Advancing Health Information Management in Saudi Arabia: Challenges and Opportunities

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ABSTRACT

The adoption of electronic health (e-health) solutions has become increasingly crucial for healthcare organizations to enhance patient care, reduce medical errors, and improve efficiency. However, despite substantial investments in e-health technologies, many healthcare providers have yet to realize meaningful returns due to underutilization by key users, such as physicians and nurses. This paper explores the recent advancements in e-health globally and within Saudi Arabia, examining the

potential benefits, key barriers to adoption, and a model for successful implementation. The Saudi healthcare system has undergone significant expansion over the past three decades, with diverse providers and variations in administration, management, and information systems. E-health offers numerous advantages, including enhanced access to comprehensive health information, faster sharing of health records, and improved medication safety. However, several barriers hinder e-health diffusion, including project/economic, technical, organizational, and behavioral challenges. Critical success factors for e-health implementation involve leadership, integration with workflows, decision support systems, and ongoing evaluation. Key e-health technologies discussed include electronic medical records, computerized physician order entry, telemedicine, and picture archiving and communication systems. The current e-health landscape in Saudi Arabia reveals a lack of coordinated efforts to establish a unified national health record network, with various independent health information systems employed across different healthcare sectors. Notably, some Saudi institutions have made significant progress in e-health implementation, while others face challenges related to infrastructure, resistance to change, and insufficient funding. This paper highlights the need for a comprehensive national e-health strategy to address these barriers and facilitate the successful adoption of e-health solutions in Saudi Arabia.

1. Introduction

Between 44,000 and 98,000 individuals in the United States lose their lives annually due to preventable medical errors, as reported by the Institute of Medicine (IOM) (Institute of Medicine (US) Committee on Quality of Health Care in America, 2000). In addition to the human cost, such errors result in financial losses estimated between $17 billion and $29 billion annually in U.S. hospitals. Medical errors also diminish patient trust in the healthcare system. One of the main conclusions of the IOM report is that medical errors often stem from flawed systems, processes, and conditions that facilitate mistakes or hinder their prevention. In response to this alarming report, some healthcare organizations have turned to information and communication technology (ICT) to enhance outcomes, reduce medication errors, improve healthcare efficiency, and eliminate unnecessary expenditures (Haux, 2006).

Over time, the role of information technology (IT) in healthcare has expanded significantly, transitioning from primarily administrative and financial applications to systems that are increasingly clinical in nature. However, despite the knowledge, investment, and efforts dedicated to these systems, many healthcare organizations have yet to see a meaningful return on their investments (Berger & Kichak, 2014). A potential reason for this challenge is the underutilization of technology by key users, such as physicians and nurses, or, in some cases, their complete lack of adoption of these technologies. There are numerous definitions of electronic health (e-health); for this paper, we adopt Eysenbach's definition: "e-health is an emerging field at 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, it represents not just a technical development but also a mindset, a way of thinking, and a commitment to networked, global thinking

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to improve healthcare locally, regionally, and worldwide through information and communication technology" (Eysenbach, 2011).

As healthcare becomes increasingly complex, involving more professionals in the care of a single patient, paper-based charts are insufficient for keeping clinicians fully informed. Paper records are limited to being in one location at a time, making simultaneous access by multiple specialists impossible, which negatively impacts the optimization of information management and reduces productivity and care quality. Consequently, electronic records are essential for health specialists to easily access and review a patient's history, including allergies, medications, investigations, and laboratory tests. As a result, healthcare organizations have begun pursuing e-health solutions to automate and integrate business processes, enable information sharing within and across organizations, enhance patient services, and ensure the security and privacy of patient information. E-health is critical for several reasons: many hospitals and medical centers still rely on paper for patient records, the volume of health information is growing, most existing information systems are administrative rather than patient-care-focused, and healthcare delivery has traditionally been organized around institutions rather than patients. It is anticipated that e-health will enhance quality and patient safety.

The primary aim of this paper is to explore the recent advancements in e-health globally and within Saudi Arabia. It examines the potential benefits of e-health, identifies key barriers to its adoption, and introduces a model for successful e-health implementation. Additionally, the paper discusses the global status of e-health, the current e-health landscape in Saudi Arabia, and some notable Saudi e-health initiatives.

1. Saudi Health System

Saudi Arabia is perceived differently by various groups worldwide. For millions of Muslims, it is the ultimate Holy Land and pilgrimage destination. For many expatriates from Asia, Europe, and the United States, it is a land of opportunity. The modern Kingdom of Saudi Arabia was established on September 23, 1932, by King Abdulaziz Al-Saud. Shortly thereafter, significant oil reserves were discovered, and within six years, commercial oil production began, transforming Saudi Arabia's fortune and propelling it towards becoming a modern industrial state. Today, Saudi Arabia is the 25th largest exporter/importer globally, with foreign trade valued at $78 billion. The Kingdom has demonstrated notable political and economic stability throughout its history. Spanning 2,150,000 square kilometers, Saudi Arabia, about one-fourth the size of the United States, is in the southwest corner of Asia. In September 2004, its total population was 22.7 million, with an annual growth rate of 3.24%.

2. Healthcare in Saudi Arabia

Over the past three decades, the Saudi Arabian government has invested billions of Riyals to improve and expand healthcare services. This has led to an increase in both public and private hospitals and medical centers. Major hospitals in the Kingdom now provide advanced treatments, including open-heart surgery, kidney transplants,

and cancer therapy. Approximately 11,350 healthcare professionals, including doctors, nurses, and personnel from the Saudi Red Crescent Society, serve the millions of pilgrims who visit Saudi Arabia annually for Hajj. Free immunizations for diseases such as tuberculosis, polio, hepatitis, and tetanus are widely available. Additionally, affordable medical insurance schemes are offered.

The rapid expansion of healthcare services in Saudi Arabia has resulted in diverse providers, with the Ministry of Health delivering about 60% of the services. Other entities, such as the National Guard, the Ministry of Defense and Aviation, the Ministry of Interior, university hospitals, and the growing private sector, provide the remaining services. This diversity has led to significant variations in the administration and management of healthcare facilities, as well as the information systems employed. Consequently, patient records are often scattered across multiple facilities, making it rare for providers to have access to a patient's complete record unless the patient consistently uses the same provider. This fragmented system leads to duplicated efforts and costs, such as repeated x-rays or laboratory tests, and can compromise patient safety.

3. E-Health Benefits, Barriers, and Key Applications

3.1 Potential Benefits of E-Health

E-health offers several advantages, including enhanced access to comprehensive and credible health information, which improves the quality of care. E-health facilitates faster and more efficient sharing of health records, potentially reducing the costs of managing chronic diseases, medications, and wellness programs. Additionally, e-health systems help prevent clerical errors in prescriptions.

Benefits for Physicians: Physicians can electronically place orders, reducing the risk of misinterpreting handwritten instructions. E-health provides real-time alerts for drug interactions, food interactions, and allergies, improving healthcare quality. Moreover, it reduces the time physicians spend locating and reviewing patient charts, enabling them to focus on patient care.

Benefits to Ancillary Departments

E-health systems provide significant advantages to ancillary departments such as pharmacy, laboratory, radiology, nursing, and others. By automating administrative tasks, resources in these departments are freed to focus on delivering higher-value care and enhancing regulatory compliance. For instance, pharmacists and nurses spend considerably less time entering orders, allowing them to dedicate more time to clinical responsibilities. Additionally, e-health minimizes the time spent on phone calls to physicians for clarifying or verifying orders.

Benefits to Patients

E-health significantly contributes to improving medication safety by preventing errors associated with handwritten prescriptions. It also fosters better interdisciplinary communication, which directly benefits patient care and outcomes.

Benefits to Management

E-health accelerates the flow of information across organizations, reducing the

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turnaround times for key processes such as medication delivery, laboratory work, radiology scheduling and completion, and other tasks. Furthermore, it helps standardize healthcare processes. On a national scale, aggregated health data, information, and knowledge from various health centers can support public health research.

3.2. Barriers to E-Health

Despite the significant potential benefits of e-health, several barriers hinder its diffusion. Research has identified numerous obstacles to the adoption of innovative technologies. These barriers can be classified into four categories: project/economic barriers, technical barriers, organizational barriers, and behavioral barriers (Attewell, 2017; Nambisan & Wang, 2012; Tanriverdi & Iacono, 2014).

Project/Economic Barriers: These barriers pertain to challenges in financing and project management when adopting innovations (Paré & Trudel, 2007).

Technological Barriers: This category involves a lack of technical knowledge necessary to implement new innovations, including issues like insufficient interoperability and the absence of established regional information networks.

Organizational Barriers: These barriers involve difficulties in integrating new technologies into existing workflows and practices. Challenges include privacy concerns and the lack of consistent national information standards and coding systems.

Behavioral Barriers: This group addresses resistance to change among individuals impacted by the implementation of new systems, as well as organizational power dynamics. Additionally, concerns over how physicians will use the technology are included in this category.

3.3. Critical Success Factors for E-Health Diffusion

To improve the likelihood of successful e-health implementation, organizations should focus on critical success factors. In May 2001, a conference involving 13 e-health experts from around the world developed key recommendations for implementing Computerized Physician Order Entry (CPOE) systems (Ash et al., 2003). These considerations, which can apply to other e-health applications, include: the motivation for implementation, leadership and vision, costs, integration with workflows and healthcare processes, value to users, decision support systems, technical considerations, project management, training and support, and ongoing learning, evaluation, and improvement.

3.4. Key E-Health Technologies

Electronic Medical Record (EMR):

The EMR is a digital system for storing patient health information with full interoperability within a healthcare enterprise. It connects outputs from various medical and technical departments, ensuring all services rendered to a patient are consolidated in one record. This promotes cohesive interactions between hospital departments and supports the delivery of excellent healthcare services. Key

components of an EMR system include:

•   Patient Management System: Facilitates appointment scheduling, bed management, and follow-up for hospitalized patients.

•   Pharmacy Management System: Automates drug management and alerts physicians to potential negative chemical interactions, reducing manual tasks for pharmacists and enabling them to focus on clinical duties.

•   Laboratory Information System: Manages laboratory requests and automatically stores results in the patient's electronic health record.

•   Radiology Information System: Manages radiology requests and records the results within the electronic health record.

•   Billing and Insurance System: Assists with generating bills and finalizing the costs of medical services.

•   Staff Scheduling System: Manages schedules for physicians and clinical teams.

Computerized Physician Order Entry (CPOE):

CPOE allows physicians to electronically enter orders and instructions for patient treatment. These orders are communicated via the EMR to medical staff, such as nurses and therapists, or to departments like pharmacy, laboratory, or radiology. CPOE is not merely a technology but a workflow redesign that integrates technology to optimize order processing. It uses clinical decision support systems and links to hospital IT systems, providing prompts and alerts to prevent errors like contraindicated medications or duplicate orders. The integration with systems such as electronic patient records ensure physicians have all the necessary information for accurate and effective ordering (Shojania et al., 2011).

Telemedicine:

Telemedicine uses advanced communication technologies to enable remote healthcare delivery. Services include remote examinations, automated transmission of diagnostic results, expertise sharing, surgical procedures, and other medical applications. This approach leverages computers and communication systems to transfer medical information for remote diagnoses. Telemedicine advancements, such as robotic-assisted surgeries, are particularly valuable in Saudi Arabia due to the country's vast geographical size and the number of remote villages.

Multipurpose Smart Card:

A smart card contains an integrated circuit for storing, retrieving, and transferring data. While its use in Saudi Arabia is currently limited to commercial purposes, other countries have adopted smart cards for healthcare, storing specific health information extracted from patients' electronic health records.

Picture Archiving and Communication Systems (PACS):

PACS replaces traditional radiological film systems with digital systems, allowing multiple physicians to examine medical images simultaneously via a computer network. This system addresses the issue of lost images, reducing the need for

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retakes and their associated costs. Advanced coordinate control systems within PACS facilitate easier image examination and referencing.

Electronic Health Record (HER):

Electronic Health Records (EHRs) have become indispensable in global healthcare systems, serving as the foundation for clinical documentation, health insurance reimbursements, and health information exchange (HIE) at various levels. Multiple studies have highlighted that public hospitals in Saudi Arabia are still in the early phases of EHR implementation. These studies consistently express concern over the limited extent of successful EHR adoption in Saudi hospitals [36, 37]. While some hospitals in Saudi Arabia have adopted EHR systems, significant challenges remain in fully implementing these systems. Key barriers include constrained budgets, as well as technical and administrative obstacles (Hasanain & Cooper, 2014).

Technical challenges represent a major hurdle for Saudi healthcare systems in general, and particularly in the implementation of EHRs. Researchers have consistently raised concerns regarding the insufficient Health Information Technology (HIT) infrastructure, which impedes healthcare advancements. Hasanain and Cooper identified HIT infrastructure deficiencies and social barriers as the most significant obstacles to EHR implementation in Saudi Arabia. Their study emphasized the necessity of further planning and research to address these issues, particularly by enhancing healthcare professionals' understanding of EHRs' value in managing patient records. A report by the World Health Organization (WHO) on EHR implementation in developing countries cited high costs, a lack of clinical terminology standards, and resistance from healthcare professionals due to limited technological literacy as significant challenges (Pacific & Pacific, 2006).

A Saudi-specific study on EHRs revealed that public hospitals primarily rely on manual patient record systems, necessitating substantial effort to transition to EHRs (Alanazy, 2006). The lack of progress in EHR development in public hospitals can largely be attributed to inadequate strategic planning and the absence of necessary technical standards. The study also found that both governmental and private sector hospitals face challenges in EHR implementation, with primary issues including resistance to new technologies among healthcare professionals, managerial attitudes, and insufficient budget allocations. To address this resistance, Khudair argued for the importance of persuading and training physicians during the initial stages of EHR implementation (Khudair, 2008).

Despite these challenges, some governmental hospitals outside the Ministry of Health (MOH) system have reported significant progress. For example, as early as 2001, the National Guard Health Affairs (NGHA) hospital at King Abdulaziz Medical City became one of the first institutions in the Middle East's Eastern Mediterranean Region to implement EHRs (Altuwaijri et al., 2012). Nevertheless, a decade later, Al-Harbi reported that most Saudi health organizations still relied on traditional paper-based methods for patient record-keeping or employed non-integrated software solutions, such as patient admission systems (Al-Harbi, 2012). Similarly, Bah and Alharthi conducted a comparative study of 19 public hospitals in the Eastern Province of Saudi Arabia and found that only three hospitals (15.8%) had

successfully implemented standardized EHRs (Bah et al., 2011). One of the primary challenges identified in these hospitals was the lack of effective interaction between physicians and nurses.

Recent research has increasingly focused on the barriers to EHR implementation in Saudi public hospitals. Mahalli investigated the challenges faced by nurses using EHRs in three public hospitals in the Eastern Province, where EHR systems had already been implemented (El Mahalli, 2015). The study identified loss of access during computer or power outages as the most frequent barrier. Additional issues included insufficient ongoing training and support for hospital IT staff, reflecting a lack of managerial and administrative understanding of nursing staff requirements. The study recommended forming an EHR committee to address and resolve staff concerns about EHR usage.

The inferior HIT infrastructure in public hospitals, compared to other governmental hospitals, has hindered EHR adoption. Alsahafi observed that while some governmental hospitals have successfully implemented integrated EHR systems, MOH hospitals continue to face significant delays in overcoming implementation barriers (Alsahafi, 2012). These challenges include workforce shortages, a lack of integrated systems, and negative attitudes among doctors toward EHR adoption. To address these issues, the MOH launched a national strategy in 2009 under the governance of the Saudi Health Council. An additional initiative, the eHealth Strategy, was also introduced to improve the quality of healthcare services.

Khudair surveyed physicians' perceptions of EHR adoption in Saudi hospitals and found resistance from hospital directors and healthcare decision-makers, along with technical and training deficiencies, as major obstacles (Khudair, 2008). Studies conducted both earlier and later indicate that EHR implementation in Saudi Arabia remains in its nascent stages. Mohamed and El-Naif, along with Hasanain and Vallmuur, highlighted that a lack of knowledge among healthcare professionals and physicians significantly contributes to resistance against EHRs (Hasanain et al., 2015; Mohamed & El-Naif, 2005).

4. Current Situation of E-Health in Saudi Arabia

Saudi healthcare providers and stakeholders have increasingly recognized the essential role of information and communications technology in healthcare delivery. Despite this recognition, there has been a lack of coordinated efforts to establish a unified national network for health records. Currently, a wide variety of independent health information systems are employed, particularly in large regional hospitals, which are not interconnected.

4.1. Ministry of Health (MOH)

The Ministry of Health has made considerable efforts to link its hospitals into a unified network; however, this goal has yet to be realized, primarily due to insufficient funding. Many MOH hospitals lack the necessary information and communication infrastructure. The fragmented initiatives aimed at advancing minor systems are limited in scope because they are not supported by a comprehensive information technology policy. These systems originate from diverse sources, making integration difficult. Recently, the Ministry has initiated a project to establish

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a central national database for electronic health records. This initiative aims to connect hospitals across the Kingdom to facilitate data flow, enable the transfer of electronic health records, and build a national electronic healthcare system.

4.2. The Private Sector

The private sector in Saudi Arabia can be categorized into medium-to-large hospitals and smaller clinics. While large private hospitals have implemented information systems, these systems tend to focus primarily on financial applications, such as billing, and are sourced from various vendors, making them incompatible with MOH systems or insurance company networks. Conversely, most small clinics and private pharmacies lack even the basic requirements for information technology.

4.3. King Faisal Specialist Hospital & Research Centre (KFSH & RC)

Since its establishment in 1975, KFSH & RC has consistently utilized cutting-edge IT solutions. The hospital adopted internet technology and telemedicine as early as 1993, supported by an advanced visual fiber network exceeding 5,000 points. Currently, over 12 MOH hospitals are part of this telemedicine network. The hospital continues to enhance its e-health infrastructure, implementing advanced commercial systems, including enterprise resource planning (ERP), electronic medical records (EMR), computerized physician order entry (CPOE), picture archiving and communication systems (PACS), and a new health portal.

4.4. National Guard Health Affairs (NGHA)

The NGHA has established advanced computer networks across its hospitals, encompassing over 20,000 connection points. Its four hospitals and 60 clinics are integrated through a wide-area network. These hospitals boast a similar level of automation to that of KFSH & RC, having implemented ERP systems, EMR, CPOE, PACS, cardiac PACS, and a modern health portal.

4.5. Medical Services of the Armed Forces

In terms of the number of hospitals, the medical services provided by the Armed Forces rank second to the MOH. While some Armed Forces hospitals have computer networks, others lack this infrastructure. The available health systems are sourced from various vendors and are not integrated. The Armed Forces are currently devising a strategy to develop comprehensive and standardized health systems for all its hospitals.

4.6. Security Forces Hospital (SFH)

The SFH has established a fully integrated information and communication infrastructure. The health information systems (HIS) implemented at SFH are comprehensive and cater to both medical and administrative needs.

4.7. University Hospitals

University hospitals possess robust information infrastructures within individual hospitals. However, these hospitals are not interconnected. The health information systems employed within university hospitals are sourced from various vendors and

are designed to serve both administrative and medical functions.

4.8. Medical Insurance

Several insurance companies have recently been officially licensed in Saudi Arabia. This development necessitates the creation of a health information network to integrate hospitals and insurance companies.

2. Conclusion

The implementation of e-health systems, particularly Electronic Health Records (EHRs), represents a transformative approach to improving the quality, efficiency, and safety of healthcare services in Saudi Arabia. Despite their critical role, the widespread adoption of EHRs in public hospitals remains in the preliminary stages, hindered by challenges such as insufficient technical infrastructure, lack of funding, and resistance from healthcare professionals. Comparative analysis highlights that while some governmental hospitals have made strides in e-health adoption, such progress has not been uniformly achieved across the healthcare sector, especially in Ministry of Health (MOH) facilities.

Key studies have identified the importance of addressing these barriers through comprehensive strategies, including the enhancement of IT infrastructure, increased training for healthcare professionals, and the promotion of collaborative planning efforts. A unified national network for health records and effective interconnectivity among healthcare providers are essential for achieving the full potential of e-health solutions.

Saudi Arabia's initiatives, including the MOH's eHealth Strategy, demonstrate a commitment to overcoming these obstacles and advancing the healthcare sector. However, substantial work remains to integrate all healthcare entities into a cohesive and efficient e-health system. By addressing existing limitations and fostering greater awareness of e-health benefits, Saudi Arabia can unlock new opportunities for innovation and set a benchmark for healthcare delivery in the region.

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