International Journal of Research in Engineering, Science and Management
Volume-1, Issue-5, May 2018
www.ijresm.com

Secured CDA Generation Using Cloud Computing

Shalaka V. Mahajan[1], Sachin A. Murab[2]
[1]*P. G. Student, Department of CSE, JCOET, Yavatmal, India*
[2]*Professor, Department of CSE, JCOET, Yavatmal, India*

***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 CDA document 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. My 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.**

Index Terms— CDA, Cloud computing, Health information exchange, software as a service

I. Introduction

In existing CDA architecture it is proposed that the system can save all the related medical details of a particular patient [1]. All the details of a desired person i.e. contact number, name, address, age, gender and other personal details are saved in hospitals database along with the detailed medical history and checkups or tests the patient has gone through [1]. Also the details of the hospital or the doctor from where the patient has taken past treatments is also save over the cloud. All these details are then arranged in an architectural manner and sent to the main cloud or rather we can say the main database where all the hospitals keeps sending their details time to time so as to keep the track of all the medical cases and the treatments provided by desired doctors from desired hospitals to the patients. The problem here is the details of the particular patient is not seen to be secured over this CDA ‘architecture. So the desired information of a patient can easily be fetched by third party and hence they can use this information of a patient to provide them with the treatments on their medical issues at low costs as compared to that of the existing hospitals from where the patient is taking treatment. Also there is no provision for the new patients to compare their symptoms with the existing patients symptoms saved in history of details of a patient for a particular medical issue he\she is suffering from.

II. Existing Work

The CDA is a document markup standard for the structure and semantics of an exchanged "clinical document". A clinical document is a documentation of observations and other services with the following characteristics: Persistence Stewardship Potential for authentication Context Wholeness Human readability. An existing CDA document is a defined and complete information object that can exist outside of a message, and can include text, images, sounds, and other multimedia content [19].

Interoperability is a requirement of recent electronic health record (EHR) adoption incentive programs everywhere. One approved structure for clinical data exchange is the continuity of care document (CCD). While primarily designed to promote communication between providers during care transitions, coded data in the CCD can be re-used to aggregate data from different EHRs. This provides an opportunity for provider networks to measure quality and improve population health from a consolidated database. Challenges to interoperability were catalogued and potential quality metrics evaluated based on available content. This research highlights the promise of CCDs for population health and recommends changes for future interoperability standards. [7]

The Clinical Element Model (CEM) is a strategy designed to represent logical models for clinical data elements to ensure unambiguous data representation, interpretation, and exchange within and across heterogeneous sources and applications. The current representations of CEMs have limitations on expressing semantics and formal definitions of the structure and the semantics. Here we introduce our initial efforts on representing the CEM in OWL, so that the enrichment with OWL semantics and further semantic processing can be achieved in CEM. The focus of this paper is the CEM meta-ontology where the basic structures, the properties and their relationships, and the constraints are defined. These OWL representation specifications have been reviewed by CEM experts to ensure they capture the intended meaning of the model faithfully. [20]

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 CDA document format because the data scattered in

International Journal of Research in Engineering, Science and Management
Volume-1, Issue-5, May 2018
www.ijresm.com

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 [13].

Semantic interoperability of clinical standards is a major challenge in eHealth across Europe. It would allow healthcare professionals to manage the complete electronic healthcare record of the patient regardless of which institution generated each clinical session. Clinical archetypes are fundamental for the consecution of semantic interoperability, but they are built for particular electronic healthcare record standards. Therefore, methods for transforming archetypes between standards are needed. In this work, a method for transforming archetypes between ISO 13606 and openEHR, based on Model-Driven Engineering and Semantic Web technologies, is presented [3].

The design and development of a kind of fully comply with an HL7 standard clinical CDA document editor for generating standard CDA standard XML file, and can extract the other clinical commercial software generating clinical document XML- related content, and modified into standard CDA XML documents, used for data exchange, data mining and clinical decision support [8]. The basic modulation of CDA is done as using the modules as follows:

1. The CDA Document:

The HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by American Nation Standards Institute in May 2005 [8]. It is an XML-based document markup standard that specifies the structure and semantics of clinical documents, and its primary purpose is facilitating clinical document exchanges between heterogeneous software systems. A CDA document is divided into its header and body. The header has a clearly defined structure and it includes information about the patient, hospital, physician, etc [16]. The body is more flexible than the header and contains various clinical data. Each piece of clinical data is allocated a section and given a code as defined in the Logical Observation Identifiers Names and Codes (LOINC). Different subcategories are inserted in a CDA document depending on the purpose of the document, and we chose the Continuity of Care Document (CCD) because it contains the health summary data for the patient and it is also widely used for interoperability [19]. Notable data included in CCD are listed as required.

2. Cloud Computing:

Cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services [5]. The user pays fee depending on the amount of resources allocated, such as network, server, storage, applications and services. Currently, three major types of cloud computing service exist: SaaS, PaaS and IaaS [17].

3. CDA Generation System based on Cloud Computing:

Following figure shows the overall architecture of how CDA documents can be generated on the health information systems of different hospitals by using our cloud computing-based CDA generation system [3]. Hospital A and Hospital B are demonstrated to show that it is easy to generate CDA documents on a variety of platforms if done via cloud.

4. CDA Integration System Based on Cloud Computing:

Deals with all the details that are needed to be considered while designing an organizational architecture and data is saved accordingly onto the cloud [15].

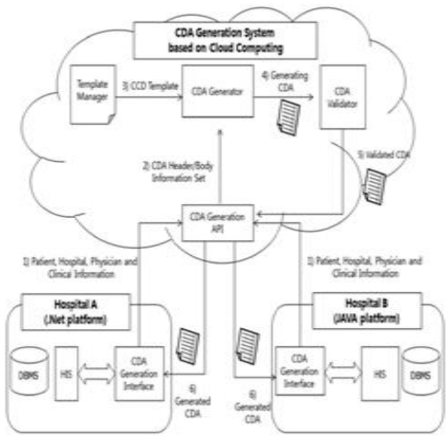

Fig. 1. Health information system

III. Proposed Work

1. The CDSS:

Clinical decision support systems (CDSS) are computer systems designed to impact clinician decision making about individual patients at the point in time that these decisions are made. With the increased focus on the prevention of medical errors that has occurred since the publication of the landmark Institute of Medicine report, To Err Is Human, computer-based physician order entry (CPOE) systems, coupled with CDSS, have been proposed as a key element of systems' approaches to improving patient safety.1–4 If used properly, CDSS have the potential to change the way medicine has been taught and practiced. This will provide an overview of clinical decision support systems, summarize current data on the use and impact of clinical decision support systems in practice, and will provide guidelines for users to consider as these systems begin to be incorporated in commercial systems, and implemented outside the research and development settings.

For this purpose the method called Naïve Bayes has been used. This provides the user with the facility to predict the disease simply by selecting the symptoms. The symptoms are hence matched with the previously added history of desired patients and hence the diseases predicted and the prescriptions given by the registered doctors can be referred.

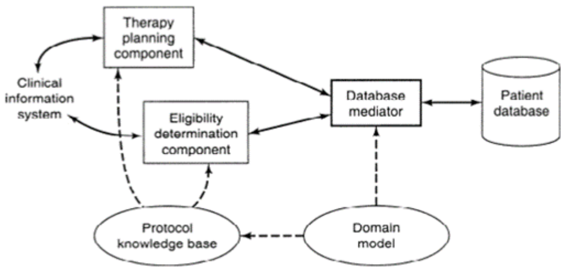

Fig. 2. CDSS system

2. *Privacy Preservation:*

In order to avoid the personal details of patients from getting leaked or shared illegally this method is implemented. The registered doctors are provided with their unique login and passwords so that no unauthorized person can illegally login to the desired doctor's portal.

Also the contact number of the patient here is encrypted here so as to maintain the privacy. No third party can unauthorizedly access to the personal details of the patients. For this purpose the AES algorithm has been implemented.

IV. Experimental Result

The Table-I shows the experimental outcome

TABLE I
COMPARISON OF EXISTING FEATURES OF CDA OVER THE PROPOSED METHOD

Aspects	Existing	Proposed
Sharing of CDA	yes	Yes
Security over shared document	No	Yes
Privacy Preserving Implementation	No	Yes
Disease prediction on Shared patient History	No	Yes

V. Conclusion

Implementation of CDA architecture was the basic agenda. Generation of structured medical document was hence implemented so as to make the structure of document more sorted. Implementation of security services over user data is taken into account by maintaining secrecy. Implementation of CDSS which is the most interesting feature added to the CDA. Development of secured organizational architecture over the existing one.

References

[1] M. Müller, T. Frankewitsch, T. Ganslandt, T. Bürkle and H. U. Prokosch, "The Clinical Document Architecture (CDA) Enables Electronic Medical Records to Wireless Mobile Computing," in *Studies in Health Technology and Informatics*, vol. 107, pp. 1448-1452, 2004.
[2] T. Benson, "Principles of Health Interoperability HL7 and SNOMED," 1st Edition, Springer-Verlag London, 2010.
[3] C. M. Costa, M. M. Tortosa and J. T. F. Breis, "Towards ISO 13606 and openEHR Archetype-Based Semantic Interoperability," in *Studies in Health Technology and Informatics*, vol. 150, pp. 260-264, 2009.
[4] Z. Lu and J. Su, "Clinical Data Management: Current Status, Challenges, and Future Directions from Industry Perspectives," in *Open Access Journal of Clinical Trials*, vol. 2, pp. 93-105, 2010.
[5] H. A. J. Narayanan and M. H. Güneş, "Ensuring access control in cloud provisioned healthcare systems," *2011 IEEE Consumer Communications and Networking Conference (CCNC)*, Las Vegas, NV, 2011, pp. 247-251.
[6] P. V. Gorp, M. Comuzzi, A. Fialho and U. Kaymak, "Addressing health information privacy with a novel cloud-based PHR system architecture," *2012 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, Seoul, 2012, pp. 1841-1846.
[7] J. D. D'Amore, D. F. Sittig, A. Wright, M. S. Iyengar and R. B. Ness, "The Promise of the CCD: Challenges and Opportunity for Quality Improvement and Population Health," in *AMIA Annual Symposium Proceedings*, 2011, pp. 285-294.
[8] J. He, and L. Xiao, "Based on the Complete CDA Standard Clinical Document Editor Research and Development," in *Journal of Software Engineering and Applications*, vol. 6, no. 3B, pp. 78-81, March 2013.
[9] NIST CDA guideline validation. Available: http://cda-validation.nist.gov/cda-validation/validation.html
[10] G. L. Prakash, M. Prateek and I. Singh, "Data Encryption and Decryption Algorithms using Key Rotations for Data Security in Cloud System," in *International Journal Of Engineering And Computer Science*, vol. 3, no. 4, pp. 5215-223, April 2014.
[11] P. Murugesan, S. P. Natarajan and L. Karthigeyan, "Clinical Decision-Support Systems," in *Computer Sciences Corporation*, CSC papers, pp. 1-18, 2014.
[12] K. S. Adewole, M. A. Hambali and M. K. Jimoh, "Rule-Based Expert System for Disease Diagnosis," in *Proceedings of the International Conference on Science, Technology, Education, Arts, Management and Social Sciences*, March 2015, pp. 1-7.
[13] S. H. Lee, J. H. Song and I. K. Kim, "CDA Generation and Integration for Health Information Exchange Based on Cloud Computing System," in *IEEE Transactions on Services Computing*, vol. 9, no. 2, pp. 241-249, March-April 1 2016.
[14] J. Swathi, B. Sharmila, R. Reena and R. K. Kapila Vani, " Mapping CDA Documents for Health Information Exchange from Multiple Hospitals using Cloud Computing System," in *International Research Journal of Engineering and Technology*, vol. 4, no. 2, pp. 1998-2004, Feb. 2017.
[15] M. M. Aradhana, C. Nagamani and T. R. Kumar, "Clinical Document architecture (CDA) Development and Assimilation for Health Information Exchange Based on Cloud Computing System," in *SSRG International Journal of Computer Trends and Technology*, Special Issue, pp. 1-6, April 2017.
[16] J. Zhao, P. Papapetrou, L. Asker and H. Boström, "Learning from Heterogeneous Temporal Data in Electronic Health Records, in *Journal of Biomedical Informatics*, vol. 65, pp. 105-119, January 2017.
[17] M. L. Müller, F. Uckert, T. Bürkle and H. U. Prokosch, "Cross-Institutional Data Exchange Using the Clinical Document Architecture (CDA)," in *International Journal of Medical Informatics*, vol. 74, no. 2-4, pp. 245-256, March 2005.
[18] A. D. R. Algarin, "Clinical Decision Support Systems in Biomedical Informatics and their Limitations," April 2011.
[19] G. Perera, L. Pedersen, D. Ansel, M. Alexander, H. M. Arrighi, P. Avillach, N. Foskett, R. Gini, M. F. Gordon, U. Gungabissoon, M. A. Mayer, G. Novak, P. Rijnbeek, G. Trifirò, J. V. Lei, P. J. Visser and R. Stewart, "Dementia prevalence and Incidence in a Federation of European Electronic Health Record Databases: The European Medical Informatics Framework Resource," in *Alzheimer's & Dementia*, vol. 14, no. 2, pp. 130-139, February 2018.
[20] R. H. Dolin, L. Alschuler, S. Boyer, C. Beebe, F. M. Behlen, P. V. Biron, and A. Shabo, "HL7 Clinical Document Architecture, Release 2," in *Journal of the American Medical Informatics Association*, vol. 13, no. 1, pp. 30–39, Jan/Feb. 2006.
[21] C. Tao, C. G. Parker, T. A. Oniki, J. Pathak, S. M. Huff and C. G. Chute, "An OWL Meta-Ontology for Representing the Clinical Element Model," in *AMIA Annual Symposium Proceedings* 2011, pp. 1372-1381.
[22] F. Andriopoulou and D. K. Lymberopoulos, "Future SDP through Cloud Architectures," in *Artificial Intelligence Applications and Innovations. AIAI 2012. IFIP Advances in Information and Communication Technology, Springer, Berlin, Heidelberg*, 2012, vol. 382, pp. 1-15.
M. A. Musen, Y. Shahar and E. H. Shortliffe, "Clinical Decision-Support Systems, in *Biomedical Informatics. Health Informatics*. Springer, New York, NY, pp. 698-736, 2006.