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Survey on Clinical Document Architecture Generation and Integration for Health Information Exchange Based on Cloud Systems

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Abstract:

The patient's details regarding its safety and quality care are laughed as with success is critical for the clinic, however it's the necessity of ability between Health data Exchange at completely different hospitals. The Clinical Document design (CDA) developed by HL7 could be a core document commonplace for assurer such ability, AN extension of this document format is vital for ability. Badly, hospitals aren't interested to adopt practical HIS as a result of its preparation price except for in a handful country. a haul arises even once a lot of hospitals begin using the CDA document format as a result of the information unfold in numerous documents are onerous to manage. during this paper, we have a tendency to describe our CDA document generation and integration Open API service supported cloud computing, through that hospitals are allowed to handily generate CDA documents while not having to get proprietary code. Our CDA document integration system integrates multiple CDA documents per patient into one CDA document and doctor and patients will browse the clinical knowledge in chronological order. Our system of CDA document generation and integration relies on cloud computing and therefore the service is obtainable in Open API. Developers using completely different platforms therefore will use our system to extend ability.

***Keywords* —** Health information exchange, HL7, CDA, cloud computing, software as a service

I. INTRODUCTION

Measure of clinical information is expanding according to the advances in medical Information framework. This has upheld the advancement of capable approaches to exchange, trade, and offer clinical data. The execution of individual, lifetime EHR frameworks, with a clinical decision steady system, would be keys to enhancing the nature of patient care and reducing medicinal goofs. In this examination, we displayed that clinical data can be viably shared, along these getting most extraordinary utilization of the data, by saving and obtaining release data through a CDA.

CDA is a XML-based, electronic standard utilized for clinical archive exchange that was created by Health Level Seven. CDA adjusts to the HL7 V3 Implementation Technology Specification (ITS), is based on the HL7 Reference Information Model (RIM), and uses HL7 V3 data writes. It was referred to earlier as the Patient Record Architecture (PRA).

CDA is an adaptable standard and is extraordinary in that it can be read by the human eye or handled by a machine. This is because of its utilization Of XML language, which also allows the standard to be broken into two unique parts. A mandatory freestyle partition enables human interpretation of the archive, while an optional organized part enables electronic preparing (like with an EMR framework). Content, images and even multimedia can be incorporated into the record. A CDA record could be, for example, any of the accompanying: discharge summary, referral, clinical summary, history/physicalexamination, diagnostic report, remedy, or general health report. To put it plainly, any record that may have a signature is a viable report for CDA.

II. LITERATURE SURVEY

K. Ashish,1] presented meaningful use of electronic health records the road ahead. For practicing clinicians, the origins and likely effects of this rule may be opaque. It would be helpful to understand the motivation behind the key components of the meaningful use rules, where they are likely to take the US health care system (and the obstacles along the way), and the 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,[3] 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) adoption incentive programs in the United States. One 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. To evaluate such potential, this research collected CCDs from 14 organizations and developed a computer program to parse and aggregate them.

M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia,[6] presented a view of cloud computing which describes cloud computing. Authors goal in this article is to reduce that confusion by clarifying terms, providing simple figures to quantify comparisons between of cloud and conventional computing, and identifying the top technical and non-technical obstacles and opportunities of cloud computing.

S. Lee, J. Song, and I. Kim,[8] 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) in Korea. Clinical data were scattered in many CDA documents and this took too much time for physicians to read. Physicians in Korea spend only limited time per patient as insurances in Korea follow a fee-for-service model. Therefore, physicians were not allowed sufficient time for making medical decisions, and follow-up care service was hindered. To address this, we developed CDA Integration Template (CIT) and CDA Integration System (CIS) for the HIES. The clinical items included in CIT were defined reflecting the Korean Standard for CDA Referral and Reply Letters and requests by physicians.

S. R. Simon, R. Kaushal, P. D. Cleary , C. A. Jenter, L. A. Volk, E. G. Poon, E. J. Orav, H. G. Lo, D. H. Williams, and D. W. Bates,[11] presented correlates of electronic health record adoption in office practices: A statewide survey in which despite emerging evidence that electronic health records (EHRs) can improve the efficiency and quality of medical care, most physicians in office practice in the United States do not currently use an EHR. We sought to measure the correlates of EHR adoption.

RELATED WORK

3.1 The CDA Document

The HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by American Nation Standards Institute in May 2005. It is a XML-based document markup stan-dard that determines the structure and semantics of clinical documents, and its primary reason for existing is facilitating clinical document exchanges between heterogeneous software sys-tems. A CDA document is separated into its header and body. The header has a clearly characterized structure and it incorporates information about the patient, hospital, physician, and so forth. The body is more adaptable than the header and contains various clinical data. Each bit of clinical data is allocated an area and given a code as characterized in the Logical Obser-vation Identifiers Names and Codes (LOINC) [15].

Distinctive subcategories are embedded in a CDA document contingent upon the motivation behind the document, and we picked the Continu-ity of Care Document (CCD) [16] because it contains the health summary data for the patient and it is also generally utilized for interoperability. Notable data incorporated into CCD are recorded in Table 1.

TABLE 1

Data Items in CCD Header and Sections in the CCD 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

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 [17], [18]. It has the identical struc-ture as the CCD and the types of data contained in the body are listed in Table 2.

2.2 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 [19]. 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

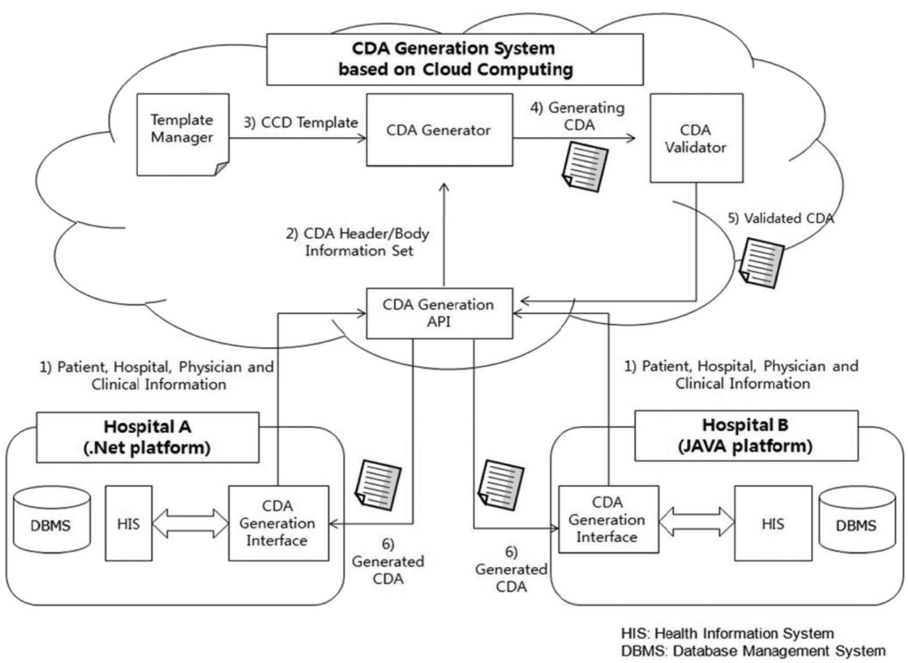

Fig. 1. The architecture of our CDA generation system based on cloud computing.

1)Software as a Service (SasS): This service model pro-vides software.

2)Platform as a Service (PaaS): Cloud providers supply a computing platform to its clients where they can deploy applications of its own, program language of its own.

3)Infrastructure as a Service (IaaS): Vendor integrates basic infrastructure such as IT systems and database and then rents them to client.

2.3CDA Generation System Based on Cloud Computing

Fig. 1 shows the overall architecture of how CDA docu-ments 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 plat-forms if done via cloud. The purpose of each of the compo-nents is as follows:

-CDA Generation API generates CDA documents on cloud.

-CDA Generation Interface uses the API provided by the cloud and relays the input data and receives CDA documents generated in the cloud.

-Template Manager is responsible for managing the CDA documents generated in the cloud server. Our system uses CCD document templates.

-CDA Generator collects patient data from hospitals and generates CDA documents in the template for-mats as suggested by the Template Manager.

-CDA Validator inspects whether the generated CDA

document complies with the CDA schema standard. The DBMS at each hospital and the HIS are linked as fol-lows. Hospital A, which uses a .Net-based system is con-nected via ODBC to connect to the DBMS while Hospital B, which uses a JAVA-based system, is linked with Hibernate. 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. We utilize SOAP (Simple Object Access Protocol) as transmission pro-tocol for the purpose of enhancing interoperability among different HIS when a hospital sends data to the cloud. CDA Generation API relays the data in the CDA Header/Body in the list type. The items included in CDA Header are: PatientID, BirthDate, Gender, GivenName, and Family-Name. In CDA Body, the following items are included:

Problem, Medication, Laboratory, Immunization, and so on. The data sent to the CDA Generation API are packaged in CDA Header Set and CDA Body Set and relayed to CDA Generator. CDA Generator retrieves a CCD template from Template Manager and fills in the appropriate fields of the CCD template with the data from the CDA Header/Body Sets. The generated CDA document is inspected by the CDA Validator whether the CDA standards are being satis-fied. It is inspected whether there is any missing element or the format is adequately followed. If no error is found, a CDA document is returned to the recipient hospital. Hospi-tals A and B are presented to demonstrate that it is possible for different development platforms to extend to generate CDA documents via a cloud server.

4.CDA Integration System Based on Cloud Computing

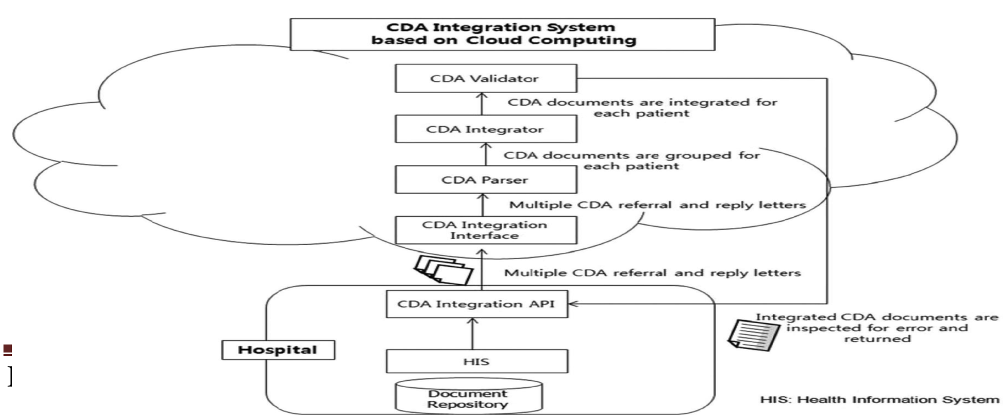

Fig. 2 indicates how various CDA documents are integrated into one in our CDA Document Integration System. The standard for this is Korean Standard for CDA Referral and Reply Letters (Preliminary Version). Templates which gen-erate a CDA utilize CCD part of Consolidated CDA which is released by ONC and made by HL7. In any case, an actually generated CDA has a type of CDA Referral and Reply Let-ters. The rationale for CDA document integration is as fol-lows [21]. At the point when CDA-based HIE (Health Information Exchange) is actively utilized among hospitals, the quantity of CDA documents pertaining to each patient increases in time. Physicians need to spend a significant part of their opportunity on reading these documents for making clinical deci-sions. In Korea, physician's consultation time spent per patient is short since the insurance demonstrate is charge for-service. Interminable patients especially are probably going to have been counseled by numerous physicians, in various hospitals. In this case, CDA documents may be scattered in various locations. Accordingly, different CDA documents should be integrated into single CDA document. On the off chance that the medical history of a patient is available in a solitary CDA doc-ument, the physician's chance can be all the more effectively utilized. This is obvious when a patient is being alluded to an alternate hospital or when a referral answer letter is sent. Our review of physicians demonstrates that displaying each segment in chronolog-ical arrange enhances the quality of care. This paper indicates how we integrate CDA documents on a cloud server with the goal that a variety of existing frameworks can be easily reached out to generate integrated CDA documents.

At a hospital, the CDA documents to be integrated are prepared through our CDA Integration API. The CDA Inte-gration Interface relays each CDA document sent to the cloud to the CDA Parser, which changes over each info CDA document to a XML protest and analyzes the CDA header and gatherings them by each patient ID. The CDA Document Integrator integrates the gave different CDA docu-ments into a solitary CDA document. In this procedure, the data in the same segment in the document body are consolidated, fol-lowing the LOINC values that set apart each segment in the CDA document. The integrated CDA document is investigated for mistake in the CDA Validator, and the outcome is returned as string to the hospital that asked for CDA document integra-tion. This is because the CDA Integration System and the CDA Generation System are separate substances, and another CDA document is made after document integration, thus it is necessary to decide if the new document follows the CDA document integration, especially whether there is any missing component, or the format isn't right. Blunder messages are returned if found. At that point the got string is changed over to a CDA document record and saved. The validation procedure by CDA Validator is based on the CDA schema. A mistake is generated when a required field has been left blank or the wrong data write has been utilized. Example: The CDA document generation time, 'effectiveTime,' should be set, at least, in the YYYYMMDD format, for example, 20140806.

CONCLUSION

Interoperability between hospitals not just ameliorates patient safety and quality of care yet additionally limit time and assets spent on data format conversion.Interoperability is act toward more important as the quantity of hospitals participating in HIE increases.As the quantity of HIE based on CDA documents increases, interoperability is accomplished. We proposed a CDA document generation framework that generates CDA documents on various creating platforms and CDA document integration framework that integrates numerous CDA documents scattered in various hospitals for each patient.The CDA document format a clinical information standard planed to guarantee interoperability between hospitals.CDA document generation and integration framework based on cloud server is more useful over existing services for CDA document if the variety of CDA document increases.

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