

Infrastructures of the System for Developing Electronic Health Record

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ABSTRACT

The overall objective of a health system is to improve health through reducing disease, disability and death. Accomplishment of this goal depends on the worldwide integrated and coordinated care continuity. Information transmission is a prerequisite to ensure the continuity of care. Widespread acceptance of health information and communication technology (HICT) and developing systems such as *Electronic Health Record (EHR)*, have changed the health care industry. Electronic Health Record is the main part of information management in an integrated health care system. Electronic health record provides access to all health information at organizational, regional, national and international levels and allows for the patient's health data [usually with geographical distribution in several health information systems] to become integrated. Since Electronic health record integrates all care events data, it can make data sharing possible between all care providers to consequently minimize the repeated diagnostic tests, and drug and treatment interactions. Furthermore, Also health care professionals can easily access to patient information at any time and this could lead to improving the quality of care and reduce costs. Accordingly, a productive system is required to provide the electronic health record. Given the significance of the electronic health record and its generating system in improvement of care quality and reducing the health care costs, authors decided to study the needs for developing the national EHR system (NHIN) The main focus of this paper was on selecting material related to the system developing an EHR and its prerequisites. Electronic health record system is a new source of valuable intelligence of real world for the whole health care industry. Electronic health record system includes people, rules, standards, storage and processing equipments, communication and support facilities. To shape this, existence of components and their coordination is necessary. Electronic health record system are established to enhance patient care and its outcome, increase efficiency, improving the availability of information and minimizing the medical errors. With the Europe union formation that in fact was an important step toward globalization, the electronic health record passed the national borders and turned into a global concept to make possible the worldwide integration and sharing of the health data. Therefore international standards are needed to share patient health information between national health systems and across borders. Infrastructure or national information network existence of proper hardware and software and finally participation of all stakeholders are necessary to develop the system. So it is necessary to prepare the infrastructures needed for development of the system in our country. Since EHR has a universal concept, it is needed to create a lifelong health information record for every individual accessible in every point in the world.

Keywords: Electronic Health Record (EHR); National Health Information Network (NHIN); Electronic Health Record system (EHRs)

INTRODUCTION

The ultimate aim of the health system is to reduce disease, disability and death [1]. Three levels of care, namely prevention, medicine and rehabilitation, are provided for achieving this aim [2,42,46]. These three levels are needed to be connected in a way to lead to worldwide coordination and integration of care

for its continuity [3]. Continuity of care is a key feature of quality health care services for patients [4,42,46].

The cross-border transfer of information on patients is an essential prerequisite for assuring of entire and continuity care [5]. The amount and quality of information available to health care professionals in patient care can

influence both on the outcomes and the continuity of care [6]. The continuity of patient care is adversely affected by the lack of sharable information among patient care providers [7]. As quality improvement in health care requires documentation, the US federal government and leadership of the private sector have set the stage for transforming health care through widespread adoption of health information and communication technology. The core component of information and communication technology is the electronic health record (EHR) [8]. The electronic health record includes all information contained in a traditional health record including patient's health profile, behavioral and environmental information. In addition to the content of the EHR, this record includes the dimension of time, which allows the inclusion of information across multiple episodes and providers, which will ultimately evolve into a lifetime record. More simply stated, this type of a longitudinal electronic health record could:

- contain all personal health information belonging to an individual .

- accessed electronically by health care providers over the person's lifetime
- be extended across a health care system including inpatient and outpatient settings [9].

A key advantage of the EHR is that it will bring all the patient information together in one place and will be easily accessible by all providers no matter where they are [10].

The highest-functioning EHR provides clinicians with real-time evidence-based decision support and the potential for aggregating and reporting quality and outcome measures [11]. EHR would provide the means to access all available clinical information, at an organizational, regional, national or international level, and would integrate an individual's health data usually residing at many geographically dispersed clinical information systems [12].

The electronic health record is just – a record. By itself, it cannot do anything. A system is required to provide the function that makes the EHR useful. Naturally, this is known as an electronic health record system (EHRs) [13]. naturally, the formation of this system require necessities and therefore objective of this study is identification of forming necessities of electronic health record system.

LITERATURE REVIEW

As indicated earlier, information related to the infrastructures of health information systems

leading to an EHR was used to form the literature review. IOM defined EHR system as a set of components that form the mechanism by which electronic health records are created, used, stored, and retrieved. It includes people, data, rules and procedures, processing and storage devices, and communication and support facilities [14].

The emergence of managed care and the health care reforms have transformed the delivery of care model in the United States. These changes have radically transformed the structure, strategic goals, and operational processes of health care or organization by encouraging the consolidation of health care providers into integrated delivery network (IDNs) of previously independent organizations with tremendous implications for information systems.

By the early 1980s, the stage was set for a shift toward corporate medicine, including the growth of for-profit firms providing health services and the reorganization of the health care industry as a whole toward greater organization, integration and control. The decade of the 1990s was marked by a large number of merger and affiliation among previously independent. Hospital started initially at affiliating and then more tightly banding into regional aggregates of healthcare service providers called IDNs [15].

The IDNs is intended to provide services across the entire spectrum of health care including: ambulatory, acute inpatients, long-term, home-health, behavioral health, rehabilitation, complementary, hospice, etc [13].

From an IDN perspective, information should be available when and where it is needed; users must have an integrated view, regardless of organizational, system, or geographic boundaries; data must have a consistent interpretation; and adequate security must be in place to ensure access by only authorized personnel for only appropriate uses [15].

With such a broad scope, the IDNs must focus on aggregate data to manage the client population. Aggregate data are effectively derived from EHR [13].

IDNs must support multimedia-capable high-speed network connectivity among all participants to achieve integration of images and data [15].

To create a functional network infrastructure, individual nodes must be connected in a way that permits sharing of information. Connections rely on the application of the agreed upon conventions, or standards for describing clinical

and administrative information and for transmitting that information electronically. A cluster as two or more nodes that have an existing written data sharing agreement and sent (or received) patient-identifiable information to (or from) any other node in the clusters.

In turn, regional Health Information Organizations (RHIOs) would be considered cluster therefore a cluster can consist of a cluster of clusters. Such a model encapsulates the U.S. Federal government's current articulated plan for achieving a National Health Information Infrastructure through the creation of Local or Regional Health Information Organizations (RHIOs) [16].

The NHII is a comprehensive knowledge-based network of interoperable systems of clinical, public health, and personal health information that would improve decision-making by making health information available when and where it is needed [16, 7,42,46].

The NHII includes electronic health record (EHR) for all providers, and also the ability to exchange information among them and their patients [17].

To date, the IOM and the National Committee on Vital and Health Statistics (NCVHS) have focused primarily on the technical aspects of EHR implementation in the United States. Both have identified two core components in the project: first, building a national health information infrastructure and, second, establishing data interoperability between systems [18].

Globalization is driving the need to communicate and share healthcare data and information across national borders. For EHRs to reach full potential, however, interoperability and connectivity to distributed data repositories is fundamental, particularly in light of distributed healthcare services, meet geographical challenges [19].

A specific barrier to the realization of the NHII has been lack of standards for system interoperability [7].

Interoperability of EHR system defined is the ability of two or more applications being able to communicate in an effective manner without compromising the content of the transmitted EHR [20].

The ISO defines these as Functional interoperability and Semantic interoperability. Functional interoperability deals with the

exchange of information between two or more systems in a format that is readable by humans. Semantic interoperability deals with the exchange of information between systems in a format that is computer process able by the receiving system [20, 14].

For interoperability in health care, many standards are needed, such as electronic health record standards [21]. In order the EHRs meet the necessary prerequisites, EHR standards are discussed in four areas:

- 1- Content standards of Electronic Health Record
- 2- Structure standards of Electronic Health Record
- 3- Messaging standards of Electronic Health Record
- 4- Confidentiality and privacy standards of Electronic Health Record [22].

Electronic health record content and structure standards

The emergence of the EHR brings anticipation about future uses, including the sharing and exchanging of information among divergent systems [23].

The border between structure and content layer is often blurred, because several content oriented aspects of are usually modeled by defining its structure .The content layer and the structure layer both are concerned with the standardization of the elements of an EHR that are meant to be exchanged between communication partners. The structure layer focuses on regulations concerning the structure of communicated EHR elements, e.g. XML-files [24].

The important standards for content and structure of electronic health record include:

ASTM E2369-05 ‘ ISO/TR20514‘ Open EHR ‘ CEN TC 13606(EHR.com) ‘ ASTM E1384‘ ISO TR 18308 [25 , 24 ,14,20] .

The content layer addresses aspects of coding the content of EHR-Element using terminological systems like classifications or controlled vocabularies [24].

Terminology systems of electronic health record are:

Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT), Current Procedural Terminology(CPT), Unified

Medical Language System (UMLS), Logical Observation Identifier Names and Codes (LOINC), International Classification of Disease – 10 revision – Clinical Modification (ICD-10-CM), RxNORM, International Classification of Functioning, Disability and Health (ICF), International Classification of Disease – 10 revision – procedure coding system (ICD-10-PCS), International Classification of Diseases-Oncology (ICD-o), International Classification in Primary Care (ICPC), International Classification of Disease – 10 revision – Health Problems (ICD-10), Diagnostic and Statistical Manual of Mental Disorders (DSM) [26 - 30].

Electronic health record messaging standards

In health informatics, the term 'message' is used in a fairly specific way to mean a packet of information sent between two applications, containing predefined content [31]. For messaging needs to semantic interoperability. Data is sent in a predetermined format so they could be processed by the receiver [32].

Various organization have worked on messaging standards; the results of their efforts are such standards as: ASTM E1238, ASTM E1467, ISO TR 18307, EN 14720, HL7, XML, National Council of Prescription Drugs Programs (NCPDP), Digital Imaging and Communications in Medicine (DICOM), X12N, IHE RID, MML[33,30,20,7].

Electronic health record confidentiality regulations and standards

When the information systems would be able to share information between more institutions, proportionally there will be more need for security measures against misuses. Misuse of patient data may harm patients and undermine the quality of healthcare. Therefore, electronic health record systems need to build the consumer and healthcare provider trust to have full usage of the system [12].

The Health Insurance Portability and accountability Act (HIPPA) established specific regulations at assuring the privacy and security of health information in electronic form in the United States. The HIPPA security standard identifies three separate types of safeguards, including: administrative, technical, physical controls [26].

The privacy rule information called "protected health information", it covers all information in electronic health record [34]. Data may be de-identified and encrypted in transit, then re-identified for proper use by the receiver [35]. The Federal Information Security Management Act of 2002 is a United States federal law enacted in 2002 as Title III of the E-Government Act of 2002. Purpose of the act FISMA is to strengthen the network security in federal government and related sectors [36]. Confidentiality and security standards information systems offered by different organizations include: E1762, E1869, ISO27000, ISO17799.

Communication and telecommunication facilities for the Electronic health record systems

To share health information among all the participants in the health care area, it is needed to implement information technology infrastructure [37].

This is an important time for federal leadership and intelligent investment in HICT. Additionally, providing targeted funds or loans to help struggling providers make the investment is necessary.

An interoperable system will require ongoing governance and leadership at the national and state levels.

National and State governance and leadership for HICT are in need of

Safeguard the confidentiality, privacy and security of health information and its proper use.

- Achieve interoperability through adoption, use, and conformance to standards.

- Ensure coordination between HICT initiatives.

- Produce incremental improvements, quantify progress and build on successes.

- Bring together providers, payers, and patients operating under a common health care governance and policy framework.

- Harmonize state confidentiality, privacy and security laws with federal standards and test new methodologies for protecting health information. Align actions among public and private health care sectors.

- Coordinate information exchange, quality improvement, public health and other programs that rely on accurate information; and

-Ensure participation of insurance company and safety net providers in infrastructure programs.[38]

In order to achieve the above goals the federal government and the private sector attempt to create a national health information infrastructure.

National health information network (NHIN) is intended to provide access to complete patient information where and when it is needed in order to improve the quality, safety, and efficacy of health care [34].

The use of intranet and internet connections using Integrated Service Digital Network (ISDN) and broadband network are common in EHR applications and HISs with a bandwidth range of between 128 kbps to 2 mbps. A widespread telecommunications network infrastructure capability provides many advantages for implementing systems across healthcare facilities in the world[39].

Electronic health record systems' processing and storage devices

Technological infrastructure is needed for successful implementation of the EHR. This refers generally to a combination of software, hardware, and personal support mechanisms to empower users in accessing the electronic health record [40].

Hardware equipment include: database server, web software server, computers, pictures server, printers, scanners, fax machine and network structure such as the network bandwidth [41]. The EHRs is made up of the applications that enable providers to modify, print, and share the information [42,13].

The certification commission for healthcare information technology (CCHIT) was established in 2004 to develop certification criteria for EHR software. CCHIT generated widespread anticipation of criteria and procedures for EHR software certification, raising the stakes for EHR standards [43].

Stakeholders of Electronic health record systems

The stakeholders consist of patients or other people who benefit from health care services, the public, health professionals, health administrators and caregivers, health policymakers and researchers, and third-party payers including health insurers [40].

CONCLUSION

National health information network is the system that develops EHR and usually it is named EHR system [42]. Electronic health record (EHR) system is created with the goals of improving patient care through improving the availability of information at the point of need, improving the efficiency and effectiveness of health and health care service, improving billing procedures, reducing the frequency of lost records or data, and minimizing medication errors. Electronic health record systems can incorporate clinically useful features such as electronic alerts, guideline reminders, and automatic monitoring of quality of care indicators [44].

The other benefits from using electronic health record systems are improving the communication between health settings such as primary and secondary care providers, and improving timely access to care [45].

By electronic links to scientific knowledge bodies, databases and other external sources, the system collects health data, as well as data of all periods of health care from different places [13].

In turn, with Europe Union formation that actually as a step toward globalization, Electronic Health Record also passed the national borders and became a global concept to create integration and sharing of information in the world. To establish this integrity there is a need for international standards to share patient information between health and care professionals, between organizations, regional, national health information systems or throughout the borders and finally current applications based upon international standards to reach interoperability [42,46].

The significant point here is that there are many standardization organizations in the world which establish different standards for EHR and there are many classification and terminology systems at use. These together make the international sharing of health information a real challenge. In order to establish the integrated EHR and make the EHR a global concept, it is necessary to achieve a global agreement on the standards[42].

It is necessary to establish infrastructures and national network as the EHR system which utilizes information technology and communication to connect all providers and users who have, or use, health related data and services, while protecting the confidentiality of health information. First of all we should connect all health service providers to each other in provinces and then these provincial networks be connected nationally and internationally to be able to exchange information globally. It also requires a combination of supportive mechanisms, software and hardware to enable users to access the EHR[46].

Relevant software should have the semantic interoperability with utilizing of standards. On the other hand participation of all stakeholders is essential for successful implementation of EHR System Coordination between all stakeholders and their mutual understanding about the system as well as its capabilities to achieve goals and exchange of information is important. Thus it is required to meet the requirements and create infrastructures of national health information network in our country to establish EHR because this record has a universal concept.

It is needed to create a longitudinal health information record for every individual accessible in every point in the world.

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