16

The Study of EHR in Improving the Security and Quality of Healthcare Services: Comparative Analysis Study

Mamta Dhaka
PhD Scholar, Research Centre, MSRDC, MAISM, Jaipur, R.T.U. Kota, India
dhaka.mamta2@gmail.com
Prof. (Dr.) Durga Prasad Sharma
Research Centre, MSRDC, MAISM, Jaipur; R.T.U Kota, India;
AMIT, AMU, MOEFDRE, UNDP
dp.shiv08@gmail.com

Abstract

In a developing country, Information Technology plays a vital role in the digital age. Most of the govt& also private hospitals manage the history manually or computerised, which makes it very intricate to manage and access history anytime, anywhere, over any device during emergency cases. Every person faces challenges nowadays; healthcare institutions are scattered, unorganised, and redundant repositories of patients' health history and prescription records. As a result, patients who need emergency or urgent medication face unnecessary, tedious filing systems every time they pass the redundant checks and fill in the long patient record data. This study aims to design and develop a next-generation state-of-the-art, interoperable, and sustainable shareable e-healthcare system model with unified integration strategies (UIS). The selected private and public hospitals to form a small, clustered federation are proposed to be selected for the primary observation, investigation, analysis, and alleviation through designing a secured solution with energy efficiency overcloud.

Keywords: EHR, UIS, E-Healthcare.

Introduction

An E-Health Record (EHR) is a patient's digital platform. EHRs are patient-centred, real-time records-maintaining systems which provide authorised users with information promptly & securely [1, 2]. While a patient's medical and treatment history is contained in an EHR system, it is designed to extend above conventional clinical data gathered in a specified manner by providing a more comprehensive view of the patient's treatment.

EHRs have been found in IT &could include medical history, diagnosis, medicines, therapeutic plans, vaccination dates, allergies, radiology & laboratory, and test results. It enables proof-based tools for providers to decide on patient care [3].

A significant aspect of an EHR is the production & management of health info by authorised providers in a digital format shared by more than one healthcare institution with other providers [4]. EHRs are designed to exchange information with other healthcare professionals & organisations, such as laboratories, specialists, medical imaging, pharmacies, emergency services & schools, and workplace clinics. They also contain information from all patient-care clinicians [5]. Our world has dramatically changed with digital technology - our everyday life & our method of communication have been turned into smartphones, tablets & Web-enabled gadgets [6]. Medicine is a comprehensive information company. A growing and more transparent flow of information inside an electronic health record (EHR) digital health infrastructure covers & utilises digital advances and can alter how treatment is given & compensated. EHRs provide info wherever it is required [7].

EHR is meant to make medical information about patients accessible in practice and whenever a person requires treatment from physicians & healthcare professionals [8, 9]. EHR systems are intended to precisely store data in a searchable digital form to track a patient's status determined with the main benefits: Reduction of the need to monitor prior medical documents of a patient to allow reliable and legible information to be available; Minimize data replication; Extraction of medical data to evaluate trends& long-term changes in a patient; Facilitation of population-based studies [10].

A. Cloud-based EHRs

On-demand scalable access to IT services can be provided through cloud-computing platforms [11]. They could quickly supply & implement an EHR system & minimise administration efforts and costs. However, it is vital to comprehend the advantages and challenges linked with a cloud-based HER [12].

- Decreasing the expense of up-front hardware &software
- Decreases continuous maintenance costs
- Let's you begin smaller and grow IT distribution as required [13].
- Provides a greater degree of availability of services than in-house IT services

- Decreasing failures in runtime

B. Green Cloud Computing in Healthcare

- The healthcare industry is rising rapidly & plays a significant role in the global economy. Energy efficiency and forestation in health care are ideal ways of addressing the climate crisis. Technology has revolutionised the global healthcare industry - from new test methods to better operating equipment, remote health monitoring technologies using modern digital devices, etc. [14].

- Many healthcare websites are available online. These portals securely provide patient information [15].

- Cloud computing allows for continuous communication from one platform to another anytime and anywhere. In healthcare organisations, data portability is possible within different medical devices utilising another medical device in another healthcare organisation. Cloud technology allows the retrieval of various treatment databases, patients, and diseases that doctors can quickly access for investigation and statistical understanding [16]. The other system gives access to a database service [17]. This involved a lot of healthcare information, data, and computing. At the time of treatment, this technology gives historical patient data [18]. If patients move from one department to another for many analyses and experiments, this leads to a higher rate of knowledge conversation among different medical departments [19,20]. This technology helps healthcare practitioners provide comprehensive and accurate patient treatment information [21].

- Adequately compensated parts of the healthcare area are usually Hospital Information Systems (HIS), with electronic medical records (EMR) used for computer-aided procedures and remote patient healthcare services [22,23]. By improving ITs in medical services, the industry faces challenges in digital data, but they can provide various medical services that can be used for better results through cloud computing [24].

- Cloud technology in healthcare can significantly increase hospitals' energy quality and knowledge of the most significant way to improve healthcare energy performance economically [25, 26].

C. Significance

Several healthcare providers have discovered that EHRs enhance the management of medical practice by improving the efficiency of practice & cost savings [27]. EHRs take advantage of several medical procedures, including:

- Low price of transcription.
- decreased pull chart, storage & repository expenses.
- Enhanced possibilities for documentation &automated coding
- Reduced medical error through improved patient access & error prevention signals
- Improved patient health/quality of treatment, improved management of diseases & patient

  Education [28].

Problem Statements

a) Managing and accessing anytime, anywhere, over any device during emergencies is very complex.

b) Institutions are the scattered, unorganised, and redundant data repositories of the patient's health history, and prescription records are spread over multiple systems in several hospitals/ clinics/ laboratories in the current practices.

c) The data access & control level is lower than the EHR system on the ground.

Research Objectives

a) To explore and examine the significant issues and challenges in the primary healthcare system.

b) To share the e-healthcare system model for unified transformation & integration of the existing healthcare record-keeping system.

c) To develop a Federated Green e-healthcare Record Repository System Model over the Cloud to provide enhanced healthcare data and information services anytime, anywhere, over any device manners.

Literature Review

S. No.	Title, Authors & Year & Journal Name/Conference	Major Findings / Contributions &conclusion	Critical Remarks to find out the research ability for the proposed research

	Name		
1	"proposal for an eHealth Dependent on Ecosystem Serving National Healthcare " by Eirini C. Schiza, Theodoros C. Kyprianou, Nicolai Petkov, 2018, in the IEEE Biomedical & Health Informatics Journal.	The research attempts to resolve the critical challenges in developing an interconnected, interoperable national health system that includes entire populations.	This study is relevant and helpful to the proposed research and provides input to the intended study. However, the eHealth system is designed based on the perspective and context of the European country Cyprus. It is difficult for a small country to apply the proposed methodology and approach. The study does not classify organisations currently using EHR or not [29].
2	Towards Jordan's National Electronic Health Record System "Majd M. Alzghoul1 Majid A. Al-Taee2 Anas M. Al-Tree, International System, Signal, & Device Multi-Conference 2016.	The significant contribution of this study is designing a central middleware architecture that enables seamless data & service sharing between Local EHRs and global remote EHR databases System.	This study provides excellent input for the proposed research with closer relevance. The researcher proposes an architecture to integrate fragmented EHR, but the question raised here is how the data could be shared and accessed between different stakeholders. The EHRs comprise sensitive data that has to be protected from any unwanted access, but the researcher failed to explain access control techniques, confidentiality, and privacy of patient records

			[30]
3	"Digitizing patient data-some perspectives & recommendations for India", by W Main St, Morehead, KY, 2019 in *Journal of BMJ Health & Care Informatics*	This study focused on the current status of National EHR and some Considerations when implementing an EHR system, such as Scalability, interoperability, & flexibility to add new features.	This study links to the proposed research in a localised context. It shows the current state-of-the-art healthcare record management status in India. This study allows us to think about the solution to the problem in multiple dimensions and better come up with new knowledge [31].
4	"Need Assessment Framework for Electronic Health Record Management System In India" by Anteneh Aklilu Addis Ababa University, 2012, *Publish in course hero*	The primary focus of this study is to design an architectural framework for electronic health record management to provide standardised health-related information for governmental and private health institutions and hospitals.	The study is related to the proposed study, which gives the best idea of the proposed study. Most of the issues raised in this study are input to the proposed study [32]. However, the shortcomings of this study are network infrastructure, security, privacy, and interoperability, which can be taken care of but are missing.

5	"Electronic discussion system design: Electronic consulting services Rama Health" By Parichart Pronsawatcha, Suchitra Auefuea, Adisak Nartthanaru, 2018 in *IEEE Conference Proceedings*	The research aimed to study & strategy a new system of electronic consultation, which Influences the collaboration between professionals improves service quality, especially in discussion procedure.	The study is relevant to the proposed research, but the researcher generally focused on health centres using EHR; health centres using paper-based medical records were not considered [33].
6	"Intelligent health systems to enhance health services performance" by Sepideh Poorejbari, Wathiq Mansoor in *(ICSPIS) IEEE 2019*	This article aims to illustrate the importance of computer technology in the general health sector, particularly cloud-based solutions. Cloud-based pervasive health care has numerous potential & positive qualities and is a new paradigm in the health industry.	Future researchers still have to tackle several issues & obstacles, such as monitoring, daily living help, medical care, general access, emergency management, or an intelligent hospital. It is vital to design a functional healthcare system to manage emergencies or medical attention [34].
7	"Research into Cloud, Green IT, & Data Science Making Healthcare Green Reduce the costs in the health care field & Combat climate change" by N. Godbole, J. Lamb in IEEE 2018.	The study's primary objective regarding Green Health, Green Computing, & Green IT is to minimise & save money on power consumption. A significant problem for the health industry is enhancing this complicated system's	It is closely related to the proposed study that in healthcare, cloud technology may substantially enhance the IT energy efficiency of a hospital with knowledge of the best ways to increase energy efficiency in healthcare at a low cost [35].

		energy efficiency and sustainability.	
8	"Electronic health recording systems cryptographic access control: a safety involvement", by Pasupathy Vimalachand, Hua Wang, Yanchun Zhang, 2017 in *International Conference, Puschino Russia*	The study revealed a cryptographic-based access control approach for electronic health records preserves high safety.	This study is essential for the proposed research since it lays the security measures. However, this security measure applied to the proposed Shared EHR system can be considered a critical input in localised conditions [36].
9	"Operationalize data compliance using Cloud-hosted sharing of healthcare data, Benjamin Eze, Craig Kuziemsk, Liam Peyton, 2018" in *International Workshop on Software Engineering in IEEE Healthcare. Systems*	The study suggested an operationalising privacy compliance framework for sharing cloud-hosted healthcare data.	This research helps the proposed study by generating a supportive concept. i.e. how to anonymise patient information for research purposes and other issues. The researcher didn't show the methods and tools for de-identification. The interoperability concept is missing. [37].

Research Design, Approach, and Methodology

A methodology is essential for guiding the research clearly according to the drafted objectives of the research work. The following methods are proposed for conduct to achieve this study's goals.

A. Research Design

This research study proposes to use an empirical and constructive research design with a mix of qualitative and quantitative research approaches.

Initially, this study explores the feasibility of shared electronic health records (EHR) over the cloud for enhancing interoperability and data exchange. It explores the answers to the questions raised in the study. Further, the study constructs a cloud model that can improve the greenness of healthcare data and information services anytime, anywhere, and over any device. The selected private and public hospitals to form a small clustered federation in the state of Rajasthan are proposed to be selected for the primary observation, investigation, analysis, and alleviation through designing a secured solution with energy efficiency overcloud. The proposed research is exploratory applied research focusing on three aspects: Investigation and Analysis of greenness, developing a green services migration model over the cloud, and validating the results with stakeholder acceptance and demonstration.

B. Research Approach

The objectives of the proposed study, qualitative and quantitative research, are proposed to be held. The fundamental benefit of qualitative research is that it gives a complete overview and interpretation of the problem without limiting the scope of the research and the participants' responses. This study proposes to use the qualitative research method because the study planned together data through open-ended questions, and the quantitative research method is also proposed to gather data through close-ended questionnaires so that the results could be presented statistically. The quantitative analysis describes, infers, and resolves numerical problems. The collection, the summary, and the drawing of inferences from these data are emphasised.
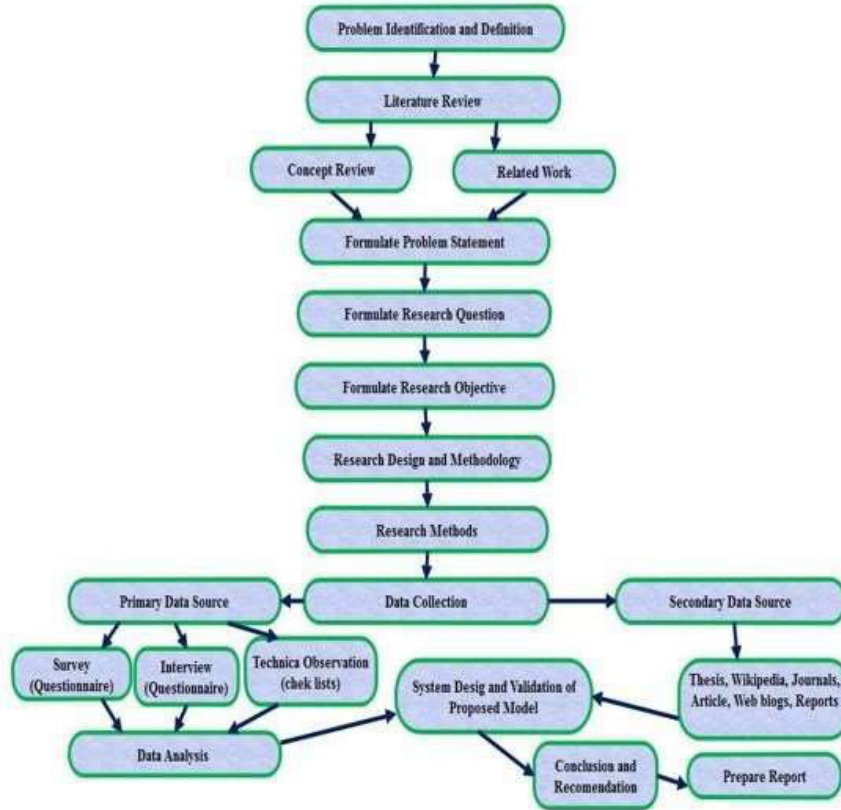
C. Research Processes

Fig. 1. Research Processes

D. Data Analysis Methods and Tool Selection

Tools are selected based on necessary features, availability, suitability, platform independence, and openness.

- **Python:** Python programming language for implementing a prototype of the proposed system [37].

- **Google Forms:** It is a survey administration application. It is one of the simplest ways to gather online data without much difficulty.

- **Edraw Max:** Edraw Max for designing conceptual diagrams. It is a compelling, all-in-one platform that can serve all purposes.

- **SPSS:** SPSS is used for data analysis. It is a comprehensive and flexible mathematical research and data management tool for social sciences

- **Cloud Simulation:** This study proposes to use Clouds for real-time simulation. Cloud Sim is a cloud computing substructure & services modelling or simulation framework. CloudSim is a cloud computing infrastructure & services modelling or simulation framework. At first, it was explicitly developed by the Laboratory for Cloud Computing and Distributed Systems (CLOUDS). CloudSim is among the most common open-source cloud simulators in research and academia.

It offers cloud computing component systems and behaviour modelling. Cloud environments with performance evaluation applications can provide valuable insights for exploring complex, massively distributed, and scalable environments [23]. The key benefits of simulation are:

- **Cost benefits:** It can be very costly for any application in the cloud to first design, develop, test, and then reshape, restore and test. Simulations exclude the building and rebuilding process using the model already built in the design phase.

- The configuration flexibility [24].

- Easy to use and customise.

Conclusion and Future Scope:

There is a lack of research defining patients' prior healthcare record-keeping practice and aiming to design and implement shareable EHR over the cloud. The proposed nationwide shared EHR system allows data sharing between different health sectors, which will help further investigation, reporting, decision-making, etc. Thus, our proposed system can handle numerous issues regarding observing patients distantly, standard daily tests, giving appropriate individual arrangements, and allowing people like specialists and family members to access patient data. In emergency cases, specialists can quickly check a patient's prior healthcare data, which will help provide better and faster care to the patient and protect from several problems and issues related to health. There are different help types in the medical care area, such as checking everyday life health status, clinical help and intelligent medical care clinics that should be focused on in the future. Patient information access rights should be an essential concern for researchers when providing security and privacy when sharing healthcare data over the cloud. So, Energy efficiency, security, and privacy of patients' case-sensitive data are the most critical issues that should be dealt with with care and accountability.

References

- [1] T. T. N. Gunter, "The emergence of national electronic health record architectures in the United States and Australia: models, costs, and questions," Journal of Medical Internet. Research, 2005.

- F. I. Reports, "e-Health and ICT projects Status Report," "Mobile Tech Contributions to Healthcare and Patient Experience". Top Mobile Trends., Retrieved 29 May 2014.

- R. Shukla, "Sharing and Integrating Electronic Health Records Using Blockchain," Published by ProQuest LLC (2019), January 2019.

- S. N. A. W. K. A.-N. a. A. M. A.-T. M. A. Al-Taee, "Blood-glucose pattern mining algorithm for decision support in diabetes management," Proc. 14th UK Workshop on Computational Intelligence, Bradford, UK, p. 8 –10, September 2014.

- J. Berhe et al, "Evaluation of Electronic Medical Record Implementation from User's Perspectives in Ayder Referral Hospital Ethiopia," Journal of Health & Medical Informatics,, pp. page 1-13, Health Med Informat 2017.

- A. Akililu, "NEED ASSESSMENT FRAMEWORK FOR ELECTRONIC," Course Hero, 2012.

- S. E.-M. A. Y. A. E. Mohammed Alnuem, "Towards IntegratingNational Electronic Care Records in saudi Arabia," pp. page 1-6, 2012.

- S. A. A. N. Parichart Pronsawatchai, "Design of the Electronic Consultation System:," IEE Conference Proceeding, 2018.

- H. W. Y. Z. Pasupathy Vimalachand an, "Cryptographic Access Control in Electronic Health Record Systems: A Security Implication," International Conference, Puschino, Russia, 7.11.2017.

- C. K. P. Benjamin Eze, "Operationalizing Privacy Compliance for Cloud-hosted Sharing of," IEEE International Workshop on Software Engineering in Healthcare Systems, 2018.

- L. Wang & G. Laszewski, "Scientific cloud computing: Early definition and experience," in Proceedings of the 10th IEEE Int. M. Rouse, "Cloud computing overview," WhatIs.com.

- S. K. A. S. A.-H. F. H. A. B. H. Abdullah, "Cloud Computing Concept, Classification, Application and Challenges," International Science Press, IJCTA, pp. 261-288, 2016, .

- A. R. C. A. d. C. Tiago Quaini, "A MODEL FOR BLOCKCHAIN- BASED DISTRIBUTED ELECTRONIC HEALTH RECORDS," IADIS International Journal on WWW/Internet, Vols. Vol. 16, pp. 66-79.

- Sepideh Poorejbari, Wathiq Mansoor, "Smart healthcare systems on improving the efficiency of healthcare services", 2nd International Conference on Signal Processing and Information Security (ICSPIS)

- IEEE 2019

- Kanchanadevi, P., Selvapandian, D., Raja, L., & Dhanapal, R. (2020). Cloud-based Protection and Performance Improvement in the E- Health Management Framework. 2020 Fourth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC).

- Kumari, A., Kumar, V., Abbasi, M. Y., Kumari, S., Chaudhary, P., & Chen, C.-M. (2020). CSEF: "Cloud-Based Secure and Efficient Framework for Smart Medical System Using ECC". IEEE Access, 8, 107838– 107852.

- Manikandan Shanmugam, Prof. Monisha Singh, "A Comparative Study on Traditional Healthcare System and Present Healthcare System Using Cloud Computing and Big data" in (ICSPC'17) IEEE International Conference on Signal Processing and Communication– July 2017.

- Omar Ayaada, Aladeen Alloubanib, Eyad Abu ALhajaac, MohammadFarhand, Sami Abuseife, Ahmad Al Hroubd, Laila Akhu-Zaheya,"The role of electronic medical records in improving the quality of healthcare services: Comparative study" in International Journal of Medical Informatics 2019

- Kumudini Sarathchandra , Shriyananda Rathnayake , "Implementation challenges and Research Gaps of Electronic MedicalRecords (EMR) in Public Sector Hospitals of Sri Lanka" InternationalJournal of Scientific and Research Publications, Volume 9, Issue 7, July 2019.

- S.Thavamani, M.Rajakumar , "Privacy Preserving Healthcare Data using Cloud Computing" International Journal of Innovative Technology and Exploring Engineering (IJITEE) August 2019

- Manisha Wadhwa, "Electronic Health Records in India" March 2020.

- Thendral Mary. A, Dr. A.Valarmathi, "E-Healthcare System in Cloud Computing" in International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT) 2017.

- Jaillah Mae Gesulga, Almarie Berjame, Kristelle Sheen Moquiala, Adrian Galido "Barriers to Electronic Health Record System Implementation and Information Systems Resources: A Structured Review" from 4th Information Systems International Conference 2017, [ISICO]2017.

- Pradeep Deshmukh "Design of cloud security in the EHR for Indian healthcare services" from Computer and Information SciencesElsevier 2017

- Fatima Shakeel, Seema Sharma, "Green Cloud Computing: A review on Efficiency of Data Centres and Virtualization of Servers" in (ICCCA2017) IEEE International Conference on Computing , Communication and Automation 2017.

- Archana Patil , Rekha Patil, "An Analysis Report on Green Cloud Computing Current Trends and Future Research Challenges" in International Conference on Sustainable Computing in Science, Technology & Management (SUSCOM) 2019 .

- Nasser S. Abouzakhar, Andrew Jones, Olga Angelopoulou, "Internet of Things Security: A Review of Risks and Threats to Healthcare Sector" in 2017 IEEE

- M. I. T. C. Eirini C. Schiza, "Proposal for an eHealth Based Ecosystem Serving National Healthcare," Journal of Biomedical and Health Informatics, pp. 1-13, 2018.

- M. M. A. M. A. A.-T. A. M. Al-Taee, "Towards Nationwide Electronic Health Record System in Jordan," international multi- conference on system,signals and devices, pp. 650-655, 2016.

- M. K. W Main St, "Digitizing patient data- some perspectives and recommendations for Ethiopia," vol. volume 1, 2019.AntenehAkliluAddis, "Need Assessment Framework for Electronic Health Record Management System in India", Ababa University,2012, Publish in course hero.

- ParichartPronsawatcha, Suchitra Auefuea, AdisakNartthanaru, "Electronic discussion system design: Electronic consulting services Rama Health", IEEE Conference Proceedings, 2018.

- SepidehPoorejbari, Wathiq Mansoor "Intelligent health systems to enhance health services performance", (ICSPIS) IEEE, 2019.

- N. Godbole, J. Lamb "Research into Making Healthcare Green with Cloud, Green IT, and Data Science to Reduce Healthcare Costs and Combat Climate Change", 2018 IEEE.

- PasupathyVimalachand an, Hua Wang, Yanchun Zhang, "Electronic health recording systems cryptographic access control: a safety involvement", International Conference Puschino Russia, 2017.

- Benjamin Eze, CraigKuziemsk, Liam Peyton, "Operationalize data compliance using Cloud-hosted sharing of healthcare data", International Workshop on a Software Engineering in IEEE Healthcare Systems, 2018.

- "What is Python? Executive Summary," Python software Foundation.

- J. Services, "Python Features," https://www.javatpoint.com/python- features, 2019