Towards Integrating National Electronic Care Records in Saudi Arabia

Mohammed Alnuem, Samir EL-Masri, Ahmed Youssef, Ahmed Emam
Department of Information Systems, King Saud University, Riyadh, KSA

Abstract - *The importance of sharing and integration of patient health records that are dispersed and distributed on many healthcare organizations has pushed many countries to work hard towards achieving this objective. In this paper, a model of integration has been proposed, to share at least a brief summary of important information about the patient health record from many healthcare providers. The challenges of this integration are numerous, although the focus in this paper is on three; integration issues, security, and uniqueness of the patient identifier. In this regard, a centralized summary healthcare record has been proposed. That summary will contain an integrated summary of the patient health record collected from all encounters records at different hospitals and clinics.*

Keywords: Electronic Summary Care Record (SCR), Universal Patient Identifier (UPI).

1 Introduction

Saudi Arabia is one of the biggest economies in the Middle East. Due to the increase in the healthcare demand and the relatively wealthy population, latest reports show that spending in the healthcare in Saudi Arabia has increased to more than 16 billion USD in the public sector the last year. On the other hand the cost of healthcare is relatively low due to the high availability of medical care staff from nearby Arab countries and the Far East. This resulted in a unique situation where health care became very accessible through thousands of small-midrange private health care centers. Add to this the limits found in the public GPs like the lack X-Rays and advanced laboratory facilities. This resulted in a situation where many Saudis have their health care in many different privet health care centers during their life. Due to this the patient health record may become fragmented in many different clinics and hospitals.

This is an important challenge that may face Saudi Arabia health system in particular. Hence adopting a unified electronic health record for patient may be a challenge. In this work we will study the possibility of having an integrated electronic summary Care record instead of having a complete electronic health record which may not be practical in the Saudi case because of the expected high level of records per patients.

2 Saudi Health Care System

In Saudi Arabia, the healthcare system can be classified as a national healthcare system and the private healthcare sector. National healthcare system provides health care services through a number of government agencies. On the other hand, there is a growing role and increased participation from the private sector in the provision of health care services. The Ministry of Health (MOH) is the major government agency entrusted with the provision of preventive, curative and rehabilitative health care for the Saudi Arabia's population. The Ministry provides primary health care (PHC) services through a network of health care centers throughout Saudi Arabia. The MOH is considered the lead Government agency responsible for the management, planning, financing and regulating of the health care sector. The MOH also undertakes the overall supervision and follow-up of health care provided by the private sector. There are also some other mini national health services that provide healthcare services for their sectors such as: the Ministry of Defense and Aviation (MODA) hospitals, the Ministry of Interior (MOI) hospitals, the Saudi Arabian National Guard (SANG) hospitals, universities' hospitals, The Royal Commission for Jubail and Yanbu hospitals and clinics, King Faisal Specialist Hospital

and research center, King Khalid Eye Specialist Hospital, and so on [9].

In Saudi Arabia, There are numerous of hospitals and clinics either public or private. For public hospitals, there are 240 hospitals around Saudi Arabia, 39 of them are in Riyadh. For private hospitals, there are 327 hospitals around Saudi Arabia, 230 of them are in Riyadh. For public clinics, there are 1690 clinics in Saudi Arabia, 361 of them in Riyadh. For private clinics, there are 620 clinics in Saudi Arabia, 205 of them in Riyadh [9].

Table 1: Number of Hospitals and Clinics in SA

	Public	Private
Hospital in SA	240	327
Clinic in SA	1690	620
Hospital in Riyadh	39	230
Clinic in Riyadh	361	205

3 Electronic Summary Care Record

Electronic Summary Care Record (SCR) extends the concept of digital health summaries to create an updated and centrally stored patient's summary record, extracting key data from local systems after each encounter [1]. SCR is formed from files of the same patient and belongs to different hospitals within the country. The record should contain an encounter, admission, discharges, electronic clinical records, medications etc. SCR should be shared and accessible across the hospitals and clinics taking into account the security rules, regulations and all medical application international standards.

The main benefits of having a shared SCR can be summarized as following:

- Reduce/Eliminate the time usually needed to transfer physical copies of patient data between hospitals.

- Provide more information about the patient condition from different sources which will increase diagnosis accuracy.
- Reduce the cost in terms of time and diagnosis.
- Reduce the medical errors and hence increase the healthcare quality.
- Help producing healthcare statistics (medical and clinical informatics) which plays important role in developing healthcare strategies and planning future improvements and extensions in healthcare systems.

Many problems occur in Saudi hospitals through transferring patients' summary records from one healthcare organization to another which result in affecting the quality of the outcomes of the treatment. In order to solve these problems, a solution to integrate the hospitals systems is proposed to be implemented in Saudi Arabia that helps to increase healthcare integration and quality.

4 Related work

Three main challenges have been identified in order to create integrated summary healthcare record in Saudi hospitals: Integration, Security and the need to have a unified patient identifier (UPI).

4.1 Integration

In usual cases the patient can have multiple electronic health records (EHR) in many hospitals recorded accordingly with their medical encounters. EHR needs to be integrated among the hospitals in order to obtain a total overview of a patient's health-history. Many countries in the world are seeking to integrate and communicate their patient information among their hospitals in order to help them to improve the quality of healthcare outcomes. Some of these countries are Canada, Australia, England, USA, India, and Korea. Canada, Australia and England have the development of national healthcare strategies. Electronic Health Record (EHR) is considered as the main component of the healthcare infrastructure. Some obstacles have been discussed such as politics, geographies, population density [2].

In England, building national Dispersed Electronic Health Record (DEHR) is proposed to be a solution to integrate the hospitals systems in England. England is divided into five different geographical areas called "clusters". Each cluster represents one database and the database could be divided into more than one instance. The National Care Record Service (NCRS) is the existing EHR project which allows the authorized people to access the patient record 24 hours a day, seven days a week [2]. NCRS based on two components: Detailed Care Record and national Summary Care Record (SCR). Detailed Care Record is used inside local healthcare where the patient care is happen [2]. The national SCR extends the concept of digital health summaries to create an updated and centrally stored patient's summary record, extracting key data from local systems after each encounter [1] such as an encounter, admission, discharges, electronic clinical records, clinical messaging etc [1]. It can be easily extracted from the hospital systems and loaded to a central database called "Spine" using Dispersed Electronic Health Record (DEHR). Spine stores the important patient records for all England's 50 million population [2]. SCR is used instead of dispersed electronic health record because a dispersed electronic health record will take a long time to be built. Uncertainty about the quality and provenance of SCR data raises concerns about patient safety, as key data may be absent and old data may persist, partially because of a lack o ownership of the summary [1].

In Australia, HealthConnect is the national Australian EHR service which involves the collection storage and sharing of patients' information in summary. HealthConnect aimed to improve the healthcare outcomes by increasing quality and enhance patient safety. The components of HealthConnect model are a serious of event summaries which contain key information about specific healthcare event such as allergies, diagnosis, medications, referrals, and EHR lists which will be extracted from the event summaries. Therefore, predefined HealthConnect views are available to access these stored event summaries. Each HealthConnect electronic health record would be stored in two locations: a HealthConnect Record System (HRS) and the National Data Store. HRS is used to process the event summaries and transactions while National Data Store preserves copies of EHR [2].

In India, Distributed Infrastructure for Global EHR Technology (DIGHT) project was built to integrate electronic health record in India. Scalability, reliability and high availability were the most challenges of DIGHT project. Some requirements of EHR storage have been implemented in order to meet the challenges such as high data availability in terms of hardware and software, high performance which will ensure the system can work effectively any time and data security which protect the patient data from any unauthorized access by using data replication algorithm. Using central storage could be a solution but it degrades the high availability and performance. However, clustering technology was used in DIGHT project as a solution [5].

In Korea, National e-health project was built to integrate electronic health record among the hospitals. Many positives outcomes were achieved: improving transparency and effectiveness, enhancing accessibility and quality, strengthening quality and satisfaction of patients, reducing medical expenses, management rationalization of healthcare organization, and enhancing accountability through public healthcare inspection system. Some policies were applied in order to prevent the patient data access from any an unauthorized access [6].

Some challenges have arisen during the integration process in the data heterogeneity [4]. There are two different types of problems that have to be addressed to make the patients' data consistent in order to share the EHR between multiple Database Management System (DBMS). First heterogeneity problem is on DBMS level which is different hospital use different DBMS. Therefore, traditional database normalization ACID (Atomicity, Consistency, Isolation and Durability) properties could be missed across the hospitals. Relaxed ACID properties were proposed to be solution. Second heterogeneity problem is on electronic health record level which is EHR incompatibility between different hospitals. No solution was proposed for this problem [4].

4.2 Security

Patient data privacy and confidentiality are considered the most important issues when exchanging

and sharing relevant patient data among multiple systems. Secure Dispersed Electronic Health Record based on cryptographic constructions was proposed to address these concerns in order to be accepted by the patient [3]. In order to protect EHR, there should be some policies, regulations, and agreements that the patents, physicians, and the other stakeholders agree on. Therefore, EHR will be protected against any illegal use [7].

Some of the agreements that used in Electronic Health Record in Serbia (EHR-S): (a) patient consent to access EHR-S agreement which let the patient sign on the agreement, (b) medical institution / medical practice access to EHR-S which allow authorized medical practitioners to update, request, and receive up-to-date EHR in timely and secure manner, (c) hospital access to EHR-S which allow authorized physicians and pharmacists to update, request, and receive up-to-date EHR in timely and secure manner, and (d) Emergency Department (ED) which has an access to the patient medical history to help the patients when they arrive to ED [7].

4.3 Universal patient identifier

Universal Patient Identifier (UPI) was proposed to address the patient uniqueness issues. It consists of four parts: birth date code with 7 digits, geographical code with 6 digits, and sequence code with 5 digits to identify people born on the same date and geographical area, and single check digit. Birth date code can be divided into three codes as: day (1-31) with 2 digits, month (1-12) with 2 digits and year (0-99) with 3 digits. Geographical code can be divided into two codes: Latitude code (0-180) with 3 digits and Longitude code (0-360) with 3 digits. Hospital code could be part of sequence code.

For example, a person born on 1 March 1993 in Minneapolis, MN the code has the appearance: 9930301^044237^00047^2 [8].

5 SCR-SA

The authors have done a survey on the main hospitals in Saudi Arabia such King Faisal specialized hospital, King Fahad Medical City, King Khalid University Hospital and found no evidence of any kind of integration between them. In order to integrate the electronic health records among Saudi Arabia's hospitals we identified two main requirements which are missing in Saudi Hospitals:

- Patient unique identifier.

- Summary care record.

These two requirements need to be considered and implemented on each of hospital systems as minimum requirement for integration.

Identifying the uniqueness of patient is a major concern in national SCR. Patient unique identifier in Saudi Arabia could be national ID for citizens and resident permit (known as Iqama) number for foreigners. But all the hospitals are not considering the national ID or Iqama number as a unique identifier and they have their own unique identifier such as medical record number. Therefore, implementing a national ID or Iqama number as a patient unique identifier across the hospitals may face many challenges. However, the Universal Patient Identifier (UPI) is proposed to be used as the patient identifier in Saudi Arabia. UPI has been suggested to be consisted of three parts as: Birth Date in Gregorian with eight digits (e.g. 19800126), Region Code with two digits (01-13) because of the thirteen regions in Saudi Arabia, sequence with three letters (e.g. XWU) to identify people born in the same date and region. Therefore, the length of the suggested UPI is thirteen characters. E.g. 1980012604XWU (Birth date: 19800126, Region Code: 04, Sequence: XWU).

The Summary Care Record (SCR) is an electronic health record summary of the patient such as an encounter, admission, discharges, electronic clinical records, medications etc. Each hospital must provide the patients' SCR in order to be easily extracted and loaded to a central database (see Figure 1). SCR should be protected; only the authorized people can access the part that they need only. So, there are some rules, regulations, and policies should be applied on SCR-SA in order to protect the data.
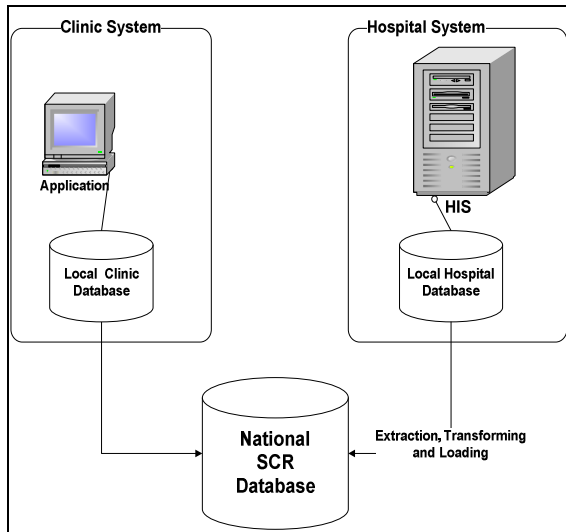
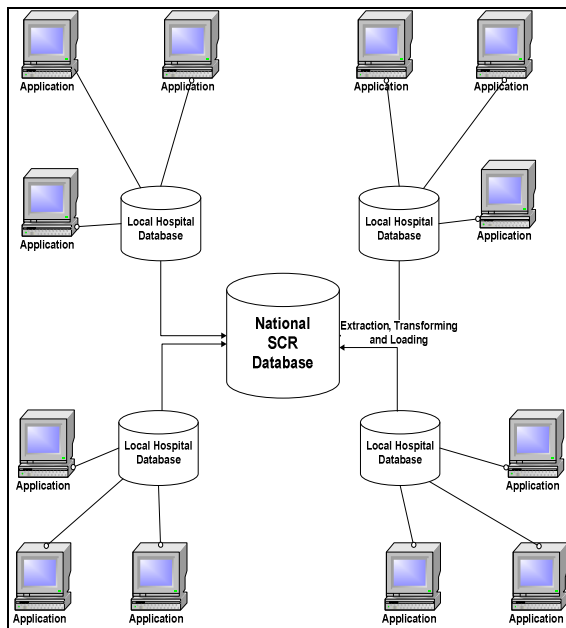Figure 1: General Structure of SCR System

Figure 2: Detailed Structure of SCR System

In Figure 2, we suggest to have a centralized national SCR database to be the center for the patients' summary data in Saudi Arabia. In order to link the hospitals and clinics to the centralized database, there should be an Extraction, Transforming, and Loading (ETL) channel between the centralized national SCR database and the client because the different hospitals and clinics use different systems and DBMS.

In order to inquire the SCR, we need to follow our proposed procedure. The procedure (see Figure 3) shows that the hospital checks whether the patient's record available in the local hospital database to be fetched, or it checks national summary care record centralized database to get the SCR. A new record will be created in both local hospital database and national SCR database if the record is not there.

SCR is believed be enough for a healthcare professional to make a decision in many cases. However in case more details about a particular medical encounter, lab or radiology results are needed, the system can retrieve them from that particular hospital.
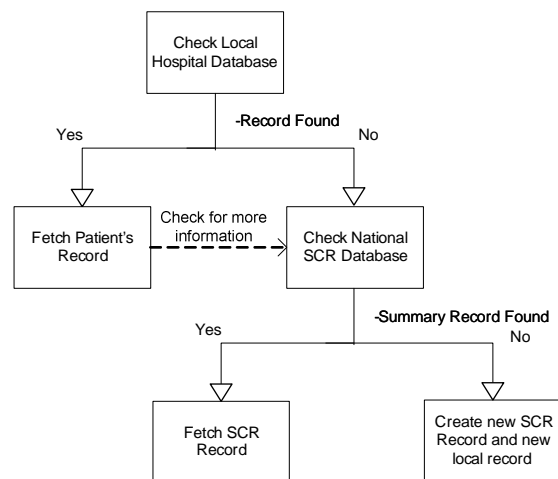

Figure 3: SCR Inquiry Procedure

6 Conclusion and future work

By applying DEHR-SA between the Saudi hospitals and clinics, we obtain a lot of benefits for hospitals, patients and ministry of health. This paper showed the elements, components, methodologies and approaches to the proposed system. The paper has showed the importance and the value added of the Summary Care Record and how it can be implemented in addition to the issues of the unique patient identifier and security. In the future, we will investigate more in depth information about the Saudi hospital systems and to make a survey to have their specifications that might help to fully integrate the Saudi hospitals systems.

Acknowledgement

7 References

[1] Enrico Coiera, "Do we Need a National Electronic Summary Care Record?", The Medical Journal of Australia, 2011.

[2] Jalal-Karim and W. Balachandran, "The National Strategies for Electronic Health Record in three developed countries: General Status", BruneI University, Cleveland Road, 2008.

[3] Jinyuan Sun and Yuguang Fang, "Cross-Domain Data Sharing in Distributed Electronic Health Record Systems", IEEE, 2010.

[4] Lars Frank and StigKjcer Andersen, "Evaluation of Different Database Designs for Integration of Heterogeneous Distributed Electronic Health Records", IEEE, 2010.

[5] Jim Dowling and SeifHaridi, "Developing a Distributed Electronic Health-Record Store for India", 2009.

[6] HeeJeong Cheong, Na Yoon Shin and YounBaekJoeng, "Improving Korean Service Delivery System in Health Care: Focusing on National E-health System", International Conference on eHealth, Telemedicine, and Social Medicine, 2009.

[7] Srdjan B Stakic and Nada Teodosijevic, Agreements Based Distribution of Responsibilities in National Electronic Health Records System, IEEE, 2010.

[8] Paul C. Carpenter and Christopher G. Chute, "The Universal Patient Identifier: A Discussion and Proposal", Division of Endocrinology and Section of Medical Information Resources, 1994.

[9] Ministry of Health Portal, Kingdom of Saudi Arabia, "Directory of medical centers", [Online]. Available:http://www.moh.gov.sa/en/eServices/Directory/Pages/MedicalCentersService.aspx. [Accessed: May 23, 2011].