Potential Benefits and Challenges Associated with the Adoption of Mobile health (m-health) in Kingdom of Saudi Arabia

Fahad M. Al-Anezi

Department of Computer Science, Community College, Imam Abdulrahman Bin Faisal University, Saudi Arabia
fmoalanezi@iau.edu.sa

Abstract— **The healthcare system in the Kingdom of Saudi Arabia (KSA) is going through transformative changes as part of the Kingdom's 2030 vision. One of the main pillars of this vision is to improve the healthcare and wellbeing of Saudi citizen. The area of mobile health (m-health) focuses on the use of mobile and Internet technologies for improving healthcare delivery. From the healthcare perspective, the introduction of new and innovative approaches of mobile and digital health solutions in the KSA are timely to enable efficient and effective healthcare delivery services that are vital for the realization of the country's 2030 vision in the healthcare and wellbeing areas. The KSA has made noteworthy strides in adopting Health IT and e-health technologies into their healthcare system, and recently a national e-health strategy was drafted and adopted by the ministry of health. However, from the m-health and digital health perspectives there are no national strategy in the KSA in these important areas. The increasing patient population in chronic diseases, combined with spiraling healthcare costs and pressure on healthcare services makes it timely and important to introduce these concepts into the wider healthcare system. These are considered pivotal drivers in the country's healthcare and patient care transformation process. Furthermore, the unprecedented penetration and usage of smart phones and internet access by the KSA population can drive this change towards accelerated and wider adoption of m-health and digital health services.**

Keywords- mHealth, Kingdom of Saudi Arabia, Digital Health, Vision 2030, Adoption

I. INTRODUCTION

The KSA is in the midst of an accelerated digitization of the country's healthcare services and related health economy as a key driver for the implementation of the Kingdom's vision 2030. Many social and economic changes in the Kingdom are driving this change. KSA is developing long-term strategic vision for diversifying and transforming healthcare systems as part of 'knowledge society' vision. From the healthcare services perspective, the Saudi Ministry of Health housed 250,000 personnel, including 31,516 physicians and 75,978 nurses, and operated 249 hospitals with 34,000 beds. The ministry is responsible for 60% of healthcare services in the country, with the remaining 40% managed by several semi-public organizations and the private sector [1]. From the digital society perspective, the KSA has one of highest penetration of smart phones, Internet and social networking usage in the Gulf and the Middle East. The recent statistics indicate that smart phone users in KSA will increase from 21.3 million users in 2014 (64%) to more than 25.3 million by 2021 compounded with high usage of social media across the Kingdom [2,3]. Historically, from the e-health perspective, it has been introduced in the Kingdom for more than a decade, but it was implemented on local and on regional levels [4-6]. More recently a national e-health strategy was drafted and adopted by the ministry of health in the Kingdom [5]. In this strategy, a five-year e-health roadmap has been planned to support the primary ministry of health business goals with the following objectives [5] like, patient care, connecting providers at all levels of care, measuring the performance of healthcare delivery and transforming healthcare delivery to a consistent, world-class standard.

However, few studies that addressed the impact and effectiveness of e-health services in the Kingdom indicated several barriers [4]. The identified barriers include the implementations of electronic medical records (EHR) in the Kingdom. These were summarized as [6,7]: Human resource and social barriers: these barriers relate to the lack of human resources also barrier that related to believes, behaviors and attitudes of the Saudi clinicians and healthcare professionals towards (EMR) adoption and implementation issues. Financial barriers: these barriers include the funding and implementation challenges of the EMR in primary care health clinics and hospitals. Professional barriers: these barriers relate to the support, motivation, appropriate time planning, support and training aspects of the Saudi clinicians and healthcare professional on different EMR systems. Legal and regulatory barriers: These include barriers like the lack of the appropriate policy and governance regulations, privacy and security challenges and the absence of relevant legislations. Organizational barriers: These include the challenges that relate to the current hospital management practices, training and the lack of effective monitoring and evaluation mechanisms and other workflow issues and technical barriers: These include IT support, interoperability and standards, security privacy and others such as system and computer updates and depreciations.

These studies also indicated that social and human resources, financial and technical barriers are the major categories towards the successful and effective implementation of nationwide EMR systems. However, recent steps have been taken by the Ministry of Health to alleviate these barriers, there are still many challenges required for nationwide and successful EMR implementation and adoption. These include long-term planning, selection of the right tools and systems and the appropriate implementation strategy. Since, 2007 and with the introduction of smart phone technologies, there has

been unprecedented intake and penetration of mobile phones among Saudis. Similarly, there has been an unprecedented and global usage of wide range of m-health solutions and healthcare delivery services that dominated the healthcare delivery landscape scene within the last decade [9]. These fundamentally altered many of the e-health implementation frameworks to meet the 21st century technological changes and to adapt to the healthcare challenges including increasing levels in the chronic diseases, aging population, communicable diseases and others. This led to the migration of most e-health access platforms of EPR and EHR to move towards mobile and wireless access technologies to provide more flexible and effective healthcare data access tools anytime and anywhere, leading eventually to more efficient access tools and better patient education and empowerment. However, this process brought other challenges including security, privacy, authentication and the resistance to change from existing health care practices. From the m-health perspective, to date there is no national mobile and digital health strategy in the Kingdom. However, this process is fast changing with increased digitization of the Saudi society and increasingly more mobile and digital health approaches are being used for different healthcare delivery applications across the Kingdom. Considering the importance and their pivotal role in transforming the Kingdom's healthcare services and citizen's wellbeing as part of vision 2030, it is timely and important that more awareness and larger mobile and digital health services to be applied and implemented across the Kingdom together with clear digital and mobile health policies to be developed and adopted. In the next section we present an overview and literature survey of the m-health studies and work to date in the KSA.

II. M-HEALTH IN THE KSA

m-health and digital health are relatively new concepts in the KSA. This is evident in the current status of limited studies and lack of large-scale research and implementation activities within the healthcare sector and research institutions in the KSA. However, more recently mobile health was focus of interest from most healthcare ecosystem and stakeholders in the KSA. The benefits of digital and mobile health have been increasing in recognition of their transformative role in improving healthcare delivery services, patient care and wellbeing and considering the high level of pervasiveness and usage of smart phone and social media technologies in the KSA.

However, there is lack of understanding of the four information and communication technologies (ICT) for healthcare pillars that need to be clarified. These areas are typically categorized into the four domains of telemedicine, telehealth, e-health and m-health [8]. The premise is that these terms are not interchangeable, because they represent different concepts and related activities, and this becomes evident if we consider their respective origins [9]. For example, from the e-health perspective the origin of the concept is still debatable, but there is a consensus that it started in about 1999-2000 with the start of 'dot com bubble' [10]. e-health was defined by the World Health Organization (WHO) as 'the cost-effective and secure use of ICT in support of health and health-related fields, including health-care services, health
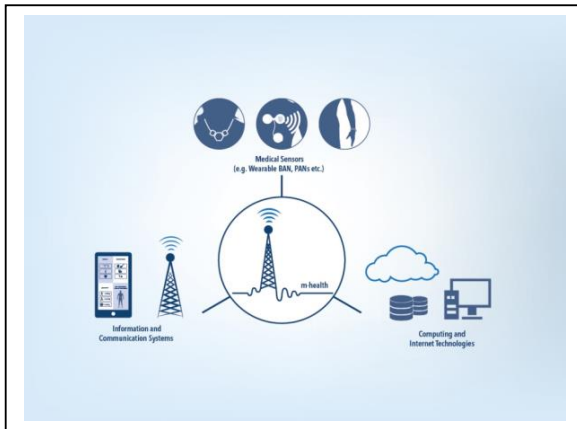
surveillance, health literature, and health education, knowledge and research' [11]. The key common ground for e-health is the use of technology, electronic processing and communication networks for different healthcare services. These are translated in the different HER or EMR systems that we discussed earlier.

Mobile health was first introduced and defined in 2003 as 'mobile computing, medical sensor and communications technologies for healthcare' [9, 11]. In 2011, the WHO, argued in their global observatory for e-health service report, asserted that there is so far no standardized definition of m-Health, citing it as 'medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices'[12]. However, some of the terminologies and interpretation used in this definition (e.g. the now obsolete PDA) are strongly debatable and adds to the confusion surrounding the m-health concept. There is obvious view that the inclusion of m-health as a sub-domain of e-health reflects the current paradox of the differentiation between the two concepts [9]. The unprecedented global growth and usage of smart phone technologies lead to the introduction numerous e-health and m-health applications and services globally. Figure 1 illustrate the general representation of the concept of mobile health [9]. m-health has been increasingly viewed as essential tool for tackling many of the global healthcare challenges facing both the developed and developing countries. These include diverse applications and clinical areas such as chronic disease management, nutrition, wellness, effective patient-healthcare provider communications, behavioral change and coaching aspects [9,11]. Further, m-health also created massive opportunities for digital market driven opportunities. These include global community from industry sectors, medical devices, data content, communications and mobile phone industry, e-commerce, clinical IT services etc. Due to this proliferation, m-health has been widely understood and recognized as 'smart phone centric' tool that enables effective communications and allows patient empowerment through innovations via mobile applications (Apps) to provide better healthcare outcomes rather than a multidisciplinary scientific area [9]. The literature review of these diverse areas and benefits of mobile health applications are numerous and is beyond the scope of this paper and can be cited elsewhere [9-12]. The term 'digital health' has been recently introduced and used synonymously with m-health. However, this represent yet unclear and ambiguous umbrella terminology that captures most of the ICT for healthcare domains mentioned earlier and combined with recent advances in digital, computing and genomic developments. These include for example big data, cloud computing, quantified self, gamification, genomic sequencing etc. However, to date there is no clear or global definition of digital health and there is ongoing debate on the nature and the origin of this term.

More recently the WHO published a classification of digital health interventions (DHIs) categorizes the different ways in which digital and mobile technologies are being used to support health system needs that are targeted primarily at public health audiences [13]. These and other cited resources can be useful references for planning and

implementing future mobile and digital health initiatives and policy framework for successful mobile and digital health programs tailored for the Kingdom's healthcare needs and patient services.

Figure 1.   The Basic building blocks of m-Health (Adapted from [9])

III.   LITERATURE REVIEW

The potential benefits of m-health in different clinical areas and improving healthcare delivery has been covered extensively elsewhere [9, 11]. Although, there has been a notable interest in mobile health in the Kingdom recently, the volume of the published studies in this area remains relatively low compared to the global interest. Furthermore, most of these studies aim to introduce the concept with basic insight of the clinical and patient benefits. A general survey of the published work on m-health in the KSA was conducted in April 2018. These studies reviewed through the Google, Google scholar and the PubMed database on the published papers and information related to mobile health in KSA. The keywords used were "mobile health", "m-health', "mobile health applications", "mobile phone", "health Apps" in Kingdom of Saudi Arabia. The articles written only in English and published after 2013 were selected. Conference papers, newspaper and other articles of commercial nature were excluded from the review. The topics of telemedicine, telecare, telehealth and e-health were also excluded from the results. This general survey yielded a modest 10 journal publications that falls within the general areas of m-health. Most of these studies can be categorized within the following areas:

1-   Mobile health and applications of social media, text messaging for monitoring and management of specific disease conditions and health problems such as diabetes, mental health, weight loss, antenatal care and other areas [14-21].

2-   Perceptions and benefits of using mobile phones for the benefits of patients and health care providers and medical practitioners [22, 23]

A summary of the extracted data of these studies are presented in Table 1. The majority of these studies fall within the literature review survey, feasibility and pilot study themes or as general introduction. These publications indicate a limited but increasing trend of interest within both research institutions and healthcare providers in m-health. However, there is need to increase this modest number of studies by introducing more research programs and funding opportunities in this important area that aim to conduct large systematic intervention studies and provide better evidence on the benefits of m-health for both patients and healthcare providers.

TABLE I.   SUMMARY INFORMATION OF MOBILE HEALTH (M-HEALTH) STUDIES IN THE KINGDOM OF SAUDI ARABIA

Authors	Type of Study	Summary of Results
Alanzi [14]	Systematic review of social media for diabetes management	Social networking can be considered as an important tool in better diabetes education and management
Alanzi et al. [15]	Social networks for Mobile diabetes management	Social networking tools tailored for Saudi patients applied for better diabetes management
Alotaibi et al. [16]	Mobile diabetes management and education system	Development of Mobile diabetes management system for improving education and better blood glucose control.
Alotaibi et al. [17]	Mobile diabetes management system	The general system architecture of a mobile diabetes self-management system for Saudi patients.
Atallah [18]	Mobile health applications for Saudi mental health patients.	The acceptability and usage of mobile health applications and tools among Saudi mental health patients for increased educational awareness and progression status of depression and/or anxiety.
Alnasser et al. [19]	Arabic mobile health application for weight loss	Weight loss application can be potentially an effective and popular tool for reducing weight in Saudi Arabia
Bahanshal [20]	Text messaging for antenatal care (Text4Baby)	The feasibility of developing an Arabic version of the text messaging for antenatal care for Saudi pregnant women with potential benefits.
Alsalamah [21]	General review of Mobile health applications in emergency medicine departments.	Not all commercially available mobile health applications can be recommended for use in emergency medicine departments. These need to be evaluated and verified before deployments.
AlKlaub et al. [22]	Feasibility study on mobile phone as educational tool for children's oral health.	Mobile phones can significantly improve the knowledge of mothers toward their child's oral health status.
Jamal et al. [23]	Evaluation of smart phone usage by Saudi medical residents.	Majority of the participants agreed with the concept of integrating medical staff mobile phones with the hospital information system.

IV.   DISCUSSION

Increasingly new m-health models and framework approaches are being introduced globally that aim for patient empowerment, better healthcare access and mobility representing disruptive opportunities for improving existing healthcare delivery mechanisms.

The unprecedented growth and interest in m-health, especially in recent years is mainly due to the recent

advances and rapid innovations in mobile communications, smart and wearable sensing linked to the internet. These are increasingly aiming to transform the quality of healthcare delivery and associated clinical benefits on a global scale. However, this massive interest and proliferation has not yet been widely introduced and translated successfully into the KSA. The KSA is undergoing major socio-economic development and progress, however, it is also facing many healthcare challenges associated with increasing cost burdens and pressure on specialist care and treatments. These are also compounded by the changing wellness and unhealthy patterns within the Saudi society such as increasing sedentary lifestyles, poor sport activities, poor pattern of eating habits and others. These leads to high prevalence of non-communicable disease such diseases such as diabetes, hypertension, cardiovascular, cancer and others. For example, the prevalence and associated costs of diabetes and its complications alone were estimated to cost (17 Billion Saudi Riyal) or $3.2 Billion in 2014 [24].

Form the technological perspective, the introduction of m-health is both important and timely to alleviate and prevent some of these health burdens in the KSA. These innovations can also contribute to the Kingdom's 2030 vision on improving the healthcare and wellbeing of citizens. However, the incorporation of m-health and digital health services into the healthcare system remain challenging. This move is fraught with many clinical, social, cultural barriers with many financial, regulatory and security hurdles. In order to realize the Kingdom's new vision and to adapt more efficient and effective healthcare services, the Ministry of Health recently adopted new institutional strategy that aim to establish a number of government owned companies and sector that will aim to compete with each other and with the private healthcare sector. The objective is to introduce and provide more effective and efficient healthcare services throughout the KSA like mobile health innovations.

The key drivers for introducing m-health in the KSA can be summarized as:
1. Increasing healthcare burden and costs of care especially in the chronic diseases and the need to improve current healthcare practices and to provide more efficient and patient centered care.
2. The rapid socio-economic changes in the KSA with high level of access and penetration of smart phone and social media usage and other digital communication channels that represent an existing use infrastructure for such services.
3. The policy of digitization of the healthcare services through new privatization strategy and with new public-private-partnerships (PPP) by the Ministry of Health.
4. The success and embrace of other disruptive economies and sectors such transport (UBER), retail (Souq/Amazon) that can form exemplars for the mobile health sector.

However, from the few studies outlined earlier, the potential to introduced earlier should not lead to the severe cases of 'pilotitis' and pattern similar to other m-health initiatives in the developing world. There is need for introduction of clear policy and strategy for moving forward with scaling-up plans beyond any of these pilot studies. There are massive opportunities for adopting m-health and digital health in the KSA, there are also many challenges and barriers that need to be overcome to allow the successful and large-scale m-health implementation within the Kingdom. These include the following barriers:
1. Lack of clinical and technical expertise: These barriers related to the lack of the clinical and human resources specialized in mobile and digital health in the Kingdom. These need to be tackled by providing new specialist training and teaching programs within the medical school to increase the level of awareness and specialty in mobile and digital health among Saudi doctors and healthcare providers.
2. Long term m-health strategy and economic policy: These include the lack of long-term m-health strategy and economic planning policy for m-health in the Kingdom. This important barrier needs to be addressed appropriately to plan new and specific m-health and digital health policy and economic strategy tailored for the Kingdom's urgent healthcare needs and challenges.
3. Social and human barriers: These barriers include the uncertainties, the motivation among patients and their awareness to the benefits of m-health in many healthcare sectors. This barrier is vital for the success of any m-health initiative in the Kingdom. Both the government and the other public and private sector (telecommunications, insurers, and healthcare providers) need to have a long term and sustainable plans to the introduction and long-term benefits of m-health.
4. Legal, privacy and regulatory barriers: These include the lack of the appropriate legal policies and governance regulations, including privacy and security challenges and the absence of relevant legislations.

The following recommendations can represent a m-health road map or action plan for new strategy within the KSA:
1. The need to increase awareness on the benefits of mobile and digital health among policy makers and healthcare providers. Also, to identify and address the key national healthcare priorities and the specific m-health interventions that can provide better outcomes and patient benefits.
2. The establishment of strategic and sustainable national m-health/digital health plan for the Kingdom.
3. Establishing mobile health/digital health research centers within the key medical and university institutions for training and education in this important area.
4. Development of vibrant medical and technology sectors in the country with private and PPPs to ensure successful and sustainable m-health services.
5. The establishment of a Saudi regulatory body to supervise these services and oversee the

relevant security, privacy and ethical issues of these systems and applications.

V. Conclusion

The potential of mobile and digital health innovations in transforming the current healthcare services in KSA is boundless. The KSA is currently undergoing major digitalization process and efficiency transformation in key economic sectors including the healthcare sector. This review presented the current status of m-Health and digital health in the KSA. The limited number of the published work in this area compared to the global levels indicate the urgent need for more rigorous efforts and strategy to increase the awareness and pervasiveness of m-health services. The study also indicated that the lack of awareness on the importance of m-health in the country compared to e-health services in the healthcare sectors. This can be attributed to the lack of clear differentiation between the two areas. However, there are many challenges associated with the introduction and wider adoption of m-health in the public and private healthcare sectors in the Kingdom. Further work is required by both the healthcare policy makers and other stakeholders interested in this area and some recommendations that can constitute an action plan or road map towards achieving these goals.

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