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Assessment of the Initial Adoption and Implementation of an Electronic Medical Records (EMR) System in a Nigerian Teaching Hospital

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Abstract
All medical information related to patients can be displayed in a digital system known as the Electronic Medical Record System. The system is an attempt by many medical facilities to design and implement a means of collecting, storing, and presenting patients' information at the point of care. EMRs are implemented worldwide because they are recognized as a potential means of improving medical services' quality, safety, and efficiency. In Nigeria, the Federal Ministry of Health has acknowledged the significance of EMRs for quality enhancement in healthcare delivery and has directed all teaching hospitals to computerize their clinical processes. Based on this directive, some teaching and national hospitals are now computerized. This paper aims to assess the initial adoption and implementation of the EMR system in a Nigerian teaching hospital. The research design adopted in this paper is a qualitative research design. Primary data were collected via participant observation and face-to-face interviews with medical staff and information technology personnel who deployed the system. Also, the researchers reviewed existing literature on adoption of electronic medical records systems and the pros and cons of adopting an electronic medical records system. The tools used in developing the EMR system were JavaScript, C#, MSSQL server, Web server (IIS), and Web browser is the program the user uses to view the web pages. The system has many modules which can only be accessed by authorized members of staff based on the role they perform. The system comprises of patient information module, Billing and payment module, Nurses module, Doctors module/clerking module, Customizable Reporting/Quality reporting, clinical coding, NHIS module, Diagnoses, Diagnostic imaging system (Radiology), E-prescription, and Laboratory information system. The system can still be improved upon through the inclusion of more relevant modules for better clinical and patient experience.

***Keywords**: Adoption, Assessment, Electronic Medical Records Framework, Electronic Medical Records System, Implementation.*

1. Introduction

The invention of new technologies has impacted every sector of human activities globally. Health, education, taxation sectors, etc., have been taken over by new technologies which have brought about many benefits to running the activities in these sectors. The impact of computer technologies cannot be overemphasized in the health sector as they have paved the way for a lot of improvement and efficiency in the activities of healthcare delivery organizations. Nigerian hospitals are now operating in new dimensions, which has made it easier to obtain high-quality medical care at all levels of healthcare facilities i.e., primary, secondary, and tertiary.

In Nigeria today, one could say that a tertiary healthcare facility operates all levels of healthcare because a larger percentage of the healthcare resources are given to the tertiary healthcare facilities by the government, leaving the primary healthcare facilities which are supposed to be the first point of contact with healthcare with little or no resources to cater for the health challenges of the people in the community. Many sorts of medical records are

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stored in tertiary healthcare facilities because they are the mother of all healthcare services in Nigeria. The basic medical records kept by these hospitals are diagnostic summary index, master name index, admission and discharge records, general outpatient records, obstetrics records, accident and emergency records, etcetera [1].

Information technology has become one of the most important components of the healthcare system. The emergence of digital systems has resulted in a revolutionary transition of paper-based medical records into an electronic version [2]. The term "electronic medical record" is defined as a digital document that contains all of the patient's health data including demographics, contact details, progress notes, diagnoses, medications and allergies, vital signs, past and present medical history, laboratory test results, and radiological images, all of which are combined into a single record that authorized personnel can view [3]. It helps provide patient health services by capturing, storing, and sharing patient data amongst healthcare providers within an organization [4]. By improving workflow, reducing medical malpractice, reducing costs and therapy time, raising revenue, strengthening ties with all caregivers, and reducing the need for file hoses and personnel for the retrieval and filing of medical records, it contributes to improving the quality of healthcare [5] [14] [18]. It includes information, expertise, and facts that can be assessed to provide an accurate diagnosis [6].

A well-functioning EMR contributes to the reduction of fragmentation in the care delivery system, which enhances quality and efficiency by minimizing gaps in care. In addition to tracking and flagging patients who fail to show up for follow-up care within a reasonable timeframe, an EMR can provide reminders of critical interventions that are required during an office visit [7]. Additionally, the EMR software may operationalize best medical practices or establish clinical recommendations. For instance, algorithms can detect drug interactions or allergies [8]. By streamlining the healthcare facility's workflow and providing quick and simple access to a patient's data, EMR lowers patient wait times and inefficiencies. Patients can quickly and easily access a more structured and effective patient-centered health system with the help of an EMR system [17].

Electronic Prescriptions, Computerized physician order entry (CPOE), Patient Portal, Automatic Transcription/ Voice recognition, Advanced Security, Customizable Reporting/ Quality reporting, 24/7 access from any device, E/M Coding/Coding standards, Simple, Intuitive and Attractive User Interface and Billing are some of the features that have been shown to enhance the dependability, caliber, and effectiveness of electronic medical records systems over time. Core components of an EMR include Patients registry, Healthcare provider registry, Diagnoses, Diagnostic imaging system (Radiology), Clinical Decision Support systems, E-prescription, Laboratory information system, and Billing System.

There are various types of EMR and they are: Cranium Hospital Management System, Swiftpractice EMR, Care 360, Cerner EMR, Optum Physician EMR, Epic Care EMR, Kareo Clinical, Praxis EMR, Open EMR, Nextech EMR, etcetera. Medical personnel, including medical records officers, nurses, and doctors, are the primary users of EMRs, which use it to access patient health data. Additionally, administrative staff and patients also interact with the system [1].

EMR is recognized as a tool for producing readable and organized patient records [9]. Because EMR systems offer benefits like lowering medical errors, improving the efficacy of healthcare services, and lowering healthcare costs, many healthcare organizations are working to develop and deploy these systems for gathering, storing, and displaying patient information at the point of care [10]. EMRs are being planned and implemented globally because they are acknowledged as promising tool for enhancing the quality, durability, safety, and efficacy of healthcare services [9].

Even though paper-based health records are still the most common method of recording and storing patient data, the use of digital health systems has increased dramatically over the past 20 years, particularly in developed nations like the US, Canada, and Western Europe [2]. Despite their high potential and widespread

focus, the overall use and adoption rate of EMRs is relatively low, particularly in developing nations like Nigeria. This is because of obstacles like setting up a system that requires a large financial investment, poor electricity supply and inconsistent internet connectivity, shortage of qualified technical personnel, issues with database conversion, lack of facilities to operate the system, interoperability issues, limited computer skills, the need to alter doctors' traditional working styles, patients' worries about record security, lack of prioritization of the EMR because of lack of policy on EMR adoption and lack of financial incentives for adoption [10] [14] [15] [16] [20]. This paper aims to assess the initial adoption and implementation of an electronic medical records system in a teaching hospital in Nigeria. Specifically, it assesses the developmental framework for the adoption and implementation of an electronic medical records system in a teaching hospital in Nigeria.

2. Related Works

The majority of Nigerian hospitals still rely on the use of paper records which is both inconvenient and time-wasting, especially when dealing with emergencies [11]. Medical record keeping on paper has many drawbacks. The inability to locate folders causes patients to stay in the hospital for a lengthy time before receiving care. Sometimes patients spend an entire day in the hospital without receiving care, and other times they are forced to pay for a replacement when their original folder goes missing. This can occasionally lead to turmoil in hospitals, as many patients quarrel with medical staff due to delays in finding their folders, misplaced records, or missing names. In certain hospital units, patients without doctor's appointments are frequently neglected, even in cases where their condition is serious because the record officers perceive finding their folders is a difficult task. In such cases, patients are often sent away without the doctor’s knowledge [12]. Paper records can occasionally be attacked by rodents, deteriorate with age, fading ink, have little or no security, and have difficulty in updating and editing. Electronic Medical Records (EMR) can solve all these problems at once [13].

According to Ndukwe & Ezeoha [14], no public hospital in Nigeria fully utilizes the Electronic Medical Record. While some hospital uses it for certain documentation tasks, it is not used for consultations. They stated that only one or two federal hospitals are using it for actual consultation, although some hospitals have begun to use it for patient registration, billing, and inventory management. The researchers observed that some hospitals that have implemented the system suddenly stop using it because it does not neatly fit into their workflow. Akor & John-Mensah [12] revealed that some private hospitals in Nigeria have nearly reached 100% electronic medical record implementation. The implementation of EMR is not common in government hospitals as EMR implementation is more prevalent in the private sector than public [1] [14]. Also, even in studies concentrating on EMR implementation in public hospitals, there is a dearth of data from hospitals in Southwestern Nigeria, despite wide-ranging research on the barriers to adoption and implementation [14][15][16].

Odekunle, Odekunle, & Srinivasan [15] outline the tactics that made it possible for the few sub-Saharan nations that have only partially embraced EMR to do so. These tactics include Implementation planning, education and training, government funding to cover implementation expenses, choosing the right EMR system, and phased implementation, which entails deploying the EMR system one unit at a time. The findings of the study conducted by Pantuvo, Naguib & Wickramasinghe [19] also showed that a trained and motivated workforce, political will from the government and health system managers, significant and sustainable funding, Information Technology equipment and infrastructure, infrastructure security, a conducive work environment, a legislative and regulatory framework that mandates a transparent procurement process, incentives for EMR adoption, and penalties for not adopting EMR or meeting standards are some of the factors thought to be essential for the successful implementation of a nationwide EHR system in Nigeria.

The use of electronic technology in healthcare is becoming more and more of a priority for many hospitals worldwide. Following the footsteps of

some developed nations, the Nigerian Ministry of Health has recognized the value of electronic medical records (EMRs) for improving the quality of healthcare delivery and has directed all teaching hospitals to computerize their clinical processes. Based on this directive, now, some teaching hospitals and national hospitals are being computerized. As a result, the researcher deemed it fit to assess the initial adoption and implementation of Electronic Medical records system in a Nigerian teaching hospital.

To the best of the authors' knowledge, this study is peculiar on account of the fact that none of the existing studies in the literature focused on an in-depth study of EMR from the point of interconnection from module to module and a detailed functional description of the system. Most Nigerian studies on EMR have been on generalized literature review on the barriers and success factors as opposed to a singular in-depth study of implementation in a single hospital setting.

3. Methodology

The research design adopted in this paper is a qualitative research design. The data collection instruments include face-to-face interview and participant observation. Primary data were collected via participant observation and face-to-face interviews with medical staff and information technology personnel who deployed the system. The participants were selected because they have a better understanding and can give in-depth descriptions of the electronic medical records system. Also, the researchers reviewed existing literature on the adoption of electronic medical records systems and the pros and cons of adopting an electronic medical records system with the help of books, conference proceedings, and electronic databases such as ScienceDirect, Researchgate, and Google Scholar. In our searches, we employed the following keywords: Electronic medical records, adoption, and EMR implementation Framework. For confidentiality, the name of the teaching hospital is not mentioned in the paper.

3.1 *Data Collected Using Face-to-Face Interview*

The following questions were asked from the medical staff:

1. Have you used any computerized system for keeping patient health information before?
2. What is the name of the first system?
3. Why did the first system fail?
4. Did you in any way try to resuscitate the first system?
5. Why did you switch to electronic medical records systems?
6. What is the name of the new EMR system?
7. Is the electronic medical records system fully deployed in all the clinical departments or part?
8. What benefit have you derived from the electronic health records system at this initial stage?
9. What are the challenges that you are facing using the electronic health records system at this initial stage?

The result of data collected through the interview is shown in table 1.

3.2 Data Collected Using Participant Observation

The researchers were able to get the developmental framework used for the implementation of the electronic medical records system after observing the system and this was achieved with the full assistance of information technology personnel that deployed the system.

4. Results and Discussion

The hospital utilizes the Health-in-a-Box Hospital Management Information System (HMIS), a comprehensive and powerful platform that automates essential processes in Nigeria's Tertiary Health Institutions. This system facilitates digital patient registration, records management, encounter triaging/ clerking, drug dispensing, laboratory and radiology services, testing and result issuance, inventory management, billing and payment

services, health insurance management, and other hospital operations. Additionally, the Health-in-a-Box HMIS delivers in-depth Management Information Services (MIS) through detailed reports and analytics, improving the efficiency of hospital administration [21].

The Health-in-a-Box Hospital Management Information System (HMIS) system was developed using the following tools:

- JavaScript: This system uses JavaScript to create the Graphical User Interface, or GUI, which enables user interaction with the system.

- C#: The system makes use of C# to create code that runs the interface and also allows the application to connect to the database.

- Relational Database (MSSQL): This offers a useful method for storing and retrieving patient health data.

- Web server (IIS): The web server operates on top of the operating system, monitors user requests on the web, responds to them, and provides the relevant web page. The web server used in deploying this system is Internet Information Services (IIS).

- Web browser: This is the program (e.g. Mozilla Firefox) the user uses to view the web pages.

4.2 General Description of the Electronic Medical Records System

The purchased client/server electronic medical records system is a web-enabled application connected to a database and resident on a central system and can be accessed by web browsers. The system relies on hyperlinks and buttons as a means of navigating from one web page to another. The system does not require an internet connection. This implies that to access EMR data, medical staff must be connected to the server which limits its mobility. The system has many modules which can only be accessed by authorized members of staff based on the role they perform. The systems comprise of:

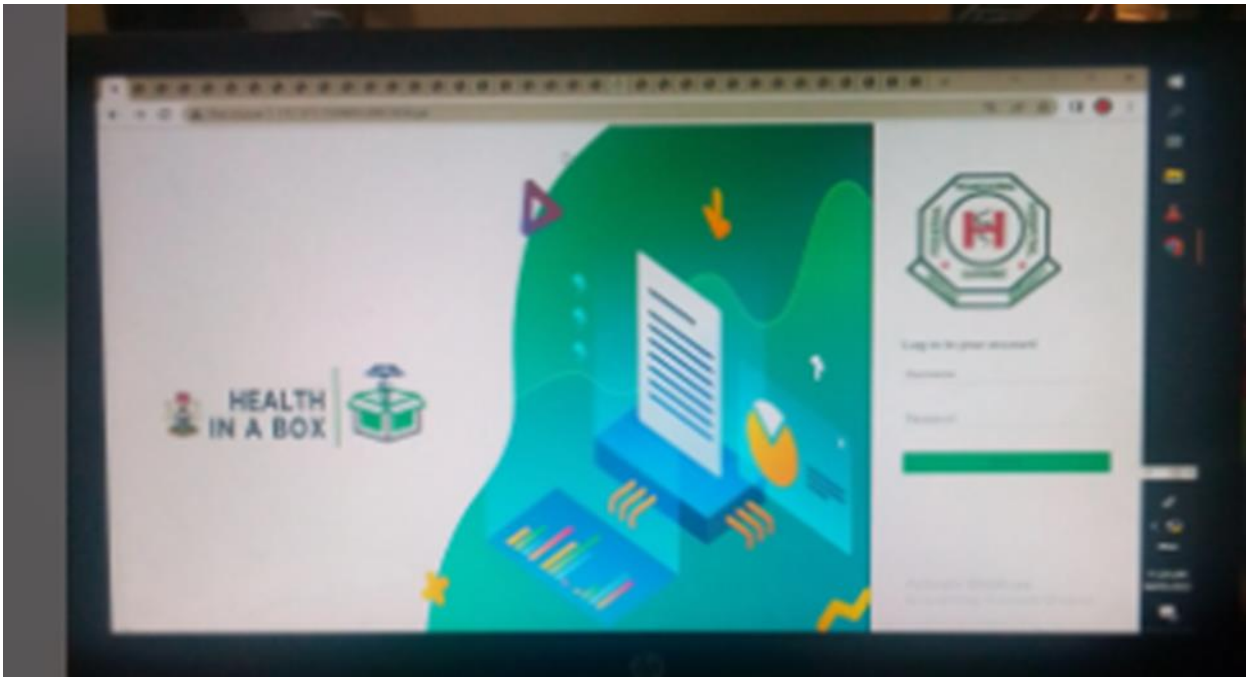

Figure 1: Health-in-a-Box Hospital Management Information System (HMIS)
https://www.goodwall.io/istifanus-yakubu-8071

4.1 System Development Tools

- Patient information module
- Billing and payment module
- Nurses module
- Doctors module/clerking module
- Customizable reporting/ quality reporting
- Clinical coding
- NHIS module
- Diagnoses
- Diagnostic imaging system(Radiology)
- E-prescription
- Laboratory information system

4.2 Detail Function of the System

In this section, the functions of the system are reviewed in detail. The functions of the electronic medical records system are itemized as follows:

1. The patient goes to the health records department to register and get the patient ID number.
2. The patient pays for consultation fees at the payment point.
3. The patient goes back to the health records department to create a clinic visit.
4. Nurses take and document patient's vital signs and assign them to a doctor.
5. The doctor selects the patient from the waiting list and does the necessary documentation (clerking).
6. The doctor raises drug prescriptions or lab requests and books the patient for the next visit or admission to the ward.
7. Patient goes to the service point (Pharmacy or laboratory).
8. At the service point, the bill is raised and the patient makes the payment.
9. The patient enjoys the service.
10. In case of admission, the patient must pay all necessary bills before the discharge button can be activated.
11. The health records officer discharges the patient and books the patient for the next appointment.

4.3 Logical View of the System

The logical view of the system shows the relationship and pattern that make up the system i.e. the linking navigation pattern.

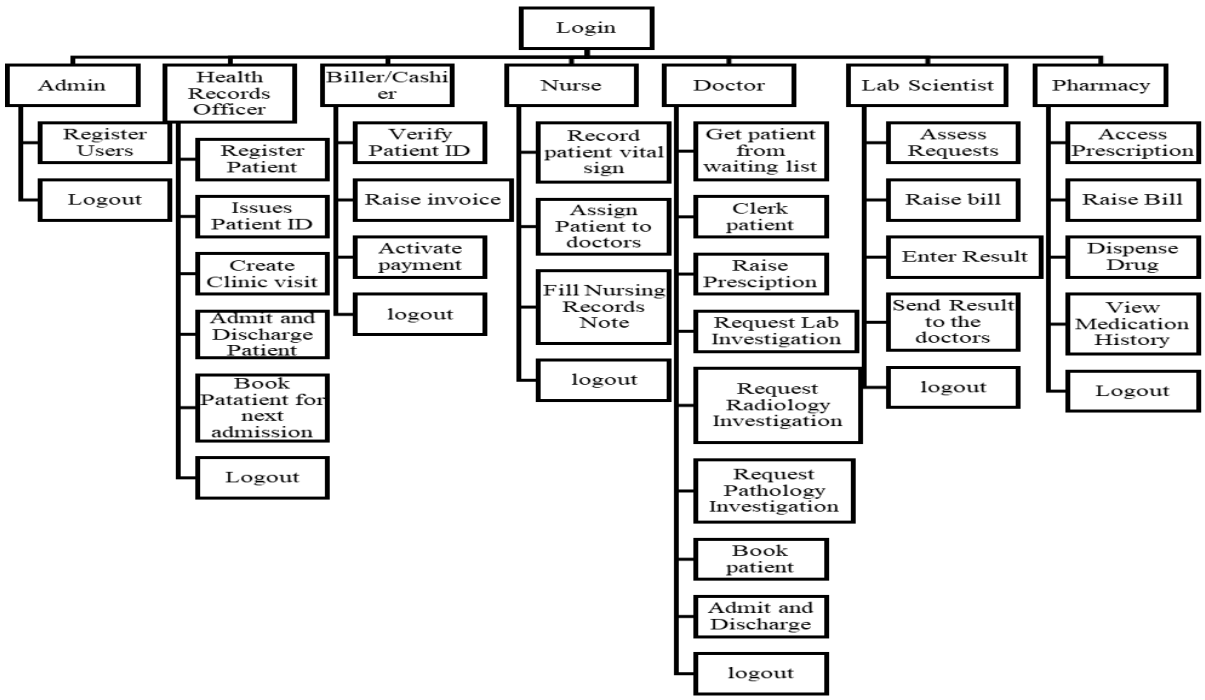

Figure 2: Logical view of the system

Table 1 shows the result of data collected through the interview.

Table 1: Result of data collected through interview

SN	Question	Response
1	Have you used any computerized system for keeping patient health information before?	Yes
2	What is the name of the first system?	All Purpose Medical Information System(APMIS)
3	Why did the first system fail?	Poor electricity supply, poor funding, Users' resistance due to lack of awareness, change in leadership and government will.
4	Did you in any way try to resuscitate the first system?	No
5	Why did you switch to electronic medical records systems?	Reliable Financial support from Public-Private partnership (PPP)
6	What is the name of the new EMR system?	Hospital Management Information System (Health-in-a-box)
7	Is the electronic medical records system fully deployed in all the clinical departments or part?	The system is not fully deployed in all clinics and departments. This system is used in Health Records, pharmacies, payment Points, Laboratories, Medical Outpatient clinic, and Children Outpatient clinic.
8	What benefit have you derived from the electronic health records system at this initial stage?	No missing case notes, Easy retrieval of patient records, quick generation of reports, and reduction in unnecessary movement of case note
9	What are the challenges that you are facing using the electronic health records system at this initial stage?	Users' resistance to change, internet connection, erratic power supply, documentation problems, transcribing old records into the system and the system did not capture all the hospital workflow.

5. Conclusion

This paper assessed the initial adoption and implementation of EMR system in a Nigerian teaching hospital. The purchased client/server electronic medical records system is a web-enabled application connected to a database and resident on a central system and be accessed by web browsers. The system has many modules which can only be accessed by authorized members of staff based on the role they perform. The EMR system was developed using JavaScript, C#, MSSQL, and Web server (IIS). The system can still be improved upon through the inclusion of more relevant modules for better clinical and patient experience.

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