Readable CDA document for Generation and Integration in Cloud using APIs

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Abstract - **Electronic Health Record helps to improve the safety and quality care of every individual patient details, is necessary that of to be maintained by the clinic, through the interoperability of Health Information Exchange (HIE) differing from hospital to hospital. The CDA document generated and integrated Open API service based on cloud computing allows us conveniently to generate CDA documents without purchase of proprietary software. Using CDA document integration system integrates multiple CDA documents per patient into a single CDA document. Both physicians and patient can utilize the clinical data in chronological order. In this paper, the CDA documents integrate into single document and can be browsed as a readable format. It is easy to read and understand for physicians efficiently. Users no need to purchase or deploy any tools to convert the CDA XML document to other format. Converting of CDA XML format to readable format increases the usage of this system and reduces the time for physicians from delay of making decisions. The conversion can be done by methods that which supports for conversion of XML based format to readable format using APIs on cloud and that document can access by physicians and patients at need of view.**

Key words - **HIE, CDA, cloud computing, Open API**

I. INTRODUCTION

Electronic Health Records is a great tool for physicians and is about quality, safety and efficiency for health care delivery. In order to ensure successful an operation of EHR, a Health Information Exchange (HIE) system need to be implemented [1]. Health Level Seven (HL7) has established CDA as a major standard for clinical documents [2]. CDA is a document markup standard that defines the structure and semantics of clinical document for the purpose of exchange. The first version of CDA was developed in 2001 and Release 2 came out in 2005 [3].The Generation of CDA document, in each hospital invariably requires a separate Clinical Document Architecture system. So the hospitals are reluctant to adopt the new system. Solution of this problem is adoption of EHR (Electronic Health Record). The amount of exchanged CDA Document increases the time because of more documents that data are distributed in different documents. So all the CDA documents are integrated into a single document, the physician is empowered to review the patient's clinical history with conveniently. Although the Clinical Document Architecture is in XML based format, the physicians can be delay for making decisions. So adopting the system of new CDA architecture can give a elegant and contented file to users.

II. CLOUD COMPUTING

Cloud Computing provides delivery of computing services are servers, storage, databases, networking, software, analytics and more over the Internet. Cloud services are collecting data and performing calculations throughout their global network and that services can access from anywhere at any time. IT analysts, industry experts and business leaders increasingly believe that cloud computing represent the next phase of internet development and will bring revolutionary innovation to the whole internet industry [4]. The innovation key of cloud computing is transforming computing capability into a service that delivered to customers. There are three kinds of service models in cloud computing such as SaaS, IaaS, and PaaS.

SaaS

It refers a method of processing software programs that originally were installed locally on the user's machine but are now being relocated to the cloud. So users can order to their needs, and payment is decided by the level of service and amount of time needed.

PaaS

It provides users with a software development, execution, management and monitoring environment, allowing these universal and reusable software resources to be delivered from the providers to users online.

IaaS

In this layer, users obtain services, such as virtualized computing, storage and network resources, from a robust remote infrastructure, and directly set up a platform and applications.

III. ELECTRONIC HEALTH RECORD WITH CDA

Electronic Health Record (EHR) is a collection of patient and population electronically is stored the health information through systematized in digital format. It is a digital version of a patient's paper chart [5]. The records are shared through different healthcare settings. The authorized providers can be created and managed of an EHR is that health information in a digital format capable shared with other providers across more than one health care organization. The EHR has the capacity to

generate a complete record of a clinical patient come across, as well as supporting other care related activities directly or indirectly via interface. The important note is, EHR is generated and maintained within an institution, like a hospital, integrated delivery network, clinic, or physician office. The patient receives those service from an auxiliary department are created as an electronic record.

CLINICAL DOCUMENT ARCHITECTURE

Clinical Document Architecture is in XML based format. It is classified from the HL7 RIM(Reference Information Model) and uses HL7 version 3 data types. The documents contain any relevant information to a healthcare provider or government entity and all information about a patient's medical history, such as allergies, medications, insurance information or lab results [6]. Each piece of clinical data is allocated a section and given a code as defined in the Logical Observation Identifiers Names and Codes (LOINC) [7]. For the integrated CDA document, we chose the Korean Standard for CDA Referral and Reply Letters format as the number of clinical documents generated when patients are referred and replies made, is large [8][9]. The CDA is divided into two categories such as Header and Body in Fig 1. In CDA Header that includes Patient ID, Birth Date, Gender, Given Name, and Family- Name. In CDA Body, the items are included as Problem, Medication, Laboratory, Immunization, and so on. Different subcategories are inserted in a CDA document depending on the purpose of the document, and chose the Continuity of Care Document (CCD) [10] because it contains the health summary data for the patient and it is also widely used for interoperability.
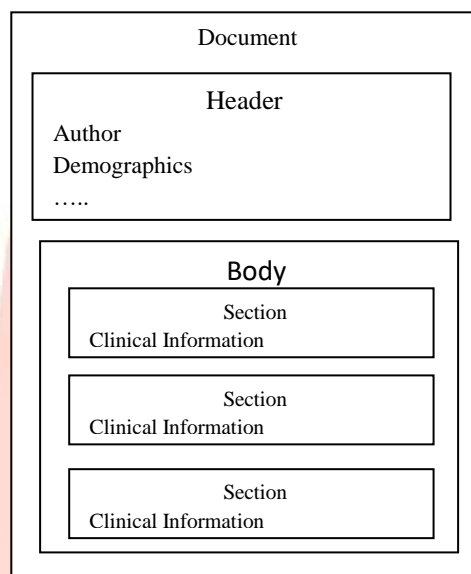

Fig 1 CDA Header and Body

CDA IN CLOUD COMPUTING

The information can exchange and use the information that has been exchanged between two or more systems or components through interoperability. The cloud computing services model refers the cloud SaaS where the software applications HIS are offered as services. A web services is any service that is available over the internet or intranet, uses standardized XML messaging system and is self describing, discoverable and not tied to any operating system or programming language [11]. So the focus on HL7 CDA (Clinical Document Architecture) and CCD (Continuity of Care Document). CDA is a document markup standard that defined with clear structure and semantics of clinical document for the purpose of data exchange and cloud be any of the following: discharge summary, referral, clinical summary, history/physical examination, diagnostic report, prescription, or public health report. In a private or public cloud, the medical data are stored with the condition for the public cloud to provide a strong security and all the departments of the hospital access this medical data of the patients. Cloud computing can help patients to gain access to their medical history from anywhere in the world via the internet [12]. It defines the new style of computing where resources are dynamically scaled, virtualized and are provided as a service on the internet. Health care Information System recommends the technology for its benefits: flexible and quick access to information, features needed more and more in these times characterized on one side by budget cutting and on the other side by ageing societies.

IV. CDA GENERATION AND INTEGRATION ON CLOUD COMPUTING

CDA generation software is platform dependant and it is not centralized. So the process of CDA document an Open API is developed. The clinical information of patient, hospital, and physician are entered through CDA Generation interfaces and sent to the cloud server by CDA generation API. The data are relays in the CDA Header/Body. The Header and Body contains about the patient's, and clinical information. The CDA Generation API are packaged the data in the CDA Header Set and Body Set and relayed to CDA Generator. The Continuity of care document template is received by CDA Generated in the cloud. Result of the generated CDa document is inspected by Validator. Usually the patients are consults with multiple physicians in different hospitals. The CDA document scattered in different location. Physicians need to spend more time on reading these documents for making clinical decisions. So the multiple CDA documents are integrated into single document in CDA Integration system. Each CDA document sent to the cloud to the CDA parser, which converts each input CDA documents to an XML object and analyses the CDA header and groups them by each patient ID. The integrated CDA sent to validator, and the result is returned as string to

the hospital that requested CDA document integration. Using the system on cloud, hospitals are enabled to conveniently generated CDA documents without having to purchase proprietary software. So all the CDA documents are integrated into a single document, the physician is empowered to review the patient's clinical history conveniently.

V. 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 download as a readable format directly from the server (cloud). So this can be a best solution for XML based CDA file to convert to other format as shown in Fig 2. 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.
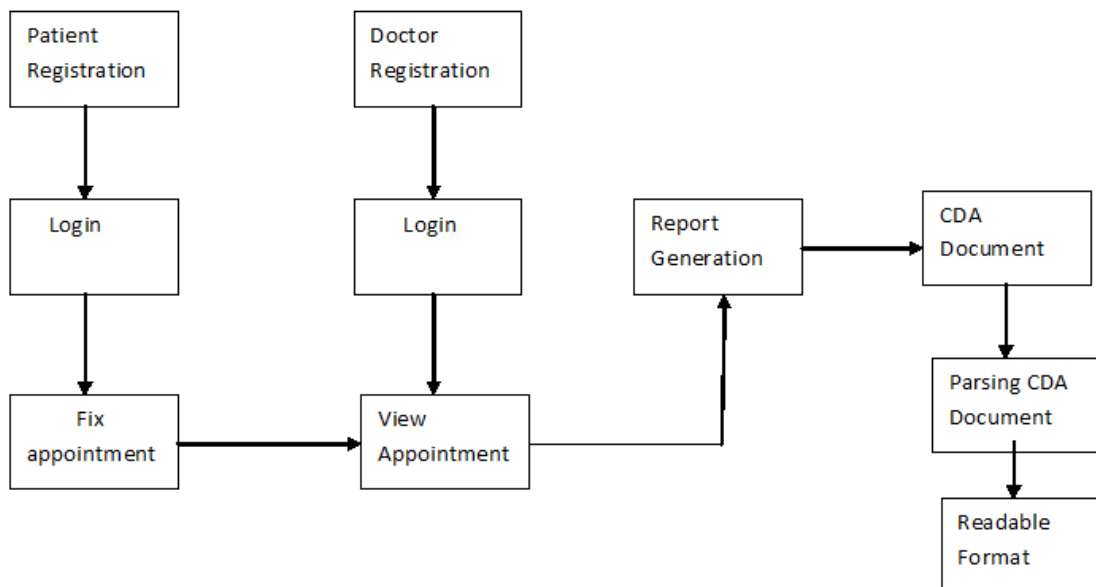

Fig 2. Conversion process and flow

VI. CONCLUSION

Interoperability not only helps to improve patient safety and quality of care but also reduce time and resources spent on data format conversion between hospitals [13]. The CDA document format a clinical information standard hospitals, a large number of HIE projects that use the Clinical Document Architecture format have been undertaken in many countries [14]. So the health information records are Generated and Integrated as a clinical document XML based file format in chronological order on cloud. The hospitals are not ready to buy licensed software to generate and integrate CDA documents. Since the upgradation of the software and supporting software's are to be purchased in regular intervals. The service can applicable to various developer platforms because the CDA document generation and integration system is drive by open API. With cloud server the document can provide easy access with CDA. Increases of HIE based on the CDA documents, achieves its interoperability. But physicians get inconvenient to refer multiple documents. So multiple CDA documents are integrates into one through CDA Integration system. Final result of CDA Document is based on XML format. In the proposed system, the CDA XML based document converted to readable format using the API.

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