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Reducing fragmentation in sharing of information in e-medical recording systems: case of open Mrs and care2x

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**REDUCING FRAGMENTATION IN SHARING OF
INFORMATION IN E-MEDICAL RECORDING SYSTEMS:
CASE OF OPENMRS AND CARE2X**

Geofrey Rweikiza

**A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of
Master's in Information and Communication Science and Engineering of The Nelson
Mandela African Institution of Science and Technology**

Arusha, Tanzania

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ABSTRACT

Integration of the Electronic Medical Records (EMR) with clinical research systems has the potential to greatly enhance the efficiency, speed, and safety of medical research. New hypotheses could be generated through mining of EMR data, observational studies may be conducted more rapidly, and clinical trial recruitment and conduct could be greatly facilitated. Such enhancements will be accomplished through secondary use of EMR data for research and the development of automated decision support systems that rely on EMR data. In this study we defined the various types of EMR and clinical research data systems in use and described the goals and rationale for integrating these two types of systems to enhance research as well as quality of care. The various approaches and benefits to integrating EMR and clinical research systems are discussed and data integration was prototyped on Open MRS and Care2X health information systems. Medical Records Exchange System (MRES) prototype was developed for exchange of information on Open MRS and Care2x hospital information systems. While major benefits are conferred by such system integration, many challenges exist as well, such as the need for stringent data quality assurance, appropriate granularity, metadata and person index management, and extremely careful handling of data access and security issues. Furthermore, the movement toward the EMR within Tanzania has been slow to date, hampering these data integration efforts. However, recent legislation to incentivize the adoption of EMRs will make the feasibility and utility of EMR data integration to support clinical research more promising in the near future.

DECLARATION

I, **Geofrey Rweikiza**, declare that the dissertation titled “Reducing Fragmentation and Overcoming Barriers to Effective sharing of Information in E-Medical Recording Systems: Case of Open MRS and Care2X” is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.



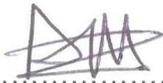
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22/03/2019
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Name and signature of the candidate

Date

The above declaration is confirmed



.....
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22/03/2019
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Name and signature of Supervisor

Date

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CERTIFICATION

The undersigned certify that they have read and found the dissertation titled, "Reducing Fragmentation and Overcoming Barriers to Effective Sharing of Information in E-Medical Recording Systems: Case of Open MRS and Care2X" qualify for acceptance by the Nelson Mandela African Institution of Science and Technology (NM-AIST) in Arusha, in partial fulfillment of the requirements for the degree of Master in Information and Communication Science and Engineering of NM-AIST.



22/03/2019

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Date

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DEDICATION

In dedication to my beloved mother Mrs. Hellen Wilbard Rweikiza.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
DFD	Data flow diagram
DHIS	District Health Information System
EHR	Electronic Health Records
EMR	Electronic Medical Record
ERD	Entity-Relationship Diagram
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
MMRS	Mosorioti Medical Recording System
MRES	Medical Records Exchange System
NM-AIST	Nelson Mandela Africa Institute of Science and Technology
PDA	Personal Digital Assistant
PHP	Hypertext Preprocessor
RDBMS	Relational Database management system
SQL	Structure Query Language
SRS	Software Requirements Specification

CHAPTER ONE

INTRODUCTION

1.1. Background Information

Information and Communication Technologies (ICTs) are transforming the lives of Tanzanians and individuals across the world in different aspects of education, health, and governance. Countries both developed and developing have recognized the potential of ICT to support and transform the delivery of quality healthcare services with a mandate to adopt and effectively use ICT in the health sector.

Electronic Health (e-health) is the commonly applied term for the application of ICT in the health sector (URT, 2012). E-Health is defined as the cost-effective and secure use of ICT in support of health and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge, and research (WHO, 2017). The healthcare delivery services are challenged with systemic misalignment of incentives, health records, lack of coordination, that spawns' inefficient allocation of resources or harm to patients collectively termed fragmentation (Eindhoven, 2009). Electronic medical records are generally fragmented across multiple treatment sites which means patients' e-medical records are distributed in different healthcare services which have different types of e-medical recording systems. This has brought challenges in sharing information between e-medical recording systems. Fragmentation occurs when there is heterogeneity among the systems which means that e-medical recording systems have different characteristics and behaviours but they all perform similar functions.

An electronic medical recording system (or electronic health recording system) is an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization, have the potential to provide substantial benefits to physicians, clinic practices, and health care organizations (Kalogiropoulos *et al.*, 2009). These systems can facilitate workflow and improve the quality of patient care and patient safety (Bouidi *et al.*, 2017). However, structural barrier on the data model is one of the factors contributing to challenges in sharing of information across e-medical recording systems (Omary *et al.*, 2010). The inconsistency on data models arise from the use of multiple platforms from multiple vendors in e-medical

recording systems. This causes a significant challenge on electronic health records adoption in terms of connectivity across health facilities and respective stakeholders (e.g. physicians). The lack of data standards and complex electronic medical recording systems is a known major barrier in exchange process of patients' information (Wu *et al.*, 2017).

This study therefore, seeks to reduce fragmentations among e-medical recording systems data models by developing integrated data models of e-medical records. Data Model is one among the major barrier to effective sharing of information in e-medical recording systems. It is therefore important to develop a mechanism or engine which can be used to integrate the systems so that they can be able to share information.

1.2. Problem Statement

There are a number of barriers which hinder effective sharing of information in e-medical recording systems, namely, security of the e-medical recording systems, policies of the organizations and the data models of the e-medical recording systems. Data Model in e-medical recording systems refer to the design of the database tables for integrating attributes of electronic medical data of the systems and the relationships between them. The data model is the major barrier to effective sharing of information in e-medical recording systems because is the key for any e-medical recording systems (Tewuh, 2011).

From literature review, we have seen that ineffective sharing of information due to fragmentation in e-medical recording systems is mainly contributed by the heterogeneity among the e-health information systems. This bring challenges in integrating medical data and also interoperability of the e-medical recording systems became complicated.

1.3. Research Justification

The significance of this study is to conduct a research through the development of an appropriate prototype to reduce fragmentation on the currently widely used e-medical recording systems data models in developing countries like Tanzania. When fragmentation is reduced, information will be shared across the e-medical recording systems for efficient and reliable health care delivery.

1.4. Research Objectives

1.4.1. General Objectives

The main objective of this research is to develop a prototype which will reduce fragmentations and overcoming barriers in effective sharing of information in e-medical recording systems.

1.4.2. Specific Objectives

- (i) To review and analyze the current existing data models for e-medical recording systems.
- (ii) To develop a prototype engine which integrate data models and hence sharing of information across e-medical recording systems.
- (iii) To validate the prototype for handling integrated e-medical recording systems.

1.4.3. Research Questions

- (i) What are the current existing mostly used e-medical recording systems?
- (ii) How do you develop a prototype engine for integration of data models of e-medical recording systems and increase efficiency in the sharing of information?
- (iii) What value is added by the developed prototype?

1.5. Research Framework

The conceptual framework of the study on Fig. 1 below indicates the data models at Muhimbili National Hospital using OpenMRS hospital information system and Tanzania Occupation Health Services (T.O.H.S) which is the private hospital which uses the Care2x system to automate its health services. The study aimed at developing a prototype engine, Medical Records Exchange System (MRES) to enable the exchange of data and information between the two hospital systems across a Secure Virtual Private Network (SVPN).

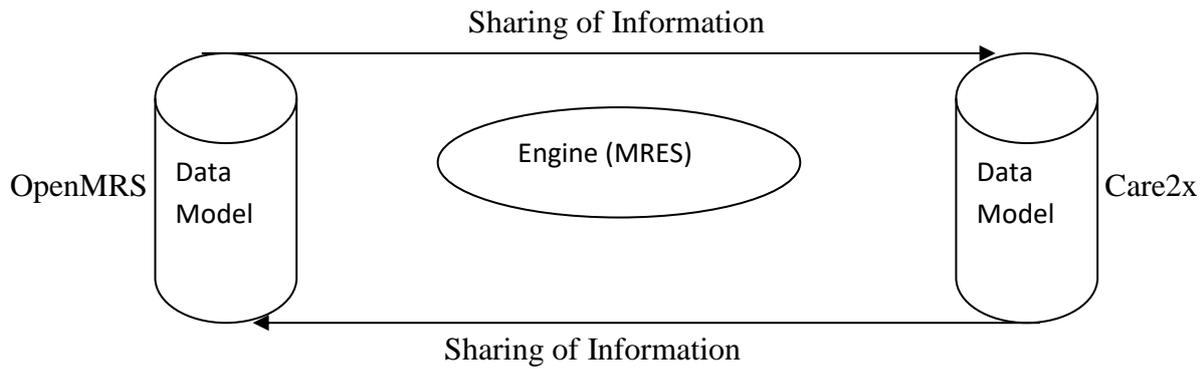


Figure 1: Conceptual framework

The scope of this research focused on developing an effective engine which will be used for the data integration across the heterogeneous e-medical recording systems and enable exchange of information across each other. The development involved studying and analyzing data models of OpenMRS and Care2x e-medical recording systems used in major hospitals in Tanzania.

OpenMRS is one of the open source electronic medical recording system which is a worldwide used and especially in developing countries like Tanzania, Uganda, Malawi, Indonesia etc. OpenMRS is the system which is designed and developed in 2004 by a group from different institutions like Regenstrief Institute etc., these institutions are non-profit institutions who developed different types of medical recording systems OpenMRS developed by using Java programming language, Tomcat Apache webserver and they used PostgreSQL as the default relational database management system (OpenMRS, 2011).

Care2x is also an integrated open source electronic system designed and developed by using PHP, apache web server and MySQL as a relational database management system. Care2x is also commonly used in developing countries especially in Africa like Tanzania, Zambia etc. (Care2x, 2013).

1.6. Organization of the Dissertation

This dissertation is organized into five chapters.

Chapter 1: Includes introduction, research background, objectives, problem statement, research questions, research justifications, literature reviews and methodologies.

Chapter 2: It covers review of data models of the mostly used open source e-medical

recording systems which are OpenMRS and Care2x.

Chapter 3: This chapter covers materials and methods which were used for the development of the prototype for integrating data models for OpenMRS and Care2x system.

Chapter 4: This chapter covers results and the discussions of the current issues concerning exchanging and interoperability of data across OpenMRS and Care2x.

Chapter 5: This chapter covers conclusion and recommendations for future works for this study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

Electronic medical record (EMR) systems is defined as "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization" (Häyrinen *et al.*, 2008). Electronic Medical Recording systems have the potential to provide substantial benefits to physicians, clinic practices, and health care organizations with respect to exchange of patients' information. These systems can facilitate workflow and improve the quality of patient care and patient safety. Despite these benefits, widespread adoption of EMRs in the Tanzania is very low (Omary *et al.*, 2010). Among the significant barriers to adoption include the following:

- (i) High capital cost and insufficient return on investment for small practices and safety net providers.
- (ii) Underestimation of the organizational capabilities and change management required.
- (iii) Failure to redesign clinical process and workflow to incorporate the technology systems.
- (iv) Concern that systems will become obsolete.
- (v) Lack of skilled resources for implementation and support.
- (vi) Concern that current market systems are potentially not meeting the needs of rural health centers or federally qualified health centers (FQHC).
- (vii) Concern regarding negative unintended consequences of technology.

Medical record keeping is undergoing a transition not only in the developed countries but also in developing countries (Chhanabhai *et al.*, 2010). The developing world does not have a well-developed health care infrastructure to support health information systems (HIS) (Kalogiropoulos *et al.*, 2009; Omary *et al.*, 2010). However, efforts have been made in recent years from improved national ICT infrastructure and currently major hospitals in Tanzania have operational HIS.

Throughout time paper-based systems have proven to become more and more inefficient and are continuously failing to meet the care provider's needs of efficiency and speed on patients care. Timely communication between care providers is a challenge with paper-based medical records system, especially in developing countries. In developed countries, a paper-filed medical record may be scanned and sent to another care provider or sometimes faxed. In the developing world, if a paper-filed medical record needed to be seen by a different care provider or someone at a different location, that paper file would have to be hand-delivered to this new location. This method is time-consuming and inefficient.

All of these efficiency problems that were previously discussed can be addressed by the implementation of electronic medical records (EMRs). Since electronic medical records can be sent from one location to another almost instantaneously, EMRs would practically eliminate the manual labor of transporting papers or even scanning or faxing papers if that technology were available. This, in turn, would save time and manpower and would decrease the time doctors and care providers take to communicate. This saved time could then be well spent for patient care, which would decrease waiting times for patients. The implementation of electronic medical record keeping promises would thus increase the overall quality of health care.

2.2 Existing health information systems for hospitals in Tanzania

Health services in Tanzania are provided by various stakeholders with major providers being the Government, Parastatal Organizations, Religious Organizations, Private Practitioners, Traditional Medicine and Voluntary Organizations (MoHCDEC, 2016). The health services delivery structure in Tanzania is pointed as indicated in Fig. 2. The bottom and first level are village health services, followed by dispensary health services, Health Centre services, District hospitals, Regional hospitals and Referral hospitals at the top (Winani *et al.*, 2007).

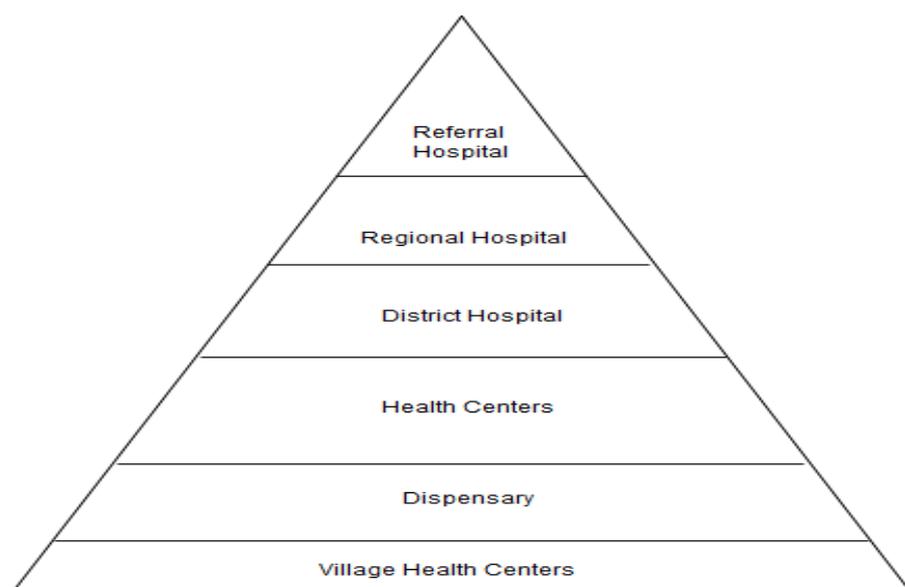


Figure 2: Health care delivery in Tanzania (Mshana, 2004)

Statistics indicate there are 55 district hospitals, 13 designated district hospitals owned by Faith Based Organizations (FBO), 18 regional hospitals and 8 consultancy hospitals in Tanzania (MOHSW, 2008). Village Health Center is the lowest level of health care delivery in Tanzania, which provides preventive normally possible to be offered at homes. The next level are dispensaries that provide a wide range of curative and preventive measures including antenatal care, family planning, delivery and postnatal care. Health centers services at the next level after dispensaries, provide services offered in the dispensaries including basic laboratory services (Hanson *et al.*, 2013).

District hospitals are a very important level in the provision of health services in the Tanzania. Each district in the country is supposed to have a district hospital by legislation. Similarly in every region, a regional hospital. Regional Hospitals offer similar services to those at the district level, however, they have specialists in various health fields and offer additional services which are not provided at district hospitals. The top most level are Referral Hospitals in the country. Muhimbili National Hospital (MNH), Kilimanjaro Christian Medical Centre (KCMC), Bugando Hospital and Mbeya Hospital are referral hospitals in Tanzania (Sawe *et al.*, 2014).

The main function of referral hospitals is to provide a complex care to patients referred from lower level hospitals (Hensher *et al.*, 2006). Although in developing countries there is no

agreed definition of which services should be provided by each level of health services. The aim of the pyramidal structure of health system in Tanzania is enabling patients to acquire health services starting from a lower level hospital to a higher level hospital. In reality, many people move direct to the referral hospitals without even passing at the lower level hospitals (MOHSW, 2008). The extensive paper-based operations at referral hospitals in turn affect services at lower levels. Health care providers at the lower level hospitals are often in doubt to refer patients to higher level hospitals due to extensive paper works involved during the process (Musau *et al.*, 2011).

It is a fact that health information is isolated within hospitals limiting accessibility of the information when there is a need for a person or another health center to access the information (Vest *et al.*, 2010). As the specialty in the field of medicine expands, the transfer of responsibility for patient care between hospitals become increasingly common, creating an urgent need to improve communication and information transfer between inpatient and outpatient physicians at the hospital (Kripalani *et al.*, 2007). The existing health information systems in hospitals in Tanzania are summarized herewith below:

2.2.1. Care 2x System

Care2x is an open source web based Integrated Healthcare Environment (IHE), the system has been in use since 2014 and the source code is given to the client. The system supports both Windows and Linux operating system (www.care2x.org). Currently, the system is in use to some hospitals in Tanzania such as Arusha Lutheran Medical Hospital (ALMC), St. Elizabeth hospital in Arusha, Selian hospital in Arusha, Hydrom Lutheran hospital in Mbulu and Kilimanjaro Christian Medical Centre (KCMC) (Kimollo *et al.*, 2010).

Care2x is web-based and has built upon other open-source projects. These projects include the Apache web server and the relational database management system MySQL. Care2x is known to be very feature rich and can be configured to many clinical structures (Care2x, 2013). Care2x is built using PHP (Hypertext Preprocessor), it can be integrated also with WebERP for accounts activities like issuing of invoices and its data model works only with MySQL relational database management systems rather than SQL-SERVER, DB2, PostgreSQL. Due to this fact it has been challenging in sharing of data because of different types of data formats and structures across database management systems. Other countries that use Care2x systems include Malaysia, India, France, Italy, South Africa, Kenya and Egypt (Care2x, 2013).

2.2.2. Electronic Health Management System

Electronic Health Management System (EHMS) is a commercial hospital information system. EHMS was developed by GPITG company and the technical support is provided by the same company. The system has been in use at Sanitas Hospital and Kairuki Hospital in Tanzania since 2012 (<http://gpitg.com/node/38>).

2.2.3. Jeeva System

Jeeva is a commercial health information system, developed by Napier Healthcare Systems in India (<http://www.napierhealthcare.com>). The system has been in use at Muhimbili National Hospital (MNH) in Tanzania since 2005.

2.2.4. MediPro System

MediPro is a commercial hospital information system from by Maxcom Africa Limited (<http://maxcomafrika.com>). The system is in use at Muhimbili Orthopaedic Institute (MOI) in Tanzania. MediPro is a commercial system and the technical support is provided by the supplier.

2.2.5. Government of Tanzania Health Management Information System

Government of Tanzania Hospital Management Information System (GoT-HoMIS) is a full hospital information system developed by the Government of Tanzania. The system is currently in use at Tumbi regional referral hospital and extended to district hospitals countrywide. GoT-HoMIS operations are managed by the President's Office, Regional Administration and Local Government (GoT-HoMIS, 2017).

2.2.6. District Health Information System

District Health Information System (DHIS) is a tool for collection, validation, analysis, and presentation of aggregate statistical data, tailored (but not limited) to integrated health information management activities. It is a generic tool rather than a pre-configured database application, with an open meta-data model and a flexible user interface that allows the user to design the contents of a specific information system without the need for programming. DHIS2

and upwards is a modular web-based software package built with free and open source Java frameworks (DHIS2, 2016). DHIS2 is an open source software released under the BSD license and can be used at no cost. It runs on any platform with a Java Runtime Environment (JRE 6 or higher) installed. In Tanzania, DHIS2 is managed by the Ministry of Health, Community Development Gender, Elderly and Children (Lungo, 2008).

DHIS2 software is used in more than 40 countries in Africa, Asia, and Latin America, and countries that have adopted and implemented DHIS 2 as their nation-wide HIS (Health Information System) software include Kenya, Tanzania (<https://dhis.moh.go.tz/>), Uganda, Rwanda, Ghana, Liberia, and Bangladesh. A rapidly increasing number of countries and organizations are starting up new deployments.

2.2.7. Open MRS

OpenMRS is an open source application that allows for the design of a customized medical records system specific to the care provider's needs with no programming knowledge (OpenMRS, 2009). However, one needs to possess medical and systems analysis knowledge. This system is based on a conceptual table structure. This structure is independent of the types of medical information to be collected or the forms to be used. This is very beneficial because it can be customized for different user needs. A concept dictionary, which stores all diagnosis, tests, procedures, drugs, and other general questions and potential answers, was created as the core of OpenMRS on the basis of the principle that information should be stored so it is easy to summarize and analyze. The conceptual dictionary allows minimal use of free text and maximum use of coded information.

Another major benefit of OpenMRS is that it is free; all of its components and all the resources needed are available for download freely. The only component that is not free is a currently used plug-in, which utilizes Microsoft's InfoPath program for data entry. This does require a license but is nonetheless a relatively small barrier to overcome. Because of its low cost, being essentially free, many developing countries have begun to implement OpenMRS. Countries currently using OpenMRS include Kenya, Rwanda, South Africa, Uganda, Tanzania, Zimbabwe, Lesotho, Malawi, Peru, and Haiti indicated on Fig. 3.

In Tanzania, OpenMRS is implemented at Tanzania Training Center for International Health in Ifakara, Morogoro and Simiyu Region (OpenMRS, 2009).



Figure 3: OpenMRS Atlas (OpenMRS, 2009)

2.3. Related works

A data model refers to the logical inter-relationships and data flow between different data elements involved in the information world (Zhao *et al.*, 2017). It also documents the way data is stored and retrieved. Data models facilitate communication business and technical development by accurately representing the requirements of the information system and by designing the responses needed for those requirements. Data models help represent what data is required and what format is to be used for different business processes (Tai-Seale *et al.*, 2017)

A data model can be concrete or abstract. It has five main components which are:

- (i) Data types.
- (ii) Data items.
- (iii) Data sources.
- (iv) Event sources.
- (v) Links.

Data models are represented by the data modelling notation, which is often presented in the graphical format. Their main focus is to support and aid information systems by showing the format and definition of the different data involved (Goldstein *et al.*, 2017). They also help prevent data redundancy. Information stored in data models is of great significance for businesses because it dictates the relationships between database tables, foreign keys and the events involved.

The three basic styles of data model are:

- (i) Conceptual data models.
- (ii) Physical data models.
- (iii) Logical data models.

Care2x and OpenMRS HIS that are the focus of this study are open source systems with different types of data models and technologies. They have the challenge of exchanging patients' information between health centers which uses Care2x and OpenMRS. This study sought to address the challenge with a suitable mechanism which will help those systems to be able to exchange data/information.

When choosing which electronic medical record (EMR) system to implement, one should consider the following factors: population, location, and availability of resources. If the population the EMR is to serve is small, one should consider "flat file" databases and possibly stand-alone systems. If the population the EMR is to serve is large, one should think about coded databases and different networked systems. If the EMR is to serve remote areas, that fact should be taken into consideration; extra thought should go into the availability of resources at that remote site. If electricity, phone service, and the internet are not available, the EMR implemented for those sites should be able to overcome those challenges. To move beyond successful prototypes to widespread use, it is essential that EMR systems are developed with open standards and sharable components. A common data model can efficiently link the wide range of technology platforms discussed earlier and ease collaboration between projects. The fact is that different EMRs are more beneficial in different locations than others. Nonetheless, electronic medical record systems should be implemented with the future in mind. It will one day be beneficial to society to link all EMR systems together. This can be done quite easily and efficiently if society takes steps towards that now by implementing EMR systems that have a common structure and framework. For

this purpose, open source EMRs seem to be a viable solution for the present and the future. It seems that OpenMRS has the most potential and is the fastest growing open source system available today. Because it has common framework and is almost completely comprised of free, open source components, OpenMRS may be the best choice for today's EMR.

No matter what electronic medical record system is implemented, it is an important thing that the overall quality of healthcare in the area will increase. Electronic Medical Recording systems will eliminate problems, eliminate errors, save time, and save money in the long run. With further research, evaluation, and development, EMR systems will continue to get easier to implement and as a whole cheaper to establish and maintain. Electronic Medical Recording systems are a must for developing and developed countries alike. Due to their importance hence this research comes out with a proper prototype which can be implemented in health centers using Care2x and OpenMRS and can make those two systems to be able to exchange information and hence reducing costs and time for patients and physicians also.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Analysis of OpenMRS and Care2x systems

OpenMRS and Care2x health information systems are open source and commonly used in developing countries in Africa including Tanzania, Kenya, Zambia to mention a few. In depth interviews were conducted with five system administrators to assess the capability of hospital information system (HIS) in sharing patient information at Tanzania Occupations Health Services (T.O.H.S) and Muhimbili National Hospital. The interview questions are attached on Appendix 1. Analysis was done using use case diagram which is a graphical representation of the interactions among elements of a system (Li *et al.*, 2001). The use case diagram has four main components is indicated on Table 2. The use case is a methodology used to analyze and clarify the system requirements. Figure 4 shows the use case diagram for the developed medical records exchange system (MRES).

Table 1: Components of Use case Diagram

S/N	Component	Description
1.	Actor	Actors define the users of the system, an actor can be person, organization or external system. Usually an actor is drawn using stick figures.
2.	Use cases	Use cases are used to define the specific roles performed by the actors of the system, usually a use case is drawn as horizontal ellipses.
3.	Associations	These are the lines shows the relationships among users and the use cases
4.	System boundary	This shows the scope of the system, usually drawn as rectangles around use cases.

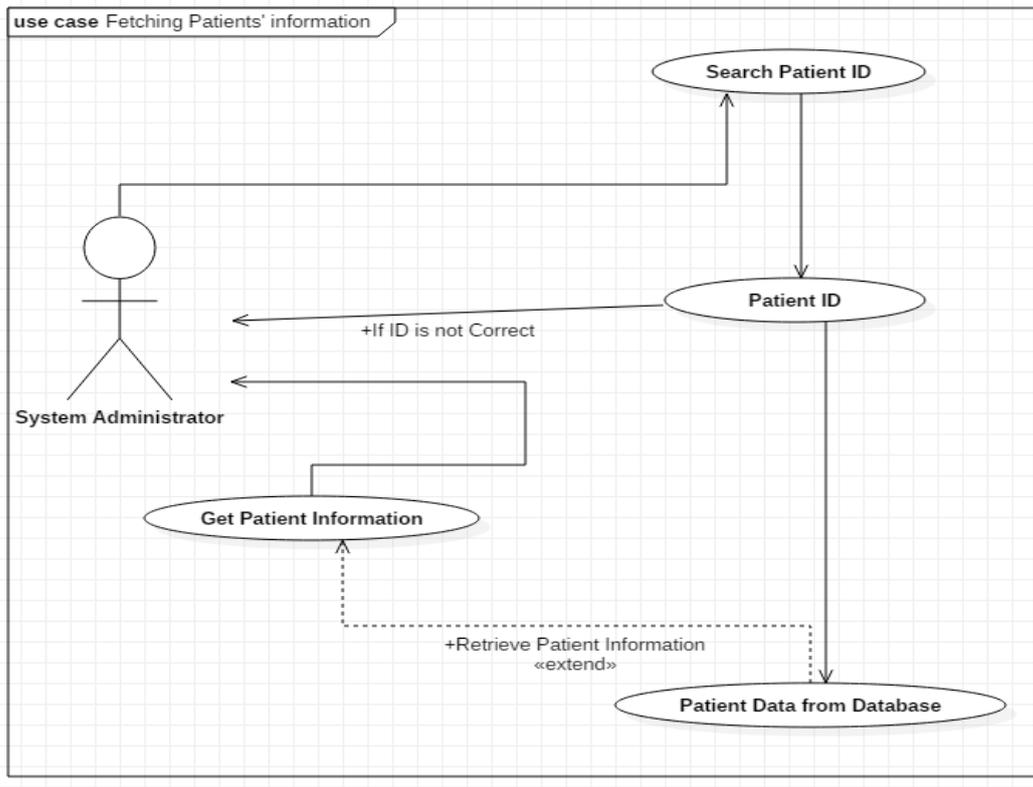


Figure 4: Use Case Diagram for MRES

Use case: Fetching Patients' information. This use case describes how a medical doctor can view patients registered to a particular hospital.

- (i) **Actor(s):** Medical Doctor.
- (ii) **Pre- condition:** Medical doctor must be logged on to the system before starts to view patients registered to a hospital.
- (iii) **Post-condition:** If this use case is successful, a medical doctor will be able to view patients registered to a particular hospital. Otherwise the system state will remain unchanged.
- (iv) **Basic flow:** This use case starts when a medical doctor wishes to view patients registered to a hospital using patients ID.

3.2. Methodology

In this study, the Agile methodology was used in software development. The Agile methodology has three objectives; first a focus on adaptive rather than predictive methodologies; secondly, a focus on people rather than roles and a self-adaptive process (Valacich *et al.*, 2001). The Agile development process is suitable in this research since it is difficult to predict in advance which software requirements will persist and which will change.

The Agile development consists of the following steps which are high level analysis, high level planning and a series of iterations which each iterations includes development and testing. In this methodology, it means that each module/functionality in the system undergoes a series of iterations and development on each iteration took between one and four weeks (1 to 4 weeks) to completion. It is equally a challenge to predict how customer properties will change as the research proceeds. Extreme Programming (XP) which is the most widely used agile software development approach will establish the foundation for the development of the model. Extreme Programming uses an object-oriented approach for development with four main activities: planning, design, coding and testing (Pressman, 2005). Figure 5 summarizes the agile development cycle framework using Extreme Programming approach.

Extreme Programming (XP)

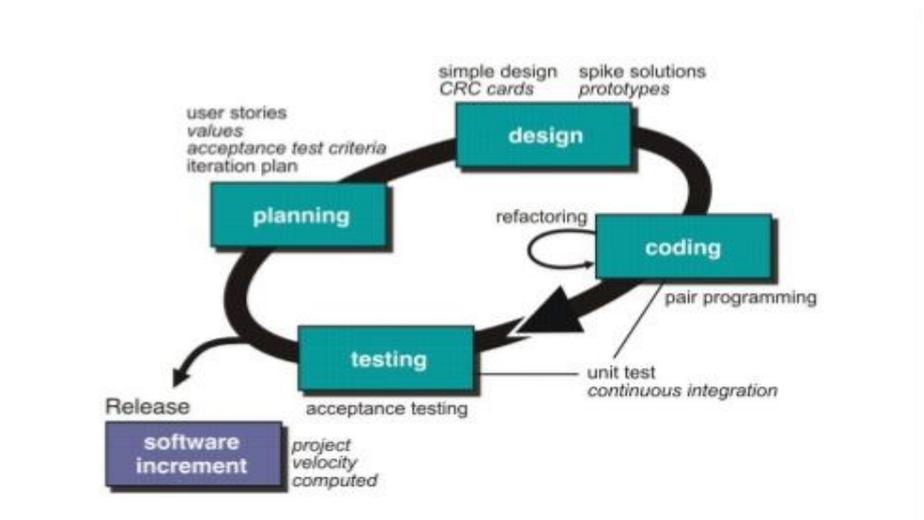


Figure 5: Extreme Programming Process to Agile Development (Pressman, 2005)

The research methods for achieving the specific objectives is indicated on Table 2 below:

Table 2: Research Methods

S/N	Specific Objectives	Methodology
1.	To review and analyze the current existing data models for e-medical recording systems.	Interviews and Literature Reviews (Muhimbili National Hospital, Tanzania Occupation Health Services – TOHS).
2.	To develop a prototype engine for data integration across e-medical recording systems	UML Diagrams, Triggers, Stored Procedures, Yii framework (PHP and MySQL), Java (Java Server Pages – JSP).
3.	To validate the prototype for handling integrated e-medical recording systems.	Unit Testing, Integration Testing and System Testing procedures

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Results

Medical Records Exchange System (MRES) is a prototype developed in this study for integrating data models for OpenMRS and Care2X systems. It is a web based application with a central database containing all the medical and treatment history of the patients in one practice. In designing an engine (MRES), the data flow across the two systems was considered. The MRES system has a central database which provides exchange of data across OpenMRS and Care2x systems and it can be connected and shared / exchange data within the network and the network can be either LAN (Local Area Network), MAN (Metropolitan Area Network) or WAN (Wide Area Network) or Internet. The Entity Relationship (E-R) diagram which describes the database is indicated in Fig. 6.

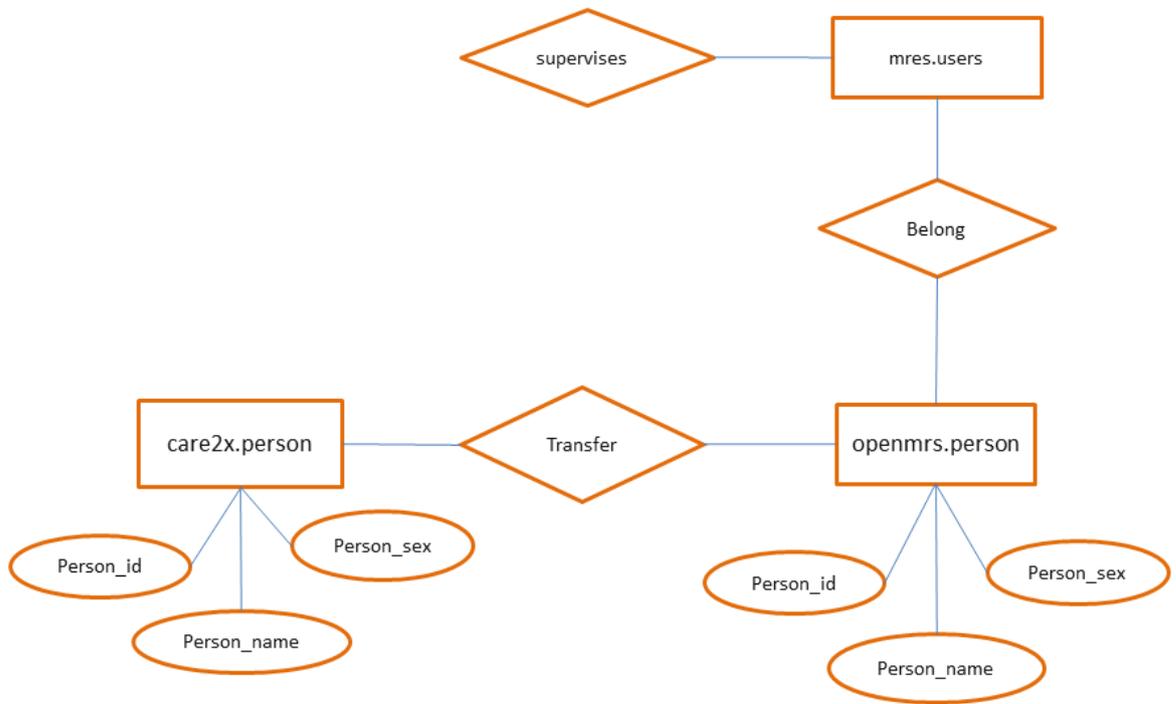


Figure 6: E-R Diagram for MRES

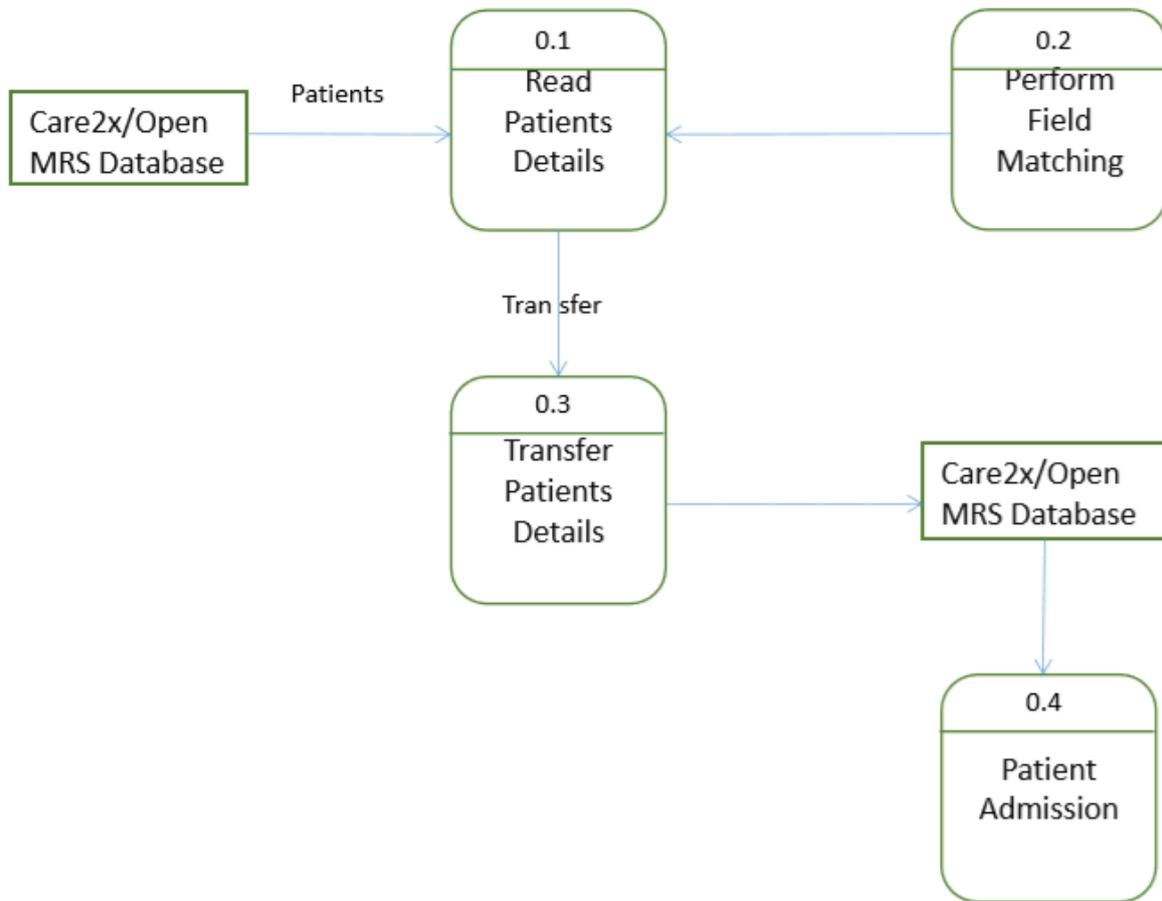


Figure 7: MRES-Data Flow Diagram

The implementation of MRES was done in PHP, a server side scripting language and MySQL, a relational database management system on the backend. PHP is cross-platform; highly supported; open source with ease of integration on web applications frameworks. On the other hand, MySQL database was selected in development of MRES since it is scalable and robust; open source with data integrity assurance from compliance to ACID properties.

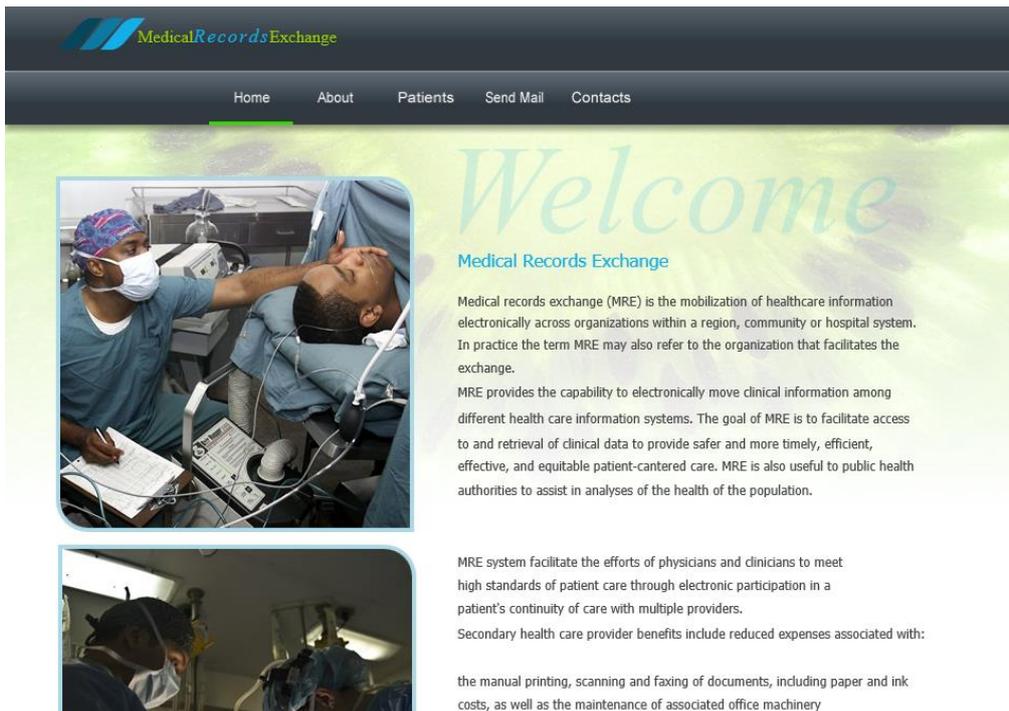


Figure 8: Homepage for the MRES

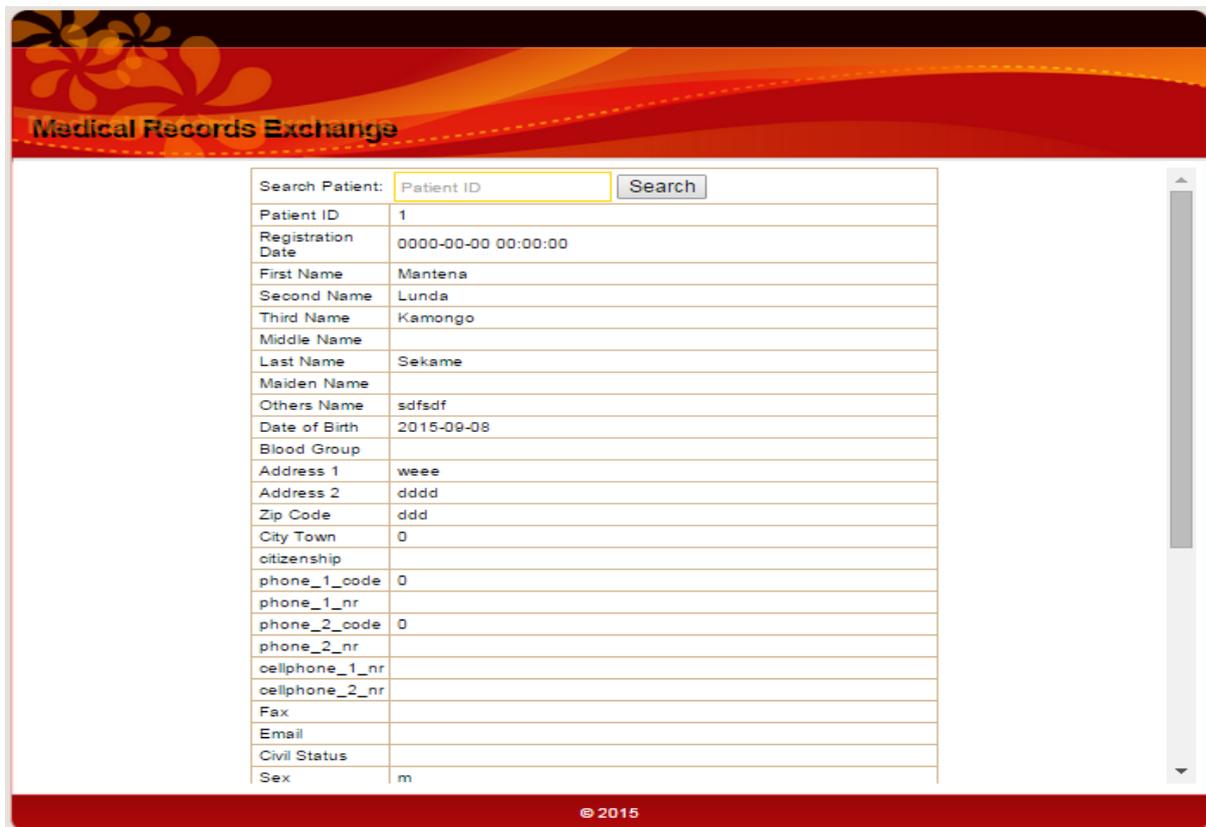


Figure 9: MRES - Patients' search page

The second iteration involved the design of sendmail module. In MRES the sendmail module is used to send email to the other hospital to provide notifications on the patients transfer to the other facility. It also contains a capability to attach any document which contains details of the patient. The development of this module involved SMTP (Simple Mail Transfer Protocol) and POP3 (Post Office Protocol version 3). Figure 10 shows a screenshot of the send mail module on MRES.

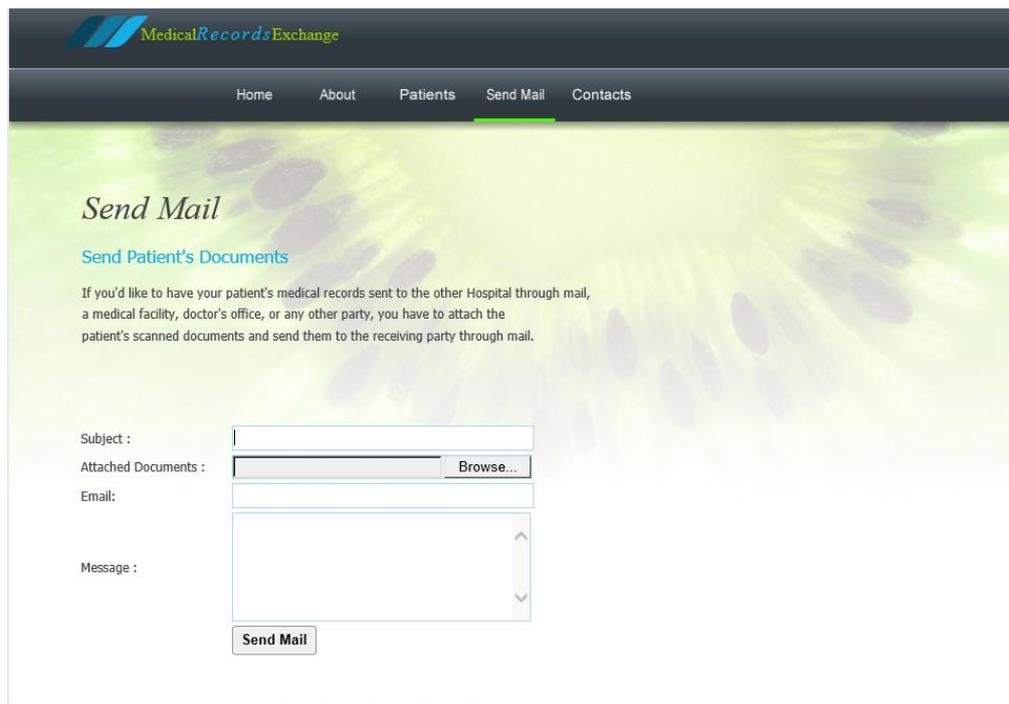


Figure 10: MRES- Send mail Module

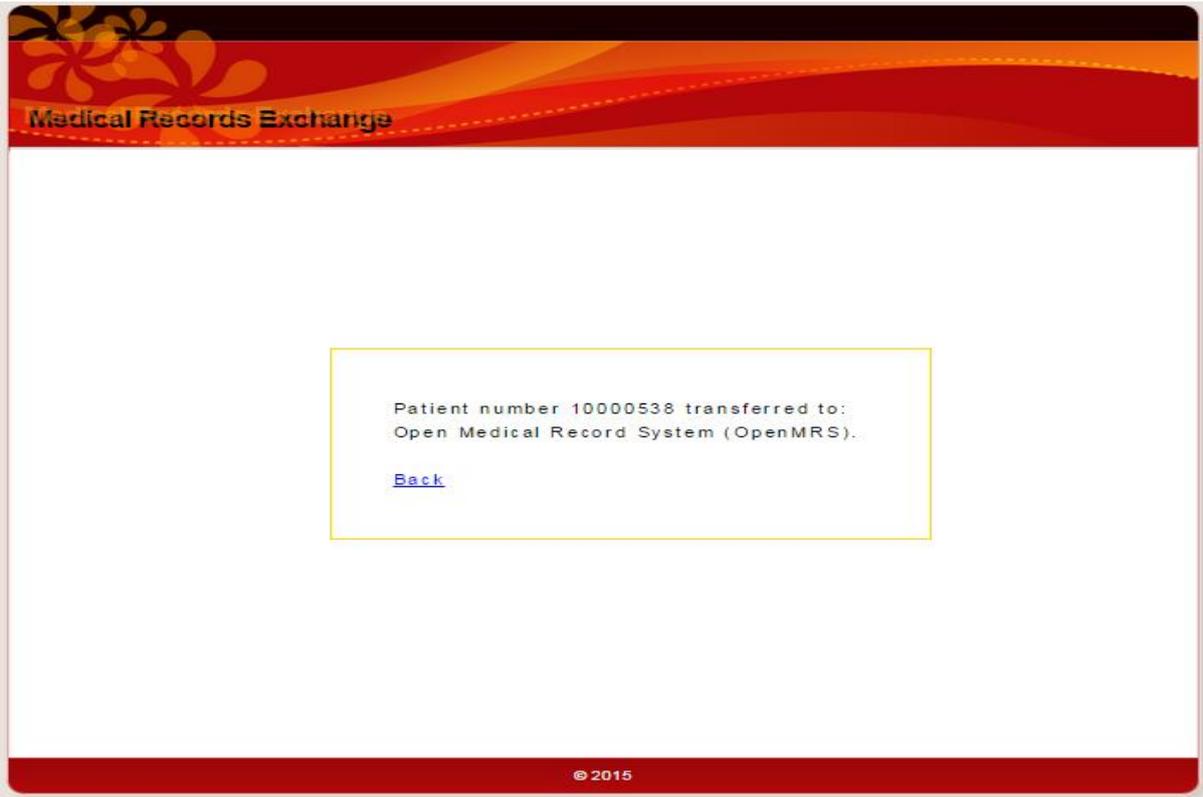


Figure 11: MRES-Message shows patient information been transferred



Figure 12: Show login page for OpenMRS

Patient Search

Find Patient(s)

Patient Identifier or Patient Name: Viewing results for 'C002' - 1 page

Identifier	Given	Middle	Family Name	Age	Gender	Birthdate	Death Date
C002	Mantena		Sekame	-1	M	08-Sep-2015	

Showing 1 to 1 of 1 entries
 Show entries

Figure 13: Shows patient’s data from Care2x stored and save in OpenMRS

Medical Records Exchange

Search Patient:

Patient ID	3
Registration Date	2015-09-07 00:00:00
First Name	Anna
Second Name	
Third Name	
Middle Name	Lasman
Last Name	Kasamse
Maiden Name	
Others Name	
Date of Birth	2015-09-08
Blood Group	
Address 1	weee
Address 2	
Zip Code	0
City Town	0
citizenship	
phone_1_code	0
phone_1_nr	
phone_2_code	0
phone_2_nr	
cellphone_1_nr	
cellphone_2_nr	
Fax	
Email	
Civil Status	
Sex	M
Tel.	

© 2015

Figure 14: MRES-shows searching of patient’s data from OpenMRS

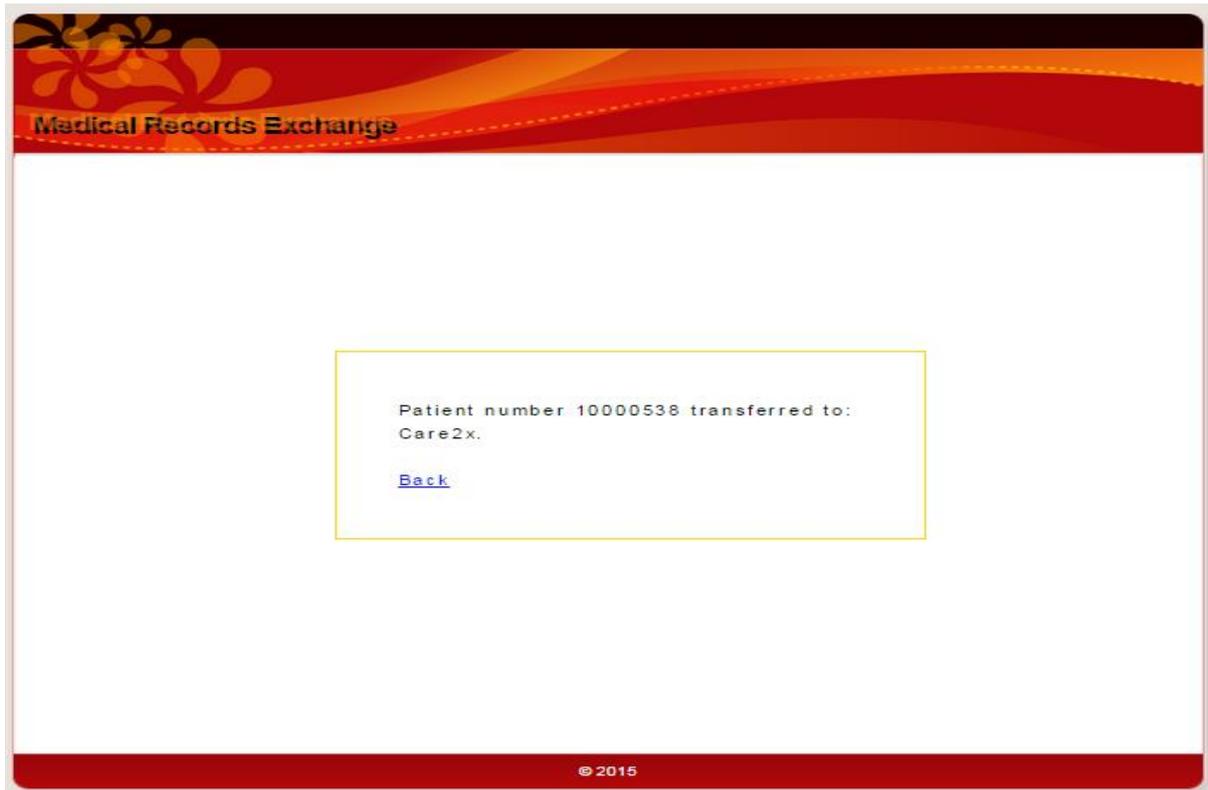


Figure 15: MRES-shows patients' data transferred from OpenMRS to Care2x



Figure 16: shows login page for Care2x

Person registration	
New person Search Advanced search Admission	
PID Nr.	3
Registration date	07/09/2015
Registration time	00:00
Title	
Family name	Kasamse
Given name	Anna
Middle name	Lasman
Date of birth:	08/09/2015
Sex:	
Address:	
Street:	weee
Town/City:	
Nr.:	0
Zip :	0
Other Hospital Nr.	
Registered by	
<input type="button" value="Choose File"/> No file chosen	
<input type="button" value="New Search"/> <input type="button" value="Update Data"/> <input type="button" value="Inpatient admit"/> <input type="button" value="Outpatient"/>	
<input type="button" value="Register a new person"/>	
<input type="button" value="Search patient's data"/> <input type="button" value="Archive"/>	
<input type="button" value="Cancel"/>	

Figure 17: Shows patient's data from OpenMRS stored and save in Care2x

4.1.1. Testing Phases

The process of performing testing usually occurs during development and after software version increments. Variety of testing methods on a system are done in order to explore functionality of the system as well as to identify problems. When testing, a series of systematic procedures are referred to determine the system performance and where the common mistakes may be found. In order to accomplish this, three different techniques are performed.

(i) Unit testing

Unit testing is a software development process in which the smallest testable parts of an application called units are individually and independently scrutinized for proper operation. Each part of the system was tested to determine if it is operating properly.

(ii) Integration testing

Integration testing is an important part of the testing process. It can be achieved by taking two units that have already been tested and combined into one component and the interface between them is tested. In this stage, the components are integrated, and their joint behavior is tested. A component, in this sense, refers to an integrated aggregate of more than one unit. The idea is to test combination of pieces and eventually expand the process to test the modules with those of other groups. This was performed to determine if all integrated modules are working and interacting with each other successfully. Normally, several components can be integrated.

(iii) System testing

System testing is the testing of behavior of a complete and fully integrated software product based on the software requirement specification (SRS) document. The system testing was performed to evaluate system requirement if they match with the developed system. The testing was done to check if the data are stored to the system successfully and updated when some changes are made.

4.1.2. Testing Results

After undergo testing phases which is unit testing, system testing and integration testing Medical Records Exchange System (MRES) found not to generate any errors, all the components, modules and functionalities of the system were found to work properly, system compatibility with other operating systems such as Windows and Linux were found to work properly and also the exchange of data with Care2x and OpenMRS were found to work properly. Generally testing exercise of the MRES were very successfully and up and running as shown in Fig. 8 up to Fig. 17 above.

4.2. Discussion

Medical Record Exchange System (MRES) is one of the solutions which help to reduce fragmentation and overcoming barriers in sharing of data and exchanging information in electronic medical recording systems. The existing electronic medical recording systems have different data structure and they run on different platforms such as Windows, Linux and MAC Operating systems and they use different relational database management system like Oracle, SQL server, MySQL, PostgreSQL and so exchange and sharing of data becomes difficult. When a patient moves from one health center to the other he / she needs to start registration process again because there is no integration between the health information systems across hospitals which will enable them to share data / information and reduce fragmentation of data. The MRES prototype provides a solution for interoperability between OpenMRS and Care2x system which by using MRES, the OpenMRS and Care2x systems can be able to share basic information of data.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

MRES promises to transform one of the most mandate and time-consuming processes for the physicians and for practice staff. Being able to process a request in a matter of minutes significantly will reduce costs, currently time spent on collecting the required information; improving response time for patients seeking insurance and allowing better utilization of staff resources within the practice.

MRES will allows a clinician to track data over time, easily identify which patients are due for preventative screenings, check how patients are doing on certain parameters such as blood pressure readings or vaccines and monitor and improve overall quality of care within the practice. An MRES will make the process of sharing of patients' information easier, more accurate and comprehensive and more efficient.

5.2. Recommendations

It is recommended for future works to focus on integrating more than two electronic medical recording systems that are open-source with other commercial medical recording systems. A mobile based application for MRES is recommended to ensure patients care throughout. It is recommended testing of the prototype (MRES) to the live environment and also further research on security issues.

REFERENCES

- Bouidi, Y., Idrissi, M. A. and Rais, N. (2017). Adopting an Open Source Hospital Information System to Manage Healthcare Institutions. *LIFE: International Journal of Health and Life- Sciences*, 3(3), 38–57.
- Care2x. (2013). Care2x: The Open Source Hospital Information System. Retrieved August 13, 2017, from <http://www.care2x.org/>
- Chhanabhai, P. N. and Holt, A. (2010). The Disparity Information and Communication Technology Developing Countries has in the Delivery of Healthcare Information. *The Open Medical Informatics Journal*, 4, 195–201. [https://doi.org/https://doi.org/10.2174/1874431101004010195](https://doi.org/10.2174/1874431101004010195)
- DHIS2. (2016). *DHIS 2 User Manual*. DHIS2 Documentation Team. Retrieved from https://docs.dhis2.org/2.22/en/user/html/dhis2_user_manual_en.html
- Einthoven, A. C. (2009). Integrated delivery systems: the cure for fragmentation. *American Journal of Managed Care*, 15(12).
- Goldstein, B. A., Navar, A. M., Pencina, M. J. and Ioannidis, J. (2017). Opportunities and challenges in developing risk prediction models with electronic health records data: a systematic review. *Journal of the American Medical Informatics Association*, 24(1), 198-208
- GoT-HoMIS. (2017). Joint and Aligned Investment in Digital Health Information Systems. President's Office, Regional Administration and Local Government. Retrieved November 22, 2017, from <https://www.healthdatacollaborative.org/>
- Hanson, C., Ronsmans, C., Penfold, S., Maokola, W., Manzi, F., Jaribu, J. and Schellenberg, J. (2013). Health system support for childbirth care in Southern Tanzania: results from a health facility census. *BMC Research Notes*, 6(1). <https://doi.org/10.1186/1756-0500-6-435>
- Häyrinen, K., Saranto, K. and Nykänen, P. (2008). Definition, structure, content, use and impacts of electronic health records: a review of the research literature. *International Journal of Medical Informatics*, 77(5), 291–304.

- Hensher, M., Price, M. and Adomakoh, S. (2006). *Disease Control Priorities in Developing Countries*. NIH. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK11737/>
- Kalogriopoulos, N. A., Baran, J., Nimunkar, A. J. and Webster, J. G. (2009). Electronic Medical Record Systems for Developing Countries: Review. In *Engineering in Medicine and Biology Society, EMBC 2009* (pp. 1730–1733). Annual International Conference of the IEEE.
- Kimollo, P., Lenoir, M. and Niemi, M. (2010). *Health Management Information System for Hospitals Lessons learned from a Tanzanian experience*.
- Kripalani, S., Jackson, A. T., Schnipper, J. L. and Coleman, E. A. (2007). Promoting effective transitions of care at hospital discharge: A review of key issues for hospitalists. *Journal of Hospital Medicine*, 2(5), 314–323. <https://doi.org/https://doi.org/10.1002/jhm.228>
- Li, X., Liu, Z. and He, J. (2001). Formal and use-case driven requirement analysis in UML. In *In Computer Software and Applications Conference, 2001. COMPSAC 2001. 25th Annual International, IEEE* (pp. 215–224).
- Lungo, J. H. (2008). The reliability and usability of district health information software. *Tanzania Journal of Health Research*, 10(1), 39–45.
- MoHCDEC. (2016). Health Services In Tanzania. Retrieved July 12, 2017, from <http://moh.go.tz/index.php/health-services-in-tanzania>
- MOHSW. (2008). *Partnership for Delivering the MDGs*. The United Republic of Tanzania. Ministry of Health and Social Welfare.
- Mshana, S. (2004). *Health Management Information System Evaluation: lesson from Tanzania*. Kuopion yliopisto.
- Musau, S., Chee, G., Patsika, R., Malangalila, E., Chitama, D., Van Praag, E. and Schettler, G. (2011). *Tanzania Health System Assessment 2010*.
- Omary, Z., Lupiana, D., Mtenzi, F. and Wu, B. (2010). Analysis of the Challenges Affecting E-healthcare Adoption in Developing Countries : A Case of Tanzania. *International Journal of Information Studies*, 2(1), 38–50.
- OpenMRS. (2009). OpenMRS. Retrieved January 14, 2017, from <https://openmrs.org/>

- Pressman, R. S. (2005). *Software Engineering: A Practitioner's Approach*. McGraw-Hill New York.
- Sawe, H. R., Mfinanga, J. A., Lidenge, S. J., Mpondo, B. C., Msangi, S., Lugazia, E. and Reynolds, T. A. (2014). Disease patterns and clinical outcomes of patients admitted in intensive care units of tertiary referral hospitals of Tanzania. *BMC Int Health Hum Rights*, 14(26). [https://doi.org/https://doi.org/10.1186/1472-698x-14-26](https://doi.org/10.1186/1472-698x-14-26)
- Tai-Seale, M., Olson, C. W., Li, J., Chan, A. S., Morikawa, C., Durbin, M. and Luft, H. S. (2017). Electronic health record logs indicate that physicians split time evenly between seeing patients and desktop medicine. *Health Affairs*, 36(4), 655-662.
- URT. (2012). *Tanzania National e-Health Strategy*. The United Republic of Tanzania; Ministry of Health, Community Development, Gender, Elderly and Children.
- Valacich, J. S., George, J. F. and Hoffer, J. A. (2001). *Essentials of Systems Analysis and Design*. Prentice Hall Upper Saddle River, NJ.
- Vest, J. R., and Gamm, L. D. (2010). Health information exchange: persistent challenges and new strategies: Table 1. *Journal of the American Medical Informatics Association*, 17(3), 288–294.
- WHO. (2017). WHO eHealth. Retrieved September 28, 2017. <http://www.who.int/ehealth/en/>
- Winani, S., Wood, S., Coffey, P., Chirwa, T., Mosha, F. and Chagalucha, J. (2007). Use of A Clean Delivery Kit and Factors Associated with Cord Infection and Puerperal Sepsis in Mwanza, Tanzania. *Journal of Midwifery and Women's Health*, 52(1), 37–43.
- Wu, H. and LaRue, E. M. (2017). Linking the health data system in the US: Challenges to the benefits. *International Journal of Nursing Sciences*. <https://doi.org/10.1016/>
- Zhao, J., Papapetrou, P., Asker, L. and Boström, H. (2017). Learning from heterogeneous temporal data in electronic health records. *Journal of Biomedical Informatics*, 65, 105-119.

APPENDICES

Appendix 1: Interview Questions for Health Information System Analysis

To be filled by System administrators.

**REDUCING FRAGMENTATION AND OVERCOMING BARRIERS TO
EFFECTIVE SHARING OF INFORMATION IN E-MEDICAL
RECORDING SYSTEMS: Case of Open MRS and Care2X**

NELSON MANDELA AFRICAN INSTITUTION OF SCIENCE AND TECHNOLOGY

Case Study of Tanzania Occupations Health Services (T.O.H.S)

INTERVIEW QUESTIONS

Introduction

I am Geoffrey Rweikiza a masters Candidate from NM-AIST Arusha. I am currently doing research on developing an engine for data sharing across electronic medical recording system in Dar es Salaam Tanzania. This questionnaire is aimed at analysis of existing data sharing of systems across health centers with interactions with system administrators.

Questionnaire number:

Date:

Name of the working location:

1. Socio-economic Profile of the Respondent

Q1.1 Name of the respondent: _____

Q1.2 Age: _____

Q1.3 Gender:

Male

Female

Q1.4 Education Qualification:

Certificate = 1	Diploma = 2	Degree = 3	Other = 4
-----------------	-------------	------------	-----------

Q1.5 Profession:

2.0. Information about the System

2.1 Do you know the meaning of electronic medical recording system?

- a. YES
- b. NO

2.2 What kind of electronic medical recording systems do you have in your hospital between the two?

- a. OpenMRS
- b. Care2x

2.3 How do you share Patients' Information with other health centers?

- a. Through manual procedures
- b. Through electronic systems

If the answer is B please describe.....

2.4. Do you integrate your system with other medical recording systems?

- a. YES
- b. NO

2.5. How secure is your data in the system?

- a. Secured
- b. Less secured
- c. Very secured
- d. Not secured
- e. I don't know

Appendix 2: Source codes for Medical Records Exchange System (MRES)

// MRES connection to the MySQL database

```
<?php
    include("parameters.php");
    $database="mid";

    $con=mysql_connect($host,$username,$password);
    mysql_select_db($database,$con);

    function Found($name)
    {
        $res = mysql_query("SHOW DATABASES");
        while ($row = mysql_fetch_assoc($res)) {
            if ($row['Database']==$name) return true;
        }
        return false;
    }
?>
```

// MRES connection to Care2x

```
<?php
    include("parameters.php");
    $database = "care2x";
    $con=mysql_connect($host,$username,$password);
    mysql_select_db($database,$con);
?>
```

// MRES connection to OpenMRS

```
<?php
    include("parameters.php");
    $database="openmrs";
    $con=mysql_connect($host,$username,$password);
    mysql_select_db($database,$con);
?>
```

// MRES home page (home.php)

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
```

```
<?php

    session_start();

    if (!isset($_SESSION["login"])){
        header("Location:index.php");
    }
?>
```

```

    }
?>
<html xmlns="http://www.w3.org/1999/xhtml" class="xr_bgh0"><head>

    <title>Medical</title>

    <script language="JavaScript"
type="text/javascript">document.documentElement.className="xr_bgh1";</scri
pt>

    <link rel="stylesheet" type="text/css" href="css/xr_main.css">
    <link rel="stylesheet" type="text/css" href="css/xr_text.css">
    <link rel="stylesheet" type="text/css"
href="css/custom_styles.css">
    <script language="javascript" src="js/pages.js"></script>
</head>

    <body class="xr_bgb0" style="background-position: 197px 0px;">
        <div class="xr_ap" id="xr_xr" style="width: 955px;
height: 946px; top: 0px; left: 197px; margin-left: 0px;">
            <script type="text/javascript">var
xr_xr=document.getElementById("xr_xr")</script>
            <div class="xr_ap">
                <span class="xr_ar" style="left: 0px; top: 0px; width:
955px; height: 946px; background-color: #FFFFFF;"></span>
            </div>
            <div class="xr_ap xr_xri_" style="width: 955px; height:
946px; overflow:hidden;">
                

                <div class="xr_s0" style="position: absolute;
left:50px; top:919px; width:752px; height:10px;">

                    <span class="xr_tl xr_s0" style="top: -10px;">Rweikiza
&#169; 2015</span>

                </div>

                <div class="xr_s0" style="position: absolute;
left:905px; top:919px; width:10px; height:10px;">

```

```
<span class="xr_tr xr_s0" style="left: -78px; top: -10px; width: 78px;"><a href="#" onclick="return(xr_nn());" onmouseover="xr_mo(this,0)"><span class="xr_s0" style="text-decoration:underline;">Geofrey Rweikiza</span></a></span>
```

```
</div>
```

```

```

```

```

```

```

```
<div class="xr_s1" style="position: absolute; left:140px; top:49px; width:10px; height:10px;font-family:Times New Roman;">
```

```
<span class="xr_tl xr_s1" style="left:-15px;top:-36px;font-family:Times New Roman;font-size:12px">
```

```
<span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Medical</span><span class="xr_s3" style="font-family:Times New Roman;font-size:18px">Records</span><span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Exchange</span></span>
```

```
</div>
```

```

```

```
<a href="about.html" target="_self" onclick="return(xr_nn());">
```

```

```

```
</a>
```

```
<a href="patients.php" target="_self" onclick="return(xr_nn());">
```

```

```

```
</a>
```

```
<a href="sendmail.php" target="_self" onclick="return(xr_nn());">
```

```

```

```
</a>
```

```
<a href="contact.html" target="_self" onclick="return(xr_nn());">
```

```

```

```
</a>
```

```

```

```

```

```
<div class="Heading_1" style="position: absolute; left:426px;
top:214px; width:478px; height:10px;">
```

```
<h2 class="xr_tl Heading_2" style="top:
25px;margin:0;">Medical Records Exchange</h2>
```

```
<span class="xr_tl Normal_text" style="top: 67px;">Medical records
exchange (MRE) is the mobilization of healthcare information
```

```
</span>
```

```
<span class="xr_tl Normal_text" style="top: 87px;">electronically
across organizations within a region, community or hospital system.</span>
```

```
<span class="xr_tl Normal_text" style="top: 108px;">In practice the
term MRE may also refer to the organization that facilitates the </span>
```

```
<span class="xr_tl Normal_text" style="top: 130px;">exchange.</span>
```

```
<span class="xr_tl Normal_text" style="top: 153px;">MRE provides the
capability to electronically move clinical information among</span>
```

```
<span class="xr_tl Normal_text" style="top: 178px;">different health
care information systems. The goal of MRE is to facilitate access </span>
```

```
<span class="xr_tl Normal_text" style="top: 202px;">to and retrieval
of clinical data to provide safer and more timely, efficient,</span>
```

effective, and equitable patient-centered care. MRE is also useful to public health

authorities to assist in analyses of the health of the population.

MRE system facilitate the efforts of physicians and clinicians to meet

high standards of patient care through electronic participation in a

patient's continuity of care with multiple providers.

Secondary health care provider benefits include reduced expenses associated with:

the manual printing, scanning and faxing of documents, including paper and ink

costs, as well as the maintenance of associated office machinery

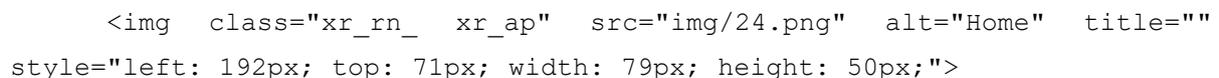
the physical mailing of patient charts and records, and phone communication to verify

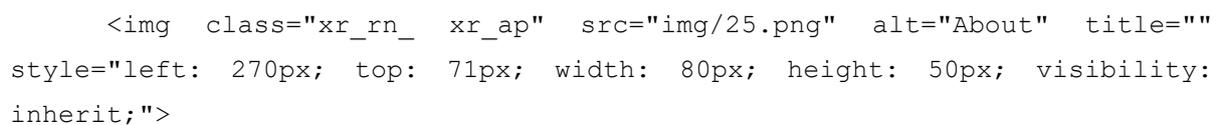
delivery of traditional communications, referrals, and test results the time and effort

involved in recovering missing patient information, including any duplicate tests

required to recover such information

</div>

 Home

 About

```

```

```

```

```

```

```
</a>
```

```
</div>
```

```
<div id="xr_xd0" style="visibility: hidden; z-index: 0;"></div>
```

```
</div>
```

```
</div>
```

```
<script type="text/javascript">xr_htm();window.addEventListener('load',
xr_aeh, false);</script>
```

```
</body></html>
```

```
// MRES loads patient data from Care2x database
```

```
<?php
class Patients
{
    function LoadPatientsFromCare2x($pid)
    {
        require_once("conn_care.php");
        $whereclause=" where pid='$pid'";
        $sql= "
            select
pid, date_reg, name_first, name_2, name_3, name_middle,
name_last, name_maiden, name_others, date_birth, blood_group,
addr_str, addr_str_nr, addr_zip, addr_citytown_nr, citizenship,
phone_1_code, phone_1_nr, phone_2_code, phone_2_nr,
cellphone_1_nr, cellphone_2_nr, fax, email, civil_status, sex,
title, photo, photo_filename,
religion, contact_person, contact_pid, contact_relation,
history, relative_name_first,
relative_name_last, relative_phone
            from
            care_person ";

        if ($pid) $sql=$sql.$whereclause;

        $res=mysql_query($sql);

        if ($res)
        {
            if ($row=mysql_fetch_array($res))
            {
```

```

echo '
        <form method="post"
action="javascript:searchpatient()"><table style="width:60%">
        <tr><td colspan="2">Search
Patient:&nbsp;&nbsp;&nbsp;<input type="text" style="font-size:11px" id="pid"
placeholder="Patient ID" required/>&nbsp;&nbsp;&nbsp;<input type="submit" id="srch"
value="Search"/></td></tr>
        <tr><td style="width:30%">Patient
ID</td><td>'.$row[0].'</td><input id="ppid" type="hidden"
value="'.$row[0].'"></tr>
        <tr><td>'.$row[1].'</td></tr>
        <tr><td>'.$row[2].'</td></tr>
        <tr><td>'.$row[3].'</td></tr>
        <tr><td>'.$row[4].'</td></tr>
        <tr><td>'.$row[5].'</td></tr>
        <tr><td>'.$row[6].'</td></tr>
        <tr><td>'.$row[7].'</td></tr>
        <tr><td>'.$row[8].'</td></tr>
        <tr><td>'.$row[9].'</td></tr>
        <tr><td>'.$row[10].'</td></tr>
        <tr><td>'.$row[11].'</td></tr>
        <tr><td>'.$row[12].'</td></tr>
        <tr><td>'.$row[13].'</td></tr>
        <tr><td>'.$row[14].'</td></tr>
        <tr><td>'.$row[15].'</td></tr>
        <tr><td>'.$row[16].'</td></tr>
        <tr><td>'.$row[17].'</td></tr>
        <tr><td>'.$row[18].'</td></tr>
        <tr><td>'.$row[19].'</td></tr>
        <tr><td>'.$row[20].'</td></tr>
        <tr><td>'.$row[21].'</td></tr>
        <tr><td>'.$row[22].'</td></tr>
        <tr><td>'.$row[23].'</td></tr>
        <tr><td>'.$row[24].'</td></tr>
        <tr><td>'.$row[25].'</td></tr>
        <tr><td>Registration Date</td>
        <tr><td>First Name</td>
        <tr><td>Second Name</td>
        <tr><td>Third Name</td>
        <tr><td>Middle Name</td>
        <tr><td>Last Name</td>
        <tr><td>Maiden Name</td>
        <tr><td>Others Name</td>
        <tr><td>Date of Birth</td>
        <tr><td>Blood Group</td>
        <tr><td>Address 1</td>
        <tr><td>Address 2</td>
        <tr><td>Zip Code</td>
        <tr><td>City Town</td>
        <tr><td>citizenship</td>
        <tr><td>phone_1_code</td>
        <tr><td>phone_1_nr</td>
        <tr><td>phone_2_code</td>
        <tr><td>phone_2_nr</td>
        <tr><td>cellphone_1_nr</td>
        <tr><td>cellphone_2_nr</td>
        <tr><td>Fax</td>
        <tr><td>Email</td>
        <tr><td>Civil Status</td>
        <tr><td>Sex</td>

```

```

        <tr><td>Title</td>
<td>'.$row[26].</td></tr>
        <tr><td>Photo</td>
<td>'.$row[27].</td></tr>
        <tr><td>Photo Filename</td>
<td>'.$row[28].</td></tr>
        <tr><td>Religion</td>
<td>'.$row[29].</td></tr>
        <tr><td>Contact Person</td>
<td>'.$row[30].</td></tr>
        <tr><td>Contact_pid</td>
<td>'.$row[31].</td></tr>
        <tr><td>Contact Relation</td> <td>'.$row[32].</td></tr>
        <tr><td>History</td>
<td>'.$row[33].</td></tr>
        <tr><td>Relative First
Name</td><td>'.$row[34].</td></tr>
        <tr><td>Relative Last Name</td>
<td>'.$row[35].</td></tr>
        <tr><td>Relative Phone</td>
<td>'.$row[36].</td></tr>
        <tr><td colspan="2" align="right"><input type="button"
id="trans" value="Transfer Patient" onclick="transferpatient()"/></td></tr>
    </table></form>
        ';
    }
    else {
        echo '
        <form method="post"
action="javascript:searchpatients()"><table style="width:60%">
        <tr><td>Search Patient:&nbsp;&nbsp;&nbsp;<input type="text"
style="font-size:11px" id="pid" placeholder="Patient ID"
required/>&nbsp;&nbsp;<input type="submit" id="srch" value="Search"/></td></tr>
        <tr><td style="width:30%"><span style="color:blue">No
patient details found!</span></td></tr>
        <tr><td><span style="color:blue"><span
style="color:blue;text-decoration:underline;cursor:pointer"
onclick="mail()">Send Email</span></span></td></tr>
        </table></form>';
    }
}

function LoadPatientsFromOpenMRS ($pid)
{
    require_once("conn_openmrs.php");
    $whereclause=" where person_name.person_id='$pid'";
    $sql=
        "
        select
        person_name.person_id,
        person_name.given_name,
        person_name.middle_name,
        person_name.family_name,
        person.gender,
        person.birthdate,
        person_address.address1,
        person_address.address2,
        person_address.city_village,
        person_address.state_province,

```

```

        person_address.postal_code,
        person_address.country
    from
    person_name inner join
    person on person_name.person_id=person.person_id
inner join
        person_address on
person.person_id=person_address.person_id ";
    if ($pid) $sql=$sql.$whereclause;

    $res=mysql_query($sql);
    print $sql;
    if ($res)
    {
        if ($row=mysql_fetch_array($res))
        {
            echo '
                <style>table,td{border:1px solid
tan;border-collapse:collapse;padding:3px;padding-left:5px}</style>
                <form method="post"
action="javascript:searchpatient()"><table style="width:60%">
                    <tr><td colspan="2">Search
Patient:&nbsp;&nbsp;&nbsp;<input type="text" style="font-size:11px" id="pid"
placeholder="Patient ID" required/>&nbsp;&nbsp;&nbsp;<input type="submit" id="srch"
value="Search"/></td></tr>
                    <tr><td>Patient ID</td>
                    <td>' . $row[0] . '</td><input id="ppid" type="hidden"
value="' . $row[0] . '"></tr>
                    <tr><td>First Name</td>
                    <td>' . $row[1] . '</td></tr>
                    <tr><td>Second Name</td>
                    <td>' . $row[2] . '</td></tr>
                    <tr><td>Third Name</td>
                    <td>' . $row[3] . '</td></tr>
                    <tr><td>Gender</td>
                    <td>' . $row[4] . '</td></tr>
                    <tr><td>Date of Birth</td>
                    <td>' . $row[5] . '</td></tr>
                    <tr><td>Address 1</td>
                    <td>' . $row[6] . '</td></tr>
                    <tr><td>Address 2</td>
                    <td>' . $row[7] . '</td></tr>
                    <tr><td>City Village</td>
                    <td>' . $row[8] . '</td></tr>
                    <tr><td>State Province</td>
                    <td>' . $row[9] . '</td></tr>
                    <tr><td>Postal Code</td>
                    <td>' . $row[10] . '</td></tr>
                    <tr><td>Country</td>
                    <td>' . $row[11] . '</td></tr>
                    <tr><td colspan="2"
align="right"><input type="button" id="trans" value="Transfer Patient"
onclick="transferpatient()" /></td></tr>
                </table></form>
            ';
        }
    }
    else {
        echo ' <style>table,td{border:1px solid
tan;border-collapse:collapse;padding:3px;padding-left:5px}</style>

```

```

                                <form method="post"
action="javascript:searchpatients()"><table style="width:60%">
                                <tr><td>Search
Patient:&nbsp;&nbsp;&nbsp;<input type="text" style="font-size:11px" id="pid"
placeholder="Patient ID" required/>&nbsp;&nbsp;&nbsp;<input type="submit" id="srch"
value="Search"/></td></tr>
                                <tr><td><span
style="color:blue">No patient details found!</span></td></tr>
                                </table></form>';
                                }
                                }
                                }
}
?>

```

// MRES connection parameters

```

<?php
    $host="localhost";
    $username="root";
    $password="mres";
?>

```

// MRES search patients from two databases (OpenMRS or Care2x)

```

<?php
    require_once("conn_mid.php");
    require_once("objpatients.php");
    if (isset($_REQUEST['pid']))
    {
        $pid=mysql_real_escape_string($_REQUEST['pid']);
        $patients=new Patients();
        if (Found("care2x")) $patients->LoadPatientsFromCare2x($pid);
        //if (Found("openmrs")) $patients->
>LoadPatientsFromOpenMRS($pid);
    }
    else
    {
        $patients=new Patients();
        if (Found("care2x")) $patients->LoadPatientsFromCare2x('');
        //if (Found("openmrs")) $patients->LoadPatientsFromOpenMRS('');
    }
?>

```

// MRES transfer patients' information to / from (OpenMRS or Care2x)

```

<?php
    if (isset($_REQUEST['pid']))
    {
        $pid=mysql_real_escape_string($_REQUEST['pid']);
        require_once("conn_mid.php");
        require_once("objtransfer.php");
        $patients=new Patients();
    }

```

```

        if (Found("care2x")) $patients-
>FetchAndTransferPatientFromCare2x($pid);
        if (Found("openmrs")) $patients-
>FetchAndTransferPatientFromOpenMRS($pid);
    }
?>

```

// MRES sendmail module

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<?php
    session_start();
    if (!isset($_SESSION["login"])){
        header("Location:index.php");
    }
?>
<html xmlns="http://www.w3.org/1999/xhtml" class="xr_bgh3"><head>
    <title>Medical</title>
    <script language="JavaScript"
type="text/javascript">document.documentElement.className="xr_bgh1";</scrip
t>
    <link rel="stylesheet" type="text/css" href="css/xr_main.css">
    <link rel="stylesheet" type="text/css" href="css/xr_text.css">
    <link rel="stylesheet" type="text/css" href="css/custom_styles.css">
    <script language="javascript" src="js/pages.js"></script>

<style>
    .custom-file-input::-webkit-file-upload-button {
        visibility: hidden;
    }
    .custom-file-input::before {
        content: 'Attach File';
        display: inline-block;
        background: -webkit-linear-gradient(top, #f9f9f9, #e3e3e3);
        border: 1px solid #999;
        border-radius: 3px;
        padding: 5px 8px;
        outline: none;
        white-space: nowrap;
        -webkit-user-select: none;
        cursor: pointer;
        text-shadow: 1px 1px #fff;
        font-weight: 700;
        font-size: 10pt;
    }
    .custom-file-input:hover::before {
        border-color: black;
    }
    .custom-file-input:active::before {
        background: -webkit-linear-gradient(top, #e3e3e3, #f9f9f9);
    }
    .button{
        background:linear-gradient(top, #e3e3e3, #f9f9f9);
        border: 1px solid #999;
        border-radius: 3px;
        padding: 5px 8px;
        white-space: nowrap;
        cursor: pointer;
        text-shadow: 1px 1px #fff;
        font-weight: 700;
        font-size: 10pt;
    }
</style>

```

```

</head>

<body class="xr_bgb3" style="background-position: 197px 0px;">
<div class="xr_ap" id="xr_xr" style="width: 955px; height: 983px; top: 0px;
left: 197px; margin-left: 0px;">
  <script type="text/javascript">var
xr_xr=document.getElementById("xr_xr")</script>
<div class="xr_ap">
  <span class="xr_ar" style="left: 0px; top: 0px; width: 955px; height: 983px;
background-color: #FFFFFF;"></span>
</div>
<div class="xr_ap xr_xri_" style="width: 955px; height: 983px;
overflow:hidden;">
  
  
  <div class="xr_s0" style="position: absolute; left:50px; top:956px;
width:752px; height:10px;">
    <span class="xr_tl xr_s0" style="top: -10px;">Rweikiza © 2015</span>
  </div>
  <div class="xr_s0" style="position: absolute; left:905px; top:956px;
width:10px; height:10px;">
    <span class="xr_tr xr_s0" style="left: -78px; top: -10px; width: 78px;"><a
href="#" onclick="return(xr_nn());" onmousemove="xr_mo(this,0)"><span
class="xr_s0" style="text-decoration:underline;">Geoffrey
Rweikiza</span></a></span>
  </div>
  

  
  <div class="xr_s1" style="position: absolute; left:140px; top:49px;
width:10px; height:10px;font-family:Times New Roman;">
  <span class="xr_tl xr_s1" style="left:-15px;top:-36px;font-family:Times New
Roman;font-size:12px">
  <span class="xr_s2" style="font-family:Times New Roman;font-
size:16px">Medical</span><span class="xr_s3" style="font-family:Times New
Roman;font-size:18px">Records</span><span class="xr_s2" style="font-
family:Times New Roman;font-size:16px">Exchange</span></span>
</div>
  <a href="home.php" onclick="return(xr_nn());">
  
  </a>
  <a href="about.html" target="_self" onclick="return(xr_nn());">
  
  </a>
  <a href="patients.php" target="_self" onclick="return(xr_nn());">
  
  </a>
  
  <a href="contact.html" target="_self" onclick="return(xr_nn());">
  
  </a>

<div class="Heading_1" style="position: absolute; left:426px; top:214px;
width:478px; height:10px;">

```

```

<h1 class="xr_tl Heading_1" style="top: -29px;margin:0;left: -357px;">Send Mail</h1>
<h2 class="xr_tl Heading_2" style="top: 25px;margin:0;left: -357px;">Send Patient's Documents</h2>
<span class="xr_tl Normal_text" style="top: 63px;left: -357px;">If you'd like to have your patient's medical records sent to the other Hospital through mail,</span>
<span class="xr_tl Normal_text" style="top: 83px;left: -357px;">a medical facility, doctor's office, or any other party, you have to attach the </span>
<span class="xr_tl Normal_text" style="top: 104px;left: -357px;">patient's scanned documents and send them to the receiving party through mail.</span>
</div>

```

```

<div class="xr_tl Normal_text" style="position: relative;height:280px;width:440px;top: 330px;left: 45px;border:0px solid red;padding:20px">
<form method="post" action="#" enctype="multipart/form-data">
<table style="width:98%;">
<tbody>
<tr><td>Subject </td><td><input name="subject" style="width:100%;height:20px;border:1px solid lightblue" type="text"></td></tr>
<tr><td>Attached Documents </td><td><input id="uploaded_file" style="width:100%;border:1px solid lightblue" type="file" class="custom-file-input"></td></tr>
<tr><td>Email:</td><td><input name="email" style="width:100%;height:20px;border:1px solid lightblue" type="text"></td></tr>
<tr><td>Message </td><td><textarea name="sms" style="width:99%;height:100px;border:1px solid lightblue"></td></tr>
<tr><td></td><td><input type="submit" class="button" value="Send Mail"></td></tr>
<tr><td colspan="2" style="color:blue">
<?php
if (isset($_POST['email']) && isset($_POST['subject']) &&
isset($_POST['sms']))
{
require("phpmailer/class.phpmailer.php");
$email = $_POST['email'];
$subject = $_POST['subject'] ;
$sms = $_POST['sms'] ;
$mail = new PHPMailer();
$mail->IsSMTP();
$mail->SMTPDebug = 1;
$mail->SMTPAuth = true;
$mail->SMTPSecure = 'ssl';
$mail->Host = "smtp.gmail.com";
$mail->Port = 465;
$mail->IsHTML(true);
$mail->Username = "aminatah.magogo";
$mail->Password = "aminageofrey";
$mail->SetFrom("aminatah.magogo@gmail.com");
$mail->AddAddress($email, "Medical");
$mail->Subject = $subject;
$mail->Body = $sms;
if (isset($_FILES['uploaded_file']) &&
$_FILES['uploaded_file']['error'] ==
UPLOAD_ERR_OK) {
$mail->AddAttachment($_FILES['uploaded_file']['tmp_name'],
$_FILES['uploaded_file']['name']);
}
if(!$mail->Send()){
echo "An error occurred! email not sent.";
}
}
}

```

```

else{
    echo "Email Sent.";
}
}
?>
</td></tr>
</tbody>
</table>
</form>
</div>


<div id="xr_xo0" class="xr_ap" style="left: 0px; top: 0px; width: 955px;
height: 100px; visibility: hidden; z-index: 0;">
<a href="file:///C:/Users/admin/Desktop/refresh/sendmail.html#"
onclick="return(false);" target="" style="visibility: inherit;">





</a>
</div>
<div id="xr_xd0" style="visibility: hidden; z-index: 0;"></div>
</div>
</div>
<script type="text/javascript">xr_hm();window.addEventListener('load',
xr_aeh, false);</script><!--<![endif]-->
</body></html>

```

// MRES Patient Module

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<?php
    session_start();
    if (!isset($_SESSION["login"])){
        header("Location:index.php");
    }
?>
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
    <title>Medical</title>
    <script language="JavaScript"
type="text/javascript">document.documentElement.className="xr_bgh1";</scrip
t>
    <link rel="stylesheet" type="text/css" href="css/xr_main.css">
    <link rel="stylesheet" type="text/css" href="css/xr_text.css">
    <link rel="stylesheet" type="text/css" href="css/custom_styles.css">
    <script language="javascript" src="js/pages.js"></script>
    <style>table,td{border:1px solid tan;border-
collapse:collapse;padding:3px;padding-left:5px}</style>
</head>

<body class="xr_bgb2">

```

```

<div class="xr_ap" id="xr_xr" style="width: 955px; height: 1581px; top:0px;
left:50%; margin-left: -478px;">
<script type="text/javascript">var
xr_xr=document.getElementById("xr_xr")</script>
<div class="xr_ap">
  <span class="xr_ar" style="left: 0px; top: 0px; width: 955px; height:
1581px; background-color: #FFFFFF;"></span>
</div>

<div class="xr_ap xr_xri_" style="width: 955px; height: 1581px;
overflow:hidden;">
  
  
  <div class="xr_s0" style="position: absolute; left:50px; top:1554px;
width:752px; height:10px;">
    <span class="xr_tl_xr_s0" style="top: -10px;">Rweikiza &#169; 2017</span>
  </div>
  <div class="xr_s0" style="position: absolute; left:905px; top:1554px;
width:10px; height:10px;">
    <span class="xr_tr_xr_s0" style="left: -78px; top: -10px; width: 78px;"><a
href="#" onclick="return(xr_nn());" onmouseover="xr_mo(this,0)" ><span
class="xr_s0" style="text-decoration:underline;">Geoffrey
Rweikiza</span></a></span>
  </div>
  


<div class="xr_sl" style="position: absolute; left:140px; top:49px;
width:10px; height:10px;font-family:Times New Roman;">
<span class="xr_tl_xr_sl" style="left:-15px;top:-36px;font-family:Times New
Roman;font-size:12px">
<span class="xr_s2" style="font-family:Times New Roman;font-
size:16px">Medical</span><span class="xr_s3" style="font-family:Times New
Roman;font-size:18px">Records</span><span class="xr_s2" style="font-
family:Times New Roman;font-size:16px">Exchange</span></span>
</div>
  <a href="home.php" onclick="return(xr_nn());">
    
  </a>
  <a href="about.html" target="_self" onclick="return(xr_nn());">
    
  </a>
  
  <a href="sendmail.php" target="_self" onclick="return(xr_nn());">
    
  </a>
  <a href="contact.html" target="_self" onclick="return(xr_nn());">
    
  </a>

<div class="Heading_1" style="position: absolute; left:51px; top:214px;
width:847px; height:10px;">
  <h1 class="xr_tl_Heading_1" style="top: -29px;margin:0;">Patients</h1>
  <span class="xr_tl_Normal_text" style="top: 25px;">Medical Record
Exchange (MRE) are entities that bring together health care stakeholders

```

generally within a defined geographic area and govern
 the electronic sharing of medical records among them for the purpose of improving health and care in that community. The fundamental concept behind
 creating MRE is that the ability to exchange medical records electronically is critical to the efforts to improve the delivery of care in Tanzania.
 Confirm the patient's details below and press the transfer button when ready.
 </div>

```

<div class="xr_tl Normal_text" id="page" align="center" style="width: 814px; height: 1000px; border: 0px solid green; top: 380px; position: absolute; padding: 20px; left: 49px;">
<?php
  try
  {
    require_once("conn_mid.php");
    require_once("conn_care.php");
    require_once("objpatients.php");
    $patients=new Patients();
    if (Found("care2x")) $patients->LoadPatientsFromCare2x('');
    //if (Found("openmrs")) $patients->LoadPatientsFromOpenMRS('');
  }
  catch(Exception $e) {
    echo $e->getMessage();
  }
?>
</div>
```

```


<div id="xr_xo0" class="xr_ap" style="left: 0; top: 0; width: 955px; height: 100px; visibility: hidden;">
  <a href="#" onclick="return(false);">
    
    
    
    
  </div>
<div id="xr_xd0"></div>
</div>
</div>
<script type="text/javascript">xr_htm();window.addEventListener('load', xr_aeh, false);</script>
</body>
</html>
```

// MRES index.php page

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<?php
  session_start();
  $sms="";
  if (isset($_POST["uname"]) && isset($_POST["pwd"]))
  {
    require_once("conn_mid.php");
```

```

$username=mysql_real_escape_string($REQUEST['uname']);
$password=mysql_real_escape_string($REQUEST['pwd']);
$sql="select * from tbl_users where uname='$username' and pwd='$password'";
$res=mysql_query($sql);
if ($res)
{
    if ($row=mysql_fetch_array($res))
    {
        header("Location:home.php");
        $_SESSION["login"]="yes";
        exit();
    }
    else
    {
        $sms="Login failed!";
        unset($_SESSION["login"]);
    }
}
else {
    $sms="";
}
}
else{$sms="";}
?>
<html xmlns="http://www.w3.org/1999/xhtml" class="xr_bgh0">
<head>
<title>Medical</title>
<link rel="stylesheet" type="text/css" href="css/xr_main.css">
<link rel="stylesheet" type="text/css" href="css/xr_text.css">
<link rel="stylesheet" type="text/css" href="css/custom_styles.css">
<script language="javascript" src="js/pages.js"></script>
</head>

<body class="xr_bgb0" style="background-position: 197px 0px;">
<div class="xr_ap" id="xr_xr" style="width: 955px; height: 946px; top: 0px; left: 197px; margin-left: 0px;">
<script type="text/javascript">var xr_xr=document.getElementById("xr_xr")</script>
<div class="xr_ap">
<span class="xr_ar" style="left: 0px; top: 0px; width: 955px; height: 946px; background-color: #FFFFFF;"></span>
</div>
<div class="xr_ap xr_xri_" style="width: 955px; height: 946px; overflow:hidden;">


<div class="xr_s0" style="position: absolute; left:50px; top:919px; width:752px; height:10px;">
<span class="xr_tl xr_s0" style="top: -10px;">Rweikiza Â© 2015</span>
</div>
<div class="xr_s0" style="position: absolute; left:905px; top:919px; width:10px; height:10px;">
<span class="xr_tr xr_s0" style="left: -78px; top: -10px; width: 78px;"><a href="#" onclick="return(xr_nn());" onmouseover="xr_mo(this,0)"><span class="xr_s0" style="text-decoration:underline;">Geofrey Rweikiza</span></a></span>
</div>



<div class="xr_s1" style="position: absolute; left:140px; top:49px; width:10px; height:10px;font-family:Times New Roman;">

```

```

<span class="xr_tl xr_sl" style="left:-15px;top:-36px;font-family:Times New Roman;font-size:12px">
<span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Medical</span><span class="xr_s3" style="font-family:Times New Roman;font-size:18px">Records</span><span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Exchange</span></span>
</div>

```

```


<a href="about.html" target="_self" onclick="return(xr_nn());">

</a>
<a href="patients.php" target="_self" onclick="return(xr_nn());">

</a>
<a href="sendmail.php" target="_self" onclick="return(xr_nn());">

</a>
<a href="contact.html" target="_self" onclick="return(xr_nn());">

</a>

```

```



```

```

<div id="page" class="xr_tl Normal_text" style="position: absolute; left: 313px; top: 405px; width: 299px; height: 177px;border: 6px solid gray;border-radius: 30px 0px 30px 0px;padding-left: 40px;">
<form id="login" method="post" action="#">
<table cellpadding="4" cellspacing="0" border="0">
<tbody><tr><td align="right">User Name :
<input type="text" name="uname" required=""></td></tr>
<tr><td align="right">Password :
<input type="password" name="pwd" required=""></td></tr>
<tr><td align="right"><input type="submit" id="log" value="Login">&nbsp;<input type="reset" id="res" value="Reset"></td></tr>
<tr><td align="right" colspan="2"><span id="sms" style="color:red;text-align:left"></span></td></tr>
</tbody></table>
</form>
</div>

```

```


<div id="xr_xo0" class="xr_ap" style="left: 0px; top: 0px; width: 955px; height: 100px; visibility: hidden; z-index: 0;">
<a href="#" onclick="return(false);" target="" style="visibility: inherit;">



```

```

        
        
        </a>
    </div>
    <div id="xr_xd0" style="visibility: hidden; z-index:
0;"></div>
</div>
</div>
<script
type="text/javascript">xr_hm();window.addEventListener('load', xr_aeh,
false);</script></body></html>

```

// MRES contacts page

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">

<head>
  <title>Medical</title>
  <script language="JavaScript"
type="text/javascript">document.documentElement.className="xr_bgh1";</scrip
t>
  <link rel="stylesheet" type="text/css" href="css/xr_main.css">
  <link rel="stylesheet" type="text/css" href="css/xr_text.css">
  <link rel="stylesheet" type="text/css" href="css/custom_styles.css">
  <script language="javascript" src="js/pages.js"></script>
</head>

<body class="xr_bgb6">
<div class="xr_ap" id="xr_xr" style="width: 955px; height: 897px; top:0px;
left:50%; margin-left: -478px;">
  <script type="text/javascript">var
xr_xr=document.getElementById("xr_xr")</script>
<div class="xr_ap">
  <span class="xr_ar" style="left: 0px; top: 0px; width: 955px; height: 897px;
background-color: #FFFFFF;"></span>
</div>
<div class="xr_ap xr_xri_" style="width: 955px; height: 897px;
overflow:hidden;">
  
  
  <div class="xr_s0" style="position: absolute; left:50px; top:870px;
width:752px; height:10px;">
    <span class="xr_tl_xr_s0" style="top: -10px;">Rweikiza &#169; 2015</span>
  </div>
  <div class="xr_s0" style="position: absolute; left:905px; top:870px;
width:10px; height:10px;">
    <span class="xr_tr_xr_s0" style="left: -78px; top: -10px; width: 78px;"><a
href="#" onclick="return(xr_nn());" onmousemove="xr_mo(this,0)" ><span
class="xr_s0" style="text-decoration:underline;">Geofrey
Rweikiza</span></a></span>
  </div>
  
  
  <div class="xr_s1" style="position: absolute; left:140px; top:49px;
width:10px; height:10px;font-family:Times New Roman;">

```

```

<span class="xr_tl xr_sl" style="left:-15px;top:-36px;font-family:Times New Roman;font-size:12px">
<span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Medical</span><span class="xr_s3" style="font-family:Times New Roman;font-size:18px">Records</span><span class="xr_s2" style="font-family:Times New Roman;font-size:16px">Exchange</span></span>
</div>
<a href="home.php" onclick="return(xr_nn());">

</a>
<a href="about.html" target="_self" onclick="return(xr_nn());">

</a>
<a href="patients.php" target="_self" onclick="return(xr_nn());">

</a>
<a href="sendmail.php" target="_self" onclick="return(xr_nn());">

</a>


<div class="Heading_1" style="position: absolute; left:50px; top:214px; width:325px; height:10px;">
<h1 class="xr_tl Heading_1" style="top: -29px;margin:0;">Contact</h1>
<h3 class="xr_tl Heading_3" style="top: 25px;margin:0;">Medical Records Exchange </h3>
<span class="xr_tl Normal_text" style="top: 59px;">Address : Tabata Kimanga</span>
<span class="xr_tl Normal_text" style="top: 100px;">Town/City : Dar es Salaam</span>
<span class="xr_tl Normal_text" style="top: 140px;">Zip/Postal code : 39821</span>
<span class="xr_tl Normal_text" style="top: 160px;">Country : Tanzania</span>
<span class="xr_tl Normal_text" style="top: 201px;">Telephone: 0000 000000</span>
<span class="xr_tl Normal_text" style="top: 221px;">Fax: 0000 000000</span>
<span class="xr_tl Normal_text" style="top: 242px;">Mobile: +255712508892</span>
<span class="xr_tl Normal_text" style="top: 262px;">Email: <a href="#" onclick="return(xr_nn());" onmouseover="xr_mo(this,0)">geofrey.rweikiza@gmail.com</a></span>
</div>


<div id="xr_xo0" class="xr_ap" style="left:0; top:0; width:955px; height:100px; visibility:hidden;">
<a href="#" onclick="return(false);">




</a>

```

```

</div>
<div id="xr_xd0"></div>
</div>
</div>
<script type="text/javascript">xr_htm();window.addEventListener('load',
xr_aeh, false);</script>
</body>
</html>

```

// MRES About page (about.html)

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" class="xr_bgh1">
<head>
<title>Medical</title>
<script language="JavaScript"
type="text/javascript">document.documentElement.className="xr_bgh1";</scrip
t>
<link rel="stylesheet" type="text/css" href="css/xr_main.css">
<link rel="stylesheet" type="text/css" href="css/xr_text.css">
<link rel="stylesheet" type="text/css" href="css/custom_styles.css">
<script language="javascript" src = "js/pages.js"></script>
</head>

<body class="xr_bgh1" style="background-position: 197px 0px;">
<div class="xr_ap" id="xr_xr" style="width: 955px; height: 1275px; top: 0px;
left: 197px; margin-left: 0px;">
<script type="text/javascript">var
xr_xr=document.getElementById("xr_xr")</script>
<div class="xr_ap">
<span class="xr_ar" style="left: 0px; top: 0px; width: 955px; height:
1275px; background-color: #FFFFFF;"></span>
</div>
<div class="xr_ap xr_xri_" style="width: 955px; height: 1275px;
overflow:hidden;">


<div class="xr_s0" style="position: absolute; left:50px; top:1248px;
width:752px; height:10px;">
<span class="xr_tl_xr_s0" style="top: -10px;">Rweikiza &#169 2016</span>
</div>
<div class="xr_s0" style="position: absolute; left:905px; top:1248px;
width:10px; height:10px;">
<span class="xr_tr_xr_s0" style="left: -78px; top: -10px; width: 78px;"><a
href="#" onclick="return(xr_nn());" onmouseover="xr_mo(this,0)"><span
class="xr_s0" style="text-decoration:underline;">Geoffrey
Rweikiza</span></a></span>
</div>



<div class="xr_s1" style="position: absolute; left:140px; top:49px;
width:10px; height:10px;font-family:Times New Roman;">
<span class="xr_tl_xr_s1" style="left:-15px;top:-36px;font-family:Times New
Roman;font-size:12px">
<span class="xr_s2" style="font-family:Times New Roman;font-
size:16px">Medical</span><span class="xr_s3" style="font-family:Times
New Roman;font-size:18px">Records</span><span class="xr_s2" style="font-
family:Times New Roman;font-size:16px">Exchange</span></span>
</div>
<a href="home.php" onclick="return(xr_nn());">

</a>

<a href="patients.php" target="_self" onclick="return(xr_nn());">

</a>
<a href="sendmail.php" target="_self" onclick="return(xr_nn());">

</a>
<a href="contact.html" target="_self" onclick="return(xr_nn());">

</a>

```

```

<div class="Heading_1" style="position: absolute; left:52px; top:214px;
width:478px; height:10px;">
<h1 class="xr_tl Heading_1" style="top: -29px;margin:0;">About</h1>
<h2 class="xr_tl Heading_2" style="top: 25px;margin:0;">What is MRE</h2>
<span class="xr_tl Normal_text" style="top: 63px;">Medical Records
Exchange (MRE) allows doctors, nurses, pharmacists, other health care
providers and patients to appropriately</span>
<span class="xr_tl Normal_text" style="top: 83px;">access and securely
share a patient's vital medical records electronically improving the speed,
quality, safety and cost of patient care.</span>
<span class="xr_tl Normal_text" style="top: 104px;">Despite the widespread
availability of secure electronic data transfer, most Tanzania medical
records is stored on paper-in filing</span>
<span class="xr_tl Normal_text" style="top: 124px;">cabinets at various
medical offices, or in boxes and folders in patients' homes. When that medical
records is shared between providers,</span>
<span class="xr_tl Normal_text" style="top: 144px;">it happens by mail,
fax or most likely by patients themselves, who frequently carry their records
from appointment to appointment. While</span>
<span class="xr_tl Normal_text" style="top: 164px;">electronic health
records exchange cannot replace provider patient communication, it can
greatly improve the completeness of patient's </span>
<span class="xr_tl Normal_text" style="top: 185px;">records, (which can
have a big effect on care), as past history, current medications and other
records is jointly reviewed during visits.</span>

<span class="xr_tl Normal_text" style="top: 225px;">Appropriate, timely
sharing of vital patient medical records can better inform decision making
at the point of care and allow providers to</span>
<span class="xr_tl Normal_text" style="top: 246px;">avoid readmissions,
medication errors, improve diagnoses, decrease duplicate testing.If a
practice has successfully incorporated</span>
<span class="xr_tl Normal_text" style="top: 266px;">faxing patient records
into their business process flow, they might question why they should
transition to electronic medical records exchange. </span>
<span class="xr_tl Normal_text" style="top: 286px;">Many benefits exist
with records exchange regardless of the means of which is it transferred.
However, the value of electronically exchanging</span>
<span class="xr_tl Normal_text" style="top: 306px;"> is the
standardization of data. Once standardized, the data transferred can
seamlessly integrate into the recipients' electronic medical records, </span>
<span class="xr_tl Normal_text" style="top: 327px;">further improving
patient care.</span>
</div>

```

```



```

```

<div id="xr_xo0" class="xr_ap" style="left:0; top:0; width:955px;
height:100px; visibility:hidden;">
<a href="#" onclick="return(false);">




</a>
</div>
<div id="xr_xd0"></div>
</div>
</div>
<script type="text/javascript">xr_htm();window.addEventListener('load',
xr_aeh, false);</script>
</body></html>

```

// MRES Structure Query Language (SQL) statement for creating database and table

```

/*
SQLyog Community Edition- MySQL GUI v6.05
Host - 5.6.20 : Database - mid
*****
Server version : 5.6.20
*/

/*!40101 SET NAMES utf8 */;

/*!40101 SET SQL_MODE='/*!;

create database if not exists `mid`;

USE `mid`;

/*!40014 SET @OLD_FOREIGN_KEY_CHECKS=@FOREIGN_KEY_CHECKS,
FOREIGN_KEY_CHECKS=0 */;
/*!40101 SET @OLD_SQL_MODE=@SQL_MODE, SQL_MODE='NO_AUTO_VALUE_ON_ZERO' */;

/*Table structure for table `tbl_users` */

DROP TABLE IF EXISTS `tbl_users`;

CREATE TABLE `tbl_users` (
  `indexno` int(11) NOT NULL AUTO_INCREMENT,
  `uname` varchar(30) DEFAULT NULL,
  `pwd` varchar(100) DEFAULT NULL,
  PRIMARY KEY (`indexno`)
) ENGINE=InnoDB AUTO_INCREMENT=3 DEFAULT CHARSET=latin1;

/*Data for the table `tbl_users` */

insert into `tbl_users` (`indexno`,`uname`,`pwd`) values (2,'admin','123');

/*!40101 SET SQL_MODE=@OLD_SQL_MODE */;
/*!40014 SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS */;

```

RESEARCH OUTPUTS

