IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

Empowering Electronic Health Record Systems (EHRs) with Cloud Storage Management

Yash Shinde[1], Mr. Sharad Adsure[2], Satyam Sakore[3], Omkar Jadhav[4], Tejas Bhandvalkar[5]
Students, Department of Computer Engineering[1,3,4,5]
Assistant Professor, Department of Computer Engineering[2]
Dr. D. Y. Patil Institute of Technology, Pune, Maharashtra, India
shindeyash0567@gmail.com, sharad241@gmail.com
satyamsakore@gmail.com, omkarjadhav1900@gmail.com, teja.bhandvalkar@gmail.com

Abstract: *We present a novel method for building cloud based interoperable electronic health record (EHR) systems. All members of the healthcare ecosystem, including patients, providers, and payers, can benefit from cloud computing in a number of ways. The exchange of healthcare information among diverse stakeholders has been significantly hampered by the lack of standardised data interoperability. In order to solve this problem, semantic interoperability is used. With the use of a reference model that outlines a common set of data structures and an archetype model that details the characteristics of clinical data, we employ a general design technique. The loosely connected, asynchronously communicating components of the application are created utilising the cloud component model technique. This article discusses our methods for attaining semantic interoperability, data integration, and high-level architecture of our EHR system.*

Keywords: EHR system.

I. INTRODUCTION

A wide range of stakeholders, including doctors, nurses, patients, insurers, pharmacies, medical supply businesses, billing departments, and even law enforcement organisations, can benefit greatly from electronic health systems. Conventional healthcare information systems are frequently compartmentalised, with hospitals and other separate organisations keeping their own networks, servers, and other systems to meet their unique requirements. It is difficult to communicate with organisations when using this solitary method. The development of data standards and technological advances has made it possible to share information seamlessly between different systems and authorities in order to address this problem.

The advent of cloud computing, which is often referred to as Internet computing, has increased user control, distribution, and access to data. Healthcare companies no longer require onsite data centres and servers because cloud computing service providers host systems and apps for their clients. Hybrid, centralised, and integrated regional healthcare services are made possible by this move towards cloud-based services. The ultimate objective is to offer patients all-inclusive services that address all of their medical requirements, and cloud based solutions are essential to reaching this. By making data accessible from anywhere at any time, they improve user efficiency and reduce the workload associated with data analysis for both physicians and patients.

On the other hand, a lot of healthcare systems in less wealthy and developed countries have been sluggish to use IT. These systems frequently lack integration and are not well equipped. There is a lack of efficient data sharing protocols, despite the fact that certain private clinics and organisations use computer-based information systems for patient administration. The ”eHealth Cloud” paradigm, which aims to develop a shared platform to improve healthcare systems, has been presented as a solution to this problem. Data outsourcing into the Cloud has become a feasible alternative due to the expanding requirement for large-scale data storage and the growing significance of protecting patient information.

The lack of computerised medical records, restricted access to patients' prior medical records, difficulties finding the right doctor and making appointments, and the analysis of large amounts of electronic medical record (EMR)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

data are just a few of the challenges facing the current method based approach to healthcare. EMR systems are being used by numerous countries and healthcare organisations in order to address these problems and improve patient care, safety, productivity, and cost-effectiveness. Large volumes of data can be efficiently stored while administrative costs are decreased thanks in large part to cloud computing.

In the field of e-health in particular, the Internet of Things presents intriguing solutions for managing the growing computing intelligence and power of various devices. IoT applications that are frequently concerned with patient survival collect and send data instantly, responding to environmental changes. The integration of mobile agents into autonomous software in Multi-Agent Systems allows for certain forms of mobility, which in turn expands the possible applications of IoT in e-health. In the realm of e-Health, MAS has become increasingly important, especially when data pre-processing on the client side is necessary prior to data transmission to the server. This method creates safe agent-based telemedicine systems by fusing medical services with computer and communication technology.

E-health systems' hardware consists of a variety of biosensors that gather personal data from users, including pulse oximetry and temperature. Along with possibilities for regular data transfer, emergency data transmission, and audio/video streaming via the mobile component, the gathered data is forwarded to the appropriate medical authorities. Biosensors provide real-time patient monitoring and data processing, which aids in medical pre-diagnosis. To store, gather, and process medical data while guaranteeing medical personnel access, a cloud component is added.

II. BACKGROUND

In the 1960s and 1970s, the groundwork for the creation of Electronic Medical Record (EMR) systems was laid. By replacing the conventional paper-based medical record format, electronic medical records (EMRs) have not only made it easier to retrieve patient health information from any location with system connectivity, but they have also had a profound effect on healthcare.

Approximately 73 healthcare facilities and hospitals had begun implementing EMRs by 1965. Dr. Lawrence Weed's 1968 introduction of the Problem Oriented Medical Record (POMR) was one significant invention during this period. With a focus on clinical data management, the POMR's main objective was to replace conventional paper records with an electronic format that would enable third parties to understand diagnoses. Hospital information systems are another name for these systems. POMR consists of five main parts: daily progress notes, initial planning, a thorough problem list, a database, and a discharge summary. On the other hand, a few medical professionals thought the POMR framework was too complicated and laborious.

Dr. Clement McDonald designed and introduced the Regenstrief Medical Record System (RMRS), the first electronic medical record, in 1972. McDonald understood that a central medical record system would help to integrate disparate healthcare organisations, rules, and authorities while also standardising the database structure. McDonald's clinical research demonstrated how EMRs may enhance patient care. However, individual physicians were not able to embrace the system due to its exorbitant cost.

Many academic and research institutions created their own electronic medical record systems to make it easier to follow patient treatments. By adding additional features and functionality including computerised patient histories, medicine dosages, side effects, allergies, and drug interactions, these systems improved the healthcare industry.

EMRs began to take shape in the late 1970s, and by the early 1990s, they became the Veterans Information Systems and Technology Architecture (VISTA). Simultaneously, EMR systems were deployed by the Veterans Administration (VA), facilitating medical ordering, treatments, blood testing, diets, and X-rays. An important development in the medical industry was the integration of hospital billing and scheduling systems with certain EMRs that included hierarchical databases. From 1971 to 1992, clinical systems such as COSTAR, PROMIS, TMR, and HELP were put into place to improve patient care in order to support research.

The development of EMR systems was greatly aided by several publications. An important text on computer-based patient records is "The Computer-Based Record: An Essential Technology for Healthcare," which was released in 1991. In 1991, the US Institute of Medicine issued policy guidelines and suggested that by 2000, doctor's offices should use technology to enhance patient care. The Health Insurance Portability and Accountability Act (HIPAA) was created in 1996 to provide regulations for the expanding field of electronic medical information.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

EMRs were designed with improved security features, such as access control, data encryption, logoffs, and backups, in the 2000s. Only 20% of doctors' offices, meanwhile, had computerised record systems installed by 2004. With the advent of web-based technology, healthcare providers may now deploy EMRs more affordably and without having to shell out a lot of money for hardware. Beyond documentation, cloud-based solutions allowed EMRs to accomplish even more.

Boricky and Kushniruk's 2012 research revealed that North American healthcare organisations were still in the early phases of using electronic medical records. It also emphasised how doctors could easily access medical information and how electronic medical records (EMRs) helped healthcare providers organise and make decisions. The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 enhanced and enforced HIPAA standards, making it simpler for EMRs to adhere to security specifications like encryption and access controls.

Chapter 18 of Kastikas' 2013 book "Handbook of Medical and Healthcare Technologies" explores how EMRs affect quickly advancing ICT (information and communication technologies), security risks, privacy issues, and moral and legal requirements.

Furthermore, AI has proven to have the ability to improve the quality of care delivered by EMR systems by increasing their efficiency, flexibility, and intelligence while resolving the difficulties that physicians encounter with intricate navigation.

III. LITERATURE SURVEY

An Enterprise Cloud-Based Electronic Health Records System

The traditional approach to acquiring and managing patient data heavily relies on paper-based records, with many medical institutions preferring this familiar method for documenting patient information, surgical procedures, observations, and prescriptions. However, transitioning to digital records can be challenging for some healthcare professionals, as the manual handling of increasing volumes of paper records leads to errors and impacts daily hospital and clinic operations. The absence of a centralized information repository exacerbates these challenges.

The move towards a "paperless" environment is motivated by various factors, including enhanced medical documentation, increased staff efficiency, reduced overhead costs, greater revenue from coding, streamlined record-keeping, improved care quality, data accumulation for managed care, and standardized information sharing among physician groups.

Electronic Health Records (EHR) adoption aims to enhance patient safety and care quality, but it faces obstacles, as some factors can hinder its success. Cloud computing offers a promising solution by revolutionizing healthcare with its costeffective and efficient model. It enables a highly integrated platform, efficient coordination of medical processes, and reduced IT infrastructure costs.

To address trust and communication challenges among health information systems, various models have been proposed, each with its advantages and limitations. The transition from paper-based records to cloud-based EHR systems offers many benefits but also presents challenges related to security, privacy, and infrastructure, which must be carefully considered in healthcare modernization efforts.

Healthcare Provision in the Cloud: An EHR Object Storebased Cloud Used for Emergency

Multiple cloud-based storage solutions are available for the secure management of Electronic Health Records (EHRs) and healthcare data. In the research by Cai et al. (2017), they propose a cloud-based EHR sharing system, allowing data owners to create EHR ciphertexts. This enables authorized users to decrypt the information using transformed ciphertexts stored in the EHR Cloud. Additionally, Cao et al. (2019) introduce a secure e-Health system that leverages blockchain technology to ensure medical institutions retain control over access to patient EHRs. Other studies focus on techniques such as attribute-based access control, delegation of authority, and hybrid encryption methods to safeguard data privacy and control access.

While these research efforts emphasize the security of healthcare data exchange, there is a notable gap in addressing the efficiency of EHR exchanges between individuals and healthcare organizations. In response, this paper introduces an innovative EHR Cloud system, incorporating the Object Storage architecture, as described by Factor et al. (2005). This system serves a dual purpose: first, it empowers users to securely store and back up their healthcare data in the

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

cloud. Second, it provides healthcare professionals with an automated, secure means of access when required, expediting the delivery of health services.

Overall, these studies collectively demonstrate significant progress in securing the exchange of EHRs and health data across various entities within cloud-based infrastructures. However, they underscore the need for further research to enhance the efficiency of EHR exchanges between individuals and healthcare organizations, a challenge that this paper aims to address.

A Systematic Review and Comparative Study of Electronic Medical Record (EMR) Systems to Support Healthcare

Several studies have shed light on the impact and challenges of implementing Electronic Medical Records (EMR) in healthcare. Williams and Borren's 2008 research underscored the positive influence of EMR systems on healthcare providers' workflow efficiency, promoting precise medication records, clear notes, accessible charts, and enhanced patient care. However, persistent challenges include hardware and software compatibility, training, quality assurance, and outdated configurations. Furthermore, issues like sustainable energy sources and reliable electricity access remain crucial for healthcare progress.

Waithera et al.'s 2017 study emphasized EMR's role in boosting healthcare productivity but highlighted funding constraints, staff computer literacy, and limited IT support as barriers. The advancement of IT in healthcare has alleviated some of these issues, improving error reduction and communication. Challenges like system failures and unattainable tasks persist, despite the global adoption of IT.

Healthcare's transformation through IT adoption was examined in several studies, emphasizing the need for addressing barriers such as patient privacy, practitioner acceptance, regulatory standards, and cost justification to realize robust EMR systems.

Additionally, studies explored the attitudes of healthcare professionals towards Health Information Systems (HIS), with perceived usefulness playing a significant role in acceptance. Interventions for enhancing EMR utilization in primary healthcare and the influence of EMRs in the United States were also investigated.

To sum up, these studies underscore the potential benefits of EMRs in healthcare, while recognizing the ongoing challenges in their implementation and the importance of addressing technical and non-technical issues for their successful adoption.

A Cloud-based Approach for Interoperable Electronic Health Records (EHRs)

In the US, VistA is the most widely used electronic health record (EHR) system. VistA has three main distributions outside of the Department of Veterans Affairs (VA): vxVista (licenced under the Eclipse Public Licence), OpenVista (licenced under the GNU Affero General Public Licence), as well as WorldVista (which is licenced under the GNU General Public Licence). OpenEHR, on the other hand, is an EHR system that prioritises improving data quality during exchanges across different healthcare industry actors in order to achieve semantic interoperability. OpenEHR uses a two-tier modelling method, where the first level of modelling is based on a reference model, and the second level is based on clinical information described as templates and archetypes.

Numerous methods for merging data from various sources have been developed in order to support healthcare data interoperability. An open-source integration engine called Mirth

Connect allows connections to external systems and databases by supporting a large number of communications standards and protocols. The FM projection consists of a collection of tools that make it possible to examine data and structures from VistA File Manager (FileMan) using representations akin to SQL.

We presented a methodology in a recent paper for collecting large amounts of sensor data in a cloud-based setting. We suggest a comparable data gathering strategy for CHISTAR, based on a distributed batch processing architecture that is cloud-based.

EHR systems handle a lot of healthcare data, so it's important to assess their performance to make sure they work well when providing care. In our previous work, we proposed a way for prototyping and benchmarking to test cloud-based systems, including EHRs. The performance of CHISTAR will be evaluated using the same methodology.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

As described in our previous work, CHISTAR uses the cloud component model technique for application design. Furthermore, CHISTAR adheres to the standards established by Radio et al. for the development of mobile apps that can take advantage of the capabilities of next-generation cellular networks.

IV. FINDINGS A N D DISCUSSION

This EMR (Electronic Medical Records) System paper's Findings and Discussion part is the main source for presenting and analyzing the findings based on our literature review. We investigate the system's effectiveness, user experiences, data security, and other crucial elements that are essential to the digital transformation of the healthcare sector by looking at the results of our research:

Improved Healthcare Efficiency: EMR systems have been found to enhance the efficiency of healthcare delivery by streamlining administrative tasks, reducing paperwork, and automating routine processes. Faster access to patient records and information facilitates quicker diagnosis and treatment decisions.

Enhanced Patient Care: EMR systems support better patient care by providing healthcare professionals with a comprehensive and up-to-date view of a patient's medical history.

Data Accessibility and Sharing: EMRs facilitate data accessibility, enabling authorized healthcare providers to access patient information remotely, and promoting continuity of care. Interoperability between different healthcare systems and institutions is a crucial factor in ensuring seamless data sharing.

Data Security, Privacy & Regulatory Compliance: Ensuring data security and privacy is a significant challenge. EMR systems must adhere to strict standards and employ robust security measures to protect patient information. Currently, in India does not have in force any specific data protection law such as the US Health Insurance Portability and Accountability Act (HIPAA). The current lawful structure for e-health protection in India is regulated by the IT Act, 2000 and the SPDI Rules, 2011 and adhering to these rules is a necessity.

Cost Savings: Over the long term, EMR adoption can result in cost savings due to reduced paperwork, lower administrative overhead, and better resource allocation. Reduced duplication of tests and procedures can lead to cost reductions.

Data Quality and Accuracy: The quality and accuracy of data input into EMR systems are crucial. Errors or incomplete information can impact patient care and clinical decision making. Health information management practices are essential for maintaining data quality.

CONCLUSION

The findings from our research on EMR (Electronic Medical Records) systems highlight their significant impact on healthcare. These systems have demonstrated their effectiveness in improving healthcare efficiency, streamlining administrative tasks, and accelerating diagnosis and treatment decisions. They enhance patient care by providing comprehensive medical histories to healthcare professionals. EMRs also promote data accessibility and sharing, ensuring continuity of care through interoperability.

However, data security, privacy, and regulatory compliance remain paramount, especially in regions like India, which lack specific data protection laws. Adherence to existing regulations is imperative to safeguard patient information. While there are initial implementation costs, the long-term cost savings, reduced paperwork, and improved data quality underscore the benefits of EMR adoption.

In summary, EMR systems have the potential to revolutionize healthcare, but their success depends on stringent data protection measures and data accuracy through effective health information management practices.

REFERENCES

[1]. Abayomi-Alli Adebayo, Aderonke Ikuomola, Olusola Oluwakemi Abayomi-Alli, "An Enterprise Cloud-Based Electronic Health Records System", Journal of Computer Science and Information Technology,

[2]. June 2014

[3]. Chrysostomos Symvoulidis, Athanasios Kiourtis, Argyro Mavrogiorgou1, Dimosthenis Kyriazis, "Healthcare Provision in the Cloud: An EHR Object Store-based Cloud Used for Emergency", 14th International Conference on Health Informatics, HEALTHINF 2021

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, January 2024

[4]. Thamodi Gamage, Nisansala Dabarera, Isuri Uwanthika, Pradeep Kalansooriya, ”A Systematic Review and Comparative Study of Electronic Medical Record (EMR) Systems to Support Healthcare”, 13th International Research Conference, 2020

[5]. Arshdeep Bahga, Vijay K. Madisetti, ”A Cloud-based Approach for Interoperable Electronic Health Records (EHRs)”, IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 17, NO. 5, SEPTEMBER 2013

[6]. Roberto Somolinos, Adolfo Munoz, M. Elena Hernando ˜ , Senior Member, IEEE, Mario Pascual, Member, IEEE, Jesus C ´ aceres, Ricardo S ´ anchez-de-Madariaga, Juan A. Fragua, Pablo Serrano, and Carlos

[7]. H. Salvador, Senior Member, IEEE, ”Service for the Pseudonymization of Electronic Healthcare Records Based on ISO/EN 13606 for the Secondary Use of Information”, IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 19, NO. 6, NOVEMBER 2015

[8]. Karuna Joshi, Tim Finin, ”Attribute Based Encryption for Secure Access to Cloud Based EHR Systems”, Proceedings of the IEEE CLOUD Conference, 2018, San Francisco

[9]. Anas M.R. Alsobeh, Rafat Hammad, Abdel-Karim Al-Tamimi, ”A Modular Cloud-based Ontology Framework for Context-aware EHR Services”, Int. J. Computer Applications in Technology, Vol. 60, No. 4, 2019

[10]. Jonathan Tancer, Aparna S. Varde, ”Cloud technology and EHR data management”, 2019

[11]. Sai Srinivas Vellela, Venkateswara Reddy B, Kancharla K Chaitanya, Dr. M Venkateswara Rao, ”An Integrated Approach To Improve EHealthcare System Using Dynamic Cloud Computing Platform”, Proceedings of the 5th International Conference on Smart Systems and Inventive Technology (ICSSIT 2023)

[12]. Takhellambam Sylvia, Dr. G. Sujitha, ”A Cloud-based system for Integration & Analytics in Electronic Health Record (EHR)”, INTERNATIONAL JOURNAL OF SCIENCE AND INNOVATIVE ENGINEERING & TECHNOLOGY MAY 2016 ISSUE VOLUME 1

[13]. Ismail Keshta, Ammar Odeh, ”Security and privacy of electronic health records: Concerns and challenges”, Egyptian Informatics Journal 22 (2021) 177–183

[14]. Emmanuel Achampong, ”Electronic Health Record (EHR) and Cloud Security: The Current Issues”, October 2013, International Journal of Cloud Computing and Services Science (IJ-CLOSER) 2(6)