

# Electronic Health Record Interoperability Using Cloud Computing System

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**Abstract :** Medical tourism is one of the emerging area throughout the globe. The movement of patient is worldwide. At the same time medical illiteracy is the common aspect irrespective of socio economic and geographical spheres and background. Careful and secured deployment of Electronic Health Record (EHR) of patients improves the safety and quality of medical care. The Clinical Document Architecture (CDA) developed by HL7 is a core document standard to comply and provide interoperability between hospitals, and propagation of the document format is very important for the exchange. But ground reality and common practice in hospitals is different and not willing to undertake interoperable Health Information System (HIS). This hindrance may be due to high deployment cost except for few developed countries. Many difficulties are faced while using the CDA document format because the data is not presented in a uniform and well organized manner and documents are more in number and leads to difficulty in management of such documents. Hence CDA document generation and integration using an Open API service based on cloud computing is very much requires, through which hospitals are enabled to easily and economically generate CDA documents without having to procure costly and custom software. This approach provides security to the CDA document through a unique identity (id) generation and avoids the interchanging and duplication of personal health reports. CDA document integration system integrates multiple CDA documents per patient into a single CDA and physicians and patients can browse the clinical data in chronological order.

**IndexTerms - Cloud computing, clinical document architecture.**

## I. INTRODUCTION

The concept of family doctor does not exist in existing system; hence it is common for a patient to visit a number of different clinics. Also medical tourism is one of the emerging areas and the movement of patients is worldwide nowadays. Healthcare industry has been one of the services that traditionally repelled outsourcing mainly because of the security and privacy concerns. The member's privacy and medical records are highly sensitive and the companies spend millions in protecting them while following the government regulated guidelines. However, rising medical costs might change the way this services is performed. Cloud computing can play a critical role in containing healthcare integration costs, optimizing resources and ushering in a new era of innovations. Current trends aim towards accessing information anytime, anywhere, which can be achieved when moving healthcare information to the cloud. This new delivery model can make healthcare more efficient and effective, and at a lower cost to technology budgets. EHR, doctor's references, prescriptions, insurance information, test results stored across different information systems. This is already happening in the radiological area, where many institutions have moved to the cloud to lower their storage costs and facilitate the exchange of images. Bigger cloud providers such Google App Engines and Amazon EC2 create and manage several copies of the data at different locations and data retrieval processes. This paper is organized and presented with the introduction in first chapter. Electronic Health Record (EHR) and Cloud Computing, Related Work, Existing System, Proposed System, Proposed Architecture, Module Description, Cloud Platform, are discussed in chapter II, III, IV, V, VI, VII, VIII and IX respectively. The Conclusion and Future Work is presented in chapter X.

## II. ELECTRONIC HEALTH RECORD (EHR)

### 2.1 Clinical Document Architecture

Clinical Document Architecture(CDA), Which is recommended by HL7, generation software is not centralized and it is platform dependant. So an open API is developed to process the CDA document. For Example, if the document is created under Windows platform, Separate cost is needed to process the document in Java platform. Moreover, duplicate records for same patient can be generated. Medical Record is confidential about the Patient. But the security to the Medical record is not provided. Our CDA document generation and integration Open API service based on cloud computing, through which hospitals are enabled to conveniently generate CDA documents without having to purchase proprietary software. CDA document integration system integrates multiple CDA documents per patient into a single CDA document and physicians and patients can browse the clinical data in chronological order. Developers using different platforms thus can use our system to enhance interoperability. A discharge summary is a document produced during a patient's stay in hospital and issued when or after a patient leaves the care of the hospital. The primary recipients of the discharge summary are healthcare providers who were providing the patient care prior to the hospital admission and will provide care to patient after discharge. It takes increasing 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 delays the medical personnel in making decisions. CDA document is generated through different platforms like window, java etc., lacks in security aspect, possibility of duplication of documents, costly proprietary software and high deployment cost.

## 2.2 HL7

CDA document generation system that generates CDA documents on different developing platforms and a CDA document integration system that integrates multiple CDA documents scattered in different hospitals for each patient. CDA Software is designed and run under browser support; the documents are to be stored in the server. So it is centralized. CDA document is generated in XML format so it is easy to feed in any platform. So it is platform Independent. Duplication of CDA document for Single patient is restricted by providing each Patient with Unique Id. Physician can download the Patient CDA document by providing their physicians ID, Patients unique Id and Password. After Login, physicians can View the health check history report, Clinical wise history, its equivalent Prescriptions and Treatments in complete Report manner. Added to that, physician can view the list of sickness or Abnormalities the patient is facing. The physicians can view the Prescription in Clinical wise. So the physician knows how to sight the instruction in sickness intelligent or scientific shrewd the novel updates in the CDA document reflected in the cloud server. For Security Purpose, All the data in CDA document is Encrypted while storing in the Cloud Server

### III. CLOUD COMPUTING

Types of clouds are Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud. Components of Cloud are Clients, Applications, Services, Platforms, Storage, Infrastructure. Services provided by cloud are Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and HaaS. Advantages of Cloud are Reduced Cost, Increased Storage, Highly Automated, increased mobility, allow IT to shift focus, Dynamic Scaling, Sharing and coordinated use of resources, Pay-as-you-go Model, Less CAPEX, Cost Efficiency, Convenience and continuous availability.

The data security is ensured through many methods like encryption and two factor authentication by Cloud security. The dynamic scalability is achieved when the usage is grown in future course of time. The data security is ensured by many methods like encryption and two factor authentication etc., The cost involved in deployment is very cheap because of pay for use model of cloud environment compared to the conventional physical infrastructure models.

### IV. RELATED WORK

CDA documents without having to purchase proprietary software. Our CDA document integration system integrates multiple CDA documents per patient into a single CDA document and physicians and patients can browse the clinical data in chronological order [1] [3]. Multiple document is converted into single document using face recognition system for patients and other users with safety and privacy [9]. Multiple CDA documents per patient into a single CDA document in chronological order. These CDA documents are converted into XML format. This readable format increases the usage of the system and reduces the time for physicians from delay of making decisions [4]. This paper addresses design and architectural issues of PHR systems, and focuses on privacy and security issues which must be addressed carefully if PHRs are to become generally acceptable to consumers [2]. The document security and system security and support easy access to the HIS applications by using light weight cryptography one-to-many AES (Advanced Encryption Standard) security algorithms and deploy cloud infrastructure as security service and share implementation experience. The cloud solution for security (encryption and decryption) in light of the Advanced Encryption Standard (AES). The browser security protocols Transport Layer Security (TLS) and Secure Sockets Layer (SSL) are used to assure safe communications over networks[5]. CDA archive coordination framework that integrates different CDA documents scattered in distinctive healing centers to each tolerant. Using open API Different designer platforms a direct result an open API is to drive our CDA report era What's more reconciliation framework. In any We recommended the CDA record arrangement a clinical data standard outlined will assurance interoperability between hospitals, and using hash message authentication code[6]. The CDA document generation and integration using Attribute based encryption technique based on cloud computing. Our CDA document integration systems integrate multiple CDA documents and encrypt the data according to the usage and privacy of the documents depending upon the attributes. The data can be viewed, analyzed, downloaded by the doctor and the patient in chronological order. Our system of CDA document generation and integration is based on data mining and stored in cloud computing [7]. Security to the CDA document and a unique identity (id) is generated and given to the patients for avoiding the interchanging and duplication of medical reports. Every detail in CDA document is Encrypted and stored in Database. All Details in CDA Document is secured using various Security Algorithms [8].

### V. EXISTING SYSTEM

Developers using different platforms thus can use our system to enhance interoperability. A discharge summary is a document produced during a patient's stay in hospital and issued when or after a patient leaves the care of the hospital. The primary recipients of the discharge summary are healthcare providers who are providing the patient care prior to the hospital admission and will provide care to patient after discharge. It takes increasing 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 delays the medical personnel in making decisions. The existing system has disadvantages like CDA document is generated through different platforms like window, java etc., CDA document lacks in security aspect, Duplication of documents is possible, Costly proprietary software, High deployment cost.

### VI. PROPOSED SYSTEM

CDA document generation system that generates CDA documents on different developing platforms. CDA document integration system that integrates multiple CDA documents scattered in different hospitals for each patient. CDA Software is designed and run under browser support; the documents are to be stored in the server and centralized. The generated XML format CDA document is simple and easy to feed in any platform and become platform Independent. Duplication of CDA document for Single patient is restricted by providing Unique Id to each patient. Physician can download the Patient CDA document by providing their physicians ID and Patients unique Id with Password. After Login, physicians can View the health

check history report, Clinical wise History, its equivalent Prescriptions and Treatments in complete Report manner. Added to that, physician can view the list of sickness or Abnormalities the patient is facing. The physicians can view the Prescription in Clinical wise. So the physician knows how to sight the instruction in sickness intelligent or scientific shrewd the novel updates in the CDA document reflected in the cloud server. For Security Purpose, All the data in CDA document is Encrypted while storing in the Cloud Server.

The proposed system has advantages like Platform independent, Enhanced security features, No duplication of CDA document, Low deployment cost, Open API service, High efficiency, Highly Dynamic Scalability. Individually Hospitals do not have to purchase EHR software to generate and integrate CDA documents. Cost of the software is not needed to be paid by the hospital management. The document generation system produces the document in such a way that is approved by the National Institute of Standards and Technology (NIST).

### VI. PROPOSED ARCHITECTURE

The details of patient X, Y, Z who are admitted in hospital A and B are registered in patient registration form along with doctor information form, organization form ,Author information form, patient diagnosis form and patient history form. These information are stored in HIS and its associated DBMS. These forms are fed to CDA generation system which generates CDA document to the patient X , Y, Z in hospital A and B with a unique id.

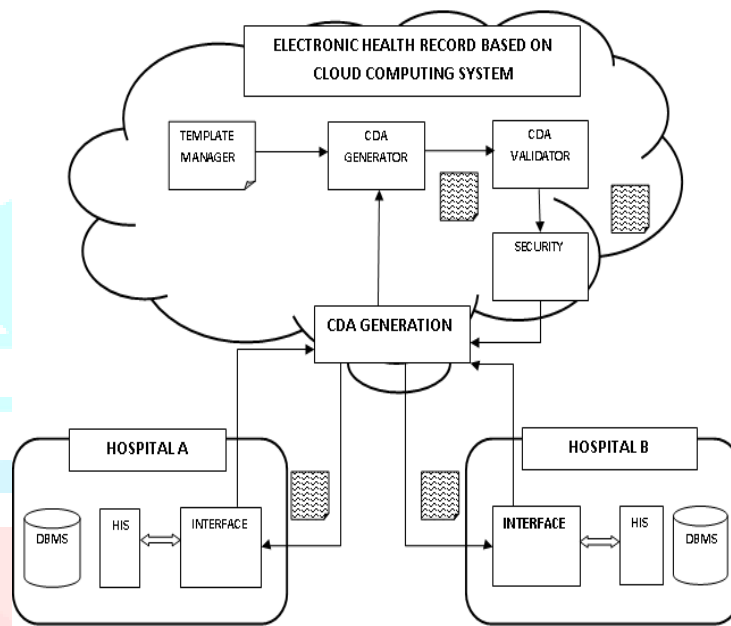


Fig.1.Proposed Architecture

Two different document is generated by different hospitals like A and B to a patient X. These documents are in different format, because different hospitals are using different platform like java, .Net etc. So it should be integrated into a single document to exchange between different hospitals. These individual different documents are integrated into a single document by CDA integration system and its stored in cloud server. The CDA generation system provide the single CDA document into the different hospital for patient X,Y,Z.

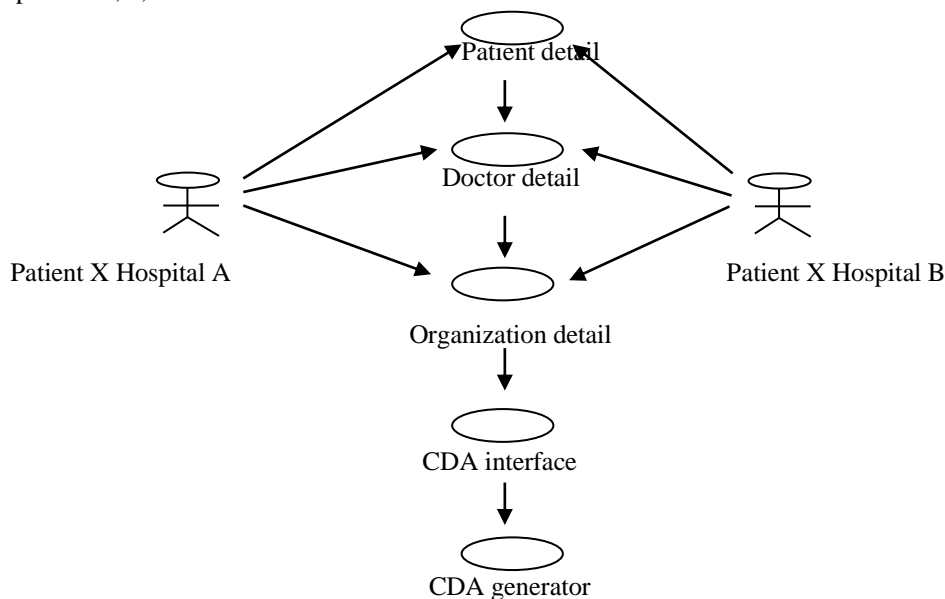


Fig.2.CDA Generation System

VII.MODULE DESCRIPTION

7.1 Hospital A Patient X CDA Document Generation Module

The details of the patient X admitted in hospital A are registered in patient registration form like name, DOB, Email id, address detail, contact detail, user name and password. This details are entered in only once in patient registration form. This information stored in HIS associated with Data Base Management System. This form is given to CDA generation system. Thus CDA document is generated to the patient X in hospital A with a unique id.

7.2 Hospital B Patient X CDA Document Generation Module

The patient X admitted in hospital B need not registered in patient registration form because the patient is already registered in hospital A. The personal, health related information is stored in HIS associated Data Base Management System. The doctor enter into the doctor login form and patient user name and password to collect the past details and diagnosis the problems of patient. The present illness details are updated and new CDA document is generated.

7.3 Patient X CDA Document Integration Module

Two different documents are generated by different hospitals like A and B to a patient X. These documents are in different format, because different hospitals are using different platform like java,.Net etc. So it should be integrated into a single document to exchange between different hospitals. These individual different documents are integrated into a single document by CDA integration system. The integrated document can be viewed and maintained by administration of the hospital. The patient can visit and get their form at anytime even after few years.

7.4 Patient X CDA Document Security Module

The detail of the patient cannot be viewed by others, because the documents are protected. Each patient has unique id and password without correct correct unique id and password even doctors could not be viewed the documents. This module ensures the security and secrecy of the personal, health related information of the patient.

7.5 Doctor Access the Patient X CDA Document Module

Physician can download the Patient CDA document by providing their physicians ID, Patients unique Id and Password. After Login, physicians can View the health check history report, Clinical wise History, its equivalent Prescriptions and Treatments in complete Report manner. Added to that, physician can view the list of sickness or Abnormalities the patient is facing. The physician can come to know about the sickness history of the patient. After the treatment, physician can update the current prescription.

VIII.CLOUD PLATFORM

8.1Amazon Web Services (AWS)

Amazon web services offers a broad set of global cloud-based products including compute, storage, databases, analytics, networking, mobile, developer tools, management tools, IoT, security and enterprise applications. These services help the organizations move faster, lower IT costs, and scale. AWS is trusted by the largest enterprises and the hottest start-ups to power a wide variety of workloads including: web and mobile applications, game development, data processing and warehousing, storage, archive, and many others.

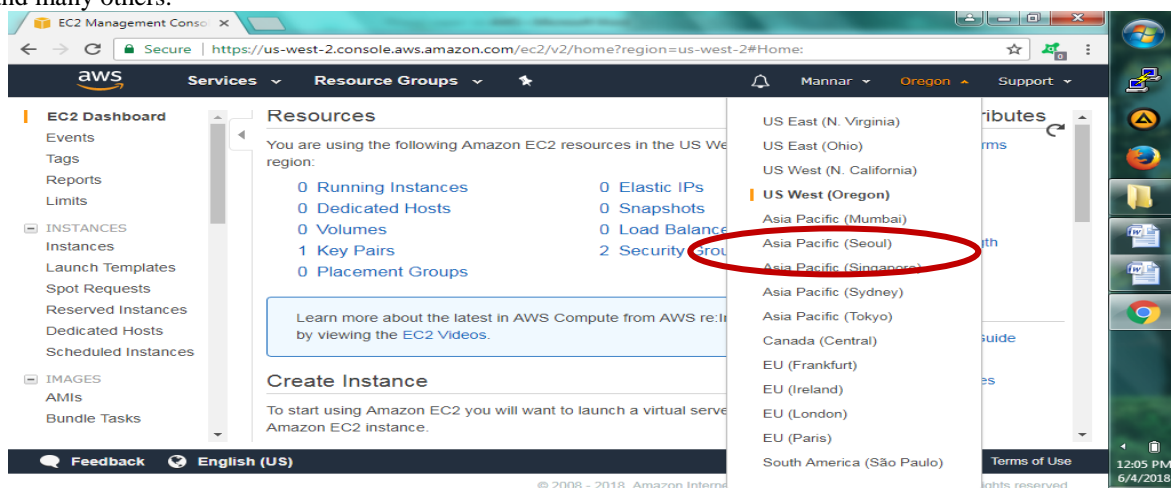


Fig.3. Amazon web service

The amazon web service provide services like virtual server from the US West (orgen) as shown in figure3. The user can chose any of the server from AWS list of servers, which is located through out the globe.

### 8.2 AWS Elastic Beanstalk

AWS Elastic beanstalk is an easy-to-use service for developing and scaling web applications and services developed with Java, .Net, PHP, Node.js, Python, Ruby, Go, and Docker on familiar server such as Apache, Nginx, Passenger, and IIS. User can simply upload their code and Elastic Beanstalk automatically handles the development, from capacity provisioning, load balancing, auto-scaling to application health monitoring. At the same time, user retain full control over the AWS resources powering user application and can access the underlying resources at any time. There is no additional charge for Elastic Beanstalk-user pay only for the AWS resources needed to store and run their applications. The AWS elastic beanstalk configuration system is configured PHP7.1 running on 64bit Amazon and version Linux 2.6.6 as shown in the figure4.

## IX.RESULTS AND DISCUSSION

### 9.1 Doctor Login Form

The details of the doctor are registered in doctor registration form like name, date of birth, Email id, address detail, contact detail, user name and password. This details are entered in only once in doctor registration form. This information stored in HIS associated with Data Base Management System. The doctor login into the doctor login form with a unique id. After Login, physicians can View the health check history report, Clinical wise History, its equivalent Prescriptions and Treatments in complete Report manner. The doctor login form is shown in the figure5, after uploaded in the cloud server.

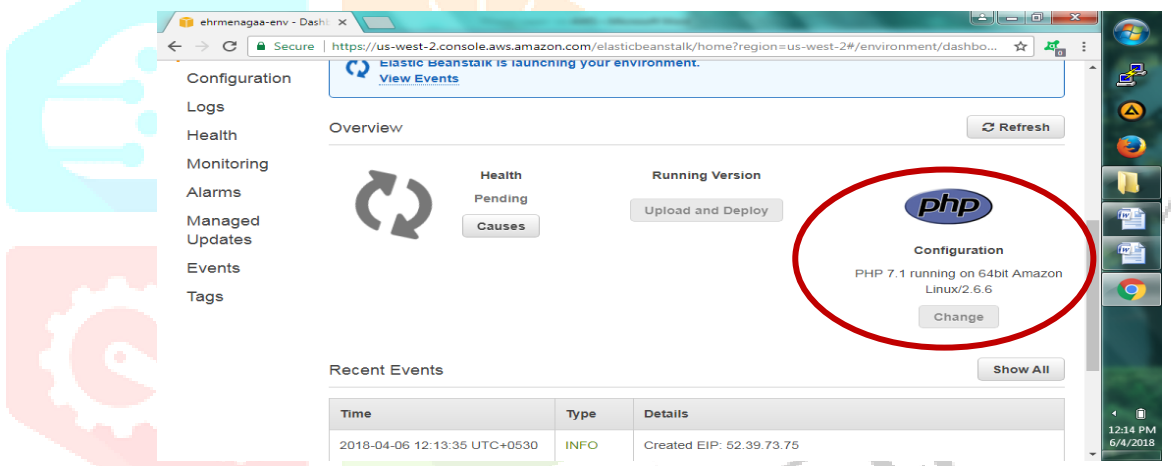


Fig.4. AWS elastic beanstalk configuration



Fig.5. Doctor login form

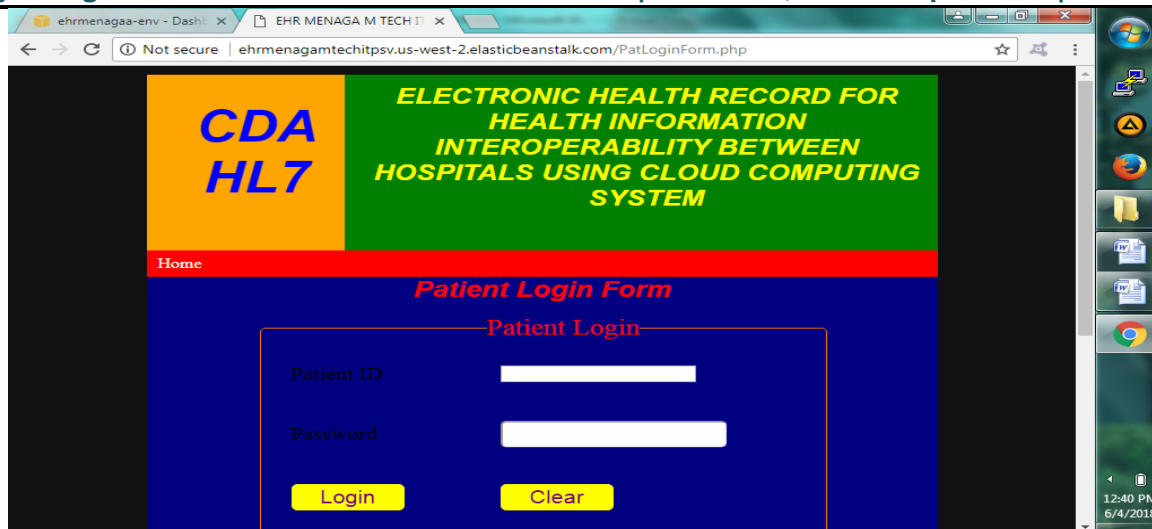


Fig.6. Patient login form

## 9.2 Patient Login Form

The patient login into the patient login form with a unique id and password and also access the details anywhere in this world. The patient login form is shown in the figure6, after uploaded in the AWS server.

## 9.3 Patient Registration Form

The patients admitted into the hospital, that patient does not have unique id and password. The admin help to create the patient registration form with the details like name, date of birth, Email id, address detail, contact detail, user name and password. This details are entered in only once in patient registration form. to the patients. The patient registration form is shown in the figure7, after uploaded in the cloud server.



Fig.7. Patient registration form

Clinical Document Architecture based electronic health record for interoperability between hospitals using cloud computing is implemented using AWS cloud server which is located in US West (orgen) with advantages like Platform independent, Enhanced security features, No duplication of CDA document, Low deployment cost, Open API service, High efficiency, Highly Dynamic Scalability. To improve the security of the system, data can be encrypted before stored into the cloud server.

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