Development and Implementation of Patient Management Information System: A case study of Nigerian Hospital

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Abstract **Information and Communication Technology (ICT) has made significant impact on healthcare industry across the globe. Its adoption and use, which result into e-healthcare, has transformed the way healthcare services are delivered. Hospitals in Nigeria are adopting e-healthcare in order to improve transparency, efficiency and effectiveness in service delivery. This paper attempts to present a developed Patient Management Information Systems (PMIS) using a case study of General (State) Hospital, Ijebu-Ode, Ogun State, Nigeria. The main objective is to design a web-based medical application capable of eliminating paper-based healthcare system where patient's health information are collected every time a patient visits the healthcare centre thereby allowing e-healthcare physicians to collect Personal Identifiable Information (PII) only once and frequently update its related medical records. The application is based on a browser/server framework. PMIS supports adaptive as well as standard recording of patient's data, along with automatic appointment notification and record keeping using the WAMP server as a delivery channel.**

Keywords: *e-health, m-health Patient Management Information Systems, Personal Identifiable Information,*

1. INTRODUCTION

According to Clifford et al. (2008), hospitals are the main health providers in developing countries. Hospitals are subjected to constant impulses from the national government and insurance companies (e.g. National Health Insurance Scheme, NHIS) to improve efficiency and effectiveness. The general quest towards improving patient's healthcare necessitates an enhanced information management. Hospitals are now becoming aware of the potential value of integrated services and the collaborative advantage of using Information and Communication Technologies increased with the aid of ICT which plays an important role in this change dispensation. As patients demand greater responsibility and accountability from their health care professionals, health providers are challenged to utilize ICT to improve their services.

The use of ICT in hospitals in Nigeria has been increasing gradually. Majority of African countries are grappling with major socioeconomic development challenges which include wars, diseases, poverty, corruption and all these affect the provision of medical care especially the poor citizens (Olugbara, et. al., 2007). Hence, Richardson (2006) argues that healthcare providers and governments have no choice but to meet healthcare demands for teeming citizens and the application of ICT is, therefore, fundamental and inevitable.

Healthcare, either in paper-based or digital format, is an information-intensive industry and it depends on the existence of patient health information (PHI) that is collected whenever a patient visits a particular healthcare centre for the first time. The collection of PHI in paper-based (or traditional healthcare setup) is highly challenging and cumbersome compared to digital method (i.e. e-healthcare). Hence, it is expedient to proffer a solution towards ensuring qualitative healthcare delivery in developing countries like Nigeria by adopting PMIS (Omary, et al, 2010).

This paper is organized as follows: Section 2 covers related work. Section 3 illustrates the methodology adopted. Section 4 contains implementation phase of the system. Section 5 states the conclusion, recommendation and future work.

2. LITERATURE REVIEW

2.1 Health Systems, e-Health and HMIS in Africa

a. Health Systems

Health systems consist of all activities whose purpose is to promote, restore or maintain health. These include, but not limited to, the preventive, curative and palliative health services provided by a healthcare

system (Chetley, et al 2006). Healthcare systems differ from all other systems due to the complex collection of data types. In healthcare, for example, the automation of patient records must deal with a variety of data requirements and specification of problems like the complexity of the medical vocabulary, the codification of biomedical findings, and the classification of health conditions and interventions. The difficulty lies in the fact that this classification can include a huge number of possible combinations. For example, South Africa health systems take the form of district health management systems (DHMIS) which help to gather data systematically used to identify public health issues. The system enables all the public clinics to collect information on national health indicators. ICT is the basis for the development and operation of information systems and enables the creation and application of knowledge. This consists of different levels of sophistication and complexity of information within the healthcare system for patient records, tracking of disease prevalence, monitoring drug supplies, maintaining ordering systems for supplies, and billing procedures, therefore, benefit from the use of ICT (Chetley et al., 2006).

b. e-Healthcare

Healthcare delivery is being transformed by advances in e-health. Currently, the term "e-healthcare", also referred to as the 21st century healthcare, has been identified to offer various services such as Hospital Information Systems (HIS), Electronic Health Records (EHR) and telemedicine (Ouma and Herselman, 2008). However, EHR has been identified as the core application as it provides electronic patients' records which are input to other e-healthcare services (Grimson *et al.*, 2000).

Electronic health (e-health) is the adoption and use of ICTs that includes the internet for more improved and better delivery of healthcare services (Qureshi et. al. 2014). It is a latest platform for handling many healthcare issues. E-health systems have presented so many gadgets which are being used across the globe and healthcare related information systems including the hardware are now inexpensively obtainable all over the world. On the other hand, successful adoption and use of e-health systems depends on the suitable infrastructure (Khoja et al., 2012). The readiness and awareness of doctors and physicians about the usage of IT-applications in hospitals can be developed and maintained by providing proper tools and devices and proper training on regular intervals for more rapid access to information on internet. For handling users-related issues and maintaining regular use of ICTs in health organizations, healthcare providers must be given opportunity to take part in information systems development process and include the system's contents according to their requirements (Rezai-Rad et al., 2012).

c. Health Management Information Systems (HMIS) in Africa

Many developed countries such as Singapore, Canada, USA and UK have invested huge amount of money in stimulating e-healthcare adoption while some developing countries are still dependent on the traditional healthcare setup. This huge investment by developed countries is motivated by the problems associated with the traditional healthcare setup such as duplication in patient's records, time wastage while preparing new records and increase in cost of healthcare delivery due to duplication of tests and procedures. Such problems associated with the traditional healthcare setup can result in a PHI which is inaccurate, incomplete, out-dated and irrelevant to physicians' priority tasks and thus not helpful in healthcare management decision-making (Igira et. al., 2007). Although many countries, both developed and developing, understand the potential benefits of embracing e-healthcare, there are many challenges to be addressed prior to its adoption. These challenges which differ between countries include lack of patient unique identifier, insufficient funds, low rate of Internet penetration and bandwidth, obsolete healthcare policies, unacceptable global standards and privacy, confidentiality and security concerns (Omary, et al, 2010).

However, the healthcare system in some developing countries is gradually changing in the last few years from a centralized system with hierarchical reporting to a decentralized system. Health systems in a centralized system only focus on morbidity and mortality reporting from individual health units to the district and national levels (Gladwin et al., 2000). With the introduction of a decentralized system, there has been significant change emphasized by the Federal Ministry of Health (FMoH), through the implementation of Health Management Information Systems (FHMIS) with emphasize on the use of information technology at the point of data collection. Through decentralization, more freedom and responsibilities are given to each point of care meaning that more skills are demanded of primary healthcare managers, concerning the data and information handling at all levels of a healthcare system on a global level (Gladwin et al. 2000).

Healthcare management is the intersection of information science, computer science, information

technology and healthcare. It deals with the use of resources, devices, and methods required in optimizing the acquisition, storage, retrieval of information in health and biomedicine. This includes not only computers but also clinical guidelines, formal medical terminologies, and information and communication systems (Burney, et. al, 2010).

2.2 ICT in Health Care

Research and development efforts within the healthcare industry and the rapid advancement in ICT over the last two decades have brought about significant advances in the quality of medical services to the patients. For the purpose of improved healthcare system vis-à-vis integration with ICT, developed countries spend huge resources. It is obvious that healthcare providers/institutions require timely information via ICT about patients at the point of care towards provision of optimal services.

ICT in the last decade has been useful in the provision of solutions to the problems in healthcare management systems. These include a wide spectrum of issues such as patient safety, dietary management, telemedicine, digital imaging, document management etc. Researches in healthcare vis-à-vis ICT explore the emerging technologies which are being used for the improvement of the healthcare process in developing countries. The developing countries such as Pakistan explore ICT to give better healthcare services as well health education. The introduction of ICT into existing health systems, according to Chetley et. al. (2006) has helped to improve the delivery of healthcare in a number of ways.

a. *Telemedicine*

Telemedicine is considered a powerful tool for improving healthcare delivery which has been successfully implemented in pilot projects in many countries. It is widely used and can improve diagnoses and treatment of specific conditions dramatically but has proven to be very costly. Telemedicine is an implementation which requires high bandwidth and sophisticated remote equipment and has only proven practical in cases where money is not an issue. It can be a cost-effective method that richer countries can employ to aid capacity building in the healthcare systems of poorer countries (Chetley, et. al. 2006). In Africa, its use has helped people in rural areas by saving money and time for travelling and long queuing lines. Clinical staff can now send patient information by email to specialists in the cities and symptoms can now be analyzed days ahead from a distance.

b. *Electronic Health Records (EHR)*

Many researchers define and refer to EHR using different terms, such as computer-based patient records (CPR), computerized medical records (CMR), patient-carried medical records (PMR), electronic patient records (EPR), electronic medical records (EMR), personal health records (PHR) and digital medical record (DMR). However, this paper adopts the definition provided by the Institute of Medicine, (IOM, 2003) and Grimson et al (2000) which identifies EHR as the longitudinal collection of electronic patient records about patients where health information is pertaining to the health of an individual. EHR includes the information about patient's demographics, past medical history, progress reports, patient's problems (past and present), medication, laboratory data and radiology reports. These records have the ability to generate a complete record of a patient from cradle-to-grave (Grimson et al, 2000; IOM, 2003; Ouma and Herselman, 2008).

c. *Document Management*

Document management is one of the areas where bar code technology and radio frequency identification (RFID) can be used effectively to manage paper documents and files. In developed countries, most of the health management system use bar coding of patient medical record folders and also the account files of patients to keep accurate file locator systems. It is used with the patient billing statements and whenever a patient submits a payment, it is easily verifiable and provides accurate data.

d. *Personalized Healthcare Information*

Another hallmark of healthcare information is that it is highly personal. Hence, any transfer of information between parties via technology involves risks - both actual and perceived - that the information could fall into the wrong hands. Although, electronic information can be made as secured as paper records, but electronic storage is perceived as having a higher likelihood of leakage, and such fears get further compounded by media attention. Thus, patients perceive probability of compromised privacy is often higher than the actual probability (Fichman, et. al., 2011). Variations in individual's willingness to disclose personal health information (PHI) is the

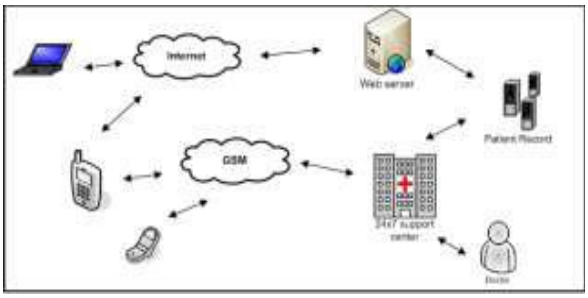

Fig. 1: Concepts of M-Health System (Burney, et. al,

focus of Agarwal et al. (2013). They posit that individuals' privacy concerns and trust in the electronic storage of PHI will affect willingness to disclose and add important insights to the literature on individual disclosure decisions and offer guidance for healthcare policy. For example, they find that the negative relationship between privacy concerns and willingness to disclose information is particularly acute when the information request comes from government/public health agencies. As digitization of health information has several benefits, Agarwal et al. (2013) further underscore the need to understand the situational factors that drive individual's comfort with sharing healthcare information in an electronic format. One implication of this research for policy makers is to explore more stringent regulations of medical information to require that stakeholders clearly identify who they are, for what purpose they will use the data, and even to set limits on the amount of time that the stakeholder will have access (Sanja, 2013).

e. *M-Health*

Advancements in ICT have paved way for provision of cost-effective e-services to the people around the globe. The combination of such wireless technologies with e-health is known as *m-health*. In general terms, m-health is the use of mobile computing, medical sensor, and communications technologies for healthcare (Istepanian, et. al, 2004). The application include the use of cell phones and other communication devices to gather health data, delivery of healthcare information to doctors, researchers, and patients. It also includes real-time and direct provision of health services. It can help improve clinical outcomes and contributes to better public health monitoring and education. This system is very handy in locations where there is a dearth of healthcare facilities and infrastructure. In m-health, the availability of ICT infrastructure will be used to get medical advice from health professionals at remote locations through the support centers working round the clock (Burney, et. al, 2010).

2.3 Hospital Information System (HIS)

HIS is used in hospitals to assist the overall management of the healthcare facility through information about diseases and information about

Fig. 2: Hospital Information System (Omary, et al, 2010)

patient care in terms of record-keeping of patient information, accounting, human resources, management, asset, stock and knowledge management (Winter, et. al., 2004). The support for patient care and administration by providing accurate, updated and accessible information in a usable format to the healthcare personnel at the right location remains the focus of HIS and such information must be correctly collected, stored, processed, and documented. HIS also deals with the knowledge about diseases, drug actions and adverse effects to support diagnosis and therapy as well as information about the quality of patient care and hospital performance (Omary, et. al, 2010). HIS, a component of information systems, is depicted in Fig. 2.

2.4 Hospital Management Information System (HMIS)

According to Shortliffe and Cimino (2006), HMIS is a comprehensive and integrated information system designed to manage the administrative, financial and clinical aspects of a hospital and it encompasses paper-based information processing as well as data processing and storage equipment. HMIS automates routine management reporting to support administrative and patient care applications to reduce time and effort of health workers such as doctors, pharmacists and nurses. It encompasses hardware, software and personnel to operate them in order to ease the duty of the management and flow of information among healthcare stakeholders (Tan, 2005).

Winter et al. (2004) also define HMIS as a socio-technical subsystem of a hospital that consist of all information processing actions and health personnel within the system. Berg (2001) states that HMIS is used for master index, patient management, billing, insurance management, pharmacy, radiology, financial management, order entry, operation theatre etc so that their functionalities may increase. A health management information system consists of two subsystems: (i) Hospital Management Information System (HMIS) and (ii) Patient Management Information System (PMIS). PMIS deals with patients' data, billing, treatment and prescription.

2.5 Benefits to e-Healthcare Adoption

The adoption and use of ICT has transformed several industries in the world (Wickramasinghe et al., 2006) and healthcare is one of the industries that have been transformed into e-healthcare. There are various perceived benefits, to individuals and governments, associated with e-healthcare adoption. Furthermore, e-healthcare improves physician's efficiency, quality of healthcare delivery, better patient-physician relationship and saves cost.

3. RESEARCH METHODOLOGY

3.1 Analysis of the Existing System

The existing system is based on manual operations and relied heavily on the ability of the nurses, doctors and clerks to keep and collect the medical records for each patient. The system shows that the first time a patient gets to the hospital; he obtains a *reference card* at the Registry followed by the *Doctor Prescription.* With the latter card, the doctor diagnoses illness and then prescribes drugs for the treatment of such illness. The doctor then directs the patients to the OPD (Out Patient Department) Pharmacy to collect/buy the drugs. After this, the treatment card is collected at the OPD and later retrieved by the clerks for the purpose of manually filing at the General Record Office according to their registration numbers. In case the patient is admitted, a *case note* containing the doctor's name, the patients' name, address, occupation, date of admission, age, date of discharge, index number, the disease diagnosed, ward or unit of treatment is opened. After the patient must have been treated and discharged, the case note is collected from the ward with the knowledge of the Medical Record Officer. All these processes make the existing system being characterized by loss of files, wrong filling, mishandling of files etc.

3.2 Overview of PMIS Development Tools

a. *Operating Systems*

The application is web-based which can run on any web-sever e.g. Linux (LAMP), Windows (WAMP) and Mascintouch (MAMP). Apache is the most widely used web-sever on the Internet. The Sever is available for both Linux and Windows platforms. It provides support for many scripting languages through modules. Modules are dynamically loaded into the Sever as needed, provide a more robust and efficient solution than Computer Graphics Interface (CGI) approach.

b. *Database Management System (DBMS)*

MySQL was chosen for the system DBMS. MySQL is the most popular Open Source SQL-based relational database. MySQL supports transaction and is available for a variety of platforms including Linux and Windows.

c. *Scripting Language*

PHP (Hypertext Preprocessor) is an open source HTML-embedded scripting language, which recently has attracted a lot of attention. Its syntax is similar to

C programming language and it conforms to object oriented programming language principles.

d. WAMP

Windows Apache MySQL PHP is a simulated sever that acts like a real server, it enables web pages to be uploaded and examined. As the name states, it is the combination of a DBMS (MySQL), HTTP SEVER (Apache) and a scripting language (PHP), that is used to simulate the proposed web-based system.

3.3 Analysis of the Current System

System analysis involves breaking down an organization into different components and then examines them critically for the purpose of identifying existing shortcomings and designing an improved system. For the current system to solve the problem in the existing system in General Hospital, Ijebu-Ode, Ogun State, Nigeria, an analysis was carried out leading to the following propositions. The overall focus of the system is to make the processes of retrieving patient identifiable information easier for the organization. These are to (i) ensure detailed and accurate storage of patient medical information into the database, (ii) reduce cost of purchasing stationeries; and (iii) reduce access time of patient information retrieval.

3.4 Input and Output Specifications of the System

The input into the new system is depicted Fig. 3. The output of the system is designed to generate printable reports from the database and is placed on a database grid that contains information about patient's records which can be produced in hardcopy or viewed on the screen. The output generated includes: (i) Patients File and (ii) Treatment Record.

3.5 Design of the System

a. *Database*

Files used in this paper are made up of different data types which are designed and linked with database using Microsoft Access. All data are stored in one location within the database and tables are stored in a single file. Thus, there is no need to separate buttons using the single database file. However, distinctions exist between files since each table is stored as a separate entity in the file. Therefore, it is possible to define (i) relationship between tables and (ii) validation of fields as well as table level to ensure accuracy of data being used. Query, report, sorting etc. are also used. The Medical Director is the overseer of all the affairs of the hospital and receives reports from various sections of the hospital.

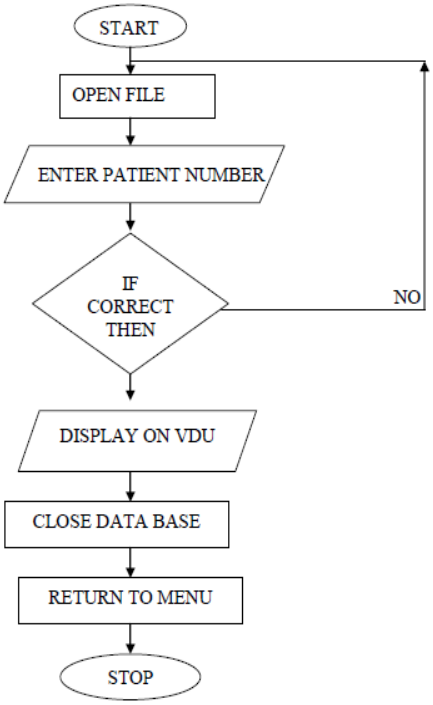

Fig.3: Input and Output Chart

b. *File Design*

The following table makes up the database (MySQL) used in the system.

(i) Admin Login

The table below (Table I) contains the username and password of the administrator.

Table I: Structural View of the Adminlogin Table

Field Name	*Type*	*Description*
Doc _ id	Int (ii)	Primary key
Username	Varchar (30)	Admin username
Password	Varchar (50)	Admin password

(ii) Patient

The table below (Table II) holds detailed information of each patient.

Table II: Structural View of the Patient Table

Fieldname	*Type*	*Description*
Count_id	Int(ii)	Primary key
P_id	Varchar(50)	Patient id
Fname	Varchar(50)	Firstname
Lname	Int(50)	Lastname
Mi	Varchar(50)	Middlename
Age	Int(50)	Patient age
Gender	Varchar(50)	Sex
Status	Varchar(50)	Health status
Brgy	Varchar(100)	
City	Varhar(100)	
Postal	Int(10)	
Remark	Text	Patient
Date_ad	Datetime	Date & time

iii. Doctor

The detailed information of each doctor is as shown in the table below,

Table III: Structural View of the Doctor Table

Fieldname	Type	Description
Count_id	Int(ii)	Primary key
D_id	Varchar(50)	Doctor id
Fname	Varchar(50)	Firstname
Lname	Int(50)	Lastname
Mi	Varchar(50)	Middlename
Age	Int(50)	Doctor name
Gender	Varchar	Sex
Status	Varchar(100)	Doctor status
Brgy	Varchar(100)	
City	Varchar(100)	
Postal	Int(50)	
Remark	Text	Doctors
Date_ ad	Datetime	Date and time

iv. Appointment

The table below holds all appointment information.

Table IV: Structural View of the Appointment Table

Fieldname	Type	Description
App_id	Int(ii)	Primary key
P_id	Varchar(50)	Patient id
D_id	Varchar(50)	Doctor id
Time	Time	Appointment time
Date	Date	Appointment date
Encoder	Varchar (50)	admin name
Datead	Datetime	Date added

3.5 Architecture of the System

The architecture implemented in the PMIS is depicted in Fig. 4.

3.6 Implementation of the PMIS on the Computer System

i. A Wamp Server software will be installed on the new computer system.
ii. The designed PMIS folder file will be saved in the directory in drive C which is the operating system folder on the hard disc.
iii. The wamp server will be opened from the start menu and launched from the task bar.
iv. On WAMP server address bar, the user will enter the localhost address (http://localhost/hms/) at the index page, the admin login with his or her username and password. If the login is successful he or she get to the homepage.

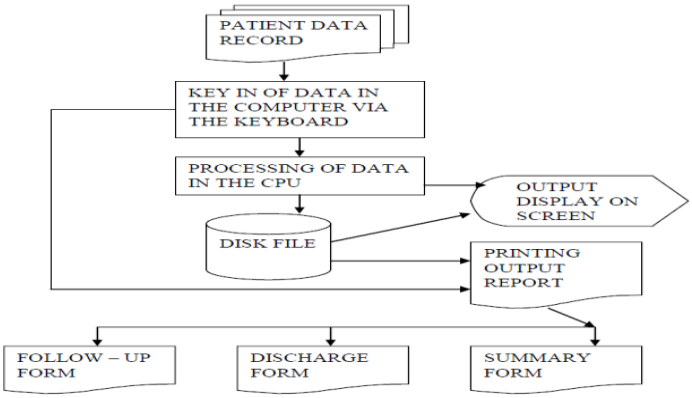

Fig.4: Architecture of PMIS

4. SYSTEM IMPLEMENTATION

4.1 System Specification

There are basically requirements, in terms of hardware and software, for both the server and client-side since PMIS is designed on sever-client architecture so as to ensure the optimal use of the medical information.

a. *Client Requirements*

All the clients need web browser to use the PMIS. Most operating systems come with a browser like Internet Explorer, Mozilla Firefox, and lately Google Chrome. The Microsoft Windows operating system which is the basis of this PMIS uses Internet Explorer.

b. *Client Software and Hardware Requirements*

The user needs a minimum of Microsoft Windows XP operating system and any webserver such as LAMP, WAMP or higher for maximum performance. A minimum of an Intel Pentium IV/M processor running at 1.2GHz or higher, 512 MB RAM., Super video graphics array (SVGA) monitor, Microsoft Windows Keyboard, CD-DRIVE (Optional), 32-bit and 64-bit Operating system.

c. *Server Requirements*

Intel Pentium IV/M 2.0GHz processor or higher, minimum of 1GB RAM, Apache version 5.1.4,MySQL version 5.022 and Microsoft Windows XP Professional Operating System or higher. MySQL version 5.022 and Microsoft Windows XP Professional Operating System or higher.

d. *Security Features*

Secure Sockets Layer (SSL) provides the necessary security and privacy in web-oriented communication system since healthcare information is highly personalized. Hence, any transfer of information between parties via technology involves risks (actual and perceived) that the information could fall into wrong hands.

4.2 Program Implementation and Graphic User Interface

The PMIS application can be hosted on Intranet within the hospital but queries are run and results are obtained from tables of the same database which houses the data from the user.

(i) User's LogIn

At the Index Page, the admin logged in by providing the following: (i) Username (ii) Password. The page allows the administrator to manipulate the database using the interface provided by the *appserv* application. The database contains four tables for storing records that are related. These tables are as shown earlier (Tables I-IV). It is only the administrator or any other authorized personnel that have access to the system, and the functions he performs in the system are to (i) add doctors and patients to the system, (ii) create appointment between the doctor and the patient, (iii) edit doctors and patients information, (iv) view patient's history.

On the creation of appointment between the doctor and patient, they get notification (reminder) on consequent time between the doctor and patient.

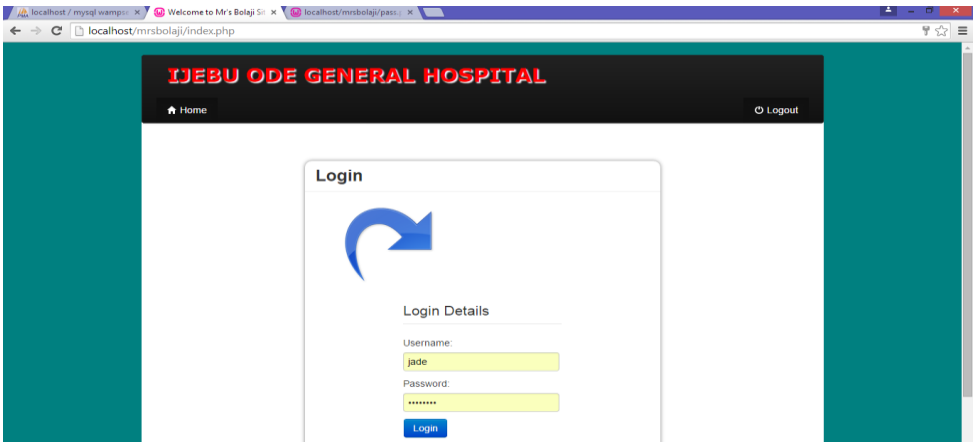

Fig.5: User's LogIn Page

(ii) The Home Page

The portion of the home page introduces the hospital PMIS and what it is about as depicted in Fig. 6

(iii) Adding Doctor

The *Add Doctor Page* contains a form for registering new doctor. Each doctor is required to provide the first name, last name, middle name, age, gender, status, birthdate, address, city/municipality, postal code and remark shown in Fig. 7.

The Add Patient Page contains entries about detailed information of the patient coming to the hospital to receive patient for the first time (Fig. 8).

(ii) Doctors and Patients List

The *Doctors' List and Patients' List* are where the administrators can view information about all the doctors and patients in the hospital respectively as indicated in Fig. 9 and 10.

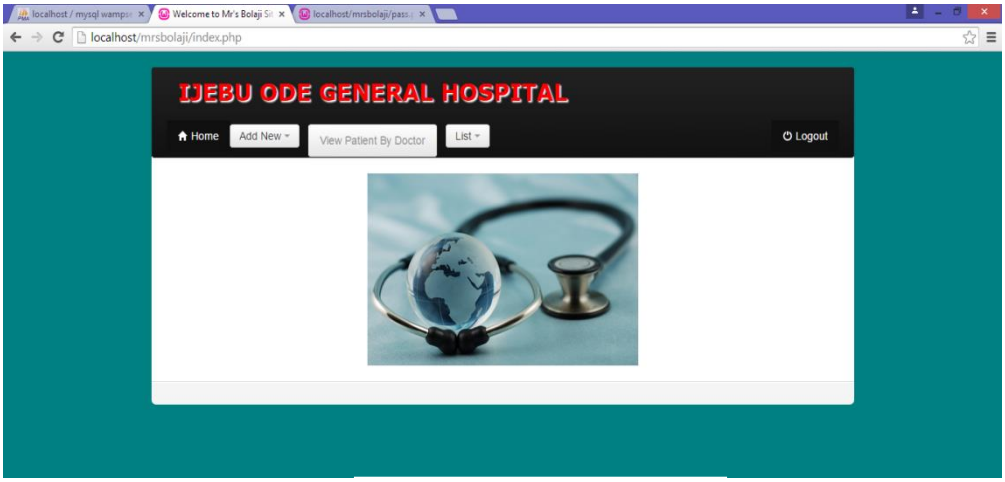

Fig. 6: The Home Page

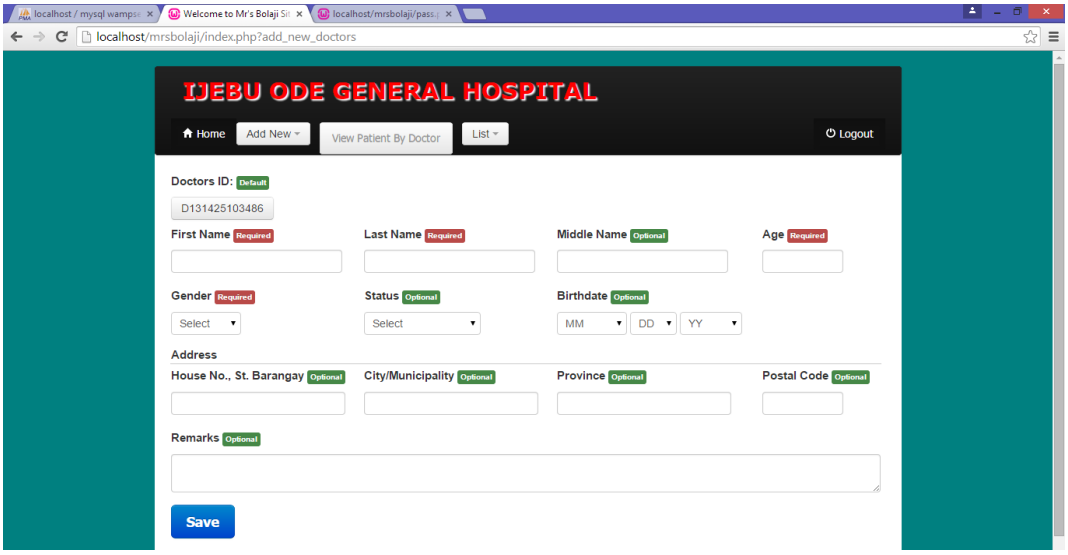

Fig. 7: Add Doctor Page

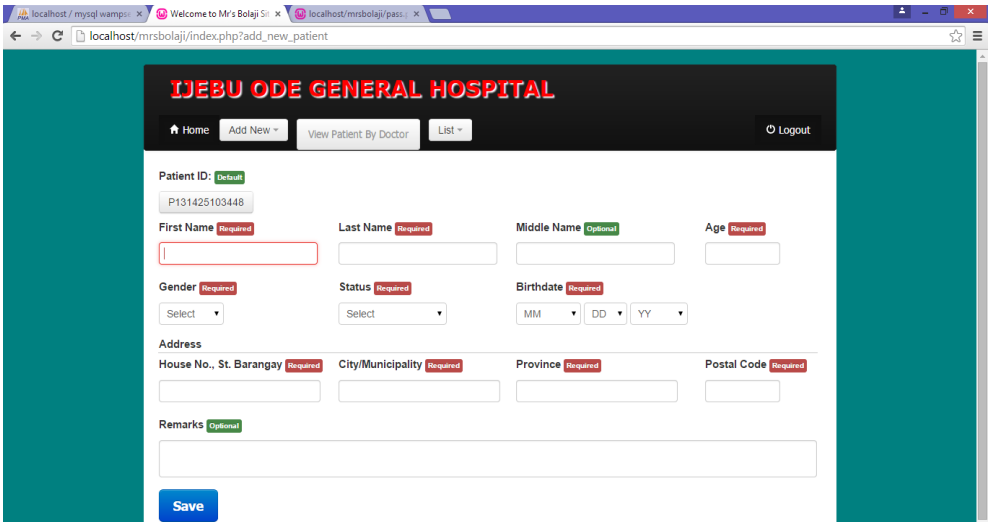

Fig. 8: Add Patient Page

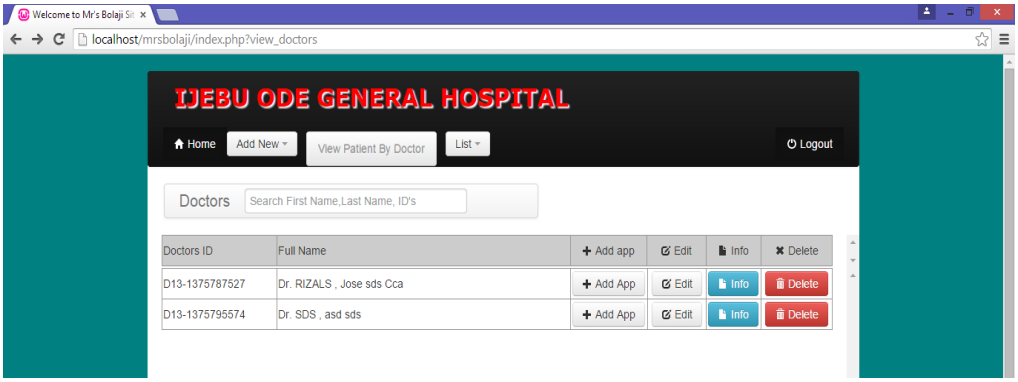

Fig. 9: Doctors List Page

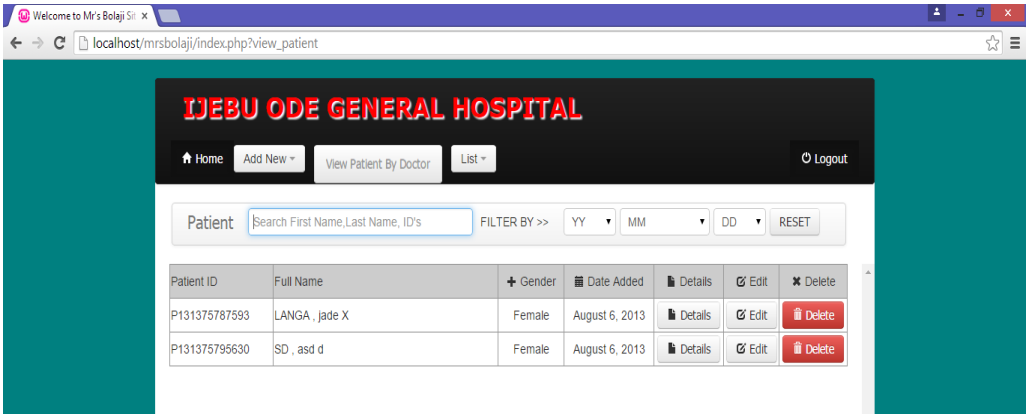

Fig. 10: Patients List Page

5. CONCLUSION AND RECOMMENDATIONS

The purpose of this study was to make accessibility of patient personal health information easy and faster and to keep up-to-date records for patient at the click of the mouse. The application can be used within the hospital via the Intranet where WAMP (Window Apache MySQL and Php) server needs to be installed. PMIS is fully functional and can be accessed and updated by the database administrator. The researchers discussed the possibility of using open source software for building an information system for the healthcare centre with particular reference to State (i.e. General) Hospital, Ijebu-Ode. The introduction of PMIS in keeping patient medical records for the hospital enhances efficiency and effectiveness on the part of the doctors and improves patient-physician relationship. By implementing the system, the hospital will be able to keep track of patient medical records and processing of patient health information accurately. Equally, it is capable of showing patients by doctor. That is, the Medical Director in conjunction with database administrator can view patients attended to by a particular doctor. This makes the administration of the hospital to monitor doctors' activities.

Having evaluated all possible sides of PMIS, it would eventually be more useful to implement the system, maintained and monitored by the ICT Department of the hospital. It is recommended to build capacity through user training among the members of staff of the hospital.

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REFERENCES

[1] G. D. Clifford, J. Blaya, R. Hall-Clifford and H. S. F Fraser. Medical Information Systems: A Foundation for Healthcare Technologies in Developing Countries. *Biomedical Engineering Online*, 7:18, 2008. doi:10.1186/1475-925X-7-18.

[2] R. Spanjers, R. Peterson, and M. Smits. Exploring ICT enabled networking in hospital organisations. Idea Group Publishing, 2001

[3] O. O. Olugbara; S. O. Ojo; M. O. Adigun; J. O. Emuoyibofarhe and Sibusiso S. Xulu.. An Architectural Framework for Rural e-healthcare Information Infrastructure with web service-enabled Middleware Support. Proceedings of HELINA 2007 Conference on Scientific at a Glance, Bamako, Mali.

[4] R. J. Richardson. Healthcare Systems Transformation: The Role of e-Health. Book of Abstract of Med-e-Tel Conference, 2006, Luxexpo, Luxembourg. Retrieved April 10, 2016 from http://www.medetel.lu/download/2006/parallel_sessions/abstract/0407/Richardson.doc.?PHP

[5] Z. Omary, D. Lupiana, F. Mtenzi and B. Wu. (2010). Analysis of the Challenges Affecting E-healthcare Adoption in Developing Countries: A Case of Tanzania. *International Journal of Information Studies.* 12(1), 2010, pp. 38-50.

[6] A. Chetley. Improving health, connecting people: The role of ICT's in the health sector of developing countries. A framework paper. 2006, www.infodev.com

[7] G. Grimson, W. Grimson, and W. Hasselbring.. The SI Challenges in Health Care. Communication of the ACM, 43(6), 2000, 49-55.

[8] Q. A. Qureshi, B. Shah, A. Nawaz, I. Khan, M. Waseem, and F. Muhammad. (2014). E-Health in Pakistan: Issues and Prospects. *Journal of Biology, Agriculture and Healthcare*. 4(17), 2014, pp. 106-115.

[9] S. Khoja, H. Durrani, P. Nayani, and A. Fahim. Scope of Policy Issues in e-Health: Results From a Structured Literature Review. *J Med Internet Res*,14(1), 2012, e34

[10] M. Rezai-Rad, R. Vaezi, F. Nattagh. E-Health Readiness Assessment Framework in Iran. *Iran J. Public Health*, 41(10), 2012, pp 43–51.

[11] F. T. Igira,O. H. Titlestad, J. H. Lungo, A. Makungu, and M. Khamis,.Designing and Implementing Hospital Management Information Systems in Developing Countries: Case Studies from Tanzania-zanzibar: Health Informatics in Africa (HELINA), 2007.

[12] J. Gladwin, R. A. Dixon, and T. D. Wilson. "Using external training materials to strengthen health information management in East Africa". Information Research, 5(4), 2000.. Available at http://information.net/ir/5-4/paper83.html

[13] S. M. Aqil Burney, N. Mahmood and Z. Abbas. (2010). Information and Communication Technology in Healthcare Management Systems: Prospects for Developing Countries.

International Journal of Computer Applications. 4(2), 2010, pp 27-32.

[14] IOM.. The Computer-based Patient Record: An Essential Technology for Healthcare. Revised edition, 2003, Institute of Medicine.

[15] S. Ouma and M. E. Herselman. E-health in rural areas: Case of developing countries. World Academy of Science, Engineering and Technology. International Scholarly and Scientific & Innovation, 2(4), 2008, pp. 304-310.

[16] R. G. Fichman, R. Kohli and R. Krishnan, The Role of Information Systems in Healthcare: Current Research and Future Trends. *Information Systems Research.* 22(3), 2001, pp. 419–428

[17] R. Agarwal, C. Anderson, J. Zarate and C. Ward. "If We Offer it, Will They Accept?: Factors Affecting Patient Use Intentions of Personal Health Record and Secure Messaging." *J. Med Internet Res. 15(2): m 2013 e43.*

[18] M. M Sanja.. Impact of Enterprise Resource Planning System in Health Care. *International Journal of Academic Research in Business and Social Sciences.* 3(12), 2013, ISSN: 2222-6990

[19] R.S. H. Istepanian, E. Jovanov, and Y. T. Zhang. Beyond Seamless Mobility and Global Wireless Healthcare Connectivity. *IEEE Transaction of Information Technology in Biomedicine*, 8(4), 2004, pp. 405-414.

[20] A.A.Winter, B. Brigi, and R. Haux.. Strategic information management in Hospitals: an introduction to hospital information system. Published by Springer. *Information Studies.* 12(1), 2004, pp. 38-50.

[21] E. H. Shortliffe and J. J. Cimino. *Biomedical Informatics: Computer Applications in Health Care and Biomedicine* (3 ed.), 2006, New York: Springer.

[22] J. Tan.. E-Health Care Information Systems: An introduction for Students and Professionals, Jossey-Bass, 2003, ISBN 978-0-78796-618-8, San-Francisco (CA).

[23] M. Berg,. Implementing information system in health care organizations: myths and challenges. *International Journal of Medical Informatics*, 64, 2003, 143-156.

[24] N. Wickramasinghe, E. Geisler, and J. J. Schaffer (2006). Realising the value for healthcare by incorporating KM strategies and data mining techniques with the use of information and communication technologies. *Int. J. of healthcare Technology and Management.* 3(3/4); 2006, pp. 303-318

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