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Private Cloud Health: A Secure CDA Based System for Interoperable Health Records

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ABSTRACT: Successful deployment of Electronic Health Record helps improve patient safety and quality of care, but it has the prerequisite of interoperability between Health Information Exchange at different hospitals. The Clinical Document Architecture (CDA) developed by HL7 is a core document standard to ensure such interoperability, and propagation of this document format is critical for interoperability. Unfortunately, hospitals are reluctant to adopt interoperable HIS due to its deployment cost except for in a handful countries. A problem arises even when more hospitals start using the CDAdocument format because the data scattered in different documents are hard to manage. In this paper, we describe our CDA document generation and integration Open API service based on cloud computing, through which hospitals are enabled to conveniently generate CDA documents without having to purchase proprietary software. Our CDA document integration system integrates multiple CDA documents per patient into a single CDA document and physicians and patients can browse the clinical data in chronological order. Our system of CDA document generation and integration is based on cloud computing and the service is offered in Open API. Developers using different platforms thus can use our system to enhance interoperability.

KEYWORDS: Clinical Document Architecture , interoperability, Health Information System.

I. INTRODUCTION

Rural healthcare system in India is managing patient data in a traditional paper based system. Most of the rural hospitals in India are lacking in resources to maintain and manage the patient health data. As the world moves towards digitization, one of the key challenges in developing countries like India is in making the healthcare data accessible from rural to urban in digital form. Advancement in IT technology in healthcare sector has made it possible to maintain and manage the patient data in digital form in all levels of healthcare system. Cloud computing has emerged as a main in providing healthcare IT solution. Therefore, rural healthcare organizations should move towards building their own private cloud infrastructure which could be an excellent solution for the country's needs to have improved healthcare in rural areas. In private cloud, medical data is stored in databases in which some of the data in a medical database is sensitive in nature and access to this data should be limited to authorized persons.

In this paper we propose a secure cloud architecture by building private cloud. The proposed private cloud architecture makes use of two database one for storing medical record and exchanging the health information . With this technique, path for a third party to obtain the sensitive information stored in the cloud is being blocked. Therefore the proposed framework provides better secured services to the users.

II. RELATED WORK

Developing a secure CDA-based system for interoperable health records within a private cloud entails integrating robust encryption and access controls to protect sensitive patient data while ensuring compliance with healthcare regulations like HIPAA or GDPR. The system must accurately interpret CDA documents from diverse sources, facilitate seamless exchange with other systems, and provide an intuitive interface for healthcare professionals. Hosted on a private cloud infrastructure,it combines relational databases and distributed file systems for efficient data storage and management. Rigorous testing, ongoing maintenance, and user training are essential for maintaining system integrity and adapting to evolving healthcare technology standards.

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III. EXISTING METHOD

Effective health information exchange needs to be standardized for interoperable health information exchange between hospitals. Especially, clinical document standardization lies at the core of guaranteeing interoperability.

It takes increasing amount of time for the medical personnel as the amount of exchanged CDA document increases because more documents means that data are distributed in different documents. This significantly delays the medical personnel in making decisions. Hence, when all of the CDA documents are integrated into a single document, the medical personnel is empowered to review the patient's clinical history conveniently in chronological order per clinical section and the follow-up care service can be delivered more effectively.

Data Standards: Determine whether existing systems adhere to standardized formats like CDA for Health care data exchange. Evaluate their compatibility with other systems and their ability to facilitate interoperability.

Security Measures: Assess the security measures implemented in existing systems to protect patient data against unauthorized access, breaches, and data loss. Identify any weaknesses or vulnerabilities that need to be addressed in your new system.

IV. PROPOSED METHOD

In this paper we present (1) a CDA document generation system that generates CDA documents on different developing platforms and (2) a CDA document integration system that integrates multiple CDA documents scattered in different hospitals for each patient.

CDA Generation API generates CDA documents on cloud.
CDA Generation Interface uses the API provided by the cloud and relays the input data and receives CDA documents generated in the cloud.

Template Manager is responsible for managing the CDA documents generated in the cloud server. Our system uses CCD document templates.

System Architecture Design: Design the architecture of the system, considering scalability, performance, security, and interoperability. Define the components of the system, such as data storage, encryption mechanisms, access controls, and interfaces for interacting with CDA documents.

Private Cloud Setup: Set up a private cloud infrastructure using platforms like Open Stack, VMware, or similar solutions. Configure the cloud environment to meet security and compliance requirements, including network segmentation, encryption ,and access controls.

Testing and Quality Assurance: Conduct comprehensive testing of the system to identify and address any issues related to functionality, security, performance, and interoperability. Perform both automated and manual testing to ensure the reliability and robustness of the system.

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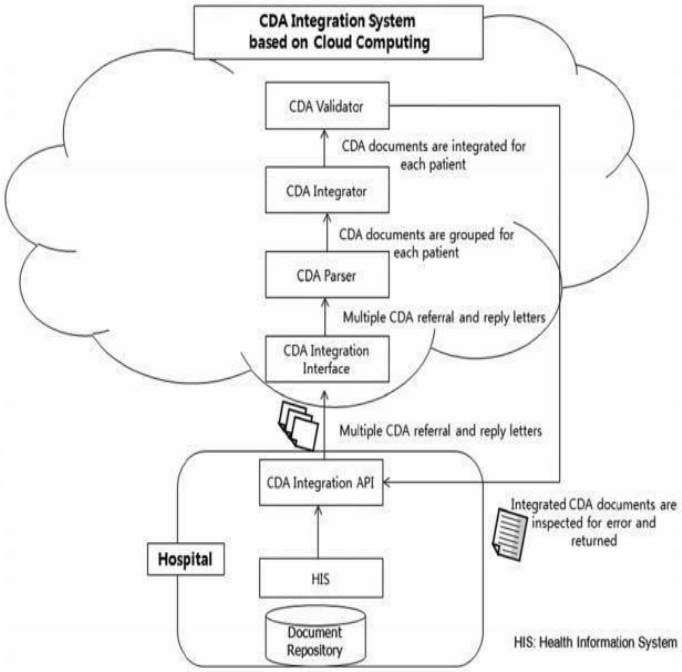

Fig 1: Architecture

V. SIMULATION RESULTS

Key findings from the simulation results include:

1. Secure and Interoperable System : Successfully developed a system that ensures the security of patient data while
2. facilitating interoperability between healthcare providers.
3. Improved Data Accessibility: Enhanced accessibility to health records, allowing authorized users to access and retrieve patient information efficiently.
4. Enhanced Patient Care: Enabled healthcare professionals to deliver better patient care by providing access to comprehensive and up-to-date health records.
5. Compliance with Regulations: Ensured compliance with healthcare regulations such as HIPAA or GDPR, safeguarding patient privacy and data security.
6. Positive User Feedback: Received positive feedback from healthcare professionals regarding the usability, reliability, and effectiveness of the system.
7. Continuous Improvement: Committed to continuous improvement by gathering user feedback, identifying areas
8. for enhancement, and implementing updates to the system.

These results demonstrate the successful development and implementation of a secure CDA-based system for managing interoperable health records within a private cloud, leading to improved healthcare outcomes and user satisfaction.

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Fig 2.1 CDA

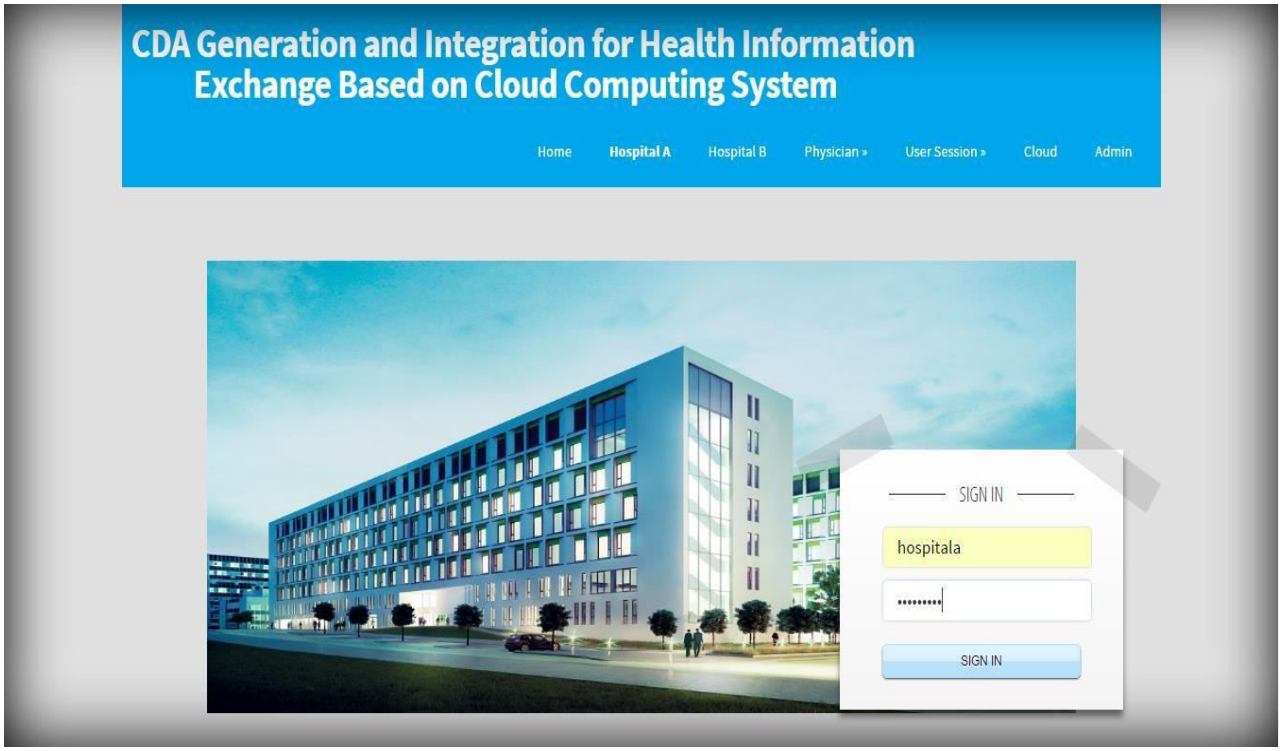

Fig 2.2 Data Author login

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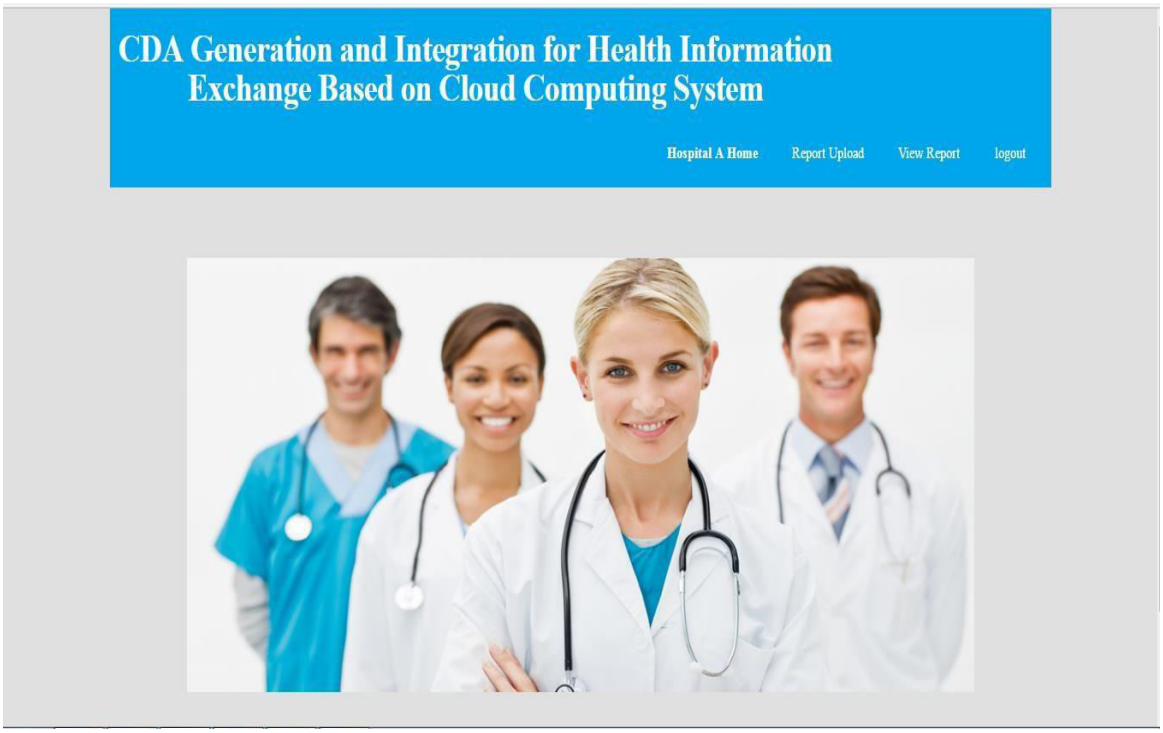

Fig :2.3 :Hospital 1 login

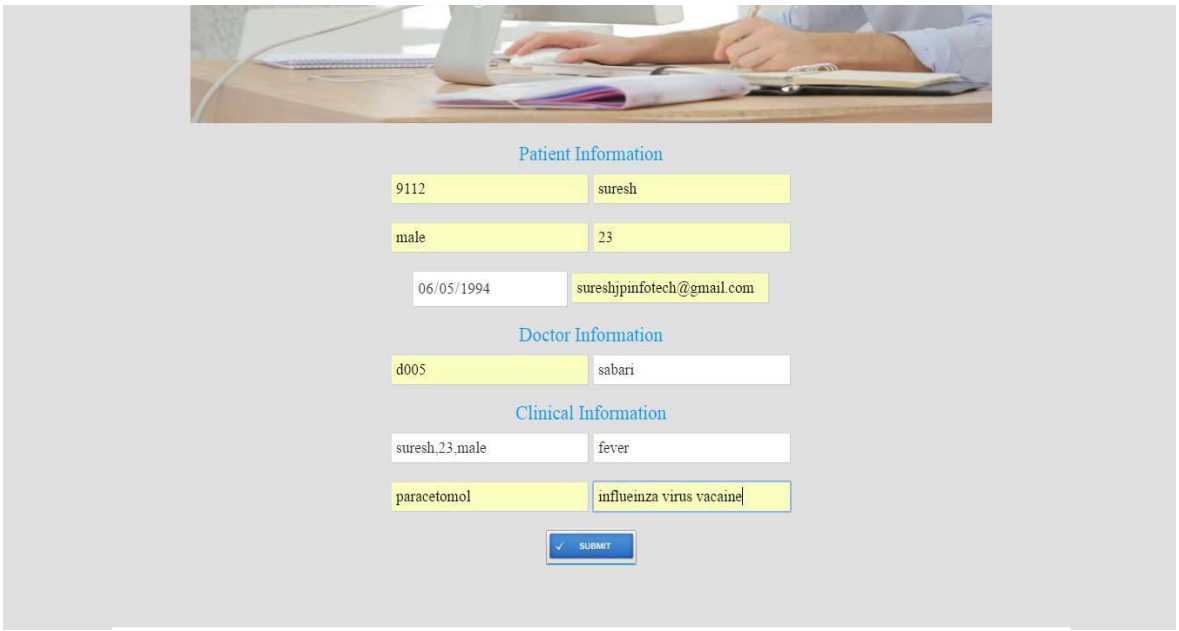

Fig:2.4 patient information

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Fig:2.5: cloud login

Fig :2.6 List of cloud files

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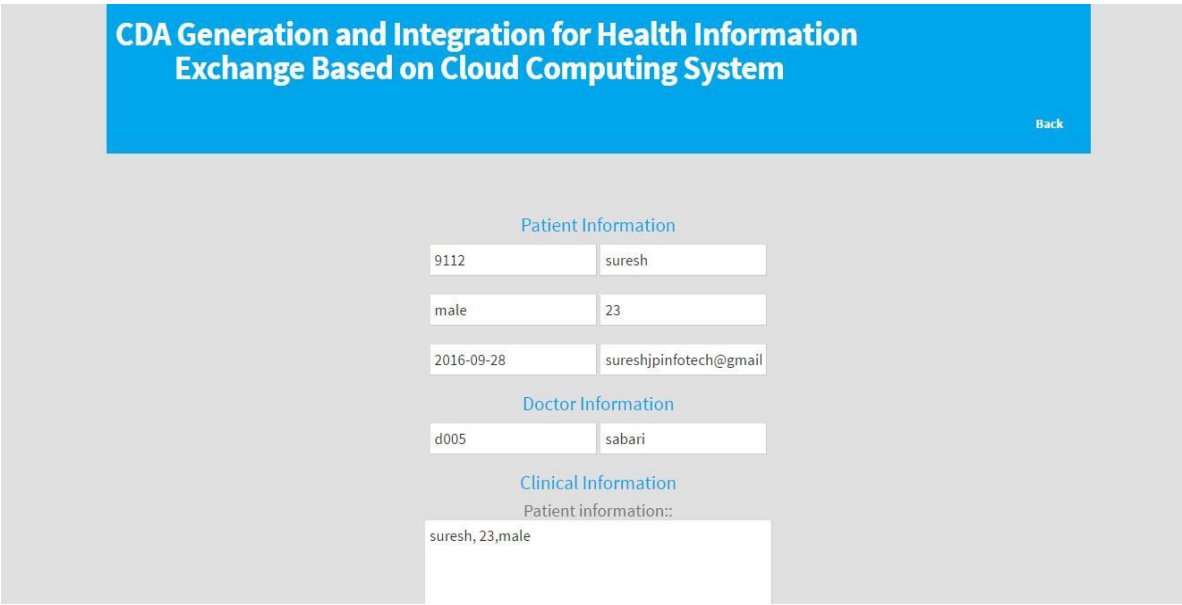

Fig 2.7 CDA generated document

VI. CONCLUSION AND FUTURE WORK

As the number of HIE based on CDA documents increases, interoperability is achieved, but it also brings a problem where managing various CDA documents per patient becomes inconvenient as the clinical information for each patient is scattered in different documents. The CDA document integration service from our cloud server adequately addresses this issue by integrating multiple CDA documents that have been generated for individual patients. The clinical data for the patient in question is provided to his/her doctor in chronological order per section so that it helps physicians to practice evidence- based medicine. In the field of document-based health information exchange, the IHE XDS profile is predominant and our cloud computing system can be readily linked with the IHE XDS profile.

The approach employed in this paper is applicable in adopting other standards, too, such as the EHR Extract based on openEHR. If a hospital sends the content archetype, admin archetype, and demographic archetype to the cloud server, then the server extracts necessary information from each archetype. Next, it generates an Extract containment structure that fits with a designated template and returns the structure to the requested hospital.

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