

Implementation of Cloud based Electronic Health Record (EHR) for Indian Healthcare Needs

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Abstract

Background/Objectives: EHR means the digital version of the patients medical report, in store the data in real time, it contains medication and treatment history which includes the broader view of patients care and it also contains patients medical history, diagnosis, medications, treatment plans, immunization data, allergies, radiology images, laboratory and test results. **Methods/Statistical Analysis:** The main intention of EHR is to have access to evidence based tools that health providers can make use to make decision and disease diagnosis about the patients care delivery. The current population of India (2014) is 1.27 billion. About 72.2% of the population lives in some 638,000 villages and the rest 27.8% in about 5,480 towns and urban agglomerations. **Findings:** In our proposed work we develop Electronic Health Records (EHR) to integrate with the health care providers all over India and to implement it with the cloud infrastructure. The main challenges that are addressed in this works are, handling heterogeneous data, data storage, use of data analytics tool for decision making, data privacy and the data security. **Application/Improvements:** This can be used to integrate the healthcare management system. Once implemented it provides remote medication, vaccination management, disease diagnosis, remote diagnosis and remote real time monitoring and personal health record.

Keywords: Clinical Data, Cloud, Feature Selection, Medical Diagnosis

1. Introduction

The government has initiated various steps in implementing the EHR for our Country. It electronically stores the medical records of users and uploads them on a secure cloud based account. From the perspective of Indian Medical care system, patients visit several doctors, throughout their life time right from visiting a primary health center to community health. Health records get generated with every clinical meet during the inpatient or emergency visits. However, most health records are either lost or remain in the supervision of health care providers and gets destroyed. As per the maintenance period of medical records generally followed by hospitals is 5 years for out-patient records and 10 years for in patient records. Medical records are however retained permanently. This

is pertinent to health care setups with a proper medical record department only. Medical record is the record of the hospital and is not part of patient or clinical department or doctor. The patient also has no proprietary right on his own clinical record today. The patient today carries with him is the discharge summary of his clinical investigation reports and usually radiology films or images. Also, important clinical data is not available for research and for reference to aide in clinical decision support. And also suffers in the study of disease trends and statistical analysis of clinical nature today.

As per the EHR standards released in August 2013 by the Ministry of Health and Family Welfare, Government of India, to create an Electronic Health Record (EHR) of an individual it is essential that all clinical health records created by the various health care providers that a person

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visits during his/her lifetime be stored in a central clinical data repository and also be shareable through the use of interoperable standards. Adequate safeguards to ensure data privacy and security must strictly be included at all the times since the patient's medical data are so sensitive and to be protected. Patients must have the privilege to verify the accuracy of their health data and gain access. The EHR standards of India emphasize on patient as the authorized owner of his health data. The standards aim to develop a system which would allow one to create, store, transmit or receive electronically using reliable media for data storage and transfer. EHRs can bring a patient's complete health information together for underneath better medical decisions.

In¹ proposed to build privacy into mobile healthcare system with the help of the private cloud. It includes features such as efficient key management, privacy preserving, data storage and retrieval for retrieval at emergencies and auditability for mining the health data. It provides the encryption where patients encrypt their own health data and store it on the third party server. It also focuses on cloud based server storage and keyword search. The build private cloud will process the data to add security protection before it is stored on the public cloud. It is the infrastructure owned by the cloud providers such as Amazon and Google which offers main storage and rich computational resource? It also addresses main security requirements like storage privacy, anonymity, unlikability, keyword privacy, search pattern privacy, etc. It also addressed the storage privacy by including the secure indexing or SSE.

In² stated that the analytics could be used to systematically review clinical data so that the treatment procedure could be based on the best available data instead of expert's decision. The survey says that the health care industry could save billions by using big data health analytics to mine the treasure trove of information in EHR, insurance claims, prescription orders, clinical studies, government reports and laboratory results. Also long wait at hospitals for a room could be reduced once calculations can be made to predict when bed might become empty.

It³ expressed an efficient way called neighboring cleaning that solved the problem and improved the classification accuracies from 5 to 10%. It also showed the distribution of data sets to be classified using different cleaning techniques. Cleaning techniques are used in order to improve classifications. It provides accuracies from 80

to 90%. Without claiming which reduced down to half for neighborhood searching, naïve bayes rule and logistics discriminate analysis whereas linear and quadratic discriminate analysis and support vector machine with the linear and quadratic minor improvements. The US⁴ spends about 17% of its domestic product on healthcare. It is expected to increase by 19% in near future. Although the advancement in health care information technologies have led to big data environments in hospitals, extracting the information that is the data which assists decision makers in better decision and increase the efficiency of the healthcare system. It also discussed some the initiatives taken by US government recently.

It⁵ provided the health system for connecting and general hospitals. It identifies the hospital preferences and patient decision making behavior. This system used the agent based modeling and simulation to build the artificial HCS platform for sharing beds, sharing doctors and cost accommodation. Due to which the patient access time can be greatly reduced. The patient preferences are categorized into three types like type, factors and evaluation index. The type includes accessibility, cost and the hospital level. The factors include conveniences, reimbursement, expense and the technical level. The evaluation index includes the access time, cost accommodation and hospital level rating. This system can be highly recommended on applications such as cooperation policies, increased utilization rates and appointment system. China has attracted a new system in the healthcare industry called urban health care system. It includes the community health system and medical delivery system. It provided a study on patient hospital preferences and related patient decision making behavior using agent based modeling and simulation. As a new tool for sharing beds, doctors and cost accommodation.

It⁶ examines the recent health analytics by describing the different health analytics and providing applications like global healthcare. The data acquisition is increasing substantially across different type of health information technology including EHR, clinical health information, medical imaging, public health database and propriety system for health care providers life physicians, insurance companies, hospitals government agencies and others.

The government had planned a pass notice on making the process of the finalized the EHR standards to be already finalized and notified by MoHFW. The EHR will be able to integrate systems, improve record keeping, promote the practice of evidence- based medicine,

accelerate research build effective medical practices and ensure safety, audit and authorization control mechanism to improve the overall quality of healthcare delivery. It also announced to adopt the EHR standards for all the states.

It⁷ introduced an efficient four stage procedure like feature extraction, feature selection, feature ranking and classification. It builds a model in which maximum classification accuracy is obtained. It also discussed about the comparison of different methods and classifiers. In the^{8,9} analysis of Electronic Health Record (EHR) data can lead to improved clinical outcomes. It can also help to predict an individual future healthcare needs which can be valuable for both the payer and provider. It fully exploits this abundance of data¹⁰, health care organization must create a culture that places a premium on fact based planning and decision making.

In^{11,12} the methods used for the feature selection and the importance of feature extraction are discussed with the necessary results. It explains the mathematical model for the feature selection and feature extraction from the high dimensional databases.

3. Proposed Work

In the recent years the data are electronically available like the travel tickets available as e-tickets, retails available as e-retails etc. So why don't we have the medical data of a person electronically. The idea is to make health records and medical history of people easily accessible to them anywhere anytime, through desktop or any mobile device. Having such an Electronic Health Record (EHR) could be lifesaving in many critical situations. Also an EHR provides the benefit of not having to store bulky hardcopies of the whole family. The paper based records^{13,14} are low in cost but have limitations such as difficult to access, time consuming to update, not secure, impossible to share and maintain for long life time. The practice of keeping electronic health and medical records is evolving in the developed countries like USA, UK etc. The country like Australia is dedicated to the development of a lifetime electronic health record for all its citizens. But the question arises how viable is this idea in a country like India. This can be possible if all sections of the society, especially the poor ones, through government's support. Once the practice of EHR is implemented in government hospitals, this initiative will be beneficial for the masses.

3.1 Data Collection

The data set primarily includes data items to capture patient clinical information and emergency contact information, doctor information, insurance information, reason for visit, patient history like present, past, personal, family, obstetrics and gynecology, surgical, immunization, allergy history, clinical test results, blood group type, diagnosis test undergone, test results, medical summary, treatment plan for medication referral etc. We follow the standard template for the storage of the medical record. The Figure 2 shows such format which is again approved by the government.

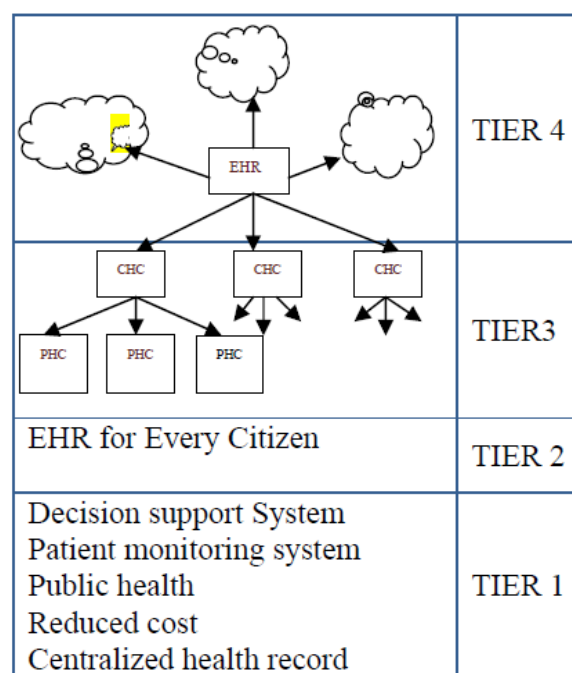


Figure 1. Proposed architecture.

The real time medical data are collected from the primary health centers, community health centers and both are integrated with the aadhar number as the unique identity. The duplication of the data will be removed.

3.2 Experimental Set Up

The collected large data sets are stored in server database. The architectural set up in such a way to manage the large amount of data. The iWeb on demand infrastructure cloud server makes hosting simple and effortless. In India, the Public Health Centres (PHC) is the state government undertaking health care facilities. They are owned by single doctor with minor facilities.

Format for Medical Records
(As specified by Medical Council of India under regulation 3.1)
Name of the patient:
Age:
Sex:
Address:
Occupation:
Date of 1st visit:
Clinical note (summary) of the case:
Provisional Diagnosis:
Investigations advised with reports:
Diagnosis after investigation:
Advice:
Follow up
Observations:
Date:
Signature in full
.....
Name of Treating Physician

Figure 2. Medical record standard template.

They are also funded by government. At present there are 23,109 PHCs in India. In our research the patient's data can be collected from every PHC located in every district's. Every PHC are connected to the Community Health Center present in every district. Every district or city can have more than one Community Health Center also. But there is a necessity to encourage and motivate to normalize, incorporate and information exchange among the service providers. The Figure 1 shows the basic architecture for the method proposed. It is divided into four tier architecture. The top layer is the centralized EHR which is connect to internet via cloud. The third tier is the interconnection between the Community Health Centers to the primary health centers. The tier two provided the EHR for the entire citizen in India which in turn is used to provide various applications like Decision support system, Patient monitoring system, Public health, reduced cost and centralized health record which in turn is present in the tier 1.

The huge amount of data collected is managed by the big data analytics. The data collected are mined using data mining algorithms. The data has to undergo some of the preprocessing techniques. After the preprocessing step

the feature selection technique is used to extract relevant feature which in turn used the wrapper method which is more efficient and less costly. After the filtering process the ranking methods are involved to find the priority of the features present. Then the data is hosted in cloud to integrate the health care system. The indexing is done to provide the authentication using cloud. The main advantage of this work is to standardize the treatment procedures in India. Once it is implemented the treatment cost for the patients will be reduced in a random manner. Also the cloud infrastructure is developed to provide the data globally. The iweb cloud server is used to store the data in cloud. It is based on windows platform.

3.3 Simulation

The R tool is used for the simulation. It is mainly chosen hence it provides the automation of the work. It is used to simulate the medical data set to do the classification of the data using feature selection and feature extraction to remove the irrelevant data and redundant data. This tool is used for the data analytics process. It provides an efficient way to do the analytics for the prediction and diagnosis process.

3.4 Implementation of Algorithms with Real Time Data

After the collection of the real time data set the feature selection and feature extraction technique is applied to remove the irrelevant data. The data are stored with the standard medical format. Then the real time data is implemented with the feature ranking in order to find the priority of the features present in the medical record format.

3.5 Analysis

The study and analysis on the existing methods for the clinical data set is considered. In the traditional method every patient has the hospital ID for every hospital. They need to carry their reports whenever they need diagnosis by their medical experts. So it is difficult to access the details of the clinical data in the emergency cases because the data is not available globally. In this research work it stores all the history of the patient electronically and it will be stored with the unique id. So he/she will be able to take the treatment wherever during a medical expert refers another medical expert. Also the test for diagnosis

need not be repeated again and again which will happen in the traditional system. This benefits the patients in reducing the treatment cost, standardized treatment procedure, diagnosis of the disease and main the history of the patient throughout the life time.

4. Conclusion

From a recent magazine report of analytics it is estimated that the health care industry could save billions by using big data health analytics to mine the information in Electronic Health Records, insurance claims, prescription order, clinical studies, Government reports and lab results. Analytics are majorly used to systematically review clinical data to provide decision based on the available data. Interesting thing is that instead of seeing only 20 patients a day doctors are available to see 75 to 100 people and get ahead of the wave. The main future of health care is to provide such physician support tools. Also to concentrate on areas such as to develop programs to prevent falls by patients in the hospital, predict the length of hospitals stays, create early warning system to spot complications after a procedure and reduce the number of people being readmitted for the same condition. The work is carried out to standardize the health record of the people for India. This work will finally have the EHR for India and finally provides many merits such as patient treatment cost will be reduced, patient data are managed efficiently, authentication of data is provided, indexing the authentication using cloud etc. Only the authorized experts can view the patient's details, since the data is very sensitive.

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