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Feasibility of Telemedicine Deployment in Major Public Hospitals: A Case Study in Yazd

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ABSTRACT

Background: Health care organizations are faced with a new technology called telemedicine which provides a platform for remote cooperation, training, and consulting. Telemedicine is the use of information technology for clinical care of patients. This study aimed to establish the feasibility of telemedicine in two educational hospitals of Yazd.

Methods: This cross - sectional study was conducted in 2014. Census and random sampling were applied to recruit 200 out of 722 clinical and administrative staffs of both hospitals. Data were then collected through a standardized three-part questionnaire entitled "telemedicine measurement tools". The first two parts of the instrument were in the form of checklist that evaluated the infrastructure, administrative culture, and education dimensions. Questionnaires were distributed among hospitals' managers and IT staffs. The third part of the questionnaire was in a five-item Likert questionnaire format that evaluated staff preparation and also any obstacles to the deployment of telemedicine from the employees' perspectives. Data were analyzed through $SPSS_{18}$ software and by using descriptive statistics, frequency, and percentage.

Results: Providing raining and providing care were selected as the best applications in telemedicine by respectively 82.4% and 76.2% of respondents. Additionally, lack of technical staff and insufficient bandwidth in telemedicine were reported by respectively 85.4% and 77.8% of participants as the biggest barriers for use of telemedicine. Distance learning and remote monitoring were experienced by 14.5% and 10% of employees, respectively. There was no strategic plan and support for the use of telemedicine in the two hospitals. Employees had the necessary knowledge on the benefits of telemedicine, as well as barriers to its deployment. Technical infrastructure required for the deployment of telemedicine at the two hospitals was not available.

Conclusion: For the deployment of telemedicine, the two hospitals should invest in technical infrastructure and administrative culture. Also, the preparation of the two hospitals' staffs is the reliable implementation of this plan.

Keywords: Feasibility, Telemedicine, Educational Hospitals

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Introduction

A new field of health is the collaboration of hospitals, physicians, health centers, financial experts, and insurance in a virtual space in which the subject, objective, policy and management of health care is information (1). Application of information technology within healthcare, especially in health centers and hospitals holds great potential for improving the quality of services and also provides efficiency and effectiveness of staffs (2). Rapid development of technology and health informatics has promoted hospitals for creating infrastructure and skills necessary to provide better service and quality (3). Today, healthcare organizations are faced with new a technology called telemedicine (4) which provides the grounds for remote training, advising, and consulting patients (5). In fact, telemedicine is the bridge between science, medicine, and engineering in which the medical community uses the engineering facilities for promoting public health (6). Telemedicine is a tool for providing medical services to remote locations lacking facilities by professionals using information technology from 1950s (7). With development of communication technology and internet, use of telemedicine has developed in many fields (8, 9). Among its applications, education (8, 10), training human resources (11), advice (12, 13), and guidance in surgery (14, 15) can be noted.

Developing countries are faced with great difficulties in the field of providing medical services and health care including financial needs, resources, expertise, shortage of physicians, specialists, poor roads, transport facilities, etc. For those countries that have limited medical resources and expertise, telemedicine can be an effective solution to the problems mentioned above (16). The most important benefits of telemedicine consist of increasing the quality of health care, improving access to health care for rural and underserved areas, enhancing professional interaction between specialists in rural areas and urban centers, reducing costs, reducing traffic and unnecessary trips, reducing travel time for patients, specialists' activity in several hospitals, increasing interaction and exchange of ideas between physicians and specialists, having access to treatment, facilitating information sharing and transfer, benefiting from the expertise, increasing productivity, reducing mortality and disability, increasing equity in health and etc. Several studies have been conducted on the operating conditions of new cases and evaluation systems in many countries. But studies to check establishment feasibility of telemedicine in hospitals is Iran are rare (18). Rahim-Zadeh and et al. (6), conducted a study to evaluate feasibility of telemedicine application and deployment in Imam Khomeini Hospital of Ardabil to prepare the required manpower and equipment. In another study conducted by Hivi and et al. (19), the feasibility of performing telemedicine in Hormozgan University of medical sciences was evaluated. It was determined that there were strategic plans to support physicians such as suitable support for using telemedicine but facilities for video conference were not available.

Mars (20) also stated in a study entitled as “telemedicine and medicating rural and urban population of Africa" that there are a lot of diseases in Africa and strong lack of medical professionals that telemedicine can result in availability of special care, improvement of care quality in urban and rural areas, and reduction in travels for receiving medical services for rural patients. Yazd province with a large geographical area and numerous scattered urban and rural areas on the one hand and reference of patients from neighboring provinces to its hospitals on the other hand is lacking various medical specialists (21). However, the aim of this study was to evaluate possibility of this technology in the current situation in the mentioned two hospitals and if necessary present strategies for its deployment and implementation. These two hospitals were selected due to their various references as well as their undeniable role in improving hospital performance in Yazd province.

Materials and Methods

This cross-sectional study was conducted in 2014 to evaluate the feasibility of telemedicine deployment in two training hospitals affiliated with Yazd University of medical university. The population of the study consisted of executives, information technology manager, and clinical staffs (595 people) and office staffs (127) working in two studied hospitals. Due to the sample size formula $n = \frac{(z_{1-\alpha/2})^2 \times s^2}{d^2}$ (s = 13, d = 2, α = 0.95) , 200 participants were recruited using stratified random sampling and to divide the sample size among classes of society due to the volume of each class, proportional allocation method was used.

Research data were collected using a standard three-part questionnaire entitled as "telemedicine measurement tool". It has been designed by the Institute for Medicare in the US to evaluate volunteer organizations' preparation for establishment and application of telemedicine. Given that validity and reliability of the instruments used in this study were measured and confirmed in previous studies (α = 0.888) (6, 19), so they were not measured and confirmed again. Subjects studied in this questionnaire included determining the existing obstacles to the use of telemedicine systems to measure the existing infrastructure and comply with the technical requirements of telemedicine, determining hospital administrative culture status in using telemedicine, determining teaching staff status in using telemedicine, and determining the status of medical and administrative staff preparation for telemedicine acceptance. The questionnaire was in a checklist format and was related to the state of necessary infrastructure to establish and implement a telemedicine system. The items were completed in Yes or No by the IT department of hospital. This part is also divided into three main components (devices and equipment (10 questions), communication infrastructure and networks (7 questions), physical space (8 questions). Scoring was so that every question with a *Yes* was scored 1 and *No* answers got zero. Totally, 25 points were attributed to this part and the score of each hospital was calculated as the following: 0-8 points as poor infrastructure, 9-17 as average, and 18-25 as good infrastructure. The second part of the questionnaire was also in a checklist form; it was related to administrative culture and provided training in the field of telemedicine which was completed by the hospital managers. The questions of this part were also in the form of Yes-No in which yes questions were scored 1 and no questions were scored zero. The total attainable score for the executive culture was 14, which was categorized in 3 groups: hospitals with scores in the range of 0-4 had poor executive culture, hospitals with scores from 5 to 10 were average, and scores of 10 to 14 showed suitable and good executive culture. Providing training also got a total score of 13, in which a score of zero to 4 implied poor education, 5 to 9 average, and 10 to 13 represented suitable education. Sampling in the two parts of the study was conducted in the form of census. The third part of questionnaire was in the form of a five-item Likert scale and included questions related to staffs' preparation and cooperation (knowledge and attitudes), prioritization of presentable services through telemedicine as well as questions related to barriers of telemedicine deployment from the perspective of employees. The population of this part of the study consisted of all clinical and administrative staffs of the two hospitals. In this part of the questionnaire demographic questions about gender, positions, and experience in the field of telemedicine were addressed. Then, employees were asked to give their comment about prioritization of presentable services through telemedicine among five options of counseling, training, care, referrals, and equipment purchase. Questions on barriers to deployment of telemedicine consisted of 20 items, each question was scored from 0 to 4 points and a total of 80 points was awarded. In this way, the most important barriers to deployment of telemedicine were determined from employees' perspective (those who earn the most points). Additionally, 24 questions were asked about staffs' awareness and attitude (preparation); awareness had 14 questions

(0 to 56 scores) and attitude had 10 questions (0 to 40 scores). Scoring on staffs' awareness was in such way that a score in the range of 0 to 18 was considered poor, 18 to 37 average, and 38 to 56 was regarded as suitable awareness. Evaluation of attitude scoring showed that a score from 0 to 13 was considered poor, 14 to 27 average, and 28 to 40 was considered positive and good. It is worth mentioning that questions were ranged from I agree a lot to I disagree a lot. Data were then put into $SPSS_{18}$ software and analyzed by descriptive statistics, such as percentage and mean scores. Individuals participating in this research answered the questions with complete satisfaction; they were initially informed about the questionnaire's contents so that they could participate in the research with complete awareness. They were further assured about confidentiality of all information.

Further, in the current study all ethical issues were observed based on the Helsinki Declaration.

Results

Results showed that among the total 200 participants, 139 individuals (69.5%) were female and 61 (30.5%) were male. Furthermore, 165 people (82.5%) were medical staffs and 35 (17.5%) were hospital administrative staffs. Results on prioritization of the presentable services through telemedicine showed that staffs considered providing training and counseling as the most important factors in using telemedicine. Moreover, based on their viewpoints, buying equipment had the least use of telemedicine (Table 1).

Results of the research on barriers of telemedicine deployment from the perspective of two hospitals' staffs showed that shortage of technical and medical staffs, insufficient band width, insurance's initial costs and reimbursement issues are the most important barrier for deployment of telemedicine system. Furthermore, barriers such as licensing, confidentiality, and poor quality of services received less value from the perspective of the two hospitals' staffs for deploying telemedicine (Table 2).

In the case of telemedicine's technical infrastructure, the collected data showed that all sectors of the two hospitals have internet access and also all computers can be connected to management systems such as HIS, DIS, etc. Both hospitals also hav video conferencing equipment to hold online meetings, but there were no necessary technical infrastructures including hardware equipment and devices, physical spaces, communicational infrastructure, and network for implementing advanced telemedicine issues such as telesurgery in the studied hospitals.

Findings on organizational culture and providing training, showed that there is no strategic plan consisting of telemedicine in any of the hospitals.

The hospitals' boards also do not support telemedicine program. There is support in Rahnemoun hospital, but there has been no effort to promote telemedicine activities in any of the two hospitals. Further, there were no appropriate regular actions taken by the two hospitals' administrators; in some cases, only information in the form of periodicals has been provided to employees (Table 4).

Results from telemedicine experience showed that the most and least experiences in the realm of telemedicine among the two hospitals' staffs were respectively tele-education and tele-surgery. Among the staffs, 63% did not have any experience (Table 5). About the staffs' preparationfor accepting telemedicine, results showed that staffs' awareness about telemedicine activities was desirable (higher than the average) in both hospitals.

Table 1. The state of presentable services' prioritization through telemedicine from clinical and administrative staffs' perspective

Hospital / Type of service	Shahid Sadoughi Mean ± SD	Shahid Rahnemoun Mean ± SD	Total Mean ± SD
Educating	4.24 ± 0.99	4.13 ± 1.11	4.12 ± 1.11
Counseling	3.72 ± 1.21	3.36 ± 1.55	3.86 ± 1.19
Providing care	3.86 ± 1.17	3.89 ± 1.30	3.81 ± 1.21
Refer of patients	3.28 ± 1.42	3.71 ± 1.31	1.47 ± 1.43
Equipment purchase	3.09 ± 1.56	3.86 ± 1.37	3.18 ± 1.56

Table 2. Priority status of telemedicine implementation from the perspective of clinical and administrative obstacles

Hospital / Barriers for use	Shahid Sadoughi Mean	Shahid Sadoughi Standard Deviation	Shahid Rahnemoun Mean	Shahid Rahnemoun Standard Deviation	Total Mean	Total Standard Deviation
Lack of technical staff	4.27	1.12	3.98	1.21	4.17	1.16
Lack of medical staff	4.21	0.92	3.82	1.25	4.08	1.06
Insufficient bandwidth	3.89	1.21	3.62	1.22	3.80	1.22
Current costs	3.75	1.29	3.68	1.04	3.73	1.21
Insurance problems and refunds	3.78	1.21	3.58	1.23	3.71	1.22
Education	3.66	1.17	3.61	1.25	3.65	1.20
No internet access	3.33	1.42	3.53	1.17	3.40	1.34
No legal background	3.00	1.33	3.23	1.21	3.08	1.30
Medical staff resistance	2.87	1.21	3.02	1.08	2.93	1.17
Competition	2.81	1.18	3.10	1.21	2.91	1.23
Fear of job loss	2.78	1.10	3.10	1.08	2.90	1.10
Licensing problems	2.77	1.23	3.08	1.17	2.88	1.22
Issues about confidentiality	2.79	1.33	2.24	1.15	2.68	1.28
Low quality diagnosis or care in Telemedicine plan	2.01	1.03	2.73	1.28	2.25	1.17

Table 3. Frequency distribution of telemedicine technical infrastructure in affiliated hospitals

Technical infrastructure	Shahid Sadoughi Number	Shahid Sadoughi Percentage (%)	Shahid Rahnemoun Number	Shahid Rahnemoun Percentage (%)
Devices and equipments	7	70	4	40
Communicational structures and network	3	43	3	43
Clinical environment	2	25	1	12.5
Total	12	46	8	31.8

Table 4. Frequency distribution of organizational culture and training presentation status in selected hospitals

Hospital / Status	Shahid Sadoughi Number	Shahid Sadoughi Percentage %)	Shahid Rahnemoun Number	Shahid Rahnemoun Percentage (%)
Organizational culture	2	14.3	4	28.5
Providing training status	2	45.4	3	23.7

Table 5. Frequency distribution of clinical and administrative staffs experienced in various fields of telemedicine

Hospital / Experience	Shahid Sadoughi		Shahid Rahnemoun		Total	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Tele-education	22	16.5	7	10.4	29	14.5
Tele-counseling	12	9	7	10.4	19	9.5
Tele-monitoring	14	10.5	6	9	20	10
Tele-surgery	4	3	2	3	6	3
None of them	81	61	45	67.2	126	63
Total	133	100	67	100	200	100

Discussion

It seems that staffs of the two hospitals consider providing training, counseling, care, referrals, and purchase of equipment as important applications of telemedicine, respectively. A research on the capabilities and barriers of telemedicine system conducted by a monitoring group and economic interests in the United States (22) showed that the most attractive perspectives of telemedicine include: Fast response to the issues of healthcare, monitoring patients with chronic diseases and those living in remote areas, providing first level care in remote areas, rapid medical response after an accident, home care, compensation for lack of experienced specialists , and reducing costs.

Debnath (23) announced the most common uses of telemedicine as education, emergency medicine, general medicine, and related disciplines. In terms of barriers on deployment of telemedicine, the findings showed that from the perspective of two hospitals' staffs the most important obstacles were lack of staff, lack of medical staff, insufficient bandwidth, initial costs, insurance problems and reimbursement, and lack of adequate training in priority order. Furthermore, low quality diagnosis or care in telemedicine plan, issues of confidentiality, licensing problems, fear of job loss, competition, and resistance of medical staffs were stated as obstacles with low priority. Jang-Jaccard (24), introduced the major obstacles to widespread use of telemedicine as high resistance of local health care providers and fear of job loss, inadequate insurance coverage, poor quality and high costs of care diagnosis or purchase. Kifle et al. (25), noted other barriers to the widespread use of telemedicine in their study as shortage of resource, poor telecommunication infrastructure (bandwidth), human and organizational factors, standards, policies, and socio- economic issues. Licensing issues are also considered as a major problem in the US to perform remote consultation (26). Comparison of this research with similar researches suggests that almost all the barriers resulted from results of this research have also been considered in other studies. In the case of infrastructure, findings showed that all departments in two hospitals had internet access. But despite using optical fiber infrastructure by the two hospitals, the practical and usable bandwidth was very low for users of two hospitals. Regarding the equipment, clinical devices, and information systems at two hospitals results showed that due to poor condition of these equipment and devices establishing a wide range of Telemedicine services is not possible practically. Only online sessions, as the most basic forms of Telemedicine and expertise that do not require physical examination or sending medical images and patient's vital signs are possible. In a study conducted by Quaid-e-Amini (27) on ICT infrastructure in Ayatollah Kashani hospital, Shahrekord, Iran it was concluded that this center from technological and information technology as well as medical-diagnostic equipment view point is in a proper state to implement telemedicine system. In comparison with the current study, it was suggested that the two studied hospitals are in a more inappropriate state in this case. According to the results of video-conferencing equipment and since the two hospitals had video conferencing

equipment, in the case of increasing their bandwidth and having counseling centers; both hospitals can provide remote counseling services. In the case of administrative culture and education, the results showed that there is no strategic plan including telemedicine in none of the hospitals. The Board of Trustees and Board of Directors of two hospitals do not support the telemedicine program. There are back-up physicians at Shahid Rahnemoun hospital but there has been no effort to promote telemedicine activities in any of the two hospitals. Main problems from the view point of hospital managers were access to primary care, emergency care, and specialized care. Jenett et al. (28), have introduced written policies as a means to create organizational preparationin telemedicine. The most important point from the perspective of researchers is the importance of formal written agenda for establishment of a desirable telemedicine system (29, 30). Based on the above discussion, it can be concluded that organizational and operational elements are required for successful application of telemedicine in two hospitals. This is one of the weaknesses of these hospitals to establish and implement a telemedicine system. In the field of staff preparation, the findings showed that staff awareness about various telemedicine activities is desirable in both hospitals. Additionally, in the field of education, findings represented that telemedicine training sessions are held despite being irregular which can be one of the causes for appropriate knowledge of hospitals' employees, especially Shahid Sadoughi hospital. One of the success factors of telemedicine is having a formal education program to inform users about applications and technologies of telemedicine (31). Telemedicine capabilities should especially be thought to the care training providers (32). Many studies have emphasized the importance of having teaching staff (33) and since telemedicine is highly dependent on the acceptance of physicians, the importance of providing training to them has double importance (25). In relation to experience and preparation, the results showed that only 38% of the two hospitals' employees have experienced in rendering a telemedicine service and 62% of employees declared that they did not have any experience in telemedicine. Comparing the results of this study with other studies suggests the importance of training staffs, especially physicians. Fortunately, the majority of staffs had the necessary knowledge in this case that can be one of the strengths of the two hospitals. But in terms of experience, staffs' experience does not seem enough to deploy and operate successful telemedicine. Rahimzada (6) in a study on feasibility of adopting and implementing telemedicine in Imam Khomeini hospital stated that apart from organizational culture, none of the infrastructures required for the deployment of telemedicine are not appropriate in Imam Khomeini hospital, which compared to the current research it seems that the status of two hospitals in this study are better in staffs' preparation, corporation, training, and infrastructure and worse in organizational culture.

Conclusion

In general, lack of technical staff, lack of medical staff, insufficient bandwidth, initial costs, insurance problems, and reimbursement were the major obstacles to telemedicine deployment from the two hospitals' viewpoints. Moreover, the state of necessary infrastructure for telemedicine deployment was almost identical in the two hospitals. Current bandwidth of both hospitals is only responsive for the lowest levels of telemedicine application. Therefore, increasing the bandwidth and providing infrastructure as well as the necessary technology for optimal use of telemedicine are essential. Administrative culture in the two hospitals was weak to establish telemedicine, but the level of staffs' preparation and education seemed desirable.

Limitations of this study include: Lack of compliance from some hospital officials due to information confidentiality, Reluctance and lack of cooperation of some employees because of being busy.

Conflicts of interest

The authors of the study state that there is no conflict of interest.

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Authors' contributions

Eghbali Zarch ME, Bahrami MA and Montazeralfaraj R designed research; Eghbali Zarch ME, Taheri GH and Aghily M conducted research; SHamsi F and Eghbali Zarch ME analyzed data; and Eghbali Zarch ME, Bahrami MA and Pakdaman M wrote the paper. Bahrami MA had primary responsibility for final content. All authors read and approved the final manuscript.

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