**DEVELOPMENT OF A CLOUD-BASED HEALTH-CARE INFORMATION SYSTEM**

**(A Case Study of Elizade University)**

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**(EU120104-023)**

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**(A Case Study of Elizade University)**

**BY**

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**(EU120104-023)**

**A Project dissertation submitted to the Department of Mathematics & Computer Science, Faculty of Basic and Applied Sciences in partial fulfilment of the requirement for the Degree of**

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# Certification

This is to certify that this report has been prepared by **OMOBO, OKEOGHENE BLESSING** with student number **EU120104-023** on the basis of my own work. Where other published and unpublished source materials have been used, these have been acknowledged.

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# Dedication

I dedicate this project dissertation to my parents Mrs. C.A Omobo, for her unconditional love, guidance, advice and encouragement that has groomed me into the woman I am growing to be. God bless you and satisfy you with good health and long life.

# Acknowledgement

I want to acknowledge Almighty God for the wisdom, strength and direction during my Four-year degree course in Elizade University.

I would like to express my deepest appreciation to my final year project supervisor Dr. Kehinde Agbele, whose contribution in stimulating recommendations, helped me to coordinate my project especially in writing this report.

I also appreciate Mr. Shorunke Muyiwa who provided me with suggestions and encouragement to complete this report.

I will also like to appreciate my friends who also contributed in their little way to make this report a success, God bless you all.

# Abstract

The Implementation and usage of contemporary computing technology in the delivering of health care services is to solely improve their quality and reliability of health care services to patients in an efficient manner at a minimal time and cost. The alternative in this context is to outsource the computing storage resources with the help of cloud infrastructure. Like most healthcare outfits in Nigeria today, Elizade University Health Centre is yet to harness the full potential of contemporary computing innovations such as the cloud to improve its healthcare delivery and services. Access to the retrieval, update and storage of staff/student medical records often at times is difficult and cumbersome due to the file-cabinet archaic method in use at the clinic. The lack of proper access has the potential to cost the University’s health Centre a huge fortune every year due to duplication and waste. The drastic reduction in the cost of healthcare services, utilization of resources, maintainability and the adoption of new technologies are some of the benefits that the University’s health center can get from cloud-based health-care information system. Also, new prospects such as easy and ever- present access to medical records and the chances to make use of services of physicians that are not readily available in the University’s health Centre are some of the opportunities offered by a cloud-based health-care information system. This study proposes and implements a cloud- based electronic medical record health information system to improve the delivery of healthcare service delivery in Elizade University.

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# Chapter One

## 1.1 Introduction

The Nigerian Health sector is still lagging behind in the adoption and implementation of modern information technology in improving its health care services and delivery. (Hitachi data systems, 2012). The prompt and swift access to patient’s medical history and records most times are clumsy and cumbersome in retrieving. The lack of proper access has caused the health care sector a huge fortune over the years due to duplication and waste of valuable resources i.e. Time & Money. The issue of data transmission and storage is one of great concern that has been lingering in the sector for so long.

Recently, most healthcare outfits are now adopting the usage of in-house medical information systems in order to improve their service delivery. This welcoming development is been stalled by the high cost of implementation and usage of these systems and also maintenance issues. These amongst many other challenges are been faced in the Nigerian healthcare industry, and the Elizade healthcare center is not an exemption. In recent years, cloud computing technology has received tremendous attention. Basically, cloud computing can be defined as a form of computing where shared resources, software, infrastructures and information are delivered to computers and other devices through network or an internet (Dipak 2012).

The accesses to information or network shared resources are not limited by the user’s physical location. Therefore, vital resources and people are connected irrespective of where they are around the world, provided there is internet network connectivity (Buyya et al 2010). The cloud possess the ability to facilitate the exchange of medical information between the healthcare stakeholders such as the doctors, nurses, pharmacist and all other healthcare institutions that are geographically isolated (Kuo 2011).

However, trivial issues such as security, privacy, and patient confidentiality and other regulatory policies have curtailed the immediate adoption and implementation of cloud computing in the management of healthcare system. One of the reasons for the slow adoption of cloud computing in the management of health care information system can be attributed to the inability to guarantee the security of data (Kuo 2011). A good example of such a scenario could be a case of a HIV or mental patient who prefers their medical information to be strictly confidential. Health care stakeholders and practitioners are weary of this issue towards the adoption of a cloud based health care information system, as patients who are direct beneficiary of all the successes also bear the brunt of lapses in the system.

Despite this disadvantage of adopting a cloud-based based Health information systems, the pros of this technology outweighs the cons. The aim of this study is to design and implement a cloud-based electronic medical record system that can be used to effectively manage the sharing of medical information in the Elizade University healthcare center.

## 1.2 Background of the Study

Elizade University is in its 4th year of operation as a licensed private tertiary institution in Nigeria. It’s staff and student population has grown over the years, thereby leading to the increase of patients been attended to at the University’s healthcare center on a daily basis. The University presently has a student population of about 700 students, and a staff base of 100 Academic staff members. The university has a health policy for all its staff and students been registered at the university’s healthcare center in order to maintain a medical record database of its patients. Currently, the Elizade University health center still makes use of the manual based system. Towards this, each staff and student is given a card which has a unique number used for retrieval of files from the cabinet of patient’s files, this job is done by clerical officers who arrange the files and give to the nurses when a student or staff arrives at the health center. Some of the challenges faced by this manual system are as follows:

1. The system is cumbersome
2. Time and Space consuming
3. More labor for the staff
4. Misplacement and damage of files

Hence, the urgent need for a health care information system in the Elizade University Health care center. The manual system used in the healthcare center causes duplication of files and there are many dangers involved i.e. missing files, Physical danger.

However with the electronic health records (EHR) system; patients will have improved diagnosis and treatment, significantly fewer errors within personal health records, faster care and decision making responses from assigned medical professionals. This will in turn provide added benefits from the cloud such as a centralized database that can be accessed anywhere once connected to the internet and can be shared to other physicians. Therefore, reduce the stress of registering the patient again and also give them vital information about the patient.

In this study, the researcher’s views the possible solution to the Health-care problem in the University. In doing therefore, a cloud based health-care record information system that will provide new prospects such as easy and ever- present access to medical records and the chances to make use of services of physicians that are not readily available in the University’s health Centre and aid high quality delivering of health care services to the University’s staff and students alike.

## 1.3 Problem Statement

Like most healthcare outfits in Nigeria today, Elizade University Health Centre is yet to harness the full potential of contemporary computing innovations such as the cloud to improve its healthcare delivery and services. Access to the retrieval, update and storage of staff/student medical records often at times is difficult and cumbersome due to the file-cabinet archaic method in use at the clinic. The lack of proper access has the potential to cost the University’s health Centre a huge fortune every year due to duplication of data and waste. The adoption of the cloud-based Health-care information system will aid easy access, retrieval, update and storage of patient’s records in the University health center.

## 1.4 Aim & Objectives of the study

The sole aim of this project is to propose the implementation & adoption a cloud- based electronic medical record health information system in Elizade University Health care system.

The objectives are specifically as follows:

* To investigate the deficiency associated with the existing medical retrieval & storage system in place at Elizade University Health-care Center.
* To design a cloud-based health care information system
* To implement a pilot test of the designed model for validation.

## 1.5 Significance of the study

Although this research predominantly focuses on improving the dwindling standard of medical information retrieval and storage at the Elizade University health center by proposing and testing a technology enabled health information system for medical information retrieval & storage, the research is also relevant to other educational institutions within the country. Recently, most Nigerian University are trailing behind in the deployment of a robust ICT infrastructure compared to peer Universities in other continent.

Towards this, the research will help contribute in making health information systems deployment & adoption a predominant method of medical information retrieval & storage in the continent of Africa.

## 1.6 Purpose of Study

This study proposes and implements a cloud- based electronic medical record health information systems. The software will maintain a centralized database system for the purpose of easy information retrieval and sharing.

## 1.7 Scope of the study

This present research work covers only records of university specifically for;

* University academic and non- academic Staff
* Students.

## 1.8 Methodology Adopted

The research approach to be employed for this study is mixed, a combination of both the Qualitative and Quantitative study design approach (interviews), in which data will be collected from medical practitioners at the Elizade University Health-care center. The qualitative approach will be utilized for data accumulation during the early phase of the research, while for the latter part of the research, quantitative approach will be employed.

## 1.8.1 Study site

This research will be done in Nigeria, using Elizade University, Ilara-mokin, Ondo state.

## 1.8.2 Data Collection Method

The data collection methods to be employed for this research are mainly via interviews and questionnaires. Face-to-Face interviews would be conducted with health practitioners, ICT technicians and students in some cases.

# Chapter Two

## 2.1 Literature Review

In this section, a literature appraisal is given that unveils the scope of the analysis that has been done concerning development of a cloud based health care information system - enforced by a spread of health establishments globally using Elizade University Health Center as a case study to aid easy access, retrieval, update and storage of patient’s records, and the chances to make use of services of physicians that are not readily available in the University’s health Centre.

The conventional way of obtaining patients records is usually paper-based. (Csiszar 2011) submitted that medical institutions would still rather use paper to gather information from their patients and also to record surgical procedures, observations and prescriptions. Keeping of records manually are terribly exhausting due to the mere indisputable fact that each day, an oversized range of records are being kept in hospitals. It will be terribly difficult to keep medical records of all patients that keep increasing each minute.

Aside the fact that the manual system is time-consuming, collecting data is hard because they are not stored in one place so searching for a patient’s record will be difficult. The use of modern data technology in the delivery of health care is to boost the accessibility and reliability of improved health care services to patients at a reduced price. Hence, the need to go paperless is inevitable because it poses so many advantages over the paper based systems.

## 2.2 Health Care Information System (Nigeria as case study)

A healthcare information system is defined as a computer system that designed to manage the hospital’s administrative and medical information to reach effectively and efficiency performance in this job (Bamiah et al., 2012).

Health care service delivery in Nigeria falls short of international standards resulting from poor state of health care infrastructure, shortage of medical professionals, threat of re-emerging infectious diseases, and poor sanitation (Benson. 2011). The government is yet to improve the health care delivery through the use of technology therefore forcing poor Nigerians to go back to the traditional medical practitioners due to lack of access and high cost of modern healthcare facilities, while the rich travel abroad to get medical attention because of either poor infrastructure of lack of adequate medical practitioners in local hospitals.

Most of the available hospitals are still limited to the paper based systems where files are stored in cabinet. Ayeni, et al. (2014), also pointed out that there is Zero level of significance in EMR based  
hospitals because only less than 10% of Nigerians can afford it and most of these EMRs  
are remotely located in hospital’s infrastructure rather than moving it to the cloud. Hence, the need to improve health care sector in Nigeria is an urgent one because it is one of the most important sector of the economy. Electronic medical records should become the traditional method and also the adoption of the cloud to improve health care delivery and allow Nigerians have adequate access to it.

## 2.3 Benefits of Health Care Information System

Health Information Systems improve workflow and increase patients’ access to health care (Ouma et al 2008; Shekelle et al., 2006; Wallis 2007). According to Sisniega (2009), ICT helps to improve on theseamless workflow among people and the organization; effective processes can also be achieved through efficient and effective interactions. Electronic health technologies enable effective networking by physicians, allow online review of patients’ treatment, and provide for accurate prescription of drugs. Radiology information systems enable the transmission of radiological images for evaluation in remote sites (Weimar, 2009).

Keenan et al. (2006) discovers that the care given to patients is enhanced and also the daily work of the physician has improved according to the following analysis: (a) the turn-around times of medication fell from 5:28 hours to 1:51 hours; (b) the procedure completion times of radiology fell from 7:37 hours to 4:21 hours; and (c) the reporting times of lab results fell from 31:3 minutes to 23:4 minutes. It was also studied that errors in orders due to transcription declined, and the length of stay in hospital decreased. The online monitoring of vital signs, improved physicians’ collaboration in patient care and multi-site review of patients records are the other benefits of electronic medical records systems. EMR speed up the access to medication administration records easily, and the ease by which consultation reports are shared, the decreased time taken to transmit test results are parts of the benefits of healthcare information system (Keenan et al. 2006). The various errors associated with paper based system drastically declined with the introduction of Health care information system.

Healthcare services are attainable between the urban and rural communities with great difference due to the social differences of the Nigerian society. The introduction of healthcare information system can help to bridge the gap (Ouma et al. 2008). Also, the clinical data captured by clinical information system helps to improve on the clinical decision making of the physician on patients care (Ward et al.2006, William et al. 2008). Clinical time optimization as a result of effective communication and also the increased level of compliance with guidelines are some of the other benefits of healthcare information system (Georgiou et al. 2009).

## 2.4 Challenges of Healthcare information system

HIS has several benefits to the hospital (Mohd et al, 2005), but in the same time they have many the challenges and issues in implementation stage (Boonstra et al, 2010). Despite of the huge potential and opportunities that health information system presents to entirely transform healthcare and the healthcare sector, many challenges are evident and inevitable. These challenges range from technology issues, the healthcare framework, system users of the system and the governing environment. (Blumenthal 2009) lists the barriers faced by healthcare information technology proponents in the U.S. namely: low adoption rates by doctors and hospitals due to associated costs, perceived lack of return on investments, use issues and concerns of privacy and security. The existing healthcare issues are as below (Boonstra et al, 2010; Chowdhary et al.2011).

* **Data storage**: The daily growth in the number of the electronic file that related to patient health record that stored in the healthcare system, this system face with storage problem and need to improve their storage of the system all the time and this study lead to increase Information Technology (IT) expenditure for healthcare information system.
* **Data transmission**: Various hospitals have different healthcare system, different format of getting and storing data that makes patient transfer difficult because of incompatibility issues and this because these hospitals lack of the integration system and universal format for data that store. So with this existing healthcare system cannot share the patient’s data effectively between the other hospitals and lead to duplication and resource waste.
* **High setup cost**: The set up cost for hospital infrastructure system that integrates all type of software and hardware is very expensive. Even for medium and large-scale hospital are also high. As a result of the high cost, hospital is like to keep the traditional system.
* **Maintenance issue**: Healthcare information system has two departments, which are the management and the maintenance department. When issues such as storage of technical arises and the maintenance department can’t solve this issues, the management department will outsource to solve this issue and support the system that incur additional cost to the hospital. However, the process usually leads to temporary interrupt in the hospital system.

## 2.5 Cloud Computing

(Gartner 2011) considered cloud computing to be the first amongst the top ten most significant emerging technologies with a positive prospect in successive years by companies and organizations. Clouds are situated in large facilities that are specifically cooled and protected for the equipment and data they house, as clusters are. Such facilities have an umpteen number of server that compute and store customer data, therein called data centers nowadays. Cloud computing brings a new business model which enables several advantages that would benefit the general healthcare community (Ahuja, et al 2012).

Cloud computing consists of three different model types of service provision (Subashini et al. 2011, Mell et al. 2011, Zhang et al 2010). In each case the services are hosted remotely and accessed over a network (usually the internet) through a customer’s web browser, rather than being installed locally on a customer’s computer.

1. Software as a Service (SaaS) according to (Subashini et al. 2011) provides the client with the capability to use the provider’s application running on a cloud infrastructure. These applications are accessible from various client devices, through a thin client interface, such as web browsers (e.g. web-based e-mail). The client doesn’t manage or control the underlying cloud infrastructures, including network servers, operating systems, storage or even individual application capabilities, with the possible exception of limited user-specification application configuration settings.
2. Platform as a Service (PaaS) according to (Mell et al. 2011) provides the client with the capability to deploy onto the cloud the cloud infrastructure, consumer created or acquired applications, produced using programming languages and tools supported by the provider. The client does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.
3. Infrastructure as a Service (IaaS) according to (Zhang et al 2010) provides the client with the capability of provision processing, storage, networks and other fundamental computing resources, and allows the client to deploy and run arbitrary software, which can include operating systems, and possibly limited control of selected networking components.

Cloud computing has been developed to reduce IT expenses and to provide agile IT services to individual users as well as organizations. It moves computing and data away from desktop and portable PCs into large data centers. By adopting the cloud in medical services both patients and healthcare organizations would obtain a huge benefit in patient’s quality of service, collaboration between healthcare organizations as well as reductions in IT cost in healthcare companies (Deng et al 2010)

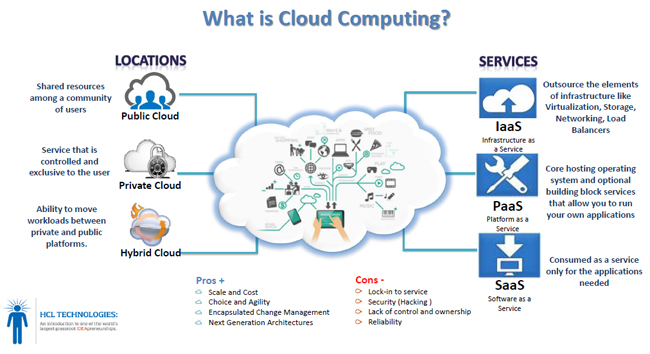


Fig 1. Cloud Computing

Source: HCL TECHNOLOGIES (http://www.hcltech.com/sites/default/files/rise-of-clouds.jpg)

## 2.6 Benefits of Cloud to Healthcare Information System

The high cost of hardware and software, complexity and inflexibility issues of the healthcare system have raised and need the low cost technology, cloud computing help to develop and solve the healthcare issues. It brings significant benefits to healthcare information system (Fern'ndez et al., 2012). By using the cloud computing in the healthcare information system, various healthcare issues can be solve such as: cost, integration system, storage and optimizing resources (Ahuja et al., 2012; Bamiah et al., 2012). Cloud computing is very useful for healthcare information system because it offer the practical benefits as below (Guo et al., 2010; Bamiah et al., 2012; Chowdhary et al., 2011).

* **Service Quality**: Cloud computing increase the collaboration among the doctor, hospital and patients and make it easier that lead to increase the quality of services.
* **Cost Reduction**: Adopting cloud computing, various virtual services in the cloud and also pay base on consumption can be of great benefit to the health care center. They do not need to pay for purchasing the server and also implementing the service based on the cloud is very cost-effective. In addition with using the cloud computing doesn’t require to employ the IT staff to maintain critical infrastructure and application, with this the organization can more focus on the core function.
* **Secured server operation**: Data of the hospital are kept on the primary server and also copy of them kept on the secondary server in existing healthcare system, often issues may occur making primary and secondary service to fail so the hospital will be unable to access to important data, while in the cloud computing, data migrates quickly into the new instance of virtual server that will be created automatically and all server can be resumed normally.
* **Improved data transmission and sharing**: With the cloud computing, hospital has integrated system and all data that store in the cloud have universal and same format, so hospitals in this condition can work closely and data can be easily transfer between them.
* **Reduced maintenance expenses**: When using the cloud computing in the healthcare system doesn’t need to have IT Stuff to support the system because all process control by cloud provider. Healthcare system needs innovation to remain timely, cost effective and also efficient.

Cloud computing has ability to improve the healthcare system. With using the cloud computing, patient, doctor and nurse can access to different data for different purpose from any location with simple Internet connection. Easy accessing to the patient health record and help to doctors to make vital decision about patient diagnosis (Bamiah et al., 2012).



Fig 2. Benefits of cloud computing

# Chapter Three

## Methodology

## 3.1 Research Design

The research design adopted for the development of this system is the spiral software development model.

## 3.1.1 Spiral SDLC

Spiral model is a combination of iterative development process model and sequential linear development model i.e. waterfall model with very high emphasis on risk analysis.

This model has four phases namely;

* Identification: This phase starts with gathering the business requirements in the baseline spiral. In the subsequent spirals as the product matures, identification of system requirements, subsystem requirements and unit requirements are all done in this phase. This also includes understanding the system requirements by continuous communication between the customer and the system analyst. At the end of the spiral the product is deployed in the identified market.
* Design: Design phase starts with the conceptual design in the baseline spiral and involves architectural design, logical design of modules, physical product design and final design in the subsequent spirals.
* Build: Build phase refers to production of the actual software product at every spiral. In the baseline spiral when the product is just thought of and the design is being developed a POC (Proof of Concept) is developed in this phase to get customer feedback. Then in the subsequent spirals with higher clarity on requirements and design details a working model of the software called build is produced with a version number. These builds are sent to customer for feedback.
* Evaluation and Risk Analysis: Risk Analysis includes identifying, estimating, and monitoring technical feasibility and management risks, such as schedule slippage and cost overrun. After testing the build, at the end of first iteration, the customer evaluates the software and provides feedback.

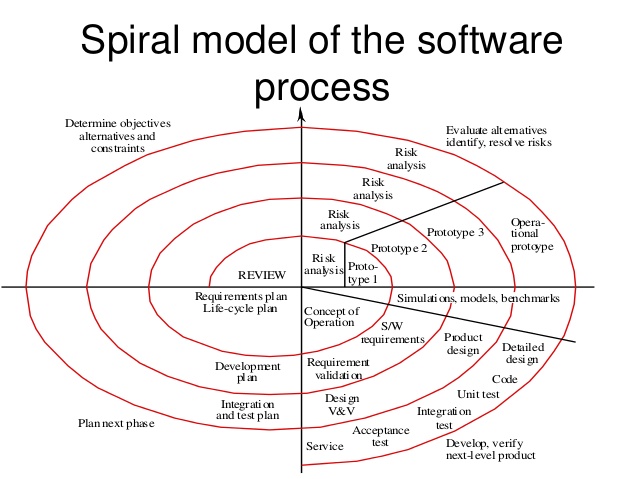


Fig 3. Spiral SDLC

Source: Slideshare (http://image.slidesharecdn.com/ch4-part2-140330120600 phpapp01/95/software-engineering process-11-638.jpg? cb=1396181564).

## 3.2 Research Approach

The research approach to be employed for this study is mixed, a combination of both the Qualitative and Quantitative study design approach (interviews), in which data will be collected from medical practitioners at the Elizade University Health-care center. The qualitative approach will be utilized for data accumulation during the early phase of the research, while for the latter part of the research, quantitative approach will be employed.

## 3.3 Data Collection Method

The data collection methods to be employed for this research are mainly via interviews and questionnaires. Face-to-Face interviews would be conducted with health practitioners, ICT technicians and students in some cases

## 3.4 Theoretical & Conceptual Framework

## 3.4.1 Theoretical Framework

After acquiring the adequate knowledge of what constitutes the users acceptance, it is significant in ascertaining the issues hindering the full deployment and adoption of cloud-based Healthcare information system. The factors determining the user’s adoptions of a technology have been thoroughly researched and varieties of frameworks have been developed in an effort to elucidate the variables influencing the decision to adopt a specific technology. The theoretical framework adopted for this research is a combination of Technology Organization Environment (TOE) and Technology Acceptance Model, from which appropriate would be made as possible challenges to deployment and adoption of a cloud-based Healthcare information system for efficient storage, easy retrieval of data and also enhance the quality of services. These frameworks provides numerous variables to an entire framework for the implementation of cloud based healthcare information system in Elizade University, in Nigeria, since the aim of this research is to propose the implementation & adoption a cloud- based electronic medical record health information system in Elizade University Health care system

## 3.4.2 Technology Organization Environment (TOE) Framework

Technology Organization Environment theory says that an organization functions along three dimensions, Technology, Organization and Environment (TOE), which influences the organization’s ability to adopt or reject a new technology (Lee, et al 2009). The Technology dimensions comprises of factors such as cost, compatibility, reliability, complexity and performance expectancy. Human and financial resources, competitiveness and innovativeness are factors in the organizational dimension. The Environment dimension factors comprises of government policies, industries, suppliers and customers. According to this theory, these factors might pose a negative or positive influence to the decision of adopting a technological innovation. In this research, the major challenges faced by the implementation of cloud based healthcare information system from a technological point of view include cost, complexity, reliability, and performance expectancy. Also the medical practitioner’s innovativeness and skill will be studied.

## 3.4.3 Technology Acceptance Model (TAM)

The TAM theory model aims at explaining how users come to accept and utilize a technology. The model proposes that when the users are introduced to a new technology, a number of factors influence their decision about how and when they will use it, used: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Legris, et al 2003). ICT adoption and diffusion in recent years has been studied in great deal by researchers within the information systems domain. It’s been studied at two levels: the organizational and individual level. If the unit analysis is an individual, then the emphasis is on the acceptance of technology. The user’s attitude towards using and the actual usage of a technology are addressed in the technology acceptance model (TAM) (Koohang, et al 2004).

## 3.4.4 Conceptual Framework

Based on the theoretical frameworks adopted, the following conceptual framework was obtained.

Dependent Variables

Independent Variables

Cloud-based Healthcare

Information System

Deployment and

Adoption

Cost of ICT Infrastructure

Healthcare Curriculum

Practitioners’ competence

Performance Expectancy

Perceived Usefulness

Perceived Ease of Usefulness

Intervening

Variable

Government Policy

Fig 4. Research framework based on the Technology Acceptance Model (TAM).

## 3.5 Feasibility Study

## 3.5.1 Technical Feasibility

The proposed system manages the equipment and programming utilized as a part of the framework whether they are of most recent innovation or not. It happens that after a framework is readied another innovation emerges and the client needs the framework taking into account that innovation. This is web-based, Java as front end innovation and MySQL as backend innovation (database). Subsequent update and maintenance of the system will be dome to meet the demands of the evolving technology.

## 3.5.2 Economical Feasibility

Cost of adoption and implementation of any system is the most utilized strategy for assessing the viability of another framework. All the more usually known as cost/advantage investigation. Java and MySQL are easily accessible and easy to use.

## 3.5.3 Operational Feasibility

The system has been developed considering different categories of users making it simple to work it. This system is exceptionally easy to understand and does not require any specialized individual to work .Thus the system is even operationally practical.

## 3.6 System Analysis and Design

## 3.6.1 Existing System

Currently, the Elizade University health center still makes use of the manual based system. Towards this, each staff and student is given a card which has a unique number used for retrieval of files from the cabinet of patient’s files, this job is done by clerical officers who arrange the files and give to the nurses when a student or staff arrives at the health center.

## 3.6.2 Challenges of Existing System

* The system is cumbersome
* Time and Space consuming
* More labor for the staff
* Low security
* Misplacement and damage of files

## 3.7 Proposed System

This proposed system suggests the adoption of the cloud-based Health-care information system that will aid easy access, retrieval, update and storage of patient’s records in the University health center. The proposed features has enhanced features to solve some of the challenges of the existing manual system of the healthcare center in the University.

## 3.7.1 System Functions

The system will allow access only to authorized users with specific roles (Administrator, Operator). Depending upon the user’s role, he/she will be able to access only specific modules of the system.

Major functions of the software are as follows:

* Login facility for enabling only authorized access to the system.
* On admission of patient, the front-desk staff checks to see if the patient is already registered with the hospital. If yes! The unique id is entered into the computer to generate the patient’s details. Otherwise the patient will be registered and given a unique identification number for easy retrieval of files.
* Staff and students records will be maintained effectively
* Manage the status of health center doctors, nurses and other staff availability
* Room allocation
* The system generates reports on the following;
  + Important details of a patient admitted in the health center.

## 3.7.2 System Modules

The proposed system will contain various modules that make up the entire system and different interfaces for various users of the system. E.g. Doctors, Nurses and Pharmacists.

The various modules include:

* Login module
  + This module deals with the authentication of user and their password.
* Doctor module
  + This is the specifically for the doctors where they can view, edit, update and delete records.
* Nurse module
  + This is for the nurses to edit, view and update some records.
* Pharmacy module
  + Here the pharmacists views the prescribed drugs for the patient and update records relating to them.
* Report module
  + This generates important reports.
* Details module
  + This generates the details of registered patients and users of the system.
* Patient module
  + This entails the details of patients (in-patients: Those on admission, out-patients: Those who just came for medications and the health records of patients)

## 3.7.3 System Design

The system will consist of various interfaces, menus and pages to create a unique interaction between users and the system to achieve their respective goals. To obtain the best possible result, the card number and detail such as picture must conform to the owner of the record. Parallel approach was adopted in the implementation of the design for the system so that the computer is allowed to run alongside the existing manual method.

## 3.7.3.1 Benefits of Proposed System to Elizade Health Center

* Communication between patients and doctors, and communicates same to experts on the web will be enhanced with adoption of this proposed system.
* Easy retrieval of patient records, you can just login to the page and enter the card number and see the detail of the patient using EHC system.

Since a database environment is been used, information’s will be queried; a query is the object which facilitates retrieval, insertion, update and deletion of records. ODM makes use of various queries in order to maintain system data.

## 3.7.3.2 Considerations of proposed system

* Cloud-based HIS: To pool different healthcare IT resources into large clouds so as to be able to share records easily.
* Authentication: Security is achieved through the use of username and passwords

## 3.7.3.3 Architecture of proposed system

The proposed system comprises of two major components namely the cloud-based system and the e-health web portal.

Elizade University Health Center

Pharmacist

  Intranet

Nurse

Doctor

Network Interface

hhsdjbx

Middleware

 Centralized Database Authentication Server

Fig 5. Architecture of a Cloud-based Healthcare Information System.

## 3.8 The Cloud-based System

The proposed system consists of namely;

* **Central Database Server**: This server acts as the central database for the healthcare center. The cloud datacenter holds the central database server as the information bank which stores electronic medical records and also retrieves patient information.
* **Unifier Interface Middleware (UIM)**: This part of the cloud provides a common platform for all the EMR systems of the collaborating hospitals. The middleware has an interface that covers the heterogeneity of all the collaborating hospitals HIS standards, to ease the communication process between the Central Database and hospitals’ systems. The middleware remains in the cloud and recognizes any type of HIS standard it interacts with. It communicates with each collaborating hospitals via network connections.
* **Authentication Server**: This part of the system handles authentication and authorization. The authentication verifies if an entity using the system has the right to perform the intended action such as (updating, retrieving, transferring, etc.) on the medical information provided. It grants access to authorized users and denies unauthorized users access to the records or resources on the system. All the members of the admin are expected to log in to the system with their username and password. The system compares the username and password with those in the local database and grants access to the user if they match, otherwise, the user is denied access.

## 3.9 The E-Health Web Portal

The e-health web portal acts as the front end of the cloud system, and the part of the cloud (top layer) that provides the application - Software as a service (SaaS) for the HIS system. The proposed cloud system has a web portal configured for end users (authorized doctors, clinicians and the hospitals administrators who serves as the cloud administrator) to navigate through the central database and the whole HIS system. The web portal communicates by sending messages and receiving response messages between the middleware and the hospital system. For each sharing hospital in the cloud, the web portal provides the user two ways to access the database, one for accessing the hospital’s local HIS system, and the other for joining the cloud central database.

Every authorized user (cloud administrator) can retrieve, update and receive medical information from the cloud’s central database through this web page with some degree of restrictions which depends on the end user’s privileges.

The Healthcare Center allows its administrator and doctors to have different view of the patient’s record in the database. The administrator can see the number of doctors and patients in the hospital and can also view their details. Only the bio-data of the patients will be displayed to the administrator and not the result of the different diagnosis and doctor’s report, this will ensure some level of privacy to the patients. Such information can be viewed only by the doctors.

The application was developed with macromedia Dreamweaver and Wamp server technology, HTML5, and MySQL for data storage.

# Chapter Four

## 4.1 Results

# Chapter Five

## 5.1 Conclusion

In this study, a cloud-based healthcare information system has been designed and implemented. Cloud computing would help healthcare centers to achieve proficient utilization of their hardware and software infrastructures and to increase profitability by enhancing the usage of resources to the maximum. The purpose of implementing cloud computing systems in health care is to facilitate and improve the quality of patient care. There is no one system which is superior from the other but they have their own uniqueness. However, the adoption of the cloud would help the system and its users to interact with other physicians using the internet to enhance its quality of services.

With time, I sincerely hope hospitals, health care regulatory bodies and the Health ministries in Nigeria will take advantage of innovations that are becoming available through internet solutions to improve healthcare system (e.g. Cloud computing) and that interaction among health care stakeholders will produce results expected from health care organizations.

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