A Secured CDA Generation Health Information Exchange in Cloud with Proxy Re Encryption

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ABSTRACT

One of the key problems in healthcare informatics is the inability to share patient records across hospitals. In order to improve patient safety and quality of care, maintenance of Electronic Health Record is necessary but there is always the need for interoperability of Patient's Health Information Exchange between different hospitals. One of the best methods is to follow the Clinical Document Architecture (CDA) which is a core document standard to ensure such interoperability. But a problem arises even when more hospitals start using the CDA document format because the data scattered in different documents are hard to collect and manage. The integration system integrates multiple CDA documents per patient into a single CDA document and that clinical document can be browsed by Doctors and patients. All of the CDA documents are integrated into a single document, the medical personnel is empowered to review the patient's clinical history in chronological order per clinical Section and the follow up care service can be delivered more effectively. We extended the system by adding security for report through proxy re encryption and for user through identity key.

I.INTRODUCTION

The health information that consists health of the patient, health care provided to that patient as well as the reaction of the patient to the provided healthcare can be stored as electronic health information in the form of longitudinal collection, thus forming an Electronic Health Record (EHR) [1]. Therefore, the implementation of HIE system is made to ensure successful maintenance of EHR [2]. But there is also a problem of incompatibility between systems and also there are different characteristics involved in HIS [3], [4]. Thus, there is a need to standardize the health information exchange between hospitals ensuring interoperability over health information. Therefore, the core of guaranteeing interoperability is to standardize the clinical document. The major standard for clinical documents is CDA which was established by Health Level Seven (HL7). CDA is the core document standard, an XML document which holds the structure and semantics of clinical documents for health information exchange. The first version of CDA was released on 2001 and it's second version was released on 2005. Many

countries have done many successful projects adopting CDA [7], [8], [9]. To improve semantic interoperability, many active works are done based on open HER and CEN3606 [10], [11]. More HIE system has to support CDA to establish confidence in interoperable Health Information Exchange. Moreover, the structure of CDA is too complex and the correct CDA Document production is difficult without the good understanding of the CDA standard and enough experience with it. Also, the HIS development platforms for hospitals differ so greatly in such a way that generation of CDA documents in every hospital invariably requires a separate CDA generation system. In addition to that, hospitals refuse to adopt a new system unless it is perfectly necessary for delivery of care. As a result, except for only few handful countries like New Zealand or Australia, the adoption rate of EHR is too low [12]. To promote EHR adoption among hospitals, the USA government had implemented an incentive program called the Meaningful Use Program [13]. A CDA document which has the record for the diagnosis is generated, when a patient is diagnosed at a clinic. This CDA document will be shared with other hospitals if the patient agrees. A person or an patient may shift his location from one place to another hence it is common for a that patient to visit a number of different hospitals for check-in or treatment. The exchange of CDA document is invoked in the following cases: when a medical personnel needs to study a patient's medical history; when referral and reply letters are drafted for a patient cared by multiple hospitals; when a patient is

in emergency and the medical history needs to be reviewed. It takes a huge amount of time for the medical personnel because the amount of exchanged CDA document increases because more documents means that data are distributed in different documents. This definitely delays the medical personnel in making decisions. Therefore, when all the CDA documents are integrated into a single document, them medical personnel is motivated to view the patient's medical history conveniently in chronological order per clinical section and the corresponding care service can be provided more effectively. Sadly for now, a solution that integrates multiple CDA documents into one does not exist yet to the best of our knowledge and there is a practical limitation for individual hospitals to develop and implement a CDA document integration interface. The benefits of implementing this system are as follows. First, the system can be accessed through an Open API and developers can continue working on their developer platforms they are specialized for example Java, .NET, or C/C++. Hospital systems can simply extend their existing system instead of completely replacing it with a new system. Second, the hospitals do not have to train their personnel to generate, integrate, and view standard-compliant CDA documents. The cloud based CDA generation service produces documents in the CDA format approved by the National Institute of Standards and Technology (NIST) [14]. Third, as these services are provided free of cost at low price to hospitals, existing Electronic Health Record are more likely to consider adoption of CDA in their practices.

II.PROBLEM STATEMENT

When a patient is recognize at a clinic, a CDA document recording the diagnosis is generated. The CDA document can be shared with other clinics if the patient agrees. The concept of family doctor does not exist in some countries therefore it is common for a patient to visit a number of different clinics. The interchange of CDA document is triggered in the following cases: when a physician needs to study a patient's medical history; when referral and response letters are drafted for a patient cared by multiple clinics; when a patient is in urgent situation and the medical history needs to be reviewed. It takes get larger 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 holds up 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. Unfortunately for now, a solution that integrates multiple CDA documents into one does not exist yet to the best of our knowledge and there is a practical limitation for individual hospitals to develop and implement a CDA document integration technology.

III.IMPLEMENTATION

For health concepts representation, CDA uses HL7's Reference Information Model (RIM), which puts data in a clinical or administrative context and expresses how pieces of data are connected. The health information system can be generated as a CDA document through CDA Generation and Integration on cloud computing Open API. The world widely adopted HL7 CDA

Standards and is based on XML (Extensible Markup Language). Common for a patient to consult a number of different clinics. When a physician needs to study a patient's medical history which are cared for patient by multiple clinics. In this case, the generation of multiple CDA documents that integrates into single document in CDA Generation and Integration of Open API on cloud. The result of the CDA document is in XML based document. For the physician it should be as uncomfortable to read and understand and take time to get conclusion. So the health information of the CDA document that is converted to readable format through API. The steps should be following as: The health information that includes patient, Hospital, Physician, and Clinical Details care send to Generation and Integration of API through interfaces. The CDA Document produced after generate and integrate process. Output of the document can be validate and returned to parser. Using java API, the parsed documents send for conversion to receive the readable format. Result can be send as a output to the recipient of the hospital. When the physicians need to make quick decision's the readable format can be as a flexible and efficient to their knowledge. Using API, CDA document can change to other format. The readable text format is comfortable to read for both physicians

and patients. Users can be avoided unnecessary conversion for specified formats. They can view as a readable format directly from the server (cloud). So this can be a best solution for XML based CDA file The defined structure of new architecture for CDA document to convert to other format is useful to the developer to give as a user friendly document that which had details of about the patient health information. We enhanced the system by adding security for report through proxy re encryption and for user through identity key.
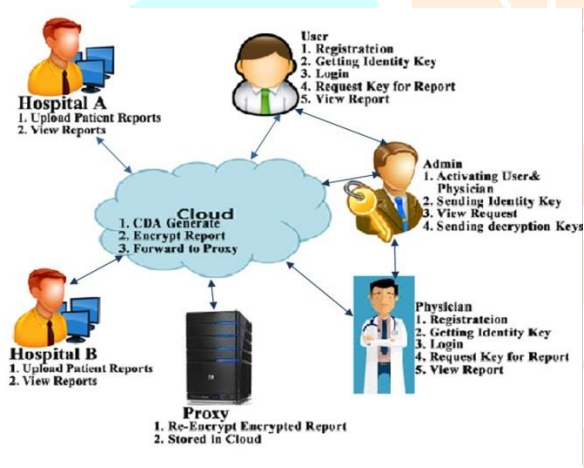

Fig: System Architecture

IV.MODULES DESCSRIPTION:

1. Construction of System Environment
2. The CDA Document
3. Construction of a Cloud Computing Environment
4. Integration of CDA Documents via Our Cloud Server

1. Construction of System Environment

In the first module we develop the Construction of the System Environment to prove our proposed

system model. In this module we develop Hospital A, Hospital B, Doctor/Physician, Patient/User, Admin, Proxy and Cloud Modules. In Hospital A, we create the User Authorization with Login Credentials. This module provides the option of Upload the Patient details as XML File in the Cloud with Encrypted and also provides the option to check the status of the uploaded file with the XML Format. The same is followed in the Hospital B too. In the Admin part, we provide the Admin Authorization with login Credentials and view pending request of users and doctors. The admin only give Approval to the request by sending secret key to user/doctor to access the file.

2. The CDA Document:

In this module we develop the CDA document. The HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by American Nation Standards Institute. 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). 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.

3. Construction of a Cloud Computing Environment:

In this module we develop the Cloud computing environment. We use DriveHQ Cloud Service provider to upload our files in the Cloud. In this module, we develop the construction of a Cloud Computing Environment and how 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 followed. 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. At a hospital, the CDA documents to be integrated are processed through our CDA Integration API. The CDA Integration Interface relays each CDA document sent to the cloud to the CDA Parser, which converts each input CDA document to an XML object and analyzes the CDA header and groups them by each patient ID. The CDA Document

Integrator integrates the provided multiple CDA documents into a single CDA Page 635 document. In this process, the data in the same section in the document body are merged.

4. Integration of CDA Documents via Our Cloud Server:

We integrated multiple CDA documents of patient referrals and replies by using the API at our server. The use case scenario and patient data used for integration are shown in this module. We adopted sample patient data provided by the US EHR Certification Program, Meaningful Use. The data does not pertain to an actual person. It is fictional, and available for public access. This module is to show how a client integrating multiple CDA documents by using our API. The sample many clinical documents are shown to be successfully integrated.

V.CONCLUSION

We establish an efficient way of generating the document format for the generated and integrated CDA Documents for the use of Patients. Our cloud computing based CDA generation and integration system has a few pronounced advantages over other existing projects. 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. First, Hospitals do not have to purchase propriety software to generate and integrate CDA documents and bear the cost as before. Second, our service is to provide security to the Report it is carried through proxy our CDA document generation and integration system. Regardless of the security and safety , CDA documents can be easily generated to support interoperability. Also, additionally the integrated CDA Documents of the patient can be viewed by the Patients. Thus, the time is saved for the doctors in taking medical decisions at emergency times and deliver the correct health care as the medical records are in chronological order. we enhanced the security by using proxy to the system.

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