eHealth Care Development in Saudi Arabia: Challenges and Problems in e-Health Systems

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Abstract
This systematic review aimed at identifying the challenges and problems of e-health in Saudi Arabia. This information is essential for subsequent identification of e-health modelling requirements and e-health opportunities in the country. The topic itself was used as the search term in Google Scholar resulting in selecting 19 papers for the actual review. The review results have been presented as abstracted findings of each selected paper (additional document) and categorisation of papers based on topics, types and research methods used in the papers. The most important compilation was consolidation of problems, challenges and barriers identified by different authors into broad groups aimed at identifying the most frequent problems and challenged reported by these authors. The tabulated data showed 19 papers to be directly dealing with the topic of this review. The remaining 9 were dealing with other topics, but barriers, problems or challenges were parts of the study. There were 8 conference papers and 11 journal papers. Surveys were the most used (10) among the research methods categorised. Some papers used more than one method. In the case of frequency of papers dealing with different problems, barriers or challenges, 29 occasions of technological and 20 occasions of ICT infrastructure-related and 13 occasions of organisational and psychosocial factors were obtained. In some papers, more than one method of the study was used, and in all the methods, similar or different barriers were identified. These results have been discussed and three recommendations have been given.

Keywords:
eHealth Care, Challenges and Problems, e-health System .

1. Introduction

In this systematic review, the problems and challenges in e-health modelling of Saudi e-health system requirements are examined and reviewed. It was already observed in that review that in spite of significant progress achieved in Saudi Arabia with respect to health care and achieving international recognition by some Saudi hospitals, its progress in e-health was not as rapid as it should be (Altuwaijri, 2008). Slow implementation of e-health in Saudi hospitals (Almalki, FitzGerald, & Clark, 2011) could be attributed to a lack of coordination. The possibility of challenges and problems were indicated with the expectation that identifying and using e-modelling requirements of healthcare may provide at least a partial answer to this problem. However, mere identification and using modelling requirements may not be adequate, as we have not fully identified the problems and challenges in that paper. Therefore, this paper focuses only on the problems and challenges of e-health requirements modelling of the Saudi healthcare system, while keeping in mind, lack of coordination as a major problem.

2. Methodology

The topic of this review itself was used as the exact search term “emerging challenges and opportunities in modelling e-health systems requirements in Saudi Arabia” in the first five pages of Google Scholar using the Any time specification. The search was repeated for searching another five pages of Google Scholar with time specification of 2015 and after to locate more recent researches. The search yielded 19 useful papers for this review, including some abstracts containing the relevant information. Papers which did not list or discuss problems and/or challenges and those not related to Saudi Arabia are not included in this review. A recheck of papers listed in the Google Scholar with differet time frames showed that no paper related to the topic has escaped listing here.

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3. List of papers and findings

Alnuem, Samir, Youssef, and Emam (2011) focused on the problems of integration issues, security, and uniqueness of the patient identifier in integrating patient healthcare records from different providers at least briefly. A model for integration was proposed by the authors.

Al-Solbi and Mayhew (2005) found a general lack of awareness about the usefulness of ICT, lack of a comprehensive national strategic plan for ICT development, absence of regulations to clearly define privacy and concerns about security issues of the organisation and individuals, lack of ICT skills and advanced technologies and specifically an ICT plan and adequate funds for e-health.

Alharbi, Atkins, and Stanier (2015) identifed high cost, complexity, shortage of ICT skills as the problems. A cloud computing framework for cloud computing decision making in e-health sector of Saudi Arabia was proposed.

Uluc and Ferman (2016) identified ICT infrastructure, regulations, cultural and clinical adaptation of users, financing, supply chain management as some of the major challenges in e-health development of Saudi Arabia and three other countries in the Middle-East.

Alshamari and Seliaman (2014) noted that a majority of staff working in public and private hospitals of Saudi Arabia either did not any experience or less than one year experience in health information systems. This is a major problem and training all of them within a short time for faster e-health development is a challenge.

Alsulame, Khalifa, and Househ (2015) identified organisational and cultural issues, end-user attitudes and lack of required skills as the major challenges of e-health implementation in Saudi Arabia.

Hasanain, Vallmuur, and Clark (2014) gave a detailed review of barriers for the implementation of electronic medical records in Saudi hospitals as reported by different workers. Cost, privacy concerns, the complexity of software as well as a lack of uniform standards and vendor support and maintenance and lack of knowledge and experience in using computers. The authors categorised the barriers into social, technical and resource barriers. Social barriers included resistance to use the system, language problem, workloads when using electronic medical records, physician attitudes affected by organisational support, and ease of using EHR. Another major problem was the physicians' attitude about the more time required for the requirement of their entering the data in the computer, thus decreasing the time available to see the patients (less patients are seen) and thus loss of productivity compared to the potential benefits of using it. The problems were more serious in the case of physicians who had lower computer literacy. Technical barriers were related to instability of EMR vendors, lack of standardized nationally integrated systems due to absence of a national regulator, complexity of the implemented EMR system, security concerns, lack of a universal patient identifier system and absence of a regular evaluation of EMR. Lack of properly skilled human resources, the required number of computers and other technological resources were the resource barriers. The authors also provided a chronological table of e-health implementation in Saudi Arabia, which is reproduced in Fig 1.

Chikhaoui, Sarabdeen, and Parveen (2017) observed that security, privacy, reliability, integration and data portability are the more critical challenges and barriers for using cloud computing in e-health applications in Saudi Arabia. These factors cause its slow adoption in Saudi Arabia.

Altuwaijri (2008) identified the barriers of project/economic/resources, technical, organisational and behavioural nature in the implementation of e-heath in Saudi Arabia. These types and descriptions are same as given in the review of Hasanain, Vallmuur, and Clark (2014).

Aldosari (2014) observed that, although adoption rates of EHR system in Saudi Arabia was comparable with developed countries, there were wide variations among hospitals with respect to the levels of adoption of individual items.

Year	*Sector*	*Action*	*Ref.*
1988	MOH	First introduction of EMR systems in Saudi Arabia.	(4)
1993	KFSH&RC	First introduction of HIS and record health related information electronically	(4)
1993	MOH	Telemedicine and Internet technology was introduced in Saudi Arabia.	(4)
1993	KFSH&RC	Developed an e-health centre.	(23)
1999	NGHA	The first IT strategic plan for implementing HIS was developed for the NGHA hospitals.	(42)
2000	MOH	A reform committee was formed to review the Saudi healthcare services, and highlighted the lack of appropriate HIS.	(20)
2001	MOH	An information technology strategic plan was developed based on the reform committee's recommendations.	(20)
2001	NGHA	The hospital purchased a commercial EMR system to be implemented in all NGHA hospitals.	(42)
2004	NGHA	System was operational in Riyadh site.	(42)
2005	KAU-HS / NGHA	Commencement of a two year Master program in health informatics.	(20)
2006	KAU-HS / NGHA	The Saudi Association for Health Informatics was developed and its first conference was conducted.	(10)
2007	Ministry of Defence & Aviation	The north-western region of Tabuk Armed Forces hospital had its first operational EMR system within all Armed Forces hospitals in Saudi Arabia.	(43)
2008	MOH	1 billion US dollar was allocated for e-health development and implementation in Saudi Arabia.	(25)
2008 - 2010	NGHA	In 2008, the NGHA started to implement EMR system in other sites, and was fully implemented and became operational in all four NGHA sites in 2010.	(42)
2010	NGHA	the Arab Health Conference awarded the NGHA the Middle East Excellence Award in electronic health records	(42)
2011	MOH	An Information and Communication Technology (ICT) team was assigned to develop a 10 year e-health strategic plan to improve the Saudi healthcare system and its services.	(18)
2011	MOH	The percentage level of EMR system implementation in 19 MOH hospitals, in the Eastern province of Saudi Arabia was identified to be 15.8%	(29)
2012	MOH	The level of EMR system implementation in 22 MOH public hospitals was: 11 hospitals had fully implemented EMR system. 8 hospitals had EMR implementations were in progress.	(28)

Figure 1. The chronology of implementation of EHR in Saudi Arabia *(Hasanain, Vallmuur, & Clark, 2014)*.

Weaknesses of legacy of paper-based data and the enormous workload of digital transformation of these data and maintenance protocols like updating and maintaining software and communication and exchange of information were the factors which affected their pace of adoption.

Alaboudi, Atkins, and Sharp (2015) noted that continuously increasing demand for healthcare in Saudi Arabia resulted in critical shortage of healthcare-related human resources and facilities. These problems were more serious in rural and remote areas. Even tlemedicine introduced in 2013 by MOH with the collaboration of Canadian Health Infoway to solve this problem has the challenges of lack of coordination among different regional zones and directorates, limited application of telemedicine modalities, lack of infrastructure and knowledge about the services and benefits of telemedicine, difficulty of application of telemedicine and resistance by healthcare personnel. These challenges were categorised into national level and facility level for identifying solutions.

El-Mahalli, El-Khafif, and Al-Qahtani (2012) identified lack of knowledge about telemedicine among healthcare professionals as the greatest barrier for its successful implementation in the Eastern Province of Saudi Arabia.

El Mahalli (2015) observed frequent loss of connectivity of the system, if the computer crashes or power fails, access to the data is lost for some time, tight functions in utilizing system, additional time required for data entry, lack of support from IT staff of the hospital to provide continuous training, difficulty in customizability of the system in relation to users' needs, technology complexity, disturbances in patient-doctor communication and lack of conviction about the benefits of EHR as the problems and challenges related to high levels of under-utilisation of most functionalities of EHR system in Eastern Province Saudi Arabia.

Al Taisan and Seliaman (2018) studied the barriers to the adoption of health information systems and EHR in the public hospitals of Alhasa city. Technical barriers, performance expectancy and effort expectancy, were related to the extent of adoption.

Khalifa (2013) identified six types of barriers (human barriers describing the beliefs, behaviours and attitudes; professional barriers according to the nature of healthcare job; technical barriers in the use of computers and IT; organizational barriers of hospital management; funding constraints; legal and regulatory barriers of laws, regulations and legislations as perceived by healthcare professionals of both public and private hospitals in Saudi Arabia. Human and financial barriers were the most serious out of them.

Binobaid, Fan, and Almeziny (2016) identified, some general barriers from reviews categorised as technical, semantic and organisational level barriers in implementing pharmacy automation in Saudi Arabia. This has wider implications on automation of health information systems in Saudi Arabia. Organisational barriers were resistance to change, lack of training, lack of financial support and shortage of professional human power. Semantic issues were mapping issues, workflow design change as per the HIT needs and inter-operability and information exchange. Technical factors were inadequate IT support and maintenance, system complexity, security, confidentialtiy and privacy, lack of standards and poor quality of IT infrastructure. In a single hospital case study, nurse to pharmacy phone communication did not facilitate documentation. There was no medication tracking system to display essential details of medicine delivery and use by the patient to check any misreading of the prescription by the pharmacist contributing to medical errors. There was limitation on the number of patient drug profiles possible. Exceeding this limit caused loss of documentation of patient medication records. Absence of clinical intervention documentation system for patients aggravated this problem. The need for medical inventory management system with the pharmacist connected to HIS, inability of pharmacist to use imaging systems to identify pescription priority, inadequacies in cancel discharge code, manual reading of CPR medication chart for children were some other specific problems of pharmacy automation found in this study.

Almuayqil, Atkins, and Sharp (2016) undertook a detailed survey of health professionals, Saudi citizens and IT professionals to rank the e-health barriers according to their perceptions and experience. Many useful data were generated which are reproduced below. Fig 2 gives a diagrammatic representation of components of e-health barriers in Saudi Arabia.

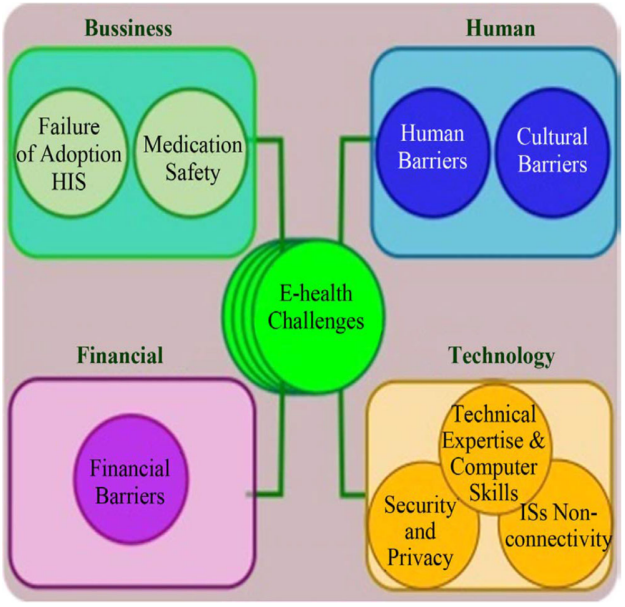

Figure 2. Components of e-health barriers in Saudi Arabia (Almuayqil, Atkins, & Sharp, 2016).

The barriers have been categorised into business, human, financial and technological barriers in this diagram. A more detailed table of these barriers applicable to different sections of e-heath users presented by the authors is reproduced in Fig 3. For example, failure of adoption of HIS

in hospitals does not mean concern citizens but is a barrier for healthcare professionals and IT specialists. IT specialists are not concerned with human and cultural barriers. Other barriers were applicable to all types of users.

Figure 3. Areas of barriers applied to different types of e-health users in the survey (Almuayqil, Atkins, & Sharp, 2016)

Table 1. Areas of study-barriers to e-health.

Areas of study	Sub-factors	Citizens	Healthcare professionals	IT specialists
Non-connectivity of ISs	Lack of national healthcare system	√	√	√
Technical expertise and computer skills	Interface design, guidelines, experience in computer applications, access and maintenance	√	√	√
Failure of adoption of HISs	Planning, technical support and running over time/cost		√	√
Human barriers	Negative believes, lack of trust and resistance to change	√	√	
Cultural barriers	Human interaction	√	√	
Meciation safety	Limited use of technology and communication gap		√	√
Financial barriers	Financial barrier	√	√	√
Security and privacy	Easy to access patients' medical records	√	√	√

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Survey responses of 117 citizens, 43 healthcare professionals and 41 IT specialists were separatedly analysed and graphed. The general trend was that medication safety was not an issue for any type of users. The mean for the IT specialists was 3.7, higher than 2.5 for healthcare professionals. IT specialists perceived limited use of technology as a major barrier (mean 4.2) compared to their perception of communication as a major barrier (mean 3.4). For healthcare professionals, the mean responses were much lower for limited use of technology (mean 2.7) and communication gap (mean 2.5). Separately graphed results are reproduced one by one below in Fig 4-6. In the case of citizens (Fig 4), connectivity to information systems (mean 4.0), human barriers (mean 3.9) and financial barriers (mean 3.7) were the highest ranking three barriers.

In the case of healthcare professionals (Fig 5), the means of all rankings were lower than those of citizens. The highest ranking three barriers were: connectivity (mean 3.5), cultural barriers (3.1) and security and privacy (mean 3.0). The mean values show that health professionals did not see any of the barriers as serious as citizens.

The survey responses of IT professionals in Fig 6 showed that none of the barriers were as serious as perceived by healthcare professionals or citizens. Only medication safety (mean 3.7), financial barriers (3.5) and connectivty to information system (3.1) were ranked first three numerically.

The results are not strictly in accordance with what we expect to be the perception of barriers by the thre types of users. Asking the same questions to all the three types of users may be one reason for this deviation. Why of this trend is unclear, due to limitations of surveys. Survey

of citizens and interviews with healthcare professionals and IT professionals would have been a better method. The number of responses of each type of users indicates this. Limited validity of using less than 50 responses of healthcare professionals and IT professionals also indicates the same.

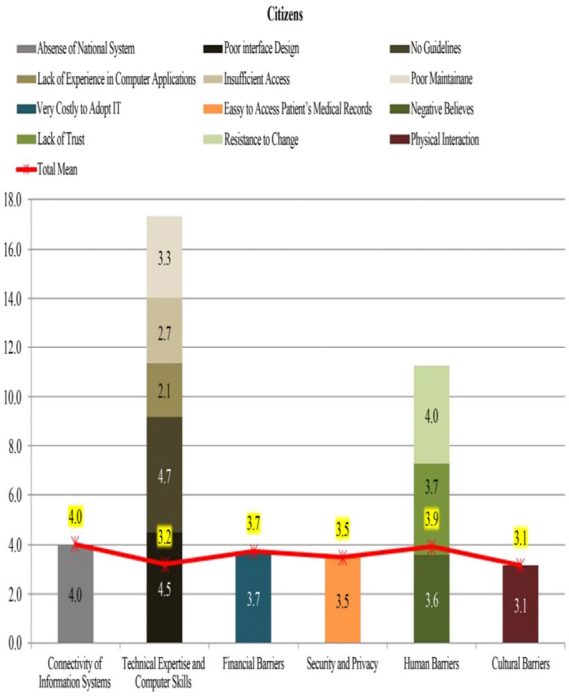

Figure 4. Survey response of citizens (Almuayqil, Atkins, & Sharp, 2016).

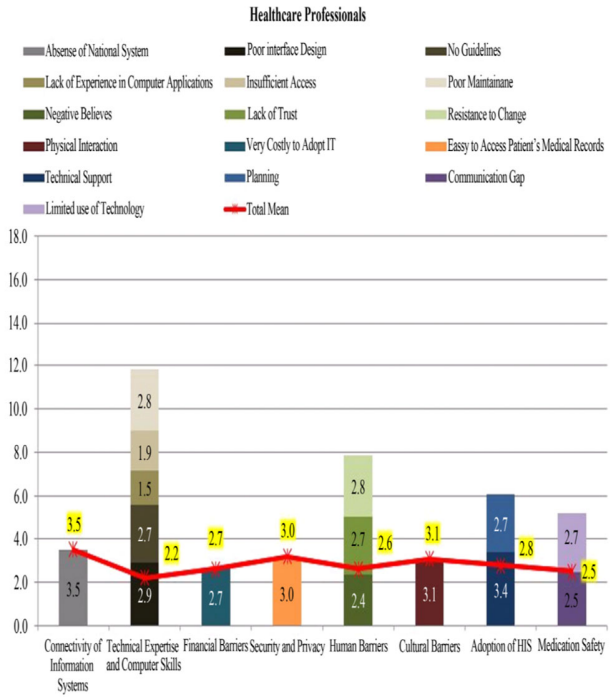

Figure 5.Survey response of healthcare professionals (Almuayqil, Atkins, & Sharp, 2016).

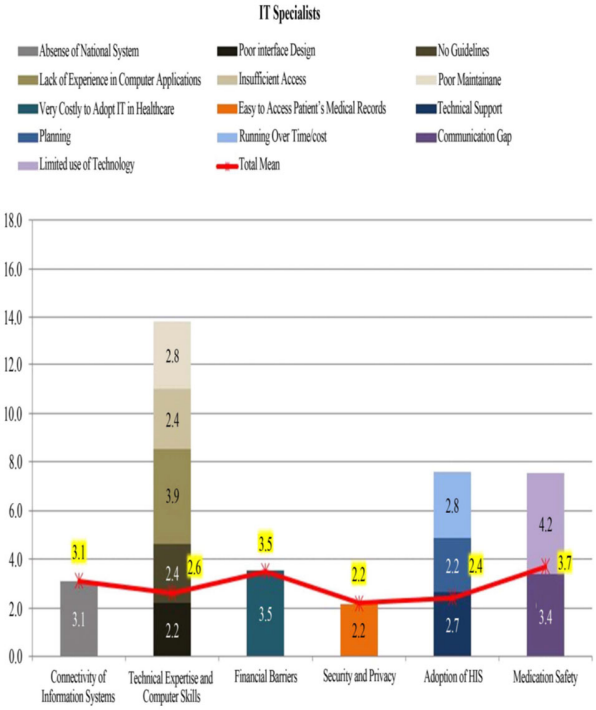

Figure 6. Survey responses of IT professionals (Almuayqil, Atkins, & Sharp, 2016).

Aldosari (2017) identified threats (barriers) of adopting health ATMs in Saudi Arabia. Lack of coordination, lack of knowledge and experience in this area, lack of high level support, lack of regional references and experiences in this area and absence of status factors like national data warehouse, unified health documentation at the national level, related legal/regulatory standards, security, and network infrastructure in rural areas, management problems of frequent changes of MOH leaders, unavailability of unified committee for health ATM and shortage of competent professionals to maintain e-healthcare systems and possible customer resistance due to lack of awareness, were identified.

Alaboudi, et al. (2016) based their studies on barriers of telemedicine adoption by HIF decision makers in Saudi Arabia on the Unified Theory of Acceptance and Use of Technology (UTAUT), the Technology–Organisation–Environment (TOE) theoretical framework, and the Evaluating Telemedicine Systems Success Model (ETSSM). The authors identified three barriers as lack of adequate financial support to implement, operate, and maintain the telemedicine system; alignment of telemedicine services with core mission, vision, needs; and constraints of the HCF and the issue of the reimbursement for telemedicine services.

Alharbi (2018) Identified the negative factors of e-health in Saudi Arabia as, “an inadequate, partially dysfunctional HIT infrastructure further weakened by each implementation failure; a dire shortage of suitably-qualified Health Information Management (HIM) professionals, incapable or reluctant to train application users, let alone additional staff members in their own department; the failure to have implemented Health Data Standards, in accordance with International Organization for Standardization specifications.”

4. Deriving common patterns

A summary of the findings on challenges/barriers/problems identified by the authors of all selected papers is given in the Appendix. The following common patterns were identified by examining the contents of the selected articles (Table 1).

Table 1. Some common patterns in the reviewed papers.

Topics of paper	**Number**	**Remarks**
Papers directly dealing with problems and challenges, security etc	10	Any problem mentioned or discussed in the article.
Others	9	
Type of paper	**Number**	**Remarks**
Conference papers	8	
Journal articles	11	
Research methods	**Number**	**Remarks**
Reviews	5	
Surveys	10	
Interviews	4	

Case studies	1	
Other	3	Mostly models and frameworks
Total	23	Total is higher than the number of papers because some papers used more than one method.

Trends were the answers to three types of queries. The first query was: Whether the paper directly dealt with the topic of review or only dealt with the topic as a part of the study? Out of 19 papers reviewed (two were used for Introduction section), 10 dealt with the topic directly, including the issue in the title itself. In the balance nine papers, the review topic formed part of the study and were discussed inside the texts.

The second query was about the type of paper. Eight of the 19 papers were conference papers, and the rest (11) were research articles. In the case of two papers (12 and 16), it was not clear from the bibliographical entries whether it was conference paper or research paper. One was included as conference paper and the other as journal article to even out any error in judging them.

The third query was about the research methods used in the studies reported. Some papers used more than one method like interviews and surveys and interviews, surveys and reviews etc. So, the total number is more than 19. Clearly, more papers used surveys.

The most important query related to the topic is the query on whether there were common problems and challenges (barriers included) identified by different researchers and whether contextual differences accounted for any differences in problems and challenges identified by them. This is tabulated next in Table 2. It can be seen that all types of barriers have been identified at various levels and contexts from the summarised findings in the Appendix. To reduce them to a few generalised factors was a difficult task. An approximate attempt is made in Table 2. Nine broad types of barriers were categorised from the findings of the selected papers. Sometimes, multiple stakeholders like IT professionals, users and healthcare professionals identify the same barriers, and they are separately counted as if they were three different reports. Therefore, the numbers reported are more than the 19 selected papers in the case of item 5 and item 8. Thus, 29 identifications of lack of resources, funds, technologies, skills, experience and training were counted. In the case of ICT infrastructure and various operational problems, 20 identifications were counted. Lack of awareness as a specific point was mentioned only in one occasion. A high frequency of organisational and psychosocial problems (13) was also noted.

Table 2. Categorisation of barriers

No.	Barrier	No of papers	Remarks
1	Integration/coordination/alignment	5	All levels
2	Security, privacy, confidentiality and regulations on them	8	
3	Lack of awareness of any type at any level	1	

4	Lack of comprehensive national strategy/plan/standards/policy/laws/regulations etc	8	
5	Lack of resources, funds, technologies and skills, experience and training	29	Including supply chain management, rural and remote areas, telemedicine, customisability, proper documentation and control
6	High cost	2	
7	Complexity	7	Including, ease of use, telemedicine
8	ICT infrastructure and operational problems	20	Including telemedicine, frequent loss of connectivity
9	Organisational and psychosocial problems	13	Including vendor support, digitisation of paper records

5. Discussions

In spite of generalisations, a substantial number of problems and challenges in currently implemented and likely challenges for future implementations of e-health in Saudi Arabia were observed. Since only Saudi papers were selected, the findings of different authors mutually supported. Clearly, Saudi Arabia has a difficult task to make its e-health systems working perfectly and show it as a model for other developing countries. The targets set for its Vision 2030 (Saudi Arabia, 2016) make the task more difficult.

The three main problems and challenges are related to the three most important aspects of e-health implementation in any country. Resources funds, technology, skills, experience and associated training, form the first part, as this review shows. Unless these factors are put together, no e-health is possible.

The importance of ICT infrastructure, especially connectivity, assuring fast connections throughout the country, is very important. Insurance against frequent failure to get connection even in remote areas is important to prevent data loss. Although the internet coverage of Saudi Arabia matches the developed countries, difficulties are experienced in rural and remote areas to get connectivity without failure. These are the very areas where there is dire need for e-health systems like telemedicine as they do not have access to specialist hospitals for serious health problems. Failure or partial success of e-health projects aggravate this problem. Lack of HIT skills can be rectified only by an accelerated training programme to train the maximum number of healthcare staff at various levels within the minimum time. The extent of delay will determine the extent of delay in implementing e-health projects successfully. All the universities and other professional institutions need to be involved to train the healthcare professionals around their areas to achieve this aim.

Data portability, inter-operability, communication and sharing of information are all parts of integration and coordination. If these are achieved, any patient can access healthcare at any place in the country, even if the original record was kept in a specific hospital. Thus, access to healthcare will be improved tremendously. The high complexity of e-health systems is a serious barrier mentioned by many authors.

Many psychosocial barriers are relevant here. Resistance or passive attitude of any stakeholders will affect e-health implementation. Negative perceptions about e-health can affect its implementation adversely. Apprehensions about

privacy, security and confidentiality can interfere. Methods like cloud computing and blockchain technology are in the research stage, and if they prove successful, these issue will disappear. In an Islamic country like Saudi Arabia, Islamic traditions can impact its success. If the support of the religious leaders is obtained, cultural barriers will cease to exist.

There is a serious deficit of national policies, strategies, laws and regulations for e-health in Saudi Arabia just as in any other country. There are no international standards specifically for e-health as yet. Some ISO standards are adapted or some WHO guidelines are used, but there no standards per se. However, Saudi Arabia can constitute a team of experts, and they can suggest Saudi e-health standards, as countries like USA and UK have done.

6. Conclusions

It is not surprising that the desired level of success in e-heath implementation has not been achieved in Saudi Arabia, given the number of problems, challenges and barriers identified by different researchers. Although more work can be suggested, first we need to use the available works to the best possibility.

However, three suggestions are given here. Involvement of all universities and other research institutions to train healthcare professionals in e-health to address skills shortage is one. The second is to get the support of religious leaders to prevent cultural barriers. The third is to constitute and expert committee to develop Saudi e-health standards which can form the basis of policies, strategies, laws and regulations for successful implementation of e-health in Saudi Arabia. These are especially important to achieve the ambitious health targets of Vision 2030.

7. Limitations

Since the scope of the work was Saudi Arabia, only research work on this country were selected. Some of the finding from other countries may have been applicable, which was not used here. Only five web pages, each with any time and 2015 and beyond, were searched in the Google Scholar. Searching more pages would have been more useful.

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