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Iranian healthcare professionals' perspectives about factors influencing the use of telemedicine in diabetes management

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Abstract

AIM

To identify factors influencing the use of telemedicine in diabetes management from the perspectives of healthcare professionals.

METHODS

This was a quantitative study that was conducted in 2016. The participants were 240 nurses and 55 physicians from three teaching hospitals as well as from one endocrinology and metabolism research center. No sampling method was used and the data were collected by using a five-point (1 to 5) Likert scale questionnaire, which had 37 questions. Descriptive and inferential statistics (Mann-Whitney *U* test) were used to analyze the data.

RESULTS

The findings showed that both physicians (4.06 ± 0.69) and nurses (4.02 ± 0.61) tended to use telemedicine technology for managing diabetes. Overall, the lowest mean value for physicians (3.79 ± 0.82) was related to the compatibility of telemedicine with other clinical activities in diabetes management. For nurses, the lowest mean value pertained to the usefulness of telemedicine in diabetes management (3.99 ± 0.53) and their attitude toward using this technology (3.99 ± 0.65).

CONCLUSION

Although physicians and nurses agreed on using telemedicine technology in diabetes management, it is necessary to consider their concerns prior to the im-

plementation and deployment of new technologies. This approach will help to improve the level of technology acceptance among the users.

Key words: Telemedicine; Diabetes mellitus; Physicians; Nurses

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Core tip: In this study, factors influencing the use of telemedicine in diabetes management were identified from the perspectives of Iranian healthcare professionals. The results revealed that both physicians and nurses intended to use telemedicine technology for managing diabetes. However, the compatibility of using telemedicine technology with other clinical activities related to diabetes management and the usefulness of this technology were two main concerns for the healthcare professionals. Therefore, it is essential to pay more attention to these factors and similar ones prior to system design and deployment.

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INTRODUCTION

Diabetes is a major cause of disability and death in the world and more than 10% of the global adult population has been affected by diabetes^[1]. In addition, 59% of all deaths across the world are caused by non-communicable diseases and 9% of them are caused by diabetes^[2]. The Center for Disease Control and Prevention has estimated that 30.3 million Americans suffered from diabetes in 2015, of which 7.2 million were unaware of their disease. The direct and indirect costs of diagnosed diabetes in the United States in 2012 were estimated to be more than \$200 billion^[3].

In Iran, the prevalence of diabetes in urban areas is higher than in rural areas, and women are more affected by diabetes than men^[4]. In the early 2010s, one in every 20 Iranians had diabetes. It is estimated that in 2025, one in every seven Iranians would have the disease^[5]. In addition to the costs and the increasing number of patients, most patients experience unfavorable side effects due to late diagnosis, negligence in controlling the disease, and physical disabilities. As a result, the use of new technologies to manage the disease has been suggested^[6,7]. For example, telemedicine can be used to offer more services to patients regardless of time and place. Thus, patients with certain conditions and those who live in rural areas can benefit a lot from these services without being referred to healthcare centers^[8].

This approach reduces healthcare costs and saves time for patients as well as care providers. In addition, it will enhance independence and self-management among patients with chronic conditions^[9].

Previous studies have shown that the use of information technology, such as telemedicine, telemonitoring, sensors, decision support systems, reminders and teleconsultation is not only economic, but is also effective for managing chronic diseases like diabetes^[6,7,10-16]. Since the World Health Organization has highlighted the alarming situation pertaining to diabetes, especially in developing countries^[12], and advised different countries to take action against the disease, the use of information technology, such as telemedicine, has drawn serious focus in managing diabetes^[13]. However, before applying this technology, it is necessary to pay more attention to providing the necessary infrastructure and equipment along with training people to use telemedicine more efficiently^[11].

In the last decade, many technologies have been developed in the area of healthcare; however, less attention has been paid to the factors that influence the use of these systems^[4]. The use of telemedicine in diabetes management is one of these technologies and it is essential to know factors that influence the use of this technology. For example, the lack of telemedicine policy, inadequacy of knowledge and skills, resistance to change by clinicians^[17], the capacity of telemedicine service providers, performance expectancy (perceived usefulness), effort expectancy (perceived ease of use), and social influences were found to be some of the factors that influence the use of telemedicine in diabetes management^[18]. However, these factors can differ across the world mainly due to legal, cultural, technical, and economic differences^[19]. Identifying these factors in each country can help to strengthen the positive aspects and to overcome the constraining factors in order to implement a project successfully. Therefore, the current study aimed to identify factors that influence the use of telemedicine in diabetes management from the perspective of Iranian healthcare professionals.

MATERIALS AND METHODS

This was a quantitative study which was conducted in 2016. The research participants were 240 nurses and 55 physicians (20 general practitioners and 35 internal medicine specialists and endocrinologists) who worked in three teaching hospitals and one endocrinology and metabolism research center. As the number of potential participants was limited, no sampling method was used. To collect data, a questionnaire was designed based on the literature review^[6,8,9,15-21]. The questionnaire had 37 questions. The first six questions were related to the participants' demographic information and the duration of using a computer by a physician and a nurse, and the next 31 questions to the factors influencing the use of telemedicine technology in diabetes management.

Table 1 Cronbach's alpha for the last six parts of the questionnaire

Questionnaire sections	Cronbach's alpha
Perceived ease of use	0.83
Perceived usefulness	0.81
Intention to use	0.85
Users' attitudes	0.86
Compatibility with other clinical activities	0.80
Security and reliability of technology	0.82

Table 2 Participants' characteristics

Nurses	(%) fx	Physicians	(%) fx
134	F 120 (89.5) M 14 (10.5)	40	F 15 (37.5) M 25 (62.5)
Age (yr)	< 30 50 (37.3) 30-39 53 (39.5) 40-49 21 (15.7) 50-59 10 (7.5)	Age (yr)	< 30 14 (35.0) 30-39 20 (50.0) 40-49 6 (15.0) 50-59 0
Education	BSc 101 (75.3) MSc 33 (24.7)	Education	GP 20 (50) Specialist 20 (50)
Use of Computer	< 1 28 (20.9) 1-2 49 (36.6) > 2 57 (42.5)	Use of Compute	< 1 7 (17.5) 1-2 23 (57.5) > 2 10 (25.0)

These questions were divided into six sections: Perceived ease of use, perceived usefulness, intention to use, the users' attitudes, compatibility with other clinical activities, and security and reliability of telemedicine technology for managing diabetes (Appendix I). The validity of the questionnaire was approved by six experts in the field of health information management, health informatics and nursing. The reliability of the questionnaire was determined by calculating Cronbach's alpha coefficient ($\alpha = 0.83$). Table 1 shows the value of Cronbach's alpha for the last six parts of the questionnaire. The questionnaire was designed based on the Likert scale with the following options: strongly agree (5), agree (4), undecided (3), disagree (2), and strongly disagree (1). Data analysis was performed using SPSS software (version 23.0) and descriptive (mean value and standard deviation) and inferential statistics (Mann-Whitney *U* test) were used to analyze the data.

RESULTS

Initially, 13 incomplete questionnaires were withdrawn. Overall, 134 nurses (55.8%) and 40 physicians (72.5%) participated in the study. The findings showed that the highest frequency of nurses ($n = 120$, 89.5%) were female and the highest frequency of physicians were male ($n = 25$, 62.5%). The highest frequency of physicians ($n = 23$, 57.5%) used computers between one and two hours per day in their clinical practices and the nurses used them for more than two hours per day ($n = 57$, 42.5%). Table 2 shows the participants' characteristics.

According to the results, most of the physicians (4.19 ± 0.40) and nurses (4.60 ± 0.60) thought that telemedicine was an easy to use technology for managing diabetes. While most of the physicians (4.40 ± 0.77) and nurses (4.14 ± 0.86) perceived that the use of telemedicine technology was easy for healthcare providers, the physicians thought that it may not be easy to use for patients with diabetes (3.80 ± 1.06) and the nurses believed that it may not be easy to learn for healthcare providers (3.93 ± 0.91). The results of the Mann-Whitney *U* test showed that there was a statistically significant difference between the perspectives of the physicians and the nurses regarding the perceived ease of learning the technology ($P = 0.004$).

Concerning the technology's usefulness, the findings indicated that most of the physicians (4.17 ± 0.61) and nurses (3.99 ± 0.53) agreed on the usefulness of telemedicine technology in diabetes management. Among physicians (4.47 ± 0.78) and nurses (4.15 ± 0.88), the highest mean value was related to the usefulness of telemedicine technology in reducing unnecessary transportation costs. The lowest mean values for both physicians (3.73 ± 1.13) and nurses (3.78 ± 0.89) were related to improving patient safety after using telemedicine technology. Moreover, there was a statistically significant difference between the mean values calculated for physicians and nurses in terms of the technology's usefulness in reducing healthcare costs in hospitals ($P = 0.007$), in saving time for healthcare providers and patients with diabetes ($P = 0.012$), in reducing costs of patients referrals ($P = 0.021$), and in improving the delivery of healthcare services to the patients with diabetes in remote areas ($P = 0.028$).

In terms of intention to use, the results showed that both physicians (4.22 ± 0.72) and nurses (4.14 ± 0.56) were interested in using telemedicine technology for managing patients with diabetes. Most of the physicians (4.45 ± 0.74) and nurses (4.10 ± 0.81) agreed that using telemedicine for managing diabetes could encourage other healthcare providers to use the technology for other healthcare services as well. For physicians, the lowest mean value (3.95 ± 1.26) was related to the desirable outcomes of telemedicine technology in managing diabetes compared to the traditional methods, such as a face-to-face visit. For nurses, the lowest mean value was related to the use of telemedicine as a basis for applying new treatment methods for managing patients with diabetes (4.04 ± 0.88). The results of the Mann-Whitney *U* test showed that there was a statistically significant difference between the opinions of the physicians and the nurses regarding patient monitoring at any time of the day by using telemedicine technology ($P = 0.016$) and encouraging other healthcare providers to use the technology for other healthcare services ($P = 0.006$).

According to the findings, the attitudes of both physicians (4.08 ± 0.71) and nurses (3.99 ± 0.65) were positive about the use of telemedicine technology in

Table 3 Clinicians' attitudes towards using telemedicine technology in diabetes management

Questions	Groups	Strongly disagree	Disagree	No idea	Agree	Strongly agree	mean \pm SD	P-value
The use of telemedicine is essential for health care providers in managing patients with diabetes	Physicians	0	2 (5.0)	9 (22.5)	15 (37.5)	14 (35.0)	4.03 \pm 0.89	0.57
	Nurses	4 (3.0)	7 (5.2)	24 (17.9)	62 (46.3)	37 (27.6)	3.90 \pm 0.96	
The use of telemedicine in managing diabetes can reduce the burden of the disease	Physicians	0	3 (7.5)	6 (15.0)	16 (40.0)	15 (37.5)	4.08 \pm 0.91	0.459
	Nurses	3 (2.2)	7 (5.2)	17 (12.7)	71 (53.0)	36 (26.9)	3.97 \pm 0.90	
The use of telemedicine in diabetes management can make working with new systems easier in the future	Physicians	0	2 (5.0)	8 (20.0)	17 (42.5)	13 (32.5)	4.03 \pm 0.86	0.824
	Nurses	2 (1.5)	3 (2.2)	19 (14.9)	71 (53.0)	39 (29.1)	4.06 \pm 0.81	
The use of telemedicine in diabetes management can increase the level of satisfaction among healthcare providers	Physicians	18 (45.0)	14 (35.0)	6 (15.0)	2 (5.0)	0	4.20 \pm 0.88	0.094
	Nurses	1 (0.7)	1 (0.7)	24 (17.9)	75 (56.0)	32 (23.9)	4.02 \pm 0.72	

diabetes management. Among physicians, the highest mean value (4.20 ± 0.83) was related to an increase in the level of satisfaction among healthcare providers when using telemedicine technology for managing patients with diabetes. For nurses, the highest mean value (4.06 ± 0.81) was associated with the impact of using telemedicine technology on making the use of other systems easier in the future. In this section, the lowest mean value for both physicians (4.03 ± 0.89) and nurses (3.90 ± 0.96) was related to the necessity of using telemedicine technology for healthcare providers in managing patients with diabetes. The attitudes of the physicians and the nurses toward using telemedicine technology in diabetes management are summarized in Table 3.

The majority of physicians (3.79 ± 0.82) and nurses (4.02 ± 0.71) believed that the use of telemedicine technology was compatible with other related clinical activities in diabetes management. The lowest mean value was related to those physicians (3.60 ± 1.12) and nurses (3.92 ± 0.95) who believed that the use of telemedicine technology could cause problems in the process of care for patients with diabetes. The results of the Mann-Whitney *U* test showed that there was no statistically significant difference between the views of physicians and nurses about the compatibility of telemedicine technology with other related clinical activities in diabetes management.

The findings showed that most of the physicians (3.95 ± 0.78) and nurses (4.02 ± 0.62) perceived telemedicine technology as a secure and reliable technology in the management of diabetes. The majority of physicians (4.40 ± 0.90) believed that security policies and instructions should be provided before using telemedicine in managing diabetes and the lowest mean value (3.78 ± 1.02) was related to those physicians who thought that the risk of privacy breaches could be prevented by using this technology. For nurses, the highest mean value (4.22 ± 0.83) was related to an increase in the level of patient confidentiality by using telemedicine technology and the lowest mean value (3.93 ± 0.95) was related to the technology's security assurance based on the available infrastructure in the

country.

Finally, the findings revealed that both physicians (4.06 ± 0.69) and nurses (4.02 ± 0.61) tended to use telemedicine technology for managing diabetes. Overall, the lowest mean value for physicians (3.79 ± 0.82) was related to the compatibility of telemedicine technology with other clinical activities in diabetes management. For nurses, the lowest mean value pertained to the perceived usefulness of telemedicine technology in diabetes management (3.99 ± 0.53) and their attitude toward using this technology (3.99 ± 0.65). As Table 4 shows, no significant differences were found between the opinions of physicians and nurses in different sections of the questionnaire.

DISCUSSION

The use of technology in the health system has changed the process of healthcare delivery from hospitals and clinics to the daily lives of patients at their homes^[22]. In this regard, the use of technology for managing chronic diseases, such as diabetes, has received particular attention^[23,24]. The findings of the present study showed that physicians and nurses generally agreed on the use of telemedicine in diabetes management. However, some researchers have reported that physicians and nurses were reluctant to use telemedicine^[25].

According to the literature, technological advances and increased computer literacy among clinical staff can help in more effective use of telemedicine and similar systems^[26]. The results of the current study showed that the nurses used computers at their clinical practices more than the physicians, mainly because the nurses used the hospital information system and the nursing information system. Similarly, Asua *et al.*^[25] and Gagnon *et al.*^[16] reported that nurses used computers more than physicians.

In terms of the perceived ease of use of telemedicine technology in diabetes management, the results revealed that physicians and nurses perceived the technology as easy to use. This is in line with Brewster *et al.*^[27]'s study in which the system's ease of use was considered as an important factor for learning how to

Table 4 Comparison between the clinicians' perspectives towards factors influencing the use of telemedicine technology in diabetes management

Factors influencing the use of telemedicine technology in diabetes management	Physicians' opinions (mean \pm SD)	Nurses' opinions (mean \pm SD)	P-value
Perceived ease of use	4.19 \pm 0.54	4.06 \pm 0.60	0.448
Perceived usefulness	4.17 \pm 0.61	3.99 \pm 0.53	0.087
Intention to use	4.22 \pm 0.72	4.07 \pm 0.56	0.078
Users' attitudes	4.08 \pm 0.71	3.99 \pm 0.65	0.488
Compatibility with other related clinical activities	3.79 \pm 0.82	4.02 \pm 0.71	0.083
Perceived security and reliability	3.95 \pm 0.78	4.02 \pm 0.62	0.805

use the system. In another study, the perceived ease of use was regarded as the most important factor in the technology acceptance model^[28]. Similarly, Rho *et al.*^[29] found that a positive perspective on a technology's ease of use led to a positive perception about the technology's usefulness.

In terms of perceived usefulness, the findings showed that compared to nurses, most physicians agreed with the usefulness of telemedicine technology. According to Pai and Huang, the usefulness of technology is associated with increasing job productivity^[30]. Besides, the perceived usefulness of telemedicine is one of the important factors that encourage clinical staff to use the technology in their daily activities^[31]. Therefore, policy-makers and planners should pay more attention to demonstrating the benefits of the technology and to introduce it as an important part of the health system^[32]. The findings of the present study are in line with the findings reported by Palmas *et al.*^[33], in which both physicians and nurses agreed upon the reduction of care costs as well as unnecessary patient transportation by using of telemedicine technology.

The intention to use telemedicine technology in diabetes management was another important factor that influenced the use of technology. According to the literature, the perceived ease of use and the perceived usefulness of telemedicine technology can affect the intention to use the technology. Apart from these factors, personal abilities, availability of resources, and subjective norms are other factors that can help predicting the behavior of users in the future^[34]. The results showed that the nurses were more interested in using telemedicine technology compared to the physicians. The nurses also assumed that the successful implementation of telemedicine technology could be a basis for applying new treatment methods in diabetes management. In Maarop *et al.*^[35]'s study, the intention to use was regarded as being equal to the need for the technology. In another study, Chuttur argued that behavioral intention determined the actual behavior of an individual. In other words, if people express their feelings about something, they will apply them in the real environment^[28].

The findings of the present study revealed that overall, the physicians as well as the nurses had positive attitudes towards using telemedicine technology in diabetes management. Therefore, it can be predicted

that this factor may positively influence the use of the technology in the future. The findings of the present study also showed that the compatibility of telemedicine technology with other daily activities in diabetes management was an important factor for both physicians and nurses. Similarly, in Gagnon *et al.*^[16]'s study, paying more attention to the users' expectations and the actual performances of telemedicine technology were considered to be a major challenge for managing chronic diseases. Accordingly, if activities, workflows, and new technologies are unfitting and incompatible, the technology's acceptance will be affected negatively^[6,25].

In terms of security and reliability of telemedicine technology, some researchers have found that the lack of technology acceptance by users might be due to the lack of confidence in using the new system^[36]. Taylor *et al.* argued that before implementing a new technology, the users should receive full training; otherwise the lack of training may lead to uncertainty and the lack of confidence, which in turn would reduce the level of enthusiasm to use the technology^[37]. According to the findings of the present study, the development of security standards and guidelines and confidentiality of information were the most important challenges from the perspective of healthcare professionals. Similarly, other studies have considered the security of telemedicine technology as one of the most important concerns of clinical staff^[25,29,34,38,39].

Limitations

The current study has some limitations. One of them is related to the limited number of participants, particularly endocrinologists. However, the results showed that in most areas, the perspectives of both physicians and nurses were similar and there was no statistically significant difference between their views. This suggests that the number of participants could not affect the final results.

This study focused on the opinions of physicians and nurses about factors influencing the use of telemedicine technology in diabetes management, but ignored the perspective of patients. Therefore, conducting research to identify factors influencing the use of telemedicine from the perspective of patients is recommended. Moreover, the results showed the perspectives of Iranian healthcare professionals and thus cannot be generalized to other settings or other countries. Similar

studies can be conducted by using the questionnaire in other settings to compare the results.

In conclusion, the use of telemedicine technology is one of the solutions for reducing the costs and increasing the quality of care, particularly for managing chronic diseases. The findings of the present study showed that physicians and nurses intended to use telemedicine technology for managing diabetes. However, the physicians were concerned with the compatibility of telemedicine technology with other clinical activities related to diabetes management, while the nurses were concerned with the technology's usefulness in diabetes management. Therefore, it is essential to pay more attention to these factors and similar ones prior to system design and deployment. This approach will help in improving the level of technology acceptance among the users. The influencing factors identified in the current study can be prioritized in future research in order to enable more focus on the most important ones in the process of system design and implementation.

ARTICLE HIGHLIGHTS

Research background

The use of new technologies to manage diabetes has been suggested and telemedicine is one of these technologies that can be used to offer more services to patients regardless of time and place. However, there are a number of organizational, legal, cultural, technical, and economic factors that may influence the use of telemedicine in managing diabetes.

Research motivation

Less attention has been paid to the factors influencing the use of telemedicine in managing diabetes. These factors can be different in different countries and investigating them can help to strengthen the positive factors and to overcome the constraining factors before implementing a project successfully.

Research objectives

The research objective was to identify factors influencing the use of telemedicine in diabetes management from the perspectives of healthcare professionals in Iran.

Research methods

This was a quantitative study and the research participants included 240 nurses and 55 physicians. To collect data, a five-point Likert scale questionnaire was designed. The data analysis was performed by using descriptive and inferential statistics.

Research results

The findings showed that physicians and nurses intended to use telemedicine technology for managing diabetes. However, the physicians were concerned with the compatibility of telemedicine with other clinical activities related to diabetes management and the nurses were concerned with the technology's usefulness in diabetes management.

Research conclusions

It is essential to pay more attention to the factors influencing the use of telemedicine technology prior to system design and deployment. This approach will help to improve the level of technology acceptance among the users.

Research perspectives

The influencing factors identified in the current study can be prioritized in future research in order to enable more focus on the most important factors during system design and implementation.

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