



The Potential of Telemedicine in the Rural Eastern Mediterranean Region for Noncommunicable Diseases: Case Study from Jordan

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Abstract

Telemedicine is the integration of technological advancements within health care systems, where distance is a critical factor, to respond to the health needs of communities. In the Eastern Mediterranean Region (EMR), the prevalence of noncommunicable diseases (NCDs) has increased in the last decade with cardiovascular diseases and kidney diseases ranking within the first top ten mortality ranks in the region. This rise in NCD prevalence is accompanied with an increase to the access of Internet technology, making the incorporation of telemedicine an asset in terms of increasing access to health care especially for people in remote areas. In Jordan, the Ministry of Health has been a pioneer in the EMR in integrating telemedicine to improve access to health care services, especially in rural areas. The Jordan initiative resulted in three telemedicine interventions, where they have focused on the experience of patients and access to telecardiology, teledermatology, and telenephrology services in two hospitals in the north and south of Jordan. The aim of this chapter is to draw together lessons learnt from these three interventions. The studies aimed to assess the impact of live interactive telemedicine consultations in cardiology, dermatology, and nephrology for diagnosis and management of the diseases and to assess the presence of an association with improvement in patients' quality of life and savings in cost and time. Results indicate that telemedicine services were successful in establishing diagnosis (71.1%, 43.2%, and 62.5% in disease categories, respectively) and treatment plans (77.3%, 67%, and 62.5% in disease categories, respectively) among patients or changing previously established diagnosis (17.1%, 19.3%, and 12.5%) and treatment plans (16%, 9.1%, and 31.2%) due to telecardiology, teledermatology, and telenephrology consultations, respectively. This impact not only improved the patients' quality of life but also decreased cost through reducing travel and waiting times to and from clinics. However, there are certain barriers for the implementation of telemedicine within the health care system. Overcoming these barriers may lead to a promising future in this region. Also, for telemedicine to be implemented within the health care system, certain efforts need to be put into practice on the policy level. These include including telemedicine on national agendas, developing a legal framework, and allocating a comprehensive budget for it. Moreover, there is a need for training on the benefits of telemedicine on the community level and building capacity in implementing it.

Keywords

Telemedicine · Noncommunicable diseases · Eastern Mediterranean Region · Access to care

Telemedicine: The Pros and Cons

Telemedicine is “the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities” (World Health Organization 2010). Telemedicine is a constantly evolving science as it depends on the incorporation of technological advancements to respond and adapt to the health needs and contexts of communities (World Health Organization 2010). Telemedicine can be an asset in improving access to health care especially for people living in remote areas, nursing home residents, and prisons (Abdul Rahim et al. 2014; Parmar et al. 2015).

Telemedicine technology has a number of applications for both non-communicable diseases (NCDs) and infectious diseases, but also in different phases of the treatment cycle, from diagnosis to follow-up (Alajmi et al. 2013; Bashshur et al. 2014; Bloomfield et al. 2014). Some examples of the utility of telemedicine in bringing expertise closer to low-resource areas include enhancing social security and quality of medical services, through linking a child health hospital in Tunisia with another in France, when other hospitals related to neurology, teleradiology, and telepathology were linked to Romania, Italy, Bulgaria, Australia, and Greece (Alsadan et al. 2015). Other examples of the ways telemedicine has improved services include monitoring type 1 diabetes patients’ sugar levels and administering insulin without injections (Ramsey 2017); screening and delivery of health care services to people with diabetes in underserved rural areas in India (Mohan et al. 2012); diagnosis of ear infections among children using the mobile phone; and online patient consultations (Wootton and Bonnardot 2015). Telemedicine can also decrease patient costs. For example, at the Chinese University of Hong Kong, the cost for telepsychiatry for nursing home geriatric patients was 13.2% lower in comparison to in-person visits when the setup and maintenance costs were shared by various departments of the university (Hyler and Gangure 2003).

Though telemedicine technologies have advantages, several challenges need to be overcome before their full potential can be realized. These challenges are common among different sectors of information technology, one which is Health Information Technology (HIT) given the interrelation between telemedicine and HIT, whereby the delivery of medical and educational services or consumer health information (telemedicine components) depends on electronic records, management information systems, and network management (Alsadan et al. 2015). A systematic review on Health Information Technology (HIT) highlights challenges related to lack of financial resources, bureaucracy and poor management in the hospitals, low information technology (IT) competency of the staff, lack of qualified staff, and lack of hospital administrators who value HIT (Alajlani and Clarke 2013). Challenges also include limited infrastructure, parallel reporting, and lack of coordination. Other challenges to implementation are the lack of supervision and feedback to lower levels of health care programs and acceptance of telemedicine, particularly doctor

and patient resistance in cases where patients are concerned and uncomfortable with being connected to doctors from different backgrounds (Alajlani and Clarke 2013).

Because of the number of benefits of and challenges to telemedicine, a framework of factors that may influence the adoption of telemedicine technologies was developed. The framework categorizes influences to adoption such as privacy, culture, attitude toward telemedicine, benefit, cost, technical support, top management support, connectivity, IT capability, compatibility, data warehouse concept, policy, and upper-level leadership (Fig. 1) (Abd Ghani and Jaber 2015).

The Eastern Mediterranean Region (EMR) includes the following countries: Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen (World Health Organization 2017). In this region, telemedicine has potential to increase access to health care services, especially where the patient to doctor ratio is high, and to reduce treatment costs (Alajmi et al. 2013). With its adaptability to different disease categories and phases of treatment and with the increase in internet users in this region, telemedicine could be beneficial in EMR in the field of NCDs.

In this chapter, after providing an overview of the burden of NCDs and on the access to Internet technology in EMR, we discuss the evaluation of three telemedicine studies that focused on the experience of patients and access to cardiology (called Study 1 hereafter) (Khader et al. 2014), nephrology (called by Study 2 hereafter) (AlAzab and Khader 2016), and dermatology (called by Study 3 in the text) (Al Quran et al. 2015) services in Jordan.

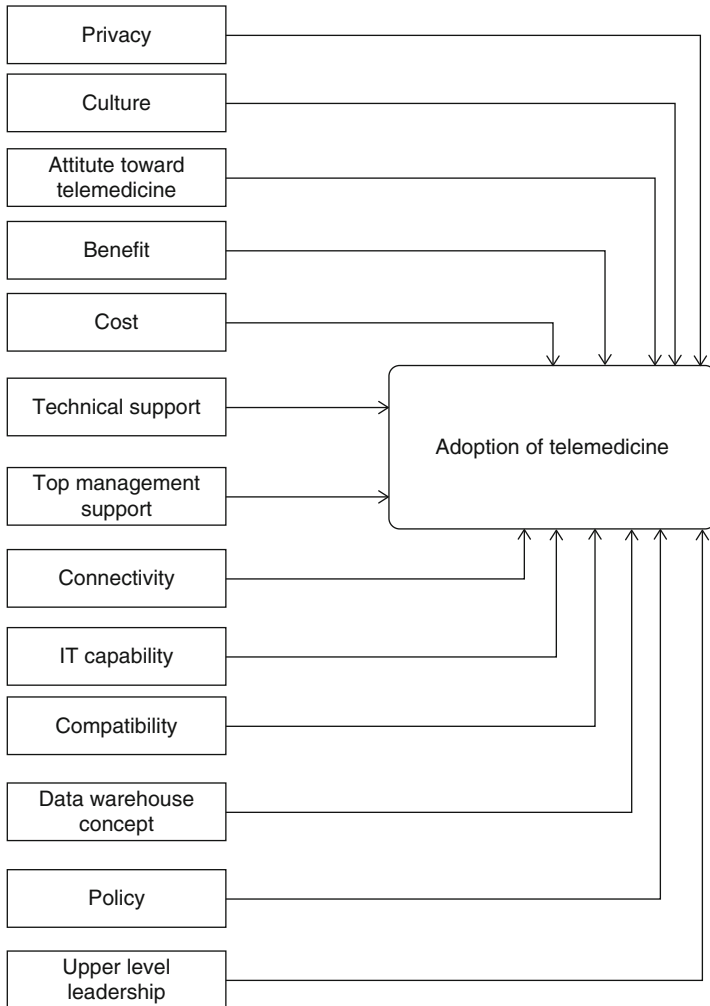
Overview of the Disease Burden in the Eastern Mediterranean Region

Countries in EMR have witnessed an increase in the mortality rate due to NCDs (Fig. 2) (Global Burden of Disease 2015).

In 2008, NCDs accounted for the death of more than 1.2 million people in EMR (Abdul Rahim et al. 2014). This accounts for nearly 60% of all deaths in this region, with more than 34% of deaths among individuals younger than 60 years (Abdul Rahim et al. 2014).

Cardiovascular diseases (CVDs) and kidney diseases are within the ten leading causes of mortality in EMR (Abdul Rahim et al. 2014). Specifically, ischemic heart disease contributed to 14.3% of deaths in 2010. On the other hand, skin disease causes a huge burden in the region and it is one of the leading causes of nonfatal burden expressed as years lost due to disability in 2010 (Hay et al. 2013).

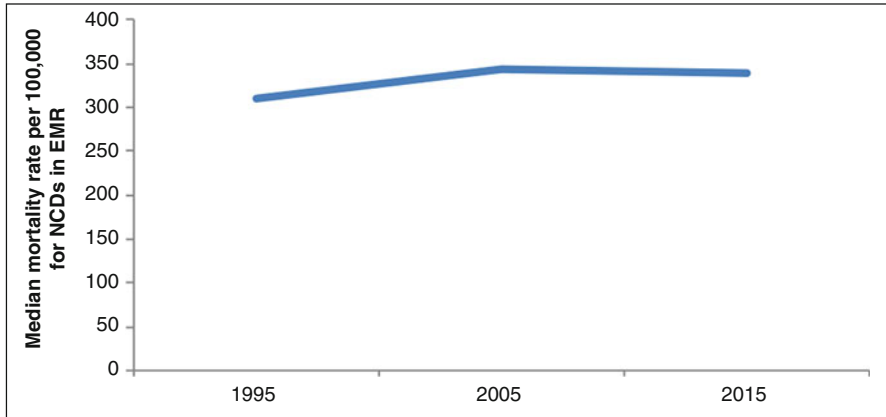
This increase in the prevalence of NCDs in the EMR is accompanied by a series of challenges in terms of diagnosing and managing patients for these diseases, especially in remote areas (Abdul Rahim et al. 2014). Trained primary care physicians are reportedly more efficient in diagnosing dermatological conditions, but 60% of patients in the region of the Middle East with dermatological diseases were treated by non-dermatologists (Al-Hoqail et al. 2002). Transportation presents another



Source: Abd Ghani, M. K. & Jaber, M. M. Willingness to Adopt Telemedicine in Major Iraqi Hospitals: A Pilot Study. *Int. J. Telemed. Appl.* **2015**, (2015).

Fig. 1 Factors influencing the willingness to adopt telemedicine. (Source: Abd Ghani and Jaber 2015)

challenge to accessing health care from remote areas in the EMR, both in terms of cost and ease of boarding public buses (Kronfol 2012). Car ownership is limited to the more economically advantaged groups (Kronfol 2012; Syed et al. 2013). As the high cost of health care services also contributes to access problems (Alsadan et al. 2015), it is clear that there is an economic gradient to health care access particularly from remote areas.



Source: Global Burden of Disease, 2015

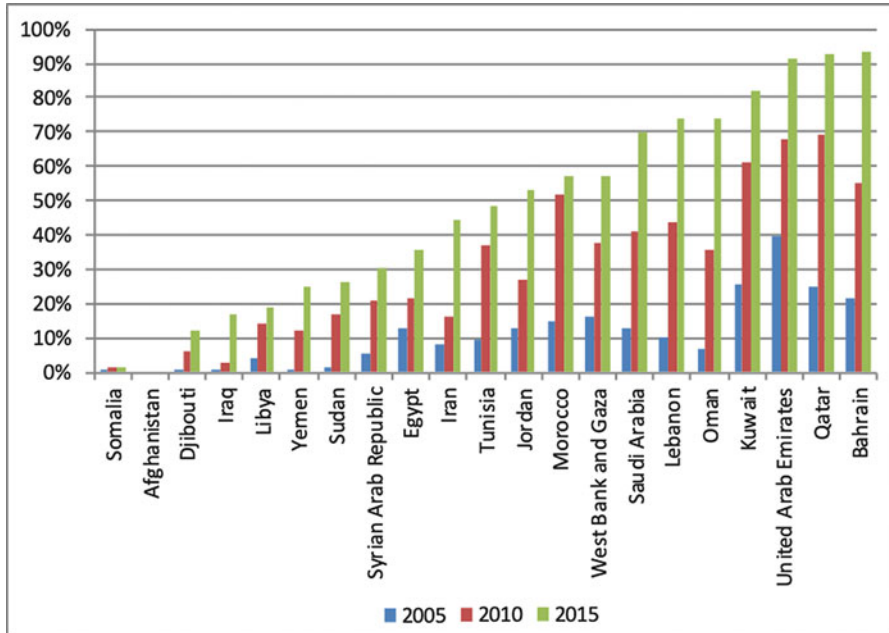
Fig. 2 Median mortality rate, per 100,000, for NCDs in the Eastern Mediterranean Region during years 1995, 2005, and 2015. (Source: Global Burden of Disease 2015)

The governance and organizational structures in the public health sector in some EMR countries have remained unchanged despite the nature of public health and health care changing in the past few decades (Saleh et al. 2014). Given the present challenges, innovative ways are needed to connect doctors to medical resources and to deliver health care services.

Overview on the Access to Internet Technology in EMR

Internet technology is evolving globally and connecting patients to health care services. In EMR, the average rate of individuals using the Internet (includes all individuals who have used the Internet within the past 3 months) (World Bank 2016) has increased from 25% in 2010 up to 44% in 2015 (World Bank 2016). The country with the lowest Internet coverage in the EMR is Somalia (1.8% of the population) and the highest Bahrain (93.5% of the population). In Jordan, the number of Internet users as percentage of the population is 53.4%. Internet usage in the EMR is increasing rapidly: in Bahrain by over fourfold from 20% in 2005 to 93.5% within 10 years, in the West Bank and Gaza by almost threefold from 16% in 2005 to 57% in 2015, and in Jordan by fourfold from 12% in 2005 to 53% in 2010, shown in Fig. 3 (World Bank 2016).

The increase in NCDs and access of Internet technology raises the potential use of telemedicine for NCDs in EMR. In Jordan, in particular, this has resulted in telemedicine interventions. The next section presents results of the evaluation of three telemedicine studies in Jordan.



Source: World Bank, 2016.

Fig. 3 Access of Internet technology in EMR (as percentage of population). (Source: World Bank 2016)

Telemedicine Utilization in EMR

Three studies were conducted in Jordan that focused on live interactive consultations via the Internet. Study 1 focused on telecardiology (Khader et al. 2014), Study 2 focused on telenephrology (AlAzab and Khader 2016), and Study 3 focused on teledermatology (Al Quran et al. 2015). The aim of the three studies was to assess the impact of live interactive – teledermatology, telecardiology, and telenephrology – consultations on the diagnosis and management of the diseases related to cardiology, nephrology, and dermatology according to the providers’ perception. The studies also aimed to assess if there was any association with improvement in patients’ quality of life and cost and time-savings according to patients’ perceptions.

The three studies were conducted at two hospitals in the north and south of Jordan.

The teleclinics were launched in 2011 at Mafraq Governmental Hospital, north of Jordan, and in 2012 at Queen Rania Hospital, south of Jordan. The three studies evaluated the process and outcomes of teleconsultations that took place in those teleclinics between September 2013 and January 2014. The studies included patients who were attending or referred to the teleclinics for suspected disease or follow-up, in both hospitals, during the study period. The intervention evaluation was done

through pre- and posttests focusing on the evaluation of telecardiology, teledermatology, and teleneurology and their impact. Evaluation forms were filled by physicians or nurses who were trained on data collection methods in both hospitals before and after the consultation session. The quality of life questionnaires were filled again 8 weeks post-consultation via phone interviews. Phone interviews were conducted according to protocols previously determined by the investigator.

Telemedicine Technology

The teleclinics in the three studies were equipped with Cisco Health Presence Technology solution, which consisted of Cisco Technologies including audio, video, security, networking solutions, and applications platform. Cisco technology is considered a leader in the field of telemedicine solutions, especially when it comes to improving access to care, in rural areas (Sidhu 2015). The technologies were integrated with AMD medical equipment including general exam camera, electronic stethoscope, vital signs monitor, ENT scope, ophthalmology scope, and dermatology scope. The Cisco audio-video technologies consisted of the Cisco TelePresence System (CTS500) offering two resolution settings (720p or 1080p) and four quality settings (lite, good, better, or best). To ensure connectivity between the main data center and all teleclinics, a National Broadband Network (NBN) of 10 MB dedicated line and a Secure Government Network (SGN) via NBN which depends on the Fiber Optic technology were used.

The Settings

The location of the hospitals is in a rural area Mafraq (North) and Ma'an (South) of Jordan (Map 1), where the estimated number of residents is 551,500 and 144,500 residents, respectively.

Evaluation of the Studies

The tools used in the three studies' evaluations included questionnaires filled by trained nurses or physicians. The questionnaires evaluated patient quality of life, their perception of travel time and cost, and consultation requests and record forms that evaluated the physician's perception on diagnosis and treatment plan after consultations through teleclinics (Table 1).

In all the three studies, all questionnaires and forms used were chosen based on a literature review of relevant studies. The questionnaires were also piloted among ten patients and revised as necessary. English questionnaires were translated into Arabic using forward-backward translation method and later adapted to the Arabic language.



Map 1 The location of the studies

Potential of Teleconsultations in EMR

In the three studies conducted, the benefits of telemedicine were demonstrated through improved treatment and diagnosis plans, improved quality of life, and patient cost saving on travel and reduced waiting times. Details on the characteristics of patients who participated, the impact of telemedicine technologies on treatment and diagnosis plans, costs and travel time, according to their perceptions, are presented below.

Table 1 Tools used in the three studies

Study	Tool used	Measured outcomes	References
Cardiology	SF-8 Health Survey ^a	Quality of life	Ware et al. (2001)
	Minnesota Living with Heart Failure Questionnaire (LHFE)	Quality of life	Rector and Cohn (1992)
Nephrology	SF-8 Health Survey	Quality of life	Ware et al. (2001)
	Kidney Disease Quality of Life survey (KDQOL)	Quality of life	Hays et al. (1994)
Dermatology (pilot 3)	SF-8 Health Survey	Quality of life	Ware et al. (2001)
	Dermatology Life Quality Index (DLQI)	Quality of life	Basra et al. (2008)

^aA health survey of eight questions that determines a person's quality of life

General Characteristics of the Patients Included in the Three Studies

Overall, a total of 228 patients participated in the three studies, with an equivalent duration of 4 months. The patients included in the studies were both males and females with an age range between 16 and 93 years old. The sources of patients' referral were inpatient/outpatient hospital clinics as well as clinics outside the hospital (Table 2).

Impact of Teleconsultations on Changes in Diagnosis and Treatment Plan

For all patients, the main reason to receive telecardiology, teledermatology, and telenephrology consultations was to establish a diagnosis or treatment plan (Table 3).

The referring providers thought that the final diagnosis was established in 71.1% of patients who received telecardiology consultations, and 43.2% and 62.5% of patients who received teledermatology and telenephrology consultations, respectively. Teleconsultations were also thought to change the diagnosis from that assigned by the referring provider in 17.1%, 19.3%, and 12.5% of patients who received telecardiology, teledermatology, and telenephrology consultations, respectively. In some cases, the diagnosis remained the same as that of the referring provider; 11.8%, 37.5%, and 25% of patients who received telecardiology, teledermatology, and telenephrology consultations, respectively.

Also, a treatment plan was established for 77.3%, 67%, and 62.5% of patients who received telecardiology, teledermatology, and telenephrology consultations, respectively. In other cases, the treatment plan was changed as a result of teleconsultations; 16%, 9.1%, and 31.2% of patients who received telecardiology, teledermatology, and telenephrology consultations, respectively. In 6.7% of patients

Table 2 General characteristics of the patients' population in the three studies

Characteristics	Cardiology	Nephrology	Dermatology
Age (years)	<i>N</i> = 76	<i>N</i> = 64	<i>N</i> = 88
	<45: 23 (30.3%)	≤50: 21 (32.9%)	<20: 37 (42.0%)
	45–54: 32 (42.1%)	>50: 43 (67.2%)	20–50: 45 (51.1%)
	≥55: 21 (27.6%)		50: 6 (6.8%)
Sex			
Females	35 (46.1%)	30 (46.9%)	31 (35.2%)
Males	41 (53.9%)	34 (53.1%)	57 (64.8%)
Hospital			
MGH ^a	68 (89.5%)	56 (87.5%)	9 (10.2%)
QRH ^b	8 (10.5%)	8 (12.5%)	79 (89.8%)
Source of patients			
Inpatient clinic	9 (11.8%)	4 (6.3%)	–
Outpatient	62 (81.6%)	52 (81.3%)	15 (17%)
Outside clinic	5 (6.6%)	8 (12.5%)	73 (83%)
Duration of the study (months)	4	4	4

^aMafraq Governmental Hospital^bQueen Rania Hospital**Table 3** The perception of the referring provider on the impact of teleconsultations on changes in diagnosis and treatment plan

Perception of provider	Cardiology, <i>N</i> (%)	Dermatology, <i>N</i> (%)	Nephrology, <i>N</i> (%)
Diagnosis			
Established as part of the teleconsultation	54 (71.1%)	38 (43.2%)	40 (62.5%)
Remained the same as the initial plan	9 (11.8%)	33 (37.5%)	16 (25%)
Changed as a result of the teleconsultation	13 (17.1%)	17 (19.3%)	8 (12.5%)
Treatment plan			
Established as part of the teleconsultation	58 (77.3%)	59 (67%)	40 (62.5%)
Remained the same as the initial plan	5 (6.7%)	21 (23.9%)	4 (6.2%)
Changed as a result of the teleconsultation	12 (16%)	8 (9.1%)	20 (31.2%)

who received telecardiology consultations, 9.1% of patient who received teledermatology consultations, and 31.2% of patients who received telenephrology consultations, the treatment plan remained the same as the initial plan.

Effect of Teleconsultations on Patient's Quality of Life

After 2 months of consultations via the teleclinics, the patients' quality of life improved resulting better health, based on assessments using the SF8 tool and other tools relevant to each study (Table 4). The mean SF8 score increased significantly in the three studies: from 40.7 to 62.4 for telecardiology consultations, from 33.1 to 45.0 for teleneurology consultations, and from 20.6 to 100.0 for teledermatology consultations. All SF8 domains (general health, physical functioning, bodily pain, physical role, vitality, social functioning, mental health, and emotional role) have improved significantly after 2 months of telecardiology and teledermatology consultations, where the highest improvements were seen in social functioning and role-emotional domains of SF8; as for teleneurology consultations, only the "general health," "bodily pain," and "role-physical" have improved significantly after 2 months of consultations.

Moreover, after 2 months of teleconsultations, the baseline mean LihFE (a self-assessment of how heart failure affects a person's quality of life) score decreased significantly from 47.8 to 34.9. As for Dermatology Life Quality Index (DLQI) scores, there was a decrease from 9.4, at baseline, to 5.9, with a mean change of -3.5 indicating that the disease had much lower effect on patient's life compared to the baseline. The teleneurology consultations resulted in significant increases in the scores of "Symptoms and Problems" subscale and "Effects of Kidney Disease on Daily Life" subscale. This implies that patients were less bothered by some symptoms caused by kidney diseases. However, there was no significant improvement in the "Burden of Kidney Disease" subscale.

Table 4 The effect of teleconsultations on patient's quality of life

Tool number	Cardiology	Nephrology	Dermatology
SF-8 results – Mean changes in score^{a,b}	21.7	11.9	26.2
General health	31.6	20.9	7.3
Physical functioning	17.5	12.0	28.9
Bodily pain	15.3	16.3	22.1
Role-physical	19.6	16.5	23.5
Vitality	17.0	8.3	18.1
Social functioning	40.8	5.4	48.4
Mental health	-4.5	5.4	18.8
Role-emotional	36.7	6.3	43.2

For the Minnesota Living with Heart Failure Questionnaire (LihFE) was used for Cardiology (Changes in score mean): -12.8 (-6.4 , -19.3); For the Kidney Disease Quality of Life survey (KDQOL) results) – Changes in score: Burden of Kidney disease subscale (-0.6); Symptoms and Problems subscale (29); Effects of Kidney Disease on Daily Life subscale (25.4); For the Dermatology Life Quality Index (DLQI) – Changes means score (95% CI): Symptoms and feeling (-1.1 (-1.7 , -0.5)); Daily activities (-1.2 (-1.7 , -0.6)); Leisure (-0.6 (-1.0 , -0.1)); Work and school (0.1 (-0.2 , -0.4)); Personal relationships (-0.6 (-0.9 , -0.3)); Treatment (-0.2 (-0.3 , 0.0))

*After minus (–) Before \Rightarrow so the score was calculated through subtracting pre from post (post minus pre)

**Before minus (–) After \Rightarrow pre minus post

Table 5 Patients' perception of the visit to the teleclinic in terms of travel time, waiting time, and cost as compared to visiting the specialist in the referral hospital

Patients' perceptions	Cardiology, <i>N</i> (%)	Dermatology, <i>N</i> (%)	Nephrology, <i>N</i> (%)
Travel time			
Same travel time required	0	2 (2.3%)	–
More travel time required	3 (3.9%)	2 (2.3%)	–
Less travel time required	73 (96.1%)	84 (95.5%)	–
Waiting time in the clinic			
Same waiting time	1 (1.3%)	4 (4.5%)	–
Increased waiting time	0	11 (12.5%)	–
Reduced waiting time	75 (98.7%)	73 (83%)	62 (96.9%)
Self-reported cost comparing telemedicine to regular visits to a specialist			
Same cost	0	0	–
Greater cost	0	4 (4.5%)	–
Lower cost	76 (100%)	84 (95.5%)	63 (98.4%)

As shown in Table 5, 96.1% and 95.5% of patients reported that their visits to telecardiology and teledermatology clinics respectively required less travel time compared to visiting a specialist clinic in a referral hospital in Amman. Half of the patients (50%) were managed locally in telecardiology clinics which meant that patients avoided travel to specialist clinics in the referral hospital.

Patients, who attended telenephrology clinics, also thought that the visits required less travel time compared to visiting the specialist clinic at the referral hospital. In addition, most patients said that their waiting time and costs of health care were reduced during teleclinic visits when compared to specialists' clinics at the referral hospital.

Future of Telemedicine in EMR: Conclusion and Recommendations

This chapter described the EMR NCD burden of disease, along with challenges of health care systems and related this to the potential of telemedicine in addressing some of these challenges. Published reports on telemedicine in the EMR region were only found for Jordan, which may not be fully representative of EMR. However, Jordan may be considered as an example of an EMR country given the similarity of the burden of disease of NCDs, demography, and limitation in access to health care services in rural areas for other EMR countries. Given the rise in NCD prevalence in some countries in the EMR region and the challenges faced in meeting health care resource needs, governments are under greater demand to consider using innovative solutions to deliver their health care service beyond traditional, but more expensive, mechanisms. The above three studies indicate that telemedicine was acceptable to both service providers and users. For service providers, the teleconsultations were

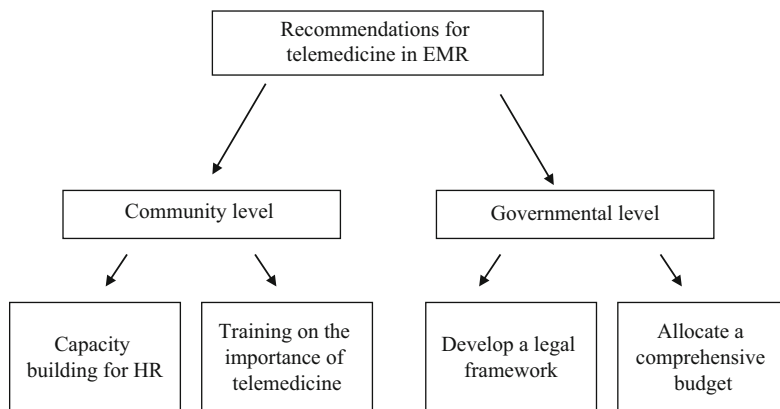


Fig. 4 Recommendations for the implementation of telemedicine in EMR

successful in establishing diagnosis and treatment plans for some patients or changing previously established diagnoses or plans. This impact not only improved patients' quality of life but also decreased cost through reducing travel and waiting times to and from clinics.

As evidenced by these studies, telemedicine is a window of opportunity for health care systems to improve the quality of health care delivery services. This improvement, using telemedicine, is increasingly becoming more possible in EMR countries as access to information technologies has increased dramatically in the last decade.

However, for telemedicine to have a promising future in this region, it is important that telemedicine is included in national agendas and further invest in this field through scaling up pilot studies, if found, or plan and implement new studies. In order to implement successful telemedicine services, governments also need to ensure that health systems are able to deliver services. We recommend that health ministries develop a legal framework for these technologies and allocate a comprehensive budget. Moreover, human resource capacity to implement these interventions needs to be developed and training needs to be conducted among end users to help the adoption of these interventions (Fig. 4).

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