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LITERATURE REVIEW

E-Health status in Saudi Arabia: A review of current literature

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Abstract
Due to recent and growing interest in e-health initiatives in Saudi Arabia, improving the state of knowledge pertaining to current e-health programs, initiatives, and efforts is of critical importance to academics, clinicians, and policy makers. In this research review the literature on specific applications of e-health in Saudi Arabia is considered, including studies investigating Electronic Health Records (EHR), Electronic Medical Records (EMR), studies investigating Computerized Provider Order Entry (CPOE) and Clinical Decision Support Systems (CDSS). Moreover, this paper explores studies on telemedicine, mobile health, and other e-health applications. The findings reveal evidence that e-health in Saudi Arabia is growing as many organizational and individual initiatives have implemented e-health applications. However, the number of studies available about e-health in Saudi Arabia remains low. Data is limited to a few organizations and does not necessarily reflect the breadth and depth of the current and potential use of e-health for healthcare organizations in the region.

Contents

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Introduction

E-health as a relatively recent term, used interchangeably with health informatics, covering all types of electronic or digital processes in healthcare. E-health refers to all forms of electronic healthcare delivered via information and communication technology channels, ranging from informational, educational, and commercial, to direct services offered by healthcare organizations, professionals, and consumers themselves. Simply stated, e-health is making healthcare more efficient, while allowing patients and professionals to access and manage data in ways that were previously impossible [1].

The main purpose of this research review is to explore existing national e-health programs, initiatives, and growing efforts in Saudi Arabia. Some researchers have highlighted the state of e-health in Saudi Arabia from a descriptive perspective and found, that while many healthcare organizations in Saudi Arabia are using information and communication technologies and systems to enhance healthcare quality, there was no organized effort to create a national network and a national database for health records for all Saudi citizens [2,3].

In 2010, the World Health Organization called for more studies on e-health in developing countries [4]. Assessing the state of Saudi e-health challenges is a relevant and timely topic. Through this research the authors examined e-health programs and initiatives, highlighting the importance of investigating e-health challenges and developing recommendations. It is essential to have a clearer picture of the current status of e-health in Saudi Arabia.

The overarching research questions were: 1) What is the current implementation of e-health practices in Saudi Arabia? 2) What are the current and emerging e-health challenges in Saudi Arabia? 3) What are the recommendations to enhance e-health initiatives for Saudi Arabia?

There are five major health authorities which serve the majority of the population. The Ministry of Health (MOH) manages 60% of the hospitals in Saudi Arabia, while the other four authorities collectively manage approximately 20% in addition to another 20% managed by the private sector. The Ministry of Health (MOH) serves Saudi nationals and insured foreigners. The MOH is still working on connecting its hospitals to each other and creating a national plan for e-health. The Medical Services of the Armed Forces serves armed forces employees and their families. Some hospitals have computerized systems while others do not. Some of the health information systems used in these hospitals are coming from different vendors and are not yet integrated. The King Faisal Specialist Hospital and Research Center (KFSH&RC) serves Saudi nationals. The hospital has connected with more than 12 MOH hospitals in joining the KFSH&RC's telemedicine network.

KFSH&RC has been developing its own e-health programs in addition to some ready-made hospital information systems. The hospital implemented enterprise resource planning (ERP) systems, Electronic Medical Records (EMR), Picture Archiving and Communication Systems (PACS), and a new health portal. The Ministry of National Guard Health Affairs (MNGHA) serves National Guard's employees and their families and Saudi nationals in specific cases such as cancer patients. The MNGHA has installed systems and networks in all of its hospitals and it has implemented EMR systems, PACS, and other systems. Security Forces Hospitals (SFH) serve security forces employees and their families. The SFH has an integrated information network and has integrated health information systems (HIS) [2,5,6]. Recommendations from future e-health assessment and implementation across Saudi Arabia could be scaled to integrate related data from these five health authorities.

Methodology

This research review aims to include the currently available knowledge of published work about e-health in Saudi Arabia.To answer the research questions proposed by this study, details about how each study was designed, what methods were used, and the nature of utilized materials, were assessed.

The inclusion criteria for this research review determined that retrieved articles would be published in English, and were from Saudi Arabia. Any article that proposed, described or discussed e-health or studied e-health applications in Saudi Arabia was also included. The exclusion criteria were that editorials were omitted as were articles written by authors in Saudi Arabia but did not discuss e-health in Saudi Arabia. Finally, articles and studies concerning health-related geographic information systems were not included.

The entire literature search was conducted on July 25, 2014. Four databases were searched. For the PubMed search, the researcher set the filter from January 1, 2003–June 30, 2014 extracting full text and abstracts. Then, the researcher searched PubMed for e-health (Telemedicine (MeSH term) OR Electronic Health Records (MeSH term) OR Computerized Physician Order Entry System (MeSH term) OR Clinical Decision Support Systems (MeSH term) OR Mobile Health (MeSH term) OR E-Health (keyword)) and found 29,949 articles. A second search was performed for Saudi Arabia using the same two filters as previously for the dates and full text as well as abstracts. This search yielded 13,590 articles.

When the researcher combined these two searches, 69 articles were identified. After reviewing these articles against

the inclusion and exclusion criteria, the final included result was 28 articles. In terms of the Cumulative Index to Nursing and Allied Health Literature (CINAHL); the researcher chose the Boolean/Phrase option and searched for e-health (Telehealth (subject heading) OR Electronic Order Entry (subject heading) OR Computerized Patient Record (subject heading) OR Decision Support Systems, Clinical (subject heading) OR Mobile Health (key words) OR E-Health (keywords)). A total of 4257 articles were found. Similarly to the PubMed search outlined above, the same filters were applied and the researcher used the Boolean/Phrase option to search for Saudi Arabia. This yielded 598 articles. When the researcher combined these two searches, the final result was three articles. The researcher reviewed these articles in terms of the inclusion and exclusion criteria and found that one article met the criteria; however, this article was already contained in the PubMed results.

In terms of Business Source Complete, the researcher chose the Boolean/Phrase option and searched for e-health (Telehealth (keyword) OR Telemedicine (Keyword) OR E-Health (keyword) OR Electronic Health Records (subject heading) OR Computerized Physician Order Entry System (key word) OR Mobile Health (keyword) OR Clinical Decision Support System (keyword)) and found 8562 articles, while searching for Saudi Arabia resulted in 29,474 articles. With both searches combined, the result showed three articles, but these did not meet the inclusion criteria.

Finally, the Institute of Electrical and Electronics Engineers (IEEE) did not allow the researcher to enter the specific month of the year. Therefore, when the researcher performed the search on July 25, 2014, all the articles were dated before May 31, 2014. Therefore, the researcher used advance research for metadata only and entered each key word in each field, and chose OR between every two keywords except before Saudi Arabia, the researcher used AND, as shown in the following example such as (Telehealth OR Telemedicine OR "E-Health" OR "Electronic Health Record" OR "Computerized Physician Order Entry" OR "Mobile Health" OR "Clinical Decision Support System" AND Saudi Arabia). This search yielded 18 articles. After reviewing these 18 articles, only three of them met the criteria. Therefore, the total of retrieved articles by all searches was 31 articles.

Results and discussion: summary of the characteristics of the literature

The review of literature examined 31 articles, all published in English. There were 6 conceptual articles, 16 quantitative studies (three retrospective – cross-sectional, eleven surveys and one quasi-experimental, and one pre and post evaluation), seven qualitative studies (interviews), and two experimental studies.

Three articles and studies discussed Islamic e-health and e-health education and initiatives in Saudi Arabia. In fact, these articles and studies showed that health information professionals in Saudi Arabia are more concerned with how e-health can be used to improve patients' spiritual health and national health planning programs. First, Islamic e-health has been proposed and defined by Househ [7]. Islamic e-health is defined as "The application and use of information and communication technologies to monitor and support Islamic spiritual health practices with the goal of improving Muslims' spiritual, mental, and physical health status". The study used various data collection methods, such as interviews, Facebook, Google, and iTunes searches using a variety of Islamic E-health-related terms [7]. The remaining two articles discussed e-health initiatives and education in Saudi Arabia [3,8]. Altuwaijri [3] highlighted the need for a national e-health program and proposed a national e-health scope of work in Saudi Arabia. This paper used descriptive analysis of the status of e-health in Saudi Arabia, along with some of the national e-health initiatives such the establishment of a new Master of Health Informatics degree program and the Saudi Association for Health Informatics. The author concluded the article by highlighting the role of the Saudi Association for Health Informatics (SAHI) in enhancing coordination among health information professionals and describing the Master of Health Informatics degree program at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) as an initiative to educate specialized professionals [3]. Househ et al. [8] designed the e-health course for the Master's program at KSAU-HS to foster future professional development in this field in Saudi Arabia. Their paper provides an overview of the program, description on the course development process, instructional methods, and course evaluation. The paper also describes the faculty's experience in the development of the course. This course defines the concept of e-health, which helps students to improve their knowledge of the e-health field [8].

Seven articles and studies discussed Electronic Health Records (EHR) and Electronic Medical Records (EMR) in Saudi Arabia. These studies demonstrated that although the adoption rate for EHR was growing, albeit at different rates among the various regions of the country, EHR and EMR implementation faced challenges that delayed their adoption. Two of the articles in particular indicated that the EHR adoption rate is growing in Saudi Arabia and that a few organizations which implemented EHR had been recognized as successful within the Middle East. Altuwaijri [9] used qualitative methods to describe the Ministry of National Guard Health Affairs (MNGHA) experience with implementing EHR. The MNGHA first created its vision to implement EHR in the three regions of Saudi Arabia. The MNGHA management then established project committees and a project team to implement the system. The project processes and implementation took around ten years, and received the Middle East Excellence Award in EHR in 2010 [9]. Similarly, Alsanea [10] highlighted the importance of EHR at the King Faisal Specialist Hospital and Research Centre (KFSH&RC). The author reported that EHR was implemented, enabling the organization to perform data analysis for the benefit of public health and to share information with national agencies and other organizations. [10]

Two studies indicated that although there were some challenges facing the adoption of EHR, the adoption rate in Riyadh seemed to be higher than in the Eastern Province. This difference can be attributed to the fact that Riyadh is the capital of Saudi Arabia, which has the main government hospitals. Bah et al. [11] surveyed 19 hospitals to determine the level and extent of usage of electronic health records (EHRs) in government-related hospitals in the Eastern Province, Saudi Arabia. Using an online questionnaire, the experiences of all IT managers in the 19 hospitals were collected. The findings indicated that only three hospitals used the EHR; the major challenge in adopting EHR was that most of physicians and nurses had uncooperative attitudes

toward EHRs mainly due to negative beliefs about EHRs relating to health information security and confidentiality concerns lack of motivation or incentives to learn and use EHRs while having heavy workloads most of the time, and a lack of sufficient training on using EHRs [11].

A similar study was conducted in Riyadh and surveyed all Riyadh hospitals, where responses from 22 hospitals were analyzed regarding the implementation, maintenance, and improvement phases of EHR system adoption. Thirty-seven items were graded on a three-point scale of preparedness/completion. Measured determinants included hospital size, level of care, ownership, and EHR system development team composition. The study results demonstrated that eleven hospitals had fully functioning EHR, eight hospitals were still in progress and three hospitals had not yet implemented EHR [6]. Three studies indicated that although hospital databases appeared to be accurate, healthcare professionals might not be interested in or prepared to use EMR in Saudi Arabia because of low computer literacy. For example, Youssef and Alharthi, [12] in their 2013 study, assessed the accuracy of an electronic database, in a major teaching hospital in the Eastern Province, Saudi Arabia, in documenting 17 comorbidities constituting the Charlson index as recorded in paper charts by care providers. The researchers randomly selected the data of 1019 patients admitted to the hospital and compared the data for accuracy with the corresponding paper charts. The study concluded that electronic databases had a promising future in healthcare management [12].

Mohamed and El-Naif [13] conducted a study where 105 physicians, 109 nurses, and 120 patients, were selected randomly from the Military hospital in Riyadh. The data was collected via a self-administered, pilot-tested questionnaire, and found that physicians were not enthusiastic to change from paper medical records to EMR because of their lack of computer literacy [13]. Similarly, Shaker and Farooq surveyed 451 physicians, from seven different hospitals in Makkah region for their computer knowledge and experience and found that the participants required more training in computer use such as Word and PowerPoint [14].

Computerized Physician Order Entry Systems (CPOE) and Clinical Decision Support Systems (CDSS) are used in conjunction in some healthcare organizations in Saudi Arabia. Eight studies focused specifically on CPOE and CDSS in Saudi Arabia, which indicated that most organizations were interested in adopting these systems to support healthcare. However, there was disagreement on their benefits in hospitals and these systems faced challenges in some organizations. In terms of evaluating CPOE alone, three studies reported that CPOE implementation could lead to positive results within organizations [5,15,16].

Only one study reported mixed positive and negative results of CPOE usage [17], while two studies reported either no improvement in patient outcomes or a negative influence on clinical workflow [18,19]. Altuwaijri et al. [5] used qualitative survey methods through conducting meetings with ICU clinicians to assess their perception on the importance of 32 validated critical success factors for the recently implemented CPOE pilot project at one of the Ministry of National Guard hospitals in Riyadh. They found that the benefits of CPOE could outweigh its shortcomings. Therefore, MNGHA management expanded the pilot project to all MNGHA clinics and hospitals to reap the benefits of CPOE [5]. Similarly, Saddik and Al-Fridan conducted a survey to measure physician satisfaction with CPOE using a 5 likert scale self-administrated questionnaire and collected 79 valid physicians' responses where they found that more than 50% of the participants were satisfied with CPOE [16].

Furthermore, Mominah and Househ [15] reviewed reported medication and prescribing errors at one of the tertiary care hospitals, in Riyadh, in 2012; identifying and analyzing around 2000 drug prescribing errors, over 12 months period of time, and subsequently exploring contributing factors. They stated that CPOE can reduce medication errors. Therefore, the recommendations of their study were to enhance policy and procedure and raise provider awareness of these errors [15]. Rowibah et al. [17], utilizing a cross-sectional research design, used self-administered questionnaires distributed to physicians in various hospital departments. Their study was conducted in Riyadh at King Fahd Medical City and got valid responses from ninety three physicians. Their study results agreed with the previous finding that CPOE enhanced efficiency. However, these investigators stated that CPOE might lack user guidance throughout the medication ordering stage and could create new types of errors [17].

The final two studies related to CPOE indicated that either the clinical workflow was negatively affected by CPOE or that implementation of CPOE demonstrated no enhancement in patient outcomes and hospital mortality. Mominah et al. [19] using a case study approach, discussed the experience of a local hospital with the use of CPOE and its impacts on clinical workflow. Results indicated that clinical workflow was negatively affected due to CPOE implementation and usage because the CPOE system was poorly designed and caused alert fatigue [19]. The second was an observational study showing before-after effects carried out in a 21-bed medical and surgical intensive care unit (ICU) of a tertiary care center. The study included all patients admitted to the ICU in the 24 months pre- and 12 months post-CPOE implementation. The results showed that implementation of CPOE produced no enhancement in patient outcomes or hospital mortality in the ICU [18]. Therefore, the conclusion was that although CPOE could be a useful tool, its effectiveness needed to be examined further.

In terms of CDSS, Almutairi et al. [20] conducted a study on three hospitals in Riyadh and found that CPOE and CDSS were not mature yet because there were many challenges, including the high cost to buy or customize these two systems and the lack of qualified health information professionals [20]. However, Omaish et al. [21] proposed a knowledge model for a clinical guideline mediated CDSS for Acute Coronary Syndrome (ACS) in the emergency department, which can provide helpful recommendations to physicians and prioritize recommendations according to the strength of the evidence [21]. Overall, these studies indicated that although CPOE and CDSS had been adapted in Saudi Arabia to some extent, there was disagreement as to their benefits.

Three articles and studies focused on telemedicine, which suggests that few organizations were implementing telemedicine in Saudi Arabia. First, Alkadi and Roudsari [22], through a descriptive study, suggested Telecare for Managing Diabetes (TeMaD) as a solution for diabetes patients to overcome the social barriers to treatment in Saudi Arabia [22]. Alkadi and Roudsari [23] applied the telecare model for managing diabetes at the Saudi National Guard Hospital in Riyadh. They used a quasi-experimental design, using a before-after

examination, on a sample of 52 patients. They found TeMaD improved Hemoglobin A1c (HbA1c) levels of 83% of participating patients, reducing the average from 9.2% to 8.4% [23]. Finally, El-Mahalli et al. [24] explored the benefits and challenges of telemedicine in the Eastern Province of Saudi Arabia. The study was conducted at one hospital not adopting telemedicine, with 252 participants, and three hospitals adopting telemedicine with 144 participants. It was a cross-sectional descriptive study, and the target population included all types of healthcare professionals. Data collection methods included two paper-based questionnaires. The benefits identified were the store-and-forward capability and the ease of follow-up after face-to-face contacts. However, most participants agreed that lack of knowledge about telemedicine and lack of infrastructure were barriers. Overall, these three studies indicated that only a few organizations had considered implementing telemedicine [24].

Five articles and studies focused on mobile health. Although these studies showed positive results, mobile health was used by only a few departments within a few organizations. First, Al-Dowaihi et al. [25] presented an asthma-monitoring prototype system that supported asthma patients and medical staff (asthma educators). It offered the patients a smartphone application to monitor their asthma condition by receiving their peak flow readings from a peak flow meter and comparing them with the normal peak flow readings stored in the system [25]. Similarly, Alanzi et al. [26] evaluated the Saudi Arabia Networking Aiding Diabetes (SANAD) system that used a smartphone diabetes management module to collect blood glucose records from Saudi Type 2 diabetes patients. Among 33 participants, 80% of the patients found the SANAD system was helpful in diabetes management [26].

In the field of dermatology, Kaliyadan et al. [27] evaluated the use of a 4G smartphone for mobile tele-dermatology. A dermatologist used the mobile to take photos of patients' skin, made a diagnosis and sent the photo to another dermatologist to compare both diagnoses. The agreement of diagnoses was high among dermatologists. A total of 166 consecutive patients were included in the study (97 male and 69 female). A questionnaire to assess patient satisfaction was administered to each patient. Most of the respondants were highly satisfied with teledermatology [27]. Finally, in terms of using mobile phones by students to understand health content and application structures, diabetes prevention and educational applications, Alghamdi et al. [28, 29] found that screen size had no statistically significant impact on user understanding of the health information contents, although larger screen size allowed participants to read the characters more quickly with less effort. Overall, although these studies showed positive results, mobile health has had limited uptake by organizations. The two papers used the data of an experimental study where 33 participants used different mobile phone screen sizes [28,29].

Five studies focused on e-health applications such as health information technology in primary care, dental informatics, Electronic Laboratory Information Exchange (ELIE), and data mining. These studies indicated that although some organizations were aware of e-health applications and had implemented various applications, there were some challenges to be addressed by Saudi healthcare organizations. Almaiman et al. [30] conducted an exploratory study to provide an overview of health information technologies (HITs) used in primary healthcare centers (PHCC) in the Kingdom of Saudi Arabia. Data collection methods included interviewing 15 key stakeholders in addition to an academic search using a variety of keyword terms. They found that although there were enhancements in health information technology such as online services for booking appointments and updating files in Saudi primary healthcare centers, many challenges remained. These challenges included the continued use of paper based medical records and variations in the allocation and usage of health information technology [30].

In terms of the current state of dental informatics in Saudi Arabia, Al-Nasser et al. [31] conducted a study to summarize the current applications of dental informatics in Saudi Arabia and to identify the challenges facing expansion of dental informatics. Searches for published articles and specialized forum entries were conducted, as well as interviews with dental professionals familiar with the topic. They found that digital radiography and administrative management systems were the most used in Saudi Arabia. In terms of dental education applications, there were web-based learning systems and computer-based assessments. On the other hand, many challenges such as the lack of IT infrastructure and non-standardization of e-health applications hindered the integration of dental software and medical health records. Therefore, more investment and development in the field was recommended [31]. Similarly, Almaiman et al. [32] conducted an exploratory study to provide an overview of the electronic dental records (EDR) systems used at Ministry of National Guard Health Affairs (MNGHA) hospitals in Saudi Arabia. Different sources of data were collected including interviews with key informaticians and dentists. The study included 20 participants each interviewed for 30–45 min. Their results agreed with the previous finding and reported low satisfaction with Electronic Dental Record and that the rate of systems adoption was low; clinical staff resisted the use of the system and lacked computer skills. Finally, participants reported usability issues, lack of management change strategy and lack of interest in utilizing systems [32].

In terms of Electronic Laboratory Information Exchange (ELIE), Al Saleem et al. [33] discussed the Saudi experience in implementing Electronic Lab Information Exchange (ELIE) within healthcare organizations. Data sources included academic literature, websites, and informaticians interviews. They found that although few Saudi healthcare organizations had been linked to ELIE, more organizations might link to ELIE and EHR in the future. Participants reported some challenges such as weak e-health infrastructure, lack of awareness of the significance of ELIE, lack of policies and procedures to make sure that employees complied with data entry guidelines, and staff resistance [33]. In terms of data mining usage in Saudi Arabia, Almazyad et al. [34] conducted a study using Oracle Data Miner (ODM) tool in the analysis and prediction of data. They used the ODM tool to investigate which type of hypertension management is most effective for each age group. They found that hypertension is increasing in Saudi Arabia, affecting one fourth of Saudi adults [34].

Conclusion

In summary, there is evidence that e-health in Saudi Arabia is growing where many organizational and individual

initiatives have implemented e-health applications. The number of studies available about e-health in Saudi Arabia is still low and studies are limited to a few organizations which do not necessarily represent the experience of many other healthcare organizations. To provide a more holistic overview of e-health in Saudi Arabia, and better understand the complete picture, it is necessary to design wider government funded and supported survey studies to include all hospitals or at least an adequatly representative sample of hospitals and other healthcare organizations. This could be enforced through a mandatory procedure of reporting e-health status by all licensed hospitals as a part of their periodic inspection by government and health authorities.

Understanding the current status of e-health in Saudi Arabia and its challenges from the point of view of healthcare professionals, health information professionals, and diverse healthcare organizations is a pressing topic. Knowledge gained in Saudi Arabia may as well be of benefit to other developing countries. Therefore, it is essential to have a clearer picture of the current status of e-health, to investigate benefits and negative aspects, as well as generate solid recommendations for future actions.

As this narrative review was limited by the articles retrieved, as well as the accuracy of the information reported in the summary of the characteristics of the literature, the main limitation of this review is the inability to combine the results of qualitative and quantitative studies on varied e-health applications. A second limitation is the small sample size in some of the studies. Finally, all the articles for the specified date range in this review may not have been found in the database searches because some journals have a lag time before material can be indexed. Hence, it is possible that very recent research had not yet been added to the databases. As mentioned, to build on existing efforts to integrate efficient e-health systems, as well as training, regulation, and evaluation methods, further in-depth study is required.

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Ethical approval

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Conflict of interest

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Authors contribution

Khaled Alsulame: study design and data collection.
Mohamed Khalifa: writing the article text and findings.
Mowafa Househ: supervising study design and data collection.

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