

A FRAMEWORK FOR THE ADOPTION OF BLOCKCHAIN TECHNOLOGY IN MANAGING MEDICAL RECORDS IN AFRICA

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Abstract

The role of medical records in the delivery of quality healthcare cannot be overemphasised. Thus, healthcare organisations such as hospitals across the globe rely heavily on accurate, well-organised and well-managed electronic medical records to deliver quality healthcare service. The records contain information related to the patient's medical history and other information that facilitates healthcare decisions, including easy access to the patient's health information. Therefore, easy access to a patient's medical history is an essential aspect of healthcare service delivery that must be regulated and monitored because of the sensitivity of the information. Hence, various countries of the world adopted blockchain technology in managing medical records in their hospitals to enhance security and transparency in generating, storing and sharing medical data. However, hospitals in African countries have not given much attention to blockchain technology in managing medical records. This is because current approaches adopted are mostly paper-based, leaving many hospitals with challenges of missing files, or records, lack of information sharing between healthcare providers, insecure records and inaccessibility of patients' health information for healthcare providers that are needed to make informed health decisions. Drawing from a case study conducted at teaching hospitals in Nigeria, this study used primary sources of data which was collected using questionnaire and secondary data (literature) to propose a scalable framework that supports the adoption of blockchain technology in addressing the challenges associated with paper-based medical records in the health sector.

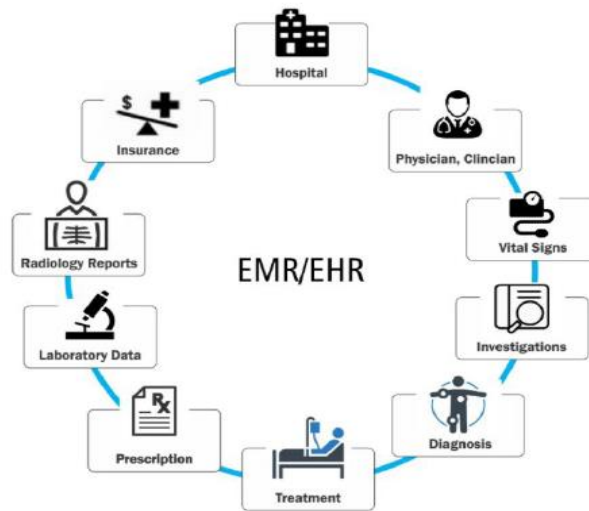
Keywords: Medical records, medical records management, electronic medical records, blockchain-based technology, healthcare systems

Introduction

Background, Motivation and Objective:

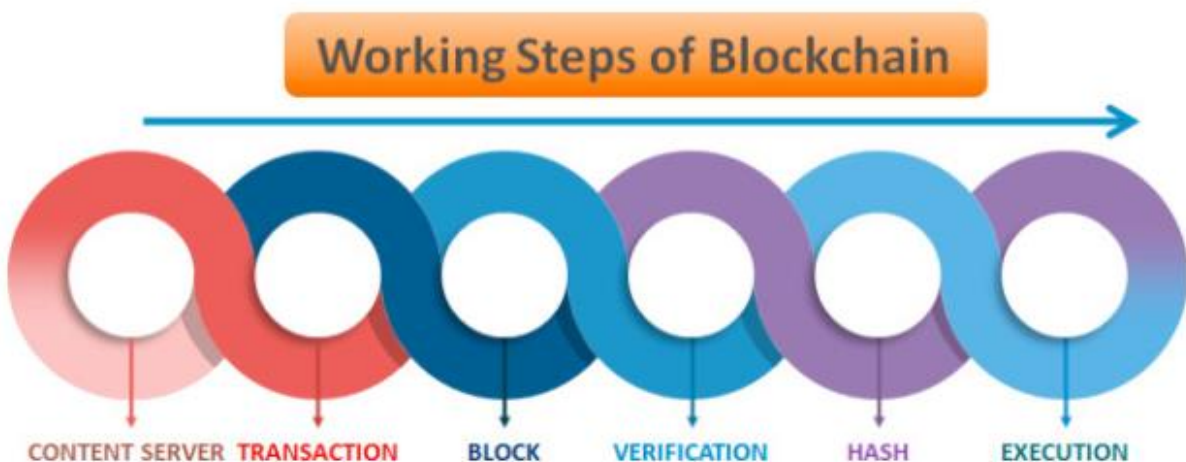
The role of medical records in the delivery of quality healthcare cannot be overemphasised. This is because the amount of data and information generated in the healthcare sector increases daily [1]. The increase is not unconnected with global population growth and environmental changes, which resulted in an increasing number of patients and the emergence of new diseases and symptoms that require hospitals to capture and manage an enormous amount of data and information through well-secured medical records systems [2]. Hospitals need well-secured medical records to deliver high-quality health service, which will, in turn, improve the health of the growing number of populations [3].

Fig. 1. Electronic Medical Record cycle [4]



Medical records are documented accounts of a patient's examination, diagnosis and treatment, including the patient's medical history and complaints; the physicians' findings; and the results of tests, procedures, medications and therapeutic procedures [1]. It was also defined as 'any records that document the pertinent facts of a patient's life and health history, including past and present illness (es) and treatment(s), as written down by the health professionals handling the patient's care [5]. Additionally, [6] defined medical records as a record containing a patient's personal data and medical information that is maintained by a legally recognised hospital, including all clinical encounters and original inpatient and outpatient records. With the introduction of different technologies into the healthcare system, the medical records management process is further enhanced for quality improvement; hence hospitals' recordkeeping approach moved from traditional manual/paper-based to electronic format. Thus, healthcare organisations such as hospitals across the globe rely heavily on accurate, well-organised and well-managed electronic medical records [see Fig. 1] to deliver quality healthcare service [7]. This indicates that electronic medical records provide hospitals with accurate, safe, and reliable information that helps them deliver quality healthcare service to patients. Therefore, to safeguard the privacy and confidentiality of patient information found in medical records due to their sensitivity, hospitals must adopt appropriate measures, hence the need for the adoption of emerging technologies like blockchain technology [see Fig. 2].

Fig. 2. Working steps of blockchain technology [8].



It is against this background that various countries of the world adopted blockchain technology in managing medical records in their hospitals because it has the potential to improve data privacy; enhance security and transparency; and provide integrity issues in the generation, storage and sharing of medical data [9]. Studies have shown that hospitals from most developed countries across different continents of the world, such as North America, South America, Europe, and Asia like USA, UK and China, as well as some developing countries with high economic potentialities like Malaysia, Philippines and Qatar have adopted the blockchain technology in the management of their medical records so as to ensure a more productive, reliable, and safe healthcare system for positive outcomes [10-14] include Malaysia 2022. However, hospitals in African countries have not given much attention to blockchain technology in managing medical records. Current approaches adopted in African countries are mostly paper-based, leaving many hospitals with challenges of missing files, or records, lack of information sharing between healthcare providers, insecure records and inaccessibility of patients' health information for healthcare providers that are needed to make informed health decisions [15]. Drawing from a case study conducted at teaching hospitals in Nigeria, this study used primary sources of data which was collected using questionnaire and secondary data (literature) to propose a scalable framework that supports the adoption of blockchain technology in addressing the challenges associated with paper-based medical records in the health sector which the study found prevalent in Africa.

Objectives of the study:

The study aimed to achieve the following objectives:

1. To find out the types of medical records generated in teaching hospitals in Nigeria
2. To identify how medical records are managed and accessed by the medical personnel in teaching hospitals in Nigeria
3. To propose a scalable framework for the adoption of blockchain technology in managing medical records in teaching hospital in Nigeria

Statement of Contribution/Methods:

Management of medical records is of enormous benefit to the successful operation of any healthcare service delivery especially teaching hospitals. Teaching hospitals perform a number of functions, much of which are centered on patient's care and well-being. Thus, in the course of, and vital to the day to day activities of the teaching hospital, the creation, receipt, maintenance and use of medical records has become very significant [16]. In a nutshell, effective management of medical records helps to ensure that authorised staff has access both to clinical and non-clinical information on a wide range of issues, including policy, precedents, legal rights and obligations, personnel, finance, buildings, equipment and resources as well as patient's medical history including diagnosis and treatment information [17]. On the other hand, failure to effectively manage medical records portends negative consequence to the healthcare system and well-being of a nation.

Studies indicates that failure to effectively manage medical records leads to poor data and information handling system in which vital patient data is documented using paper-based filing system, scanned images, and electronic data, whose inefficiency ultimately increases medical costs [18]. Several studies have confirmed poor management of medical records in Africa and links various forms of medical errors like inappropriate diagnoses and treatment, unnecessary delay and waste of time, and high mortality rates in the region to poor recordkeeping [1, 14, 19, 20]. For instance, in South Africa, in spite of an attempt to provide equal access for healthcare service to all citizens, poor management of medical records has hindered the delivery of healthcare service and created numerous other problems that are devastated to the development of healthcare system [21]. In Kenya, poor recordkeeping created disparity between the rich and poor in accessing health care services and provided an avenue for chronic corruption and spread of counterfeit drugs that worsen patients' health conditions [22]. Also, in Nigeria, it was revealed that majority of the hospital records are documented on paper and kept in a folder with few operating hybrids recordkeeping approach [18, 20, 23]. Paper records could easily get lost, misplaced, or

illegible due to cases of fire accident or any form of human mismanagement; thus, it could lead to poor records management and medical errors which could be a leading cause of death when a wrong medicine was given to a wrong patient [24].

It is against this background, that this study investigated the management of medical records in teaching hospitals in Nigeria and recommends a framework for the adoption of blockchain-based technology to address the challenges associated with paper-based medical records which the study found including unauthorised access. Experts have recommended the adoption of blockchain-based technology in healthcare settings, as it could provide a reliable, dependable and highly secured platform for electronic medical records management [25]. Blockchain technology is a new type of digital technology that consists of a shared, immutable ledger that can better ensure the resilience, provenance, traceability, and management of health data [26].

Methods:

In choosing the methodology for this study, consideration was on quantitative research method, because the approach is considered suitable for the study looking at the area of coverage and its population, there is a possibility of making a generalisation of the findings as stated by Gorman and Clayton [27]. In this regard, a cross sectional design was employed for the study. Zikmund [28] sees cross-sectional survey as a way " the researcher collects information from a sample drawn from a predetermined population", thus cross-sectional survey was used in order to make generalisation of the findings for the whole of Africa.

Research Design:

The study location is three teaching hospitals in northern Nigeria; they include Ahmadu Bello University Teaching Hospital (ABUTH), Aminu Kano Teaching Hospital (AKTH), and Rashid Shekoni Teaching Hospital, (RSTH) Dutse. The population of the study comprises all 197 medical record personnel from the three teaching hospitals. Respondents of the research were drawn from medical records department, which includes all the medical record personnel.

Sample:

The sample size of the study is the entire 197 medical records personnel which was determined using census approach. census sampling techniques was used for the study. According [29] census is attractive for small populations (e.g., 200 or less). It eliminates sampling error and provides data on all the individuals in the population. It literally means that the entire population would have to be sampled in small populations to achieve a desirable level of precision. Therefore, based on the above justification and taking into consideration that the entire population is 197; the researcher did not use any sampling technique based on the above reason.

Data Collection:

Considering the survey strategy, which was applied in this study, questionnaire was used as the data collection instrument. Data collection process consists of two (2) stages in this study. The first stage includes using literature as secondary data to propose the research framework, which has been done and explained in the statement of contribution. In the second stage, primary data was gathered through the distribution of a questionnaire. In this stage, the questionnaire was distributed to the medical record personnel of the three teaching hospitals in northern Nigeria.

Data Analysis:

The data which was collected for this study were analysed using descriptive statistics. Descriptive statistics are used to describe and summarise data [30]. Percentages, frequency, and tables have been used to present the analysed data results.

Results, Discussions and Conclusions:

The results and discussed the first research question of the study which was hinged on the types of medical records found in the teaching hospitals. The respondents (see Table 1) were asked to indicate the form of medical records generated (Table 2); the types of medical records generated (Table 3), forms of medical records mostly managed in the teaching hospitals (Table 4); as well as access to the medical records (Table 5).

Table 1: Respondents Rate

Response rate	Frequency	Percentage (%)
Administered questionnaire	197	100
Returned questionnaire	178	90.4
Not returned	19	9.6

Table 1 shows that a total of one hundred and ninety-seven (197) questionnaires were distributed to the medical record personnel in the Teaching Hospitals, and (178:90.4%) were returned duly completed and usable, while only (19:9.6%) were missing, but this has not any way affected the conduct of the present study.

Table 2: Form of Medical Records generated

Form of Medical Record Generated	Frequency	Percentage (%)
Paper-based Medical Records	122	68.5
Electronic Medical Records	56	31.5

The findings identified the form generated by the individual teaching hospitals as depicted in table 2 above, and the respondents indicated that a significant number of paper-based medical records (122:68.5%) were generated while (56:31.5%) which is electronic medical records were generated.

Table 3: Types of Medical Records generated

Types of Medical Records Generated	Yes	Percentage (%)	No	Percentage (%)
Patient history and physical examination reports	134	75.3	44	24.7
Discharge summaries	140	78.7	38	21.3
Laboratory and pathology reports	144	80.9	34	19.1

X-ray reports	136	76.4	42	23.6
Operative reports	89	50.0	89	50.0
Radiology reports	114	64.0	64	36.0
Emergency reports	111	62.4	67	37.6
Progress note reports	62	34.8	116	65.2
Referral letters	122	68.5	56	31.5
Daily reports	120	67.4	58	32.6
Scan reports	135	75.8	43	24.2
Therapy reports	134	75.3	44	24.7
Clinical notes	117	65.7	61	34.3
Consultation reports	129	72.5	49	27.5

Table 3, shows that Patient history and physical examination reports (134:75.3%), Discharge summaries (140:78.7%), Laboratory and pathology reports (144:80.9%), X-ray reports (136:76.4%), Operative reports (89:50.0%), Radiology reports (114:64.0%), Emergency reports (111:62.4%), Referral letters (122:68.5%), Daily reports (120:67.4%), Scan reports (135:75.8%), Therapy reports (134:75.3%), Clinical notes (117:65.7%) and Consultation reports (129:72.5%) are all types of medical records generated in the teaching hospitals of North western States of Nigeria.

Table 4: Forms of Medical Record mostly managed in the Teaching Hospitals

Forms of Medical Record mostly used	Frequency	Percentage (%)
Paper-based medical record	137	77.0
Electronic medical record	41	23.0

However, in terms of forms of medical records that are mostly managed in the teaching hospitals in northern Nigeria, table 4 show that a high level of the respondents (137:77.0%) mostly used paper-based medical records while partly (41:23.0%) used electronic medical records.

Table 5: Access to Medical Records in the Teaching Hospitals

Access to Medical Records	Frequency	Percentage (%)
Opened access	18	10.1
Closed access	160	89.9

Table 5 shows that a very high number of the respondents (160:89.9%) agrees that they have closed access to the medical records while only (18:10.1%) have opened access.

Conclusions:

One major finding of this study was that the form generated by the individual teaching hospitals are sharply divided into two, paper-based medical record and electronic medical records. The study also found some challenges associated with paper-based medical records including unauthorised access, inadequate safety, and lack of appropriate security measures in safeguarding medical records in the affected teaching hospitals. This shows that there is the need to for the teaching hospitals fully embrace use of emerging technologies, hence the study recommends the adoption of blockchain-based technology in managing medical records in the affected hospitals and by extension the entire healthcare sector in Africa. Blockchain technology offers several important and impressive chances for the healthcare industry, from science and logistics to relationships among practitioners and patients [31-33]. Fig. 2 elaborates on the capabilities of blockchain-technology in healthcare settings.

Fig. 2. Capacities of blockchain technology for healthcare domain [8].



This indicates that blockchain technology could provide a new paradigm managing medical records among healthcare organisations as suggested by various scholars [8, 34-36], hence it is recommended for adoption in healthcare system especially in Africa.

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