Electronic Health Records and its Acceptance by Stakeholders: General Discussion

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ABSTRACT

There is a definite need of complete health information of a patient. Medical history of the patient should be maintained in prescribed format. It is definitely required to identify information about patient's medical interactions, allergies, laboratory tests, medication, and so on. Patient's all such record should be kept at secured place. Instead of keeping record in conventional paper form, it is definitely feasible to maintain it in digital form. In this paper there is detailed discussion of EHR system, historical perspective of EHR, EHR Challenges in India. This paper also has an overview towards adoption of Information and communication Technology (ICT) in healthcare. There are various strategies towards implementation of successful EHR system. EHR system and its acceptance of use is mapped with universal theory of acceptance and use of technology (UTAUT). Patient's record can be maintained in EHR standards that are recommended by health information authorities.

Keywords

EHR, ICT in Healthcare, Patient, Interoperability, EHR Standards, UTAUT.

1. INTRODUCTION

India is one of the dense populated countries and health care is challenging issue. In India numbers of healthcare facilities are very less compare to the actual demand in our country. There are sufficient healthcare centres available in big cities, but there are some areas in rural region where health care facility is challenging issue. There is also a global demand for better and more efficient healthcare services. This can be considered as definite solution to keep patient's health Information. This adoption of ICT is also termed as Electronic Health Record (EHR). Due to complexity of health problems, multiple healthcare providers are involved in treatment of a patient. Healthcare is mandatory for every person. Person is availing the healthcare facility from the very first day of his life. Various health care regulatory authorities have recommended various standards to maintain patient's healthcare information. Some of these standards easy to use and that can be adopted effectively to implement EHR system. Many countries are promoting increased use of IT in healthcare services. Use of EHR is found suitable to provide continuity of care to patients. The concept of maintaining patient's health care information is not a new concept as it was developed by Hippocrates In the fifth century B.C. with two specific goals [EHR Overview 2006] as a) Preserving course of a disease and b) Indicating probable cause of a disease. These goals are still precise. Medical records are stored since ancient era as few carvings are found that is a evidence of medical record keeping, see figure 1 below.

Figure 1: Carvings that describe the ancient healthcare practices, Source: https://images.app.goo.gl/RP6MDGS7JjGUPSgBA

Earlier the patient record was maintained in paper format and preserved in huge cabinet and used whenever required for reference or verification. It was necessary to preserve the treatment plan to be used for future use and also to keep track of patient health. During the period of 1990 to 2000 medical transcription was emerging field where doctors use to send their dictation in sound files and that is converted into computer file.

Users can further enhance the use of healthcare information using information and communication Technology. In India National Electronic Health Authority (NeHA) has initiated some efforts towards implementation of health Records using effective EHR Standards such as ICD, SNOMED CT, DICOM, LOINC. There are various communication standards to share the health information. These communication standards are nothing but HL7, XML. If patient's all interactions related to healthcare are recorded in prescribed format, it will be very easy to decide the treatment plan for particular patient. Sometimes there is a need to refer the patient to expert medical practitioner or to transfer patient to advanced medical treatment to specialised healthcare centre. If patient's history is readily made available it will also save time to analyse the patient's case. With adoption of EHR there is a definite assurance of the systematic workflow of healthcare and a secured and authorized access to health information, faster access to health records irrespective of place and time [16].

2. WHAT IS EHR?

EHR is nothing but Electronic Health Record and it can assure the systematic Healthcare due to effective record management of patient's Healthcare information. In this section there is an overview of few terminologies with respect to Electronic Health Record.

Here are few Definitions: An Integrated Care EHR: "A repository of information regarding the health of a subject of care in computer process able form, stored and transmitted securely, and accessible by multiple authorized users. It has a standardized information model, which is independent of EHR systems. Its primary purpose is the support of continuing efficient and quality integrated healthcare and it contains information, which is retrospective, concurrent, and prospective" [defined by ISO/DTR 20514]

"EHR is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter, as well as supporting other care-related activities directly or indirectly via interface including evidence-based decision support, quality management, and outcomes reporting" as defined by Health Information and Management Systems Society [HIMSS 2011].

With respect to Electronic Health Record there are different terminologies as mentioned below:

2.1 Electronic Medical Record (EMR)
EMR is often used in parallel with EHR. Each stake holder should be allowed to access patient's healthcare information. It is not only a set of records of single encounter or a single care episode. It is definitely an overall information of all encounters of a patient.

2,2 Computer-Based Patient Record (CPR)
CPR was first used to conceptualize the idea of EHR [Richard et al. 1997]. It is a lifetime health record of a patient, which includes information from all specialties. It requires full interoperability (potentially international interoperability) that may be achieved in the near future.

2,3 Electronic Patient Record (EPR)
EPR is similar to CPR, but does not necessarily contain a lifetime record and focuses on relevant information only. This may be a patient's interaction for particular treatment for limited time period.

2.4 Personal Health Record (PHR)
PHR is managed and controlled by a patient. It is mostly considered to be web-based. Usually, PHR is another patient-side view of an EHR/EMR maintained by a particular group of healthcare providers.

3. NEED OF EHR IN INDIA
Recently Ministry of health has framed the guidelines for Electronic Heath Records (April 2016) which describes the need for elimination of conventional health record and how it will help to Provide medical facilities with ease [3]. The major focus is to identify how Interoperability for medicinal services can be framed and to identify or test the feasibility and acceptance of the EHR. It is mandatory to provide maximum feasibility to use "EHR" as per the guidelines framed by Health Ministry. It is a major task to provide a suitable architecture for Electronic Health Record System along with an acceptance model for EHR system. Medical data is generated in various forms by large number of medical practitioners and hospitals [6]. Health related information itself has witnessed exponential growth. The traditional data applications are not appropriate to analyse and process this huge amount of data. Data is being generated from various sources. Data capturing, analysis, searching, sharing, storage, data visualization and security are emerging as major challenges. Data is currently stored in paper format and it is mostly unstructured data. For example, a document may contain a few structured fields, such as Patient Name, Age, and Gender Physician Information; and so on, but also contain some largely unstructured text components, such as Medical History, Treatment, Reports and Precautions [7].

3.1 Major Challenges in India
Due to the size of the population, high percentage of rural population (28% urban versus 72% rural, Source 2011 Census Data). This data may change rapidly in upcoming years as urbanization is gradually increasing [14]. Due to rapidly growing Urbanization, industrialization, environmental degradation and the persisting inequality in health status between and within States/UTs, India currently faces challenges such as
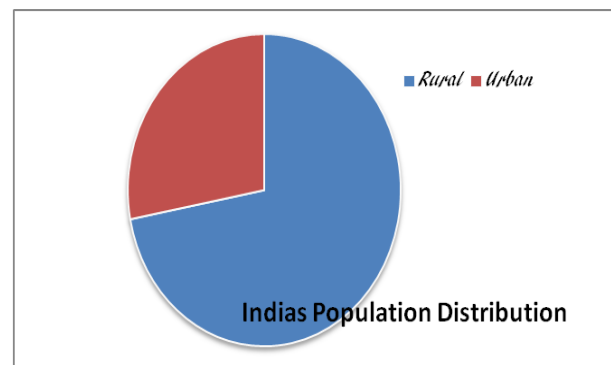

Figure 2: India's Population Distribution

1. No specific plan to manage health related challenges.

2. Emerging Diseases related to lifestyles.

3. Emerging Infectious Diseases.

4. Lack of manpower.

5. Lack of infrastructure.

6. Minimum use of Information and communication Technology.

Apart from above there is comparatively less awareness to store and use health information in prescribed format. To create awareness among stakeholders government has initiated National Health Portal and various web services to upload and store patient information [17]. Following are few areas there is a scope for improvement and that will help to identify objectives of implementing EHR System[8] .

1) A health information system that has a patient centric approach needed to be developed.

2) Health information management system using standards specified by ministry of health and family welfare.

3) There is a need to test the existing system with respect to share health records using HL7 or XML message format.

4) It is also necessary to build communication Portals, Connecting to various platforms and Help aid for the patients.

5) Security and privacy issues should not be ignored over growing demand in healthcare data. The challenges of EHR are Privacy, Security, user friendliness, portability and interoperability need to be addressed.

6) There is definitely a need of interoperability to address various activities such as insurance, Pharmacy, Pathology, post medical healthcare using effective architecture.

It is observed from recent survey that people are aware about insurance and other facilities related to healthcare but there is no effective EHR system existing. Most of the family physicians or general practitioners are not maintaining patient record in systematic format. Awareness need to be created among citizens and medical practitioners regarding EHR system [13].
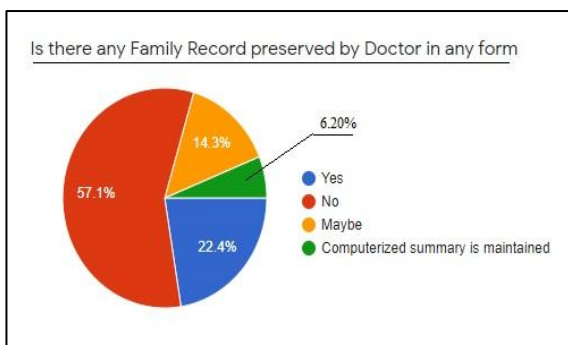

Figure 3: Survey Result regarding preservation of Medical Record and people having insurance
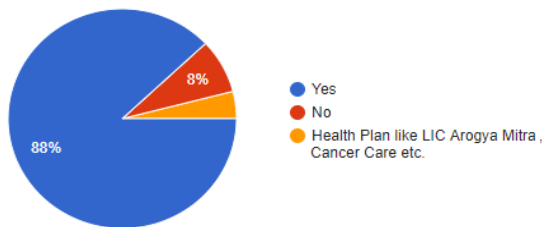

Figure 4: People who availed Medical Insurance

4. EHR AND BIG DATA

Healthcare data is having some level of relationship with 'Big Data' as it is Diverse, high volume, high-velocity and valuable information [4]. It needs different forms of processing to enable enhanced decision making, insight discovery, and process optimization. Health records are generated at various locations by various categories of the users. Healthcare data is also generated in various forms as there is no any standard methodology adopted by healthcare workers [12]. Most of the hospitals have the hospital management system limited to billing but data is still maintained in conventional form. Hence health data is having vast Datasets that exhibit variety, include structured, unstructured, and semi-structured data and generated at high velocity with an uncertain pattern [1]. Health related information do not fit neatly into traditional, structured, relational databases. There is a huge scope for capturing , processing, transformation and analysis in a reasonable amount of time. There is definite scope for sophisticated information systems [5].

5. BENEFITS OF EHR

Data could become more accurate and retrieval time will be reduced. Also less storage space is required and hospital or clinical administration becomes easier. All the stakeholders involved in healthcare starting from patient to insurance companies can access data remotely and instantly [3]. In EHR all the functionalities can be incorporated with ease. Standard modules such as patient registration, patient documentation, keeping systematic clinical notes, prescriptions, and billing can be made available as per need of the healthcare team[2]. The major attraction of the EHR systems is that information can now be accessed and shared from multiple places.

6. EHR STANDARDS

EHR standards are recommended to assure the accurate notification of the diseases. If patient data need to be shared to expert it is necessary to provide a correct specification of the disease to assure accurate treatment. Most of the medical practitioners are using either locally identified names or abbreviations of the disease to record patient's diagnosis information. It is necessary to use the clinical terms in prescribed format. Standardized information will help to create systematic records of the patients. Following are various EHR Standards recommended by ministry of Health and family welfare.[9]

Table 1: E.H.R. Standards at a glance [20]

Sr.	EHR Standard	Owner or Initiating authority	Description
1	ICD: International Classification of Diseases	**U.S.** National Center for Health Statistics (NCHS).	The International Classification of Diseases is a globally used diagnostic tool for epidemiology, health management and clinical purposes.
2	SNOMED-CT: Systematic Nomenclature of Medicine and Clinical Terms.	SNOMED International	It provides a standardized way to represent clinical phrases captured by the clinician. SNOMED CT based clinical information benefits individual patients and clinicians as well as populations and also supports evidence based care.
3	DICOM: Digital Imaging and Communication	American College of Radiology (ACR) and the National Electrical	Digital Imaging and Communications in Medicine - is the international standard for medical images and related information. It defines the formats for medical images that can be exchanged with the data and quality necessary for clinical use.

		in Medicine	Manufacturers Association (NEMA)	
4	LOINC: Logical Observation Identifiers Names and Codes		It is owned, maintained and distributed by Regenstrief Institute, Inc USA.	Test and Measurement Observations. A formal, distinct, and unique 6-part name is given to each term for test or observation identity. The database currently has 84868 terms that can be accessed and understood universally.
5	UMLS: Unified Medical Language System		National Library of Medicine	**Unified Medical Language System**, is a set of files and software that brings together many health and biomedical vocabularies and standards to enable interoperability between computer systems. It is in short an Ontology of biomedical Concepts
6	HL7 : Health Level 7 Communication Standard		HL7 international	This is a Communication Standard used to share healthcare Data in systematic format, exchange, share, integrate and retrieve health information.

The major expectations from electronic health record standards are:

- Promote interoperability.

- Promote technical innovation.

- Encourage participation and adoption by all vendors and stakeholders.

- Keep implementation costs as low as reasonably possible.

- Consider best practices, experiences, policies and frameworks.

India is witnessing phenomenon / growth in health care segment, huge human data is generated, but it is in paper form. Data should be used, generated and stored based on industry standard.

Standard is a framework of specifications that has been approved by registered organization or accepted and widely used throughout an industry [10].

Interoperability refers exchanging standard based data within different parties or entities. Healthcare

Information Management System Society (HIMSS) says interoperability means ability of Health information system to work together with and across organization boundaries [19].

Concepts for interoperability are

1) Syntax: structured format on how data should be exchanged

2) Services: ensures that system understand data i.e. being exchanged usually by use of appropriated data.

In medical sciences classification denotes groups of similar objects.

For e.g. reports: Blood, Urine, MRI, USG etc. and Ontology denotes relationship (hierarchy) i.e. random fasting, PP etc. Trends of grouping are moving from classification to ontology.

Different vendors use different standards; so it becomes complicated when more and more data is gathered.

In medical terminology same disease can be written in many ways. For e.g. common cold can be called as acute coryza or doctor may only write CC or ACT.COR or any other locally identified name which can be coded in following ways as

<diagnosis> common cold </diagnosis>

<diagnosis> acute coryza </diagnosis>

If someone search for string common cold then patient data with acute coryza may be ignored.Technology standard will help to identify whole record as similar category record. Users must be provided with pick list or drop down menu that will help to insert a health related information in the form of standard.

7. EHR SYSTEM MODEL

To fulfill an expectation that medical practitioners should adopt the digitization of Health record, simple and easy to use mechanism is a web based system and that can be provided easily to all health centers with less cost and less efforts. Areas where there is a non availability of internet facility a local area network (LAN) based systems can be established and the record can be transferred on the internet later. Data will be stored at local servers and then it can be transferred to main server by data workers or facilitators. If stakeholders (all participants in healthcare system) are motivated to ue the system it will benefit a lot. There are certain techniques that can be used to record the health data in systematic format.

Following (Figure 5) is the typical web based patient information gathering module implemented on a website http://ehrsystem.co.in where patient data is stored and patient ID can be used to access medical information.

Figure 5: Simple HTML Page to record Patient's Data

The patient data can be stored in a database with no extra efforts. Figure 6) is the record stored in database.
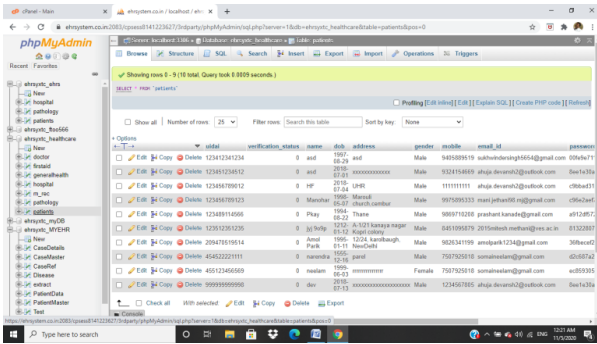
Figure 6: Database that shows patient's record inserted in Table

Health care team can further record the patient related information using detailed analysis of the system as per the requirement of the doctors and health center managers who are considered as subject matter experts of the system [15].

8. ACCESSING AND USING HEALTHCARE DATA

Storing healthcare data is not difficult but ensuring meaningful use of health data is very essential. There are certain challenges with respect to security of healthcare data. There is need to adopt certain security standards for maintaining privacy and confidentiality of healthcare data. One should be able to use the data for analytics and research is also recommended once data is preserved in systematic format.

In earlier few publications a detailed discussion has been represented the mapping of disease names to various standards which are recommended by national electronic health authority of India (NeHA). Following figure describes how mapping can be done. As shown in the figure below a knowledge base can be created by accessing the directory of standards and equivalent standard name can be mapped with fully specified name or Locally identified term for the disease.
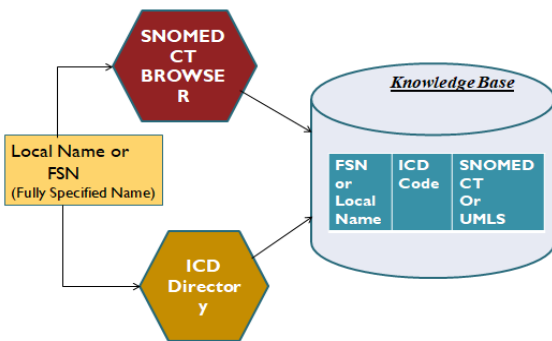

Figure 7: Mapping of FSN to Various Standards

9. NATURAL LANGUAGE PROCESSING APPROACH

Natural language processing intends to automatically extract coded medical data from free text. The basic advantage of natural language processing is that physicians do not have to alter the way in which they express their findings or document their decisions. Only when its application domain is strictly confined can natural language processing offer advantages. A fundamental disadvantage of natural language processing is that the data-capturing process itself cannot be influenced and improved. Data that the physician has not written or spoken

remain unknown. Freedom of expression is inherent to free text (Moorman et al., 1994). Therefore, it is difficult to impose structure on data that are used as input for natural language processing.

10. EHR TECHNOLOGY AND ITS USE AND ACCEPTANCE

Whenever a new technology is introduced there are various factors are focused the factors are mainly individual social and based on the user's persona.

If we see the following model represented by venkatesh, it has various blocks such as Performance expectancy, effort expectancy, social influence and behavioural intention and use behaviour. The other human factors such as, gender, age, experience and voluntariness of use of technology.

The unified theory of acceptance and use of technology (**UTAUT**) is a technology acceptance **model** formulated by Venkatesh and others in "User acceptance of information technology: Toward a unified view"[18]. The **UTAUT** aims to explain user intentions to use an information system and subsequent usage behavior.
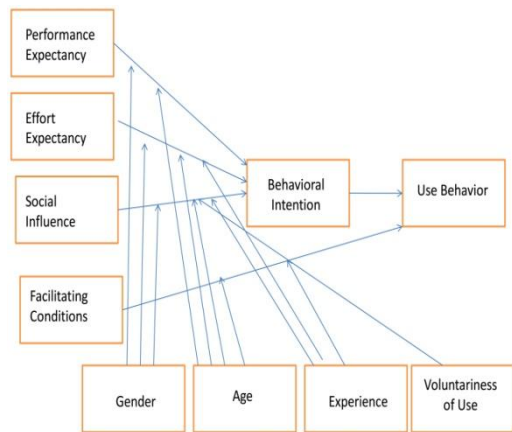

Figure 8: Unified Theory of Acceptance and Use of Technology

- Performance Expectancy: the degree to which an individual believes that using the system will help him/her to attain gains in job performance. (*Perceived usefulness*).

- Effort Expectancy: the degree of ease associated with the use of the system. (*Perceived ease of use*).

- Social Influence: the degree to which an individual perceives that important others believe he or she should use the new system.

- Facilitating Condition: the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.

- Other factors tell about characteristics of users such as age, gender, user experience etc.

To identify the real need of EHR system a systematic survey is also carried out to identify the views of medical practitioners by sharing a Google form to accept their views regarding EHR standards and digitized patient's healthcare data. Here is the statistical graphics of the responses given by medical practitioners. Doctors are willing to accept digital records.
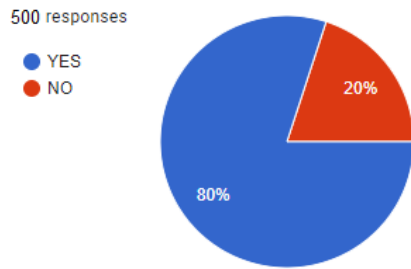
Figure 9: Doctors response to record data in Electronic Form

In the same survey doctors have also shared their challenges to accept the EHR system. Challenges such as professional training, Internet connectivity, lack of infrastructure are few challenges listed.

Another major challenge is that very few doctors are aware of the EHR standards recommended by health ministry in India. As shown in the figure below we can observe that only 20% medical practitioners are aware of the EHR guidelines and out of remaining 80% half of them(40%) are not aware of the same.
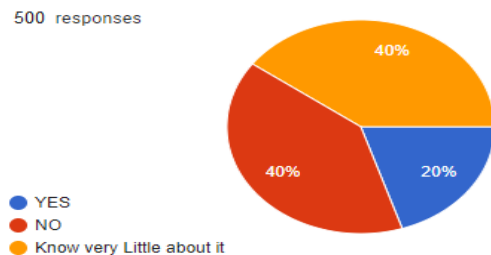

Figure 10: Awareness among practitioners regarding EHR Guidelines

To assure the acceptance of Technology we have created simple approach to record and have meaningful use of the Health Records [11].

Patient's record is maintained in prescribed format in following manner:

Step1: Patient visits a health centre with a health issues.

Step2: Patient's Personal and demographic Information is recorded.

Step3: Patient interact with physician and treatment is suggested.

Step4: Patient's Clinical Information and all interaction is recorded in prescribed format and updated in system using standards.

Step5: The updated information is used when and whenever required.

Step6: If patient's Health related data need to be shared it will be converted in HL7 or XML format and shared as a Text file, XML file or any format that is accepted by both the systems.
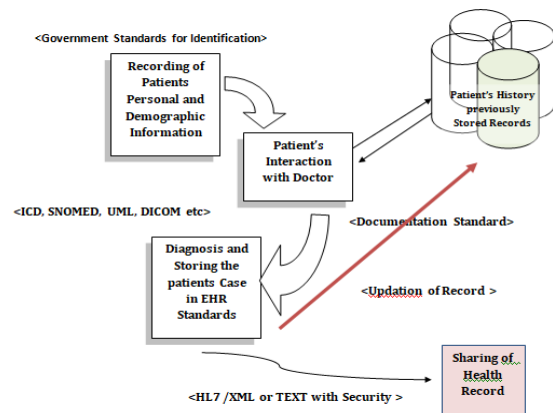
Same is described in the figure 11 below.

Figure 11: General easy to use EHR system for storing and accessing Health Data

11. CONCLUSION

EHR System is very much necessary in India. If doctors and healthcare team is trained to use the EHR system, it will be beneficial for overall improvement of Health care quality in Our Country. Unified Theory is perfectly mapped towards acceptance and use of ICT in Healthcare. In this paper there is a discussion on providing a standard system for health care service providers and patients. Detailed study of guidelines provided by ministry of health and family welfare to adopt the electronic health record system has been carried out. The major aim is to eliminate the conventional health record system. The major focus in this research is to propose the interoperable electronic health Record system (IEHR), and test the feasibility and acceptance of the EHR. Further there is a scope to promote the services in select locations such as hospitals and primary health centres. Medical centres can store patient's health information with minimal efforts.

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