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CDA Generation and Integration for Health Information Exchange Based on Cloud Computing System

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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 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. 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 useour system to enhance interoperability.

INTRODUCTION

ELECTRONIC Health Record (EHR) is longitudinal collectionof electronic health information for and about persons, where health information is defined as information pertaining to the health of an individual or health care provided to an individual and it can support of efficient processes for health care delivery [1]. In order to ensure successful an operation of EHR, a Health Information Exchange (HIE) system need to be implemented [2]. However, most of the HIS in service have different characteristics and are mutually incompatible [3], [4]. Hence, 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. Health Level Seven has established CDA as a major standard for clinical documents [5]. CDA is a document markup standard that specifies the structure and semantics of 'clinical documents' for the purpose of exchange. The first version of CDA was developed in 2001 and Release 2 came out in 2005 [6]. Many projects adopting CDA have been successfully completed in many countries [7], [8], [9]. Active works are being done on improving semantic interoperability based on openEHR and CEN13606 [10],

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. The benefits of adopting this system are as follows. First, the system is accessible through an Open API and developers can continue working on their developer platforms they specialize in such as Java, .NET, or C/Cþþ. Hospital systems can simply extend their existing system rather than completely replacing it with a new system. Second, it becomes unnecessary for hospitals to train their personnel to generate, integrate, and view standard-compliant CDA documents. The cloud CDA generation service produces documents in the CDA format approved by the National Institute of Standards and Technology (NIST) [14]. Third, if this service is provided for free at low price to hospitals, existing EHR are more likely to consider adoption of CDA in their practices. This paper is organized as follows. In Section 2, detailed explanations are given on the format of CDA document, cloud computing, and the overall architecture of our proposed system. Section 3 describes the efficacy of the proposed system and contrasts it to different HIE systems in various countries to highlight the strength.

MATERIALS AND METHODS

In this section, we present the necessary techniques in detail for the design, and explain the implementation of our CDA generation and integration system based on cloud computing.

2.1 The CDA Document the HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by

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American Nation Standards Institute in May 2005. 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. 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) [15]. Different subcategories are inserted in a CDA document depending on the purpose of the document, and we chose the Continuity of Care Document (CCD) [16] because it contains the health summary data for the patient and it is also widely used for interoperability. Notable data included in CCD are listed.

CDA INTEGRATION SYSTEM BASED ON CLOUD COMPUTING

Multiple CDA documents are integrated into one in our CDA Document Integration System. The standard for this is Korean Standard for CDA Referral and Reply Letters (Preliminary Version). Templates which generate a CDA use CCD part of Consolidated CDA which is released by ONC and made by HL7. However, an actually generated CDA has a form of CDA Referral and Reply Letters. The rationale for CDA document integration is as follows [21]. When CDA-based HIE (Health Information Exchange) is actively used among hospitals, the number of CDA documents pertaining to each patient increases in time. Physicians need to spend a significant portion of their time on reading these documents for making clinical decisions.

In Korea, physician's consultation time spent per patient is very short since the insurance model is feefor- service. Chronic patients especially are very likely to have been consulted by multiple physicians, in different hospitals. In this case, CDA documents may be scattered in different locations. Therefore, multiple CDA documents needs to be integrated into single CDA document. If the medical history of a patient is available in a single CDA document, the physician's time can be more efficiently used.

This is evident when a patient is being referred to a different hospital or when a referral reply letter is sent. Our survey of physicians shows that displaying each section in chronological order helps improve the quality of care. This paper shows how we integrate CDA documents on a cloud server so that a variety of existing systems can be easily extended to generate integrated CDA documents.

RESULTS

In this section, we report the results concerning the implementation of CDA generation and integration system based on cloud computing 3.1 Construction of a Cloud Computing Environment and Deployment of CDA Generation and Integration System Based on It We chose Amazon Elastic Compute Cloud (EC2) as the cloud platform for our CDA generation and integration system. Microsoft Windows Server 2008 Base was selected as its operating system. We chose Singapore as the server location.

Java (JDK 1.6) was used for CDA document generation and integration system and Tomcat 6.0.26 was selected as the web server platform for service deployment. As discussed in Section 2, we developed the CDA document integration and integration system and deployed the system on the Amazon Cloud Server.

Hospitals conveniently generate and integrate CDA documents by exploiting the API offered by our system.
Generation of CDA Documents on Different Developer Platforms through Cloud To verify whether the system functions as designed, we requested CDA document generation on multiple systems implemented on different developer platforms via our API. For input data, we used the sample patient data offered by the US EHR Certification Program, Meaningful Use [22]. The data does not pertain to any actual person. It is fictional, and available for public access. The use case scenario and data for CDA document generation are shown in Table 3.

Fig. 3 shows the JAVA-based HIS (Health Information System) indicated in Fig. 1. Fig. 3 is a screenshot of our API when requesting a CDA document generation for a hypothetical hospital that uses Java as its developer platform. Fig. 4 is a screenshot of using the API of our service to generate a CDA document by a hypothetical hospital that uses C# as its platform. When the user clicks on the button 'Generate CDA,' the data in each tab is first transmitted to the CDA Generation API in the cloud server via CDA Generation Interface and a CDA document is generated.

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DISCUSSION AND CONCLUSION

Interoperability between hospitals not only helps improve patient safety and quality of care but also reduce time and resources spent on data format conversion [23]. Interoperability\ is treated more important as the number of hospitals participating in HIE increases. If one hospital does not support interoperability, the other hospitals are required to convert the data format of their clinical information to exchange data for HIE. When the number of hospitals that do not support interoperability, complexity for HIE inevitably increases in proportion.
Unfortunately, hospitals are reluctant to adopt EHR systems that support interoperability, because changing an existing system adds cost for software and maintenance [24], [25]. The advantages of an API service as ours are at the amount of resources that hospitals need to allocate for interoperability is minimal [26]. Therefore, offering a system that supports interoperability with cloud computing is a good alternative for hospitals that have not yet adopted EHR because of cost issues. The CDA document format a clinical information standard designed to guarantee interoperability between hospitals, a large number of HIE projects that use the CDA document format have been undertaken in many countries. Table 5 shows various HIE projects and whether they generate CDA documents or integrate multiple CDA documents. Our cloud computing based CDA generation and integration system has a few pronounced advantages over other existing projects. First, hospitals do not have to purchase propriety software to generate and integrate CDA documents and bear the cost as before.

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 [27] 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.

In addition, patients are enabled to use the CDA document integration service to obtain Personal Health Record (PHR) [36], [37], [38], [39], which contains not only clinical documents but also Personal Health Monitoring Record (PHMR) [40] and Patient Generated Document (PGD) [41]. Patients can effectively generate and manage their PHR by using our cloud-based CDA document integration service. The following problems were encountered while developing our CDA document generation and integration system. First, the default language of the Amazon Cloud OS is US English and it did not adequately handle Korean language in the CDA documents. While the client handled the strings in Korean language without problems, the server did not, which was resolved by installing Korean language pack in the server OS. When SaaS is offered targeting hospitals of different languages, developers will need to pay extra attention to this issue. Second, the API parameter for our CDA document generation service was of the list type, but under the C# language environment.

REFERENCES

[1] Y. Kwak, "International standards for building electronic health record (ehr)," in Proc. Enterprise Netw. Comput. Healthcare Ind., pp. 18–23, Jun. 2005.

[2] M. Eichelberg, T. Aden, J. Riesmeier, A. Dogac, and Laleci, "A survey and analysis of electronic healthcare record standards," ACM Comput. Surv., vol. 37, no. 4, pp. 277–315, 2005.

[3] T. Benson, Principles of Health Interoperability HL7 and SNOMED. New York, NY, USA: Spinger, 2009.

[4] J. L€ahteenm€aki, J. Lepp€anen, and H. Kaijanranta, "Interoperability of personal health records," in Proc. IEEE 31st Annu. Int. Conf. Eng. Med. Biol. Soc., pp. 1726–1729, 2009.