

Telemedicine application and difficulties among Prince Sultan Medical City in Saudi Arabia

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Abstract. The rapid changes in the technological environment in Saudi hospitals sector have exerted significant pressures on the health services provider's to pay attention to updating medical technology strategies in general and health service delivery strategy/telemedicine in particular. Therefore this research investigates telemedicine application and difficulties among Prince Sultan Military Medical City (PSMMC) in Saudi Arabia. This study proposes and tests a two factors model that explains the considerable variation in telemedicine application and difficulties in PSMMC. In order to explore this issue, a descriptive method was used to collect primary data through a questionnaire, which was administered in the PSMMC in Riyadh the capitals city in Saudi Arabia and, via in-depth semi- structured interviews with hospital managers and experts in the telemedicine. All heads of medical departments, IT department, telemedicine department, and medical education department in (PSMMC)-Riyadh were targeted in this research rather than a representative sample of these hospitals. A purposive sampling strategy was used to choose the participants in this research. In total, 40 senior managers were participated in this study. The results confirm that telemedicine system helps the hospital to minimize the process of referring patients to other hospitals. Furthermore, the results show that telemedicine system helps in increasing the quantity and quality of information available, which reflects positively on the quality of medical service. Regarding the difficulties of applying telemedicine the results also highlight poor training in the utilization of techniques necessary for the application of telemedicine system at the hospital. Because of the contributions made by telemedicine in improving health care services, researchers advocate gradual circulation of a draft of telemedicine at all military and governmental hospitals for capacity building and promotion by users and to avoid the difficulties that might occur.

Keywords: Telemedicine, Armed Forces Hospitals, Saudi Arabia.

1. INTRODUCTION

Dramatic changes in the political and regulatory, economic, socio-cultural, technical, and natural environments in which hospitals and health services institutions operate suggest that health service providers may need to reconsider their health service delivery approaches for future success and survival (Ahmad, 2012). Khong and Dhanjoo (2006) note that healthcare planners must seek ways to improve their health service delivery systems without compromising health services to patients. Telemedicine technology is a tool used to facilitate interactions between primary and specialist care physicians (O'Malley and Reschovsky, 2011). This tool may improve the quality of care, despite geographical distance between the

practitioners (Saudi Ministry of Health and Care Services, 2001; 2008). Telemedicine, or real-time videoconferencing, is a technology for joint work. Using it, general practitioners and specialists discuss patient treatment, which increases the information and knowledge available to each participant. Therefore, videoconferencing continuously supports two-way work and follows the treatment route of the patient (Scrogham, 2009). A higher quality of health care services presupposes knowledge exchange and learning. In Kingdom of Saudi Arabia (KSA); general practitioners in armed hospitals, specialists, and consultants in medical centers use telemedicine as a tool for cooperation work to enhance the quality of health services outcomes. In this case, they exchange knowledge so that the diagnosis of these cases may be done locally without traveling to the centers.

This research explores the use of telemedicine in armed hospitals and its impact on improving the quality of health services where patients live. The objective is to find out the most significant contributions of telemedicine, and difficulties faced, to improve health services from the viewpoint of the heads of medical departments, IT department, telemedicine department, and medical education department in the Prince Sultan Military Medical City (PSMMC)-Riyadh.

2. LITERATURE REVIEW

2.1 Definition of the telemedicine

Telemedicine, although a relatively new term in the medical field, is now familiar to most health care professionals and many patients. Telemedicine has been described by Larkin as “an enabling technology – an expansion of what we have used since the telephone was invented” (Larkin, 1997). Telemedicine is the process of utilizing telecommunications technologies for the purpose of transmitting information including audio and visual images between individuals that are at a distance from each other in order to provide medical management (Brecht and Barrett, 1998; Field, 1996; Larkin, 1997). According to Purcell (1998) telemedicine is the use of telecommunication technologies as a medium to deliver various medical services to different sectors of the population in partnership with teaching hospitals associated with academic health centers. Telehealth is broader than “telemedicine” in that it also encompasses the use of computer-assisted telecommunications to support functions other than the clinical aspects of healthcare, namely management, surveillance, literature and access to knowledge (Mandil, 1995).

Telecommunication tools and services could be used to improve access to quality healthcare, the extent and quality of education and training of human resources, the cost-effective surveillance of diseases and services, and technological developments for affordable diagnosis and treatment (Bashshur et al, 2001; Gagnon et al, 2005).

2.2 Telemedicine applications

Virtual access can be provided to patients via telemedicine which has the capability to improve both healthcare quality as well as efficiency (LeRouge et al., 2010). Although telemedicine has numerous benefits, for the successful deployment of this technology healthcare organizations must deal with several challenges before adopting it (Chinn, 2002). It is thus inherent that healthcare organizations need to find an approach to facilitate the successful deployment of telemedicine.

Telemedicine aims at providing expertise to the patient where he/she is instead of requiring the patient to seek expertise. A notable advantage of telemedicine is its ability to provide expertise to patients residing in remote and not easily accessible areas within moderate time or distance (Bangert et al, 1999; Bashshur et al, 2001; Aas, 2001; Baldwin et al, 2002; Croteau and Vieru, 2002).

Telemedicine is characterized by:

- A geographic separation between client and provider,
- Enhancement of clinical utilities through setting up of communication and interfacing among client and health care provider
- A specially designed fundamental system for the residential care. this includes a partition of labor and specialization among the providers and staff; and clinical maintenance and operational

functions inside the system. (Bangert et al, 1999; Bashshur et al, 2001; Aas, 2001; Baldwin et al, 2002; Croteau and Vieru, 2002).

Telemedicine will have an impact on the following:

Expansion and export of skills: Teaching hospitals could expand and export their skills to the remote primary centers. Distance becomes immaterial. Other examples include access to archived electronic scans and health care records; health care information on preventive vaccination programs; information for expectant mothers; information about specific diseases; support groups, etc. All these could be made universally available at the touch of a button. By installing CT scanners in peripheral hospitals, a national emergency teleconsultation system would be possible with high quality video transmission of pictures. The speed, quality and completeness of information exchange would result in instantaneous emergency tertiary consultation (Bangert et al, 1999; Baldwin et al, 2002).

Fetal telemedicine: Pilot projects have proved the efficacy of transmitting fetal ultrasound images from high risk pregnant women. Importantly, patient's satisfaction is significantly high - video consultation seems almost as satisfying as face-to-face. Further, there was a significant fall in unnecessary referrals to specialists. (Aas, 2001; Croteau and Vieru, 2002; Baldwin et al, 2002).

Tele-endoscopy: Present day technology enables transmission of (reasonably) high quality images via telecommunication networks at an acceptable cost. The signals from a video camera attached to an endoscope can be compressed and digitized by a video codec prior to transmission to a remote institution through a 2MB circuit. The receiver can "see" the endoscopic examination on a monitor and influence the control and movement of the endoscope by communicating over two-way sound and picture connection with the person operating it (Bangert et al, 1999; Bashshur et al, 2001; Aas, 2001; Croteau and Vieru, 2002; Baldwin et al, 2002).

Telemedical education: A regional, national and international medical educational system becomes a reality. With the presence of telecommunication providers, live two-way interactive transmissions of major surgical procedures from one part of the globe to another are possible (Aas, 2001; Croteau and Vieru, 2002).

Telepathology: A pathologist, using micromanipulators, could remotely change the field of view, focus, and magnification of a slide located under a microscope thousands of miles away (Aas, 2001; Croteau and Vieru, 2002).

Patient's convenience: Retaining specialists in non-urban areas is very difficult and is a worldwide problem. The unequal distribution of specialists in any country results in more medical institutions and unequal access to specialists in various disciplines in different locations of the country. The answer presently is to move patients to the expertise. Telemedicine can help avoid unnecessary or even harmful travel and expense for the patient and family. Once the virtual presence of a specialist is acknowledged, a patient could also access resources in a tertiary referral centre. Telemedicine enables patients to remain at home and ensure much needed family support (Knorr et al, 1998; Bashshur et al, 2001; Aas, 2001; Croteau and Vieru, 2002; Baldwin et al, 2002).

2.3 Telemedicine challenges

The major challenges to the wide deployment of telemedicine have been in the areas of expenses, quality of transmission, and the amount of complex equipment required (Field, 2002). During the past few years, transmission-related expenses have been declining because of digital technology. Additionally, the quality of transmission equipment has improved substantially. Digital technology has also resulted in reduced equipment size and costs (Field, 2002).

Telemedicine has presented some issues that create legal questions. For example, physicians providing services across state borders may create licensure and liability issues. Challenges have arisen in the regulatory arena because telecommunication is a regulated service (Field, 2002). Other challenges that may slow the use of telemedicine include the lack of a workforce trained to use the available technology, the lack of acceptance of the technology by patients, and the lack of restructured health services to accommodate the new environment. Successful deployment of telemedicine will require a new way of thinking to bring together the patient and the health care professional. Moore (1996) groups challenges for telemedicine into three categories:

- (1) Professional practice, which includes multi-state licensure and liability.
- (2) Quality of care.

(3) Financial, which includes the ability to generate positive net income, reimbursement, restrictions of coverage, and payment for procedures by non-physicians. Reimbursement appears to be the largest challenge to widespread deployment (Haugh, 2003).

Financing the cost of telemedicine can be a challenge for hospitals. Identifying the costs associated with one specific telemedicine service can make it challenging to evaluate telemedicine deployment decisions (Sisk and Sanders, 1998). Crowe (1998) states that "the types of costs that should be included in a cost analysis of telemedicine projects include: project establishment, equipment, maintenance, communication, and staffing costs". Grigsby (1998) states that "most new medical technologies, including telemedicine, are usually inappropriately initially publicized as being cost-effective".

Generally, the new technologies result in higher costs in the early stages. Rate of usage is a major factor in the cost-effectiveness of telemedicine projects because usage is generally low when initially deployed (Strode et al., 1999).

Charles (2000) takes the position that providers should consider the return on investment before proceeding with the deployment of telemedicine projects.

Although the government has provided funding, it has now begun to recognize the importance of telemedicine in delivering services to underserved rural areas and the importance of financial issues to deployment (Jones, 2004).

2.4 Obstacles facing telemedicine

There are a number of obstacles facing telemedicine, including:

- 1 - Lack of adequate knowledge of medicine, communication and the numerous benefits of many health leaders and doctors alike.
- 3 - Obstacles related to training and organizational culture.
- 4 - Difficulties caused by the traditional societies that do not trust the common pattern of treatment
- 5 - Problems related to insurance and recovering the costs of telemedicine services.
- 6 - Financial and technical constraints (David, 94, p41).

Considerations for the application of good systems for telemedicine:

Telemedicine system is a relatively modern system which is exposed to rapid changes due to the association of information and communication technologies, so the success of the application of telemedicine requires a number of fundamentals, including the following:

A - Financial and human resources.

B - Appliances mechanism.

C - A great deal of training for staff and users (Tachakra & Colleagues, 1999).

3. TELEMEDICINE IN ARMED FORCES HOSPITAL (PSMMC)

The Telemedicine Academic Center in PSMMC in Riyadh is one of the new projects in Saudi Arabia that was established since 2003 to make the exchange of knowledge and information between the medical centers easier. Telemedicine services in the Hospital are divided in to three main sections:

- TRC – Teleradiology Communication (X-Ray, CT-Scan, Ultrasound, Nuclear medicine and MRI).
- TPC-Telepathology Communication.
- Medical Advice.

The Center offers a lot of Lectures, Seminars, Conferences and Surgical operations inside and outside the Kingdom. There are many services provided by the telemedicine center at PSMMC (e.g. Cardiac, Orthopedic, Neurology, Ophthalmology, Medicine, Endoscopy, and Oncology).

4. RESEARCH OBJECTIVES

Based on the research problem and relevant literature of telemedicine and health care improvement, the research objectives are:

- 1) To examine the relationship between telemedicine application and health care improvements in the PSMMC in Riyadh-Saudi Arabia.
- 2) To recognize the significant difficulties facing telemedicine technology application in the PSMMC in Riyadh- Saudi Arabia.

5. RESEARCH METHODOLOGY

5.1 Research population and sample

This research is a descriptive study that elucidates the nature of the relationship between the telemedicine technologies and how the application of telemedicine will affect the health care improvements. The research population in this study consists of heads of medical departments, IT department, telemedicine department, and medical education department in the PSMMC -Riyadh, Saudi Arabia. Participants were recruited through purposive sampling techniques. As the numbers of respondents were few, all the respondents were included as part of the study. Forty respondents were included as part of the study. All the questionnaires were collected, yielding a response rate of 100%. It should be noted that every questionnaire was personally handed and instructions were given to each respondent before completing the questionnaire. Eighty-five (85%) of the respondents were males, and the remaining (15%) were females. (65%) of the respondents were between (41-50) years, while the remaining (30%) were between (31-40) years. Regarding the level of education, (95%) possessed a PhD in their specializations. Majority of the health service sector respondents (60%) had over (11-20) years experience. See table (1).

Table 1 Demographic Data (N=40)

Demographic	No.	%
<i>Gender</i>		
Male	34	85
Female	6	15
<i>Age</i>		
Under or 30	0	0
30-40	12	30
41-50	26	65
Over 50	2	5
<i>Education Level</i>		
Secondary school or less	0	0
Diploma degree	0	0
Bachelor degree	0	0
Master degree	2	5
PhD degree	38	95
<i>Experience</i>		
Less than 10	4	10
11-20	24	60
21-30	11	27
Over 30	1	2.5

5.2 Data collection

The research questionnaire was designed on the formats of previous empirical literature. The questionnaire design was pre-tested and redesigned through personal interviews with physicians and employees from different departments and levels at the hospital by undertaking a pilot study work (Aaker et al, 2001). The research questionnaire was used as a primary data collection method. The components of telemedicine (contributions and difficulties) items were measured on 5-point Likert-scale ranging from 5 (strongly agree) to 1 (strongly disagree). For the telemedicine dimensions, the research respondents were asked to indicate

the degree of agreement or disagreement on the telemedicine items that the hospital used in order to achieve health care quality improvements. This format has been recommended for health services surveys. Both the research variable(s) deployed in the research are explained in Table 2 and 3 according to the research questions.

6. RESULTS AND DISCUSSION

First question: what is the significant contribution presented by telemedicine in improving health care quality from the standpoint of heads of medical departments, IT department, telemedicine department, and medical education department in the PSMMC -Riyadh?

For the general level analysis, the results demonstrate that the most significant contribution which is presented by telemedicine in improving health care quality in PSMMC in descending order of importance are:

- Reducing the referral cases to other hospitals.
- Telemedicine system helped in the use of updating medical equipment is not available at the hospital.
- Telemedicine system helps to hold video conferences between physicians and specialists and consultants in remote locations inside and outside the Kingdom to discuss cases of patients, thus helping to achieve high quality of diagnosis and treatment.
- Telemedicine system has helped in increasing the quantity and quality of information available, which reflects positively on the quality of medical services.
- Telemedicine system has led the hospital to the extent of sending samples and reports by regular mail for inside or outside the Kingdom, resulting in a lower cost.
- Telemedicine system has helped in raising the competencies of doctors, technicians and nursing staff at the hospital by offering opportunities for education, training and access to updated knowledge in their field of specialization.
- Telemedicine system has helped the hospital in the integration of medical services provided to patients by obtaining the services of others that are using the Telemedicine Network.
- The least critical item is that, Telemedicine system has helped in the speed up of diagnosis and treatment in emergency situations that necessitating rapid transfer to other hospitals for treatment. Other items, too, are important in PSMMS, but with different scores for each items.

Table 2 Chi square test for telemedicine contribution in PSMMC

No	Item	Chi Square	df	Sig
1	Increased the efficiency of physicians, nurses, and technicians	24.050	2	0.001
2	Increased the use of high tech medical equipments	8.100	1	0.004
3	Increased the numbers of visual conferences	8.103	1	0.004
4	Increased the qualitative and quantitative information	23.767	2	0.001
5	Increased the integration of medical services	39.872	2	0.004
6	Helped in obtaining all the medical services	33.800	3	0.001
7	Increased the speed of delivering health services	31.400	3	0.001
8	Increased the speed of the diagnosis and treatment(e.g. urgent cases)	18.950	3	0.001
9	Helped in using updated medical equipments	19.600	3	0.001
10	Helped in raising the level of health situation in the serving area	16.200	2	0.002
11	Help in decreasing the mortality rate	27.600	3	0.001
12	Helped in reduction of diseases expansion and concomitantly reduction in the related expenses	9.950	2	0.001
13	Reduced the referral cases	8.750	3	0.001
14	Reduced the travelling of physicians	13.850	3	0.002
15	Reduced the use of post mail for samples	29.450	3	0.001
16	Helped in the effective use of the available infrastructure	27.004	2	0.001
17	Helped in making new job opportunities available	29.705	2	0.001

A Chi-square test was used to determine whether there was significance among the items related to contributions provided by the telemedicine application in health care services from the perspective of the heads of medical departments, IT manager, medical education, and telemedicine staff. The table (2) shows the actual result of the Chi-square. We can see from this table that our test for all items is significant $p < 0.05$. We can, therefore, reject the null hypothesis and conclude that there is a statistical significance for the contribution presented by telemedicine in improving health care quality dimension ($n = 40$). This was evidenced by the agreement level approval for members of the research population, which came in high levels among all the determinants of the first question.

Second question: What are the main difficulties faced by the telemedicine experience from the standpoint of heads of medical PSMHC -Riyadh?

For the general level analysis, the respondents were asked about the degree of agreement in all items for this dimension.

As shown in table 6 the most active item in this dimension is that users of the system suffer from a lack of training on the use of the techniques necessary for the practice of Telemedicine System, whereas the least active item is there is no encouragement and support from the top management of the hospital to follow updated scientific methods in telemedicine. The following lists them in descending order of relative agreement:

- There are no adequate number of qualified human resources in the hospital for the operation and maintenance of telemedicine in the hospital.
- There are no incentives or allowances for users of telemedicine system at the hospital.
- The telecommunications infrastructure in the Kingdom is a modern and well-breadth which provides one aspect of the ingredients required for the telemedicine system.

Table 3 Chi square test for difficulties faced telemedicine experience in PSMHC

No	Item	Chi Square	df	Sig
1	There is no encouragement from the top management of the hospital to follow updated scientific methods in telemedicine.	43.550	2	0.001
2	The hospital's top management considers telemedicine system as an unnecessary costly technique.	39.350	2	0.001
3	There are no incentives or allowances for users of telemedicine staff at the hospital.	35.400	3	0.001
4	The Hospital is suffering from the lack of sites and devices intended to use and application of telemedicine system.	29.400	3	0.001
5	Doctors and nursing staff at the hospital are unaware of how to use modern methods of computer systems and modern facilities of communication.	29.00	3	0.001
6	There is awe among the users of telemedicine system in the hospital for their unawareness in the use of this technique.	30.200	3	0.001
7	Physicians, technicians and nursing staff do not desire to seek counseling in the event of difficulties in using the telemedicine system.	40.550	2	0.001
8	Users of telemedicine are suffering from a lack of training on the use of the techniques necessary for the practice of telemedicine system in the hospital.	12.100	1	0.001
9	Users of telemedicine do not have a readiness and/or desire to receive training on the use of the techniques necessary for the exercise of the Telemedicine system.	48.650	2	0.001
10	The computer system at the hospital is considered as one of the obstacles for successful implementation of the telemedicine system.	0.100	1	0.752
11	The Telemedicine system in the Hospital suffers from the failure to provide hospital devices and technologies needed to deliver the	6.400	1	0.011

	telemedicine service properly.			
12	There are no adequate number of qualified human resources in the hospital for the operation and maintenance of telemedicine system in the hospital.	14.400	1	0.001
13	The high cost of establishing and maintaining a telemedicine system is one of the negative aspects of the potential success for this technique.	18.200	2	0.001
14	The telecommunications infrastructure in the Kingdom is a modern and well-breadth which provides one aspect of the ingredients required for the telemedicine.	35.400	3	0.001

A Chi-square test was used to determine whether there was significance among the items related to study the obstacles facing the implementation of telemedicine system in the hospital from the perspective of the heads of medical departments, IT manger, medical education, and telemedicine staff. The table (3) shows the actual result of the Chi-square. We can see from this table that our test for all items is significant $p < 0.05$. Accordingly, the null hypothesis was rejected. It can be evidenced that there are statistically significant differences in the main difficulties faced by Telemedicine experience from the standpoint of medical department heads and computer, medical education, medicine contact dimension ($n = 40$). This was evidenced by the agreement level approval for members of the research population, which came in high levels on all the determinants of the first question.

7. Research Conclusion

By the field study conducted by the researchers, it was possible to achieve the following conclusions: First: In respect of contributions that can be provided by the telemedicine in improving health services from the perspective of the heads of medical departments, IT department, telemedicine department, and medical education department in the PSMC -Riyadh, the most important of these include:

- Telemedicine system helps the hospital to minimize the process of referring patients to other hospitals.
- Telemedicine system helps in the use of modern medical equipments that are not available at the hospital (e.g. radiology, laboratory tests services, etc.) which raises the quality of medical services.
- Telemedicine system helps to hold video conferences between physicians (specialists and consultants) in remote locations inside and outside the Kingdom to discuss the cases of patients, which helps to achieve the quality of diagnosis and treatment plans.
- Telemedicine system helps in increasing the quantity and quality of information available, which reflects positively on the quality of medical service.
- Telemedicine system in the hospital leads to the reduction of sending samples and reports by regular mail and other facilities for inside or outside the Kingdom, resulting in a lower cost.
- Telemedicine system helps in raising the efficiency of doctors, technicians and nursing staff at the hospital by offering opportunities for education, training and access to modern knowledge in their fields and specifications.
- Telemedicine system helps the hospital in the integration of medical services provided to patients by obtaining the services of others using the telemedicine network.

Second: With regard to the most important difficulties faced by the telemedicine experience from the standpoint of heads of medical departments, IT department, telemedicine department, and medical education department, the most important of these obstacles are:

- Poor training in the utilization of techniques necessary for the application of telemedicine system at the hospital.
- The lack of a sufficient number of qualified human resources at the hospital for the operation and maintenance of the telemedicine system.
- The lack of incentives or allowances for staff that are using the telemedicine system at the hospital.
- Failure to provide devices and technologies needed to deliver the service properly.
- The high cost of construction and maintenance of the telemedicine system.
- The lack of sites and devices intended to use and applications for the telemedicine system.

8. Research Recommendations

Theoretical study and field researchers recommend the following:

- 1 - Because of the contributions made by telemedicine in improving health care services, researchers advocate gradual circulation of a draft of telemedicine at all military and governmental hospitals for capacity building and promotion by users and to avoid the difficulties that might occur.
- 2 – Insurance of training of doctors and technicians team to equip them with the necessary expertise in the field of telemedicine through prolonged training with practice in the field of the advanced work in hospitals abroad is considered a pioneer in this field.
- 3 - Providing telemedicine department in hospitals of qualified human resources, locations and devices and techniques necessary to provide the service properly.
- 4 - Develop financial incentives and allowances to users of telemedicine system hospitals.

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