STUDIES OF EHR IMPLEMENTATION AND OPERATION IN DIFFERENT COUNTRIES WITH PARTICULAR REFERENCE TO SAUDI ARABIA

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Abstract

Electronic Health Records (EHRs) have led to a significant transformation in the healthcare sector. EHRs have improved the nature of healthcare delivery in the various healthcare organizations. While recognizing the changes in healthcare sector, this thesis studied the implementation and the use of EHRs in four developed countries, the United State (US), United Kingdom (UK), Australia and New Zealand and one developing country, Saudi Arabia. By employing primary and secondary literature, EHR's benefits, challenges, success factors as well as lessons for developing countries were identified.

The implementation of the EHRs in the ambulatory care was almost universal in the UK, Australia and New Zealand (each >90%), except the US which is lagging behind (46%). The low rate of EHR adoption in the US was attributed to factors such as lack of requirements imposing the use of computers in medical practises. Although, there is no good data for the use of EHRs in hospitals in the studied countries, EHR use remains uncommon in hospital settings. The use of EHRs in Saudi Arabia is uncommon; however several projects have been established by the government of Saudi Arabia to increase the awareness of such technologies as well as to develop strategies for implementing EHRs. Saudi Arabia and other developing countries should learn the best practices from developed countries and that it is important that they come up with initiatives and legislations to support the implementation of EHRs.

Currently, all of the studied countries set the implementation of a national EHR as a priority in their healthcare system reform. Two approaches for the presentation of national EHR database were identified in the developed countries; centralised or distributed.

While EHR provides various benefits to clinicians, patients and healthcare managers, its implementation poses many challenges such as confidentiality, privacy, security, lack of standards, start-up cost and content of discharge summary. To achieve successful implementation of EHRs, factors such as leadership, organization structure, goals, visions, communication, organization culture and workflow redesign should be considered.

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Abbreviations

AMCs	Academic Medicines
CDR	Clinical Data Repository
CMWF	Commonwealth Fund
CPOE	Computerized Physician Order Entry
DCR	De-tailed Care Record
DHBs	District Health Boards
eDS	Electronic Discharge Summary
EHRs	Electronic Health Records
GPs	General Practitioners
HIMSS	Health Information Management Systems Society
HIPAA	Health Insurance Portability and Accountability Act
HMOs	Health Maintenance Organisations
HRQA	Healthcare Research and Quality Agency
ICTs	Information and Communication Technologies
IOM	Institute of Medicine
LIMS	Laboratory information management systems
MOH	Ministry of Health
NCVHS	National Committee on Vital and Health Statistics
NHI	National Health Index
NHS	National Health Service
NPfIT	National Programme for Information Technology
PIHI	Privacy of Individually Identifiable Health Information
RIS	Radiology Information System
SCR	Summary Care Record

Chapter 1

Introduction

1.1 Health Records

Records are kept to act like a means of communication, source of reference or even for the purpose of accountability. This happens in all sectors of life. In healthcare, records have been used for the same purposes. Previously, there was not much need for definition of health records other than as notes on history, ailments, complaints and allergies that to treat any health problem. However, due to the emerging role of individuals collecting and compiling information about their health, and the emergence of new technologies such as the internet, different definitions have been developed (Van Fleet, 2010), although, the core meaning remains the same. It is noteworthy that health records have raised a concern and need for privacy as outlined by Health Insurance Portability and Accountability Act (HIPAA) in the USA and elsewhere (Princeton Insurance, 2005).

1.2 History of Health Records

Doctors and physicians used to keep records of their patients and practice. This was revolutionized by the American College of Surgeons in 1928 when the college decided to start an association that would keep all the records of patients. In this way, the college wanted to improve service delivery and increase the standards of record keeping in healthcare. This led to the development of the American Association of Records Librarians. This professional organization still exists today although it now goes by the name American Health Information Management Association (AHIMA) (Van Fleet, 2010). As can be deduced, information was usually in written records and filed for future retrieval. This is because, at this time, there were no computers to hold data. Even when the first digital computer was invented in the 1940s, it was used for scientific purposes and not for record keeping (Hovenga, Kidd & Cesnik, 1996). At this time, computer programmers

only worked at developing software for mathematical and other scientific calculations and manipulations. However, later, it was noted by scientists that computers could also be used to assist the process of record keeping in many fields including healthcare.

The paper-based records were kept in libraries and were, therefore, time consuming in their retrieval not to mention that they were vulnerable to loss and damage. This is what led to the development of the intermarriage between the computer and medical records in the late sixties and early seventies (Van Fleet, 2010). Universities developed software for certain healthcare facilities but, they were highly specialised. In addition, cost and performance issues were of concerns (National Centre for Research Resources, 2006). Limitations of electronic health records (henceforth, EHRs) were later overcome due to the emergence of non-profit organizations such as HL7 which aims to enhance the implementation of EHRs by providing a comprehensive framework and standards for exchanging, integrating, sharing and retrieving electronic health information (http://www.hl7.org). This, therefore, led to success in the development of software and applications of computers in health records and health information management. To understand the benefits that have been brought forward to health information management, it is essential to look at paper-based records and contrast them with EHRs.

1.3 Paper Based Records

For years, patient medical information has been maintained in paper-based records. These records are usually handwritten and kept in files. Depending on the legibility of the handwriting of the physicians carrying out the examinations on patients; the information may not be helpful in the future (Kohn, Corrigan & Donaldson, 2000). Additionally, it is crucial to keep in mind that whenever the patient comes in for a check up, the file is retrieved taking a lot of time and the physician scribbles on the same sheet of paper or adds a new sheet of paper. This further increases the shortcomings because the history is not consistent. It is extremely hard for one to make sense of fragmented information besides being ambiguous (Carter, 2008). Sometimes the file may experience mechanical destruction during retrieval and storage so that some information is torn off or is no longer legible. This renders the health record useless to a large extent. It is necessary to understand that even

today; the paper records are the primary mechanism of collecting information from the patients although now this information is later fed into the computer. Paper records are usually bulky and pose storage problems in the healthcare facility. On the contrary, EHRs require minimal space for a computer. To sum up on the paper records in healthcare, there are several issues that are seen as paramount shortcomings of this style of records (Roukema et al., 2006). These include illegibility, ambiguity and fragmentation. Inaccessibility and bulk of storage are also disadvantages of this system.

1.4 The Need for a New Approach

Health records are central to the treatment of patients (Chassin, Galvin & Donaldson, 1998). It is, therefore, necessary that health facilities ensure that they keep relevant and accurate client health information safely and in a manner that supports privacy. Maintaining paper-based records in a health facility is tedious, time consuming and inefficient compared with EHRs. However, this should not be misconstrued that paper-based records are not essential. They are so valuable because they were the primary methods of data collection and therefore contain historical and archived information. However, advancement in information technology is fast leading to obsolescence of this technique of data collection. The current paper-based records can be scanned and maintained in an electronic format.

As has been indicated in the introductory part of the report, it is extremely beneficial to ensure that health information is kept private and confidential. Access to EHRs can be more tightly controlled than access to paper-based records. In addition, EHRs can result in better safety for patient. For instance, a reduction in medication errors in hospitals can be achieved by the utilization of EHRs (Bates et al., 1998). Moreover, with the advent of the internet and intranet, it is easier to transfer this information from one facility to another, or even across different departments. These could be the lab, pharmacy or central medical centre. This is a significant advancement in record keeping and information sharing.

1.5 Electronic Health Records

EHR system refers to a database where all the information on the health of an individual has been recorded (Hayrinen, Saranto & Nykanen, 2008). It enables easy retrieval of information whenever a need arises. Information is particularly valuable to both the patient and the health practitioner. To ensure that information is used for the purpose of reference and enhances service delivery in the healthcare system, EHRs have become a significant tool and a necessity. It has been noted that there has been a rise in the number of patients keeping records for themselves. This has led to personal health records, which can also be computerized or even take other forms of electronic storage.

There are instances when IT offers loopholes in the information management, but mostly, there are more benefits than shortcomings (Frolick, 2011). The crux of the matter is that in most fields, including education, paper-based records are being phased out as a way of reducing costs and shortcomings, and healthcare is no different. In a nutshell, infrastructure in IT and advancement in both hardware and software development offers potential for change in record keeping. This means changes are inevitable in EHRs to make the system even better.

1.6 Research Objectives and Research Questions

The essence of this research is to analyze and evaluate the transformation of the health records from the paper-based health record system to the EHR in different countries including the US, UK, Australia, New Zealand and Saudi Arabia. Among these five countries, four are developed countries, the US, UK, Australia and New Zealand, and one is a developing country, Saudi Arabia.

This research seeks answers to the following questions:

1. What are the EHRs' level of implementations, benefits, challenges and success factors in US, UK, Australia, New Zealand and Saudi Arabia?
2. Are there any common factors affecting the deployment of EHRs in the four developed countries? If yes, how do those factors relate to the Saudi context?

3. Is there a significant relationship exists between the healthcare system and the successful implementation of EHRs?
4. Should EHRs be centralised or distributed?

1.7 Rationale for the Study

This study aims to explore the implementation of EHRs which is considered to be one of the most inevitable implementations of Information and Communication Technologies (henceforth, ICTs) in the field of healthcare nowadays. The importance of implementing such technologies can be supported by both potential benefits of implementing EHRs and some weaknesses in the conventional way of reporting. The use of ICTs in EHRs enhances the process of managing, storing, and retrieving medical information (Erstad, 2003). Moreover, EHR system lays at the centre of any computerized health information systems (Blum, 1986).

This research will provide an overview of EHRs' definition, history, components, benefits and barriers to its implementation. In addition, the answers to the research questions will show the gaps between these five countries in implementing EHRs and the causes. Moreover, this research will look at the critical success factors of implementing EHRs. In short, this research is important because it revolves around a vital implementation in the field of healthcare which has the potential to improve its delivery.

1.8 Structure of the Research Report

The rest of this report will be organized as follows: Chapter 2 provides an overview of EHR's definition, history, standards, system integration, benefits and challenges; Chapter 3 describes the methods used in conducting this research; Chapter 4 to chapter 8 will present the research results for the implementation of EHR in the US, UK, Australia, New Zealand and Saudi Arabia respectively; Chapter 9 will develop a comparison across these countries as well as rise a discussion for distinguished areas across these countries in EHR implementation; Chapter 10 will summarise the research findings and conclude the report with some indications for future studies.

Chapter 2

Literature Review

2.1 Definitions of Electronic Health Records

The concept of EHRs has often been referred to by other terms such as "Electronic Patient Record" (EPR), "Electronic Medical Record" (EMR) and "Computerized Patient Record" (CPR). These and many other alternative terms reflect different shades of meaning, relying on the health sector and defining country. Until recently, there have been few formal definitions for EHR, presenting more similarities than differences regarding their purpose, functions and goals of EHRs (Hayrinen, Saranto & Nykanen, 2008).

The Health Information Management Systems Society (HIMSS) has defined EHR as:

> "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."

EHR systems should be capable of performing a number of major functions. Eight functions have been determined by the Institute of Medicine of the National Academies (2003) as key capabilities for any EHR systems that should be performed. These functions are:

- Health information and data,
- Result management,

- Order management,
- Decision support,
- Electronic communication and connectivity,
- Patient support,
- Administrative process and reporting,
- Reporting and population health.

It is noteworthy that EHRs are created and maintained within an institution, such as a hospital, clinic or physician's office. In short, an EHR is a software application that captures and manages patient data digitally in a manner that is far more efficient, secure and accessible than a conventional paper-based record system. Since its inception, there have been rapid developments in the technology used to support medical care. The following section will demonstrate these developments since the late 1960s, when the concept of using technologies to better manage health data was first investigated, until the present time (Hovenga, Kidd & Cesnik, 1996).

2.2 History of Electronic Health Records

A hospital is a place or organization that is technologically advanced that treats patients and saves lives. It is an institution where medical or surgical treatments are given to sick or injured persons. In order for clinicians to ensure crucial information for decision making, patients' medical documentation is highly essential. A single patient can have countless visits to hospitals or clinics and therefore a significant amount of medical data can be generated to document these visits. It was estimated by Weed (1989) that, up to 50, 000 data items can be generated by an individual patient during his/her life. Moreover, this large amount of data should be maintained and available to access for future visits. Doctors or clinicians used to use paper-based record systems to document these visits, but the present way of documenting patient data is easy and does not require advanced skills. There are many limitations and issues associated with the system, as has been mentioned in the introductory part of this paper. A timely integration of this data is required by healthcare

givers to support good decisions in treating patients. However, it has been pointed out that the capacity of processing information in the human brain is limited in its ability to timely and accurately deciphers this clinical data without errors (Miller, 1956). In addition, these errors in decision making can be further increased when there is an arbitrary noise data (i.e., an unpredicted data input in stressful situation), a common occurrence in healthcare. Limitations in this conventional system of paper-based records, such as incompleteness of information, difficulty in searching for specific information, illegibility of handwriting, and inaccessibility of information, stand as obstacles in the development of healthcare delivery (Ayatollahi, Bath & Goodacre, 2009).

Unlike other industrial sectors, healthcare has lagged behind in the adoption of information technology. Healthcare is the world's single largest market, with $1 trillion yearly cost. As a consequence of using ineffective information systems, almost $270 billion is wasted annually (McHugh, 1998). With the previously mentioned weakness and the continuous demand on better healthcare quality, the adoption of information technology in the field of healthcare has been realized as a fundamental approach in addressing weaknesses like cost and the large number of medical errors.

This has led to the concept of electronically recording patient information as a promising tool being recommended by many researchers to address such weaknesses inherited in paper- based records and to enhance healthcare quality. This notion has been around since the late 1960s, when the concept of the Problem Oriented Medical Records into medical practice was introduced by Larry Weed (Weed, 1989). The notion behind Weed's innovation was to create a record that makes it possible to independently validate the diagnosis by a third party.

Since the 1960s there has been a rapid development in the technology used to support medical care and this has resulted in better delivery of healthcare by providing an enormous amount of data and information that is available to access (Blum 1986).

The first medical records system was developed by the Regenstreif Institute in the 1970s. After that, several EHR systems were developed for major government clinical care organizations (National Center for Research Resources, 2006). Some of these projects include:

- COSTAR (the Computer Stored Ambulatory Record), developed by Harvard. It was placed in the public domain in 1975 and deployed in a number of sites throughout the world.

- HELP (Health Evaluation through Logical Processing), developed at Latter-Day Saints Hospital at the University of Utah. It was well-known for its capabilities of decision support.

- TMR (the Medical Record), developed by Stead and Hammond at Duke University Center.

- THERESA, Walker, at Grady Memorial Hospital, Emory University, it was distinguished for its success in supporting direct physician's data entry.

However, these early projects faced large programmatic and technical issues, such as system interfaces and non-standard vocabularies (Buxbamum,2011). Since then, the absence of standardized clinical data has been an obstacle in exchanging this data all over the healthcare domain. This is widely due to the non-standardized language used in documenting patients' clinical records. Consequently, it has been difficulty for EHR systems to interpolate and identify patients and to locate their records across a large number of healthcare providers. Moreover, different EHR systems used by different organizations can sometime be incompatible (Bott, 2004).

In 1980s, the first EHR system that was capable of exchanging data across different departments was introduced, when there was an increase of clearinghouses that offered a service to exchange claims and other financial and administrative transactions across providers and payers of a fee (Buxbamum, 2011). The cost of this service was justified by many healthcare organizations in order to make business operations more efficient and get better revenue cycle management. At that time, the need to develop electronic data-interchange standards which could be used across different sectors was widely recognized. The work toward developing the current standards was begun by standards groups and industry organizations (International Federation of Library Association and Institution, 1993). A few years later, in 1987, the not–for-profit organization Health Level Seven (HL7) was established to enhance medical practice, management, delivery and evaluation

of healthcare services. It provided a comprehensive standards and framework for exchanging, sharing and retrieving electronic health information (http://www.hl7.org). At that time, the effort of establishing information sharing between healthcare providers concentrated on a linear linkage between physicians and their associated hospitals. Soon after, "many-to-many" relationship between healthcare providers was supported by the emergence of community health information networks (CHINs) (Buxbamum,2011).

Recently, the EHR is at the centre of the Institutes of Medicine goal of eliminating most handwritten medical data by the end of this decade (Institute of Medicine, 2001). Moreover, governments have emphasized the importance of such technology in improving healthcare delivery and have signed a large budget for implementing EHRs within their healthcare sittings. For example, in the United State, President-elect Barack Obama pushing his economic stimulus plan in a speech on January, 2009, called for all US residents to have EHRs within five years. Obama said:

> "To improve the quality of our healthcare while lowering its costs, we will make the immediate investments necessary to ensure that within five years, all of America's medical records are computerized."
>
> He added, "This will cut waste, eliminate red tape and reduce the need to repeat expensive medical tests. But it won't just save billions of dollars and thousands of jobs, it will save lives by reducing the deadly but preventable medical errors that pervade our healthcare system."

Through his speech, Obama said he would assign $50 billion over five years for supporting the implementation of EHR systems (http://www.ihealthbeat.org).

In short, the history of EHRs begun in the early 1960s with systems performing limited functionalities and also lacking government funding. Since then, a huge development has been carried out resulting in better standards and different frameworks. Today, EHRs are a goal for many governments, as a promising tool to improve quality of care and save cost.

Although, the adoption of EHRs can result in various benefits for clinicians, healthcare managers, and patient representatives, there are also some limitations and barriers

associated with such implementation which will be illustrated later in this chapter.

2.3 Value of Electronic Health Records to Academic Medicines

An Academic Medicines (AMCs) considers multiple organizations within one. AMCs usually enclose several healthcare amenities such as affiliated hospitals, clinics, treatment centres, laboratories associated with teaching and research, and complex business operations to administer all of these components. AMCs are more complex than other community hospitals because these organizations are providing tertiary medical care as well as conducting research. Therefore, a considerable amount of data is generated and has to be maintained. For instance, MedStar Health is a $2.7 billion healthcare organizations. It operates seven hospitals in the Baltimore-Washington region. It also operates several facilities for research, such as Georgetown University Hospitals (National Center for Research Resources, 2006).

The key value of EHRs to such a complex environment is that they can result in better communication between physicians within one or different facilities, as they enable practitioners to document their care and access the relevant documentation about their patients (Burton, Anderson & Kues, 2004). Additionally, certain features in EHRs such as email can facilitate the process of communication between physicians despite being in different locations (Erstad, 2003). Moreover, EHR systems can enable researchers to analyze the effectiveness of medications in patients with co-morbidities. Therefore, EHR systems are valuable to such complex organizations as they can enhance workflow efficiency and improve patient care as well as assist researchers in conducting their research and analyzing the effectiveness of the medications on patients.

In summary, a healthcare organization is a very complex environment. Within one hospital, there may be many services offered to patients such as radiology, laboratory, or pharmacy. Each of these services represents a component of the EHR system. Integration between these components is fundamental in implementing EHRs. The next section will illustrate the components of the EHRs in more details.

2.4 Key Components of Electronic Health Records

Patients receive several services from an ancillary department, such as laboratory, radiology, or pharmacy. An electronic record can be designed for each of these services. Some of these clinical systems support digital capture for nursing notes or clinicians' orders. Often, these systems are not integrated with each other and each of them has its own patient identification systems. A set of different systems will be demonstrated in Figure 1.

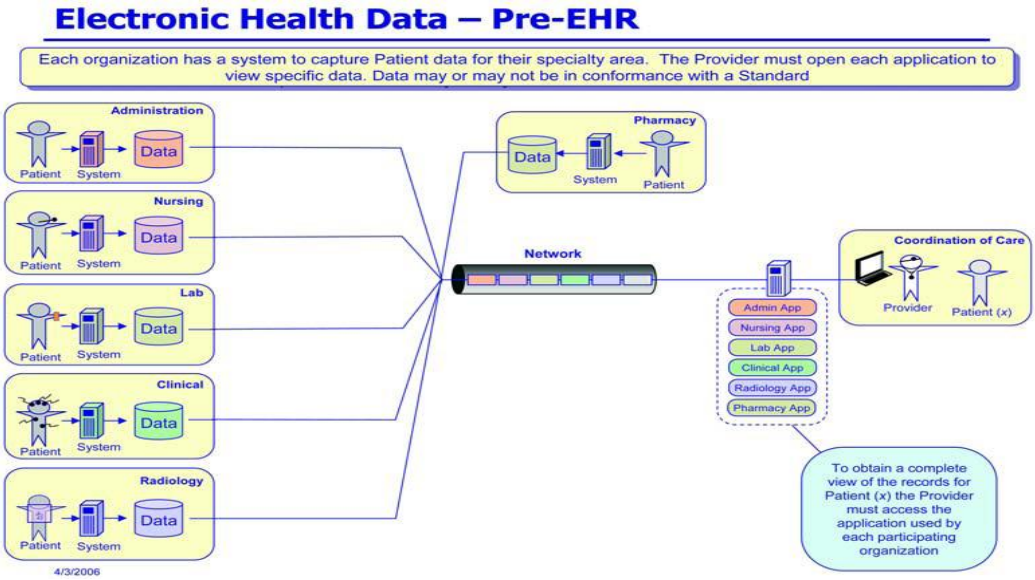

Figure 1: Electronic Health Data. (Source: National Center for Research Resources, 2006)

Each of these systems might be supplied by different vendors and thereby use varied standards for vocabularies and identification systems for both user and patient. Therefore, clinicians require log-in to different applications for different services to obtain information regarding their patients.

EHRs are designed to combined data from all ancillary services, such as pharmacy, laboratory, and radiology, with other medical care components like nursing notes and physicians' orders. There are different methods for this clinical data to be shared or imported from these various components, such as presentation integration or data integration (Carter, 2008). These will be illustrated later in this chapter.

2.4.1 Administrative System Components

An administrative system is a comprehensive and flexible system used to assist hospitals in managing and administrating its tasks more effectively. It covers both in-patient and out-patient operations. This system performs a number of major functions including registrations, admission, discharge, and transfer (RADT), key components of EHR systems (National Center for Research Resources, 2006). These systems are often designed to be user-friendly by having an easy to use graphical user interface (GUI) which is totally menu-driven. The EHR registration component contains a unique patient identifier. A patient identifier typically consists of a numeric or alphanumeric sequence which is unidentifiable outside the organizations. Accurate patient identification is fundamental to achieving the benefits of EHRs and ensuring patient safety. Moreover, the positive staff ID is needed to better control their log-in and protect patient privacy (Smith, 2008).

2.4.2 Laboratory System Components

Laboratory information management systems (LIMS) are computer-based application software intended to store and manage information generated as the result of the laboratory work. These systems are designed to control and manage test results, samples, standards, reports, laboratory staff, instruments, and work flow automation. Therefore, LIMS addresses the requirement of analytical services for laboratory and sample management (Muller, Bassin, Troyon & Novak, 1999). It can also help in providing more integrated environment by linking the analytical instruments in the lab to several workstations or computers. Each instrument has an interface like an integrator for the purpose of forwarding the data from the instrument to the personal computers. Then, the data is structured into meaningful information. Based on the type of report desired, this information is additionally classified and structured into different report formats. Consequently, LIMS can greatly enhance the quality of laboratory services. Hence, better efficiency and competitiveness of the laboratory can be achieved (as cited in Ozlem & Semih, 2004).

In fact, LIMS is extremely important for the successful implementation of EHRs in the contemporary healthcare system and healthcare organizations (Williams, 2010). LIMS should provide the personnel working in laboratories with an opportunity to have access to the health records of patients. They could also obtain information and add new information concerning patients' health (Gibbon, 1996). For instance, when tests are conducted in the laboratory, their results should be recorded in the electronic health records of patients. First, the laboratory should obtain the tested material from patients. After that, the laboratory tests the material and makes records in the electronic health records of patients, while healthcare professionals interpret the results and define the necessary treatment for patients.

2.4.3 Radiology System Components

A radiology information system (RIS) is networked computer-based software used by the radiology department for the storage, management and distribution of patient medical imagery and related data. An RIS particularly valuable for managing radiological records and associated data in several locations and is frequently used in combination with a picture archiving and communication system (PACS). It complements an EHR system and is vital to efficient work to radiology practices (Crowe & Sim, 2004). The software and the entire radiology system should provide accurate results of radiological studies and scanning of patients and add the findings of each scanning to the EHR of each patient (Faggioni, Neri, Cerri, Turini & Bartolozzi, 2011). At the same time, the radiology system needs to examine patients, for instance to make an X-ray. In such a way, the radiology system obtains information about a patient.

The next step is processing the information. Healthcare professional or special software defines whether the patient has some health problems or not. As soon as the results of the X-ray are obtained, they are recorded in the EHR of the patient. Therefore, the system remains the same as was the case of the laboratory system in which patients are examined. The data is then collected and processed, and, finally, healthcare professionals record the results in electronic health records and take decision on the further treatment of patients.

2.4.4 Pharmacy System Components

The pharmacy system components record the drug and related medications prescribed for a patient during their visit of clinical care. At the same time, the pharmacy system needs to prevent the risk of the development of certain health problems, such as allergic reactions in patients. If such problems are identified, patients are informed and they will not receive medication that may be potentially dangerous for them (Hines et al., 2011). For instance, if a patient gets a receipt from a physician, the medication should be safe and should help the patient to recover from his/her health problem. In such a situation, the pharmacy system should be able to test whether the prescribed medication will be safe for the patient or whether some changes have to be introduced, or some other medication should be used instead to ensure the patient's health (Silcock, Raynor & Petty, 2004). Therefore, the pharmacy system should have access to the electronic health records. Otherwise, the risk of error arises when patients get prescriptions and use drugs without any analysis of their impact on the health of patients. The more detailed information the pharmacy system has about the condition of a patient's health the more effective the medication treatment may be.

2.4.5 Computerized Physician Order Entry

Computerized Physician Order Entry (CPOE) refers to electronically entering medication orders or other physician instructions in place of paper charts. CPOE is one of the most important components of any EHRs as it can assist in reducing errors related to illegibility of handwriting or transcription of medication orders. Medication errors were defined by the American Society of Health-System Pharmacists (1998) as:

> "Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer." (Shamliyan, Duval, Jing & Kane, 2008)

Some of the most common errors that can be reduced through CPOE are prescribing errors, including wrong drugs, form, dosage or frequency; incorrect route; and contraindicated drug use and interaction (Fontan et al., 2003).

In the CPOE system, orders are incorporated with patient information such as laboratory and prescription data and further they are automatically checked for potential errors or patient harm. In this respect, healthcare professionals should be able to digitally record all the information about the health of patients into their EHRs. This means that healthcare professionals should be able to access patients' EHRs and make changes in the records in respect to any change in the condition of the patient.

2.4.6 Clinical Documentation

A number of more than 1 billion clinical notes are generated by clinicians in the US annually. These notes represent about 60% of all medical information and are used as the main source of information for reimbursement and verification of service (Dolin, 2010). Therefore, clinical documentation is playing a significant role in clinical information. Due to the previously mentioned facts about the importance of such documentation to the efficiency of healthcare as well as the awareness of the potential benefits associated with electronically documenting clinical data, there has been a major push toward improving the capture and the use of clinical information by using advances in information technology. With the transmission from a paper-based documentation to an electronic based documentation and charting environment, healthcare providers are able to take advantage of available advanced technology tools to eliminate inconsistencies in clinical documentation. This can lead to an enhancement in the health and safety of patients by enabling full compliance with all essential elements of clinical documentation (McAllister & Rhodes, 2010).

2.5 System Integration

Integrating the EHRs, that is, enabling the EHR system components and other associated software applications to accurately exchange and share data which is one of the critical tasks in implementing an EHR system. Although most EHR systems perform with similar features and functions across healthcare organizations, they can be considerably different in the way that these functions are assembled (Carter, 2008). EHR systems used in hospitals and their integrated delivery system are usually virtual systems created by gathering and sharing clinical data between several component systems like laboratories, radiology and pharmacy (Ball, Douglas & Lillis, 2001). On the other hand, EHR systems used in outpatient settings are usually independent applications where all functions are built on top of a single, shared database. The capability of an EHR system to perform advanced features such as computerized order entry and decision support mainly relies on the level of integration of its previously mentioned components (Carter, 2008). Therefore, integration between these heterogeneous component systems is fundamental in order to achieve successful implementation of EHR system.

Integration of system components can be achieved on different levels: the data level, the presentation level, and the business logic level (Paulheim & Probst, 2010). According to Carter (2008) the presentation and data levels represent the common levels of integration and therefore will be discussed below.

2.5.1 Presentation Integration

At the presentation level, a common interface is used to share data from all the previously mentioned components (see figure 2). Systems like this seem to be one coherent system because a single interface is required to combine its components' presentation front-ends (Carter, 2008). While integration on the presentation level is quite useful, such systems are limited when more than simple data retrieval is required.

A major disadvantage to presentation-level integration is the lack of query capability across all systems (Carter, 2008). For instance, this type of integration does not support a query

such as “find all patients with a diagnosis of congestive heart failure who are not taking an ACE inhibitor” because the patients’ medical data reside on different components of the system.

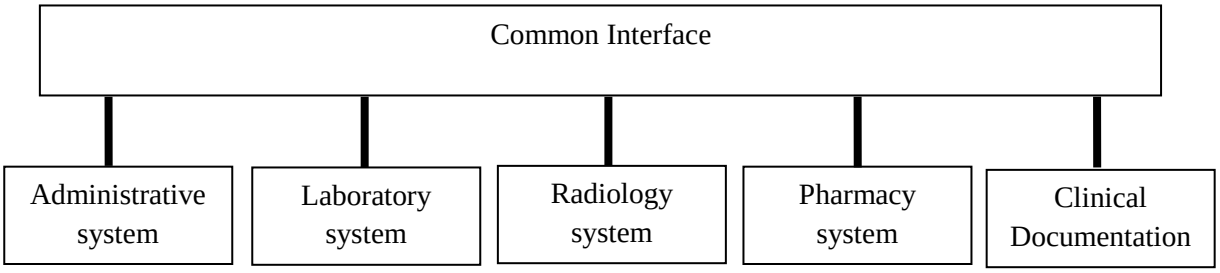

Figure 2: Presentation level of integration

2.5.2 Data Integration

Data integration is the fundamental requirement to achieve true EHR functionality and it is difficult to obtain (Carter, 2008). In this type of integration, data from all components such as laboratory and radiology, reside on one central system (see figure3). The central system represents a large database called a clinical data repository (CDR) in which patients’ data reside. Data-level integration requires that all the system components use a consistent format for coding data elements, representing a mechanism for the data movement from all components to the CDR.

The CDR is the major source of information for the entire EHR system and is accessible by all the EHR components. The most common method used to populate the CDR is through the use of interfaces to link each of the EHR components. Interfaces are special computer-based software designed to move data between systems. Component systems in which the data reside might be designed by diverse vendors and consequently use proprietary data models. Therefore, similar named data elements from different component systems may have different characteristics which prevent them from being interchangeable. It’s worth noting that the use of simple messaging interface alone cannot resolve complicated semantic problems presented by data from different systems. This implies that, in order to obtain successful data-level integration, additional applications such as medical data

dictionaries are required to resolve problems present in reconciling terms, data elements, and data formats between EHR component systems. The lack of broadly accepted data standards as well as the cost associated with implementing interoperability between EHR component systems stand as major barriers to the deployment of EHR for many healthcare organizations (Nieves, De Mues, Espinoza & Rodriguez-Alvarez, 2011).

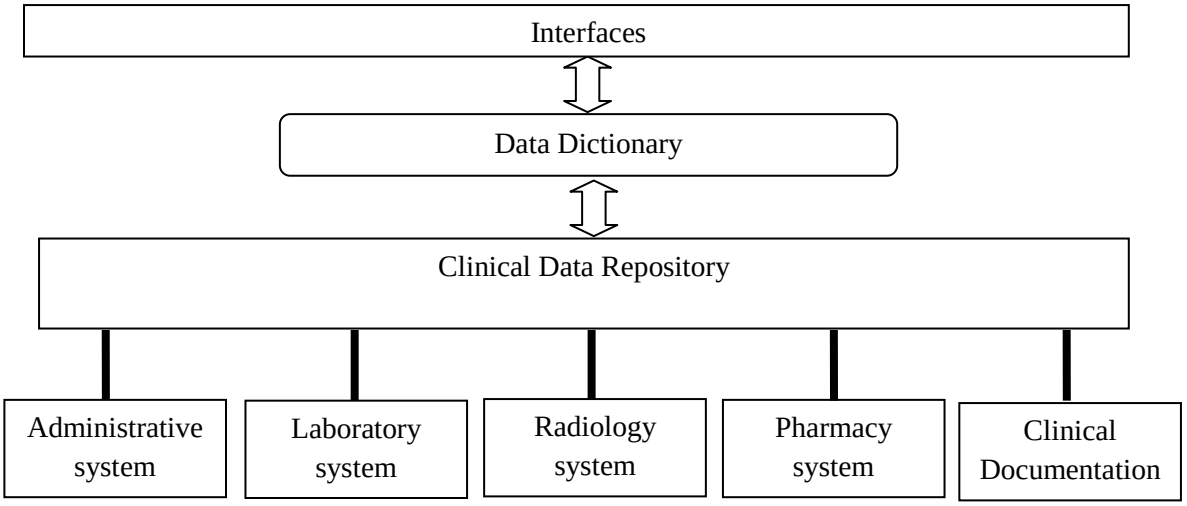

Figure 3: Data Integration Models

2.6 Consideration of Standards

Definitive standards are highly required for achieving the core goal of EHR by representing relevant clinical information in one shared EHR system. The importance of developing and adopting national and international standards for EHR interoperability can be illustrated in the following (Schloeffel, Beale, Hayworth, Heard & Leslie, 2006):

- Enabling healthcare organizations to exchange clinical information in a multi-disciplinary advanced shared-care environment.
- Providing interoperability between healthcare providers locally or even across national borders.
- Supporting the interoperability between systems supplied by different vendors.

However, different approaches have been followed in developing these standards (DeNardis, 2011). Below are a definition and an outline of the key standards developed for representing and exchanging relevant medical information.

2.6.1 Definitions

A standard is "A document established by consensus and approved by a recognized body that provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context" (as cited in the European Telecommunications Standards Institute).

Medical information systems have traditionally captured and stored clinically and administratively related patient data in proprietary formats which are not interoperable with other vendors' systems. The emergence of EHR standards aims to develop common electronic formats and structures for supporting the integration of relative medical patient information as well as enabling this information to be shared and exchanged within several medical systems developed by different vendors (DeNardis, 2011).

The development of e-health standards including medical vocabularies and structured data organization significantly improves the capability of medical information systems to effectively interoperate and interconnect with each other, leading to a meaningful implementation of EHRs (National Center for Research Resources, 2006).

2.6.2 Key Standards

According to the National E-Health Transition Authority (2006), two key types of standards and associated specification are required to define and exchange EHR information efficiently:

- Shared EHR Architecture Standards:
  These standards aim to identify the content and the logical structure of interoperable EHR information and its associations to medical concepts.

- E-health Information Interchange Standards:
  Information interchange standards aim to identify the format, including syntax and representation of shared EHR information, in order to enable this information to be exchanged between several medical systems.

Internationally and notionally, there are several organizations concerned with the standardization of EHR systems. Below is an outline of two common institutions aimed to develop standards for supporting the implementation of EHRs, HL7 and Open EHR (Bott, 2004).

- HL7 CDA (Clinical Document Architecture)

  HL7 (Health Level Seven International) is a non-profit organization established in 1987. Its objective is to provide providing a comprehensive framework and standards for the integration, exchange, sharing and retrieval of digital health information in order to enhance the workflow of clinical practice as well as the management and delivery of health services. Here, "Level Seven" refers to "the seventh level of the International Organization for Standardization (IOS) seven-layer communications model for Open System Interconnection (OSI) – the application level"(www.HL7.org).

- Open EHR

  Open EHR is also a non-profit organization founded in 1999 by the University College London and the Australian company Ocean Informatics. By enabling ICT, it aims to effectively support healthcare delivery, clinical research and associated areas. The main obstacle for implementing ICTs in the field of healthcare is to represent the semantics of the field, which includes terminology, ontology and a semantically enabled medical computing platform where compound meanings can

be represented and shared. Technically, open EHR is about building specifications, open source software, and tools for enabling ICT to greatly enhancing the healthcare delivery. It also aims to support the clinical space by constructing high-quality, re-usable clinical form of content and process, archetypes, as well as official interfaces to terminology. For a standardization development purpose, Open EHR is effectively participating in a universal standardization organization including CEN and HL7 providing proposals for the specification and development of EHR component systems. The main specification provided by Open EHR is the EHR Reference Model, concerned with the structure and content of EHRs (www.openehr.org).

2.7 Benefits of Implementing EHRs

There are several benefits that can be obtained through the use of EHRs. These benefits go to all the parties involved in the healthcare facilities, but especially the clinicians, healthcare managers and the patients. Below is an outline of the major benefits that each party will get (Moumtzoglou & Kastania, 2011).

2.7.1 Clinicians

Clinicians are the medical workers directly involved with the patients, be they nurses, physicians, psychiatrists or psychologists. They might be operating in private practice or they may be in the public health sector. All medical facilities keep records on the patients they attend. The following are the benefits that EHR may have for them in the course of their practice.

- *Promotes evidence – based decision making*

Availability of a system of information that is easy to access and which is detailed pertaining to a patient will assist the clinician to make solid decisions about the patient's needs based on the past data like drugs administered, allergies found, reactions to certain drugs or procedures and effectiveness of initial treatments (Health & Medicine, 2006). For instance, if a patient had been treated in a certain healthcare facility for a particular disease

and then he returns with the same complaint, the clinician, after referring to past medication given to the client, may choose to change the medication. They will find it easier to locate the patient's health records from the EHR than from physical documents such as files, which can easily be misplaced or be concealed in huge volumes of files (Milewski, 2009).

- *Allow easy access to support information*

Most systems offering EHR will also have integrated research and technical data on medical practice information regarding a wide range of health issues (Ventres et al., 2006). Information such as current research, online doctors' consortiums, and other developments in the field of healthcare provision will be easily available using EHR from many hospitals all over the world. It would be easier, for instance, for a clinician to perform a quick search of documented health issues similar to those of a patient they are handling without having to leave their station and search in file cabinets, journals and statistical manuals.

- *Timely, reliable, easy patient information management*

The presence of an integrated electronic health information system will allow clinicians to find and follow up on patient issues such as bookings, progressive lab reports and medical history more easily and conveniently than paper records. As such, it also allows easy patient file sharing and information access between clinicians in facilities where patients are not assigned personal doctors (Koeller, 2002).

2.7.2 Healthcare Managers

Healthcare managers are the professionals responsible for the leadership, administration and management of hospitals, healthcare systems or networks. They have the responsibilities of ensuring a progressive, efficient working environment in the healthcare units (Menachemi, 2006). They oversee all departments such as radiology, laboratory and pharmacy among others. Some of the benefits of EHR as pertains to their role are as follows:

- *Easy workflow management*

EHRs combine total patient experience in a healthcare facility including laboratory reports, bookings, billing reports and referrals, among others. Additionally, the EHRs may contain statistical analyses of healthcare facilities operations such as a number of patients seen in a unit time, medical traits of patients in response to a particular treatment, number of referrals into and from the hospital and so on. Such information is necessary for healthcare managers and hospital management teams. It may also be required by the National Public Health Committees (Kathleen, 2000).

- *Easy inter-hospital patient information sharing*

EHRs provide each patient with a unique patient identifier number, called a Master Patient Index (MPI) (Menachemi, 2006). This number can be traced back to a particular patient regardless of which care facility they access. Even though EHRs do not automatically resort to patient data access outside of the primary institution where it is retained, and any such data sharing may be governed by certain industry and privacy regulations. EHRs will ultimately allow healthcare management to do vital services such as referrals, pharmacy transcriptions, more easily with completed, updated patient records. This will allow continuity in healthcare for patients in different hospitals (Health & Medicine, 2006).

- *Cost reductions*

Though the initial cost of equipment installation may be costly, the day-to-day expenses of a healthcare unit can be greatly reduced if it applies the appropriate EHR system. EHRs make utilization of structured flow sheets, clinical notes, and point-of-care documentation which can lead to a reduction in medical transcription costs (Agrawal, 2002). It is estimated that the employment of EHRs can save 300$ - 1000$ of transcription cost per month, per physician (Mildon & Cohen, 2001). Besides saving time and thus reducing the workforce, it will also reduce other facilities like cabinets, files and free up space that can be used for other purposes.

2.7.3 Patients

The benefits of the EHR to the patient are as follows:

- *Easy access to personal health records*

EHRs provide easy access by the patient to their health records including past diagnostics, medical traits, drugs administered and much more. If the EHR is available online, the patient may also be able to manage health bookings and consultancy (Perlin, 2006).

- *Easy records retrieval*

Due to the fact that EHRs are centrally stored and managed, the cases of personal information loss due to negligence or misplacement are reduced. This means that patients will not have to fill in fresh forms each time they visit a healthcare facility (Appel, 2008).

- *Time saving*

Patients spend less time waiting to be attended, as in the case with physical records retrieval. With EHRs, the clinician has all the files centrally placed and easily accessed (Bourne, 2009).

2.8 Barriers and Risks Associated with EHRs Implementation

There are, however, barriers hindering optimization of EHRs, as well as risks that should be resolved. The issues as discussed below.

2.8.1 Security

The information contained in EHRs is accessible by various departments in a healthcare unit, an aspect that requires a very secure maintenance procedure. High standards of security also translate to high cost of implementation and maintenance, which many care providers may not be able to afford. Further to this, clinicians in a facility may have different competencies in EHR systems usage. This may become dangerous when vital information is either omitted or accidentally altered (Hoffman, 2008). Apart from security concerns within the organizations, it is also to be considered that such health record

systems are prone to unauthorized access and damage by external parties such as web hackers, viruses and other internet-based security threats.

2.8.2 Privacy

EHRs are centrally managed where different personnel may have access to them. Thus, a patient's medical record may be easily accessed by different departments within a facility and even externally by other healthcare units. This means malicious usage of patient information can result. There is also the issue of manipulation of data, where a patient's information may be wrongly entered, leading to a wrong diagnosis and/or prescription of medication (Smaltz and Eta, 2007). Because EHR usage is a relatively recent development in medical practice, there are insufficient rules governing the use and disclosure of personal information. This is a major challenge in the use of EHR systems.

For the EHR system to succeed there needs to be an accountability and integrity in carrying out the different roles in medical practice. This will include accountability on the parts of the patient, clinician, other hospital staff, health management and insurance companies. While healthcare key players and governments may try to implement such measures, there are concerns that the number of personnel with access to EHR would be so great and the patient base so huge that there would be mass breach of confidentiality and patient privacy (Bourne, 2009).

2.8.3 Lack of Standards

There are no clear set rules and regulations governing the creation, retention and sharing of patient information. First, there needs to be a harmonized way of creating a patient's file. This involves having a unique patient identifier that will apply across all healthcare providers. Secondly, there is a need for a standard layout for patient information collection across the healthcare profession (Menachemi, 2006). Thirdly, there must be a standard method of information sharing between the various hospitals or healthcare units when the need arises. Such circumstances include referrals, change of preference by the patient or even cases where certain healthcare units close down and patient information needs to be

retained. There have been two approaches suggested to enhance health data sharing between hospitals. These were the centralized data server model and the peer-to-peer model of file synchronization. While both are viable, they are still rendered unusable because there is no standardized method or format of record creation (Waegemann, 2003). This means that even if the records would be passed to different units, the usability of these records would be limited.

2.8.4 Summary Issues

Kallem, Burrington-Brown & Dinh (2007) indicate that an electronic discharge summary (eDS) is an important document for the purpose of transferring information between the primary care physician and hospitalist. Some of the information to be included in the eDS includes reasons for hospitalization, methods and treatment offered significant findings among other things. The main challenge facing the information to be included in the discharge summary is determination of the extent of the significant findings. Although some healthcare interprets significant findings to mean only the abnormal results, most of them do not recommend the limiting of this summary to the abnormal findings. The main issues associated with eDS were identified as (National Information Clinical Leadership Group, 2010):

- Lack of standard content of discharge summary.
- Addressing the formatting problems at the receiving end as well as updating messaging standards.
- Enabling primary care physicians to upload vital information into their system in a structure effective way.

Chapter 3

Research Methodologies

3.1 Primary versus Secondary Research

Basically there are two main methods of conducting qualitative research. These are primary and secondary research methods. In the primary research method, there is no ready data available and the researcher has to conduct the research from scratch. The researcher accomplishes this by the use of interviews, filling questionnaires and collecting samples, among others (Shi, 2008). Therefore, the data collected through this research method is normally raw data. It has to be processed in order for the researchers to make sense out of that data. On the other hand, the secondary research method involves getting data that has already been collected and analysed. This kind of data can be found in company reports, journals and other written or digital sources. In this kind of research, the person doing the research does not need to start from scratch (Shi, 2008). When comparing these two methods of research, one can already note that each has its advantages and disadvantages, but the most important thing to note is the fact that the primary research method takes more time to conduct and is more costly compared to the secondary research method (Hinkel, 2010).

In order to establish that the secondary method of research is more appropriate for this research, one has to first examine the advantages and disadvantages of each method of research. The primary research method has always been hailed as the better method when compared with the secondary method (Lancaster, 2005). One advantage of the primary research method is the fact that the data collected is usually highly relevant. This is because the researcher acquired it first hand, hence there is no distortion of the data. Another advantage is the fact that the researcher is able to get the precise data he has targeted. Data collected through primary research is usually easy to interpret. Finally, the data collected is usually very recent as compared to secondary data sources. One of the disadvantages of

primary research is that it is expensive to conduct this kind of research. Also, the process of collecting primary data is very time-consuming and more often than not the feedback is inaccurate and inconsistent.

One the other hand, in secondary research the whole process is usually very economical. This means that it does not consume as much resources as does the primary research method. It also saves much time. Secondary data can be used to streamline primary data by helping fill out the gaps and also add additional information that might have been overlooked in primary data collection (Collins, 2009). Secondary data collection helps one understand the problem more clearly and, finally, it forms a basis for comparison of the data collected by the researcher. This method of data collection also has some disadvantages. First, the data collected from secondary sources rarely fits the framework of the question that was to be answered in the research. Another disadvantage is that the accuracy of the data cannot be truly established and it might also not be up to date (Collins, 2009).

3.2 Justification for Selecting Secondary Research Method

With the previously mentioned points in mind, one can decide what method best suits a given scenario in conducting research. While conducting research on the use of EHRs in health institutions in five countries, one has to consider several factors. The first is the ease of access to the required data. The second is the time frame allocated to that research. The third is the funds available. Finally one has to decide the kind of data to be expected.

When conducting this research using the primary research method, there may be some difficulties that could be encountered. The first is ease of access. It can be very taxing for someone to travel across five countries visiting each and every health institution to collect data; indeed it is almost impossible. Even when using web survey methods, it can be very challenging to obtain and analyse data regarding five countries within this research time frame, one year. However, by use of secondary sources one can obtain that data without even leaving the country. One can obtain this kind of data through the internet or request fax copies from the health centres. Another problem of using the primary research method

is time. Using the primary research method can waste a lot of time in this research. It can even make the end result irrelevant because the data will be outdated by the time the research is complete. Another problem of the primary research method in this scenario is using many resources which can be otherwise saved when using a secondary research method (Stewart, 2007).

To sum up, the secondary research method is the best way of collecting data in this research. It will ensure that time is saved. The other advantage is that the use of secondary sources can also help one understand the problem more clearly. This is because secondary data sources can contain more information which can help the researcher fill in some gaps which he/she would have found out through primary data collection. Therefore, the secondary research method is the best for this research.

3.3 Research Questions Directing this Study

1. What are the EHRs' level of implementations, benefits, challenges and success factors in US, UK, Australia, New Zealand and Saudi Arabia?
2. Are there any common factors affecting the deployment of EHRs in the four developed countries? If yes, how do those factors relate to the Saudi context?
3. Is there a significant relationship existing between the healthcare system and the successful implementation of EHRs?
4. Should EHRs be centralised or distributed?

3.4 The Research Methods and Data Collection

This research employed primary and secondary literature to study EHRs and its implementation in five nations. The primary and secondary literature in this research included academic journals, primary records, internet websites, government documents, publications, reports and periodicals. Through the library database of Massey University, these resources were accessed. In addition, non-peer-reviewed literature was also searched

in Google, Google Scholar, and other search engines using search terms such as “electronic health records,” “computerized records,” “medical health records” within each of the five countries.

Moreover, in each of the five countries, the following criteria were investigated:

- Healthcare structure
- Healthcare coverage
- Healthcare finance
- EHR implementation
- EHR model of implementation
- Healthcare ICT issues

Due to the variation in the literature regarding the essential clinical functions that an EHR should perform, and in order to make an accurate comparison between these five countries in this respect, results mainly obtained from the latest Commonwealth fund survey were used to compare EHR implementation in these countries. In this survey, 14 clinical functions were identified to determine different levels of EHR use in eleven countries including US, UK, Australia and New Zealand. These clinical functions include:

- “Electronic ordering of medications”,
- “Electronic ordering of tests”,
- “Computer access to test results”,
- “Computer access to medication lists”,
- “Computer alerts/prompts”,
- “Decision support”,
- “Computerized reminder systems for prevention”,
- “computerized reminder systems for follow-up care ”,
- “Computerized ability to list patients by diagnosis”,
- “Computerized ability to list patients by lab results”,
- “computerized ability to list patients by medications”,
- “Electronic entry of notes”,

- "Electronic entry of medical histories".

Based on these 14 clinical functions the implementation of EHR in these four developed countries was classified to three different level, low (0-3 clinical functions), middle (4-7), and high (8-14). (Commonwealth Fund International Health Policy Survey of Primary Care Physicians, 2009).

Based on these previously mentioned criteria, a comparison was developed across these five nations which showed the gap between them in implementing EHRs. In addition, the comparison illustrated the main factors affecting the implementation of EHRs, from which lessons for developing countries like Saudi Arabia can be drawn. Moreover, the study raised a discussion for distinguished areas in EHR implementations in these countries.

Chapter 4

The Implementation of EHRs in the US

The United State healthcare system is the most costly health system in the world; however, relative to other countries, it constantly underachieves in most aspects of performance, (Davis et al., 2007). Most developed countries have national health insurance programmes operated by the government and financed through general taxes. Almost all citizens in such countries are covered by insurance and so are entitled to receive healthcare services. The US is unlike other countries because not all Americans are covered by health insurance (Chua, 2006). The following provides an overview of the US healthcare system, including the structure, development, EHR implementation and some of the issues facing its development.

4.1 The Healthcare System in the US

Similar to all other countries, there are both private and public insurers in the US healthcare system, but, unlike other countries, the US healthcare facilities are mostly owned and operated by the private sector. The public health system covers the elderly and low-income families while all other Americans mainly receive insurance coverage through employer-sponsored private insurance (Chua, 2006).

The Medicaid program covers poor families and the disabled. States are responsible to cover low-income pregnant women, children, the elderly and the disabled. In addition, States can also increase their coverage. People over age 65 are covered by the Medicare programme.

Children whose families are not eligible for the Medicare programme but who cannot afford to purchase private health insurance are served under the State children's Health Insurance Programme (Tewes, 2009).

4.1.1 Coverage

Most type of insurances often cover inpatient and outpatient hospital care as well as physician's visits. Some insurance plans also include dental care, preventative services and prescription drugs. Benefits vary according to the type of insurance in the US.

Employer-sponsored private insurance has to accept everyone at the same cost. Such insurance plans are usually underwritten, based on factors such as age, weight, and health history (Johnson, 2010).

Medicaid covers a variety of care services such as outpatient care, physicians and medications. Medicare basic plan covers hospital services, but extra coverage can be gained by paying additional premiums.

Health maintenance organisations (HMOs) are also well-known alternative to the previously mentioned health insurance plans because they offer lower cost healthcare services. HMOs provide healthcare to their members through a network of general practitioners (GPs), hospitals and clinics. Members must choose a GP from a list of doctors in the HMO's network. GPs refer cases needed advanced care to hospitals or specialists (Texas Department of Insurance, 2012).

4.1.2 Finance

Health expenditure in the United States is the highest in the world: near $2.6 trillion in 2010 (Martin et al., 2012). The US government uses money generated from taxes to repay care providers who offer health services to patients enrolled in Medicare, Medicaid and SCHIP. There is also a tax subsidy of employer–based insurance. The total health expenditure in the US (%GDP) is 17.9 (see figure 4), while the public expenditure on health is 53.1 % of the total expenditure (The World Bank, 2011).

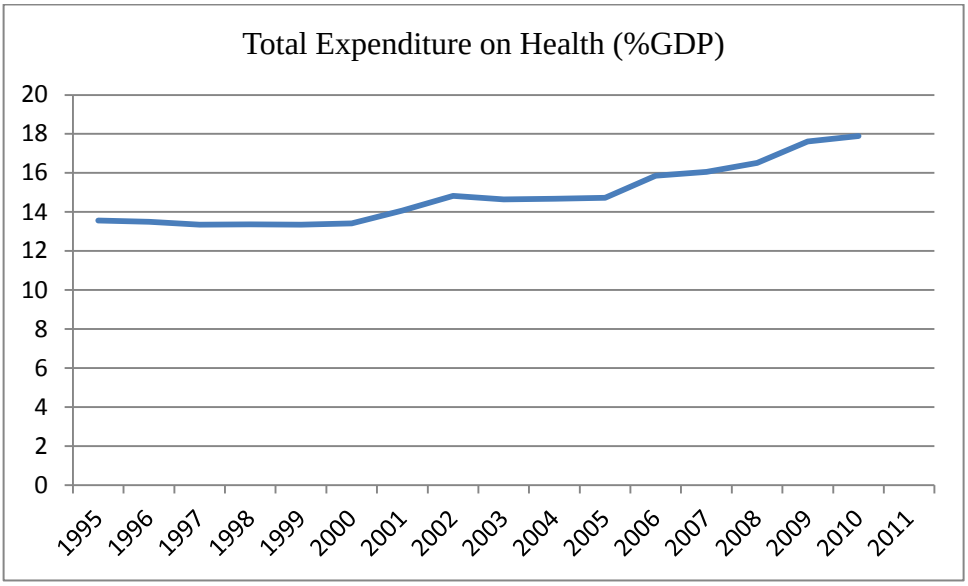

Figure 4: Total health expenditure in the US (%GDP) (World Bank, 2011)

The employer-based insurance premium is mostly paid by the employers, while employees pay the remaining amount. Health providers get a direct co-payment by patients, and cost-sharing provisions differ by type of insurance.

4.2 Developments of Health Information Management in US

The health information management (HIM) system has a long history in the United States. According to Van Fleet, (2010), the health information industry has been around since 1928 when the American College of Surgeons decided to start an association that would keep all the records of patients. In this way, the college wanted to improve service delivery and increase the standards of record-keeping in healthcare.

In 1969, the first project in health informatics was funded by the Healthcare Research and Quality Agency (HRQA). Since then, the Agency has continued to support the use of information technology to improve the quality of healthcare by awarding $250 million to fund more than 150 projects in health informatics (Ortiz & Clancy, 2003).

In 1998, the Institute of Medicine (IOM) established the Committee on the Quality of Healthcare in America. The main goal of this committee is to identify strategies for improving the United State healthcare quality. In this regard the committee noted:

> ‘‘Information technology must play a central role in the redesign of the healthcare system if a substantial improvement in quality is to be achieved over the coming decade’’ (Ortiz & Clancy, 2003).

A reemphasis on electronic medical records emerged in 2000, as a result of the increasing numbers of patient deaths and injuries caused by medical errors. For this reason, the government’s Center for Medicare and Medicaid stated that electronic medical records would allow “providers to make better decisions and provide better care” and “reduce incidence of medical error by improving the accuracy and clarity of medical records” (Van Fleet, 2010).

Three years after its establishment, the committee published a seminal report in March 2001; ‘Crossing the Quality Chasm: *A New Health System for the 21st Century*.’ This report focused on issues affecting the healthcare quality in the US, and the main findings of this report were as follows (Ortiz & Clancy, 2003):

- The healthcare system in the US did not constantly deliver the type of high-quality care that Americans expect to receive.
- The report provided a framework as well as a strategy for redesigning the healthcare system to enhance the delivery of healthcare.
- The report puts strong emphasis on the use of information and communication technology to achieve substantial improvement in healthcare quality by enhancing the access to medical information and supporting evidence-based decision making.

The committee also called for a national commitment to constructing an information infrastructure to support delivery of healthcare, consumer health, public accountability, medical research and clinical education.

Later in the same year of 2001, the HRQA included $50 million as an introductory step towards reducing medical errors and providing better patient safety by using advanced ICTs (Ortiz & Clancy, 2003). Consequently, a series of research solicitations was developed by the agency to:

- Design and evaluate best practices for reducing medical errors in multiple healthcare settings;
- Promote the science base to inform these efforts;
- Reduce medical errors by providing better education to care providers;
- Take advantage of IT advances to translate effective strategies into extensive practices.

This is considered to be the single largest investment the federal government has ever made to improve healthcare quality by using ICTs to reduce errors in medication.
Clinical Informatics was one of these solicitations, aiming to improve patient safety by the use of IT to reduce medical errors. This tendency of Clinical Informatics generated an enthusiasm among patient safety and ICT researchers, resulting in a large number of proposed designs from a variety of public and private sector organizations. Most of these proposals aimed to use handheld wireless devises, computerized decision support tools, electronic medical record systems, or e-prescribing applications to improve patient safety and reduce medical errors.

To support such IT innovations, the HRQA allocates 2.5 percent of its extramural research budget to support the small business in developing innovative technology that has the potential to promote the delivery of healthcare in the United States (Tewes, 2009).
After the realization of the potential that ICTs can have to improve the quality of healthcare, further emphasis was placed on the need for EHR advancement by President George W. Bush. In January 2004 Bush stated that, "By computerizing health records, we can avoid dangerous medical mistakes, reduce costs and improve care", (http://stateoftheunionaddress.org/2004-george-w-bush) (Van Fleet, 2010).

The interest in implementing the EHR has been in progress since that time and currently rests with the American Recovery and Reinvestment Act (ARRA), which was introduced by President Barak Obama in 2010. In this plan, more than $1 billion was allocated for the implementation of EHR in the United State (Van Fleet, 2010).

To sum up, there has been huge development in the management of health information in the United States. It started in 1928, with an attempt from the American College of

Surgeons to keep all the records of patients in an association to improve service delivery. After that, a series of actions have been driven by the federal government such as the establishment of agencies focusing in health information management development, founding ICTs research and allocating a large amount of the budget for the deployment of computerized health records.

4.3 Implementing EHRs

The implementation of EHR in US can be categorized by two distinct periods. The period before 2004 represents the first period of implementation, marked by very low level of government activity to support EHR diffusion. In 2004, President Bush called for a "Universal EHR Adoption" within the next 10 years, making the major wave of activity and increased awareness of the potential benefits that EHR has in improving healthcare quality. A study aimed to compare the EHR adoption in the United States before and after 2004 (2001-2004 and 2001-2007 correspondingly) found that the physicians' willingness to adopt EHR in their practice has increased during the second period. In addition, it estimated that by 2014 (47.3%) of physicians will have implemented the EHR (Ford, Menachemi, Peterson & Huerta, 2009). The following Figure 5 shows the EHR diffusion in the United State based on this study.

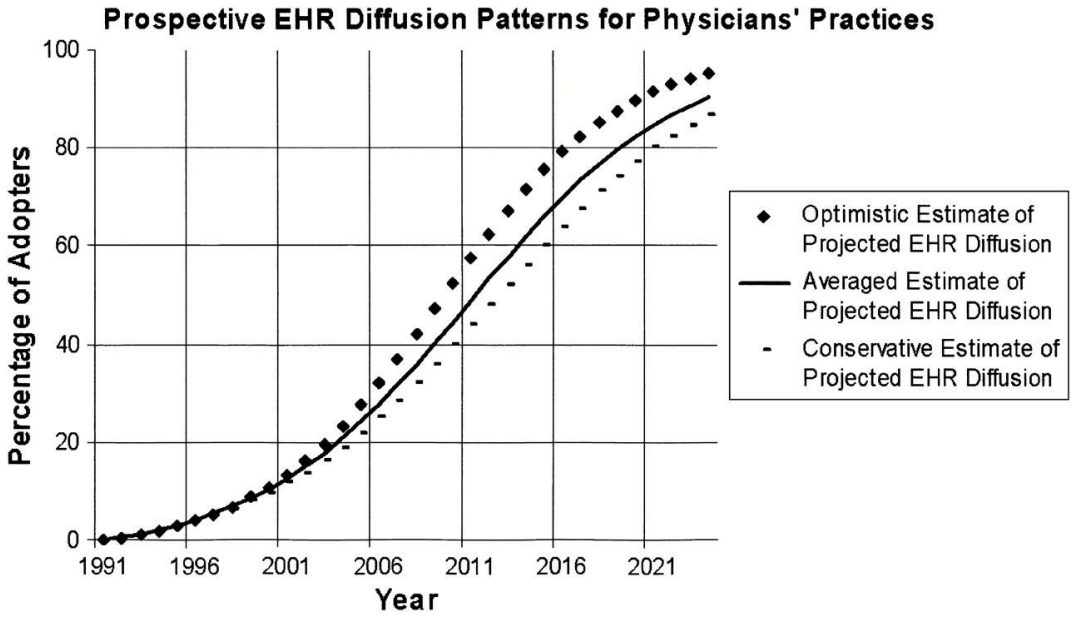

Figure 5: Two estimates of EHR diffusion (source: Ford, Menachemi, Peterson & Huerta, 2009)

4.3.1 US's EHR Model

The development of EHR model in the US is evolving at the national level. In the implementation of EHR in the US, technical parts are given main priority by the IOM and the National Committee on Vital and Health Statistics (NCVHS) (National Committee on Vital and Health Statistics, 2008). Two core components in the projects have been identified by the IOM and NCVHS: first, constructing a national infrastructure for health information, and second, setting up data interoperability and comparability for the protection of patient data. In order to attain the interoperability and data comparability, a recommendation for the adoption of core standardized EHR terminologies has been given by the IOM and NCVHS (e.g., CPT-4 to code medical procedure) (as cited in Gunter & Terry, 2005).

The current stage, architects of EHR national model development in the US are focusing on data interoperability and comparability for the safety of medical data (Gunter & Terry,

2005), developing a full "pull" structural design. This means centralised and local records can introduce semantically comparable data.

4.3.2 EHRs in Ambulatory Care

Ambulatory care refers to an outpatient basis where medical care is given to patients who do not required to be admitted to a hospital. According to the Commonwealth Fund survey (CMWF) and some other high quality surveys, approximately 26 % of GPs use some type of EHR, and roughly 10% of physicians use an EHR supporting computerized physician order entry (CPOE) (Jha et al., 2008). However, some research estimates that the computerized physician order entry (CPOE) use among physicians is as high as 22%. It was also indicated that the use of EHR various broadly by the size of practice: GPs who are in a small practice have lower percentage of EHR use than GPs who are in large practices, where roughly half of them use some form of EHR (Hing, Burt & Woodwell, 2007).

In addition, it was also reported that 29.2% of office-based physicians used full or partial EHR in 2006, which marked a 22% raise since 2005 and a 60% raise since 2001. Based on the minimal features for a comprehensive EHR "computerized orders for prescriptions, computerized orders for tests, reporting of test results (lab or imaging), and clinical notes" considered by health information technology experts, the following statistics were estimated:

Only 12.4% of GPs used full EHR system in 2006. There was no significant different from the 9.3% estimate in 2005. However, the rate of medical practice using comprehensive or partial EHR has risen from 2005 to 2006 by 42% (Hing, Burt & Woodwell, 2007). In actuality, the share of office-based physicians with EHR grows. The following Figure 6 shows the dynamics of this growth:

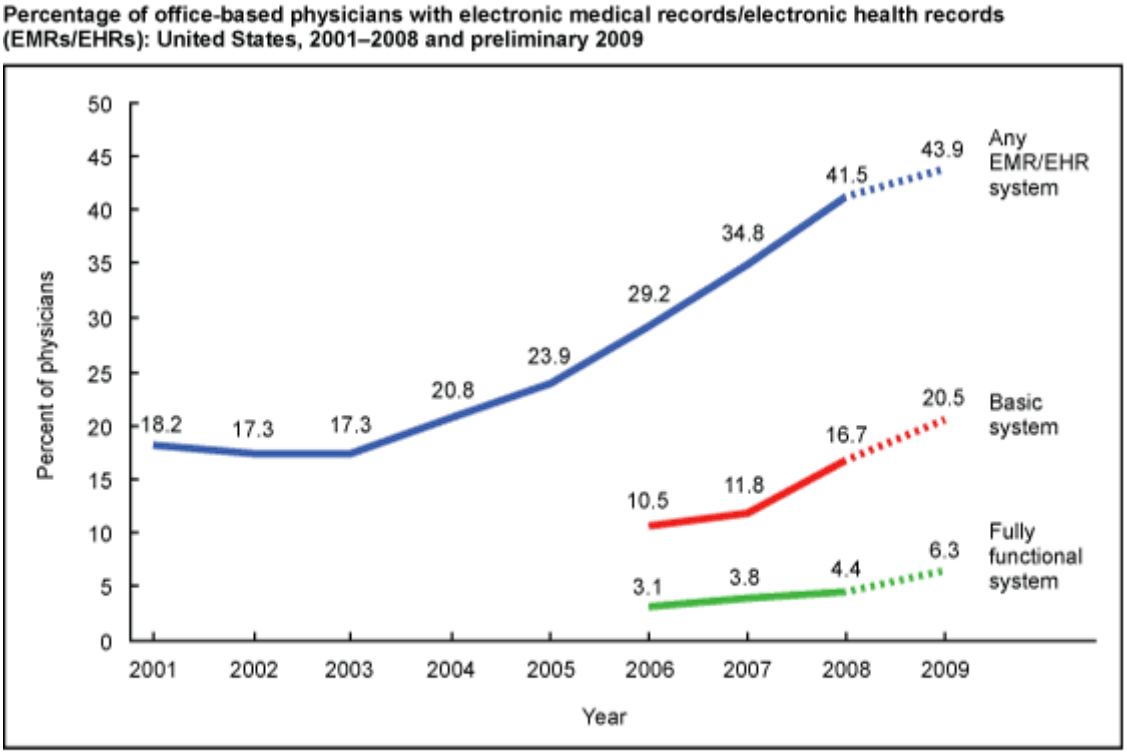

Figure 6: The share of office-based physicians with EHR (source: Notional Ambulatory Medical Care Survey)

More recently, in 2009 when the most recent results of the CMWF survey became available, it is possible to determine different level of EHR use among GPs in the US. In this survey, 14 clinical functions were identified to classify the use of EHR "as low (0-3), middle (4-8), or high (9-14)" (Schoen et al., 2009, p. 1175).

It was found that 51% of primary care physicians in the US use an EHR system that performs from 0-3 function (Low), while 23% of them use a system that capable of performing from 4-8 functions (Middle). In contrast, 26% of GPs in the US use a comprehensive EHR system that performs from 9-14 functions. The following Table 1 shows the different levels of EHR implementation among GPs in the US.

EHR use in practices	EHR functions (0-14) in practices		
	Low (0-3)	Middle (4-8)	High (9-14)
46%	51%	23%	26%

Table 1: Different levels of EHR implementation among GPs in the US

4.3.3 EHRs in Hospitals

Today, the number of healthcare organizations using EHR grows but still the share of healthcare organizations using EHR is low. It was estimated that in 2008 only 1.5% of hospitals in the US have a full EHR (i.e., implemented in all clinical departments), and further, 7.6% have a basic system (i.e., implemented in at least one clinical department). In addition, only 17% of hospitals in the US have implemented CPOE for medication (Jha et al., 2009). However, a study conducted in 2010 that aimed to compare EHR adoption in US hospitals in 2008 and 2009 found that the percentage of hospitals implementing a comprehensive EHR nearly doubled, from 1.5% in 2008 to 2.7% in 2009. At the same time, the study indicated a moderate increase in the number of hospitals that adopted a basic EHR, from 7.6% in 2008 to 9.2% in 2009 (Jha, DesRoches, Kralovec & Joshi, 2010). In total, 11.9% of US hospitals had either a basic or comprehensive EHR system in 2009. The following Figure 7 illustrates this increase in the adoption of EHR in US hospitals during 2008 to 2009.

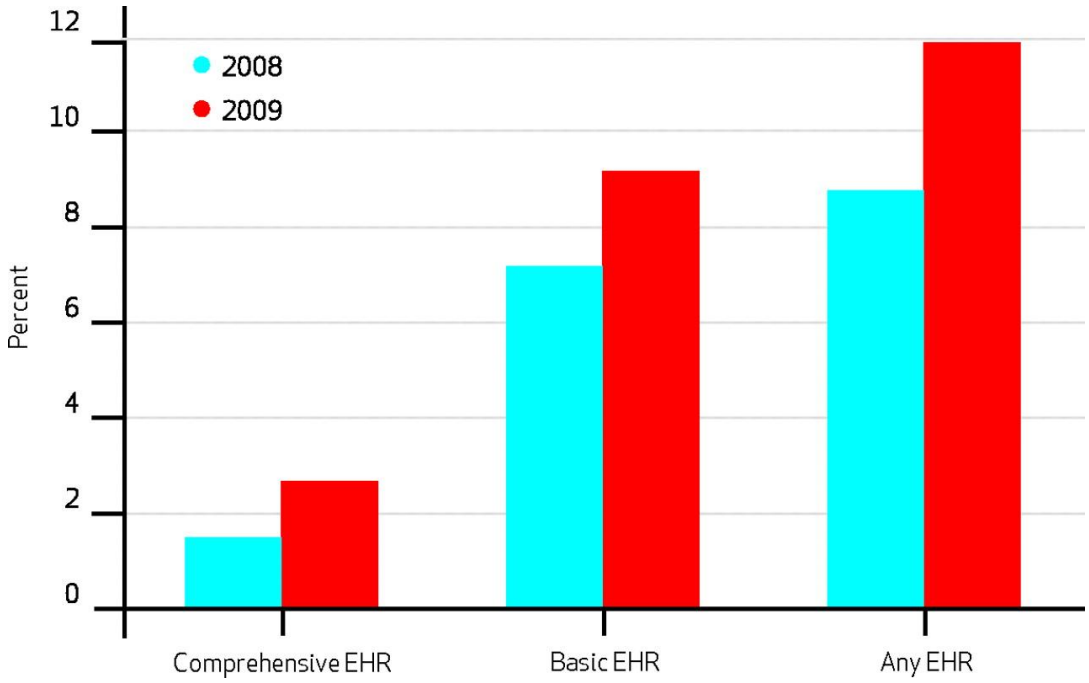

Figure 7: Changes in EHRs Adoption Rate from 2008 to 2009 (Source: Jha, DesRoches, Kralovec & Joshi, 2010)

It was also pointed out that larger hospitals, those placed in cities, and teaching hospitals were more likely to have EHR systems (Stalker, 2009). Respondents from hospitals that have not implemented EHR noted capital requirements and the high costs of maintaining such systems as the major obstacles to their adoption. However, hospitals implemented EHR systems were less likely to indicate these obstacles.

However, costs of EHR grow consistently. In 2011, a study conducted by Fleming et al., (2011) estimated the average cost of implementing an EHR was $162,000, with ongoing cost averaging $85,500 during the first year. It was also estimated that an average of 611 hours was needed for the network and practice teams to prepare and implement the EHR system. Moreover, 134 hours per physician, on average are required by the "end users"- physicians and other clinical and nonclinical employees - in order to get ready for use of EHR system in their practice.

It was estimated that the average practice paid for its EHR expenses in 2.5 years and profited considerably afterwards; nonetheless, some practices could not pay expenses

promptly; the majority of health providers consumed more time at work at first, and some practices faced extensive financial threats (Miller et al., 2005). Today, the costs of EHR have increased substantially. While 28% of health facilities use this system, generous support ($66,000 for doctors and more for hospitals) are expected to increase usage of the EHR system among healthcare facilities (Menachemi, 2011).

At this point, it is important to dwell upon the major challenges that healthcare organizations have to overcome to introduce EHR. The following section will provide an overview of the major ICTs challenges that face healthcare providers.

4.4 Healthcare ICTs Issues

The implementation of EHR raises numerous challenges in face of healthcare organizations. First, healthcare providers have to develop effective and reliable information security systems to secure information concerning patients. Therefore, healthcare providers should secure information and enhance their information systems (Ekmekci & Turley, 2008). The maintenance of effective and reliable information systems is costly and may be unaffordable for many healthcare organizations. For example, as mentioned before, the initial average cost for EHR implementation estimated $162,000, with ongoing cost averaged $85,500 per year (Fleming et al., 2011). It was stated by Schloeffel et al., (2001) that " The greatest challenge in the new world of integrated healthcare delivery is to provide comprehensive, reliable, relevant, accessible, and timely patient information to each member of the healthcare team, whether in primary or secondary care and whether a doctor, nurse, allied health professional, or patient/consumer".

Second, considering extensive federal financial support to be obtainable soon to providers who make "meaningful use" of EHRs, tracking the growth of this healthcare technology transformation is a policy main concern (Jha et al., 2010). Therefore, healthcare organizations should introduce an EHR to meet existing requirements. In addition, healthcare professionals should be able to access EHR whenever and wherever they need it.

In this regard, training healthcare professionals becomes particularly important because they should be able to use new technology effectively and they should maintain

confidentiality of their patients. Healthcare professionals should learn how to use EHR. On the other hand, they should pay a lot of attention to confidentiality of patients to prevent the risk of access of third parties to EHR of their patients (Menachemi, 2011).

Moreover, healthcare providers strive for getting access to government support, while introducing EHR. In fact, the government support can facilitate the introduction of EHR because the government can give healthcare organizations access to new technologies to facilitate the introduction of EHR. At the same time, the government elaborates national standards, which healthcare organizations should meet while introducing EHR.

Simultaneously, the implementation of EHR raises a number of ICTs issues that patients may face in the US. In this regard, it is important to place emphasis on the fact that patients face a risk of information breaches and loss of private information related to their health problems (Layman, 2008). Basically, this is the major threat and the most significant issue. The problem of information breaches is closely intertwined with ICTs. The EHR contains important information related to the health of patients. Therefore, ICTs should provide the reliable protection regarding privacy, confidentiality, and security. Otherwise, information breaches can cause serious harm to patients. In the US, the Health Insurance Portability and Accountability Act (HIPAA), passed in 1996, assigned the federal government to a procedure of "Administrative Simplification" to decrease healthcare expenses. That decree included rule authority to declare notional standards for Privacy of Individually Identifiable Health Information (PIHI) (Gunter & Terry, 2005). The PIHI rules only control the exposé of data related to patient's health; they place no limitation on the collection of such data. Even though the rules limit exposé with a "minimum necessary" rule, that restriction is inappropriate in cases of treatment or when exposé needed by law. Moreover, PIHI allow exposé to a variety of public health, judicial authorities, and law enforcement, and health provides for less than robust control of exposé for secondary uses. Lately, the HIPAA rule has assigned increase to complete federal safety regulations that rule the communications of healthcare. Their limitations, in spite of the policies made under HIPAA, apply to existing health records stored by most health providers and are similarly applicable to EHR data. However, the development of EHR in US seem unlikely to be associated by any additional protection for either collection "privacy" or disclosure "confidentiality" regulations or by derogating from a pure "pull" data aggregation model.

On the other hand, EHR are very helpful for healthcare professionals and patients are interested in the introduction of HER because they can count on the improvement of healthcare services after the implementation of EHR (Menachemi, 2011). Patients may be certain that their physicians will receive the detailed information about their health and they will choose the best treatment on the ground of the current condition and history of each patient. For example, in the word of one patient,

> *"I don't want much - just for my medical records to be seen only by those whom I authorize and for the record to be readily accessible to them wherever they are. . . I would like a bigger say in what goes into my notes, and if I don't like something I would like it taken out.*" (Mandl, Szolovits &Kohane, 2001).

However, patients are also concerned with the costs of EHR and possible difficulties associated with its introduction. Obviously, it will be patients who pay for the implementation of EHR because healthcare organizations will have to raise costs of healthcare services to cover their expenses on EHR. Naturally, the rise of costs of healthcare services will lead to the rise of prices patients will have to pay to cover their healthcare costs. In such a situation, the health insurance may become unattainable for many Americans. In 2009 (The most recently available data), the percentage of Americans with heath insurance decreased where almost 51 million people having no health insurance coverage (DeNavas et al., 2009).

Therefore, patients may face the problem of the high costs of healthcare services that can make EHR unavailable for them if they cannot cover their healthcare costs. In such a context, the introduction of EHR becomes pointless for those Americans, who cannot cover their healthcare costs or their health insurance. It was stated that,

> "The cost of healthcare poses the greatest single threat to the fiscal health of the United States" (America's Internists on the State of America's Healthcare, 2011).

In fact, the introduction of EHR in the time of the economic recession is not the best time because many Americans are concerned with saving, while the introduction of EHR is likely to increase their spending.

In such a situation, the government should support the introduction of EHR but the government support should not be limited to fragmentary funding of specific programs but

it should be a large-scale program to help patients to cover the increased costs of healthcare services.

4.5 Summary

In the US, the private sectors are responsible for providing health insurance, just elderly and low-income families are eligible for public insurance. What is covered by insurance depends on the type of the insurance. Inpatient and outpatient hospital care, and physician's visits are often covered by all types of insurance. The healthcare system in the US is the most costly system in the world. In 2010, the health expenditure was about $2.6 trillion. The EHR model used in the US focuses on the data interoperability and comparability. The awareness of the benefits of EHR has been increased since 2004 with a high support from the government which has led to an increasing adoption of EHR among physicians, about 50% of physicians in large practices use some forms of EHR. The high cost of implementing such systems hinders EHR adoption in most of the hospitals. However, there has been an increase in the number of the hospitals adopting an EHR (11.9% in 2009). The cost of developing reliable security information systems and the need for providing training for using the new technology are some of the major ICTs issues. Although patients are interested in introducing EHR since it leads to an improvement in healthcare services, there is a decrease in the number of Americans who have healthcare insurance due to the high cost which makes them unable to pay to cover their health insurance.

Chapter 5

The Implementation of EHRs in UK

The National Health Service (NHS) was founded in the UK in 1948 (Grosios, Gahan & Burbidge, 2010). It is among the most comprehensive and efficient health services in the world. The NHS is free (apart from charges for dental and optical services and some prescriptions) to all citizens and long term residents, currently more than 62 million people. This system has an exceptionally strong focus on the gatekeeper role of primary physicians.

5.1 The Healthcare System in UK

The health system is organized in the following ways. The first element of the system are the physicians who in this case are GPs. This set of physicians is usually the first point of encounter with patients. They have to pass through their hands before they receive secondary care services. Most GPs are reimbursed straightforwardly by primary care trusts through an arrangement of systems: remuneration, capitation, and fee-for-service (Boyle, 2008). On the other hand, private providers of general practitioner services lay down their own fee-to-service tariffs. The second element of the system is targets. These have been laid down by the British government for a variety of variables that mirror the standard of care delivered (Grosios, Gahan & Burbidge, 2010). Most of these targets are scrutinized by the regulatory bodies. The third element of the system is National Service Frameworks (NSFs). The British department of Health always ensures that it develops a set of NSFs projected at improving certain quarters of care, for instance, cancer, diabetes and coronary health. This lays down the national values and categorizes chief interventions for definite services. The last element of the system is a quality and outcome framework. This is concerned with measuring the value of care offered by the General Practitioners. When practitioners deliver quality services to their customers, they are usually awarded points or bonuses (James, 2005).

5.1.1 Coverage

The NHS covers ambulatory care for both inpatients and outpatients, hospital care, GPs services, inpatient and outpatient drugs, dental care, learning disabilities and mental healthcare (Boyle, 2008). However, there are a few cost-sharing arrangements for the publicly-covered health services. For example, a co-payment of £6, 85 per prescription is required for drugs prescribed by GPs, but about 88% of prescriptions are free of charges (Department of Health 2007). In addition, a co-payment of £200 per year is also required for dental services. It was estimated that out-of-pocket payments accounted for 11.9% of the total health expenditure in 2005 (World Health Organization 2007).

5.1.2 Finance

The NHS accounts for 83.9% of the total expenditure on health (9.6%GDP) (World Bank, 2011). It is particularly funded by general taxation (76%) and in part by national insurance contributions (19%). An assortment of for-profit and not-for-profit insurers provides ancillary private health insurance. Private insurance provides a choice of medical professionals, avoidance of long queues for voluntary surgery, and better services compared with the NHS. Furthermore, people also finance the health systems by paying directly for some services (Boyle, 2008). The following Figure 7 demonstrates the health expenditure in UK from 1995 to 2010.

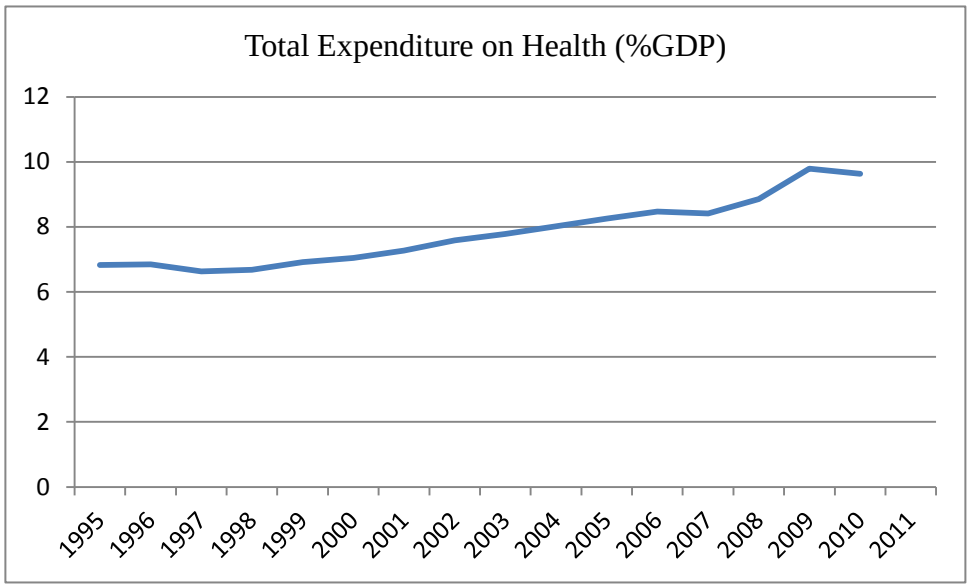

Figure 8: Total health expenditure in UK (%GDP) (World Bank,2011)

5.2 Developments of Health Information Management in UK

Health information includes statistics required to determine the right course of action to achieve a health system that is effective in reaching the required goals of medical care. Not many countries in the world possess an effective health information system, but that has not hindered calls for a full-bodied information system in developed countries like the UK (Smith & Duman, 2009). Hence, nations like the UK have initiated major programmes to ensure their systems are able to identify and manage health problems and provide relevant health information at the opportune moment (Crompton, 2007).

Developing an effective and efficient health information system in the UK has encountered significant challenges such as the size, complexity of such data, high cost, and the training of health staff. Development of health information has employed efficient techniques that include using well-trained personnel, modernization of IT sectors. In this regard, a number of IT projects have existed in UK that attempt to use technologies to improve the quality of healthcare. Examples of these projects are: The Experimental Computer Programme (launched in 1986), a Second Information Strategy for the NHS (existed in 1998), and finally the current biggest health informatics project in the world: the National Programme

for Information Technology (NPfIT) launched in 2002 (O'Brien, 2009), and due for completion in 2014-2015(Crompton, 2007).

The estimated cost of this programme has ranged from £6.2 billion to £20 billion (Committee of Public Accounts, 2007). According to the latest report from the National Audit Office regarding this IT program the cost is estimated to be £12, 7 but it has pointed out that "there remains some uncertainty around the estimates of ...costs"(National Audit Office, 2006).

As a result of this large public funding, there have been constant calls for the NPfIT to be independently reviewed to make sure that taxpayers' money is well spent (O'Brien, 2009). Following that, on 6 June 2007, in the House of Commons, the Shadow Minister Stephen O'Brien, MP, encouraged an independent review to be conducted on the NPfIT. He proposed that "this House acknowledges the aims of the NHS National Programme for Information Technology and supports them in principle, recognizing the potential benefits IT can bring to patients and NHS staff...but...calls for a full and independent review of the NHS IT programme" (O'Brien, 2009).

In 2008, a review report on NPfIT was published by the NHS Chief Executive and Permanent Secretary at the Department of Health. The main points of this review are as follows (Department of Health, 2008):

- For secondary care, the minimum required functionalities for the system to be acceptable to clinical stakeholders are: "a Patient Administration System (PAS) with integration with other systems and sophisticated reporting; Order Communications and Diagnostics Reporting (including all pathology and radiology tests and tests ordered in primary care); letters with coding (discharge summaries, clinic and Accident and Emergency letters); scheduling (for beds, tests, theatres etc.); e-Prescribing (including 'To Take Out' (TTO) medicines)".

- For the NPfIT to be beneficial and successful, "there is a need for interim initiatives so patient information can be made available across different IT systems, different care providers and different care settings ahead of strategic systems delivery".

- It also pointed out that there is a need to "clarify ... the role of NHS CfH as the source of technical, commercial, service and programme management support expertise to the NHS, not simply as the implementers of the NPfIT."

5.2.1 NPfIT Vision and Plan

As mentioned earlier in this section, the NPfIT was established in 2002 by the Department of Health. The goal and strategy for this programme were illustrated by the Department of Health in the document, "*Delivering 21st Century IT Support for the NHS".* The report ended with some goals that would be delivered by NPfIT. They are (Crompton, 2007):

- Connecting healthcare, so that all staff have the needed equipment.
- Fundamental national services.
- National standards for both data quality and data interchange.
- A set of compliant systems for critical local application.

Moreover, the report identified the core national services to be delivered by the programme. They are:

- E-Prescription services.
- E-Booking for healthcare services.
- EHR service.

The programme separated England into five areas. These areas are: Southern, London, Eastern, North West, West Midlands and the North East. Each of them is assigned to a local service provider. This was done to build competition between providers in delivering the services at the local level as well as to make them independent so the failure of one provider would not affect other work.

It leads to huge progress in the implementation of EHR in England, which will be highlighted in the following section.

5.3 Implementing EHRs

The implementation of EHR is one of the national healthcare reform goals in the UK. The EHR programme was initiated by the Ministry of Health in England with the aim of improving healthcare delivery (Schade, Sullivan, Lusignan & Madeley, 2006). The planned vision for NPfIT is to have single central electronic patient records by 2010, and to connect 30,000 GPs, 300 hospitals and other involved agencies in healthcare (Crompton, 2007). In 2007, a survey report showed that 80% of this plan had been completed (NHS Connecting for Health, 2007).

5.3.1 England's EHR Model

The EHR architecture in England based on the separation of EHR systems into local EHR system (used by one healthcare setting) and shared systems (Ge, Paige & McDermid, 2009). In England, the EHR systems was established at two levels: a Summary Care Record (SCR) accessible anywhere in England; and a De-tailed Care Record (DCR) accessible within a locally identified healthcare community which may include primary and secondary care givers within a particular area such as London. Access to both EHRs will be controlled by strict security and confidentiality roles. The SCR aims to support an accident and emergency care, while DCR aims to provide detailed health information for daily routine clinical practices.

5.3.2 EHRs in Ambulatory Care

Unlike the situation in the US, the adoption and use of EHR among GPs in the UK is comparably high. In 2006, a study reported that 97% of the 8, 819 practices in England had implemented EHR systems that support clinical documentation (Deutsch, Duftschmid & Dorda, 2010). According to different surveys across all of the UK, it has been found that 89% of GPs use EHR in their practices (Schoen et al., 2006). In addition, it was pointed out that the majority of GPs use these systems for documenting clinical notes and managing

laboratory results. In spite of the high percentage of EHR adoption among GPs including electronic documentation for the prescriptions and laboratory results, it was indicated that transmission to the lab and pharmacy is far from universal (Jha et al., 2008).

In 2009, the most recent available results of the CMWF survey regarding the use of EHR among the ambulatory practices in several countries including UK, the US, New Zealand and Australia became available (Schoen et al., 2009). It was found that 11% of primary care physicians in the UK use an EHR system that performs from 4-8 functions (middle), while 89% of them use a comprehensive EHR system that provide 9-14 functions. In total, 96% of GPs in UK use EHR system. The following Table 2 shows the different level of implementation of EHR among GPs in UK.

EHR use in practices	**EHR functions (0-14) in practices**		
	Low (0-3)	Middle (4-8)	High (9-14)
96%	0%	11%	89%

Table 2: Different levels of EHR implementation among GPs in UK

5.3.3 EHRs in Hospitals

The adoption of EHR in UK hospitals is uncommon, even though there is not enough data regarding this topic. In spite of the almost universal use of EHR among GPs in the UK, the use of such a system in UK hospitals has been a priority for future efforts. In 2004, it was estimated that 7.7% of UK hospitals have fully electronic clinical results, while only 2.6% of hospitals use an electronic prescribing system (Jha et al., 2008). Unlike the case in ambulatory care, hospitals leaders have often viewed such technology as an extra cost with little benefits (Benson, 2002).

NpfIT promises a number of benefits for both patient and healthcare organization, once the project is accomplished (http://www.connectingforhealth.nhs.uk). In 2002, National Audit Commission reported that "NHS spends £3.6 billion in medical negligence claims a year" (as cited in Saleem, 2009). In the same report, it was estimated that "1,000 deaths annually

are caused by medical errors - most notably by clinicians not having the right patient information at the point of care". The same report pointed out that 75% of these deaths could have been saved by using an EHR system. However, there are number of difficulties facing both healthcare providers and patients that need to be resolved, which will be illustrated in the two following sections.

5.4 Healthcare ICTs Issues

The implementation of the EHR has brought about numerous benefits that have greatly enhanced the provision of healthcare services. However, there are barriers and risks associated with its implementation.

The increasing cost of such technology stands as an obstacle for many healthcare providers. In the early stage of the EHR programme in England, the cost was supposed to be £2 billion, while the cost now is estimated to go up by 440% to 770% of the original estimate (Saleem, 2009). The computer technology is mainly contributing to this increasing cost, as the technology changes constantly. Therefore, it is very difficult to keep up with the cost of this change in technology. One of the hospital leaders in the UK, Andrew Way, stated that,

> "Problems with the e-records scheme had cost [his] trust £10 million and meant fewer patients could be seen." He added that "the hospital had to employ an additional 40 administrative staff just to handle the extra workload" (Swaine, 2009).

The complexity of clinical data also makes it difficult to implement EHR (Saleem, 2009). It requires a huge database to contain data for over 50 million people. In addition, it is very difficult to keep it updated, maintained and available round-the clock. For example, England strategy for building a centralized database of EHR had faced a number of obstacles such as the high cost and huge amount of data which lead the government to change this strategy. The new announced strategy aimed to overcome the previous by implementing distributed systems (De-tailed Care Record) and a much smaller central system containing a summary to be accessible anywhere in England (a Summary Care Record). Moreover, one of the issues facing healthcare providers is the problem of illegal

immigrants, visitors and short-term workers in England: how do they get their data and what would be done with the data once they leave the country.

In addition, doctors' acceptance of such change in practises slows the adoption. According to a survey observing doctor's attitude towards the EHR implementation, the doctors' confidence in the successful adoption of the EHR considerably reduced in the course of the project (Campion et al., 2011). In 2003, a survey found that "56% of practising doctors and 75% of hospital doctors were enthusiastic about the programme; three years later the corresponding figures were no more than 25% and 41%, respectively".

The National Audit Office reported a number of barriers to the implementation of EHR in UK (Deutsch, Duftschmid & Dorda, 2010). These problems are: challenges in following the planned schedules for the project, difficulties in meeting NHS requirement of the implemented system, a lack of public and NHS staff support, no clear return in investment. Also, there were difficulties with the process of replacement of the current hospital information system and clinicians' poor integration into the project.

One of the researchers found that a large number of the population is not ready for notional ID cards (Saleem, 2009). So, that raises a concern about people's acceptance of a NHS card with equally important and related information, as it is planned for a national ID card. It is important that people have faith in the system, in order for them to disclose every detail regarding their life.

In addition, other research investigating issues facing EHR implementation pointed out that confidentiality is one of the most sensitive issues to patients (Jenkings & Wilson, 2007). In this regard, it was concerned that EHRs may lead to an increase in non-disclosure of medical data, or some patients, older ones in particular, might give their approval too readily due to a misunderstanding of who has access to records and therefore fail to obtain 'informed' consent.

In general, the study indicated that there were legal issues in the process of transferring patient information which should be addressed; as the confidentiality status should differ according to the type of data included. However, it was noted that this issue could be solved by employing appropriate security methods and assessment trials.

5.5 Summary

Physicians, targets, National Service Frameworks and quality and outcome framework are the main elements of the healthcare system in UK. A part from some few charges, the NHS in UK covers most of the health services. Despite the challenges faced such as the size, complexity of data and the need for training, UK could successfully achieve an effective health information system. A huge progress was achieved in England as a result of developing NPfIT. Using such a program helps assign a service provider to five different areas, Southern, London, Eastern, North West, West Midlands and the North East. Two levels of EHR were established in England, a SCR which can be accessed anywhere in England with the aim of supporting emergency circumstances and a DCR to be used locally with the aim of providing detailed-health information. Implementing those two levels has helped the government to overcome some of the difficulties concerning the cost and the huge amount of data. EHR is universally implemented among GPs, but it has not been implemented yet in most of the hospitals. The increasing cost of technology, doctors' and people's attitudes of the implementation of EHR are some the main issues that hinder the wide implementation of EHR in UK.

Chapter 6

The Implementation of EHRs in Australia

The Department of Health and Aging in Australia identifies national health policies, while state and territory governments provide financial support for health services. The total expenditure on health accounts for about 9.8 per cent of Australian's gross domestic products provided by government and the private sector (Department of Foreign Affairs and Trade, 2008).

6.1 The Healthcare System in Australia

Similar to other countries, the health services in Australia are provided by both the public and private sector. Publicly, healthcare services are delivered by a comprehensive programme, Medicare, introduced in 1984 (Commonwealth Department of Health and Aged Care, 2000). Medicare provides free or low-cost access for entitled Australian residents to medical, optometric and public hospital care, while they also have the choice of private health insurance.

Individuals contribute in financing the public healthcare system through 'a taxation levy' based on their income. The state and territory governments in Australia are responsible for financing the public hospital system. Patients admitted to public hospitals as public (Medicare) patients are treated by doctors and specialists selected by the hospitals. These services are free of charges.

Private healthcare services account for one-third of all hospitals bed in Australia. Most medical services are provided in these private hospitals. Private physicians also provide a large portion of dental and associated health services. It was estimated that about half of all Australians have signed for private health insurance. Nine million people are covered by hospital insurance for health services as private patients in both public and private healthcare providers. Also, forty-three percent of the population is covered for non-medical

services supplied out of the hospital, like, dental services, physiotherapy and the purchase of eyeglasses.

6.1.1 Coverage

A range of direct health treatments are provided by state and territory governments. They also provide community and public health services, such as dental health, school health, disease elimination activities and child health.

The patients who have signed to a private health insurance have the choice of the doctors who deal with their case either in public or private hospitals. Medicare contributes a total of 75% of the Medicare plan fee for treatments provided by doctors. For patients with private insurance, some or all the treatment fee might be covered. Privately insured patients are charged for accommodation and substances such as medicine. These costs are covered by their health insurance.

6.1.2 Finance

Like other countries, the increasing cost of technological changes in the field of healthcare in Australia, increases the demand on funding the healthcare system. For example, the health expenditure in Australia has risen from $72.2 billion in 1999-00 to$121.4 billion in 2009-10 (Australian Institute of Health and Welfare, 2011). The total health expenditure in Australia (%GDP) is 8.7 (see figure 9), while the public expenditure on health is 68 % of the total expenditure (The World Bank, 2011).

The Australian government supports the healthcare system by providing 67% of public healthcare expenditure, while state, territory and local governments grant the rest. The Australian government finances widespread medical and pharmaceutical services and also financially supports public hospitals.

Individuals also contribute to healthcare expenditure through a general taxation which is known as the Medicare levy.

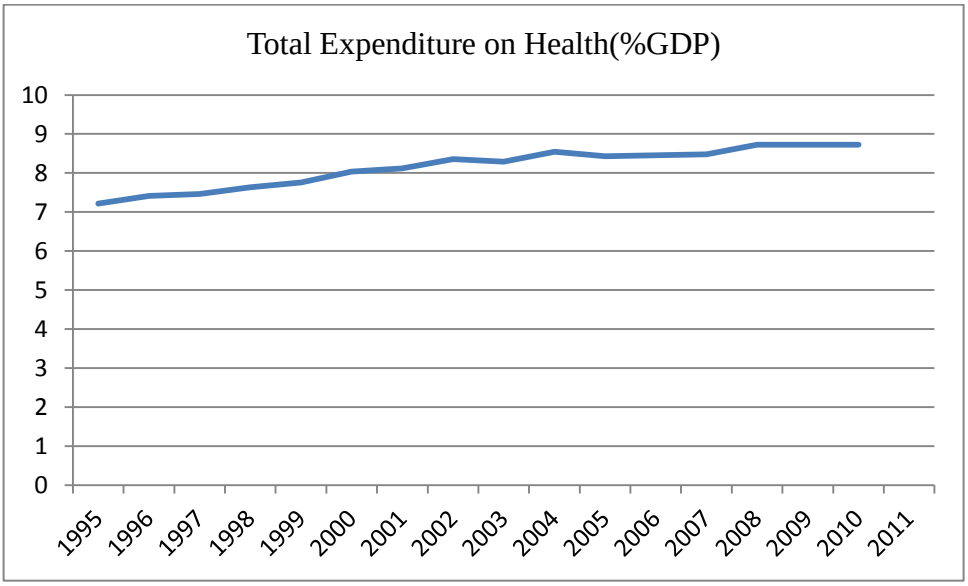

Figure 9: Total health expenditure in Australia (%GDP) (World Bank, 2011)

6.2 Developments of Health Information Management in Australia

The introduction of new technologies raises new problems such as personal training, which may be costly. Further, the introduction of new technologies such as EHRs can contribute to saving healthcare costs and increase the quality of healthcare services. In addition, technological innovations are essential because of the overall technological progress of society and medicine (Winthereik, 2003). In such a situation, the Australian government considers introducing changes in the national healthcare system, its funding and functioning to meet the needs of customers, to implement advanced technologies, to raise the quality of healthcare services, to improve the public health saving in public funds and to increase the participation of insurance companies in the coverage of healthcare costs.

The current progress of technologies and the emergence of information technologies contribute to consistent changes in the national healthcare system and its management. In fact, the progress of information technologies has led to quite controversial effects (Nixon & Ulmann 2006). On the one hand, information technologies facilitate management and functioning of the national healthcare system because hospitals and healthcare professionals can share information faster and obtain important information on patients and important

issues easier than they used to do in the past. On the other hand, many healthcare organizations turn out to be overloaded with information (Wagner, 1993). Moreover, they may face difficulties with processing the information and the huge amount of data. The huge flow of information may become an unbearable burden, if the national healthcare system fails to introduce new information technologies that facilitate the processing of information.

In addition, data storage and protection is also important in terms of information management because healthcare organizations and professionals are responsible for the confidentiality of patients. They should protect privacy of patients, while new information technologies raise the problem of the adequate protection of patients' privacy (Wainwright & Waring, 2007). Hence, information management should involve development of an effective and reliable information system that maintains a high level of information security.

The Australian government has already implemented some programmes that aim at the introduction of information technologies. The Australian government has introduced several projects at state and regional levels. For example, the NSW government has established an EHR project, NSW EHR*Net. This project aims to enable healthcare providers to electronically access a summary of a patient's medical history held by NSW public health system. Another example is the "NSW Health 2002" which is a pilot project at the Alfred Hospital in Melbourne. This project supports electronic exchange of admission and discharge information between the hospital and 20 GPs (Minister for Health and Ageing 2001). Moreover, in 2001, the Australian government has introduced the national health information network, HealthConnect (Gunter & Terry, 2005). This programme contributed to effective information sharing between care providers because it could provide healthcare services of the higher quality to patients on the grounds of the information shared within HealthConnect.

In such a context, it is obvious that the national healthcare system of Australia needs effective information management that can increase consistently the quality of healthcare services and can provide patients with a high level of information security (Weiner et al., 2007). In this regard, the introduction of EHRs is one of the main priorities in the development of the national healthcare system and its information management. In fact, the

introduction of EHRs has become a priority in the development of the national healthcare system because it has the potential to improve the quality of healthcare services and may create the core of the information management of the national healthcare system. Today, the Australian government has already started to stimulate the introduction of EHRs and incorporated the introduction of EHRs in the strategy of the development of the national healthcare system. At the same time, the introduction of EHRs may raise a number of issues not only for the government and care providers but also for the patients.

6.3 Implementing EHRs

There has been significant development in the implementation of the national EHR in Australia. The work towards this implementation was initiated after the House of Representative's 'Health On-Line' report (Slipper & Forrest, 1997). In 1999, the National EHR Taskforce was established as a subcommittee of the National Health Information Management Advisory Committee. The Taskforce established 'A Health Information Network for Australia' (2000), where a recommendation for a national approach to the adoption of EHR was included. In 2001, the '*HealthConnect'* programme was introduced, which is the core national EHR initiative planned in Australia. The HealthConnect programme is an Internet-based network that aims to support the collection, storage and share of summary patient information (HealthConnect Programme Office, 2002).

More recently, in 2009, the introduction of an individual health identifier for Australians was announced by the Commonwealth, state and territory health ministers (Minister for Health and Ageing, 2010). In addition, $446.7 million was allocated in the 2010 Federal budget for a two years period to support this project, which will enable Australians to check their health records online through the introduction of personally controlled EHRs. The plan towards the national EHR is planned to be accomplished by 2014.

6.3.1 Australian's EHR Model

The Health Connect model aimed at extracting a summary record from locally gathered patient data which then were aggregated to make a centralized Health Connect record that was shared among participating and authorized providers (Gunter & Terry, 2005).

A HealthConnect 'event summary' consists of the "critical information considered to be useful to other healthcare providers involved in the future care of the consumer" (Commonwealth of Australia, 2003). Accordingly, HealthConnect does not generate a complete longitudinal record. Rather, it is the responsibility of patients with their health providers to choose which elements may be extracted from their locally generated health records and transmitted to the HealthConnect records. In addition, health providers with their patients may consistently add new data to the HealthConnect records. Therefore, the HealthConnect is a "push" system, sending selected data to a centralized record (Gunter & Terry, 2005).

6.3.2 EHRs in Ambulatory Care

The use of EHR in the ambulatory care in Australia is very high. In this regard, research conducted by Mclnnes and colleagues pointed out that 98% of GPs in Australia use an electronic prescribing system. Moreover, 90% of these systems have some levels of clinical decision support (McInnes, Saltman & Kidd, 2006). It was also indicated that 64% of GPs electronically document their patients' clinical notes. According to the 2006 commonwealth fund survey (CMWF), 79% of GPs reported using EHR systems, while 81% of them reported using EHR that support e-prescribing (Schoen et al., 2006).

More recently, in 2009 when the most recent results of the CMWF survey became available, it is possible to determine different levels of EHR use among GPs in Australia, based on 14 identified clinical functions for the comprehensive EHR system.

It was found that 3% of primary care physicians in Australia use an EHR system that performs from 0-3 function (Low), while 6% of them use a system that capable of performing from 4-8 functions (Middle). In contrast, a large percentage of GPs in Australia, 91%, use a comprehensive EHR system that performs from 9-14 functions. In total, 95% of

GPs in Australia use the EHR system. The following Table 3 shows the different levels of implementation of EHR among GPs in Australia.

EHR use in practices	EHR functions (0-14) in practices		
	Low (0-3)	Middle (4-8)	High (9-14)
95%	3%	6%	91%

Table 3: Different levels of EHR implementation among GPs in Australia

6.3.3 EHRs In Hospitals

The use of EHR among Australian hospitals is uncommon, although there is not enough data in this regard. Some researchers mentioned that quite large number of hospitals in Australia have electronic administration system as well as electronic reporting for the laboratory results (Jha et al., 2008). In addition, studies show that patient medical summaries were sent electronically from hospitals to GPs.

6.4 Healthcare ICTs Issues

In actuality, the introduction of EHRs is strategically important for the national healthcare system. Incidentally, the introduction of EHRs is particularly important for healthcare providers because they can improve the quality of healthcare services being provided for patients consistently (Greenhalgh et al., 2009). At the same time, in the course of the implementation of EHRs, healthcare providers may face substantial challenges, which they have to overcome to use EHRs effectively. On the one hand, there are a number of positive issues. For instance, the implementation of EHRs may have positive effect on the quality of healthcare services but EHRs need change management to be implemented successfully. Moreover, EHRs are cost-efficient and, therefore, they are beneficial for the government and public. In this respect, specialists (Deutsch, Duftschmid & Dorda, 2010) argue that

EHRs provide the high quality of healthcare services because healthcare professionals have access to the patients' history and can obtain health records from their EHRs. The information on the patients' history may be crucial for the effective treatment of patients (Moumtzoglou & Kastania, 2011). In such a context, the use of EHRs is definitely positive for the national healthcare system at large and healthcare providers in particular.

Nevertheless, the introduction of EHRs should be carefully planned and managed. The implementation of EHRs may raise substantial difficulties, which the government and the national healthcare system will have to overcome to make EHRs effective and reliable. The accurate and effective plan of the introduction of EHRs can help to implement them successfully in the national healthcare system.

The government should implement the effective strategy with clear objectives. The ultimate goal of the government is the improvement of healthcare services, saving costs and enrolment, with possibly larger number of Australians in healthcare programmes of high quality (Department of Foreign Affairs and Trade, 2008). EHRs can help to improve the quality of healthcare services and save costs, but the government and the national healthcare system should come prepared to the introduction of EHRs because they may need considerable changes not only in the management of healthcare system and information management but also in the national legislation.

In fact, legal changes are essential to provide Australians with the high degree of data protection. The legal data protection is essential. Otherwise, Australians may face a threat to their privacy. EHRs can make them vulnerable to information breaches, identity thefts and other privacy-related issues, if EHRs are not protected adequately (Deutsch, Duftschmid & Dorda, 2010). The adequate protection means the introduction of the reliable and effective information security. In this regard, the state and federal governments in Australia place the protection of patient information as a high priority (Pyman & AnneTeicher, 2008). The Commonwealth National Privacy Principles (Weedon, 2009) are sensitive to the need of the health information field and protect patients with collection-centric (by placing restrictions on data gathering and saving patients anonymity rights) and disclosure-centric rules. They also address the quality and security of data as well as the access rights. In 2001, the Australian Federal Privacy Commissioner established his leading initial Guidelines on Privacy in the Private Health Sector that clarify the National

Privacy Principles to the health context and offer a full-bodied collection-centric approach. Usually, consent is required before the collection of patient health information. In addition, the purpose of collecting patient medical information should be included in the consent. Moreover, "the information collected should be limited to what is necessary for the health service provider's functions and activities" (Office of the Federal Privacy Commissioner, 2001). It is also stated in the Guidelines that a care provider should "only use or disclose personal information for the primary purpose for which it was collected, or for directly related secondary purposes if these fall within the reasonable expectations of the individual" (Office of the Federal Privacy Commissioner, 2001). Consequently, the National Privacy Principles grant a satisfactory framework for emerging EHR models, while the Australian HealthConnect patient-controlled "push" model is fundamentally protective of patient needs.

In addition, training of staff is needed to use EHRs effectively (Mahon, 2002). Obviously, untrained healthcare professionals may face difficulties with using EHRs to the extent that they may fail to use them properly. The misuse of EHRs will minimize the positive effects of EHRs. On the contrary, the misuse of EHRs will increase the risk of the violation of patients' privacy right and other issues.

The introduction of new technology may also raise difficulties in the national healthcare system because the new technology will need investments and resources. In this regard, the strategy of using EHRs nationwide should be elaborated and focus on the standardisation of all EHRs nationwide. What is meant here is the fact that the government should have a clear strategy of how to implement EHRs nationwide (Holen, Sara & Rezo, 2002). This is not a mere technological issue but also a legal and healthcare one. This means that contemporary technologies provide the national healthcare system with ample opportunities to introduce EHRs (Glaser & Salzberg, 2011). The problem is that the national healthcare system needs the unified, homogeneous EHRs, which meet national healthcare standards. This further means that the lack of unification of EHRs leads to the emergence of diverse EHRs, which have different forms, standards, use different operation systems, software, and so on. Naturally, such EHRs are absolutely ineffective, when they are implemented in the national healthcare system. Therefore, the national healthcare system needs to elaborate and introduce common standards of EHRs which can be applied nationwide without any

difficulties and problems. In such a way, national standards will make EHRs homogeneous and applicable in any part of Australia (Schloeffel et al., 2006). Otherwise, if EHRs do not have common standards applicable nationwide, they will be useless and, more importantly, they may be misleading, if the information obtained from EHRs is interpreted in the wrong way or is out of date just because of the difference in EHRs' standards.

Nevertheless, the improvement of the quality of healthcare services due to EHRs outweighs possible risks and threats to patients' privacy (HealthConnect Program Office, 2003). Obviously, contemporary technologies allow protecting the private information, effectively minimizing the risk of information breaches. On the other hand, the awareness of patients of possible risks related to the use of EHRs is very important because they will pay more attention to control over their EHRs and protection their private information (Deutsch, Duftschmid & Dorda, 2010).

6.5 Summary

Healthcare services in Australia are provided by both public and private sectors. Public insurance (medicare) covers about 75% of the treatments fee while all of the fee may be covered by private insurance. 67% of healthcare expenditure is provided by the Australian government, state and territory governments are responsible for the rest. Individuals also contribute to healthcare expenditure through the Medicare levy. Different programs have been implemented to introduce information technology such as HealthConnect which was introduced by the government in 2001. Through a centralized HealthConnect record, a summary record of patients' data can be shared between the authorized providers. The use of EHRs among GPs is very high whereas it is uncommon among hospitals. There are some ICTs issues that should be taken in consideration by the government to achieve a successful implementation of EHR such as effective planning and training and information security. In order to address security of data, Initial Guidelines on Privacy were established by the Australian Federal Privacy Commissioner in 2001. Some of these guidelines are obtaining consent from the patients before collecting their health information and using the information for the primary purpose or for related secondary purposes.

Chapter 7

The Implementation of EHRs in New Zealand

In recent years, the New Zealand healthcare sector has been moving away from market-based structures into community-focused District Health Boards (DHBs) by combining the healthcare purchaser and provider functions (Kerr, 2004).

7.1 The Healthcare System in New Zealand

Today, the healthcare system in New Zealand is well-developed and provides patients with healthcare services of high quality. At the same time, the Ministry of Health is fully responsible for the coverage of the healthcare costs of citizens (Bramhall, 2003). In particular, it is responsible for assigning funding to the DHBs and other legal corporations in the health sector and monitoring their performance (LI, 2006). The DHBs are responsible for the delivery of healthcare services within their geographical areas. GPs are the first point of care and they cover a variety of out-of-hospital services such as mobile nursing and sexual health services, while they refer cases require advanced care to hospitals. However, the development of the national healthcare system has been accompanied by the development of private medicine as well. Even though the government covers healthcare costs, there are private insurance and healthcare services along with public healthcare system in New Zealand at the moment.

7.1.1 Coverage

In fact, the national healthcare system covers all citizens. Still, it is worth mentioning the fact that, even though the government takes responsibility for coverage of healthcare services and funding healthcare system, residents of New Zealand still have to cover some costs of healthcare services, such as visits to GPs (Bramhall, 2003). Some citizens of New Zealand cannot afford to pay for their visits to GPs because of their low-income or because

they have to do it too frequently and their financial position prevents them from being able to pay for all the visits to GPs that they need.

To enrol all citizens in the national healthcare system and to provide them with healthcare services of the highest quality, the government provides subsidies for some categories of the population. To put it more precisely, low income citizens of New Zealand, whose income is under $9,800 (USD) are eligible for a Community Service Card (CSC) (Bramhall, 2003). The government subsidizes GP visits for patients with a CSC. In this way, the government helps low income citizens to cover their healthcare costs. In addition, patients with CSC can also receive subsidies on prescribed drugs. So, not only can low income patients be diagnosed due to the government subsidies for GP visits, but also their treatment is covered, at least partially through subsidies for purchasing prescribed drugs. In this way, the government makes healthcare services available for all citizens, regardless of their socioeconomic status.

There is also a High Use Health Card (HUHC) which allows for additional subsidies for GP visits and prescriptions (Bramhall, 2003). To be eligible for HUSC, patients need to have visited a doctor over twelve times a year. HUSC were developed specifically for those residents of New Zealand, who have chronic illnesses or serious health problems and have to receive treatment regularly.

7.1.2 Finance

The finance of the healthcare system in New Zealand is a tax-based financing system and so the healthcare is mainly funded by general government expenditure, 83.2% of total health expenditure. The total health expenditure in New Zealand (%GDP) is 10.1(see figure 10) (The World Bank, 2012).

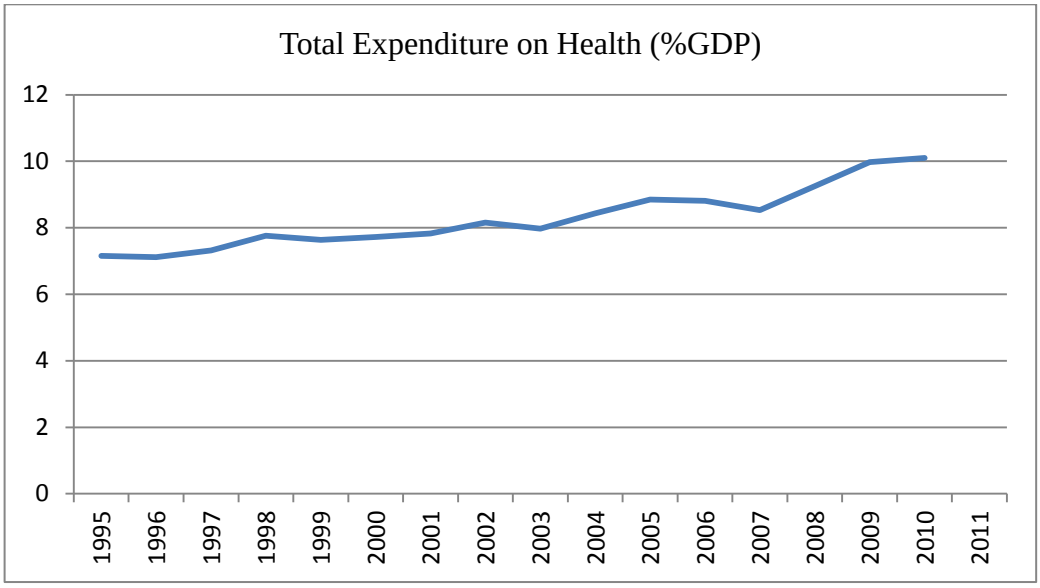

Figure 10: Total health expenditure in New Zealand (%GDP) (World Bank, 2011)

The funding of the national healthcare system occurs in the following way. First, money is redistributed from the state budget to DHBs (currently 21). The government defines the services that DHBs have to provide for patients (Bramhall, 2003). Then, DHBs purchase these services from a wide range of providers, including public hospitals, non-profit health agencies, and private organizations. Therefore, when patients visit GPs and pay for them, GPs refer them to specialists, and the further diagnosis and treatment is covered by DHBs.

The government bears ultimate responsibility for the coverage of healthcare costs, even when it is provided through private institutions (Bramhall, 2003). Along with the government, there is private insurance in New Zealand, but the government funding is still the main source of funding of the national healthcare system. Residents of New Zealand use their private insurance only when they do not want to wait in queues and need to be diagnosed or to receive healthcare services faster in private clinics. However, even in such a case, they may count on the government subsidies or coverage of their healthcare expenses.

At the same time, there are always serious cases when patients have special needs. In this regard, the Ministry of Health sets aside $6.5 million a year for special high cost treatments. In fact, these funds are used in exceptional cases, when the treatment of patients is essential and needs substantial financial resources, such as kidney transplantation for instance.

7.2 Developments of Health Information Management in New Zealand

There are a number of factors driving the development of health information in New Zealand. One of the major factors contributing to the development and wide implementation of information technologies in the national healthcare system of New Zealand is the emergence of new information technologies (Tian, 2011). In fact, technological progress has led to their wider implementation in all spheres of life, including healthcare. As a result, new technologies are introduced in the healthcare system of New Zealand.

They are not introduced spontaneously, however, they are introduced to improve the quality of healthcare services. At this point, it is worth mentioning that high standards of healthcare services and larger opportunities to improve them due to high technologies are important factors that stimulate the introduction of new technologies. What this means is that new technologies increase the quality of healthcare services and patients can benefit from new information technologies being introduced in healthcare practices (Roukema et al., 2006).

The higher efficiency of healthcare services due to the use of information technologies is beneficial not only for patients but also for healthcare professionals because they can work more effectively. For instance, information technologies can save the time of healthcare professionals and provide them with an opportunity to increase the accuracy of their diagnosis as well as make other improvements.

In addition, the better management of healthcare services and patient care through the use of information technologies is another important factor that contributes to the wider introduction of information technologies in the national healthcare system of New Zealand (Tian, 2011). Contemporary information technologies help the sharing of information. Therefore, they can optimize and improve the management of the healthcare system. In this

regard, it is important to emphasise that effective management of the national healthcare system consistently affects the quality of healthcare services being delivered to patients.

In this respect, New Zealand's government has established many projects aimed at using computer technologies to improve the management of health information. In the late twentieth century, New Zealand started to introduce projects and programmes that aimed at the introduction of new information technologies in the national healthcare system and to increase the effectiveness of information transmission. For example, Child Health Information Strategy (CHIS) (1998) is a strategic plan to guide the development, collection and use of information about the health of children and young people (Child Health Information Strategy, 2003). This strategy has helped the introduction of information technologies and creation of the database, where information on the history of each child can be stored.

One part of the CHIS is a hierarchy of registers of children. The National Health Index number allows information gathered from different providers to be attributed to one individual. Another part of the CHIS is information technology infrastructure, which carries information between local care providers and regional and national registers (Child Health Information Strategy, 2003). The third part of the CHIS is the requirement to develop local and regional service initiatives to enrol all children in the healthcare services.

Furthermore, the Health Information Strategy for New Zealand (2005) coordinates and stimulates the implementation of information technologies at all levels (National Information Strategy, 2005). This strategy defines the overall development of the national healthcare system and the implementation of new information technologies. It guides the development of information system that aids and improves the performance of healthcare professionals, organizations, and national healthcare system at large.

Also, it is possible to refer to the National Mental Health Information Strategy for New Zealand (2005), which defines priorities and development of information technologies in the mental health system of New Zealand (National Mental Health Information Strategy, 2005). This strategy aims at the introduction of information technologies in the mental health organizations of New Zealand.

In 2003, the National Information Standards Organisation (HISO) was established in New Zealand, aimed at supporting the deployment of information management and technology standards for the Health Sector in New Zealand (Kerr, 2004). The HISO is responsible for ensuring that applicable standards, such as HL7, are identified for the development of the health sector.

Today, New Zealand has many of the required infrastructures to support the development of well-established EHRs. Some of these infrastructures which are already in place are secure networking for the health information via the Health Intranet, a unique patient identifier (NHI), well-developed privacy and security roles and a national standards organisation.

The existing Primary Information Systems Management (PrISM) on the West Cost of New Zealand is an example of a regional EHR system. It is an EHR that is regionally incorporated and available throughout the district and integrates multiple components of EHRs such as laboratory test results, digital radiology, and a patient administration system (Greenwood, 2007). It was established in 2004 and the West Cost DHP responsible for its maintenance.

Another example is the TestSafe project implemented between Auckland, Counties Manukau and Waitemata, the three Auckland DHBs. It aims at enhancing the sharing of patient's information among community and hospital care providers (Naylor, Analyst & Palliative Care Council of New Zealand, 2010). TestSafe provides healthcare professionals with the ability to access diagnostic results from both DHB facilities and community laboratories.

In fact, the implementation of EHRs is one of the main priorities in the development of the national healthcare system in New Zealand. The following will highlight the implementation of EHRs in New Zealand. In addition, it will provide a description of the national approach in implementing EHR and will identify some of the main issues facing its implementation

7.3 Implementing EHRs

For many years New Zealand has stayed away from developing a national EHR system. Today, New Zealand has developed one of the most technologically advanced information sharing infrastructure for the primary healthcare in the world. In late 2009 the government of New Zealand reconfirmed its laissez-faire approach to the development of EHRs. The progress into this development is moving forward rapidly, with a goal to develop a patient-centred record by 2014 (Jacobs & Bowden, 2010).

The widespread use of a patient identifier, the National Health Index (NHI), simplifies the implementation of EHRs in New Zealand. The NHI is used for all public hospitals, almost all private hospitals, most GPs and most community pharmacy and laboratory interactions (Naylor, Analyst & Palliative Care Council of New Zealand, 2010). Studies also show that New Zealand EHRs are becoming progressively more technologically advanced, making use of decision-support systems, public key infrastructure (PKI), electronic certificates and a high level of HL7 standards (Kerr, 2004).

7.3.1 New Zealand's EHR Model

The New Zealand Health sector was wracked for two years from 2007-2009 in indecision over whether or not to support the introduction of regionally shared EHRs. Later, the decision was made to build an EHR system based on an interoperability approach, aimed at providing a decentralised patient-centred EHR system (Jacobs & Bowden, 2010). This approach provides the availability to access these records for both consumers and healthcare providers. It is important to note that New Zealand's health sector sets the development of an interoperable and connected/ distributed approach as a key priority to ensure the safe sharing and transfer of patient EHR.

It has been pointed out in the Health Information Strategy Steering Committee (2005) that a nationally single centralised EHR is not generally seen as workable due to the current systems' incompatibility. However, it has also been mentioned that by making use of a

network approach, a system of several connected regional or organization-specific EHRs could be developed to build a 'virtual' national EHR (Leech, 2004).

In comparison to other countries, New Zealand seems to be well placed to improve the sharing of health information by having an established national unique patient identifier (NHI) and therefore providing better access to patients' health information. This has proved to be the keystone of any nationally distributed system that permits the connection of all health information on a person.

7.3.2 EHRs in Ambulatory Care

The computerization of clinical notes and medical prescriptions among GPs in New Zealand is ranked as the second highest use of computerization among primary care providers worldwide. Most private specialists use a computer system adapted to their practice. In addition, almost all public hospitals issue digital discharge summaries, to be transmitted via secure email or FAX to the patient's GP.

One of the studies found that 99% of GPs in New Zealand are making use of a Patient Management System (PMS) which is capable of supporting medical activities electronically. (Didham, Martin, Wood & Harrison, 2004). As a result of this high use of PMS, 90% of GPs enter prescriptions digitally, 81% electronically receive laboratory results, and 72% digitally store medical documentations. Moreover, the 2006 CMWF survey pointed out that 92% of GPs in New Zealand use EHR and 78% document prescriptions electronically (Jha et al., 2006).

According to the most recent survey of the CMWF regarding the implementation of EHR in 11 countries including New Zealand, 92% of primary care physicians in New Zealand use a comprehensive EHR system that performs from 9-14 clinical functions (Schoen et al., 2009). In addition, 6% of GPs use a system classified as (Middle) which performs from 4-8 clinical functions. Finally, only 2% of GPs use a system performs form 0-3 clinical functions classified as (Low). In total, 97% of GPs in New Zealand use an EHR system in

their practices. The following Table 4 shows the different levels of implementation of EHR among GPs in New Zealand.

EHR use in practices	EHR functions (0-14) in practices		
	Low (0-3)	Middle (4-8)	High (9-14)
97%	2%	6%	92%

Table 4: Different levels of EHR implementation among GPs in New Zealand.

7.3.3 EHRs in Hospitals

Hospitals in New Zealand have already implemented computerized systems for patient administration and many of them use electronic reporting for the laboratory results (Jha et al., 2008). However, digital documentation of patients' health information is limited to electronic discharge summaries through which this information is directly transferred to GPs and there is no good data on electronic prescription in hospitals in New Zealand. It is important to note that all public hospitals and a large number of private hospitals in New Zealand make use of the NHI (Naylor, Analyst & Palliative Care Council of New Zealand, 2010). This will simplify the collection of all the information that is related to a particular patient.

7.4 Healthcare ICTs Issues

The introduction of information technologies and the creation of EHRs in New Zealand are accompanied by certain risks and threats. Both clinicians and patients concern about the privacy, security of EHRs and the unauthorised access to patient medical information

(Chhanabhai et al., 2006). In particular, New Zealanders are concerned about private health information being "leaked out" or accessed by unauthorised persons and spiteful software that may damage an EHR (Chhanabhai & Holt, 2007). Moreover,

> "Māori have expressed concern about rights of access to, and use of, personal health information. The principle of rangatiratanga, whereby Māori are guaranteed the right of ownership over their taonga, or knowledge, has been interpreted as meaning health-related data about Māori belongs to Māori, especially when it is used as grouped data" (Chhanabhai & Holt, 2007, p.1).

Healthcare professionals' main concern is centred on patient consent, information level that should be accessible in the EHR, rights of access, and the safety of transferring data between healthcare settings (UMR Research, 2009). In addition, some healthcare professionals have scarce experience of using EHRs. Therefore they may face difficulties with using them effectively and, more importantly, they may provoke information breaches because of their lack of skills in using such systems. Hence, healthcare professionals can make errors and provoke information breaches that may affect the privacy of patients. In such a situation, patients may be uncertain of their privacy. Therefore, they will not have confidence in healthcare professionals, and that will lead to their resistance to the introduction of EHRs, regardless of their obvious benefits for patients' health. One of the studies emphasized that the level of identification associated with personal health information accessed from EHR is a vital factor that should be taken in consideration in implementing EHR. The study further recommended that the access should be limited to a summary of the health records rather than allowing access to all personal health information (Hunter et al., 2009).

In this regard, New Zealand has relatively well established privacy legislation, mainly indentified in the Privacy Act 1993 and additionally illustrated for the health domain in the Health Information Privacy Code 1994 which deals with the safety and privacy of personal health information in association with the use of NHI numbers (New Zealand Government, 1993). Examples of the privacy rules related to the use of EHRs are (Privacy Commissioner, 2008):

- Rule 3: "obliges health agencies to inform individuals why information is being collected, what it will be used for, who will see it, responsibility of the individual disclosing information and rights of access".
- Rule 5: "ensures that health agencies take reasonable steps to ensure security of health information".
- Rule 10: "sets limits on how health information is used to ensure that it is used for the purpose for which it was gathered, unless specific exceptions apply".
- Rule 11: "sets limits on the disclosure of health information, as well as exceptions".

There is also the problem of choosing the right approach to the implementation of EHRs. On one hand, the centralized approach implies the creation of the national information system and standards of EHRs, which have a homogeneous structure and protection at the national level (Wilcox, 2006). The centralized approach involves the elaboration of the national information system and standards of EHRs. As a result, healthcare professionals will be able to use them effectively in any part of the country, while patients can move safely from one region of New Zealand to another and be certain that healthcare professionals will be able to use their EHRs. However such an approach is complex and costly and raises many issues related to safety and security of personal health information.

On the other hand, the distributed approach implies the development of EHRs at the local level but this approach raises the problem of adequate information sharing nationwide (Bergmann, Bott, Pretschner & Haux, 2007). The approach has certain limitations because it may provoke diversity in EHRs standards. As a result, healthcare professionals may face difficulties with accessing them and sharing information concerning patients' history and other important issues.

Moreover, the lack of standardized e-health systems which has appeared as a consequence of the early adopters implementing different systems slows the implementation of a national EHR in New Zealand (Moriarty & Boswell, 2009). There are also funding debates in New Zealand about who pays for what system to talk to whose network, and who really

benefits. In contrast, pharmacists in New Zealand have a compatible national computerized reporting system, which is used for claiming financial supports at a national level and is also used for capturing data prescriptions by prescriber and by patient.

Finally, the quality of the eDS content is considered to be very high when it is short (Mukherjee, 2007). In this regard, several studies (Hopcroft & Calveley, 2008; Were et al., 2009) noted issues in the quality of the eDS as well as deficiencies in its content and accuracy. Moreover, a study found that New Zealand's GPs are concerned about the accuracy and the quality of follow up information in eDSs. In another study, Kazmi (2008) pointed out the issues of incorrect consultant names, omitting follow up appointment, discharge date and diagnosis in eDSs. Correspondingly, Callen et al., (2008) identified missed discharge date, secondary diagnoses and follow up instructions to GPs.

7.5 Summary

The MOH in New Zealand fully covers the costs of the healthcare services for all the citizens. The DHBs, which are funded by the MOH, are responsible for the delivery of healthcare services in their districts for all citizens. The healthcare is mainly funded by the government (83.2%). The government also sets aside $6.5 million a year for special needs. GPs is the first stage for providing healthcare services, the hospital is the next stage if advanced care needed. Although care services are provided for free, people still need to pay some costs of healthcare services. Therefore, low-income people are provided with a CSC to subsidize their GP visits and prescribed drugs. Citizens who have serious health problems are provided with a HHUHC to get additional subsidizes. Besides the healthcare public systems, there are also private insurance and healthcare services. Different programs and projects have been introduced aiming at increasing the effectiveness of healthcare services such as Child Health Information Strategy and the TestSafe project and the National Information Standards Organisation which was established in 2003. The implementation of EHRs has been enhanced by the introduction of the National Health Index (NHI). EHR systems are widely used among GPs (97%) and hospitals. There are different issues accompany the implementation of EHRs in New Zealand such as the

privacy, which approach to choose (centralized/distributed) and the quality of the eDS content.

Chapter 8

The Implementation of EHRs in Saudi Arabia

The Saudi Arabian government has given healthcare services a high priority. The past few decades have witnessed a great improvement in health and medical services, in terms of quality and quantity, in Saudi Arabia (Almalki, Fitzgerald & Clark, 2011).

8.1 The Healthcare System in Saudi Arabia

The Ministry of Health (MOH) in Saudi Arabia holds responsibility for planning, managing and providing health policies and the supervision of health programmes. It is also responsible for monitoring health services in the private sector, as well as directing other government and private organisations on approaches to achieving the objectives of the government's health (Altuwaijri, 2008).

The World Health Organisations (WHO) ranked the healthcare system in Saudi Arabia as 26th among 190 healthcare systems in the world. It appears prior to many other global healthcare systems. For example, Australia was ranked 32th, Canada (30), New Zealand (41). It also appears before several systems in the Middle East region, such as Qatar (44) and the United Arab Emirates (27) (World Health Organization, 2000).

In spite of these achievements, the healthcare system in Saudi Arabia faces various challenges that call for new approaches and polices by the MOH as well as effective collaboration with other sector.

The last official survey in 2010 placed Saudi Arabia's population at 27.1 million, compared with 22.6 million in 2004. It was estimated that the population growth rate was 3.2% per annum annually, for the period between 2004 to2010 (Central Department of Statistics and Information). Saudi citizens represent approximately 68.9% of the total population. It is estimated that 67.1% of the population is under the age of 30 years, while about 37.2% are under 15 years and an estimated 5.2% comprises the population over 60 years (as cited in Almalki, Fitzgerald & Clark, 2011). According to United Nations projections, it is

estimated that, by 2025 Saudi Arabia's population will reach 39.8 million (United Nations, 2003). Therefore, there will be an increasing demand on the necessary services and facilities including healthcare services as a result of this unprecedented growth in the population, while simultaneously creating economic opportunities.

8.1.1 Coverage

The government of Saudi Arabia provides free and full access to all publicly provided healthcare services to all Saudis and expatriates working in the public domain (Jannadi et al., 2008). The MOH in Saudi Arabia offers healthcare services at three levels: primary, secondary and tertiary (Ministry of Health, 2009). The primary healthcare (PHC) centres provide primary healthcare services such as preventive and curative care, while they refer the cases requiring more highly developed care to public hospitals (the secondary level of healthcare), or to specialized hospitals in cases needing more complex level of care (the tertiary level of healthcare).

At the current time the healthcare services in Saudi Arabia is mainly provided and financed by MOH, with a total of 244 hospitals (33,277 beds) and 2037 PHC centres (Ministry of Health, 2009). These provided services represent 60% of the total healthcare services in the country. The other government healthcare agencies include referral hospitals (e.g. King Faisal Specialist Hospital and Research Centre), army forces medical services, security forces medical services, Ministry of Higher Education hospitals (teaching hospitals), National Guard health affairs, Royal Commission for Jubail and Yanbu health services, ARAMCO hospitals, school health units of the Ministry of Education and the Red Crescent Society. Excluding referral hospitals, Red Crescent Society and the teaching hospitals, each of the previously mentioned agencies provides healthcare services to a defined people, usually employees and their families. It is worth noting that all of them provide healthcare services to all residents during times of crisis and emergency (Almalki, Fitzgerald & Clark, 2011).

Additionally, the private sector also provides healthcare services, usually in large towns and cities, through a total of 125 hospitals and 2218 clinics and dispensaries (Ministry of Health, 2009).

8.1.1.1 Health Services in the Pilgrimage (*Hajj*) Season

Saudi Arabia has a distinctive location in the Islamic world, where the two holiest places of Islam, Mecca and Medina, are located. Annually, around two million pilgrims throughout the world perform the *hajj*. For instance, there were 2.3 million pilgrims, 69.8% of whom came from overseas countries during the 2009 *hajj* season (Ministry of Health, 2009). The annual host of such an event is a significant challenge that needs an intended and structured effort across many organisations and departments to ensure sufficient services, including healthcare services (Jannadi et al., 2008). During the *hajj* season, the healthcare services provide both preventive and medicinal care for all pilgrims, regardless of their nationality. For instance, in 2009, there were twenty-one hospitals, seven of which were seasonal. In addition, there were 157 PHC centres, of which 119 were seasonal.

Annually, the Saudi government represented by the MOH, tries to improve and enhance the delivery of healthcare services to pilgrims (Jannadi et al., 2008). Nevertheless, it should be noted that all healthcare services provided during this season are free of charge for all pilgrims. This creates significant demand on the healthcare budget in particular, and therefore it has become necessary to look for new approaches to deliver better healthcare at a lower cost.

8.1.2 Finance

Overwhelmingly, the finance for healthcare in Saudi Arabia is mainly provided from government revenue. The MOH is the main government financer of healthcare services in Saudi Arabia. The Saudi government expenditure on the MOH rose from 2.8% in 1970 to 6.2% in 2009 (see table 5) (Ministry of Health, 2009). According to the World Bank, the total expenditure on public health during 2010 was 4.3% GDP (see figure 11) (The World Bank, 2012).

Years	Government budget (SR)	MOH budget (SR)	%b
2005	280 000 000	16 870 750	6.0
2006	335 000 000	19 683 700	5.9
2007	380 000 000	22 808 200	6.0
2008	450 000 000	25 220 200	5.6
2009	475 000 000	29 518 700	6.2

Table 5: Budget appropriations for the MOH in Saudi Arabia in relation to the government budget, 2005–09 (adopted: Ministry of Health, 2009)

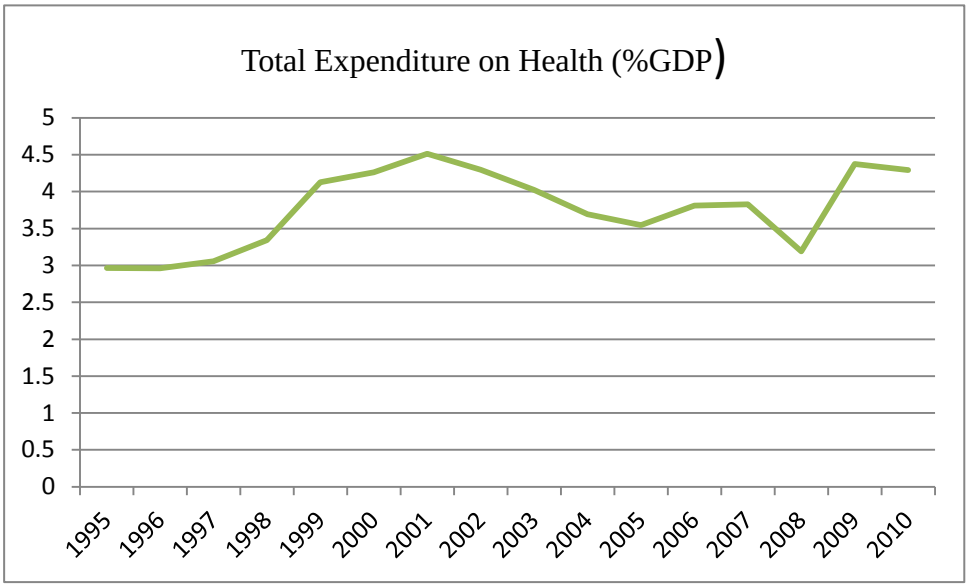

Figure 11: Total health expenditure in Saudi Arabia (%GDP) (World Bank, 2011)

8.2 Developments of Health Information Management in Saudi Arabia

Recent decades have witnessed a significant improvement in the healthcare services in Saudi Arabia (Walston, Al-Harbi & Al-Omar, 2008). In 1925, by royal official order from King Abdulaziz, the first public health department was established in Mecca (Almalki, Fitzgerald & Clark, 2011). This department aimed to sponsor and monitor free healthcare

for the population and pilgrims via the establishment of several hospitals and dispensaries. Although this step was very vital in providing medicinal healthcare services, the national income was not adequate to reach key progress in this sector.

The establishment of the MOH in 1950 was the next vital development in the healthcare domain in Saudi Arabia. In 1970, the five-year plans were introduced by the government aiming at improving various domains of the country, including the healthcare system (Mufti, 2000). Since then, the Saudi government has achieved significant improvements in healthcare.

The development of healthcare services in Saudi Arabia, in association with other factors such as improvement in the access of public education and more health awareness among the community, have contributed to the considerable enhancements in health pointers. However, it has been pointed out that, in spite of the variety of healthcare services providers, there are no apparent communication channels between them. This leads to duplication of efforts and a waste of resources in the healthcare sector (Alhusaini, 2006).

For instance, there are significant opportunities for the healthcare domain to benefit from laboratories, equipment, training aids and well-qualified personnel from diverse countries. Nevertheless, the benefit of such opportunities is narrow within each domain, as a result of weak integration and coordination among these sectors. In order to address this issue of poor coordination among healthcare providers in Saudi Arabia and to provide the residents with well-updated, organised, affordable and comprehensive healthcare system, in 2002, a royal decree led to the establishment of the Council of Health Services. It was directed by the Minister of Health and included representatives of other government and private healthcare domains (Almalki, Fitzgerald & Clark, 2011). Although the Council aimed at enhancing the coordination and integration among all healthcare sectors in the country, there has not been significant progress in this regard.

Today with the increasing realization of the major positive impact that technology can have on the quality of healthcare, many healthcare providers in Saudi Arabia have been increasingly relying on information and communication technology by implementing advanced information systems. However, this effort has not been accompanied by integration and coordination between these implemented systems. Therefore, this leads to diversity in the systems used among healthcare providers, which makes it difficult to create a standard national network and repositories for the health records. At the same time, there

are huge efforts to connect MOH hospitals, but this objective has yet to be achieved by the MOH because of the lack of information and communication infrastructures, as well as a lack of sufficient funds. It has been announced by the Health Minister in Saudi Arabia that the implementation of a notional EHR is set as a high priority in the healthcare reform plan (Altuwaijri, 2008).

Nevertheless, there are some good examples for EHR implementation among healthcare sectors in the country, such as King Faisal Specialist Hospital & Research Centre (KFSH & RC), which has deployed the latest ICTs since its inception in 1975. Internet technology and telemedicine have been introduced in the hospitals since 1993. The hospital has deployed an advanced network of optical fibers that exceed 5,000 points. Currently, more than 12 MOH hospitals have joined this network (Altuwaijri, 2008).

More insight into the implementation of EHRs in the kingdom will be provided in the following section.

8.3 Implementing EHRs

Saudi Arabia is facing increasing concern about the lack of usage of EHR systems among healthcare sectors. The move toward the implementation of EHR systems has been already underway in many hospitals and organisations, such as the KFSH & RC, National Guard Health Affairs, university hospitals and health services of the army forces (Altuwaijri, 2010). While EHR implementation in MOH hospitals is moving gradually, there are several information systems functioning in the district directories and in main hospitals. However, these implemented systems are not connected with each other or integrated with other healthcare sectors (Altuwaijri, 2008).

Although there is no good data about the level of EHR implementation in Saudi Arabia, one recent study conducted by Bah et al., (2011) regarding EHR adoption among 19 MOH hospitals in the Eastern Province found the following:

Only three out of 19 hospitals have implemented EHR. That means the percentage of EHR use is only 15.8% in the Province. All three hospitals are using the same EHR system, partly as a result of the centralization at the MOH. Therefore, mostly the three hospitals are using the same EHR functions. So, the main features of radiology, laboratory, and

pharmacy electronic components are used by the three hospitals. In addition, the system used in the three hospitals is equipped with decision support tools and clinical documentations to generate and retain lists of common patient-related health problems, and to document patient-discharge information. However, the study pointed out that the three hospitals underused some features presented in the EHR system, such as external access to EHRs by either physicians or patients.

The MOH allocated a budget of SR 4 billion (US$1.1billion) to establish a four year development programme (2008-11) to develop e-health initiatives in the public health domain (Almalki, Fitzgerald & Clark, 2011). Moreover, a number of conferences on health informatics have been organised by the Saudi Association for Health Information to put emphasis on the significance of health informatics in the enhancement of healthcare quality as well as to investigate the essential strategies, rules, applications and infrastructure (Saudi Association for Health Informatics, 2008).

One successful implementation of EHR in Saudi Arabia has been achieved at the National Guard Health Affairs (SANG-HA), a leading healthcare supplier in the country. This implementation has received the QuadraMed Corporation's (QCPR™) award of "the prestigious Excellence in EHRs" at the 2010 Arab Health Awards in Dubai. This award was given for developing an advanced EHR in their facilities (QuadraMed, 2010). It was achieved via the use of QCPR at its King Abdulaziz Medical City (KAMC) in the capital city, Riyadh, and this application was expanded to two Eastern Region hospitals as well as their GPs centres. The KAMC contains 1,000 beds and is widespread grid of GPs and teaching hospitals, serving the members of National Guard and their families, as well as citizens of Saudi Arabia who require advanced care. Another contract also has been made with QuadraMed to implement EHR at twelve outpatient clinics throughout the country. QCPR has been already implemented at primary care units affiliated with KAMC.

8.4 Healthcare ICTs Issues

Despite the fact that several actions have been undertaken by the MOH in Saudi Arabia to reform the healthcare system, many challenges remain which need to be addressed. These challenges relate to many factors such as financing and expenditure, accessibility to

healthcare services, integration, health workforce, and development of e-health strategies and national health information system (Almalki, Fitzgerald & Clark, 2011).

As a result of the poor integration between healthcare providers in the country, different administration, financial management and information systems have been used. This leads to a lack of a unified system for the health record. Consequently, patient health record is scattered amongst diverse healthcare providers. Therefore, it is very rarely for a patient to have a complete health record within one healthcare provider, except when a patient selects one care provider for receiving medical care at all times. This further leads to a duplication of efforts and a waste of resources in the healthcare sector resulting from treating patients continually for the same health issues where patients might be asked to repeat x-rays and other required tests (Alhusaini, 2006).

The shortage of local healthcare professionals including physicians, nurses and pharmacists also stands as an obstacle for healthcare system reform in Saudi Arabia. Most of healthcare professionals are expatriates which leads to instability in the health workforce. It was pointed out by the MOH that the total health workforce in Saudi Arabia is about 248, 000, where 125, 000 of them work in the MOH. Therefore, attracting more Saudis into the health professions, nursing in particular, is set as a priority in the health system reform.

Another challenging factor faced by the MOH is funding healthcare service. As the total spending on public health provided by the government and health services are free, this lead to significant demands on the healthcare budget in particular. The high demands on the healthcare budget can be attributed to different factors including the rapid increase in the population of Saudi Arabia and the increasing cost of new technologies.

To meet these challenges, the MOH has established a national strategy for improving the healthcare services in the country. In April 2009, this strategy was permitted by the Council of Ministers. The strategy aimed to diversity fund sources, develop information systems, develop the human workforce, activate the administration and monitoring the MOH role over medical services, encourage the private sector to provide health services and distribute healthcare services equitably to all regions. The implementation of this strategy is to be done by the MOH in cooperation with other healthcare sectors, and the Council of Health Services will be responsible for supervising this implementation.

Moreover, an e-health conference was organised by Saudi Association for Health Informatics in 2006 with the aim of addressing health informatics issues. The conference

pointed out some recommendations to enhance the e-health in the country including a proposed plan for e-Health in the Kingdom; however the movement towards implementing EHRs is still very slow in Saudi Arabia.

The same study mentioned before (Bah et al., 2011) regarding EHR implementation among MOH hospitals in Eastern Province, further investigated the ICT issues facing EHR adoption from the IT managers' perspectives. The study pointed out that respondents indicated the "lack of seriousness of the doctors in inserting a prescription" was one of the biggest challenges facing them in this regard. Moreover, one respondent noted the "unwillingness of doctors in the introduction of electronic medical prescription" was also a big obstacle. In general, the acceptance of physicians and nurses in using such system seems to be of the big challenges facing the implementation of EHR. Moreover, poor ICT infrastructures among the MOH hospitals also have been indicated as one of the main challenges in moving toward the implementation of EHRs in the country (Altuwaijri, 2008).

The MOH has a vision to enhance healthcare services in the kingdom in terms of availability, standards, equability and quality. A five year strategic plan has been developed by the MOH to realise this vision. In addition, the MOH has placed eHealth as a primary transformation agent and enabler in this vision. To achieve the vision, MOH, cooperating with national and global advisors and IBM, has established an eHealth Strategy and 5 year plan. The goals of the eHealth Strategy are: (Ministry of Health, 2011)

- "To Care for Patients".
- "To Connect Providers at all levels of care".
- "To Measure the Performance of healthcare delivery".
- "To Transform Healthcare Delivery to a consistent, world-class standard".

8.5 Summary

The MOH in Saudi Arabia is responsible for providing the healthcare services to all citizens. Healthcare services are provided in three levels: primary, secondary and tertiary based on the level of the services needed. Besides MOH, the healthcare services are also provided by other government agencies such as referral and teaching hospitals and by the private sectors. However, the MOH is the main financer for the healthcare services. The

Saudi government has achieved a great development over the last few decades despite facing significant challenges such as the increasing number of population and the hosting of around two million pilgrims annually in the Hajj season which requires great efforts to provide effective healthcare services. In order to improve the quality of healthcare provided, a great effort has been made to connect MOH hospitals, but lack of communication infrastructures and sufficient fund are the main barriers faced. A budget of SR 4 billion was allocated by MOH to establish a four year development programme (2008-11) to develop e-health in public hospitals. Furthermore, a number of conferences have been held to emphasize the importance of health informatics. Nevertheless, there are good implementation of EHRs among healthcare sectors such as King Faisal Specialist Hospital & Research Centre (KFSH & RC). Another successful implementation of EHRs has been achieved at the National Guard Health Affairs (SANG-HA), one of the leading healthcare providers. There are different challenges that MOH need to overcome in order to increase the effectiveness of the healthcare services. Some of these major challenges are a lack of a unified system, the shortage of health workforce and doctors' attitudes to EHR implementation. A national strategy has been established to meet these challenges which to be implemented by MOH and under the supervision of the Council of Health Services. Moreover, an eHealth Strategy has been established by MOH which also aims at enhancing the quality of healthcare services.

Chapter 9

Discussion

This chapter comprises a comparison and discussion. A comparison will be presented across the countries in the study in regard to healthcare systems and implementation of EHRs. At the same time areas that have been distinguished between these countries in implementing EHR will be discussed. The discussion part will include EHR technology, benefits and challenges of EHRs, and the centralised or distributed approach in implementing EHRs. To conclude this chapter, critical success factors for implementing EHRs based on various studies and lessons for developing countries such as Saudi Arabia, based on successful implementations of EHRs achieved by the UK, Australia and New Zealand, will be discussed.

9.1 Paper-based and Electronic-based Record Comparison

Recording data related to the patient's medical information and diagnosis is particularly important for the quality of healthcare delivery. All the information associated with a patient's health can be recorded so a faster and accurate treatment can be done in the future. Clinical diagnosis can be studied using a variety of information sources, such as hospital and clinical discharge records (Kallem, Burrington-Brown & Dinh, 2007). The traditional method of recording this sort of information was paper-based records. Although documenting the data in paper format is still a common practice nowadays, the tendencies are changing. EHR is being implemented in the healthcare domain as a way of improving the quality, quantity and access to information. Due to the complexity of the healthcare environment and the numerous decisions that must be made, the need for reliable, accurate and up-to-date information becomes highly critical. The paper-based records cannot provide the flexibility that EHR presents. Coiera (2003) contrasts a paper-based record to an EHR in terms of portability, ease of use, accessibility, reliability, cost, and data entry which will be presented in the following Table 6:

Feature	Paper based Record	Electronic Record
Portability	"Can be carried around easily, no need to plug in." "Easy to carry around"	"Desktops are bulkier and cannot be carried around; PDAs are quite portable but have less use so far." "Laptops have the potential (will require trolley for ward rounds) but still expensive."
Ease of Use	"A familiar form for information recording, no special training required."	"May require special training of health professionals to be able to use."
Accessibility	"Limited to user(s) at one location at a given time." "Difficult to locate record if there are several stacks of old records."	"Available across several locations at any given time to authorized users." "Record can be located easily with a few clicks."
Reliability	"Paper is susceptible to damage and may degrade with time."" Paper-based records can get missing easily."	"With backup systems, records can be kept for a longer duration of time."
Cost	"Relatively cheap, but maybe more expensive over a long term period."	"Start up cost very expensive, but cheaper to run."
Data Entry	"Freestyle data entry makes paper-based records easy."	"Predefined format of data entry must be adhered to."

Table 6: Paper based and electronic records: *adapted from Coiera (2003)*

The importance of implementing such technologies can be supported by both potential benefits of implementing EHRs and reviewing some weaknesses in the conventional way of reporting. Limitations in paper-based records such as incompleteness of information, difficulty in searching for specific information, illegibility of handwriting, and inaccessibility of information stand as obstacles in the development of care delivery. The use of ICTs in EHRs enhances the process of managing, storing, and retrieving medical information. EHRs have been recommended by many researchers as a promising tool to address such weaknesses inherited in paper-based records. More insight into the benefits and challenges of EHRs and how developed countries deal with these challenges will be discussed later in this chapter.

9.2 EHR Technology

EHRs are managed through health information systems which present the technological approach that is used within contemporary health record management systems (Hayrinen, Saranto & Nykanen, 2008). The adoption and implementation of technology in the form of health information systems is motivated by the efficiency and effectiveness in which health records are managed through this approach (Swartz, 2004). The most significant role of record management in a healthcare institution such as a hospital is to facilitate collection, storage, retrieval and use of the health records (Spiro, 2012). Health records comprise of information and data on the healthcare staff and patients. Health records are very sensitive and therefore the security of the health record management system is one of the vital considerations by health record managers and administrators.

EHRs contain demographics of new and past patients. The electronic information within this system also includes the procedures which patients have to go through or have already undergone during the processes of treatment or therapy. The EHR also contains electronic discharge summary (eDS) which is used for the purpose of transferring patient medical information between the primary care physician and hospitalist. The quality of the eDS content is considered to be very high since it is short (Kallem, Burrington-Brown & Dinh, 2007).

The healthcare employee data such as personal details and work records are also part of the EHR of a health institution (Hayrinen, Saranto & Nykanen, 2008). These individuals include physicians, doctors, nurses, emergency staff, social workers, interns and support staff. More significant is the data on patients which is confidential unless the patient provides consent or authority for it to be passed to other parties such as relatives (Jha, DesRoches, Kralovec & Joshi, 2010). The equipment used in the management of electronic records within a health institution includes the hardware, software, policies and procedures for the management of electronic records. The electronic data and information themselves also comprise the components of the healthcare system.

The information system within a healthcare institution which defines the management system of health data and information also contains a database. The database is the storage where the information on employees and patients are safely kept for retrieval and use. A health database management system is necessary for the healthcare centre to be able to manage the information within the database in the most effective and efficient manner (Carter, 2008). The hardware of EHRs comprises of computer terminals, hard discs and external storage appliances. These devices have found wide use in the management of EHRs. The software include the server operating systems, PC operation systems or system software in addition to application software through which users are able to access and make use of the electronic information within the electronic records of the health institution in question.

The topology of the information system within the health facility defines the arrangement of the electronic record database. In this sense the electronic record database would be centralized or decentralized. Nonetheless, most healthcare records are electronically managed through a hybrid topology in which the database is both centralized and decentralized. A centralized topology means that the database of the electronic records is controlled from a central location. A decentralized topology is recommended for healthcare facilities in the management of their electronic records. The justification for a decentralized topology in electronic record management is due to its less complex nature and low-cost in the management of such records (Jha, DesRoches, Kralovec & Joshi, 2010). This is because a decentralized system makes every department of the hospital to manage its records while the same records would be accessed through a central database.

The arrangement of the network topology for the EHRs must be designed in a way that a central server is used to manage the flow of information between and among departments (Carter, 2008). This means that if the pharmacy department needs to confirm the medication of the patient, it would be able to contact patient records from the physician through the information system. Additionally, the inpatient departments, emergency departments, obstetrics and gynecology, surgery and pediatric departments would be able to share patient information through a common database. The decentralization of the database within the hospital will play a central role in facilitating the sharing of patient information among the departments concerned with the management of the conditions of the patients.

The standardization of ICTs in the management of health records is an important aspect of record management of such sensitive information or data. The standardization includes the design, adoption, implementation policies and procedures of handling electronic records (DeNardis, 2011). Therefore, the policies laid by healthcare facilities must comply with the legal framework for the privacy and confidentiality of individual information. The standards must also include the procedures of retrieval and use of patient and staff information so that the issue of security for the information is given top priority. For example, policies for electronic records include the use of cryptographic approaches such as passwords in securing patient and employee data from unauthorized access and use by malicious network attackers or hackers.

In the light of the above discussion and illustrations, it is evident that effective management of electronic records of a health facility includes a proper infrastructure, topology, policies and procedures. Proper electronic record management system within a hospital information system must also consider securing the privacy and confidentiality of information. Furthermore, the retrieval and use of data and information within the database must be designed for efficiency and effectiveness. This includes a decentralized topology which is less complex and low-cost.

9.3 Healthcare System Comparison

This section will present a comparison across the countries in this study, the US, UK, Australia, New Zealand and Saudi Arabia, in terms of healthcare structure, coverage and finance. In each of the previous criteria, a comparison between the four developed countries will be raised first and then Saudi Arabia as a developing country will be compared to them.

9.3.1 Structure

The five countries studied represent a mix of primary care and insurance system. The US system is different in its dependence on internal medicine and pediatrics for primary care, and its highly distributed referral systems. The other three developed countries, UK, Australia and New Zealand, rely widely on general or family practice physicians. In these three countries patients register with GPs, who usually serve as "gatekeepers" for referral for more advanced care. Primary practices or GPs in these countries generally operate as private practices. In the US and Australia, commonly a fee-for-service has to be paid by insurers. In the UK and New Zealand a mix of capitation and fees for visits or targeted care are used.

Insurance systems vary across these four developed countries in patient cost sharing. The US and UK have no or little share of cost for clinical care. In Australia, GP visits are often "bulkbilled", with no charge to patients. New Zealand has been dropping patient fees for GP visits.

In Saudi Arabia, the structure of the healthcare system is similar to that in the UK, Australia and New Zealand, though medical services are provided free of charge at all three levels of care: primary, secondary and tertiary for all residents. Similar to other countries, GPs are the first point of care in Saudi Arabia, while they refer the cases requiring more advanced care to public or specialized hospitals.

9.3.2 Coverage

Almost all countries except the US provide some form of universal healthcare coverage for their citizens. Unsurprisingly, given the absence of universal coverage in the US, many Americans go without required healthcare services as a result of cost more often than other nations. The public healthcare system in the US covers only the elderly and low-income families while all other Americans mainly receive insurance coverage through employer-sponsored private insurance (Chua, 2006).

In contrast, all other countries provide their citizens with some form of universal healthcare coverage. For example, the NHS in UK with few cost-sharing arrangements covers ambulatory care for both inpatients and outpatients, hospital care, GPs services, inpatient and outpatient drugs, dental care, learning disabilities and mental healthcare (Boyle, 2008). Similarly, Australia's Medicare provides free or low-cost access for entitled Australian residents to medical, optometric and public hospital care, while they also have the choice of private health insurance. Medicare contributes a total of 75% of the Medicare plan fee for treatments provided by doctors. Like the case in the UK and Australia, the MOF in New Zealand is fully responsible for the coverage of the healthcare costs of citizens (Bramhall, 2003). However, residents of New Zealand still have to cover some costs of healthcare services, such as visits to GPs. Low income citizens of New Zealand, whose income is under $9,800 (USD) and who cannot afford paying for all the visits to GPs that they need are eligible for a Community Service Card (Bramhall, 2003).

The case in Saudi Arabia in regard to healthcare coverage is quite similar to that in the UK, Australia and New Zealand. The Saudi government provides all citizens and expatriates working within the public sector with full and free access to all publicly provided healthcare services (Jannadi et al., 2008). In addition, all other healthcare sectors including private hospitals provide free healthcare services to all residents during times of crisis and emergency, while the MOH covers the cost of these treatments in private hospitals (Almalki, Fitzgerald & Clark, 2011). Moreover, the MOH provides free of charge healthcare services for all pilgrims during *hajj* season.

9.3.3 Finance

In most developed countries, healthcare services are largely paid by the government or a related organisation, using taxes collected from citizens. In general there are two approaches to finance healthcare system; government-based and market-based finance. Examples of government-based finance system are those in UK, Australia and New Zealand. For instance, UK has a "single-payer" system where the government pays directly for healthcare. In contrast, a portion of the healthcare system in the US is market-based in which the government uses money generated from taxes to repay care providers who offer health services to patients such as Medicare, Medicaid and HMOs. However, the US government may provide healthcare to vulnerable people. In New Zealand the case is similar to that in the UK in which the healthcare finance is mainly provided by the government using taxes collected from citizens. In Australia, the government provide 67% of public healthcare expenditure, while state, territory and local governments grant the rest.
Since it has an oil-based economy, Saudi Arabia's healthcare finance is mainly provided from government revenue. The MOH in Saudi Arabia is the main government provider and financer of healthcare services in Saudi Arabia. These provided services represent 60% of the total healthcare services in the country.
In comparing the total expenditure in healthcare by these countries (see figure 12), the US health expenditure appears as the highest in the world: near $2.6 trillion in 2010 (Martin et al., 2012). It was estimated that the total health expenditure in the US (%GDP) is 17.9, while the public expenditure on health is 53.1 % of the total expenditure (The World Bank, 2011). In between these five countries, New Zealand comes as a second (10.1%GDP), while the UK as the third highest in total healthcare expenditure (9.6%GDP). The total expenditure on health in Saudi Arabia appears extremely low compared with these developed countries with only 4.3% GDP.

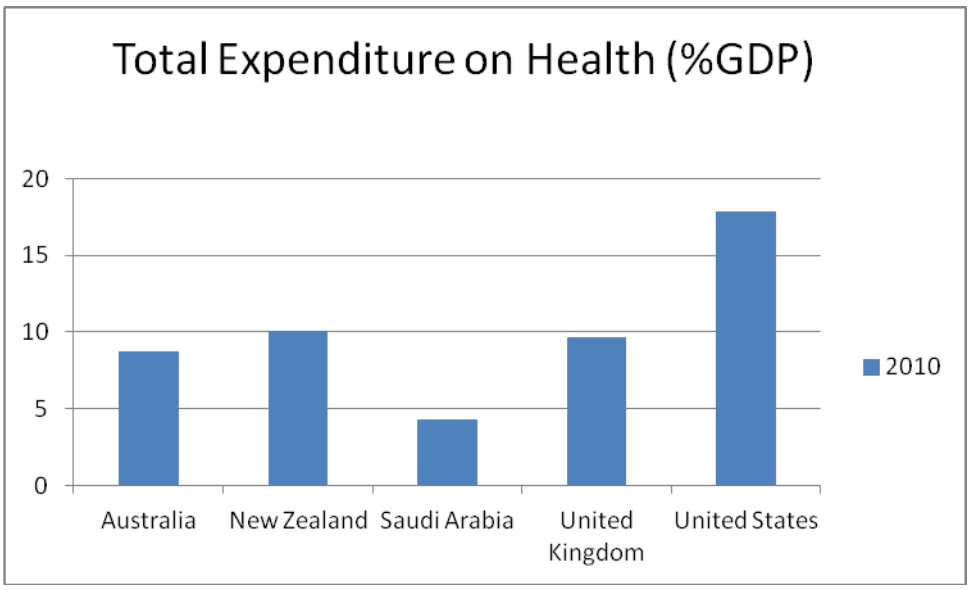

Figure 12 : Total expenditure on healthcare by the five countries

Overall, the US ranked last in comparison with other countries in the study in term of healthcare coverage; however it has the most costly healthcare system in the world with 17.9 (%GDP) as a total expenditure on healthcare. All other countries including Saudi Arabia provide their citizens with almost universal healthcare coverage, while 40 million people are uninsured in the US. The US healthcare system is mostly market-based, and it is changing back to a government-based financed system to some extent. In Australia, the healthcare system is less marketed than the US, in which the Australian government provides 67% of public healthcare expenditure. In the UK, New Zealand and Saudi Arabia healthcare finance is mainly provided by the government.

9.4 EHR Implementation Comparison

This study investigated the state of EHR implementation in four developed countries, the US, UK, Australia, and New Zealand, and one developing country, Saudi Arabia. Both similarities and remarkable differences were found among the four developed countries in implementing EHRs.

Although, the adoption and use of a national EHR system are in the early stages in these four countries, the UK, Australia and New Zealand were far ahead of the US in implementing EHRs in the primary care settings. While only 26% of ambulatory care

physicians in the US use a comprehensive EHR, almost all GPs in the UK, Australia and New Zealand use a highly computerized health record system. The following Table 7 illustrates different levels of EHR adoption among GPs in these four developed countries.

Countries	**EHR functions (0-14) in practices**		
	Low (0-3)	Middle (4-8)	High (9-14)
US	51%	23%	26%
UK	0	11%	89%
Australia	3%	6%	91%
New Zealand	2%	6%	92%

Table 7: different levels of EHR adoption among GPs across the US, UK, Australia and New Zealand

The table illustrates that the large percentage of GPs in the US use an EHR system classified as *Low*, while less than 4% of GPs in Australia and New Zealand use such a *Low* performance system. In contrast, New Zealand ranked as first in implementing *High* performance EHR systems among GPs (92%), while Australia comes as a second (91%), and, with only two percentages less than Australia, the UK comes as third. The US lagged far behind these three countries in implementing a *high* performance EHR system where only 26% of GPs using such system. It is noteworthy that these percentages do not reflect the exact utilisation of these 14 clinical functions, while they represents the quality of the EHR systems implemented among GPs in these countries.

The deviation in EHR adoption among GPs in the four developed countries can be attributed to different causes. For example, high rates of EHR use among GPs in UK appear as a result of a complex set of factors including a long history of computerization, partly supported by free or cheap hardware and software. Moreover, one of the factors that contribute to this high rate of adoption is the NHS 2003 contract with GPs, which assigned significant financial incentives for achieving quality standards. In New Zealand, a combination of factors were behind the high adoption of EHRs, in which the government

indirectly played an important role by requiring all GPs to use an electronic system for submitting claims and capturing other data (National Information Strategy, 2005). In contrast, GPs in the US receive no extensive external funding, and obtain few encouragements or other requirements imposing the use of computers in medical practice. The country has therefore lagged behind considerably (Stalker, 2009).

The fact remains that there has been slow EHR implementation among hospitals across these four developed countries. In general, hospitals have larger resources than individual practitioners and much of the data about clinical benefits of EHR have been proven in the hospital setting. Two explanations can be indicated for this slow adoption of EHR among hospitals. First, little attention has been given by policy makers in these countries to EHR implementation in hospitals. Second, is the high costs of hospital EHR systems which are often required to incorporate with a legacy system. As a consequence of unclear incentives, hospitals have seen little reason to implement EHRs.

In Saudi Arabia, the implementation of EHRs has already been under way in many hospitals such as the KFSH & RC, National Guard Health Affairs, university hospitals and medical services of the army forces (Altuwaijri, 2010). While EHR implementation is moving slowly in the MOH hospitals, there are number of information systems operating in the regional directories and in central hospitals. However, these systems are not connected with each other or integrated with other healthcare sectors. Although, there is no good data in how advanced these systems in performance are, there is a good example of EHR implementation which has received the QuadraMed Corporation's (QCPR™) award of the prestigious Excellence in EHRs at th e 2010 Arab Health Awards in Dubai. This implementation has been achieved at the National Guard Health Affairs (SANG-HA), a leading healthcare provider in the country.

This slow adoption of EHR in Saudi Arabia can be attributed to many factors including financing and expenditure, accessibility to healthcare services, health workforce, and development of e-health strategies and national health information system.

The four developed countries in this study are in the process of developing a national EHR system. However, these countries are following different approaches into this development

to provide more integrated healthcare environment. These different approaches, centralised or distributed, will be discussed later in this chapter.

9.5 The Benefits and Challenges of EHR Implementation

The use of EHRs has been very critical, not only in helping to effectively manage health records, but also in helping storage, access, and dissemination of information that is important in the provision of healthcare services. Young (2000) argues that EHRs have been crucial in making it easier to transfer medical records of more mobile populations to the point of care. There has been increasing complexity in managing health records due to the fact that an increasing number of patients are often cared for by more than one medical organization or single physician; care of patients is nowadays done through a collective process which includes administrative staff, consulting specialists, nurses, and diagnostic technicians, and EHRs have been instrumental in making this a reality. The presence and the use of the EHR has brought about numerous benefits that have greatly enhanced the provision of healthcare services, thereby meeting or even exceeding the expectations of the clients (Hersh, 2004). On the other hand, it is faced by common challenges that threaten to undermine provision of quality healthcare services.

So, what are the benefits and challenges of EHRs? In regard to the benefits, EHRs increase the storage capabilities for considerably longer periods of time. Besides, these records can be accessed by many people from remote sites at the same or different times and the retrieval of the required information can be done almost immediately. Of more significant importance is the fact that the EHR are continuously updated and concurrently available for use anytime and everywhere. A study conducted in Australia found that this makes the records immediately accessible at all unit workstations whenever they are needed (Walker, 2004). In addition, EHRs can provide medical reminders and alerts. EHR systems are designed in such a way that they have certain built-in intelligence capabilities, such as those recognizing drug interactions that are potentially life-threatening or recognizing anomalies in lab results. EHR can also link the clinician to literature databases, care plans, protocols, pharmaceutical information, and critical paths among other healthcare knowledge databases (Ventres et al., 2006).

Another benefit of EHRs is that they can allow for customized views information that are relevant to the various specialties' needs. The American Congress of Obstetricians and Gynaecologists (ACOG) conducted a research and found out that the EHR is much more flexible in the sense that it allows its users to use and design reporting formats that have been tailored to their particular needs, as well as organizing and displaying data in different ways (American Congress of Obstetricians and Gynaecologists, 2010). Moreover, EHR is used as a management tool which helps in providing information that improves assessment outcomes and risk management. It decreases charting errors and charting time, thereby decreasing medical errors and increasing healthcare workers' productivity. Furthermore, it has financial benefits as it provide more accurate information on billing and allows the care providers to electronically submit their claims, which enables them to receive their payments more quickly. EHR also makes the patient happier since he or she would not have to provide the information provided previously as it is already available in the EHR system (Waegemann, 2003).

The benefits of EHRs notwithstanding, EHRs have several challenges that are threatening the effective implementation of EHR. One of the most cited disadvantages is start-up costs which may be relatively high; as healthcare organizations are seeking to minimize their costs, allocation of capital to EHRs can prove to be a challenge (Stephanie et al, 2008). In the event that a health organization installs the system, chances are very high that it might pass the costs onto the patients, therefore making healthcare services expensive to the patients. In addition, the substantial learning curve involved is another disadvantage of the EHR, as its users are required to have some sort of technical knowledge and experience. This becomes a challenge especially to physicians who are the EHR's primary users, but may not have the technical knowledge. Arguably, usability can be a main obstacle that affects the EHR implementation (Waegemann, 2003). Also, the implementation of EHRs is faced with the challenge of a lack of a common definition and a common vision. Since there are various terms that are associated with EHR and each indicates a specific vision which are different from others, its users are unable to identify their future and even current trends. Consequently, they have difficulty in selecting systems that can meet their healthcare needs. Similarly, the vendors of EHR systems have a difficult time in supplying the systems. In order to address this challenge, studies in New Zealand have suggested that

standardized and global EHR systems should be developed and made available in the market (Young, 2000).

The most prominent challenge that has been identified in regard to EHR is that of confidentiality, privacy and security. There has been much discussion regarding the debate of protecting patients' records and ensuring that the records are accessible to the healthcare professionals to provide medical care. It has been argued that EHR potentially reduces privacy and confidentiality of the patients. The Health Information Privacy Code 1994 in New Zealand acknowledges the concerns of the EHR system infringing on patient confidentiality and privacy and calls for measures to avert this situation (Stephanie et al, 2008). However, the Health Insurance Portability and Accountability Act in the US notes that patient data under the EHR-based practices are secured with several protection layers and that its benefits supersede the privacy infringement by far. The necessity of accessing the patient information has been emphasized by the Guidelines on Privacy in the Private Health Sector in Australia, which states that laws should not be very stringent to the extent that they prohibit access to healthcare providers who have the right to patient information. However, these guidelines also emphasize that unauthorized access should be protected by the use of available technologies such as passwords and firewalls as a solution to that vice (Carter and American College of Physicians, 2008).

To sum up, it is clear that EHR provides the fundamental infrastructure required to enable the effective use of healthcare information and effective information management through tools such as care planning and computer-based decision support. While the benefits of EHRs are clear, these challenges are clear as well. As such, there is a need for involvement by the private sector and the government in overcoming the challenges to ensure that EHR helps in the attainment of healthcare goals.

9.6 Centralized vs. Distributed Approach in Implementing EHRs

As mentioned before, EHRs refer to the use of ICTs and database management to capture code and disseminate health information in electronic form for the main purpose of improving healthcare provision. It offers information on a patient concerning previous

conditions, tests carried out and results and other background information. The database can be presented as a centralized system or a distributed system (Jha *et al.*, 2009).

A centralized system is designed in such a way that medical practitioners submit information concerning their clients to a central database that can be accessed by both clients and medical personnel. In theory, complications that result when conducting research through multiple data holders are abated. Countries such as Australia that have a centralized EHR do not allow the posting of identification information of patients (Gunter & Terry, 2005). Even so, the main concerns in this model are proprietary, security, legal, operational and patient privacy concerns. It is possible to reverse-engineer the information to gain knowledge of the patient. Due to these limitations, Australia allows for a partial generation of a longitudinal record. The patients, together with their healthcare providers, have the obligation to determine what is sent to the central data base, HealthConnect.

The other alternative is using a more distributed research network. It permits the access of information and evaluation across multiple databases. Data is stored within the in-house information system of the health institution that has created them (Mason, 2012). Security of client information is more protected as each data holder controls their protected data and all its uses. The data from each of the data holders is required to be in a similar model that provides for same data naming conventions, data storage formats and data definitions. This will ease data access and research done on multiple networks. New Zealand adopted this approach in 2009 to establish a distributed patient-centred EHR system to ensure safe sharing and transfer of electronic health information of patients. The country already had a national unique patient identifier, which made it better placed to transcend into the distributed EHR system.

In England, for example, the architecture is based on the separation of EHR systems into local EHR system (used by one healthcare setting) and shared systems. There are two levels of the EHR system; Summary Care Record (SCR) and the Detailed Care Record (DCR). The SCR is accessible anywhere in England and contains a summary of health record without contact information that will assist in accident and emergency care. The DCR gives more detailed information concerning the health of an individual to provide detailed health information for daily clinical practice and can only be accessed within a

locally identified healthcare community. There is strict security and confidentiality in accessing these resources (Ge, Paige & McDermid, 2009).

The United States' EHR model is adopting a national approach. In 1996, the Health Insurance Portability Act (HIPAA) was passed in order to lay a foundation against threats to a centralized EHR system. However, this has not adequately addressed concerns over threats of the information stored in a central repository. Such threats include:

- Human threats E.g., Hackers and employees
- Natural and environmental threats
- Technological failures, such as a system crash.

The IOM and the National Committee on Vital and Health Statistics (NCVHS) are the two organs responsible for implementing the technical aspects of EHR in the US. The main components of the project are the construction of a national health information infrastructure and to set up data interoperability and comparability for the safety of data (National Committee on Vital and Health Statistics, 2008). The major challenge is not to construct the infrastructure but to design a data interoperability and comparability system that will ensure patient data safety. The architects tasked with the responsibility of the national EHR model in the US are focused on designing foolproof architecture to protect patient data. They recommend that this can be done through adopting a core standardized EHR set of terminologies. The problem with this system is that patient autonomy is jeopardized since the patient is not in control of what is posted and what is not. Furthermore, Jacob M. Appel, New York University Professor, argues that the information will have to be accessible to over twelve million people. This opens up doors of abuse of information. The proposed solutions are not only difficult to put in place; they also have prohibitive costs that must be borne by the tax payer (National Association for Health Professionals, 2011).

Both distributed and centralized EHR systems face similar challenges including cost, organization size and government policies.

9.7 Critical Success Factors in Implementing EHRs

The EHR has received great recognition from both healthcare professionals and the public in entirety. With the current competitive trends in the healthcare sector, EHRs are set to face momentous growth in the future. The success of EHRs implementation in the healthcare sector depends on various salient factors.

Having the right organizational leadership in the various healthcare delivery centres is a primary and fundamental success factor in EHR's implementation (Merrill, 2010). Leaders in healthcare need to prioritize technology in healthcare and adopt the right channels for engaging all members in the particular healthcare organizations in conceptualizing and integrating technology within the establishments. In so doing, leaders in the healthcare sector and centres in particular should employ a top-down strategy in the introduction and implementation process of the EHRs. Glaser (2009) adds that members in the particular healthcare organization should receive adequate information on the priorities of the individual organization in implementing EHRs. This will help in reducing and managing resistance and ensuring that the participants assume their respective roles.

Vision sharing is another success factor requiring consideration in the implementation of EHRs in a healthcare establishment. Healthcare organizations should define clear visions and ensure that everyone involved is fully aware of the vision and goals of such a project (Wegener & Woodman, 2004). The goals should be measureable, realistic and meaningful as far as the EHRs technology is concerned. An example of the vision relevant to the successful implementation of the EHRs technology in healthcare sectors is ensuring safety and professional care to all patients. This vision will become possible only when patients' health records are safe and protected from corruption and sabotage. In order to achieve the intended vision for implementing an EHR system, healthcare organizations need to organize vision sessions to collect ideas of every stakeholder concerning the progress and potential of the technology in improving services. According to MacKinnon and Wasserman (2009), vision sessions will also help in collecting ideological views on areas requiring improvements. Generally, vision sharing has the potential of motivating and ensuring participation of all stakeholders in the implementation process.

According to Walker, Bieber and Richards (2006), rightful culture in the healthcare organization is another success factor in the implementation of EHRs. Rightful organizational culture entails readiness to change and adopt upcoming positive technologies. In addition, right cultures in an organization involve the ability to avail right resources, training and education to the stakeholders. From those perspectives, successful implementation of the EHRs in the healthcare sector will only become possible when individual healthcare organizations are ready to provide other incentives necessary machines, training and education to the healthcare practitioners. Furthermore, the individual healthcare organizations must be ready to accommodate and support innovations destined to enhance the use of EHR technology by the stakeholders (HIMSS, 2010). Moreover, successful implementation of EHR technology is dependent upon the level of tolerance in the individual healthcare centres towards the opposing stakeholders and offer relevant information to unify the team.

Another factor that needs consideration in ensuring successful implementation of EHRs is communication. As outlined by Glaser (2009), individual healthcare organizations need to identify and establish proper communication channel and structure to help in the management and sharing of ideas among stakeholders. The management of the individual healthcare organization has to schedule meetings with the staff to communicate and consult on the workflow, performance and effectiveness of the EHRs technology in accomplishing duties. A similar structure of communication is essential between the organization and the patients, as it helps in the collection of data concerning the relevance of the EHRs technology to the patients (HIMSS, 2010). Such data can help in improving service delivery and restructuring of the organization to ensure the ultimate and rightful implementation of the technology. Transparent and honest communication among the stakeholders in the healthcare centres will also help in averting rumours and hearsays that may cause resistance and ruin the entire process of implementation.

Since the EHR is a new system in healthcare sector, workflow redesign is a contributory factor towards successful implementation of the technology. Healthcare organizations need to create comprehensive and clear workflows to suit the infused EHRs technology in service delivery. The redesigned workflow should be known to all the stakeholders including care providers and patients. Workflow redesign as a way of achieving successful

implementation of the EHRs will ensure total attendance and complete service delivery to the individual patients, as well as reducing backlog of activities (Walker, Bieber & Richards, 2006).

As depicted by Shoniregun, Dube and Mtenzi (2010), initial education and perhaps training defines another factor dictating successful implementation of EHRs. Yet-to-be healthcare providers who are under training need to get additional education and training in information technology. This will help them infuse well in the digital world of healthcare and contribute towards implementation of EHRs technology. Acting healthcare providers also need to attend regular seminars to get notification about any improvement or different but viable approach that can help in achieving successful implementation of EHR technology (Gans, Kralewski, Hammons & Dowd, 2005). Furthermore, public awareness about the existence, use and access to the EHRs is also necessary in achieving successful implementation of the technology. Public education about IT will enable individuals to access their health records and information online without necessarily having to move to the individual healthcare centres. Realistic timelines and expectations by the management of individual healthcare organizations is a necessity in ensuring successful implementation of EHR technology.

Overall, EHRs define one of the positive aspects attributed to advancing technology in healthcare sector. EHRs have eased file and data storage in the field of healthcare. In spite of the many benefits linked to the EHRs, its implementation has remained to be the most challenging issue. To ensure successful implementation of EHRs in the healthcare sector, leadership, organization structure, goals, objectives, visions, communication, organization culture, level of education and training, among others, requires consideration. Essentially, leadership remains the central factor that dictates all other factors. Leadership in healthcare organizations defines goals and priorities as well as visions and direction taken by a given organization towards implementation of EHRs. Another very important factor in ensuring successful implementation of EHRs is education and level of training. When healthcare practitioners obtain more education in IT during their training, they will provide the required forces in achieving successful implementation of the technology. In addition, public education and awareness concerning the emerging technology will have great influence and impact on successful implementation of EHRs.

9.8 Lessons for Developing Countries, Saudi Arabia

Countries across the world have implemented the EHR but with varying rate of successes. This study shows that developed countries such as the UK, Australia, and New Zealand have recorded remarkable success in implementation of EHRs, compared to developing countries. This scenario has been attributed to a number of factors such as relatively more resources allocated to EHR systems in developed countries and the approach used in implementation (Iakovidis, 2001). Since effective implementation of EHR is crucial in ensuring that the objectives of EHRs, as well as those of the healthcare industry, are achieved, developing countries should learn the best practices from the developed countries.

Developed countries have committed to changing the work processes to be in tandem with the EHR systems; they have insisted that all relevant stakeholders and, particularly physicians, use the computers; they have included the physicians at all stages of implementation; they have designed EHR system in such a way that everyone, including ordinary people, knows how the system works; and they have constantly added additional functionality to the system where they deem necessary. Inadequate focus on these aspects (of course among other factors) by developing countries is what has hampered effective implementation of EHRs. The developed countries have attained their present status of healthcare informatics by focusing largely on these aspects, as well as other aspects that are instrumental in EHR implementation (Iakovidis, 2000).

Saleem (2009) argues that the present healthcare informatics state of the developed countries has been achieved by gradually developing the EHR technology over time. He also argues that they have actively developed the social values and culture for information systems to thrive. Saleem therefore advises that the developing countries ought not to re-invent the wheel but rather to share and contribute to the new global village achievements. They can achieve success in this endeavour by learning some vital lessons from developed countries such as the UK, Australia, and New Zealand. From the UK, developing countries can learn how to develop the information system standards which healthcare facilities and vendors should meet. These standards will ensure that the EHR systems are compatible and meet the organizational requirements. Also, developing countries can learn from the UK

how to develop EHR step by step, to make the costs more bearable and aid the contribution of the private sector (Saleem, 2009).

Australia has recorded remarkable success in working towards ensuring that all of its citizens are in the EHR. One of the main challenges that has been cited to hamper implementation of EHR in developing countries is limited coverage of citizens in the EHR system (Grimson, 2001). Therefore, important lessons can be learnt from Australia on how to achieve widened or whole coverage of citizens in these countries. Australia has attained an increased uptake of citizens into EHR system through various initiatives: enhancing the participation of remote indigenous communities; increasing accessibility to computers; training of more clinicians on the operation of EHR systems; providing learning and training sessions for patients; and development of privacy and security legislation that is widely accepted (Berg, 2001). Developing countries should include these initiatives in the implementation of EHR programmes.

Just like Australia, New Zealand is considered to be one of the countries that are on the verge of making vital breakthroughs in healthcare reforms, particularly in respect to EHR systems (Mason, 2012). New Zealand has made crucial progress in critical areas that are central to the implementation of EHR programme; it has enacted privacy legislation and made provision for unique patient identifiers. The National Health Index (NHI) of 1977, the New Zealand Health Privacy Code of 1994 and the New Zealand Privacy Act have particular policies that are important in implementation of EHR (Heeks et al, 1999). From this, developing countries should learn that it is important that they come up with initiatives and legislations that can support implementation of EHR.

Chapter 10

Conclusions

The healthcare sector across the world has witnessed remarkable transformation and improvement towards enhanced delivery of quality service. Many of these improvements can be attributed to the rapid advancement in the information technology, which has seen the introduction of digital EHRs in file management, record keeping and diagnosis of diseases.

Five countries were studied in this research regarding EHR implementation and operation. Four of them are high-income developed countries, the US, UK, Australia and New Zealand, while one is a developing country, Saudi Arabia. By developing a comparison across these four developed countries, EHR's use, benefits, challenges, and success factors were identified. Further, the comparison illustrated lessons that developing countries like Saudi Arabia should consider when implementing EHRs.

Across the four developed countries, it was found that there is almost universal use of EHRs among GPs in the ambulatory settings except for the US which is lagging behind. The lack of encouragement or requirements imposing the use of computers in medical practises was among identified as factors slowing EHR implementation in the US. Although, there is no good data in the implementation of EHRs in hospitals, its use among hospitals remains uncommon. This was attributed to the little attention that has been given by policy makers in these countries to its adoption in hospitals. The four developed countries are following different approaches in developing a national EHR system, centralised or distributed. It should be noted that, New Zealand is well placed in developing a distributed patient-centred EHR system as a result of having an established NHI. The others are separating EHR implementation into local and centralised databases. In, the UK and Australia, the centralised EHR contains only a summary of patient health records in order to provide more protection to patient privacy, while it imports semantically similar data to that in the local system in the US.

EHRs represent promising tools in providing various benefits to clinicians, healthcare managers, and patients. Some of these identified benefits are improving communication between physicians, reducing clinical errors, reducing billing errors, enhancing the quality of care and improving patient safety. However, its implementation has remained to be the most challenging issue. Confidentiality, privacy, security, lack of standards, start-up cost and content of discharge summary are some of the barriers and challenges hindering implementation of EHRs. To ensure successful implementation of EHRs in the healthcare sector, leadership, organization structure, goals, visions, communication, organization culture, workflow redesign, level of education and training, among others, requires consideration.

In Saudi Arabia, the move towards EHR implementation already has been under way in many hospitals such as the KFSH & RC, National Guard Health Affairs, university hospitals and medical services of the army forces. While EHR implementation is moving slowly in the MOH hospitals, there are several information systems operating in the regional directories and in central hospitals. However, these systems are not connected with each other or integrated with other healthcare sectors. A good example of EHR implementation in the country has been achieved at KAMC which received the QuadraMed Corporation's award of Prestigious Excellence in EHRs.

This lack of usage of EHR systems among healthcare sectors in Saudi Arabia is related to factors such as financing and expenditure, accessibility to healthcare services, health workforce, and development of e-health strategies and national health information system. The Ministry of Health of Saudi Arabia is aware of the potential benefits that EHRs can provide to enhance the delivery of healthcare in the country. Therefore, the implementation of EHRs has been put as a priority in the national e-health strategy. Saudi Arabia and other developing countries should learn the best practices from the developed countries in implementing EHRs. Some of the lessons that should be learned are how to develop information system standards, how to manage the costs of EHRs, how to enhance the participation of remote communities, and how to protect patient privacy and confidentiality. This thesis has some limitations. The scope of this study was limited to only one developing country among four developed countries. It would be more interesting to see the gaps between developing countries in implementing EHRs and the kind of challenges they

share in this regard. Also, due to the deviation in the literature in determining EHR's essential clinical functions, this study relied heavily on one source of information, CMWF surveys, to compare EHRs use in the four developed countries. As this study only relied on data obtained from primary and secondary research, there was also lack of data in the awareness of such technologies among people in Saudi Arabia. Therefore, it is of much interest to conduct an empirical study to investigate and observe Saudi people, patients, clinicians and healthcare managers, awareness of such technologies and their attitudes towards the implementation of EHRs in Saudi Arabia. This is particularly important, as their contribution represents one of the main success factors to its implementation.

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