Clinical Data Analysis for Information Exchange on a Cloud Server

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ABSTRACT: *As the health care organizations are increasing more and more in different locations, each and every individual health organization maintains an individual UI model for storing and accessing their patient's information. Also we know that in some times, information exchange between different hospitals need to be done, so there is a need to share some common database for information exchange in online or offline, such a database is known as Clinical Document Architecture (CDA). So once if any hospital needs any information from other at some urgent situation they both may not match in UI structure, which leads to wrong information extraction. Hence in our proposed thesis we proposed a common format designed in XML for storing the records of CDA from various health care organizations. Also in our proposed thesis we designed CDA document generation and integration of Open API services based on cloud computing which is mainly used to store all the information on a live cloud server. Here we take DRIVEHQ as a cloud service for storing all the CDA information in an encrypted manner rather than in a plain manner.*

Key Words*: Encryption, Decryption, Clinic Document Analysis, Health Care Organization, Information Exchange.*

I. Introduction

Now a day's Electronic Health Record (EHR) is one form of collection of electronic health information for and about patients as well as individuals, 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 [3]. In order to ensure successful an operation of EHR, a Health Information Exchange (HIE) system need to be implemented [4]. However, most of the HIS in service have different characteristics and are mutually incompatible [5], [6]. 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. CDA is a document mark-up 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 [7]. Many projects adopting CDA have been successfully completed in many countries [8], [8], [9]. Active works are being done on improving semantic interoperability based on open EHR and CEN13606 [10], [7].

In-order establish a secure confidence in hospital information support systems for exchange of information between each other interpersonally, more number of hospital information support systems need to support the novel CDA. As we look into the exact structure of CDA, it is very complex and the production of correct CDA document is hard to achieve without deep understanding of the CDA standard and sufficient experience with it. In addition, the HIS development platforms for hospitals vary so greatly that generation of CDA documents in each hospital invariably requires a separate CDA generation system. Also, hospitals are very reluctant to adopt a new system unless it is absolutely necessary for provision of care. The CDA document can be shared with other clinics if the patient agrees. The concept of family doctor does not exist in Korea, hence it is common for a patient to visit a number of different clinics.The exchange of CDA document is triggered in the following cases: when a physician needs to study a patient's medical history; when referral and reply letters are drafted for a patient cared by multiple clinics; when a patient is in emergency and the medical history needs to be reviewed.

II. Related Work

In this section we mainly discuss about the related work that was carried out inorder to find out the proposed CDA for health care information exchange between different hospitals. Now let us discuss about that in detail as follows:

Preliminary Knowledge

In this section we will find the related background work that was analyzed and studied in order to implement this current thesis. This section will describe the work that is related to the various types of cloud servers and also the traditional approach of data sharing in the cloud. This is mainly discussed because the idea of CDA implementation is adopted in cloud server storage for easy and fast access by all the HIS which are located in and around the country. For this reason we mainly discuss about the primitive ways of data hosting in cloud computing. Now let us look about that in detail in this below section:

Now let us look about the some of the various types of cloud data storage in detail:

I) Personal Cloud Storage

It is also known as mobile cloud storage, personal cloud storage is a subset of public cloud storage that applies to storing an individual's data in the cloud and providing the individual with access to the data from anywhere. It also provides data syncing and sharing capabilities across multiple devices. Apple's iCloud is an example of personal cloud storage. This personal cloud storage is mainly dealt in various mobile operators which provide easy access for data storage inside the cloud.

II) Public Cloud Storage

Public cloud storage is where the enterprise and storage service provider are separate and there aren't any cloud resources stored in the enterprise's data center. The cloud storage provider fully manages the enterprise's public cloud storage. Normally in the current days all the cloud storage providers provide public cloud as storage medium with min 2GB and Max 10 GB for data storage with free data access and usage. If that space exceeds then we need to pay the excess storage cost more than 10 GB, which acts as a private cloud.

III) Private Cloud Storage

It is a form of cloud storage where the enterprise and cloud storage provider are integrated in the enterprise's data center. In private cloud storage, the storage provider has infrastructure in the enterprise's data center that is typically managed by the storage provider. Private cloud storage helps resolve the potential for security and performance concerns while still offering the advantages of cloud storage.

IV) Hybrid Cloud Storage

Hybrid cloud storage is a combination of public and private cloud storage where some critical data resides in the enterprise's private cloud while other data is stored and accessible from a public cloud storage provider. A Hybrid Cloud Storage is the combination of public and private cloud storage, till less than 10 GB it is treated as public cloud and more than 10 GB treats as a private cloud storage. Hence an account which contains both these combine is known as hybrid cloud data storage.

III. Proposed CDA Generation System Based On Cloud Computing

In this section we will mainly discuss about the proposed CDA generation system based on the cloud computing.Now let us discuss about this proposed model in detail as follows:

Scope

The HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by American Nation Standards Institute in May 2005. It is an XML-based document mark-up standard that specifies the structure and semantics of clinical documents, and its primary purpose is facilitating clinical document exchanges between heterogeneous software systems. Each and every CDA document is mainly divided into two parts

1) CDA Header Part

2) CDA Body Part

The header part clearly define the structure of the patient record, it mainly contains the information about the patient, hospital information and the physician who is visited for the patients etc.

The body part is the main part in this CDA, where it contains a more flexible data than the header which contains only basic information. In the body part we mainly contains all the various clinical data and clinical history about the patient, where each and every piece of clinical data is allocated a separate section and it is marked individually in an XML page. Also the separate section is also represented with an separate name like Logical Observation Identifiers Names and Codes (LOINC) [6].Now let us look about the most notable data which is included in CCD are listed in Table 1.

TABLE 1
Data Items in CDA Header and Sections in the CDA Body

CDA location	Data items
CDA Header	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	Payers
	Advance Directives
	Support
	Functional Status
	Problems
	Family History
	Social History
	Allergies
	Medications
	Medical Equipment
	Vital Signs
	Results
	Procedures
	Encounters
	Plan of Care

When we want to look for the integrated CDA document, we chose the Korean Standard for CDA Referral and Reply Letters (Preliminary Version) format as the number of clinical documents generated when patients are referred and replies made, is large [4], [6]. It has the identical structure as the CCD and the types of data contained in the body are listed in Table 2.

As we all know that we are integrating this novel CDA into the cloud server, we need to know about the 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. 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:

TABLE 2
Sections in the Korean Standard for CDA Referral and Reply Letters Body (Preliminary Version)

Sections in CDA body	CDA Referral letter	CDA Reply letter
Diagnosis	Yes	Yes
History of past illness	Yes	No
History of Medication Use	Yes	Yes
Laboratory studies	Yes	Yes
Radiology studies	Yes	Yes
Pathology studies	Yes	Yes
Function Status Assessment	Yes	Yes
Surgical Operation Note	Yes	Yes
Relevant Diagnostic Tests	Yes	Yes
Reason for referral	Yes	No
Special Treatments and Procedures	Yes	No
Subsequent Evaluation Note	No	Yes
Plan of Treatment	No	Yes

The CDA Generation System Based On Cloud Computing

This is mainly explained to show 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. 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. The purpose 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 all the CDA documents generated in the cloud.
3) Template Manager is responsible for managing the CDA documents generated in the cloud server. Our system uses CCD document templates.
4) CDA Generator collects patient data from hospitals and generates CDA documents in the template formats as suggested by the Template Manager.
5) CDA Validator inspects whether the generated CDA document complies with the CDA schema standard.

IV. Conclusion

In this paper, we for the first time designed and developed a novel Clinical Document Architecture (CDA) and integrating of various CDA for Health care information systems into the cloud server. As the health care organizations are increasing more and more in different locations, each and every individual health organization maintains an individual UI model for storing and accessing their patient's information. Also we know that in some times, information exchange between different hospitals need to be done, so there is a need to share some common database for information exchange in online or offline, such a database is known as Clinical Document Architecture (CDA).Also in our proposed thesis we designed CDA document generation and integration of Open API services based on cloud computing which is mainly used to store all the information on a live cloud server.

VI. References

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