

# Electronic-health in Saudi Arabia

*Just around the corner?*

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## ABSTRACT

لقد شهد القطاع الصحي في المملكة العربية السعودية تطورا مذهلا خلال العقود القليلة الماضية مما مكن العديد من المستشفيات السعودية الحصول على سمعة عالمية. إلا أن ذلك وللأسف لم يترافق مع تطور في استخدام تقنية المعلوماتية الصحية أو الصحة الإلكترونية والتي أصبح استخدامها ضرورة للمستشفيات لتحقيق عدة أهداف منها زيادة الجودة الصحية وتقليل الوقت والتكلفة لعمل ذلك. وفي هذه الورقة سوف يتم استعراض للصحة الإلكترونية في العالم وفي المملكة إضافة إلى بعض المبادرات الوطنية في هذا المجال. كما تتضمن الورقة نموذج مقترح لتطبيق مشروع الصحة الإلكترونية في المملكة.

The Saudi health sector has witnessed significant progress in recent decades with some local hospitals receiving international recognition. However, this has not been accompanied by advancement of the electronic-health (e-health) field, whose applications have become a necessity for hospitals to achieve certain objectives such as enhancing the quality of healthcare, and reducing the time and cost for healthcare delivery. In this paper we investigate the advancement of e-health in the world and in Saudi Arabia. A new model for e-health diffusion in Saudi Arabia is also proposed.

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Between 44,000 and 98,000 Americans die each year as a result of medical errors that could have been prevented, according to the Institute of Medicine report (IOM).<sup>1</sup> Beyond their cost in human lives, preventable errors also result in an estimated total cost of between \$17 billion and \$29 billion per year in US hospitals. Medical errors are also costly in terms of loss of trust in the healthcare system by patients. One of the IOM report's main conclusions is that medical errors are commonly caused by faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them. In response to the IOM shocking report, some healthcare organizations embarked on information and communication technology (ICT) to improve outcomes, reduce medication errors, increase healthcare efficiency, and eliminate unnecessary costs.<sup>2</sup> Information technology (IT) in healthcare has expanded steadily from primarily administration and financial oriented to more and more clinically oriented systems. However, despite their knowledge, investments, and best intentions, most health organizations have not realized a return on their investments.<sup>3</sup> One probable reason for this problem is that the key users, including physicians and nurses, are not using the technology to its greatest potential or, in too many cases, have not begun to use the technology at all. There are several definitions for electronic-health (e-health), however in this paper we use the Eysenbach's definition:<sup>4</sup> "e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology".

As healthcare is getting more and more complex with more healthcare givers involved in patients' health, paper-based patients' charts cannot keep clinicians completely informed. Paper records can only be in one

place at a time, and thus cannot be shared between 2 or more health specialists at different locations simultaneously, which has a negative impact on optimization of information management in healthcare and as a consequence reduce productivity and quality of care provided. Therefore, records must be available in an electronic format so that health specialists can easily access and review patient's history, including allergies, medication, investigation, and laboratory tests performed. Consequently, healthcare organizations have started seeking e-health solutions that can automate and integrate business processes, enable information sharing across the organization and between different organizations, enhance services to patients, and ensure security and privacy of patient information. Nevertheless, e-health is of an importance for the following reasons: most hospitals and medical centers still record patient information on paper; the amount of health information is increasing; most of the existing information systems are of administrative nature rather than patient-care focus; most healthcare systems have historically organized the delivery of healthcare around institutions and not around patients, it is believed that e-health will enhance quality and patient safety.

The main purpose of this paper is to investigate the recent evolution of e-health in the world and in Saudi Arabia. We discuss some of the potential benefits of e-health as well as the key barriers to e-health adoption. We introduce the international status of e-health, the current situation of e-health in Saudi Arabia, and some Saudi e-health initiatives. We also present a new model for successful e-health adoption and implementation.

### **1. Saudi health system. Saudi Arabia country profile.**

The Kingdom of Saudi Arabia means different things to different people. For millions of followers of Islam across the world, it is the ultimate Holy Land and pilgrimage destination. For a large number of expatriates from Asia, Europe, and the United States (US), it is a land of opportunities. On September 23, 1932, King Abdulaziz Al-Saud laid the foundation of the modern Kingdom of Saudi Arabia. Large reserves of oil were discovered soon after, and within a span of 6 years, commercial production of oil began. The fortune of Saudi Arabia changed forever and the Kingdom rapidly moved on the path of a modern industrial state. Today, Saudi Arabia is the world's 25th exporter/importer, with a foreign trade of US \$78 billion.<sup>5</sup> In all these years, the Kingdom has displayed remarkable political and economic stability.<sup>5</sup> Saudi Arabia, about one-fourth the size of the US is spread over 2,150,000 square kilometers and located in the southwest corner of Asia. The total population as of September 2004 was 22.7 million with an annual growth rate at 3.24%.<sup>5</sup>

**2. Healthcare in Saudi Arabia.** Over the past 3 decades, the government of Saudi Arabia has spent billions of Riyals to develop and improve the quality of healthcare, and expands its coverage. This has resulted in an increase in the numbers of both government and private hospitals and medical centers. Major hospitals provide all sorts of sophisticated treatments including open-heart surgery, kidney transplants and cancer therapy.<sup>5</sup> Approximately 11,350 doctors, nurses, and other medical personnel, including the Saudi Red Crescent Society, provide medical service to the millions of people who visit the Kingdom for the annual pilgrimage of Hajj. Immunization against tuberculosis, polio, hepatitis, and tetanus is freely available. Medical insurance schemes are available at reasonable cost. Due to this rapid expansion, healthcare providers in Saudi Arabia have varied. While the ministry of health provides around 60% of the healthcare services, the remaining portion is provided by other government bodies such as the National Guard, the Ministry of Defense and Aviation, the Ministry of Interior, the University hospitals, and rapidly growing private sector. This variation of health service providers has led to variations in the way the healthcare facilities are administered and managed with significant variation in the information systems used. As a result, patient information/record has become scattered in different healthcare facilities without a provider having the complete patient record except in very rare cases where the patient chooses to receive healthcare from one provider at all times. One additional negative impact of varied healthcare systems is the great waste of efforts and money resulting from treating patients repeatedly for the same health problems in several medical centers. Patients may at times be asked to repeat x-rays and other laboratory tests, and may be given different medications which may compromise patient's safety.

### **3. E-health benefits, barriers, and key applications.**

**3.1. Potential benefits of e-health.** One of the most important e-health benefits is the enhanced patient access to comprehensive and credible health information and knowledge, which will enhance the quality of care. The e-health becomes a conduit for improved and faster sharing of health records. Such sharing of information may result in a lower chronic disease management costs, lower medication costs, and lower wellness program costs. Additionally, e-health helps prevent prescribing errors resulting from clerical mistakes.

**Benefits to physicians.** Physicians' orders are placed electronically, which prevents wrong interpretations of handwritten orders. Physicians will have full control over the ordering process benefiting from the real-time alerts (drug-drug, drug-food, or allergy), which enhances the quality of healthcare. The e-health helps reduce the time of locating and reading patient charts.

**Benefits to ancillary departments (pharmacy, laboratory, radiology, nursing, and others).** Resources in ancillary departments will be freed up from administrative tasks and hence have more time to provide higher care value and improve regulatory compliance measures. Pharmacists and nurses now spend much less time entering orders and spend more time in clinical care. The e-health will reduce the amount of time spent on phone calls to physicians to enquire about and verify the orders.

**Benefits to patients.** The e-health plays an important role in improving medication safety. It prevents medication error resulting from handwritten orders. It enhances interdisciplinary communication towards patient health.

**Benefits to management.** E-health helps move information instantly around the organization, reducing turnaround time for medication delivery, obtaining and processing lab work, scheduling and completing radiology exams, and other tasks. It helps standardize the healthcare process. At the national level, health data, information, and knowledge from several health centers can be combined to support public health research.

**3.2. Barriers to E-health.** In spite of the great potential benefits of e-health, there are some barriers to e-health diffusion. Various study researches highlighted several barriers to innovation.<sup>6-8</sup> The adoption and implementation of a complex IT solution is influenced by the organization's ability to lower or remove the various knowledge barriers. Knowledge barriers associated with the adoption of larger-scale IT solutions, such as e-health, can be categorized into 4 categories: project/economic barrier, technical barriers, organization barriers, and behavior barriers.<sup>9</sup> *a) Project/economic barriers.* This category is concerned with the financing and project management issues faced when acquiring innovation. *b) Technological barriers.* This category is concerned with the lack of knowledge required to carry out technical tasks needed to adopt new innovations. This includes the lack of interoperability and the lack of existing regional information networks. *c) Organizational barriers.* This category is concerned with the difficulties of deploying a new technology into existing practices and processes. This includes privacy concerns and the lack of consistent national information standards and code sets. *d) Behavior barriers.* This group is concerned with the resistance to change among individuals affected by the implementation. It is also concerned with organizational power dynamics. It includes also the concerns on physicians' usage.

**3.3. Critical success factors to e-health diffusion.** In order to increase the likelihood of successful implementation of e-health applications, organizations should consider certain critical success factors. In May 2001, 13 e-health experts from around the world gathered

at a 2-day conference for the purpose of developing recommendations for Computerized Physician Order Entry (CPOE) system implementation.<sup>10</sup> A list of high-level considerations was generated to benefit organizations thinking about implementing CPOE, and possibly other e-health applications, as follows: motivation for implementing the solution, vision/leadership/people, costs, integration/workflow/health care processes, value to users/decision support systems, technical considerations, management of project, training/support/help at the elbow, and learning/evaluation/improvement.

**3.4. Key e-health technologies.** *Electronic medical record (EMR)* is an electronic health care information record that stores patient information with full interoperability within a health enterprise. It helps connect the work produced by different medical and technical departments. All services rendered to the patient will be stored in the patient record, which secures a more integrated and harmonious interaction between the hospital departments with a view to providing an excellent health service. The EMR consists of the following:<sup>2</sup> patient management system that is used for making appointments, bed management, and patient follow-up while hospitalized. Pharmacy management system that helps in managing drugs automatically and notifying physicians of possible negative chemical complications of some drugs prescribed. Many manual tasks at the pharmacy will be automated, which will help make the pharmacist totally devoted to clinical work. A laboratory information system that manages laboratory requests and stores their results automatically in the electronic health record. Radiology information system that manages radiology requests and stores the results in the electronic health record. Billing and insurance system that helps issue bills and finalize cost accounts of medical services rendered to the patients. Staff scheduling system that manages scheduling for physicians and clinical teams.

*Computerized physician order entry* is a process of electronic entry of physician's orders and instructions for the treatment of patients. These orders are communicated over an EMR to the medical staff (nurses, therapists, or other physicians) or to the departments (pharmacy, laboratory, or radiology) responsible for fulfilling/documenting the order. This system is not a technology, rather it is a workflow design (or redesign) of clinical processes that integrates technology to optimize physician ordering of medications, laboratory tests, and so forth.<sup>11</sup> It uses clinical decision support systems and links to hospital systems to generate prompts and alerts during the ordering session to notify of potential errors such as contra-indicated medications, or routes, or duplicate orders. Integration with other hospital information technology systems including electronic

patient records, pharmacy, laboratory, and other services provides the physicians with all the information necessary to develop and transmit an effective, error-free order.<sup>12</sup>

**Telemedicine** is a technology that allows physicians to provide healthcare at distance through advanced electronic communications systems. Treatment here involves remote examination, automated forwarding of examinations and analyses' results, exchanging expertise, conducting operations, and other medical applications. These medical applications make use of computer and communications systems in transferring medical information to other locations for remote diagnosis. Research works in this field succeed with the advancement of using robots in surgical operations. Surgeons can use a robot in conducting an operation in another city. This service can be greatly utilized in the Kingdom of Saudi Arabia due to the vast area of the country and the existence of a large number of villages.

**Multipurpose smart card.** It is a card that contains an integrated circuit to store, retrieve, and transfer data. This card services many purposes worldwide. However, its official use in the Kingdom is only confined to commercial purposes. Some countries have already made use of the smart card for health purposes where certain health information elements extracted from the citizens' electronic health record are added to the card.

**Picture archiving and communication systems (PACS).** This system aims to replace manual medical imaging systems that depend on radiological films with a digital system that enables more than one physician to examine digital images through a computer network. This overcomes the problem of lost images, which reduces the cost of taking images for the second time. It normally contains advanced systems to control the image's coordinates, which facilitates easy examination and reference. The low price of digital storing systems led to the decrease in the price of PACS, which consequently made this technology quite popular in a large number of hospitals.

**Electronic health record (EHR).** This is a nationwide system that serves the health sector in terms of presenting the patient's information electronically, which gives way to deduce personal and public information, and provide information for decision support and performance quality. The electronic health record requires wide networks to share health information. Public health is the leading field in using this technology with a view to achieving 2 main goals: linking health organizations inside and outside their geographical spheres, and activating interaction lines among patients, physicians, healthcare providers, and health planners.

#### 4. International trends of e-health.

**4.1. Australia.** One of the great e-health experiences, so far, is the Australian national electronic health

record implementation project. The project is called HealthConnect, and began operation in 2002. The basic model is to extract summary information from locally collected patient data, which is aggregated to create a centralized record that may be shared among health institutions and authorities. The program is a joint initiative among Australian, State, and Territory Governments.<sup>13</sup> It is estimated that the program will save Australian \$300 million per year by reducing errors and duplication of efforts. Enrolment in the program is voluntary in which patients, and their health providers, choose which elements from patients' records may be extracted and transmitted to the HealthConnect record which can be added to or updated by the providers with the consent of patients.

**4.2. Canada.** Along with the technology advances, Canada initiated a major initiative for e-health and EHR and is considered one of the leaders in that field. This has been considered seriously since 1997 when the Minister of Health established the Advisory council on Health Infrastructure. In 1999, the council released the final report: "Canada Health Infoway: Paths to Better Health". As a result, the Canadian government established an independent, not-for-profit corporation called Canada Health Infoway with a mandate of accelerating the adoption of interoperable EHR across Canada. The corporation became operational in early 2002, with a total capital budget of \$1.2 billion (CDN) from the federal government.<sup>14</sup> Infoway has embraced a plan with a core objective of providing electronic health records to half of the Canadian population by 2010. These records will include patient information and provider registries that include diagnostic images, laboratory test results, medication profiles, hospital clinical reports, immunization history, and public health data.

**4.3. United States.** Since the 1999 report on medical errors from the Institute of Medicine,<sup>1</sup> health care organization have been alerted on the financial and health risks associated with paper-based medical records. Therefore, they established the Office of National Coordinator (ONC) to call for action and launch strategic framework.<sup>15</sup> By July 2004, the ONC outlined 12 strategies to achieve the main goal. According to the study, only 17% of clinics applied the EMR. The main goals of the study are to inform clinical practice by bringing EHRs directly into clinical practice; interconnect clinicians in order to allow information to be portable and move with citizens from one point of care to another; personalize care in order to help to individuals manage their own wellness; and improve population health.

**4.4. European countries.** Most European countries are advanced in using electronic medical records. The countries with the largest proportions of general

practitioners using EMR are Sweden (90%), the Netherlands (88%), Denmark (62%), United Kingdom (UK) (58%), Finland (56%), and Austria (55%).<sup>16</sup> The National Health Service (NHS) in the UK, which established the effort since 1948, has conducted wide pilot programs of EHRs and patient held electronic records over 2 years. By April 2005, it became responsible as a guide toward the country's EHR initiative to access the national electronic patient record (EPR) within the next 10 years over 300 hospitals in England, and connecting the patients to this service. The EPR will provide support for clinical and administrative tasks and track clinical pathways according to patients' conditions.<sup>17</sup>

**4.5. World Health Organization (WHO) e-health resolution.** In its 58th World Health Assembly, in May 2005 with its 28th resolution,<sup>18</sup> WHO urges its members to consider drawing up a long-term strategic plan, develop the infrastructure for information and communication technologies, build closer collaboration with the private and non-profit health sectors, endeavor to reach communities, mobilize collaboration for determining evidence-based e-health standards, establish centers of excellence for e-health best practice, and establish national public-health information systems.

**5. Current situation of e-health in Saudi Arabia.** In recognition of the vital role played by information and communications technology, Saudi healthcare providers and health stakeholders have been increasingly relying on advanced systems of information and communications technology. Unfortunately, this has not been accompanied by a coordinated effort to set up a unified national network and repertoire for the health records. There are a large number of different health information systems independently in use particularly in the big regional hospitals without being connected to each other.

**5.1. Ministry of Health (MOH).** There are strenuous efforts to connect MOH hospitals. However, this objective is yet to be achieved due to the lack of proper funds. Most of the MOH hospitals lack information and communication infrastructure. The individual efforts exerted to promote some minor systems are limited in use because they have not been based on a clear policy of information technology. These systems are based on different sources, which make it difficult to be connected. The Ministry has recently launched a project whose aim is to build a central national database for the electronic health records, which may link hospitals in the Kingdom to ensure the flow of data and transfer of electronic health records and build a system for a national electronic healthcare.

**5.2. The private sector.** The private sector is divided into 2 categories: medium to large size hospitals and small clinics. Large private hospitals have some

information systems that lay more emphasis on the financial applications such as billing systems. These systems are acquired from different sources and have no links with other agencies such as the MOH or insurance companies. Meanwhile, the majority of the small clinics and private pharmacies lack the minimum requirements of information technology.

**5.3. King Faisal Specialist Hospital & Research Centre (KFSH & RC).** Since their inception in 1975, KFSH & RC has applied the latest IT. The hospital has introduced internet technology and telemedicine since 1993 as it has had an advanced network of visual fibers that exceed 5,000 points. More than 12 MOH hospitals have joined the telemedicine network. The hospital is currently developing its e-health programs by implementing commercial systems. It has implemented the enterprise resource planning (ERP) system, EMR, CPOE, PACS, and a new health portal.

**5.4. The National Guard Health Affairs (NGHA).** The NGHA have installed advanced computer networks in all its hospitals that exceed 20,000 points. Four hospitals and 60 clinics are interconnected via a wide area network. The NGHA hospitals enjoy the same level of automation as in KFSH & RC. It has implemented the ERP system, EMR, CPOE, PACS, Cardiac PACS, and one of the latest health portals.

**5.5. Medical services of the Armed Forces.** The medical services rendered by the Armed Forces come after the MOH in terms of the number of hospitals. Some hospitals have computer networks while others do not. Some of the health systems available are derived from different sources and not integrated. The medical services at the Armed Forces are currently developing a strategy that secures comprehensive and common health systems for all the Armed Forces hospitals.

**5.6. Security Forces Hospital (SFH).** The SFH has an integrated information and communication infrastructure. The health information systems (HIS) available at the SFH are integrated, and serve the medical and administrative sides.

**5.7. University Hospitals.** The university hospitals enjoy information infrastructure within each hospital, however they are not connected to each other. The applied HIS are derived from different sources, and serve the medical and administrative sides.

**5.8. Medical insurance.** A number of insurance companies have been officially licensed. This requires a health information network that joins hospitals with insurance companies.

**6. E-health initiatives in Saudi Arabia.**  
**6.1. Health Informatics Master Program at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS).** The KSAU-HS is a newly founded university established in 2004 and specializes in health sciences studies. The university offers a Masters Program in

Health Informatics which is the first of its kind in the Middle East.<sup>19</sup> The mission of the program is to advance the quality and efficiency of the Saudi healthcare system through improved information management. The program is aimed to provide scientific education that includes theory, specialized knowledge, and practical skills in e-health. The 2-year program is designed based on the recommendations of International Medical Informatics Association on Education in Health and Medical Informatics. The program is a more of Applied Health Informatics, which emphasizes the need for health informatics specialists to deploy ICT to support health systems. The program targets health professionals such as physicians, nurses, pharmacists, and other health specialists in addition to IT professionals working in health sectors. The Masters program is a dedicated full time 2-year program. It is organized in modules (courses) consisting of 3 hours of lectures per week excluding the time spent for exercises, seminars, and practicums. It requires a minimum of 14 courses totaling 42 semester credit hours of course work. The program of study includes a variety of graduate level foundation courses, health informatics courses, computer science courses, and health management courses. The program started in September 2005 with a group of 25 students (16 female and 9 male). The group came from different education backgrounds including medicine, health, IT, and biomedical engineering. The group also came from different health organizations such as the National Guard, the Ministry of Defense and Aviation, the Ministry of Interior, University hospitals, and private hospitals. Twenty more students were accepted in the following year.

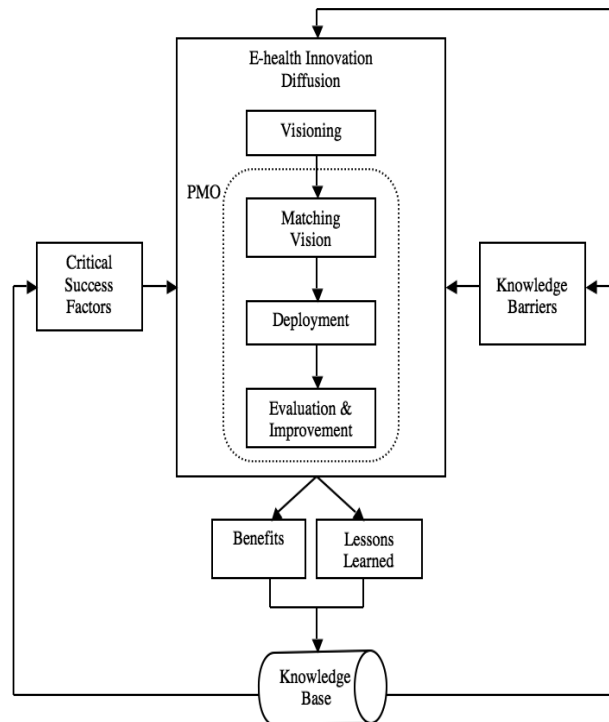
### **6.2. Saudi Association for Health Informatics (SAHI).**

The SAHI was established in 2005 under the direct supervision of KSAU-HS. The association practices its activities in promoting theoretical and applied sciences and rendering consultations, studies, and general and special applications in accordance with the regulations of scientific associations in the Kingdom. The SAHI aims to develop and promote scientific thinking in the field of health informatics by holding symposia, seminars, and courses related to the field of health informatics; provide technical consultations in the field of health informatics, upgrade the professional and academic knowledge of members of the association by conducting studies, pamphlets, and scientific periodicals related to the field of health informatics; facilitate the exchange of academic endeavor and ideas in the field between the relevant institutions and organizations inside and outside the Kingdom; set general regulations of professional ethics; and act as an umbrella for health stakeholders to make use of the health informatics applications in the medical and research aspects.

**6.3. The Saudi e-health Conference 2006.** One of the activities of SAHI is the Saudi e-health conference which was held for 2 days (May 8-9 2006) in Riyadh, Saudi Arabia.<sup>21</sup> The main topics addressed in the conference were hospital information systems, picture archiving, and communications systems, enterprise resource planning for healthcare, emerging technologies in healthcare, and telemedicine and medical e-learning. The main recommendation of the conference emphasized the importance of building a national e-health strategy for the country. The highest priority recommendations made by the conference call for 1) building cadres specialized in the field of health informatics; 2) supporting the Saudi Association for Health Informatics; 3) establishing centers of excellence in health informatics in Saudi Arabia; 4) designing the specifications of the electronic health records; 5) expanding the telemedicine network in the country; and 6) building national registries for common diseases and epidemics.

**7. Proposed model for e-health diffusion in Saudi Arabia.** In this section, a new model for the adoption and implementation of e-health programs in Saudi Arabia is proposed. The model is based on the theory of diffusion of innovations,<sup>20</sup> the theory of barriers to innovation,<sup>6-8</sup> the studies of critical success factors,<sup>10</sup> and the advancement of project management theories. The model, shown in **Figure 1**, consists of 3 main components; the first component is concerned with the stages taken by organization to deploy e-health programs, which is in turned composed of 4 stages: visioning, matching vision, deployment, and evaluation and improvement. In visioning the phase, health organizations define the corporate mission, objectives, and strategy. This phase is mainly concerned with identifying and prioritizing the organizational problems and opportunities that form the basis of the need to acquire innovations.<sup>20</sup> Ideal strategy for e-health should aim to: 1) increase the efficiency and effectiveness of health organizations; 2) increase return on investment of health assets and resources; 3) focus on patient and provide better patient care that is continuous and integrated; and 4) provide secure access and support planning and quality management.

The second phase is concerned with the fit between a need identified in the first phase and the innovation (e-health application) proposed. In this stage, we should determine whether the innovation would at least solve one of the problems identified in the first phase. At the end of this phase, the organization decides whether or not to approve the innovation project. In the event that the project is approved, the third phase of the process, deployment, begins. This phase includes all decisions and actions related to the deployment of the innovation. It includes also the assimilation and the integration of the innovation within the organization. At the end of this phase, the e-health innovation solution is deployed



**Figure 1** - A proposed model for e-health diffusion.

within the organization. Evaluating performance is an important step for ensuring the quality of the innovation deployment. This phase emphasizes process flow optimization and continuous expansion of the system to gain a competitive advantage.

The second component deals with the main knowledge barriers to IT innovation diffusion as explained earlier in this paper. Organizations should address the knowledge barriers as follows: *Economic barriers*. These barriers should be addressed during the visioning phase of the first component as explained above. As the visioning phase is usually affected by the availability of funds. *Technical barriers*. These include the technical infrastructure readiness and have high impact on the deployment phase of the first component. *Organization barriers*. Organizations should address change management processes to align e-health with existing practices and processes. *Behavior barriers*. Organizations should address clinicians' resistance to e-health.

The third component is concerned with the critical success factors of e-health innovation deployment as suggested by various literatures.<sup>10</sup> Organizations should determine and consider factors that are critical to the success of e-health projects. Usually this is achieved by investigating other e-health programs experiences. Critical factors may have more influence on some phases of the implementation process. For example,

motivation for implantation, e-health vision, and cost/benefit factors have more influence on the visioning phase. However, the integration, values to users, project management, technology, and training factors has more influence on the deployment phase.

After the successful deployment of innovation, the list of benefits and lessons learned feeds a knowledge base which in turn feeds all 3 components described in the model. Knowledge sharing behaviors facilitate learning among project team members and enable them to resolve problems similar to situations encountered by others in the past, thus enabling more successful projects. The proposed model calls for the establishment of an e-health Program Management Office (PMO) to implement corporate strategy for e-health project management. The main goal of this office is to translate the organization's strategic plan into e-health projects and programs. The PMO is accountable for enterprise-wide distribution of project management best practices.

The main advantages of this model is the strategic alignment of projects, which bears on the synergy created by the management of relations between projects, and the ability to develop a better understanding of the challenges faced in carrying out information systems projects, the factors for success, and the strategies required to take advantage of IT. The acts of sharing are very important since a project's knowledge will have small impact on the organization unless it is made



available to other projects. Such learning organizations would be aware of the repeated knowledge barriers to innovation adoption, and a well-defined plan to address these barriers would be developed. Moreover, the knowledge base will help these organizations refine their strategies and prioritized plans. This allows for focusing on preparation for future projects, which is rarely covered in literature.

We conclude that over the past 4 decades, Saudi Arabia has spent billions of dollars in developing and improving the quality of healthcare and expanding its coverage in the country. Due to this rapid expansion, healthcare providers in Saudi Arabia have varied. This variation of health service providers has led to variations in the administration, financial management, and Information systems, which in turn led to a lack of a unified system for the health record. As a result, patient history is scattered amongst different healthcare providers with no one provider having the complete patient record except in very rare cases where the patient chooses to receive healthcare from one provider at all times. One additional negative impact of this problem is the great waste of efforts and money resulting from treating patients repeatedly for the same health problems in several medical centers. Patients may as a result be asked to repeat x-rays and other tests and may be given different medications, which may present patient safety threats.

There are already some initiatives with regard to e-health in Saudi Arabia such as the establishment of a new program in Health Informatics and the establishment of the SAHI. Moreover, an e-health conference was organized in 2006 to address e-health topics.<sup>21</sup> The conference presented some recommendations to promote e-health in Saudi Arabia; however the movement is still very slow. It is very important that the government should establish a national e-health program in order to realize some of the benefits promised by such program.

In this paper, a new model for the adoption of e-health is introduced. The model aim to develop a better understanding of the challenges faced in carrying out an e-health program.

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