in care delivery facilitates automatically generated data and interoperability between patients, physicians, and clinic cloud servers, enabling the provision of substantial level hospital facilities.

Aim: To design a customised medicare and cloud-enabled data analytic platform in remote areas involving medical equipment integrated with multiple control systems that send valuable data to a central system. The paper also aimed to highlight various data management issues arising from various healthcare givers using EHR to attend to the management of their patients, which includes missing value, ambiguity in abbreviation usage, misspelling and so on.

Methods: Methodology involves situational analysis of the current deficiencies seven departments that are managing patients with Electronic Medical Records (EMR) are experiencing. 500 questionnaires were distributed among them.

Results: The results generated showed that some are having issues with handling referrals on the EMR platform. Several deficiencies were highlighted.

Conclusion: The paper concludes by giving recommendations for establishing a committee that will regulate and standardise the usage of medical abbreviations and the proper engagement of end users with programmers to ensure that there is adequate coverage of specific needs in order to effectively and efficiently capture patients' data.

Key Words: Data Management, IoT, Customised Medicare, Electronic Medical Record, Cloud Server.

Introduction

Globally, the need for actively bringing adequate health care and support for people wherever they are, is part of the reason why Electronic Health Records (EHR) are gaining popularity around the world. However, research studies show several healthcare users are yet to consent to the technology, especially in developing countries for reasons such as data security and the improper utilisation of available information and communication technologies (ICTs) in healthcare (Susanna *et al*, 2022, Seonheui and Soyoung, 2021, Yi-Ching *et al* 2021, Homan and McGowan, 2002). These should as a matter of fact allow access to be gained into the previous patient's medical history regardless of its source to allow for proper and adequate continuity of care. It will be recalled that patients' records in hardcopy format (case notes) contain various forms that are used by different departments all contributing to managing patients' health care better. When data undergoes processing, it becomes 'information'. However, forms for various purposes in the hard copy should be inculcated into the EHR which will accept the aim for which all the various forms were created. On the EHR platform, there should be opportunity for access to data creation, collection, collation, storage and dissemination (Anna and Silvia 2021, Melissa, 2018, Palmer, 1996). This means that adequate information should be made available for members of health teams to be able to adequately manage their patients' health. Data Management either in hard copy or electronic format has issues of inadequacies, hence, data duplication cannot be over emphasised. Duplication of data can mostly be linked to data integration procedures in the database, human imposed error because of manual data entry, various sources compiling several sets of data on one patient and similar events. The resultant consequences could have adverse effects on data evaluations, decision-making, service personalisation, user implementation, approval and customer service resulting in improper strategic conclusions (Otmane *et al*, 2022, Greenhalgh *et al,* 2002). When a consent form is to be signed by a patient for a procedure to be carried out on them, there should be provision for it under the EHR which must be adequately captured. Pharmacists should be able to access patients' prescriptions through the EHR (e-Prescription) without the patient necessarily carrying prescription sheets around (Jesus *et al,* 2022,

Greenhalgh *et al*, 2002). Also, the laboratory scientist should be able to have access to the type of investigation that is required by a patient and be able to communicate same to the attending doctor; otherwise, the aim of EHR is not fully achieved.

Norris (2002) recognised EHRs as one of the 'holy grails' promoted as a universal remedy to problems in healthcare information management, but also identified challenging areas, including safety measures and privacy issues that occur at the point of data storage and transmission. He added that lack of standardisation (coding of medical conditions, vocabulary of medicine) and the necessity for supporting and reconciling various views on the structure and the content of the EHRs, because of the different users and their different needs (physicians, patients, nurses, administrative staff), raise important problems. EHRs make it possible to collect and keep separate patient health data which are available for access whenever the need arises in any level of care. EHR comprises health information about a patient's medical/personal history, results of test from laboratory, and diagnostic films kept in a digital layout which is available to providers of health care contributing to the patient's care through a computer network. Compared to EMR, the EHR has a more wide-ranging report of the patient's general health. Thus, the EHR affords access to diverse information pertaining to numerous clinical encounters the patient has had and represents it in sequential order to support healthcare professionals in providing quality healthcare for the patients (Manohara, *et al* 2021). Although, EHRs possess great capabilities to improve patient care and its management, when necessary patients' clinical data is missing, it jeopardises its aim. This study proposes a customised medicare and cloud-enabled data analytic platform in rural areas involving medical equipment integrated with multiple control systems that send valuable data to a central clinic system. It also assesses the various data management issues that may be encountered in EHR utilisation.

Data Management in Hospitals

Clinical data archives are managed by healthcare networks in agreement with the hospital-wide EMR architecture. Information is compiled at various network facility centres and integrated into an EMR system. All facility units must have information

marts that feed data to the EMR data base which can then be used for disease control, quality control, patient monitoring, and wellness providing information. Since the data must be integrated from multiple sources, it may comprise raw data, missing information, duplicates, and discrepancies (Nada, *et al* 2022). If the duplicate data is kept in the repository, the storage overhead will increase or quickly fill up. Accessing such information for research is difficult, as it can lead to contradictions and erroneous data assessment. As a result, introducing de-duplication techniques prior to backing up in an EMR repository is critical. Management of the hospital's large and diverse data sets that are growing at an exponential rate may be referred to as a health care big data management. This includes the amounts of data, the rate at which it is generated and collected, and the sample size enclosed. Big data is analysed in digital formats using software developed exclusively for managing large, complex data sets. Commercial systems, customer accounts, health records, logs of online network usage, cellular phone applications, social media, scientific information, machine data, and real-time data obtained contribute to hospital big data. In health care big data evaluation, information can be employed in its raw form or pre-processed to be available for market data use, employing data mining algorithms or information processing tools. The speed required to process a hospital's big data adds complexity to the crucial computing platform. The computational power required to process massive amounts of data quickly can tax a system or network of data centres. As a result, clinics must employ intelligence computing capacity to attain the pace at which big data tasks can be managed. As a result, many data centres may frequently concentrate on Hadoop and Apache Spark technologies, in which a task is transferred across multiple nodes in a grouping fashion. Achieving such a rate while remaining cost-effective is also a concern. Many clinics, especially those which do not operate 24 hours a day, are wary of investing in data centres worthy of storing and retrieving information. As a result, big data systems are now hosted on a cloud-based server. A cloud can store up to 1015 bytes of data and scale up servers until a task is complete. A hospital can be charged for the amount of data stored and the time it takes to process it. However, when the cloud is used again, its instants will be decommissioned. The open cloud service provider offers big data capabilities, such as EMR by Amazon, Azure HDInsight by Microsoft, and Cloud Dataproc by Google. EHR contains sensitive personal information such as

a patient's medical history. As a result, the confidentiality of such information is critical. Without efficient information analytics that can connect with the audience and go beyond the walls of medical institutions, digitalisation in health care services cannot be accelerated. Data analytics in healthcare, including the general populace's health data, can greatly facilitate clinical information, promote creative treatments, cut costs, and more notably, save lives (Sabah, *et al* 2022). Hospitals in developing countries are required to follow the government's rules. As a result, archiving and disseminating EHR data is difficult. EHR managers face numerous technical challenges such as server limited capacity which is vulnerable to single-point failure and cyberattacks. Most of the patients are unaware of where their sensitive information is stored or how it is shared. Due to the fact that people make use of different social platforms, interoperability among health professionals and patients can provide improved health recommendations. Mostly, in remote areas where the deployment of physicians is limited, a cloud based customised medicare can be implemented as proposed in this study to capture accurate medical information for the improvement of patient care.

Utilising Big Data Analytics in Healthcare Sector

Maternal EHR relevant use is critical to enhancing medical processes and patient care delivery. Big data analytics is an instrument that helps health professionals achieve EHR's objectives by using data mining algorithms. Many hospitals in the United States use medical sensor data acquisition methods to discover patients' movements and regulate their activities while they are in the clinic. They can thus offer quality healthcare more effectively and quickly, improve current processes, and avoid some potential health risks. Undoubtedly, the use of big data analytics within EHRs is based on the data life cycle approach, which has four main elements: data collection, data transmission, data storage, and data utilisation (Quan, *et al*, 2019) as illustrated in Fig. 1. The above reasonable elements that influence development help health professional comprehend how to turn EHRs into significant clinical understandings using big data analytics.

Data Collection Method

This element includes all of the information sources and EHR categories. In a broad sense, EHRs are distributed into structured information (for example, patient demographics, treatment plan, health status, and lab tests) and unstructured

information such as diagnosis notes, clinical graphics, and x-rays. This information is gathered from different medical wards within the health centre as well as from external units.

Data Transmission Method

One of the key considerations in delivering effective services to users is establishing the appropriate transmission order for information sharing between objects. With the growing popularity of social provider digitalisation in current history, information suppliers such as the Internet, the IoT, financial management, supply chain, electromagnetic, and other aspects have experienced index-level development economic expansion. Hence, the transmission of big data is a critical component of the fundamental issue of big data processing. High-performance communication systems can ensure successful data processing, particularly real-time evaluation. A large data transmission mechanism must be implemented and fulfil data model safety, data transmission reliability and data network adaptability. General data protection initiatives must be introduced to avoid data leakage. The speed and accuracy of information transfer have upgraded as processing storage systems and data transfer routes have been improved on a regular basis. When acquiring the information source, the information pipe should provide a secure transmission in effort to attain certainty.

Data Storage Method

Depending on the origin of statistical information and the configuration of the message, EHRs are preserved in computerised locations. This component's purpose is to manage information from diverse sources in the following stages: Transformation and Storage. EHRs can be moved, cleaned, split, translated, merged, sorted, and validated using the conversion machine. Organised EHRs information would be retrieved from a hospital information system and transformed into a standard quality data format, arranged by requirements such as the patient’s personality, health status, prescription drug history and afterwards the documentation would be placed in the appropriate location. The EHRs are therefore loaded into the intended databases such as Database Management System (DMS), Hadoop Distributed File Systems (HDFS), and cloud for further evaluation (Min, *et al*, 2020).

Data Sharing and Utilisation Method

This aspect is used to manage various types of EHRs and present the results for patient assessment. Due to the type of information and the objective of the evaluation, EHR assessment may include Map/Reduce, channel programming, and in-database analysis tools. Map/Reduce can process vast quantities of unstructured and structured EHRs in batches in an enormously parallel computing atmosphere. For EHRs, channel information technology can sustain near real-time analysis. Hospital personnel can continuously monitor EHRs in rotation using flow information technology to react to incidents and decide the right next steps. In-database analytics is a widely used data mining technique which allows EHRs to be evaluated within the directory. It could provide high-speed multiprocessing and a stable environment for handling private patient records. This element also creates a wide range of imaging reporting as well as real and significant market intelligence points of focus on the findings. The investigating system is a vital big data analytics option that enables EHRs to be meaningfully viewed to sustain hospital personnel day-to-day transactions and clinical decisions (Evaristus, *et al*, 2021).

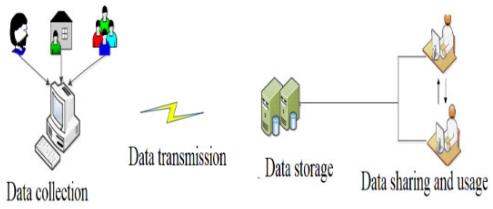


Fig. 1: Cycle in Hospital/Clinic Big Data

Data Management Issues in Manual Record Keeping

For starters, several medication instructions are documented in the text files (Indicates) of EHRs in a range of forms. Manually viewing a chart to gather additional patient data takes time and is not recommended for real-time medical system data requirements (Jingqi, *et al*, 2020). Manual Record keeping involves the use of hard copy records otherwise known as case note which is used for storing patients Health Information which is then retrieved whenever the need arises. In the manual way of keeping records, issues like illegible handwriting, incomplete or incorrect documentation, non-availability of various forms for

capturing relevant data, wrong prescriptions and lack of standardisation of medical terms are common issues. Partial documentation of patients' health information may not reflect a patient's true health and could, in the worst cases, lead to late action taken or improper management of the patients' health. When bias is introduced in documentation, data management becomes challenging. In a study comparing manual with computerised record keeping, manual record-keeping caused the loss of clinically important information (Schalkwyk, *et al*, 2011).

EHR and data management issues

Big Data has been a well-known concept related to the huge collection of information at the point where conventional data analysis methods are ineffective. Volume, velocity (streaming data) and wide range (semi-structured and unstructured data) are the main worries in big data. EHRs involve the use of various computers networked together over a terminal. It facilitates patient management, by providing appropriate access to longitudinal patient data that assures timely and efficient diagnoses, effective patient result assessments, and correct therapeutic treatments, devoid of repeated examinations or tests (Da, *et al,* 2021) As much as EMR is expected to remove the data challenges associated with the manual way of keeping records, it still poses its own challenge as observed by many who had been using it in attending to patients. This includes but is not limited to inadequate documentation which may be due to laziness on the part of the person, its accessibility and availability particularly from authorised persons needing it in appropriate forms without wasting time, and lack of privacy from unauthorised persons. There may also be limited use from various hardware and data forms thereby preventing its interoperability among diverse systems. Another identified issue is the concern of security and confidentiality whereby a patient cannot ascertain who had privy access to their data and for what cause. A lack of provision for data cleaning in case of duplicated data and its validation may also be another challenge. Not having EHR content as instantaneously as possible could be another challenge particularly when there is limited access to Internet facilities or an unstable network, having consistent several data from many sources because of the different area of interest from various physicians and specialist may also be another challenge. Having any or all of these challenges solely depends on the kind of programmer being used for each organisation, hence the need for standardisation and uniformity in the software so that whatever information appears in facility A, can be the same with facility B, without necessarily having different metadata (Orfanidis, *et al*, 2004)

Interoperability of input of various departments using EMR

The Interoperability of the system has to do with the ability of one computer to communicate with another from different terminals. It can be used to represent

hardware and software entities characterised by communication, programmability sensing and actuating capabilities. In Fig. 2, it is seen that a central working network must be available with which all departments each with their system and various data will be connected, in order to enhance coordination of care rendered to patient. The place of interoperability in the Application (App) used by various departments cannot be overlooked. Despite having the input of various healthcare professionals from their various Apps, the information is harnessed to ensure better coordination of care. The proposed interoperability in this paper where each huge IoT connects software that has been uploaded has a configurable interface in terms of performance, so that smart device detecting appropriate data is forwarded to that specific module for computation. It can also obtain intelligent assessment with the 5G core broad band services; to provide and store the resulting intelligent data at the cloud for further processing.

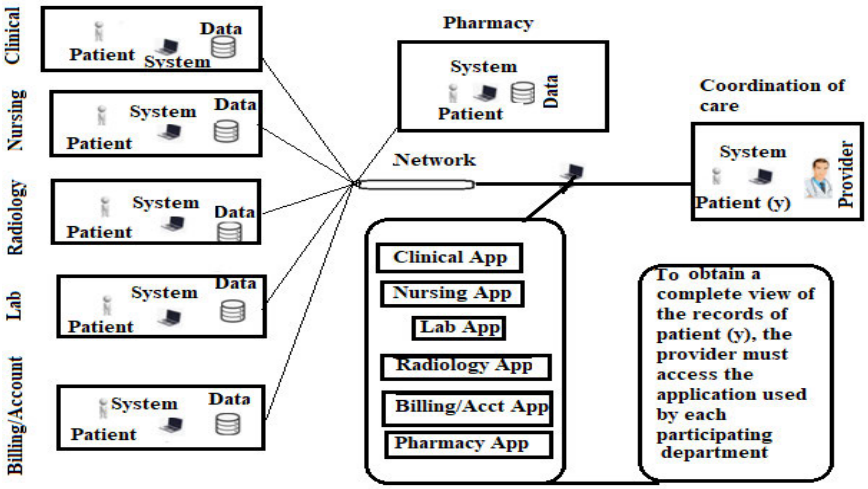


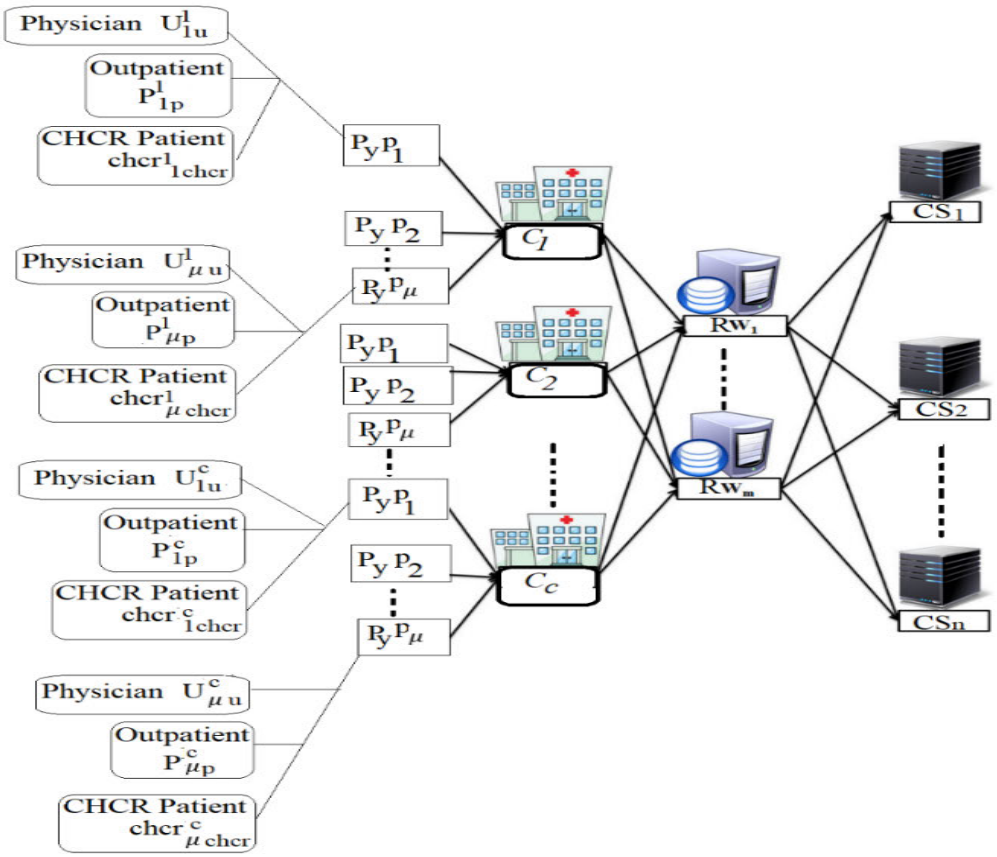
Fig. 2: Showing the interoperability of various departments in patient management with EHR *(Author designed).*

Problem Formulation

This must take into account a cloud-based medical management sector with $'c'$ clinics in a given C, where $C = (C_1, C_2, \ldots\ldots, C_c)$ and $c \in C$. Fig. 3 depicts the formulation of the communication model between a remote clinic cloud server and the integrated interoperability system. Let various units be affiliated with one clinic, with the assumption that each clinic has the same and equal No of units. Let $N = (N_1, N_2, \ldots., N\mu)$ be the set of the unit No related with each clinic. Furthermore,

each unit is associated with a different physician outpatient treatment, and Chronically Healed Care Recipients (CHCR), which are the main derivation of the clinic big data. It is worth mentioning here that the out-patients are patients who come to the clinic for medical consultation but do not stay overnight. CHCR patients are chronic patients who have intelligent sensing devices installed to their bodies to observe their health status all around clock. Let (P_y) be the No physicians present in a set U_{ij}^k, where $j = (1,\ 2, \ldots . d)$ in the i^{th} unit of k^{th} clinic, $\forall_i \in UP_y$ and $\forall_k \in C$. Hence, $U_{ij}^k = \left(U_{1c}^k \cup U_{2c}^k \cup \ldots . \cup U_{\mu c}^k\right), \forall_i \in UP, \forall_k \in C$. The ${P_y}_{21}^{\ 3}$ denotes Physician 1, that belongs to Unit 2 in the clinic 3. Let P_{ij}^k be the usual of patients (p) , $j = (1, 2, \ldots \ldots, p)$ in i^{th} unit of k^{th} clinic, $\forall_i \in P_y p$ and $\forall_k \in C$. Thus, p No of patients that are present in the i^{th} unit of k^{th} clinic. $P_{ij}^k = (P_{1p}^k \cup P_{2p}^k \cup \ldots . \cup P_{\mu p}^k)$, $\forall_i \in P_y p$, $\forall_k \in C$. i.e., P_{21}^3 denotes Patient 1 that belongs to the Unit 2 in clinic 3. CHCRs are taken to a clinic, which may be a patient or a CHCR at the same period. Likewise, let $chcr$ denote the number of CHCRs in a set CHCR. Where $CHCR_{ij}^k = \left(CHCR_{1chcr}^k \cup CHCR_{2chcr}^k \cup \ldots . \cup CHCR_{\mu chcr}^k\right)$, $\forall_i \in P_y p, \forall_k \in C$. And a diverse No of CHCR exists in numerous units within a clinic such as $CHCR_{21}^3$ signifies the CHCR 1 that belongs to Unit 2 in the clinic 3. A window-based temporal data collection and tracking design is used in this proposed system to upgrade the effectiveness of healthcare management. Let $T = 0, 1, 2, \ldots, t$ be a consistent timeline separated into w No of windows, which each have z components of timeframe. Depending on the application, each moment timeframe can be a minute, an hour, a week, a month, or a year. Thus, ${P_y}_{ij}^{\ k}(w), P_{ij}^k(w), and\ CHCR_{ij}^k(w)$ demonstrates the quantity of data produced by the physician, patients, and CHCR within every window (w). As shown in Fig. 3a, the information obtained within w is represented in various cloud servers. Let $(CS_1, CS_2, \ldots .,\ CS_n)$ be the Q No of geo-distributed information centres represented in the cloud. Where $n \in Q$: these information centres are linked by Y No of routers $R = (RW_1, RW_2, \ldots . , RW_y)$, where $y \in Y$. In this approach, C Nos of clinics are linked to Q Nos of geographically distributed data centres via R numbers of routers. As is well known, the privacy and security of medical records is a worldwide concern. Thus, cloud technology is being used to protect activities such as correspondence confidentiality, protection, and interoperability of an electronic medical record in a clinic. The proposed

integrated interoperability flow chart for the clinic cloud database is shown in Fig 3b, where smart sensing applications are based on various smart IoT devices which obtain data, which is then transmitted to the cloud system, where resilient and smart server nodes contain and create separate configurable codes that transform the signified data stream into syntactic and semantic frames. It becomes a remedy for implementation interoperability on which abstraction, processing, and analytics are performed to obtain updated results that are upgraded at the same time by the high speed $5G$ core activities according to the information detected and forwarded by a specific smart device.



(a)

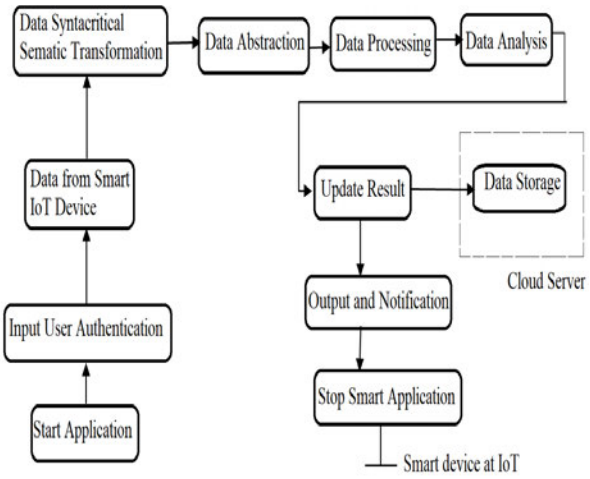


Fig. 3: (a) Communication Model between Clinic and Cloud Server (b) Integrated Interoperability Methodology

Customised Medicare for Remote Clinics

A customised Medicare system that makes use of interoperability and cloud-based to manage medical data is proposed for clinics located in remote areas as shown in Fig. 4. It shows an innovative patient-centred medical strategy which can be employed in a clinic located around a rural community that seeks to enhance the conventional medical system. The patient information obtained from patient EHR, IoT sensor devices, wearables and mobile devices, web-based information, and social media is the concentrate of this new innovation. The proposed Customised Medicare uses Artificial Intelligence (AI) strategies on the available dataset to achieve a better disease progression, disease prediction, patient self-management, and clinical treatment. It is incorporated with Machine Learning (ML) technologies which is used in this context to establish optimisation algorithms. This approach could be employed in the remote area medicare development services and health care delivery. The design system primarily analyses data gathered from sensing devices and other sources in order to determine behaviour responses and medical complications in patients. It analyses the information to recognise the patient's significant improvement, attitudes and anomalies in regular activities. It can also monitor the variations in the patient’s falling asleep while under treatment, movement, eating, drinking, and gastrointestinal system. The proposed customized medicare for remote clinics can enable medical professionals to gather clinical information/data with ease for proper monitoring and data management.

The system compositions are made of ML and IoT, diagnostic care, assistive care and monitoring in Fig. 4a. IoT is a system of world wide web medical instruments, attached devices, and software packages that links hospital information technology. With the expansion of the 5th (5G) telephone system, IoMT has evolved into new advanced technologies that streamline operations and enhance the patient's satisfaction (Fei, *et al*, 2022). In diagnostics care, bio-module gadgets could help the patient undertake a few diagnostics. Doctors, for example, are in short supply in rural areas. Pathologists and medical instrument operators are also in short supply in rural areas. These obstacles can be resolved with customised medicare proposed in this paper. The incorporated diagnostic services enabled by IoT and ML can significantly enhance personalised medical care. Countless people's lives have already been impacted by ML and IoT-based assistive services (Shahrestani, 2017). Because of modern technology, the impact is also increasing. Nevertheless, assistive customised medicine must also resolve functionality, conceptual anticipation and real value, and accessibility. Moreover, the confidentiality and verification issues with the relatively small amount of equipment can cause deep concern because they can be hacked and modified if not fully protected.

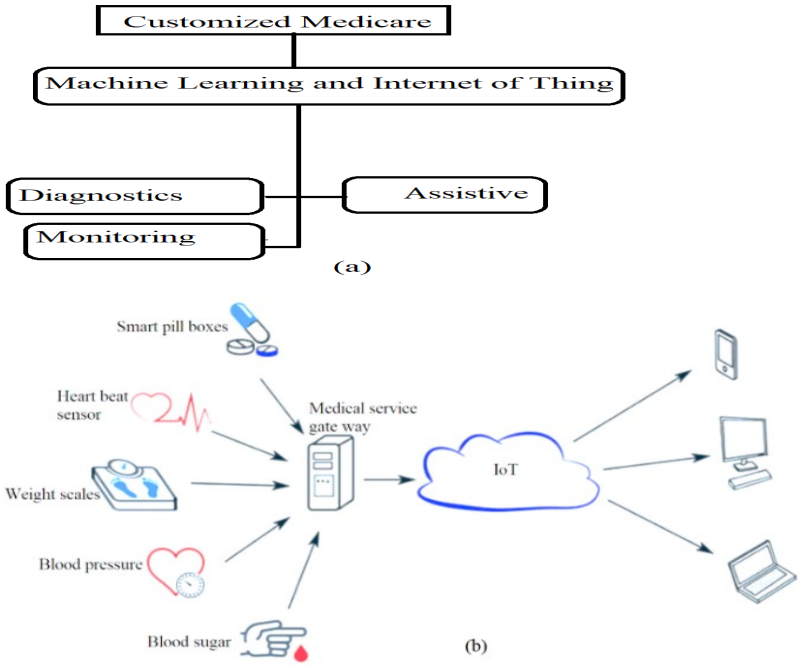


Fig. 4: (a) Characteristics of IoT and ML in Customised Medicare (b) Dataflow and process in Customised Network.

Distant location monitoring is essential in the provision of customised medicare services. Remote management as part of customised medicare is available to hospitalised patients, people living remotely, and older adults living in community care. Patients' personal data can be uploaded into the cloud server via the wireless connectivity of medical status via IoT devices. Moreover, depending on the stored customised medicare data, cloud-based data services can undertake intelligent predictive analysis. In this approach, the data link has to be effective in order to pass data on individual users. The sensor captures and transmits data including heart rate, EEG, blood sugar, and pressure to a database/cloud server. The information is saved there for the individuals involved to access. Simultaneously, the database employs a ML technique to analyse the captured data, establish a patient's risk factor, medical improvement, and further actions based on the result. Fig. 4b depicts a comparable architecture that consists of data sources, a central repository, monitoring and analytics. (**Data Source**: These are advanced technologies and facilities that gather and securely transmit significant data from a wide range of sources such as patients, equipment, hospital staff, vehicles, and so on. **Central Repository**: A repository where all transmitted information is analysed and saved for later coding. **Monitoring and Analytics**: A mechanism that processes relevant data to provide rich insights and prompt action.) In this simple scenario, each step has its own series of issues and difficulties. Sending data and packet drop issues, as well as data protection and verification concerns with sensing devices, must be handled. Machine learning is tightly linked to statistical analogy, decision-making process from available data, and forecasting based on prior knowledge. In the case of healthcare management, the machine learning-based technique will assess the issue using the trained dataset. Most of the time, the training dataset is critical in effectively forecasting future trends of a provided different concept. This dataset could be influenced at occasions but might not be versatile enough to describe a broad range of situations. Information that is noisy, dirty, or inadequate may lead to lesser prediction ratios for detecting and forecasting a wellness diagnosis and advisory notice. Sleep trends and sleeping routines vary between individuals. Their maturity level, and general health will affect the particular instance of sleep monitoring and sleep apnea monitoring. As a result, a comprehensive dataset of all case reports might not even be accessible to detect sleeping habits, which might result in incorrect customised medicare

evaluation. Forecasting analysis enables clinic scheduled release for sick people who need to be readmitted to the clinic when using machine learning-based customised medicare services. Forecasting is useful for developing a risk prediction design in which certain patients are handled with greater care.

Incomplete and poor documentation in Hospital Data Management

In several situations, the accurateness of time data has resulting medical, medico legal, and research consequences; for instance in childbirth, death, surgery, anaesthetics, or even in resuscitation procedure, due to the varying non-synchronised method adopted in knowing the time. Having many inaccuracies makes it difficult to precisely restructure the order of events thereby increasing the risk of liability in case of lawsuits. Some of these incomplete and poor documentations can be in form of:

Missing Value: this involves the absence or omission of an important attribute e.g., the sex of a patient not filled.

Syntax error: this is going against the data recording format for example writing a date of birth in form of YYYY/MM/DD instead of DD/MM/YYYY.

Misspelling: this can be due to typing errors, or not having knowledge about the correct spelling, e.g., typing Prostrate instead of prostate in a type of cancer.

Ambiguity in abbreviation usage*:* Several medical abbreviations have different meanings, using this type of abbreviation can lead to wrong documentation. Such as the use of abbreviations should be clearly spelt out to avoid confusion. e.g., OLB may mean Open Liver Biopsy and may also mean Open Lung Biopsy etc.

Incorrect value: Documenting a wrong age for a patient may affect the treatment given to the patient (Ricardo, 2009).

Some common effects of wrong/poor documentation of patient:

When you wrongly document or have an incomplete documentation of a patient, either as a Health Information Manager (HIM), a Doctor, Nurse, Physiotherapist, Radiographer or any other Health care giver using EHR, the resultant effects are as follows:

- It can lead to medication errors thereby posing a threat to the life of the patient.
- Reduction in quality of care rendered to patients.

- There is lower agreement between administrative data and chart review data.
- There is possibility of decreased turnaround time.
- Reimbursement might be delayed for getting claims.
- There is partial communication among providers on the patient because of poor documentation.

Methodology

The relationship between knowledge mode of EHRs and meaningful use of EHRs among healthcare workers in Ekiti State University Teaching Hospital is investigated. A situational analysis of the existing current deficiency experienced in data management in the various departments of Electronic Medical Records (EMRs) is carried out using Ekiti State University Teaching Hospital as a case study. This includes sampling the opinion of categories of EMR end-users on patient management. The data collection method is the primary source of data through the use of structured questionnaire distributed among the 7 categories of health care workers involved in using EMR in patient management. Randomly, 500 respondents are selected among the HIM, Billing/Account, Nurses, Laboratory, Pharmacist, Radiology and Doctors. Data collected is analysed in Excel spread sheet software. The result generated is collated, analysed and evaluated for possible recommendation.

Result and Discussion

56% of the respondents, which constitute the largest percentage, had some deficiency being encountered in the use of conventional method of data recording in the discharge of their duties, 31.2% were of the opinion that it is faster, less time consuming and more accurate to take data from smart medical devices EHR while 12.8 % from the remote clinic accepted the use of customised medicare to acquire patient data. Most of these people in the central hospital had lodged complaints about the various challenges encountered; some of the results had been improvised while some were yet to be attended to, thereby causing difficulty and inadequacies in collecting correct and complete patient information. It was observed that the majority of respondents recommended training in EHR. About 67.8 % of the respondent confirmed the lack of accessibility to LAMA/DAMA form

that should be filled on the platform, thereby making them use manual methods in this regard as shown in Table 1 and Fig. 5. In addition, it was the opinion of 319 of the 500 population that handling referral was a challenge. Other responses refer to the preference of the respondent for the use of EMR with 46.6 % as the highest percentage preferring this. The majority had an interest in its usage and about 38% disagreed on network issues. This means that there is reasonable availability of networks with which to work but having 37% of the respondents agreeing to network issues cannot be overlooked while 18% recommend the adoption of smart customised medicare. This study shows that there should be proper discussion and engagement of the software developer for each clinic trying to adopt the use of EHR so that their needs will be well captured and thereby allow perfect running of the system in the organisation. The outcome showed that a reasonable number of health workers showed interest in making using of EMR, some recommend more training in EMR handling while some show no interest at all.

Table 1: EHR Adoption Analysis

QUESTIONS	AGREE	DISAGREE	NEUTRAL
Deficiency with EMR	280 (56%)	156(31.2)	64(12.8)
Training	375(75%)	90(18%)	35(7%)
Recommendation			
Preference	233(46.6%)	207(41.4%)	60(12%)
Interest	302(60.4%)	115(23%)	83(16.6%)
Networking issue	185(37%)	240(48%)	75(15%)
Challenge handling	319(63.8%)	116(23.2%)	65(13%)
Referral			
DAMA/LAMA Issue	339(67.8%)	127(25.4%)	34(6.8%)

Conclusion and Recommendations

With the growth and development in the health sector, the advent of the Internet, cloud computing, and IoT technology, as well as the widespread adoption of medical/health information technology, medical/health related data is growing at an amazing rate. Simultaneously, the rising popularity and application of sensing device technology, as well as the rapid growth of wearable mobile medical and mobile health technology, propel the field of health care into the big data era. The system proposed in this paper is a strategic model for improving patients' health, utilising EHR knowledge to enhance medical service. This model employs cutting-

edge technology to activate advanced features, propelling health care to new heights. As hardware and sensor innovation advances, we will develop better skills for recording a wide range of relevant and rich datasets that can be used to make the system smarter. Analytics and software improvements could be used to transform data into further significant observations. Interoperability of huge datasets across multiple data sources, as well as effective delivery of health multimedia data, are critical research issues in EHR systems.

8.4 Paper 3

Title: Using Electronic Health Records to Improve Health Care Information Management

Status: Under review in *the* ***International Journal of Electronic Health Care*****.**

ABSTRACT

Diverse patients' health information requires an appropriate approach that meets the plethora of needs of both healthcare providers and patients for effective management. The exchange of medical information between professionals is critical to the delivery of quality care. Ekiti State University Teaching Hospital (EKSUTH)'s information exchange is currently paper-based and error-prone. As a result, an Electronic Health Record (EHR) is being developed where data can be transferred between members of healthcare in the hospital. This paper demonstrates how EHR improves the management of patients' health information. A cross sectional study design was used where a total population of HIM professionals at EKSUTH were given questionnaires on related questions. The results showed that there is environmental support for ICT and the benefits and barriers towards the implementation of EHR were identified. Summarily, healthcare information management will thrive in the face of EHR when adopted and integrated into healthcare services.

Keywords: Healthcare Information Management, Electronic Health Record (EHR), Healthcare professionals, ICT, Health Information Management Professionals, Healthcare providers, Information Technology, Healthcare quality, patients' health Information, Healthcare services.

Main Manuscript Text:

INTRODUCTION

Healthcare is primarily concerned with maintaining and improving people's health through the prevention, diagnosis, treatment and cure of diseases. This is a service typically provided by healthcare professionals and people in the related health field. Quality healthcare helps prevent disease and improves

people's quality of life. Effective communication between healthcare providers can help improve care delivery and the well-being of those seeking care. Healthcare information management is the responsibility of everyone involved in patient care management. In the past, patient information was carried from one location to another on paper. This has created some challenges for both the patients and the healthcare management team, including poor communication, illegible handwriting, output errors, missing records, and avoidable workload for healthcare team members such as physicians, healthcare information management professionals, nurses, laboratory scientists, pharmacists, and others within the healthcare organisation. The goal of collecting and storing patient information is to make it available for making good treatment plans at the point of care and disease profiling for strategic interventions. It is important to recognise that most individual patients have multiple sources of care. It is vital that their personal patient information is available at all points of care. For this to work, patient information should be linked to improved communication. Essentially, regardless of where a patient accesses care, whether at the primary, secondary, or tertiary level, their information should be available at all times and well managed for better management of healthcare. The timeliness and availability of information will enable healthcare providers to make better decisions and provide better care. Given these high expectations and current technological advances, this is only possible through the use of electronic health records, which have been growing rapidly in developed countries but are just beginning to gain popularity in developing countries.

BACKGROUND

Communication and access to patients' health information and management of their records should not be limited to one department or healthcare facility, but should be managed using a good software system from wherever they wish to access care, without necessarily going into a specific one or having to go to a hospital where they have previously received care. There should be a standard model that allows for the electronic transmission of patients' health information and records management, either within a hospital (Electronic

Medical Record, EMR) or well beyond the geographic area of the institution (Electronic Health Record, EHR). In the last two decades, the adoption of electronic medical records has been advocated. Meanwhile, healthcare organisations/providers have improved the standards for records made in clinical settings. Most hospital patient records include details, name, address, family history, complications, and patient care outcomes. Patient documentation in hospitals is gaining popularity as it is vital to the safety of both patients and healthcare providers. It can therefore be used in all countries after healthcare providers realise that they can better treat patients with competent and accurate medical stories (Emeka and Lalit, A Systematic Review of Blockchain in Healthcare: Frameworks, Prototypes and Implementations. 2020). One of the main advantages of using computer systems in healthcare lies in the ability to provide healthcare professionals with useful information for decision-making, so their main goal is to increase the quality and efficiency of healthcare. To fulfil these purposes, health information systems must meet interoperability standards, quality, security, scalability, reliability, timeliness, data storage and processing conditions (Sandra, The Electronic Health Record and Its Contribution to Healthcare Information Systems Interoperability. 2013). Patient healthcare management strategies have been accessed in traditional paper-based record keeping (TPBRK) for many years. Its simplicity, low cost to set up and maintain, universal recognition and acceptance, and ease of data entry have stood the test of time. Nonetheless, the fragility of paper-based large- scale storage mastery, the time it takes to organise paper records, the consistency of data recording, the susceptibility to errors, insufficient multiple access at the same time, the absence and misplacement of paper records/medical notes, inability to access them remotely, attaching number of new paper pages to patient records, which can lead to overloading of the shelf or an additional storage facility are among the disadvantages of paper-based documentation (Neha, *et al*. 2021). The main problem with paper-based procedures is the timing of the accessing of patient data, which the physician needs immediately to assess the historical patient data, the prescription, and a decision. Time is very important in healthcare. Paper-based documentation cannot be considered a safe media format, it can

be exposed to moisture, water and fire (Brent 2021). Conversely, all medical information must be enclosed in a storage/secure area to ensure the privacy, integrity and protection of the medical data.

Norris (2002) recognised EHRs as one of the holy grails, touted as a universal cure for healthcare information management problems, but also identified challenging areas including security measures and privacy issues that arise at the point of data storage and transmission. EHR includes health information about a patient's medical/personal history, laboratory test results, and diagnostic films stored in a digital layout and available over a computer network to health care providers contributing to patient care (Norris 2002). Electronic Health Records (EHRs) involve the use of various computers networked together through a terminal. They facilitate patient management by providing appropriate access to longitudinal patient data, enabling timely and efficient diagnoses, effective patient outcome assessments, and correct therapeutic treatments without repeated examinations or tests (Da, *et al*. 2021). The data, its timeliness and availability will enable healthcare providers to make better decisions and provide better care. Boonstra *et al*. (2014) wrote that EHR implementation initiatives are typically driven by the promise of improved patient data integration and availability, by the need to improve efficiency and cost-effectiveness through changing the doctor-patient relationship toward shared care team of healthcare professionals and/or by the need to deal with a more complex and rapidly changing environment. These showed that it is worthwhile to implement EHR considering that it has more positive effects on health management, especially with regard to patient information and file management (Boonstra, Boddy and Bells, Implementing Electronic Health Records in Hospitals: A Systematic Review. 2014).

1. Transition from Paper-Based to EMR systems

The integration of data in a paper-based medical record with an electronic record offers significant clinical and operational benefits for the healthcare provider and patients. Effective integration of paper-based to electronic medical records (EMRs) in the healthcare system involves thorough monitoring, coordination of various facets, execution, training and maintenance (Elena, *et*

al. 2021). Paper-based integration with the EMR brings with it the processing of changes, use of a new technical tool, and procedural training that could lead to changes in the roles of healthcare professionals within the practice. Acceptance of EMR will be difficult without assessing clinical workflows, information needs, and insufficient planning during go-live, which can result in falling back to paper. By considering the workflow along with understanding the expected benefits, the EMR implementation could be a success.

2. Electronic Medical Records

The acceptance of ICT in the healthcare institution provides effective and safer delivery of healthcare services, improves procedures, practices, regulations, standards and protocols, leading to system transformation (Thielst 2007) (Omotosho, *et al*. 2019). ICT is becoming a key enabler for active business and clinical ventures. The development of EMR technology replaces many of the tasks of the traditional paper card and the application of EMR systems guarantees significant advances in patient care. EMR mostly occurs in an electronic version of the paper-based record. EMR could take lots of information like full name, full address, date of birth, gender, person to report to in case of emergency, insurance, medication, details of current and past history, allergies, lab and test results, immunisation, medical, surgery and hospitalisation history, as well as the documentation of the patient's progress assessment, vital signs, care plan, education and research, which can be accessed from different locations within the hospital, respecting the security, privacy and confidentiality of the patient (Binkheder, *et al*. 2021). EMR is a computerised medical record that can be accessed by numerous integrated systems at any point of care within the healthcare organisation when caring for patient privacy, confidentiality, and security (Nordin, *et al*. 2021). The condition of practicing before EMR is cumbersome, e.g. difficulty in reading various handwritten notes, manual filing system, and most information is written by a health care professional, which is usually transcribed and could be difficult to interpret (Williams 2021). The process of filing and retrieval can result in delays in treatment, increased length of hospital stay, and increased medical errors due to missing or inaccessible data, while EMR can facilitate a

centralised archive of patient information and enable documented records of patient care that reflect current and future medical care support professionals and provide a medium of communication between healthcare professionals that contributes to the healthcare of patients.

3. Electronic Health Cross-service Management (EHCM)

EHCM is aimed at the hospital staff, where data can be exchanged between health actors and doctors with the other departments of the hospital. The web-based EHCM allows medical records professionals and physicians to access and share patient-related data between different settings and departments (Ngusie, *et al.* 2022). The EHCM includes all liaisons of hospital doctors, as well as liaisons of health workers, nurses and other healthcare professionals within the hospital. This includes patient information on diagnoses, medication, prescriptions for medical aids, symptom-related treatment plans, information on specialist medical care such as wound documentation, ventilators and an overview of authorised persons. ECHR synchronised the medical information of the patients on the doctors' and health professionals' computers. For example, when a patient is discharged or a patient has a new diagnosis, the comprehensive information appears in the EHCM for all healthcare professionals to know. EHCM is a platform that provides all the information about hospital patients and their planned treatment for the healthcare professionals to view from different locations. The most up-to-date medication plan, the date of the doctor's appointment and any changes necessary for the doctors and healthcare professionals involved in the patient are available (Zhang and Saltman 2022).

4. Theoretical Framework

The maintainability and performance factors of EHR performance are described in Figure 1. The willingness of hospital management and healthcare professionals to collaborate in conducting the EHR will initiate the process and outcome. When the level of readiness is high, all barriers and obstacles can be removed to produce quality and make healthcare satisfactory.

5. Conceptual framework of EHR

The conceptual framework, readiness and adoption of EHR can be described in Figure 1. The success of EHR depends on the organisational readiness of the hospital management and the individual readiness of the hospital staff. Both individual and organisational readiness are influenced by psychological and structural factors.

6. Enabling factors and Barriers

The first consideration when implementing EHR is the activation factor. This enabling factor is the inspiration driving EHR readiness in any organisation as shown in Figure 1. Individual readiness must be supported by organisational readiness to overcome the barriers. Any deficit in individual or organisational readiness will impact the implementation of EHR.

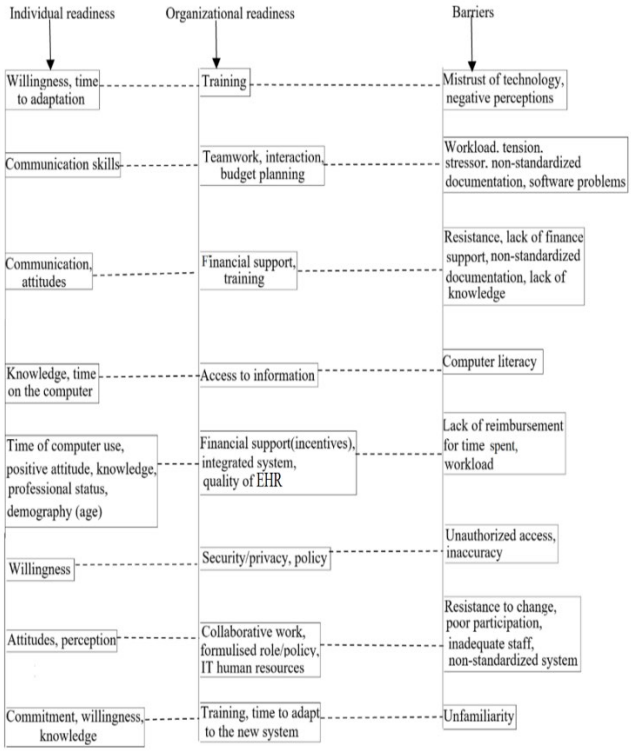


Figure 1: Enabling factors and Barriers

METHODS

The study was conducted among health information management professionals at Ekiti State University Teaching Hospital (EKSUTH), Ado Ekiti. EKSUTH is a government teaching hospital in south-west Nigeria that provides all the services expected of a tertiary level hospital. Assessment for the study was conducted using the 61 Health Information Management Professionals who manage patients with EHR at Ekiti State University Teaching Hospital Ado Ekiti. Respondents were specifically selected because they are directly involved in the creation, retention, management, and disposal of patient health information. A structured questionnaire was developed to assess the level of usage, knowledge and challenges they encounter in using EHR for healthcare information management. The questionnaire had two sections. Section A consisted of questions 1-4. These were demographic questions, where respondents can check any box, while Section B included questions 5-10 on level of skills in IT use for record keeping, environmental support for use of ICT, attitudes of staff towards the switch to electronic records, types of electronic patient care, level of agreement with the benefits of integrating patient's records into an electronic system and level of agreement with the barriers to electronic integration of patients' data and records management. The structured questionnaire was self-distributed and collected after proper completion. The retrieved questionnaire was subjected to analysis using frequency distribution, percentages and one sample test.

RESULTS

Table 1: The sex of the respondents with their age.

		Frequency	Percent
Sex	Male	10	16.7
	Female	50	83.3
	Total	60	100.0
Age	20-30	18	30.0
	31-40	25	41.7
	41-50	15	25.0
	51-60	2	3.3
	Total	60	100.0

Table 2: Length of service of respondents

Length of service	Frequency	Percent
<10	37	61.7
10-<20	23	38.3
Total	60	100

Table 3: Respondents' skills in the usage of some computer/smartphone software/functions

One-Sample Statistics

	Frequency	Mean	Std. Deviation	Std. Error Mean
MS Excel	59	3.81	1.152	.150
MS Word	59	4.22	1.052	.137
MS Access	58	3.50	1.354	.178
Email	58	3.83	1.272	.167
WhatsApp	58	3.98	1.221	.160

Table 4: Respondents' opinion on availability of environmental support for EHR usage.

Item	Responses as Frequency (%)						N	Mean (SD)	p-value
	Strongly disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree			
Reliable internet connection	2	2	-	7	26	23	60	5.03	<.001*
Reliable power supply	2	-	1	3	24	28	58	5.26	<.001*
Availability of technical support at all stages	1	-	-	3	42	11	57	5.07	<.001*
Sufficient & reliable computers	3	-	-	13	22	21	59	4.93	<.001*
Back-up power e.g., solar/ inverter/ generator	1	-	-	3	23	32	59	5.46	<.001*

* Indicates significance at the 95% level

Table 5: Responses to barriers at 3.5 test value.

	Test value=3.5					
					95% Confidence Interval of the Difference	
	t	Df	Sig.(2-tailed)	Mean Difference	Lower	Upper
Staff shortages	4.964	58	.000	.873	.52	1.22
Large numbers of patients	3.919	57	.000	.776	.38	1.17
Lack of ICT navigation skills among the staff	3.813	58	.000	.720	.34	1.10
Poor staff attitudes towards electronic record keeping	1.469	58	.147	.297	-.11	.70
Inadequate ongoing training for those who need it	6.649	58	.000	1.195	.84	1.55
Lack of availability of line thermal printers on EHR network	2.308	55	.025	.536	.07	1.00
Lack/shortage of scanners for scanning previous records	2.450	58	.017	.568	.10	1.03
Lack of needed funding	4.252	58	.000	.839	.44	1.23
Concern about privacy and confidentiality	5.019	57	.000	1.034	.62	1.45

Table 6: Benefits of EHR at 3.5 test value using one sample test

	Test value=3.5					
					95% Confidence Interval of the Difference	
	t	Df	Sig.(2-tailed)	Mean Difference	Lower	Upper
Patients' waiting time will be reduced	10.763	57	.000	1.603	1.31	1.90
Reduction in medical errors, e.g., wrong diagnosis, medication errors etc.	15.690	56	.000	1.868	1.63	2.11
A longer timespan of patients' information can be stored	14.941	56	.000	1.851	1.60	2.10
Enabling quick and easy access to past medical records thus ensuring prompt continuity of care	15.667	57	.000	1.931	1.68	2.18
Patients' information is easily accessible from anywhere	8.253	56	.000	1.482	1.12	1.84
Access to health care at any location since medical records would be easily accessible	16.503	57	.000	1.724	1.51	1.93
More efficient/faster ward rounds	11.933	57	.000	1.655	1.38	1.93
Reduction in staff workload	15.751	58	.000	1.788	1.56	2.02
Reduction in the number of duplicate diagnostic tests ordered	11.655	56	.000	1.763	1.46	2.07
Reduction in loss of patients' information	12.789	57	.000	1.724	1.45	1.99
Information can be shared across disciplines & specialties for quick decision making	14.295	57	.000	1.793	1.54	2.04

DISCUSSION

From the total population of all HIM professionals used, respondent 43 was removed from the study as she only gave demographics which does not add any value to the study. A few others did not answer many more questions, but they have been retained for whatever they did contribute. These are the reasons why the total number reported in the table may not add up to 61. As shown in Table 1, the highest percentage of the respondent were females with 83.3% with the highest age range of 31-40 having 41.7%. The highest respondents were those who have spent less than ten years in service with 61.7% as shown in Table 2. Questions were raised about the knowledge skills of the respondents on the use of some computer/smartphone software/functions. It can be deduced that efficiency in using each of the computer applications was rated significantly above the average rating of '3'. These respondents rated their efficiency highest for MS Word and lowest for MS Access as shown in Table 3. In addition, the question was also raised to assess the environmental support availability for EHR, where respondents were asked to indicate their level of agreement (from 1= strongly disagree to 6= strongly agree) that specific aspects of environmental support exist for effective usage of ICT. As shown in Table 4, it is noted that there is significant agreement that environmental support exists for the effective use of ICT. Questions were raised highlighting possible barriers to the adoption and usage of EHR in patient Information Management. The following barriers were highlighted: shortage of staff, large numbers of patients, lack of navigation skills among the staff, and so on as seen in Table 5. It was deduced that there is significant agreement to all the barriers except for poor staff attitudes towards electronic record keeping which has neither significant agreement nor significant disagreement as shown in Table 5. However, the benefit of using EHR outweighs the barriers. In Table 6, the 3 highest responses to the benefit of using EHR for healthcare Information Management were that: it enables quick and easy access of past medical records thus ensuring prompt continuity of care, longer span of patients' information can be stored and reduction in medical errors e.g., wrong diagnosis, medication errors in descending order. Other benefits are as indicated in Table 6.

CONCLUSION

Our findings have shown that there is a staff and organisational readiness for the implementation of EMR to improve healthcare information management. There are also barriers that exist, with other identified challenges as inadequate ongoing training for those who need it and concern about privacy and confidentiality being outlined. However, the numerous benefits will assure effective healthcare information management.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

SUPPORT

The study received no grants or financial support from anyone.

ACKNOWLEDGEMENT

This study appreciates all the respondents.

8.5 Paper 4

Topic: Using computer skills knowledge to enhance the adoption of HER in South West Nigeria; Insight from EHR Study in a State Tertiary Hospital.

Status: Under review in *African Health Sciences*.

Abstract

Introduction: Adopting a new change has been seen as something that is often resisted, so also is the case of adopting the use of Electronic Health Record (EHR) in healthcare organization. Embracing this will require computer knowledge in handling the system for the management of patients and their care. **Purpose:** To determining the computer skills towards uptake of Electronic Health Records (EHR) by healthcare workers in an annex of a State Teaching Hospital which is Okela Health Centre (OHC) Ado- Ekiti. **Methods:** The study uses a cross sectional research design with the use of a structured questionnaire distributed to the total 30 healthcare workers across 7 disciplines working in the hospital. Descriptive statistics of frequency tables and percentages were used to ascertain the relationship between computer skill usage and the adoption of EHR.

Results: Majority of the respondents were only efficient in the usage of Microsoft Word (MW), Email and WhatsApp with 63.4%, 76.6% and 73.3% respectively while majority were not efficient in the usage of Microsoft Excel (ME) and Microsoft Access (MA) with 56.7% and 70% respectively.

Conclusion: Computer appreciation is an important basis for the adoption of EHR in the Hospitals.

Keywords: Computer skills, patients' management, EHR, ICT, healthcare workers.

1. Introduction

The voluminously stored health care data in electronic health record needs to be updated from time to time. Patients' information must be readily available anytime and anywhere to support treatment course as patients' previous history. Such stored information requires highly skilled manpower with an Information Communication and Technology (ICT) which must be continuously maintained. Healthcare organization requires managing the right of access to the data, its retrieval and communication [1].

Several data are generated from activities of health care worker during the process of patients' management. These are needed to be stored and processed in an efficient way to allow for quick access and dependable storage of the information [2]. The work of healthcare givers, decision and policy makers is largely dependent on their use of quality data in Health information system towards ensuring an effective, efficient, and reliable health care services. Several poor data qualities due to integrating data from various sources had been reported as part of the reasons for non-adoption of Electronic Health Record (EHR), this invariably leads to different data structure which makes extracting useful information from the data difficult. When there are quality data, it helps in the earnings of the hospital. It also helps in the smooth processing and plan of healthcare services, therefore, having a reliable and dependable quality data cannot be overemphasized to guide against false conclusions and wrong decisions emanating from such hospital. EHR will assist a great deal in ensuring structured data entry and smart interfaces [3]. The EHR is regarded as a cornerstone that facilitates the integration of several e-health techniques among the various Health Information Technology (HIT) initiatives in the international healthcare system. Many countries tried to create an EHR, resulting in a 46% significant rise over the last five years. Nevertheless, over half of the world's electronic record-keeping programs fell short of their objectives. Particularly, the adoption of EHR continues to be a significant obstacle for health services in low-income nations. Only 15% of low-income nations have nationalized the use of electronic record-keeping in medical facilities. Due to the digital divide and other socioeconomic concerns including electrical power failures, healthcare providers who are resistant to using new technology, and ICT infrastructure, Sub-Saharan countries seem to be more likely to be behind in implementing these technologies [4]. Computer literacy could be described as the computer-associated knowledge required to acquire, communicate, process, and comprehend the fundamental knowledge needed to make sound health decisions [4]. Electronic Health Records (EHR) has been gaining popularity around the word but still experiencing slow adoption in underdeveloped and developing countries. EHR refers to patient information that are stored digitally to eliminate the practice of manual registries and repositories. It provides secure storage, secure information exchange,

and is made available to different levels of healthcare practitioners (Mohmad, et al. 2020). It could also refer to a digital repository of patient data that is kept safe and communicated and readily available by numerous authorized personnel. Adopting EHR in hospitals offers many benefits like;

- minimizing cost,
- increased revenues,
- improved patient care,
- eliminating the need for filing space,
- enhanced confidentiality of data,
- reduction in medical and dispensing errors,
- centralized patient data management, and
- allows for sharing medical information among members of health team.

Despite the great benefits, many hospitals are yet to embrace EHR in the management of their patients. In research of the primary factors that affect healthcare professionals' willingness to adopt an EHR, computer literacy was discovered to be one of them. [4]. Healthcare in developed countries had gone far in various technologies which are used in carrying out several of the activities. Information is transmitted and transferred between and among healthcare givers through this, communication within the way relied largely on various information technologies that are evolving. The electronic Medication Management Assistant (eMMA) is an example of this. It is a laboratory prototype for a mobile app aimed at assisting patients take their prescribed medication on a constant schedule and adhere to drug therapy. This employs a Conversational User Interface (CUI) to notify users to take their medications. It is mainly intended to help the particular patient at home prior to her admission as an inpatient, as well as following her discharge from rehabilitation [6]. Research was carried out in South

Africa on the theoretical framework for adoption of patients' record management systems with the goal of determining the variables that influence patients' exchange of information among physicians, which stimulates the advancement of diagnosis; slow adoption of EHR was seen to be contributing to diagnosis errors. Frequently, data contained on electronic systems is desired and may be communicated by a variety of medical specialists, including hospitals, laboratories, pharmacies, government agencies, employers, healthcare institutions, academic research institutions, and public health organizations. There had been advocacy on the need to increase the use of ICT in healthcare organizations [7] [8]. Adopting EHR as for other technologies may be determined and explained by the use of the Technology Acceptance Model (TAM) which is depicted in the figure 1 below:

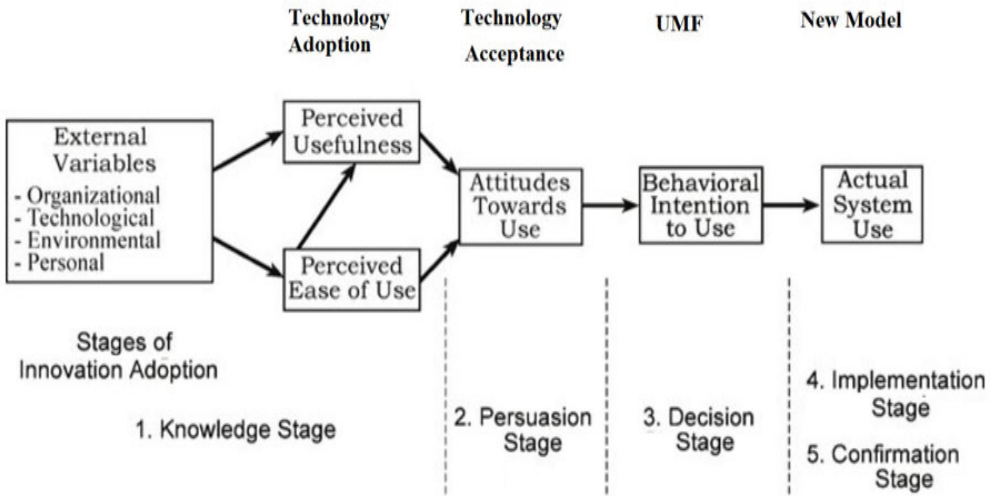


Figure 1. Adopting EHR through the use of TAM model.

Using the TAM diagram, when a technology is introduced, the first stage has to do with assessment, that is assessing what is currently being used in the organisation including the technological which is the probable tools and equipment, assessing the environmental- buildings and personal which involves evaluating their knowledge on the use of EHR which in this case is the computer skills thereby leading to knowledge stage. The unfreeze-move- freeze entails assessing the way their paper based is

being used, encouraging the people towards adopting the new system (move) and final implementation of the adopted system before it is freezed back [9].

FACTORS AFFECTING THE ADOPTION OF EHR

The factors that affect the adoption of EHR are includes: Attitude toward EHR, perceived usefulness, perceived ease of use, social influence, computer self-efficacy, potential threat to physician autonomy and confidentiality concerns.

- **Attitude Toward EHR**

This refers to a patient's positive or negative feelings about engaging in the desired behavior. One's mindset toward using technology is a critical indicator in the Technology Acceptance/Adoption Model. In implementing EHR, effort must be concentrated on developing peoples' attitude towards its use.

- **Perceived Usefulness**

This is an extent to which people beliefs that adopting a system like EHR will increase their job performance

- **Perceived Ease of Use**

This is individuals thought that using the system will require less effort in its usage. According to TAM, user satisfaction of use is a significant component in both attitudes toward technology use and its perceived benefits (Mohammad, Fully Decentralized Multi-Party Consent Management for Secure Sharing of Patient Health Records. 2020).

- **Social Influence**

The kind of influence one get on usage of a system from peers and colleagues, has a long way to go on its adoption from a number of people. If a person believes that individuals who are significant to him or her are using the system, his or her involvement is likely to be swayed toward its adoption. Coworkers and peers, as well as top management, are examples of people who can have a social influence on healthcare teams' acceptance of EHR.

- **Computer Self-Efficacy**

One’s ability to use the computer quite well determines his/her efficacy. Members of healthcare who have high self-efficacy are more likely to use EHR than their counterparts who do not. As technology advances, it becomes necessary for healthcare providers to be computer compliant, as this has become a requirement for employment in several organizations. Following that, a constant on-the-job training program can be planned to refresh people's computer knowledge prior to EHR implementation to boost its acknowledgement.

- **Potential Threat to Physician Autonomy**

Physicians are distinguished by their high level of professional independence. This is when an individual assumed that by employing a specific system, he or she would lose control over the circumstances, methods, procedures, or content of his or her work, which was untrueThough opposition is likely due to the significant changes occurring in EHR implementation, which may influence leadership roles or power dynamics in medical practice, this shouldn't influence their choice to utilize EHR [11].

- **Confidentiality Concerns**

It is a source of wider issue, especially in developing countries that EHR could be accessed by unauthorized persons; some are concerned about the confidentiality of patients' information, which is one of the reasons they are hesitant to adopt EHR (J. Li, et al. 2013). Having relevant rules and guidelines in place, as well as informed consent from patients, could serve as safeguards against concerns about confidentiality.

POSSIBLE EFFECTS OF POOR MANAGEMENT OF EHR ON PATIENTS’ CARE MANAGEMENT

In research on the implementation and feasibility of an Electronic Health Record-Integrated Patient-Reported Outcomes Symptom and Needs Monitoring Pilot in Ambulatory Oncology, EHR was discovered to be a helpful technique for patient maintenance and appointment reminders. Patients received a reminder via their patient portal to complete assessment on Epic MyChart. Epic MyChart is a tool used to complete the assessment through a previously stated preferred mode (ie, via e-mail, MyChart patient portal message, or phone call). Evaluations were accessible in

English and Spanish and took about 8-10 minutes to complete through the patient's MyChart account (web or smartphone app). Patients were instructed to finalize these evaluations 72 hours prior to their next appointment. Without adequate knowledge of healthcare staff on computer use, it will results to missing of appointments which may have been corrected through messages, emails and calls to the patients at least 72hours before the appointment time and date. There is also possibility of work overload as staff will be forced to do this on behalf of patients at their walk-in time [13].

Another effect of poor implementation of EHR on patients' care management will results into waste of resources. For the fact that some things have been committed into implementing EHR financially no matter how small, hence the need for its effective use otherwise, it leads to waste of resources. Sustainability of the system is imperative which may be assured through the training of health care professionals, change of attitude and right mindset on the part of the end-users [14].

Automated clinical data that should be generated for possible policy making, disease incidence definition and care outcomes will be in disorganized manner thereby forfeiting the impact of EHR on patients' care management [15].

The issue of training cannot be overemphasized. Khan S.Z *et al* (2012) opines that EHR will not be very effective if there is no necessary training. The technical complexity involved in the use of EHR demands a high level of technical competency on the part of the healthcare giver in order to guide against seen information use as a burden when EHR is put in place and also poor preparation and use of data [16].

Having considered the various factors affecting the adoption of EHR, then there is need to highlight the aim of the study which is to determine the need for computer skill as a determinant to the adoption of EHR in Okela Health Centre (OHC) an annex of Ekiti State University Teaching Hospital Ado – Ekiti, in South West Nigeria.

2. Materials and Methods

A structured questionnaire was designed and distributed to the entire population of the healthcare professionals working at OHC Ado Ekiti, which comprises of 4 Nurses, 13 Community Health Extension Workers, 5 Attendants, 1 Health Assistant, 1 Pharmacy Technician, 1 Laboratory Technician, 3 Doctors, 2 Health Information Management Technicians totaling to 30 respondents. These were given the questionnaires to fill and was retrieved back after completion. The retrieved questionnaire was subjected to analysis using frequency tables and percentages.

3. Results

Respondents' level of skills in ME is depicted in Table 1, it is shown that majority of the respondents, constituting about 56.7% were not efficient in the use of ME while 43.3% were efficient. Mostly EHR platform are in forms of spreadsheet, hence the need for staff to develop their skills in this computer skill to enhance smooth adoption of EHR to their work in the management of their patients. Table 2 shown the Respondents' level of skills in MW, majority of the respondents (63.4%) are efficient in the use of MW while there are 36.6% that were not efficient. 70% of the respondents affirms not being efficient in the use of MA while the remaining 30% are efficient as shown in Table 3. In the usage of email as part of computer appreciation use, Table 4 shown the respondents' level of skills in email usage, the highest percentage of 76.6% confirms their efficiency in its use while 23.4% were not efficient. Table 5 depicted the respondents' level of skills in WhatsApp, 73.3% of the total respondents were efficient in the use of WhatsApp, while 26.7% were not efficient. From the above findings, it is evident that with the percentage of people that were not efficient in the use of these few computer functions, implementing a EHR for management of patients will be difficult, hence the need for prioritizing computer literacy as part of requisite for employment and also train and retrain those already in the system for its use.

Table 1. Respondents' level of skills in MS Excel

	Frequency	Percentage (%)
Not at all Efficient	**15**	**50**
Moderately not efficient	**2**	**6.7**
Efficient	**6**	**20**
Moderately Efficient	**4**	**13.3**
Extremely efficient	**3**	**10**
Total	**30**	**100**

Table 2. Respondents' level of skills in MS Word

	Frequency	Percentage (%)
Not at all Efficient	**7**	**23.3**
Moderately not efficient	**4**	**13.3**
Efficient	**8**	**26.7**
Moderately Efficient	**3**	**10**
Extremely efficient	**8**	**26.7**
Total	**30**	**100**

Table 3. Respondents' level of skills in MS Access

	Frequency	Percentage (%)
Not at all Efficient	**15**	**50**
Moderately not efficient	**6**	**20**
Efficient	**2**	**6.7**
Moderately Efficient	**3**	**10**
Extremely efficient	**4**	**13.3**
Total	**30**	**100**

Table 4. Respondents' level of skills in email

	Frequency	Percentage (%)
Not at all Efficient	**5**	**16.7**
Moderately not efficient	**2**	**6.7**
Efficient	**6**	**20**
Moderately Efficient	**3**	**10**
Extremely efficient	**14**	**46.6**
Total	**30**	**100**

Table 5. Respondents' level of skills in WhatsApp

	Frequency	Percentage (%)
Not at all Efficient	**2**	**6.7**
Efficient	**6**	**20**
Moderately Efficient	**5**	**16.7**
Extremely efficient	**17**	**56.6**
Total	**30**	**100**

4. Discussion

This result is consistent with the findings on the study conducted on Artificial intelligence healthcare service resources adoption by medical institutions based on Technology-Organization-Environment (TOE) framework, where computer processing power, computer experience, computer knowledge, perceived usefulness of intelligent systems and their ease of use are seen as part of the factors influencing the adoption of intelligent healthcare services by medical institutions with integrated medical care [17].

All healthcare professionals, be it nurses, Health Information Management Practitioners, Doctors, Laboratory scientist, Pharmacist, and all other members of health care team are expected to be vast in the knowledge and competent use of computer system in the management of their patients' health care using EHR. Adopting EHR will largely depend on the computer skill usage of the end users before it can optimally be put into use. In the light of the huge data needs and improved patient care, there is pressing need for all healthcare professionals to acquaint themselves with adequate computer appreciation in order to meet the with the needs of improved healthcare services through improved electronic health appliances that is fast growing around the world.

There is need for continuous training and retraining for existing staff while computer literacy must be emphasized as part of the requisite for employment. This will ensure the smooth running of EHR in hospitals. Future research can be done on the applicability of these computer appreciation on the practical use and challenge encountered with EHR.

Author Contributions: Conceptualization of this research was done by O.R.A; methodology,investigation, formal analysis and original draft preparation was done by O.R.A Review, editing and supervision were done by M.N.S and O.O. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

8.6 SUMMARY OF THE CHAPTER

This chapter had discussed four different papers that have been written and submitted to accredited journals for publication as an output of this research work.

CHAPTER 9: DEVELOPMENT OF A COMMUNICATION MODEL

9.1 INTRODUCTION

This chapter presents the communication model template in a hospital setting depicted through a diagram which shows the connection and workflows between various healthcare providers as they attend to patients (Figure 9.1).

9.2 COMMUNICATION MODEL

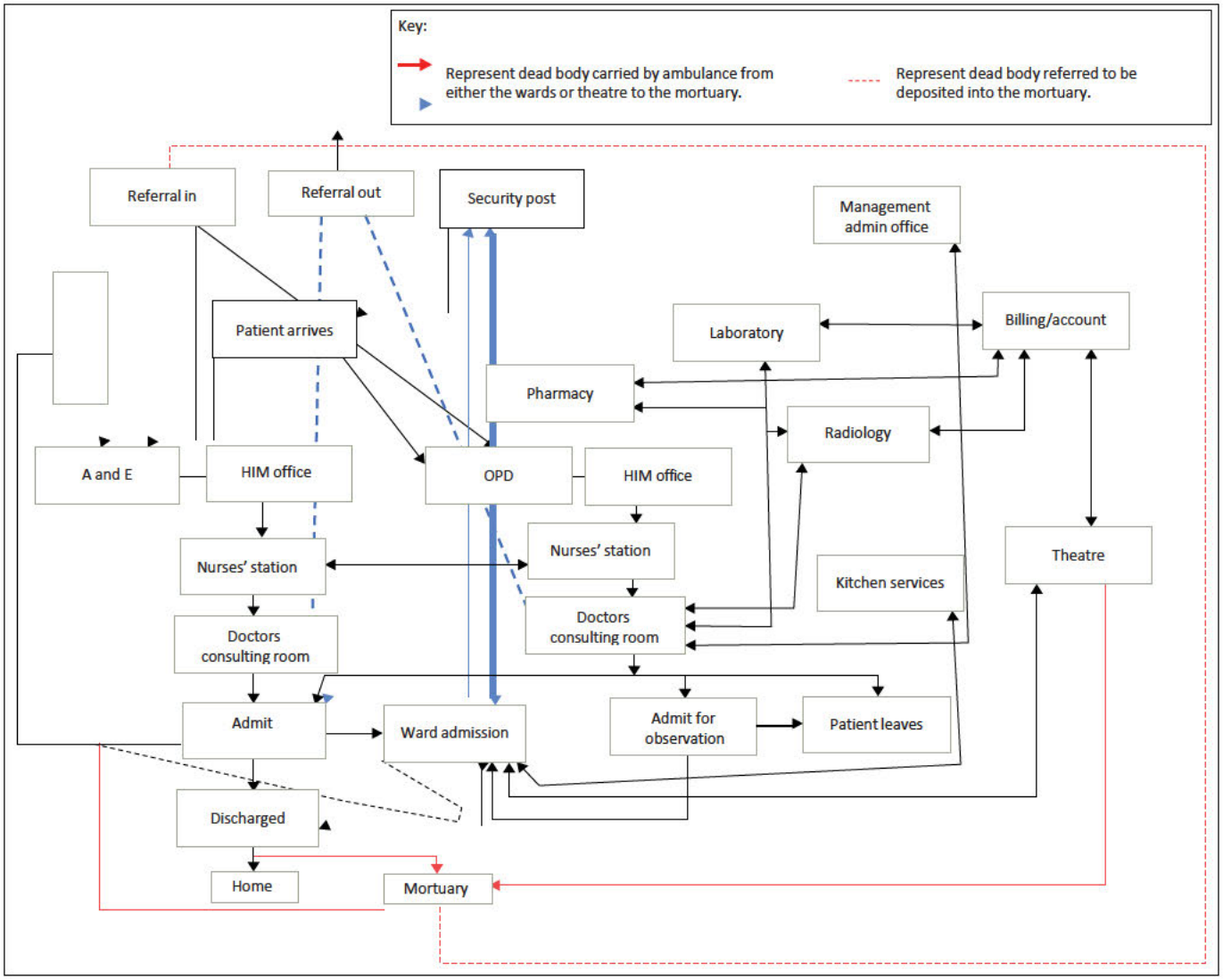


Figure 9.1: Communication model flow using electronic health record

9.3 EXPLANATION OF THE COMMUNICATION MODEL

This model explains how patients move and/or communicate with health professionals within a standard tertiary hospital. For example, patient Y who came as an emergency patient with a ruptured appendix will consult the HIM professionals in the emergency ward who will get his or her information documented and forward it to the nurses for vital signs to be taken and documented. After this, the doctors attend to the patient and may require that an ultrasound scan be carried out, thereby sending a request to the Radiology Department via the EHR. At the same time, some required laboratory investigations can be sent to the laboratory via the platform after samples had been taken. The patient's relatives and hospital assistance can take the samples to the laboratory without any hardcopy form, the billing for the two investigations is done and sent to the Billing/account Department where payments are made and communicated back to the department from which services are being requested, which is carried out on the same platform.

The result of the requested investigations is sent back to the consulting doctor to review and guide towards the right diagnosis and line of management. Thereafter, the patient can be transferred to bed or sent to the theatre for surgical procedures before he/she is returned back to the wards. All the correspondences are carried out solely by the use of EHR. If there is any patient who dies whilst in theatre, the body can be sent to the mortuary after adequate preparation, consultation and documentation has been performed from the sender even to the recipient. After all the treatment procedures, the patient can be discharged, either home or to the mortuary as the case may be.

Patient X also came into the hospital as an outpatient. He/she will go through the HIM office where he/she will be documented and registered on the EHR platform before transmitting the information to the nurses for records of vital signs after which the patient is sent for a consultation with the doctor. If it is a

patient requiring a medical certificate of fitness or medical report not just because the patient is sick, doctors can request for investigations from laboratory and Radiology Department. Billing/account people are contacted, and bills are settled and the results are sent back within a short turnaround time. After this, the doctor writes the report and connects with the managements' administrative office for authorisation and stamping without necessarily having the patient moving around, and the report can be printed for the patient. Alternately, a sick patient presenting at the OPD can be admitted for observation right there before his or her release home when the condition is satisfactory and stable. Pharmacy orders can be sent and drugs collected after due settling of funds for proper administration. Patients not requiring admission procedures can have their drugs picked up at the pharmacy and leave. However, some cases might require emergency action to be taken after due assessment, thus their information is sent to the wards or A&E notifying them about the patient ahead and contacting the ambulance service for transporting the patient to the correct ward.

At each point of admission, the kitchen service is contacted for meals, either a special diet or a general meal in order to cater for the patient whilst on the hospital bed without putting the stress and burden of nutrition on either the patients or their relatives. Patients with mental health issues who try to escape from the hospital or violent patients' relatives trying to evade payments and abscond can be nabbed by connecting to the security office via the same EHR platform, notifying them to help salvage the situation. Also, patients can be referred to the hospital via the A&E department or OPD, and doctors may at any point decide to refer a patient out of the hospital either as an inpatient or outpatient for better management. A corpse can also be transferred from outside the hospital into the mortuary after going through the necessary processes as shown in Figure 9.1 above.

9.4 SUMMARY OF THE CHAPTER

The chapter has discussed the movement and communication flow of patients and healthcare givers within the hospital using an EHR communication model. This will lessen the burden of patients trying to access care and services and also ease the work of the healthcare givers.

CHAPTER 10: SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

10.1 INTRODUCTION

This chapter discusses the summary of the study, the study limitations, recommendations and conclusion of the study.

10.2 SUMMARY

The study 'electronic integration of patients' health information and records management' had been carefully carried out and it is revealed that health information of patients can be better managed electronically, more safely, more efficiently, while allowing for accessibility of health services by the patients and a robust management of the patients' records by the healthcare givers which may be impossible or difficult with paper-based methods. Hospitals already on paper-based records can upgrade their records and integrate them electronically by embracing the use of EHR for optimal care to be provided to patients.

10.3 LIMITATIONS

The term limitation refers to weaknesses within a research design which may influence the results and conclusion of a research work (Ross and Bibler Zaidi 2019). This study does not include the outreach centres of the study area because they are yet to be incorporated into an electronic system, thereby causing patients that are referred from such places to still come with their paper records despite that the main annex are integrating theirs into an electronic system. Future studies should discuss how patients referred from such hospitals will be able to fit in into an EHR environment. Discussions can also be centred on EHR communication with other hospitals. They may also opt to include all other professionals managing patients with EHR in the filling in of questionnaires instead of focusing on HIM professionals alone.

10.4 RECOMMENDATIONS

The following are the recommendations based on the findings of the study:

- For effective EHR, it should be enforced at least in all tertiary hospitals for old patients' case note to be incorporated into an EHR in order to make EHR usage to be maximally put into use.
- Being ICT compliant must be a prerequisite for all health professionals who are recruited for a particular position so that each member of the healthcare team will be able to contribute their own quota to patients' management without any limitation.
- A standard EHR format should be adopted by all tertiary hospitals for uniformity's sake and easy communication between healthcare professionals managing patients' health information in the hospitals.
- Policy makers intending to make decisions about patients' health data can be better assisted with the use of EHRs which should be recommended for hospitals.
- Future researchers can concentrate on communication of patients' information to outside the facility as this research only concentrate on within a facility.
- There should be continuous training and retraining of staff managing patients' health information and their records.
- Constant maintenance should be done on the hardware involved in EHR in order to avoid its total breakdown thereby resulting in the loss of patients' health information and records management.
- There is a need for managerial support and intentional interest on the part of the management of each of the hospitals if EHR will see the light of the day as it requires excellent funding.
- Alternate sources of power supply should be considered before integrating patients' health information and records management, particularly for developing countries who may have challenges with power supply.

- Efforts should be made by hospitals that are just adopting electronic record to scan previous records in paper format into the system for complete patients' health history and better management.

10.5 CONCLUDING REMARKS

The thesis had been able to critically examine the electronic integration of patients' health records and information management in tertiary hospitals using Ekiti State University Teaching Hospital as a study area. Patients' information in hard copies can better be managed electronically to ease accessing healthcare and also decision making. Healthcare professionals should be able to effectively communicate patients' health information without carrying paper-based records. When healthcare information is managed electronically, patients will be able to access care anywhere, anytime without necessarily being confined to a particular healthcare facility where they are previously being attended to and healthcare workers will be able to better manage patients' health information and their records. This will enhance qualitative care and continuity of patients' health with ease. There will also be less burden and stress for patients seeking specialised care within the same facility, without being time consuming and presenting the problem of carrying paper case notes from one place to another as all information will be readily available in electronic format. Loss of information or deterioration of records will be eliminated when patients' information is integrated electronically. In conclusion, there is assurance of confidentiality when dealing with electronically managed patients' information.

10.6 SUMMARY OF THE CHAPTER

This chapter has extensively discussed the summary of the study, the limitations, recommendations and conclusion of the study.

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APPENDICES

Appendix 1: University's ethics clearance

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwin Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: irechead@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

29 November 2021

Ms O R Akinyemi
15 Hellen Baxter
Clenmon

Dear Ms Akinyemi

A Communication Model on Electronic Integration of Hospital Patient Health Information and Records Management in Tertiary Hospitals.
Ethical Clearance number IREC 197/21

The Institutional Research Ethics Committee acknowledges receipt of your notification regarding the piloting of your data collection tool.

Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Professor J K Adam
Chairperson: IREC

Appendix 2a: Letter of request for gatekeeper permission to conduct research

15 Hellen Baxter,
Clenmon, South Africa.
[Date]

The Chief Medical Director,
Ekiti State University Teaching Hospital (EKSUTH),
Ado-Ekiti,
Ekiti State.

Request for Permission to Conduct Research

Dear Sir/Madam

My name is Ms Akinyemi Oluwatoyin Rhoda, a PhD student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis involves Design of communication model on Electronic integration of hospital patient health information and records management in tertiary hospitals.

I am hereby seeking your consent to conduct my research.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC). Some members of staff who meet up with the inclusion criteria of participating in this study will be required to fill in some questionnaire and answer online survey questions for the purpose of this study.

If you require any further information, please do not hesitate to contact my supervisor, Prof Sibiya. Her email address is nokuthulas@dut.ac.za

Thank you for your time and consideration in this matter.

Yours sincerely,

……
Akinyemi Oluwatoyin Rhoda (Ms)
Durban University of Technology
Email: akinyemitoyin6@gmail.com
Tel No: +2348032349236

Appendix 2b: Approval letter from the Ethics and Research committee to conduct research

EKITI STATE UNIVERSITY TEACHING HOSPITAL
ADO-EKITI, NIGERIA.

ETHICS AND RESEARCH COMMITTEE

CLEARANCE CERTIFICATE

PROTOCOL NUMBER : EKSUTH /A67/2021/011/009

PROJECT TITLE : DESIGN OF COMMUNICATION MODEL ON ELECTRONIC INTEGRATION OF HOSPITAL PATIENT HEALTH INFOMATION AND RECORDS MANAGEMENT IN TERTIARY HOSPITALS.

INVESTIGATOR : OLUWATOYIN RHODA AKINYEMI
SUPERVISOR : PROFESSOR M .N SIBIYA AND DR. O. OLADIMEJI .

DEPARTMENT : HEALTH SCIENCES .
INSTITUTION : DURBAN UNIVERSITY OF TECHNOLOGY, DURBAN SOUTH AFRICA.

DATE CONSIDERED : 24/11/2021
DECISION OF COMMITTEE : APPROVED

CHAIRMAN : PROFESSOR J.O FADARE *SIGNATURE & DATE:* 24/11/2021

DECLARATION BY INVESTIGATOR/PRINCIPAL INVESTIGATOR

PROTOCOL NUMBER (Please quote in all enquiries) **EKSUTH /A67/2021/011/009** to be completed in three copies and two copies returned to the secretary, Ethics and research committee, University Teaching Hospital, Ado Ekiti, Nigeria.

I/we fully understand the conditions under which I am/we are authorise to conduct the above-mentioned research and I/we guarantee that I am/ will ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved, I /we undertake to resubmit the protocol to the Ethics and Research Committee.

Signature

Date : 25/11/2021

NB: Any erasure, cancellation or alteration renders this certificate invalid

Appendix 3a: Letter of information for the interview participants

Title of the Research Study: Design of communication model on Electronic integration of hospital patient health information and records management in tertiary hospitals.

Principal Investigator/s/researcher: Ms Akinyemi Oluwatoyin Rhoda (PhD: Health Sciences Candidate).

Co-Investigator/s/supervisor/s: Prof M.N. Sibiya (D Tech: Nursing) and Prof O. Oladimeji (PhD).

Brief Introduction and Purpose of the Study: A heap of modifications is taking a position in a health information/record management system, as a consequence of the introduction of electronic means of patient clinical information management worldwide. Gradually, paper-based records are being superseded by electronic method of records/data keeping, the small shelf / cabinet is being replaced by portable computer system. However, electronic integration of patient data/medical records has not been incorporated in most of Africa hospitals. In order to accomplish electronic medical record, health information systems must fulfil interoperability standards, quality, security, scalability, reliability, timeliness, data storage and processing terms.

Purpose of the Study: The aim of the study is to develop a communication model on electronic integration of hospital patient health information and records management in tertiary hospitals.

Good morning,
I am a PhD student at DUT doing research for my Doctorate degree in Health Sciences.

I would like to invite you to participate in the suggestion of formulation of template design of communication model for the electronic integration of hospital patient health information/records management.

Outline of the Procedures: You are invited to participate on an online interview that will take approximately 10-20 minutes. The interview will involve you answering questions and filling it electronically through your WhatsApp line. You are requested to click on the link and answer the questions and submit accordingly.

Risks or Discomforts to the Participant: There is no anticipated risks or discomfort by participating in the study.

Explain to the participant the reasons he/she may be withdraw from the Study: The participants can withdraw in case the research involves any form of physically invasive, or potentially harmful procedures [e.g. drug administration, needle insertion, rectal probe, pharyngeal foreign body, electrical or electromagnetic stimulation, etc.?] The participant can withdraw if the data process involves blood sample collection, cutting of body tissue sample and any other fictitious act.

Benefits: The results of the study will provide a template model and guidelines that tertiary hospitals can adopt for electronic integration of patients' health information and record management to enhance patient centred care and also the research outcomes may bring a major reform to the health sector across Africa.

Reason/s why the Participant May Be Withdrawn from the Study: You may withdraw from the study at any stage without any repercussions.

Remuneration: Your participation is voluntary, and no remuneration will be provided.

Costs of the Study: You will not bear any costs for participating in this study.

Confidentiality: The data collected will be disseminated in a manner that will ensure confidentiality of the participants. The participants will not be identified by their names, codes will be used instead. Data collected will be kept in a protected locker and electronic data will be kept in password protected hardware and shred after 5 years.

Results: A proposed model for the design of communication model on electronic integration of hospital patient health information and record management may results in improved patient record safety, improved job performance and satisfaction. Health record manager relationships may also be enhanced. The suggested method will integrate the role of manual/paper-based method of accessing patient medical information with the use of electronic method, the use of small shelf/cabinet file system shall be replaced by portable computer system. Likewise, daily operations, programming, scheduling and billing, duplicate patient medical records and inaccurate patient information that can lead to claim denial shall be minimized. There will also be improvement in the way doctors and other care giver manage their patients.

Research-related Injury: There is no anticipated research-related injury by participating in the study.

Storage of all electronic and hard copies including tape recordings: A copy of the thesis shall be made available to DUT repository and findings made available to participants upon request.

Persons to contact in the Event of Any Problems or Queries: Please contact the Supervisors: Prof M.N. Sibiya, 031-373 2284, nokuthulas@dut.ac.za and Prof O. Oladimeji, +2347035234566, ooladimeji@hsph.harvard.edu and the researcher Akinyemi Oluwatoyin Rhoda +2348032349236, and akinyemitoyin6@gmail.com or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za

Appendix 3b: Letter of information for the survey participants

Title of the Research Study: Design of communication model on Electronic integration of hospital patient health information and records management in tertiary hospitals.

Principal Investigator/s/researcher: Ms Akinyemi Oluwatoyin Rhoda (PhD: Health Sciences Candidate).

Co-Investigator/s/supervisor/s: Prof M.N. Sibiya (D Tech: Nursing) and Prof O. Oladimeji (PhD).

Brief Introduction and Purpose of the Study: A heap of modifications is taking a position in a health information/record management system, as a consequence of the introduction of electronic means of patient clinical information management worldwide. Gradually, paper-based records are being superseded by electronic method of records/data keeping, the small shelf / cabinet is being replaced by portable computer system. However, electronic integration of patient data/medical records has not been incorporated in most of Africa hospitals. In order to accomplish electronic medical record, health information systems must fulfill interoperability standards, quality, security, scalability, reliability, timeliness, data storage and processing terms.

Purpose of the Study: The aim of the study is to develop a communication model on electronic integration of hospital patient health information and records management in tertiary hospitals.

Good morning,
I am a PhD student at DUT doing research for my Doctorate degree in Health Sciences.

I would like to invite you to participate in the design of communication model for the electronic integration of hospital patient health information/records management.

Outline of the Procedures: You are requested to completely fill in copies of questionnaire that will be self-administered to each participant in their workplace. The questions will take between 10-15minutes to be completed after which it should be returned to the researcher.

Risks or Discomforts to the Participant: There is no anticipated risks or discomfort by participating in the study.

Explain to the participant the reasons he/she may be withdraw from the Study: The participants can withdraw in case the research involves any form of physically invasive, or potentially harmful procedures [e.g. drug administration, needle insertion, rectal probe, pharyngeal foreign body, electrical or electromagnetic stimulation, etc.?] The participant can withdraw if the data process involves blood sample collection, cutting of body flesh sample and any other fictitious act.

Benefits: The results of the study will provide a model and guidelines that tertiary hospitals can adopt for transition of paper-based medical record to electronic based to enhance patient centred care and also the research outcomes may bring a major reform to the health sector across Africa.

Reason/s why the Participant May Be Withdrawn from the Study: You may withdraw from the study at any stage without any repercussions.

Remuneration: Your participation is voluntary, and no remuneration will be provided.

Costs of the Study: You will not bear any costs for participating in this study.

Confidentiality: The data collected will be disseminated in a manner that will ensure confidentiality of the participants. The participants will not be identified by their names, codes will be used instead. Data collected will be kept in a protected locker and electronic data will be kept in a password protected hardware and shred after 5 years.

Results: A proposed model for the design of communication model on electronic integration of hospital patient health information and record management may results in improved patient record safety, improved job performance and satisfaction. Health record manager relationships may also be enhanced. The suggested method will integrate the role of manual/paper-based method of accessing patient medical information with the use of electronic method, the use of small shelf/cabinet file system shall be replaced by portable computer system. Likewise, daily operations, programming, scheduling and billing, duplicate patient medical records and inaccurate patient information that can lead to claim denial shall be minimized.

Research-related Injury: There is no anticipated research-related injury by participating in the study.

Storage of all electronic and hard copies including tape recordings: A copy of the thesis shall be made available to DUT repository and findings made available to participants upon request.

Persons to contact in the Event of Any Problems or Queries: Please contact the Supervisors: Prof M.N. Sibiya, 031-373 2284, nokuthulas@dut.ac.za and Prof O. Oladimeji, +2347035234566, ooladimeji@hsph.harvard.edu and the researcher Akinyemi Oluwatoyin Rhoda +2348032349236, and akinyemitoyin6@gmail.com or the Institutional Research Ethics

Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za

Appendix 4: Consent

Full Title of the Study: Design of communication model on Electronic integration of hospital patient health information and records management in tertiary hospitals.

Names of Researcher/s: Ms Akinyemi Oluwatoyin Rhoda

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Ms Akinyemi Oluwatoyin Rhoda, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, Akinyemi Oluwatoyin Rhoda herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

AKINYEMI OLUWATOYIN RHODA	30-05-2021	
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Appendix 5: Observation checklist

1. INFRASTRUCTURE AVAILABILITY

	Unacceptable	Poor	Fair	Good	Excellent
1.1 Number of computers available for use					
1.2 Adequate space					
1.3 Internet connectivity					
1.4 Power Supply					
1.5 Central support unit for handling technical problems					
1.6 Available printers (in working order)					

Comments

_____

_____

2. STAFF AVAILABILITY FOR EQUIPMENT USE

STAFF	**INADEQUATE**	**AVERAGE**	**ADEQUATE**
DOCTORS			
NURSES			
HIM			
LAB.SCIENTIST			
RADIOGRAPHERS			
PHARMACISTS			

Comments

_____

_____

3. PATIENTS WAITING TIMES LONGER THAN 30 MINUTES

Never	Rarely	Sometimes	Often	Always

Comments

_____

_____

Appendix 6: Questionnaire

Please **DO NOT** write your **Name** on the questionnaire.
Select **ONE** response option for each question by using **'X'**

SECTION A – DEMOGRAPHICS

1. Please indicate your gender?

Male	Female

2. Please indicate your age

20 - 30 years	31- 40 years	41- 50 years	51- 60 years	61 years & above

3. Please indicate how long you have been in the service of EKSUTH

Less than 10 years	10 - <20 years	20 – 30 years	Over 30 years

4. Please indicate your job title (Select **ONE** option only)

Health Information Management Officer	
Health Information Management Technician	
Nurses	
Doctors	
Pharmacist	
Laboratory Scientist	
Radiographers	
Other (specify please) _____	

SECTION B – ELECTRONIC MANAGEMENT OF RECORDS

5. **LEVEL OF SKILLS IN 'IT' USAGE FOR RECORD KEEPING.**

Rate your level of efficiency (from 1= Not at all efficient to 5 = Extremely efficient) in the usage of these computer/Smartphone software/functions?

	Not at all efficient 1	**2**	**3**	**4**	**Extremely efficient 5**
5.1 MS Excel					
5.2 MS Word					
5.3 MS Access					
5.4 Email					
5.5 WhatsApp					

6. **ENVIRONMENTAL SUPPORT FOR ICT USAGE**

Indicate your level of agreement that the following support exists for effective usage of ICT?

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
6.1 Reliable Internet connection						
6.2 Reliable power supply						
6.3 Availability of technical support at all stages						
6.4 Sufficient & reliable computers						
6.5 Back-up power e.g. solar/ inverter/ generator						

7. STAFF ATTITUDES TO MOVING TO ELECTRONIC RECORD KEEPING

Indicate your level of agreement that moving to electronic record keeping is a good development

Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

8. MODE OF ATTENDING TO PATIENTS ELECTRONICALLY

Indicate how often you use the following **mode of communication** when attending to patients

Mode of communication	Never	Rarely	Sometimes	Often	Always/ Nearly Always
8.1 Physical contact					
8.2 Telephone					
8.3 Voice mails					
8.4 Emails					
8.5 Online/WhatsApp chatting/Zoom					
8.6 Letter					

9. Indicate your agreement that the following are **BENEFITS** of integrating patients' records into an electronic system.

Benefits	Strongly Disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
9.1 Patients' waiting time will be reduced						
9.2 Reduction in medical errors e.g. wrong diagnosis, medication errors etc.						
9.3 Longer time span of patients' information can be stored						
9.4 Enable quick and easy access of past medical records thus ensuring prompt continuity of care						
9.5 Patients' information is easily accessible from anywhere						
9.6 Access to health care at any location since medical records would be easily accessible						
9.7 More efficient/faster ward rounds						
9.8 Reduction in staff workload						
9.9 Reduction in number of duplicate diagnostic tests ordered						
9.10 Reduction in loss of patients' information						
9.11 Information can be shared across disciplines & specialties for quick decision making.						
9.12 Increased revenue and prompt claims reimbursement.						

10. Indicate your agreement that the following could be **BARRIERS** to electronic integration of patients' health information and record management.

Barriers	Strongly Disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly Agree
10.1 Staff shortages						
10.2 Large numbers of patients						
10.3 Lack of ICT navigation skills among the staff						
10.4 Poor staff attitudes towards electronic record keeping						
10.5 Inadequate ongoing training for those who need it						
10.6 Lack of availability of line thermal printers on EHR network						
10.7 Lack/shortage of scanners for scanning previous records						
10.8 Lack of needed funding						
10.9 Concern about privacy and confidentiality						

Thank you for your participation

Appendix 7a: Demographic data for the interview participants

SECTION A: DEMOGRAPHIC DATA

Please answer the following questions in the spaces provided by placing X in the most appropriate option.

1.1 Please indicate your gender?

Male	
Female	

1.2 Please indicate your age

20-30 years	
31-40 years	
41-50 years	
51-65 years	

1.3 Please indicate where you work

Eksuth Main Annex	
JTD IRE	
Okela Outreach Centre	
Igbemo Outreach Centre	

1.4 Marital status

Single	
Married	
Divorced/ Separated	
Widowed	
Cohabiting	

1.5 How long have you been in service?

Less than 5 Years	
5 - <10 Years	
10 - <15 Years	
15 - 20 Years	
More than 20 Years	

Appendix 7b: Interview guide

SECTION A: Demographic information

1 Gender

Male	Female

2 Age

Up to 30	31-40	41-50	Over 50

3 Position and department _____

4 Length of Time you have been working in the institution.

<5 years	5 - <10 years	10 - <15 years	15-20 years	>20 years

SECTION B: INTERVIEW QUESTIONS

1a How are medical records currently been kept in this institution? (a) Manual (b) Electronic (c) Both;

1b. How are they shared/communicated between personnel and departments?

(a) Manual (b) Electronic (c) Both

2 Do you encounter any problems with this system?

(a) Yes, please elaborate----------

(b) No.

3 How would you feel about changing from a paper-based to an electronic system for record keeping?(a) Relaxed (b) Efficient (c) Less burdened (d) Fulfilled (e) Others----------

4 Can you think of any benefits from using ICT to keep the records? (a) Improved confidentiality (b) Minimized workload (c) Reduced patients' waiting time (d) Easy communication (e) Others----------

5 What barriers could prevent the successful transition to electronic record keeping? (a) Lack of IT skills (b) Inadequate equipment (c) Poor internet facility (d) Unstable power supply (e) Others----------

6 Can you suggest any protocol that could be put in place to ensure the confidentiality of medical records is maintained? (a) Restriction of access to users (b)Individual username and password (c) Occasional change of password (d) Frequent top management review and checkmating of users' access (e) Others----------

Thank you for your time to participate in the study.

Appendix 8: Letter from the Statistician

Gill Hendry B.Sc. (Hons), M.Sc. (Wits), PhD (UKZN)
Mathematical and Statistical Services

Cell: 083 300 9896
Email: gillhendrystats@gmail.com

21 September 2022

Re: Assistance with data analysis

Please be advised that I assisted Oluwatoyin Akinyemi (Student number 22063671), who is currently studying for a PhD: Health Sciences at DUT, with the statistical aspects of her study.

Yours sincerely

Dr Gill Hendry
Private Consulting Statistician

Appendix 9: Editing certificate

Sarah Frost

B.A. (Hons in English Literature) (UCT), Masters in English Literature (UKZN)

Editing Services

Cell: 074 384 2772

Email: sfrost@juta.co.za

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19 October 2022

Re: Editing services rendered

Please be advised that I edited a thesis written by Oluwatoyin Akinyemi (Student number 22063671), written as part of her PhD degree: Health Sciences at the Durban University of Technology.

Regards

Sarah Frost

Editor

Appendix 10: Turnitin Report

Faculty of Health Sciences,
Department of Health Sciences,
University of Technology, Durban,
South Africa.
21/10/2022.

Dear Sir/Ma,

TO WHOM IT MAY CONCERN: To avoid misconception of the thesis by the examiners and faculty office

I, OLUWATOYIN RHODA AKINYEMI hereby declare that this PhD thesis is my work, and each text has been correctly referenced or cited. However, the similarity index of the Turnitin from the SAJIM is the published journal papers out of the research output.

1. South African Journal of Information Management accounting (SAJIM) for 15% of the similarity, being one Chapter of the Thesis published as Journal Articles. Thus, the base Similarity Index is effectively 12%.

If the above is minus from the 28% such that (28-15= 13%). The total similarity will be **13%.**

Thanks for the understanding and swift processing of my thesis.

Kind Regards,

OLUWATOYIN RHODA AKINYEMI

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