

A Review Paper of the Current Status of Electronic Health Records Adoption Worldwide: The Gap between Developed and Developing Countries

Amal Mohammad AL-ASWAD¹, Simon BROWSELL², Rebecca PALMER³ and Jonathan P. NICHOL⁴

The University of Sheffield, United Kingdom

Abstract. This review paper represented a critical literature review of some related studies to the means of electronic health records in addition to their advantages and disadvantages from different perspectives and viewpoints. The main aim of this paper is concluded in reviewing the adoption of electronic health records in different countries in order to trace out the current status of adopting this technology worldwide. Through this paper, some concentration will be done on the adoption of electronic health records at Saudi Arabia since the researcher aims to follow this paper with a research to measure the “adoption of electronic health records at Saudi Arabia”. However, this paper will follow a critical review method of the “adoption” of electronic health records starting by its implementation then its distribution worldwide in some countries. This study aims to find the gaps in the literature that are related to the adoption of electronic health records worldwide.

Keywords: Medical Records (MR); Health Records (HR); Paper based Medical Records (PBMR); Electronic Health Records (EHR); Adoption of Electronic Health Records.

Introduction

The medical record is an account of the patient which contains information regarding presenting symptoms, with annotations from the physician and other health professionals detailing their observations as well as discussions with the patient [1]. As far as history is concerned, medical records are as old as medicine itself. One of the oldest recorded medical practices is the ancient Egyptian medicine which developed parts of the oldest form of health records. Ancient Egyptians used carvings, drawings and symbols (known as hieroglyphics) on the walls of tombs and temples to document the medical history of the deceased. The hieroglyphics provided information about the illnesses, treatments and operations performed during the life of the deceased [2].

However, the first more formal, medical record was developed in the fifth century B.C by Hippocrates who set two goals for medical records. The first goal was that a medical record should accurately reflect the course of the disease. The second goal was

¹ Corresponding Author: Amal Mohammad Al-Aswad, e-mail: a.alaswad@sheffield.ac.uk

² e-mail: s.browsell@sheffield.ac.uk

³ e-mail: r.l.palmer@sheffield.ac.uk

⁴ e-mail: j.nicholl@sheffield.ac.uk

that a medical record should indicate the probable cause of the disease. These two goals are still valid and appropriate for medical records [3]. Similarly, Galen of Pergamon, a Roman physician of Greek origin also made great contributions to anatomy and medicine and was known for documenting his observations about the care he provided to his patients [4].

In the 1890s, hospitals became more organized and began to keep records of patients' admissions and discharges. Massachusetts General Hospital records of admissions started in 1821. In the successive decades, many improvements in standards of professionalism were seen. The American College of Surgeons was formed in 1913 as an educational association for surgeons. The college set high standards for surgical education and practice. These standards led the movement to maintain more comprehensive documentation of medical records. Later on standardization was gradually replaced by accreditation [5].

Today, management of large amount of patient information in medical practice made the medical record the cornerstone of communication and documentation [1]. This patient information is being stored in the form of paper based medical record entirely until early 1960s when the idea of electronic medical record was introduced [6]. Advocacy for the implementation of electronic health record has been seen in last two decades, even today paper-based medical record systems are in practice widely in health care setting [1].

1. Motivations of this study

The researcher write this paper in order to find out the gap in reviewing the adoption of electronic health records (EHR) in different countries in order to trace out the current status of adopting this technology worldwide. Some focus is done through this paper on the adoption of electronic health records at Saudi Arabia as one of the most developed countries in the Middle East, surely from the developing countries, since the researcher aims to follow this paper with a research to measure the "adoption of electronic health records at Saudi Arabia" by using various kinds of methodologies.

2. Electronic Health Records (EHR)

There are several terms used in literature interchangeably for electronic health record (EHR) such as electronic medical record (EMR), computer-based patient record (CPR) and electronic patient record (EPR) [7]. Owing to this uncertainty about what exactly constitutes a computer-based medical record, there are several definitions of EHR in the literature. In an attempt to differentiate between EHR and EMR, the National Alliance for Health Information Technology (NAHIT) produces two different definitions. It defines EMR as "*the electronic record of health-related information on an individual that is created, gathered, managed, and consulted by licensed clinicians and staff from a single organisation who are involved in the individual's health and care*", whereas EHR is "*the aggregate electronic record of health-related information on an individual that is created and gathered cumulatively across more than one health-care organisation and is managed and consulted by licensed clinicians and staff involved in the individual's health and care*" [8].

3. Implementation of Electronic Health Records (EHR)

Transition from paper based-health records (PBHR) to EHR in a health care setting takes time [9; 10]. There are certain factors contribute towards transition time which include; availability of financial support, uncertain return on investment, and standard of technology, level of resistance to change and level of priority for change [11]. In America, in an attempt to create an electronic medical record for most Americans by 2014, the US government established the Office of the National Coordinator for Health Information Technology in 2004 [12]. According to a recent survey by the HIMSS [13], only 1.1% of hospitals are completely paperless whereas nearly 90% of hospitals are at various levels of transition from PBMR to EHR. Similarly, in Canada, no hospital is completely paperless yet but nearly 50% of the hospitals have partial levels of EHR implementation and further efforts from government are being placed for EHR implementation [14].

In the United Kingdom, the NHS set a target in 1998 to have electronic medical records implemented in all its trusts by 2005 [15]. However, in 2002 only 3% of the trusts were found to achieve this target [16]. Budget constraints and lack of required IT standards were the main reasons for this low rate [17]. In response to this, the government allocated £2.3bn for a new national programme for information technology (NPfIT) [18]. Despite critics over the speed of program, the Department of Health advocates the project's potential capability to deliver value for money [19] and according to National Audit Office (NAO) it is expected to be completed by 2016 [20].

As far as other European countries are concerned, a high proportion of electronic medical record is being used at general practitioners (GPs) level. According to a study, the percentage of GPs using electronic medical record in Sweden, the Netherlands, Denmark, Finland, and Austria is 90%, 88%, 62%, 56%, 55% respectively [21]. However, in order to develop cross border EHR implementation, the European Commission launched two electronic health initiatives in twelve member states in 2004 including (i) Smart Open Services (SOS) (ii) Community eHealth Action Plan [22].

The commission aims to achieve and maintain cross-border interoperability of electronic health record systems by the end of the year 2015 [23]. Similarly, according to Department of Health and Aging [24], the Australian government has a plan for a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians. The Government is investing \$466.7 million over two years for the (PCEHR) system and the registration will be online, from 2012-13.

Along with developed countries, EHR adoption has also been successfully undertaken in different countries around the world. Two hospitals are now operating as paperless hospitals in Malaysia, eleven hospitals in Korea and a number of hospitals in China are using some form of EHR [25]. Similarly, hospitals in Asia are also in the process of adopting EHR technology [13]. There are number of hospitals in South Korea as well as in Singapore who have successfully implemented EHR systems and set an example for other developing countries [26].

4. Adoption of Electronic Health Records (EHR) In Different Countries

In the following sections, the adoption of electronic health records is described in certain leading countries of the world such as United Kingdom, European Union countries, United States and Australia.

4.1 United Kingdom (UK)

The NHS set a target in 1998 to have EMR implemented in all its trusts by the year 2005, in 2002 only 3% of the trusts were found to achieve the target [15; 16]. Budget constraints and lack of required IT standards were the main reasons for this low rate [17]. In response to this the government allocated £2.3bn for a new national programme for information technology (NPfIT) [18]. It is considered the biggest IT programme in the history of the NHS due to its complexity and size. Its purpose was to develop centrally mandated electronic care records for patients so that nearly 30,000 staff can be connected to 300 hospitals and have secure and audited access to patients' records [27].

However, the NPfIT, like other large-scale programmes around the world; has faced some problems in its implementation [28; 29]. The targets of the original performance are consistently missing in the NPfIT [30; 31]. The strategy to move towards an electronic medical record has not yet reached the expected levels of uptake as a dramatic variation can be seen in the progress of the programme in the different regions, for instance more progress was seen in London whereas there is little progress in other areas e.g. in the North, Midlands and East, just four out of ninety-seven systems have been installed [10; 32]. Based on the poor return of investing £2.7 billion so far on the programme, the NAO does not expect that the remaining planned funding of the £4.3 billion will make any difference in the NPfIT. The NAO concluded that the Programme is failing to represent value for money [31; 19].

The Office of Government Commerce (OGC) Gateway process examines a wide range of projects and programmes to provide assurances that they can make successful progress. It uses independent experts from outside the programme to examine the progress and likelihood of successful delivery of the programme or project. The review provides a valuable perspective on the issues being faced. The Health Gateway Process provides the NHS, DH and its Arm's-Length Bodies (ALBs) with free and confidential support using well established peer review and principles [18]. The Gateway Reviews produced for the NPfIT gave a red code which is the worst status. Nine of the 31 reviews published by the OGC gave the project a red status and called for immediate action to achieve success. Nineteen out of the 31 reviews gave the NPfIT an amber status, which means that the project should proceed whilst taking the OGC recommendations seriously. Only two of the 31 reviews gave the NPfIT the green status, based on their concern about the infrastructure developed for the programme [33]. The NAO attributed the problems to many factors such as: unrealistic ambition, the complex nature of the NHS and problems with technology [31; 19].

Although the NAO has not suggested scrapping the entire scheme, the BBC has mentioned that there are some critics that call for such action. For example, on May 18, 2011, Tory MP Richard Bacon, a member of the House of Commons' Public Accounts Committee said: "This turkey will never fly and it is time the Department of Health faced

reality and channelled the remaining funds into something useful that will actually benefit patients". Despite critics, the Department of Health advocates the project's potential capability to deliver value for money [19].

4.2 The European Union

Two major electronic health initiatives to develop cross-border EHR have been launched by the European Commission. The aim is to support seamless care to Europeans during their time spent living or travelling abroad. This large-scale project is called Smart Open Services (SOS) and involves 12 member states. The SOS is a step in the direction of pan-European emergency health records that will connect pharmacy systems at the national level. The project will support free health care to citizens in any EU member state. Citizens will be allowed to access their health information stored in the EHR anywhere and at any time. The project will also enable health care providers to access clinical information of patients from other EU member states [22].

According to the European Commission the SOS will ensure compatibility of electronic medical information without the need to develop a common system throughout the EU. The electronic records will be voluntary and will respect the privacy of the citizen. It will be created only upon request from the interested citizen. Although there is no agreement about the contents of the electronic health record, it is expected to include important information such as allergies, medications and blood group [22].

In 2004, the Community eHealth Action Plan identified interoperability of electronic health records as one of the top priorities for Member States in the roadmap to the Action Plan. As a follow-up to the Community eHealth Action Plan, the European Commission drafted in 2008, the recommendation on cross-border interoperability of electronic health record systems. The recommendation aims to enable the free flow of patients as well as eHealth products and services. One of the major obstacles hindering the achievement of the economic and social benefits of eHealth is the lack of interoperability of electronic health record systems across the states. The lack of interoperability has aggravated the existing fragmentation in eHealth. Using incompatible information and communication systems by member states impedes the access to health information that is necessary for providing high quality and safe health care across Europe [23].

The European Commission (2008) recommended to member states a set of guidelines for the deployment of interoperable electronic health record systems that facilitate cross-border exchange of patient health information. Developing such electronic health record systems should provide healthcare providers with a secure and timely access to the vital health information while protecting the patients' rights to confidentiality and privacy. The Recommendation facilitates ePrescription solutions through a set of guidelines for interoperability of emergency data, patient summaries, and medication records [23].

The purpose of the guidelines is to make sure that electronic health records systems in the EU member states can interoperate (communicate to each other) to allow rapid access to vital patient information by health care providers across the EU. The objectives addressed by these guidelines include: establishing features of EHRs that allow exchange of vital patient information between systems; enabling share of health data; building

network systems that cover all areas of health care, while meeting operational, legal and training requirements [23].

The Commission aims to achieve and maintain cross-border interoperability of electronic health record systems by the end of the year 2015. According to the Commission, to achieve this, member states are urged to undertake action at five levels: 1) the overall political leaders should make the necessary regulatory and financial environment to make eHealth infrastructure and services interoperable; 2) to create a common domain and interface that enable the national domains to interact; 3) to promote the use of technical standards and develop common interoperability platforms; 4) to agree on common priorities and specific applications; and 5) to improve education and awareness for monitoring and considering all intended and related developments [23].

4.3 United States (US)

In an attempt to create an electronic medical record for most Americans by 2014, the US government established the Office of the National Coordinator for Health Information Technology in 2004 to promote and coordinate health information technology. Four goals were identified to guide the adoption of IT in the public and private health care sectors; 1) the adoption of electronic health records; 2) the establishment of a secure national health information network; 3) the use of personal medical records by individual patients; and 4) the use of research, dissemination of evidence, and quality measurement to improve the public health [12].

Only 1.5% of the American hospitals had implemented comprehensive electronic health records and that 7.6% had basic EHR. An expert panel set criteria for each of the "comprehensive" and "basic" EHR for the purpose of the study. The criteria for the "comprehensive" EHR included 24 functionalities while it included only ten for the "basic". Examples of the functionalities were; physician notes, laboratory reports and medications [34].

Although, progress seems to be slow, the results are considered significant in the light of the 19 billion dollars allocated by Congress for the adoption of EHR and other health information technology. The major barriers to the implementation of electronic health records among US hospitals that did not have EHR included: financial limitations (73%), maintenance costs (44%), cultural barriers (36%), uncertainty about return on investment (32%) and lack of IT training (30%). The study shows that physician resistance and inadequate capital are the major barriers for hospitals seeking to implement EHR [34].

4.4 Australia

The National Electronic Health Records Taskforce proposed in 2000 the 'HealthConnect'. It is an IT system funded by the Australian government to allow collection, storage and sharing of health information. The availability of complete and updated electronic health information that can be easily shared by care providers and patients would help decision making and seamless care. The HealthConnect objectives are to improve the effectiveness and efficiency of health care through electronic information that will be collected at the point of care and can be accessed online and shared as needed.

The government has established trial sites around the country to test the effectiveness of HealthConnect and learn from these trials [35]. The Federal Enterprise Architecture Framework set policies and standards for the electronic health record that include security, privacy, access control, data control, application and technology [36].

In July 2010, the Computer Sciences Corporation (CSC) conducted an independent study on Australians' views of electronic health records. The research found that consumers see an individual electronic health record as a basic Australian right and they are waiting for the government to deliver it. The research also showed that Australians want to have personal control over their health records and they like to know about its contents and who has access to it [37].

Australia has a plan for a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians. The Government will invest \$466.7 million over two years for the (PCEHR) system and the registration will be online, from 2012-13. A draft Concept of Operations document is released to stimulate informed discussion with stakeholders regarding characteristics, design, build and implementation of the PCEHR [24].

4.5 Kingdom of Saudi Arabia

Saudi Arabia is one of the rapidly developing countries in the Middle Eastern region. Its total area is 2.15 million Km² with a population of approximately 25 million [38]. In Saudi Arabia, 60% of the health care services are provided by the Ministry of Health (MoH) whereas the remaining is provided by other government bodies such as the Ministry of Defence and Aviation, Ministry of Interior, National Guard, University Hospitals and rapidly growing private sector [14].

Most medical record systems in the country are still paper-based and those centres, which have started using electronic medical records, have variations in terms of software and capabilities. Most importantly, most of the electronic medical services are not interconnected. This situation resulted in fragmented patient information, duplication of work, incomplete data entry and negative effects on the quality, safety and cost of health care [14].

In recent decades, Saudi Arabia has made significant progress in the health sector with several hospitals receiving national and international accreditation, but EHR has not experienced equal progress. Since 2002, Saudi Arabia has shown great interest in adopting EHR to improve the quality of health care, enhance patient safety and reduce the cost of health care services.

In 2004, the King Saud Bin Abdul Aziz University for Health Sciences (KSAU-HS) was created to support ICT in the health care sector. The year 2005 witnessed the establishment of the Saudi Association for Health Informatics (SAHI) to promote health informatics training and education and to support the implementation of the system throughout Saudi Arabia [39]. Similarly, the Central Board for Accreditation of Healthcare Institutions (CBAHI) is a national accrediting body, established in 2007, to promote the quality of health services and increase the degree of safety through accreditation. CBAHI has developed standards for medical records and information

management both manual and electronic [40]. Despite these efforts, diffusion of IT applications in Saudi Arabia is still problematic because it is often associated with problems that are not only technical, but that are also cultural, political, economic, educational and social [41].

Taking all situations under consideration, the Saudi MoH initiated a project to automate 30 hospitals in different regions of the country including a unified electronic medical record in 2008. It was found that this project would save 10-15 % of its annual health budget upon the adoption of the EHR system. The project is meant to pave the way for a unified EHR at the national level [42]. Similarly, in 2010 the Saudi Ministry of Health launched its five-year eHealth Strategy for 2011-15 for the Kingdom of Saudi Arabia. The strategy consists of three phases: analysis and vision, strategy design and strategic roadmap. The aim of the first phase is to understand the gap between the current and expected state of the eHealth/ICT. The second phase will include the design of the strategic plan for eHealth/ICT. The final phase is to develop a five-year roadmap for the implementation based on findings from the first two phases [43].

Since MoH has taken initiatives to enhance EHR adoption in healthcare settings in 2008 and 2010, no study has explored the level of EHR adoption at the national level. However, Bah and others [44] evaluated the situation of EHR adoption in the Eastern province of the country and collected the information from 19 out of 244 MoH hospitals. Only three of the hospitals have adopted EHR partially and the level and extent of EHR usage is undetermined despite the commitment of funding from the government [44].

5. The Adoption of EHRs and related Studies

Health IT systems have the potential to reduce health care costs, improve efficiency, and enhance quality of care and patient safety [45]. One of the promising systems is EHR. While interest in EHRs adoption is high, the rate of EHRs adoption still remains slow in many countries [46]. Many countries have launched such national programs to move towards a single shared EHR for patients and to connect general practitioner and hospitals [47; 48]. One of the main initiatives of these national programs is to study in depth the different challenges of the adoption of EHRs in those nations [49].

In Saudi Arabia, little is known regarding the adoption of EHRs and in particular within MoH hospitals owing to lack of studies and government roles [50; 44; 14]. According to some few papers concerning health IT systems in Saudi Arabia [50, 44, 14], there is a concurrent need for such studies to assess the level of EHRs capabilities and adoption within Saudi hospitals. In the context of Saudi Arabia, the concept of EHRs is a relatively new that needs a lot of attention [50; 44].

However, one of the major challenges in identifying the level of EHRs and use is the lack of consensus on what EHRs capabilities mean and constitute [51]. The differences in the definitions used for EHRs and methodological issues in previous studies in the literature might explain the variation in the EHRs adoption rates in some countries such as US or Europe countries [51]. The most appropriate method indicated by many related studies to show the level of EHRs capabilities and adoption in a nation is to use simple percentage into an analytical model to deduce the level of EHR adoption and its. In this

regards, most of the previous studies have created either their own analytical model (e.g. consensus among experts to identify functionalities) or asked about the presence or absence of EHRs [34; 52]. However, this will only produce different results and contradictory from one study to another [51].

Another way is the use of an international analytical model that is used by many healthcare institutes and organisations worldwide such as HIMSS Analytics and categorization scheme [44]. HIMSS Analytics and categorization scheme is the most reliable method for assessing the level of sophistication of EHRs capabilities within hospitals today and helps in international comparison of EHR adoption [51; 44].

In the light of the adoption process of EHRs, many studies were found in the literature with the different research approaches, the different explanations [53]. Most of those studies were built based on Rogers' [54] sociology model for the adoption of technology innovations to explain the adoption of EHRs [53; 55].

Rogers' theory explains how individuals or groups learn about innovations and thereafter make their decisions either to adopt or reject the innovation. This theory illustrates five generic innovation characteristics that might influence the adoption of innovation:

- Relative Advantage: the degree to which individuals or groups perceive the innovation as superior to existing ones.
- Compatibility: the degree to which individuals or groups feel the innovation is consistent with their present needs, values and skills.
- Complexity: the degree to which the innovation is easy to understand or use.
- Trialability: the degree to which the innovation is experimented with on a limited basis of efforts.
- Observability: The degree, to which the innovation's benefits can be observed, imagined or described to the individuals or groups.

Although Rogers' theory is thought to be appropriate, it needs to be expended to better fit the complex EHRs adoption context for several reasons. Rogers' theory defined very broad five generic innovation characteristics which are widely prevalent or generalizable across technologies [53]. In addition, previous studies often subsumed some factors into a single factor of the broad five generic innovation characteristics which reduces the ability to clearly measure and understand the component effect of each factor [53; 56]. Further, every social situation conditioned by interacting variables such as time and culture and therefore no two situations are identical [57] For example, early research of health IT adoption found other factors beside the broad five generic innovation characteristics of Rogers' theory such as the role of hospital and environmental factors (e.g. hospital scale and ownership) in technology adoption decisions [58].

In addition, recent studies reported several issues associated with the adoption of EHRs. For example, governance strategies can successfully address the issues associated with the adoption of EHRs such as cost and patient data security and privacy that can, in other circumstances, act as barriers to the adoption process [59]. Variety of factors

attributed to the low rate of EHRs adoption such as macro-level factors (e.g. the lack of national policy and the lack of informatics standards) and the micro-level factors (e.g. individual perceived complexity and resistance from physicians) [53].

6. Results and Discussion

The implementation and adoption of EHR in throughout the world differ in developing and developed countries. This field is no that new field in the developed countries and their strategies of adoption is drawn from the last century. But in developing countries it appears that the topic should be researched more in future researches in order to cover all its aspects since the implementation of EHR has not distributed all over these countries. From the researcher observations, it appears that the developed countries are looking forward to change all their system to depend on the EHR as the only way of development. But in the developing countries, the main aspect was forwarded to get EHR as a supporter of paper-based health records [60]. The implementation of EHR and its adoption have been reviewed in this paper and it appears that there are some countries from both developed and developing implement and adopt the means of EHR but they does not achieve the desired rate of distribution.

1. One of the developing countries has been studied through this paper, which is the kingdom of Saudi Arabia, since it is developed in a quick rate comparing with other developing countries. However, it appears that the first step towards implement and adopt EHR was in 2002. But, in some way, very huge gap appear through reviewing related literature for this country, which is the limited number of studies that are covering the topic. Therefore, it is recommended to *make some surveys and studies to cover the topics about the adoption of EHR in Saudi Arabia and its implementation.*

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