

Influences and Barriers in the Kingdom of Saudi Arabia Affecting Technology Adoption in Healthcare: A Review Paper

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Abstract

The healthcare industry continues to adopt and integrate smart technology in its operations, from medical devices to managing operations. However, the adoption curve has not been smooth, and the historical record of technology adoption in the Kingdom of Saudi Arabia reveals the existence of both known and unknown issues. This review paper is aimed to explain the influences and barriers present in the Saudi healthcare sector affecting IoT technology adoption. A comprehensive discussion of the literature illustrated that Vision 2030, the privatisation trend, transformation in disease patterns and ageing, issues in management and increasing public awareness are the key drivers that may influence the need for the medical Internet of Things (mIoT) in Saudi healthcare. However, based on the past trend, the introduction and adoption of mIoT will likely experience issues such as non-compliance from doctors and nurses due to negative beliefs, lack of knowledge and inadequate perception of effort requirements. Thus, in-depth research of the factors associated with mIoT technology adoption is suggested for a smooth transition.

Keywords:

Internet of Things, Medical IoT need in KSA, Technology adoption barriers

1. Introduction

Information technology advancements continue to transform service delivery and efficiency in various industries. It has led to modern smart objects that create a new era of applications that are powered by the Internet of Things (IoT)-based networks [1,2]. The healthcare industry continues to adopt and integrate smart technology in its operations, from medical devices to managing operations. However, the adoption curve has not been smooth, and the historical record of technology adoption in the Kingdom of Saudi Arabia reveals the existence of both known and unknown issues, which can vary significantly depending on the type of information technology being implemented. Given these circumstances, this review paper is aimed to explain the influences present in KSA supporting the need for IoT technology adoption in the healthcare sector. In addition, the discussion on the barriers creating substantial hurdles

in the technology adoption path is included in this review paper to provide a holistic view.

2. IoT need in healthcare - Vision 2030

Saudi 2030 vision is based on three basic principles: a thriving economy, a vibrant society and an ambitious nation [3]. It is a bold measure taken by a country whose society is comparatively restrictive and strongly influenced by Islamic teaching [4]. The critical aspect of Vision 2030 is the quick uptake and utilisation of digital solutions to solve various issues in society. The vision encompasses economic remodelling and diversification. The objective is to transfer reliance from natural resources to trading venues incorporating digitally advanced investment hubs [3]. This objective is planned to be achieved through adopting cloud computing, fast Internet (5G) robotics, IoT and AI [3]. Further, in 2017 just over 75% of the Saudi citizens had access to the Internet KSA. However, it changed rapidly, and according to the 2021 data, 100% of the Saudi population had access to the Internet [5,6].

This demonstrates rapid advancement and the potential of IoT in the country, as access to the Internet is the key requirement for the introduction of IoT-based systems. The recent inauguration of Line City is the practical implementation of Vision 2030 and demonstrates an example of smart cities planned to be built across the Kingdom [7]. One of the key features of smart cities is the massive inclusion of sensors that can conduct business without human involvement, which leads directly to the incorporation of IoT and AI. The IoT technology market in KSA is on the rise; according to Khalil [8], around \$1.48 billion was spent on IoT-related technologies in 2019, and it is predicted to increase exponentially in the coming years, making the KSA IoT market the largest in the Gulf, of Cooperation Council (GCC) region [8].

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Vision 2030 has been very beneficial for the field of health, in particular, in the Kingdom. In contrast to the past, the health sector has opened its door to foreign investors, who can retain 100% ownership, which is not possible in other sectors of the economy [9]. Considering this initiative, foreign investment touched US\$ 3.5 billion in 2018 in KSA, and it is predicted that healthcare investment will increase sustainably in the next few years [9,10]. Furthermore, the key aim of healthcare privatisation was to increase the capacity of healthcare and improve the quality of care; it is aimed to add 26,000 more beds for healthcare by the year 2035 [9]. Moreover, the government and the health ministry are in the process of developing “medical cities”, which are intended to offer world-class healthcare services by including state-of-the-art equipment [11]. All these measures significantly highlight the need for the inclusion of IoT in the healthcare system, as increasing private investment and medical care capacity and quality requires automation and precision, which demand IoT [12,13].

2.1 Privatisation trend in the Saudi healthcare system and potential technological revolution

The Saudi health sector is very robust, and 29 of its hospitals have been listed among the best hospitals in the world for the year 2022 by the American magazine - Newsweek [14]. It is important to note that Saudi Arabia entered into the world-class category first time in history, and this list included 2,200 hospitals from 27 countries around the globe [14]. The Ministry of Health (MOH) is the main body responsible for providing healthcare services in the Kingdom, with 60% of the healthcare services provided by the MOH [15]. Apart from MOH, other government bodies such as the Ministry of Education, the National Guards and the Military also provide healthcare services through specialised hospitals such as King Faisal Specialist Hospital and Research Centre [16]. The healthcare facilities offered by the MOH are delivered through the hierarchical structure of three levels - primary, secondary, and tertiary. The primary health care (PHC) centres stand at the primary level, where both therapeutic and preventive medicine is provided. The complicated cases are referred to the public hospitals, which come under the secondary level. Finally, the specialised hospitals which deal with complicated cases are categorised at the tertiary level [16].

However, the dominance of the MOH and the KSA government in the health sectors will change; the current 78.9% contribution of the KSA’s government in the health sector will be replaced by the private sector [17]. A new private holding company will take over the healthcare facilities usually supplied by the MOH [18]. The company has already been approved by the Saudi Cabinet and is focused on providing medical services via a combination of independent companies specialising in different sectors [18]. As a result, the role of MOH in the near future will be limited to the regulation and supervision of all the public and private health institutions in the country [18]. However, this news did not come out of the blue. Instead, it was part of a bigger plan ‘Privatization Program’, launched in 2018, which aimed to enhance the role of the private sector in the country. The key part of the plan was to privatise 290 major hospitals and 2300 PHCs by the year 2030 [8,18].

The transition towards privatisation will have a significant impact on the working structure and dynamics of the health workforce in the Kingdom. It is expected that, like every other privatisation, the tolerance towards performance inefficiencies will be significantly reduced in the health sector [19,20]. Similarly, it is also believed the focus towards quality of care and cost-effectiveness will be shifted dramatically in the health sector [10]. In other words, the privatisation trend will bring a technological revolution in the health sector to reduce costs and increase accountability at a very fast pace, which may not have been witnessed before in the Kingdom [10]. Thus, the privatisation trend is a significant facilitator, and understanding this aspect will motivate healthcare professionals to adopt IoT.

3. Health needs of the Saudi society and opportunities for medical Internet of Things (mIoT)

Assessing the current and future issues or needs of a particular society and synchronising them with the potential of a particular technology can highlight the relevance and significance of that technology. This comparison can also influence the adoption factors, such as expectations associated with the performance and effort requirements, along with the social impact of that technology.

3.1 Transformation in disease pattern

The Kingdom of Saudi Arabia is undergoing significant changes in the country's disease pattern and shifting towards chronic disease [21,22]. This shift in the disease pattern is increasing the burden on the current healthcare facilities as the available PHC services, patient education facilities, and patient follow-up approaches are not enough to accommodate the increasing demand [22]. For instance, in KSA, more than 3.8 million adults aged between 20 to 79 years were diagnosed with diabetes in the year 2017, which suggests a prevalence of 17.75% [23]. Diabetes has almost doubled in the last decade among the obese population, and the country's obesity and hypertension rates are among the highest in the GCC region [23,22]. However, the capacity of the public health sector has not grown proportionally and is under a huge burden of non-communicable disease prevention and management [24].

Also, the increase in health workforce demand is not the only issue accompanying the transformation towards non-communicable diseases; a substantial increase in healthcare cost is another major global threat associated with this transition [24]. Public healthcare in KSA is free for all Saudi citizens and is supported by the central government. Moreover, MOH per capita expenditure, although low pertinent to a number of nations in its league, still has increased substantially, putting economic burden on the country [15]. Considering this, healthcare organisations around the globe are moving towards the adoption and use of eHealth solutions, which incorporate the increased use of ICT in the health sector.

Similarly, the global health leader, the World Health Organization (WHO), suggested that the inclusion of eHealth systems is mandatory to attain universal health coverage and stated that "e-health is the cost-effective and secure use of ICT [information and communications technology] in support of health and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge and research" [24]. Thus, there is a crucial need to introduce advanced IT technologies such as mIoT to manage the demand and cost associated with the increased risk of chronic diseases in Saudi society.

3.2 Change in population demographics and healthcare deficits

Apart from the transition in the disease pattern, Saudi Arabia is also witnessing significant changes in its population demographics. The population is projected to grow to 40 to 50 million in 2030 [25,26]. With the increase in population, the average life expectancy is also expected to increase significantly in the next two decades [10]. Similarly, the number of individuals between the age group 40 to 59 years is projected to increase by 1.5 times and with over 60 years are likely to increase by more than three folds. With 44% of the population 40 years and old, KSA is critically heading towards the times that require the dire need for advanced healthcare as the ageing lifestyle demands and chronic diseases mentioned above are going to overwhelm the healthcare system [23,22,10].

The WHO has already indicated that the Kingdom requires highly advanced medical and surgical interventions due to rapidly increasing ageing lifestyle diseases and linked comorbidities in the Saudi population, suggesting to push an upturn in the adoption of cutting-edge technologies such as Medical IoT [14]. If adequate measures are not taken, it is estimated that 73% of all deaths by 2025 will be linked to non-communicable diseases in the country [10]. The transition in the disease pattern and population demographics has put great pressure on Saudi hospitals to increase their capacity to meet the upcoming demands. There are about 415 hospitals managed by the MOH and other sectors of the government and around 127 privately managed hospitals which provide a total capacity of 69,394 beds to patients [27].

However, more is needed; the country needs more than 20,000 beds in the near future to cover the increasing healthcare demands. Considering the global statistics on the hospital bed to population density, the country faced a deficit of 14,000 beds in 2016, which as the current projections going to touch 40,000 in the next decade [10]. Additionally, the healthcare workforce in KSA is highly dependent on the expatriates, and it is expected that the government is going to require over 13,000 doctors by 2030, which will be a difficult task considering the substantial reliance on the foreign workforce [28,10]. The issue of recruitment is not enough, let alone the need to train the foreign workforce to provide standardised quality

of care across the board [28]. In between all of this, the government's major initiative to privatise the healthcare previously provided by the MOH will support the system by increasing efficiency but will disturb the bureaucratic power structures of the hospitals [29,10]. Consequently, this may lead to additional difficulties in hiring and managing healthcare staff.

However, it is believed that hospitals that are equipped with cutting-edge technologies such as medical IoT will attract experienced and well-reputed doctors, administrators, nurses and other medical staff from across the globe, which not only support the health sector but also support the reputation and economy of increasing medical tourism in the Kingdom. It is also noted that the current quality of healthcare services and healthcare professionals varies significantly with the geographical region of the country; this lack of standardisation could be due to not having adequate technology that can support effective communication within healthcare institutions across the country [28]. In a nutshell, mIoT is the need of the hour for the Saudi healthcare system to keep up with the changes coming along with the Vision 2030 plan and maintain an essential balance in the system.

4. Public awareness

Increasing public awareness is another crucial factor that can drive technology adoption demand in the Kingdom's healthcare sector. The Saudi population is on the path leading towards higher levels of education, increasing health quality awareness, better doctor-patient communication and all other doctrines of Westernisation [30]. These all have supported the citizen's awareness to a level which is demanding significant improvement in the quality of service and effectiveness of treatment provided by the clinicians [31]. In addition, the current Saudi youngsters, which include individuals from the X, Y, and Z generations, are relatively more aware of their health determinants and are also significantly conscious about their appearances [30].

Moreover, it is essential to note that the general Saudi population has shown a great attitude towards self-care digital solutions, and according to Al Kuwaiti et al. [32] around 84% of Saudi consumers consider technology as a significant factor in the

management of their own health. These all suggest that the health force is KSA, if not now, but in the near future, will face pressure from the public to use state-of-the-art technologies, including IoT, in their practice. KSA is a society that is driven by the social norms and expectations of society [33]. Respect in the health workforce, in particular, is associated with social image, which is linked to meeting the demands of the public. Thus, incorporation of IoT in healthcare should be one of the top priorities in the Kingdom.

5. Issues in management

The health sector of KSA, without a doubt, has improved significantly in the past decades. However, the sector is still facing substantial management-related challenges. These challenges originated from a range of causes, such as changes in population growth, inequitable access to healthcare, issues in the electronic health system (eHealth), poor communication between health sectors and highly centralised structure [34,35,36]. The Saudi government has created and tried several strategies to counter these issues, and one of the most recent ones is the Strategic Plan for the Ministry of Health (MoH) 2010–2020 [21], which has led to the dismissal of seven health ministers in a period of just one year [15]. This indicates the complexity and gravity of the administrative concerns in the Saudi health sector caused due to a number of issues mentioned above.

Moreover, the shortage of medical staff and overreliance on the foreign workforce has also increased the severity of the management issues. Alqahtani et al. [37] highlighted that over 75% of doctors in dentists in KSA are non-Saudis, and over 60% of nurses are from outside the Kingdom. The diversity in the cultural and educational backgrounds, along with the limitation of the resources and significantly affected the quality and quantity of the staff training programs, hence creating issues in the management [15]. The inclusion of advanced digital solutions, such as medical IoT, has the potential to play a major role in managing if not all but the majority of issues stated above.

6. Barriers experienced by past eHealth technologies in KSA

The track record of technological introduction and adoption in the Kingdom's healthcare sector is not smooth, and various issues have been identified by the studies conducted in KSA in the last decade. One of the earliest studies was conducted by Bah et al. [38], who examined 19 hospitals in KSA to evaluate the extent of EHR use in the Kingdom. The study found critical issues in the adoption of EHR, which included non-compliance from the doctors and nurses due to negative beliefs associated with security, confidentiality, absence of incentives and motivation, increase in workloads pressure and inadequate EHR training [38]. Moreover, another study conducted in the Riyadh region highlighted the advantage of EHR systems and indicated an improvement in accuracy in the database system of the hospital. However, despite this, the healthcare professionals in the hospital showed a lack of interest in EHR due to low computer literacy [39]. The findings related to computer skills inadequacy are also supported by Farooq & Shaker [40], who conducted a study with 451 physicians from seven hospitals in Makkah, KSA. The study concluded that participants required more training in even basic computer software such as Microsoft Word and PowerPoint [40].

The above findings can be further validated with the robust research conducted on EHR systems in the Kingdom by El Mahalli [41], who reported underutilisation of EHR functionalities across the board in the hospital. Apart from these, the doctors reported data entry time, lack of adequate IT training and support, the complexity of technology, lack of customizability option of the EHR system according to user's needs, and disturbance in communication between doctors and patients as grave barriers linked with EHR adoption. Apart from these issues, the healthcare staff in KSA also highlighted the English language as a significant barrier. The studies by Hasanain et al. [42][43] showed a significant positive association between English language proficiency and computer and EMR knowledge levels, suggesting that 80% of the study participants were at risk of inadequate EMR literacy. Apart from these, professional respect and prestige are other issues

associated with introducing digital solutions in the health sector.

Alsadan et al. [44] suggest that professionals fear that they might lose respect and privileges with the introduction of eHealth projects in the Kingdom. Apart from EHR, Computerised Physician Order Entry Systems (CPOE) research has also shown adoption issues. For example, Mominah et al. [45] conducted a study with a local hospital in KSA and found that inadequate application of CPOE caused fatigue and disturbance in clinical workflow in the hospital [45].

7. Adoption issues with more recent eHealth technologies – Telemedicine

In broad terms, telemedicine includes the remote connection between a doctor and a patient, and it can have many types and can be classified as mIoT [46]. For instance, if only a messaging app is used to connect a doctor with a patient, then it has a limited scope under mIoT [46]. On the other hand, if camera and video conferencing are incorporated, then it can be classified as a sub-component of mIoT. Moreover, if, along with a camera, sensors are used to remotely collect physiological measurements, and AI is used for the diagnosis, then it can be classified as full-functioning mIoT [46,47]. The current telemedicine scope in KSA is limited to the use of smartphones, email and video conferencing to provide remote clinical care [48]. However, despite the limited application of telemedicine, past research conducted in KSA has identified various issues.

The study by El.Mahalli et al. [49] reported that only one-third (33.3%) of the professionals were using telemedicine, which was at that time significantly low compared to Western nations such as Australia [50]. Moreover, telemedicine adoption also varied with the demographics of the professionals (gender, profession and experience). For instance, more male professionals (37%) adopted telemedicine compared to female professionals (26%). Similarly, consultants with 20 years or more experience demonstrated the highest frequency of telemedicine use (48%) compared to others El.Mahalli et al., [49]. Furthermore, lack of knowledge, time constraints, and inadequate perception of the importance of

telemedicine, its functions, and services were the main barriers to telemedicine adoption in KSA. In addition, a lack of awareness due to inadequate workshops, seminars and conferences may be the reason behind these barriers [49]. Similar to this, Albarrak et al. [48] highlighted that telemedicine knowledge is still low among physicians; around 46% of the participants had low knowledge, and 53% had no familiarity with telemedicine tools and their applications [48].

Despite the above-mentioned issues, the participants in Albarrak et al. [48] study showed very high agreement (90 -95%) that their colleagues are willing to use telemedicine technology in their practice [48]. However, another study conducted in Riyadh, almost at the same time, showed that around two-thirds (66%) of the doctors supported office visits over telemedicine [51]. The participants cited various reasons for this preference, such as the capability to conduct comprehensive examinations, ease of discussion with patients, provision of more time and efficient use of time in office visits vs telemedicine [51]. This suggests that the introduction of telemedicine varied significantly even in the same region of the Kingdom. Moreover, even at the presumably best telemedicine adoption settings, the clinicians had insufficient knowledge and low familiarity with telemedicine tools and their applications [48].

8. Conclusion

This paper concludes that the introduction and use of eHealth technologies in the Saudi health sector have experienced significant issues due to inadequate planning and research. The use of advanced technology, such as mIoT, in healthcare is the need of the hour due to a myriad of reasons stated in this paper. However, the adequate introduction and adoption of eHealth or mIoT technologies can only be conducted through in-depth research of the factors associated with that particular technology.

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