A Holistic Framework for Assisting Decision Makers of Healthcare Facilities to Assess Telemedicine Applications in Saudi Arabia

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***Abstract*—This paper outlines some of the challenges that currently face healthcare systems in Kingdom of Saudi Arabia (KSA). Increasing and continuing demand for healthcare services is aggravated by a critical shortage of health human resources (HHR) and healthcare facilities (HCFs) especially in rural areas. In 2013, 17.8% of the population lived in rural and remote areas with a huge disparity in HCFs distribution, and 76% of physicians and 44.7% of nurses are non-Saudis. Current studies have shown the potential of telemedicine to alleviate these challenges. The use of telemedicine has been adopted and the telemedicine roadmap has been developed by the Ministry of Health (MOH) in KSA in collaboration with Canada Health Infoway (Infoway). This roadmap has identified many barriers and challenges likely to face the implementation of telemedicine in KSA. This paper describes a holistic framework to address these challenges and to assess telemedicine applications in order to assist decision makers of HCFs in KSA. The proposed framework is developed in collaboration with the National eHealth Strategy and Change Management Office in the Ministry of Health (MOH) and Prince Mohammad Medical City (PMMC) in KSA.**

Keywords- Telemedicine; Healthcare challenges; Holistic framework; Saudi Arabia.

I. INTRODUCTION

Saudi Arabia's government is committed to provide free healthcare services to all Saudi citizens [1]. The Ministry of Health (MOH) is responsible for managing the country's healthcare system through the healthcare facilities (HCF) who are the core provider and represent 60% of the total healthcare services in the KSA. While some HCFs, who are under governmental sectors, provide services to their employees and their families, other HCFs, who provide private healthcare, are mostly located in urban areas [2].

The healthcare system in KSA is complex as the MOH is responsible for the supervision of HCFs in all sectors [2]. In 2013, MOH operated 2,279 Primary Healthcare Centres (PHCs) and approximately 3,000 hospitals with 37,921 beds [3]. It delivers healthcare services at three levels: (1) the primary healthcare centres (PHCs), (2) public hospitals (Outpatient Clinic), and (3) central or specialised hospitals (Medical City) [2][4]. The PHCs are the primary level and the cornerstone of the Saudi healthcare system allowing the MOH to provide healthcare services to the population in KSA that includes vaccinations, common procedures, and mother-and-child services [2]. The public hospitals (Outpatient Clinic) are the secondary level where cases that require more advanced care both preventive and curative are referred to be detected by specialists or consultants, while cases that need more complex levels of care are transferred to central or specialised hospitals (medical city) (the tertiary and third level of healthcare) [4]. In some exceptional cases, where the cases are very complex or rare, patients are referred to either King Faisal Specialist Hospital and Research Centre (KFSHRC) or outside KSA for treatment (the quaternary and fourth level) [1].

This paper is organised as follows. Section II presents the healthcare challenges in KSA. Section III discusses the use of telemedicine in KSA. In section IV, a proposed holistic framework for telemedicine in KSA is outlined. Section V concludes the paper and outlines future work.

II. HEALTHCARE CHALLENGES IN KSA

Like many countries, the Saudi healthcare system faces many challenges. The first set of challenges is caused by its geography. KSA is one of the developing countries where some of the people are living in rural and remote areas with a huge disparity in HCFs distribution. KSA is vast country, with an area of 2.2 million km², 150 cities, and more than 2,000 Villages [2]. In 2013, the total population was roughly 30 million, the population growth rate was over 3%, and nearly 18% of residents live in rural and remote areas [5][6]. The impact of geography on healthcare system has been proven [7].

The second set of challenges is caused by its lack of medical expertise and shortage of medical and qualified HHR [8]. Saudi's healthcare services are provided largely by expatriates and the high adoption of expatriates in HHR in KSA can be deduced from the statistics that are issued by MOH. The latest statistics indicate that 76% of physicians and 44.7% of nurses who are working in KSA are non-Saudis [2]. Furthermore, in KSA, the numbers of physician consultants are mostly less than the number of hospitals and in the worst case, the consultant physicians are permanently unavailable in all hospitals in some provinces. Besides, 55% of the total private hospitals and 83% of the total private clinics of the private HCFs sectors are concentrated in two provinces of KSA, Riyadh and Makkah, representing 49% of KSA population [2].

The third set of challenges is related to the increase in the population and the elderly, in particular, leading to the growing demand for healthcare services [9][10]. The

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expectancy, in medium variant, of the population growth of KSA is expected to reach approximately 40.4 million in 2050 and that is 35.1% increase compared to 2012; the number of people over 65 years old is predicted to represent 18.4% of the population in Saudi Arabia by 2050 [11]. In addition, cultural and traditional factors, such as dealing with the opposite sex and the driving ban for women, increase the burden of HHR shortage challenges and could be a huge obstacle [12].

The fourth set of challenges is related to equity of access to resources as most of the resources are concentrated in the main cities, with varying disparities [12]. A concentration of physicians in capital cities is a common feature in many countries [7]. Consequently, the density of physicians is commonly greater in urban regions which reflect the concentration of specialised services [7]. In 2012, 50% of the world's population lived in rural and remote areas served by only 25% of the world's physicians and less than 33% of the world's nurses [13]. In KSA, in 2013 alone, around 90,000 patients were referred from varies hospitals to other hospitals inside KSA for treatment [14]. Correspondingly, MOH has an 'Outreach' programme that enables specialists to conduct visits to rural/remote hospitals [3].

To address these challenges, MOH in KSA has begun investigating telemedicine as a potential solution and learning from other countries and consulting organisations such as the World Health Organization (WHO).

III. TELEMEDICINE IN SAUDI ARABIA

The quality and accessibility of healthcare have been successfully improved by telemedicine applications [15][16]. Telemedicine would serve to replace some of the in-person visits through video conferencing and provide healthcare services to patients regardless of their geographic location. In other words, while the traditional medical care relies on face-to-face communication between a patient and a physician, in telemedicine concept a patient is treated by a physician who is a distance away by utilising ICTs [17]. Therefore, telemedicine is particularly beneficial for groups that traditionally suffer from lack of access to healthcare since patients can be consulted and treated miles away by specialists [15][18].

In the 1990s the innovation of new technologies, the rapid growth of computer and information technology as well as the rapid declines in the cost of ICTs has created new possibilities and opportunities for healthcare services and delivery [19][20]. They have enabled HCFs to visualise and consider the implementation of new methods and more effective and efficient ways of providing healthcare [21].

The developments in telemedicine applications as well as new projects for implementation including the Saudi Telemedicine Network (STN) and a proposed holistic framework for KSA will be presented in this section.

A. Development of Telemedicine in KSA

Many telemedicine projects are being implemented by individual HCFs in KSA. In 1994, the first telemedicine application had been successfully applied in King Faisal Specialist Hospital and Research Centre (KFSHRC) [22]. In 1998, KFSHRC established its telemedicine network to connect several hospitals in different provinces in KSA to assess patients' medical status prior to transferring them to KFSHRC thus minimising the needs for moving patients. In 2013, more than 27 hospital sites were connected and each site was considered as 'a health partner' as well as 'a triage point' by taking advantage of available equipment and HHR management via the KFSHRC telemedicine network [17].

B. Saudi Telemedicine Network (STN)

In 2010, the MOH planned to implement telemedicine, as one of its key National e-Health Strategy projects, to cover all HCFs and to provide services to all patients in KSA [23]. For the first step of the implementation to be successful, MOH cooperated with Infoway Canada, a pioneer in the telemedicine field, to provide guidance to MOH in the development of a telemedicine roadmap for KSA. The Infoway report indicated that telemedicine would have a significant positive impact on healthcare in KSA and would alleviate many of the issues currently facing the KSA healthcare challenges [17]. It has confirmed that KSA has a degree of readiness for telemedicine as successful projects already exist and the necessary technical infrastructure expertise for telemedicine is either existing or under development [17].

However, the report has also identified many barriers and challenges likely to face the implementation of telemedicine in KSA given the healthcare complex structure system as the HCFs are divided into three sectors and supervised by different regional zones and directorates [17]. In addition, the majority of them are autonomous and each HCF has different business strategies and funding incentives [17]. Other barriers, identified by WHO are equally relevant to KSA, namely issues of cost, legal, culture, infrastructure, police, priorities, standards, knowledge, and expertise [24]. El-Mahalli et al. [25] carried out a case study to investigate the successes and challenges in the implementation of telemedicine in the eastern province of KSA. Their study concluded that, although the MOH in KSA has allocated a huge budget for eHealth, the telemedicine modalities used were very limited [25]. The top barriers as perceived by HCFs in KSA were lack of infrastructure and knowledge about the services and benefits of telemedicine, difficulty in the application of telemedicine, and HHR's resistance [25].

To address these barriers and ensure a successful implementation for STN, the report proposed to divide these barriers into two levels: a national level and an organisational (HCFs) level [17].

To resolve the national level challenges, the report advocated the establishment of a fully funded STN agency as an enabler and a provider of telemedicine services in KSA to oversee governance, infrastructure and common services used by participating organisations (HCFs) [17]. Other duties to be included are the setting of national telemedicine policies and STN connection standards for all end-point equipment, software, and processes to ensure security, interoperability and compatibility for all features and capabilities across the network [17].

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C. The Proposed Holistic Framework for Telemedicine for KSA

The aim of this research is to develop a framework to support the adoption and development of telemedicine based on the findings of the Infoway report. This framework is designed to assist decision makers (stakeholders) of HCFs in KSA to evaluate the viability and effectiveness of telemedicine applications. This research is collaborating with two organisations: PMMC as one of the HCFs in KSA [26] and the National eHealth Strategy and Change Management Office in MOH in KSA who is the sponsor and owner of STN project [27].

We have also collaborated with PMMC as this is one of five newest medical cities in KSA, and provides healthcare services to residents in remote areas and different [28].

Based on the findings of the Infoway report it became apparent that any proposed framework must take a holistic approach to address the many barriers and challenges at national and organisational levels. The proposed holistic framework is also designed to provide guidance to HCF's decision makers to identify critical barriers and challenges of their HCF based on STN standards and produce tangible and measurable criteria to support the adoption of telemedicine applications.

To develop this framework, three initiatives have been undertaken. The first initiative focused on identifying the fundamental pillars (barriers) and their concepts (sub-factors) specific to ensure a successful implementation of telemedicine applications. The concepts (sub-factors) of each fundamental pillar are specific to each HCF's requirements and challenges; they are used to generate critical success factors (CSF) for that fundamental pillar. The CSF is defined as an element of characteristics, conditions or variables that is necessary for an organisation or project to achieve its mission; it has a direct impact on viability, efficiency and effectiveness of a project, program or an organisation [29].

To identify the fundamental pillars (barriers) and their concepts (sub-factors) a survey has been carried out and individual-depth interviews (IDI) have been undertaken with experts and stakeholders in eight different HCFs in KSA, located in both rural and remote areas [26][27]. These interviews and survey have led to the identification of five fundamental pillars for the proposed framework, namely Human, Organisational, Technological, Environmental, and Business-Financial pillars, as shown in Figure 1.

Since the majority of HCFs in KSA are autonomous and have different business strategies and funding incentives, the concepts of each pillar in the proposed framework is to be adapted to address the challenges and needs of HCFs at national and organisation levels. Although the literature review offers a wide range of CSFs for telemedicine implementation in different countries or organisations, CSFs are unique to the environment and the organisation context and may not be easily shared by all countries or organisations [30]. Many of the old barriers and challenges that limited telemedicine applications in the past may no longer exist or their influences may have partly diminished; furthermore, some barriers may now be an opportunity [31].

The second initiative was to identify appropriate theories to support the fundamental pillars (barriers) and understand their interactions. Mitchell and Jolley [32] claimed that theories tend to be more internally consistent with existing facts than common sense, so theories do not ignore facts. Furthermore, theories link individual facts, give them meaning, and try to explain and measure them.

Technological, *Organisational*, and *Business-Financial* are three of the five pillars of the proposed framework. These three pillars are complementary so require a carefully balanced understanding of the pillars and concepts associated with each HCF. The framework is based on the Information

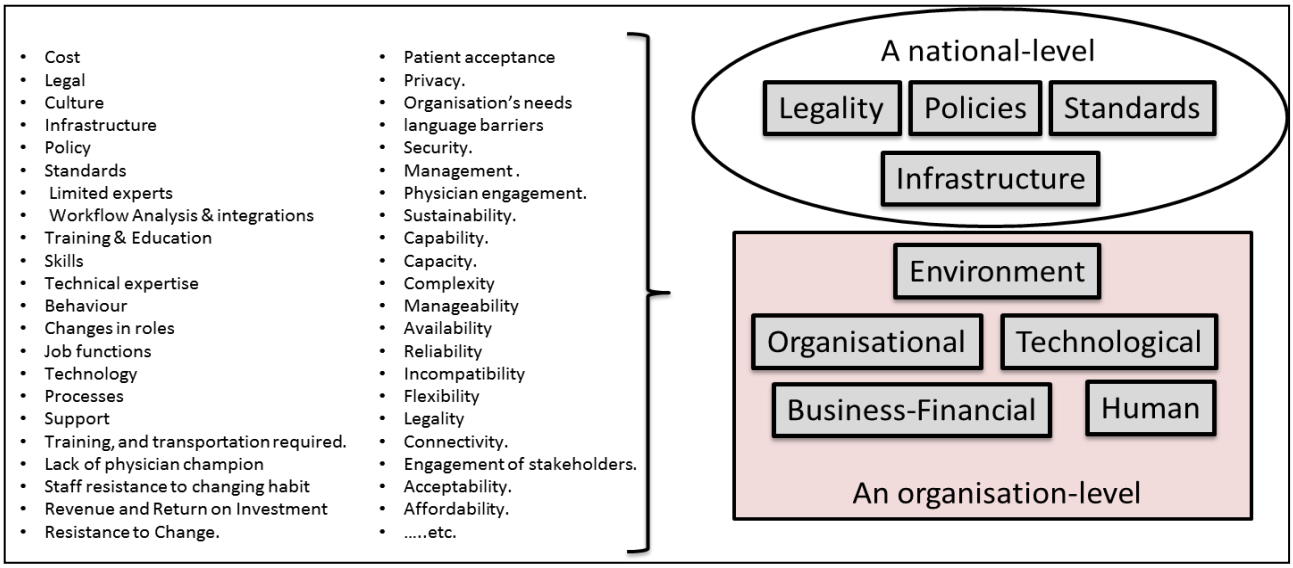

Figure 1: Identifying the Fundamental Pillars and their Concepts for the Proposed Framework

Systems Strategy Triangle (ISST) of Pearlson and Saunders [33] which argue that business strategy (*Business-Financial* pillar) drives both the organisational strategy (*Organisational* pillar) and the information system (IS) strategy (*Technological* pillar) and therefore organisations must carefully balance these three strategies [34][33]. In other words, any change in the IS strategy must be accompanied by changes in the organisational strategy and must accommodate the whole business strategy so the balance needed for successful operation is perpetuated and success can only be achieved by balancing these three components of the strategy triangle [33]. In our framework, the *Business-Financial* pillar is a fundamental barrier for each HCF which has specific funding incentives and seeks distinct return on investment and impact on costs.

The *Environmental* pillar, which is not included in the ISST framework, is another important pillar in our framework since the adoption of technology in HCFs has to conform to the various demographic needs of their residents and their geographic locations. The Technology-organisation-environment (TOE) is a theoretical framework, developed by Thornatzky and Fleischer in 1990, to identify the features of technology *(Technological* pillar), the readiness of the organisation *(Organisational* pillar), and the environmental conditions *(Environmental* pillar) as key drivers of technology adoption [35].

The *Human* pillar, which refers to the HHR in the HCFs and their citizens/patients, is the fifth fundamental pillar which focuses on human's specific problems related to acceptance and use of technology as well as individual attitudes and behaviours of groups [36]. Tough telemedicine is not aimed at replacing face-to-face healthcare with technology; it affects the nature of healthcare and needs additional provision to address the new challenges by HHR to ensure that they are able to use their skills, judgement and knowledge within this new context [37]. Brewster et al. [37] clarified that HHR is the key to the successful delivery and implementation of telehealth or any health information technology (HIT) in HCFs. HHR acceptance is critical to service innovation in healthcare, and is currently an ignored area of research [37]. The decision of whether or not to adopt a telemedicine solution, by an organisation, involve many stakeholders or adopter groups which the majority of them are HHR [38]. HHR are commonly considered the end users of telemedicine and can comprehensively influence the outcome of telemedicine adoption [38]. For these reasons, the Unified Theory of Acceptance and Use of Technology (UTAUT2) are relevant theories to support the *human* pillar in our framework. UTAUT2 theory is an extension of the Unified Theory of Acceptance and Use of Technology (UTAUT) which was developed through the review, mapping and integration of eight dominant theories and models in order to provide a unified theoretical basis to facilitate research on information system and information technology adoption and diffusion [39]. UTAUT was developed by Venkatesh, Morris, Davis, and Davis [40] in the field of information systems, and it has been employed by many studies in the field of telemedicine such as [41], [42], and [43]. Figure 2 shows the theories have contributed to formulate our framework.

Finally, the third initiative is to identify a suitable technique to classify each fundamental pillar and its concepts for each HCF telemedicine application to produce tangible and measurable results to support the adoption activities and to assist HCFs' decision-makers. This initiative is to be developed after the first two initiatives are tested and

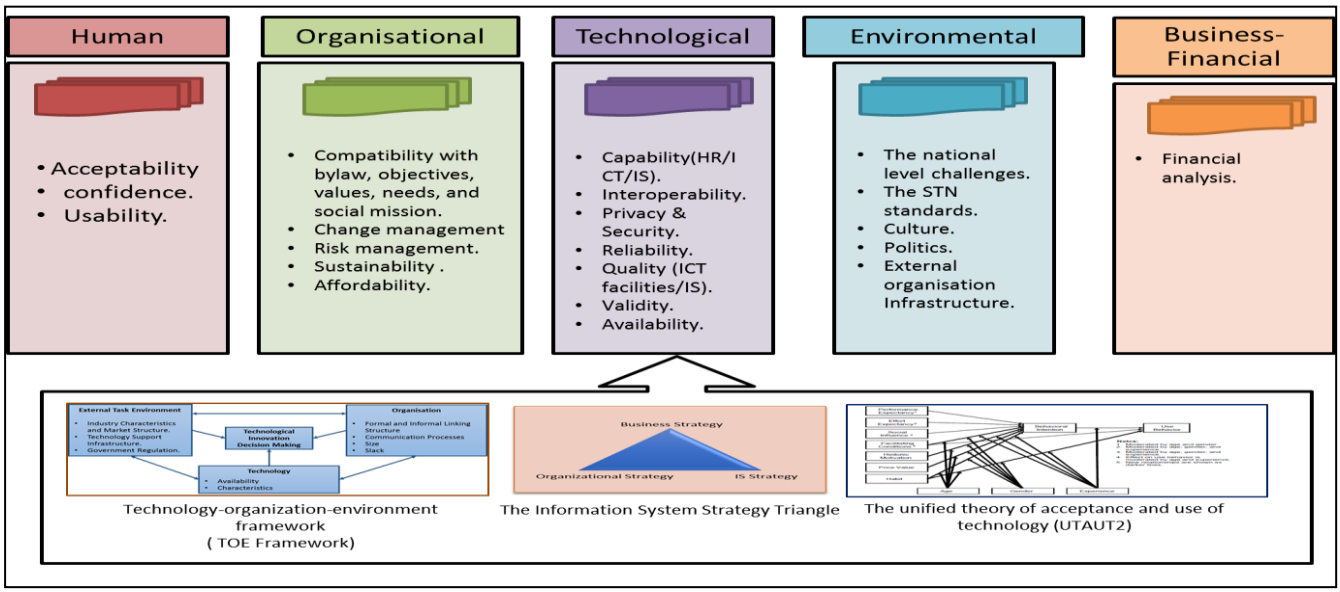

Figure 2. The Proposed Holistic Framework for Telemedicine for KSA

evaluated. We expect that some of the concepts of each fundamental pillar may be extended or enhanced to cover all HCF barriers that may affect the fundamental pillars of our framework which in turn may affect HCF decisions in adopting telemedicine solution.

IV. CONCLUSION AND FUTURE WORK

To summarise, there are a number of challenges currently facing the healthcare system in KSA; these could be alleviated or reduced by adopting telemedicine solutions. This paper has outlined these challenges and proposed a holistic framework to assist decision makers in HCFs to assess the adoption of telemedicine applications. This framework is based on the findings of the Infoway report, the extensive survey and interviews carried out with stakeholders in eight different HCFs in KSA.

Our future work is to evaluate our proposed framework. We propose to use questionnaires and focus groups to collect and substantiate the necessary data amongst Saudi healthcare stakeholders to address any new emerging challenges. This will assist us in determining practical and measurable results to support the adoption activities at national and organisational levels. In the longer term, the intention is to extend the framework to be suitable not only for telemedicine applications but also for all technological innovations in healthcare in KSA.

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