



## **CDA For HIE Based on Cloud Computing System Cloud-Based by Providing Stability and Security**

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### **Abstract:**

Now-a-days effective Health Information Exchange (HIE) needs to be homogeneous for interoperable health information exchange between hospitals. In this paper, to ensure interoperability, CDA (Clinical Document Architecture) document generation and integration service has been provided. Interoperability between hospitals not only helps in improving patient safety and quality of care but also condense time and resources spent on data format conversion. The procedure to be carried for ensuring interoperability has enabled to generate CDA documents in open API service that is based on cloud computing in such a way that the hospitals are able to conveniently generate CDA documents. After CDA document generation, with respective to CDA document integration system integrates multiple CDA documents and make them to browse in chronological order. With the existence of this service, it becomes unnecessary for hospitals to train their personnel to generate, integrate, and view standard-compliant CDA documents.

### **Keywords:**

Interoperability, Clinical Document Architecture, PHMR.

### **I. INTRODUCTION**

Cloud computing mentions to the provision of scalable IT resources over the Internet, as opposed to hosting and operating those resources locally, such as on a college or university network. There are four different deployment models of cloud computing.

They are Public cloud, Community cloud, Hybrid cloud and Private cloud.

#### **A. Public Cloud:**

A public cloud, or external cloud, is the most common form of cloud computing, in which services are made available to the general public in a pay-as-you-go manner.

#### **B. Private Cloud:**

A Private Cloud, or internal cloud, is used when the cloud infrastructure, proprietary network or data centre, is operated solely for a business or organization, and serves customers within the business fire-wall.

#### **C. Hybrid Cloud:**

A composition of the two types (private and public) is called a Hybrid Cloud, where a private cloud is able to maintain high services availability by scaling up their system with externally provisioned resources from a public cloud when there are rapid workload fluctuations or hardware failures [4].

#### **D. Community Cloud:**

The idea of a Community Cloud is derived from the Grid Computing and Volunteer Computing paradigms. In a community cloud, several enterprises with similar requirement can share their infrastructures, thus increasing their scale while sharing the cost [3]. Interoperability is treated more important as the number of hospitals participating in HIE increases.



It helps in improving patient safety and quality of care between hospitals and even reduce time and resources consumed on data format conversions [2]. When the number of hospitals which does not support interoperability, complexity for HIE certainly increases in focusing more on data format conversions. But, hospitals are hesitant to adopt EHR systems that support interoperability, because changing an existing system adds cost for software and maintenance [5]. The advantages of an API service is the amount of resources that hospitals need to allocate for interoperability is marginal. So, proposing 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[7].

The following are the few advantages of proposed system that is cloud computing based CDA generation and integration system are that the hospitals do not have to purchase propriety software to generate and integrate CDA documents and next is the service is readily applicable to various developer platforms because an Open API is to drive our CDA document generation and integration system[1]. Generally, when a new type of CDA document format is established, hospitals have to upgrade or purchase proprietary software to accommodate files in that new format but with API, no need to change the software on the client-end and only the software at the server-end needs to be changed to adopt the new CDA document format. The CDA document integration service from the cloud server effectively report this dispute 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 [6] and the cloud computing system can be readily linked with the IHE XDS profile. 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. Patients can effectively generate and manage their PHR by using our cloud-based CDA document integration service.

## II. BACKGROUND WORK

The paper presents evocative use of electronic health records the road ahead. It would be helpful to comprehend the motivation behind the key components of the meaningful use rules, benefits and risks of a rapid transformation from paper to electronic record systems. J. D. D'Amore, D. F. Sittig, A. Wright, M. S. Iyengar, and R. B. Ness,[5],[8] proposed the promise of the CCD: challenges and opportunity for quality improvement and population health. Interoperability is a requirement of recent electronic health record (EHR). This provides an opportunity for provider networks to measure quality and improve population health from a consolidated database.

S. Lee, J. Song, and I. Kim,[3] proposed clinical document architecture integration system to support patient referral and reply letters. Many Clinical Document Architecture (CDA) referrals and reply documents have been accumulated for patients since the deployment of the Health Information Exchange System (HIES)[9]. The 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.

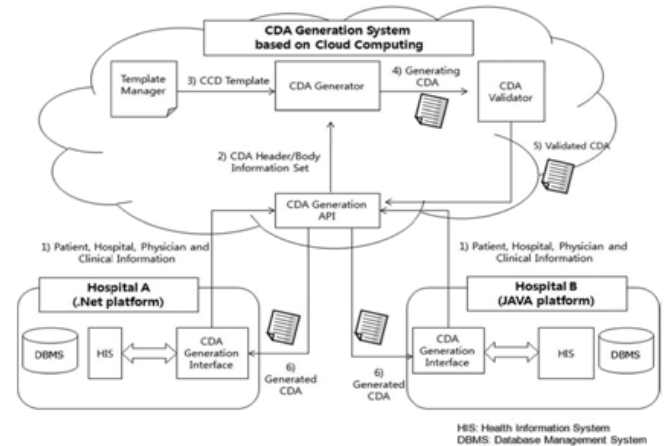
This provides an opportunity for provider networks to measure quality and improve population health from a consolidated database[4]. To evaluate such potential, this research collected CCDs from 14 organizations and developed a computer program to parse and aggregate them.

### III. OUR APPROACH: CDA Generation and Integration System

#### 3.1 Process carried out for CDA generation system:

In the work processed for CDA generation system, the CDA document is divided into its header and body which defines structure and it comprises information regarding the patient, hospital, physician, etc. The flexibility of body is more when compared to header as it contains various clinical data in which each portion of clinical data is assigned 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 here the Continuity of Care Document (CCD) is chosen because it contains the health summary data for the patient and it is also extensively used for interoperability.

CDA Header includes data items like Document Information (creation time, template ID, language code, purpose), Patient’s information (ID, name, gender, birth date), Author’s information (ID, name, represented organization), Organization’s information (name, address, phone number). CDA Body includes data items like Payers, Advance Directives, Support, Functional Status, Problems, Family History, Social History, Allergies, Medications, Medical Equipment, Vital Signs, Results, Procedures, Encounters and Plan of Care.



**Fig.1: The architecture of CDA generation system based on cloud computing.**

From the Fig.1 shown, it is depicted that it is easy to generate CDA documents on a variability of platforms if done via cloud. The tenacity of each of the components is as follows:(1)CDA Generation API generates CDA documents on cloud.(2)CDA Generation Interface uses the API provided by the cloud and relays the input data and receives CDA documents generated in the cloud.(3)Template Manager is responsible for managing the CDA documents generated in the cloud server. Current system uses CCD document templates.(4)CDA Generator gathers patient data from hospitals and generates CDA documents in the template formats as advised by the Template Manager.(5)CDA Validator inspects whether the generated CDA document complies with the CDA schema standard. Let us consider an example application like at a hospital, the clinical information of patient, hospital, and physician is entered via CDA Generation Interface and sent to the cloud server via CDA Generation API. SOAP (Simple Object Access Protocol) is used as transmission protocol for the purpose of enhancing interoperability among different HIS when a hospital sends data to the cloud[10]. CDA Generation API transmits the data in the CDA Header/Body in the list type.

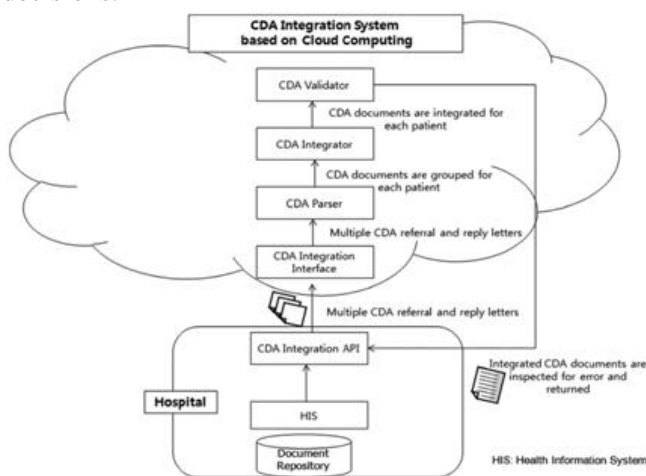
The data items included in CDA Header and body are as specified earlier. The data sent to the CDA Generation API are packaged in CDA Header Set and CDA Body Set and dispatched to CDA Generator. CDA Generator regains a CCD template from Template Manager and fills in the suitable fields of the CCD template with the data from the CDA Header/Body Sets. The generated CDA document is examined by the CDA Validator whether the CDA standards are being satisfied. It is inspected whether there is any missing element or the format is suitably followed.

**3.2 Process carried out for CDA Integration system:**

The following fig.2 explains the procedure of integrating multiple CDA documents into one in CDA Document Integration System. Templates which generate a CDA use CCD part of Consolidated CDA which is released by ONC and made by HL7. An actually generated CDA has a form of CDA Referral and Reply letters. When CDA-based HIE (Health Information Exchange) is keenly used among hospitals, the number of CDA documents relating to each patient increases in time and this intimates the physicians to spend a major portion of their time on analyzing these documents for making clinical decisions.

Enduring patients particularly are very likely to have been consulted by multiple physicians, in different hospitals. So here, the CDA documents may be dispersed in various locations. Consequently, 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 and the patient is referred to a different hospital or referral reply letter are sent. This paper shows the integration of CDA documents on a cloud server so that a variety of existing systems can be easily prolonged to generate integrated CDA documents[2]. The CDA Integration Interface transmits each CDA document sent to the cloud to the CDA Parser, which translates each input CDA document to an XML object and examines the CDA header and groups them by each patient ID.

The CDA Document Integrator integrates the provided multiple CDA documents into a single CDA document. In this process, the data in the same section in the document body are merged, following the LOINC values that set apart each section in the CDA document. The integrated CDA document is checked for error in the CDA Validator, and the outcome is reverted as string to the hospital that requested CDA document integration[10]. The CDA Integration System and the CDA Generation System are distinct things, and a new CDA document is made after document integration it is necessary to determine whether the new document complies with the CDA document integration, specifically whether there is any missing element, or the format is wrong. Error messages are returned if found. Then the received string is converted to a CDA document file and saved. The validation process by CDA Validator is based on the CDA schema. An error is generated when a required field has been left blank or the wrong data type has been used[8]. The CDA document generation time, 'effective Time,' needs to be set.



**Fig.2: The architecture of CDA integration system based on cloud computing.**



#### IV. IMPLEMENTATION: Generating and Integrating CDA for HIE based on cloud computing system

To verify the system functions designed, the CDA document generation on multiple systems can be implemented on different developer platforms via open API specified. For input data, the information regarding data items included in header and body can be specified as its fields of patient data. When requesting a CDA document generation for a hypothetical hospital, Java can be used as its developer platform. Next the UI actions and interactions are as usual and be performed as instructed. Integration of multiple CDA documents of patient referrals and replies by using the API at cloud server is shown in the above figure(5).

**Fig.3: Data items included in the header of CDA Document**

**Fig. 4: Data items include in CDA Body**

**Fig.5: Integrating CDA on Cloud Computing System**

#### V. CONCLUSION

The importance of interoperability in all the hospitals participating in HIE has been increased. The advantages of an API service is the amount of resources that hospitals need to allocate for interoperability is discussed and examined it as marginal. The proposed system supporting interoperability with cloud computing is a good alternative for hospitals that have not yet adopted EHR because of cost issues. The assurance of generating and integrating various CDA documents has been given on various developer platforms. The extended features of proposed system can include like making a concrete estimation of the reduction in cost when the EHR system becomes cloud-based by providing stability and security.

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