Determinants of Physicians' Technology Acceptance for Mobile Health Services in Healthcare Settings

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A B S T R A C T

Introduction: World Health Organization reports indicated that the image of health care service delivery has changed by application of mobile health and wireless technologies for supporting and achieving the objectives of the health industry. The present study aimed to determine the level of physicians' familiarity and investigate the factors affecting the acceptance of mobile health from the viewpoint of physicians working in educational hospitals of Zahedan University of Medical Sciences.

Method: A cross-sectional study was carried out in Zahedan University of Medical Sciences in the southeast of Iran in 2016. The statistical population included all physicians working in five University Teaching Hospitals (n=150). In this study, systematic random sampling was used. A validated questionnaire, prepared based on the variables of Technology Acceptance Model 2 and models, was used for data collection. To analyze the data, we used descriptive and analytical statistics (Confirmatory Factor Analysis, linear and multiple regression).

Results: Most of the respondents (112, or 74.4%) were female and 84 of them (56%) were less than 30 years old. All of the physicians (specialist and general physician) used Smartphones. The score of perceived usefulness, behavioral intention, perceived enjoyment, subjective norm, perceived ease of use, image, volunteering, and objective usability constructs were higher than the average baseline, representing the acceptance of mobile phone by them. The relationship of all the constructs with each other towards the attitudinal and behavioral objectives of the mobile health services acceptance was significant (P< 0.05). However, demonstrability construct had no correlation with perceived usefulness (P>0.05).

Conclusion: The results of this study provide useful information to health managers and policymakers so that they can take steps to improve the quality of services using modern technologies. Plans can also be made by considering the factors as behavioral acceptance of mobile health and other effective factors to increase the willingness to use it.

Keywords: Mobile Health, Physician, Acceptance

Introduction

The prevalence of diseases all over the world and lack of universal access to high-level health care are considered as major threats to the health care system (1). Health services are shifting from medical care to disease prevention and health management models. Moreover, telemedicine in different areas is developing, and Mobile Health Services had attracted the attention of a number of physicians which also has a considerable potential for growth and development (2). On the other hand, the use of mobile devices (mobile health services) by health care professionals (HCPs) has highly changed the aspects of clinical measures (3). According to the WHO's report, mobile health and wireless technologies for supporting and achieving the objectives of health industry have

changed the image of health care service delivery in the world (4). Furthermore, according to the International Telecommunication Union, there are more than 5 billion mobile phone users throughout the world and more than 85% of the world population is covered by commercial wireless signals (5). Mobile health services are used in health care centers to provide the patients-related information to the specialists, measure physical activities, remind the time of medications, and support the disease diagnosis (6). In addition, mobile health monitoring services are extremely effective for patients with chronic diseases (7). Therefore, mobile health is defined as a combination of mobile computations, medical sensors and communication technologies for health care (8). Accordingly, manifold barriers including structural, financial, and attitudinal

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obstacles are required to be removed before implementing the mobile health services to use the latter for providing comprehensive medical care (9). Health care system has to be developed based on the perception and factors affecting the acceptance to provide favorable services by mobile health. To this end, appropriate studies are required to be done. Nevertheless, few studies have been carried out in terms of the users' attitudes towards the mobile health services in Iran. The present was study carried out to assess the perception of mobile health service users and importance of its usage and determine its associated factors as well. Moreover, this study has discovered different perceptions about the factors affecting the mobile health acceptance from the physicians' viewpoint; hence, the results could be optimally considered an applicable guide for the development of mobile health services by the providers and policy makers.

The conceptual model of the study is presented in Figure 1.

The present model was developed based on the review done on behavioral theories and studies. To this end, Technology Acceptance Model (TAM) 2 and 3 were used as the basic models of the study. On the other hand, numerous studies using the aforementioned models have been done in the area of health care (10). On this basis, in the present study perceived usefulness, result demonstrability, image, subjective norm, experience, volunteering, and perceived ease of use, objective usability, perceived enjoyment, behavioral intention, and use of behavior constructs were chosen respectively from TAM2 and TAM3; consequently, the conceptual model of the study was developed based on the above mentioned factors.

Based on the model, the relationship of variables with one another and that with perceived usefulness and behavioral intention are to be investigated. Moreover, the items used in this model were defined in Table 1.

Figure 1. The study conceptual model
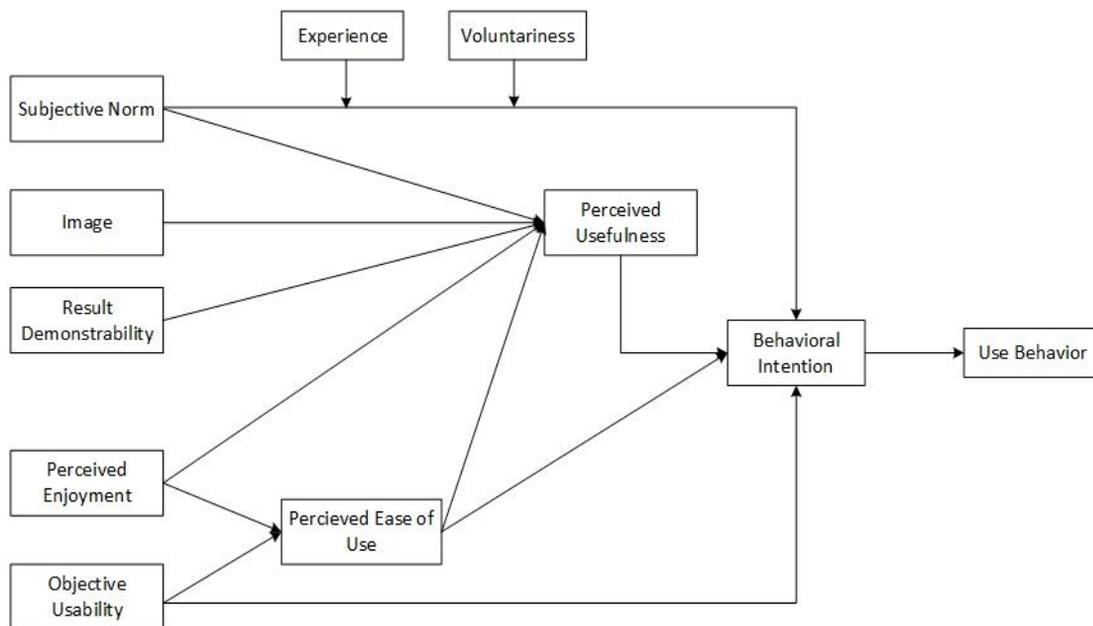
Table 1. A review on the parameters used in the conceptual model of the study

Constructs	Definition
Subjective Norm (SN)	The expected behavior of the social environment (11).
Image	Degree to which the use improves the status (12).
Experience (EX)	Professional experience (11).
Result Demonstrability (DM)	The tangible results of the use of new technology (12).
Perceived Ease of Use (PEOU)	The degree to which a person believes that the use of technology does not require a lot of effort (13).
Voluntariness (VT)	The degree to which a person is free in the use of new technology (11).
Perceived Enjoyment (ENJ)	The degree to which the use of new technology, taking into account the consequences of using it enjoyable (14).
Objective Usability (OU)	Comparison Systems based on the actual level (and not withdrawn) on specific tasks (11).
Perceived Usefulness (PU)	Assess the usefulness of the system by the user (13).
Behavioral Intention (BI)	The degree of willingness to use system that behavior is specified (13).
Use Behavior	The use of the system during the day (13).

Method

This cross-sectional study was carried out in Zahedan University of Medical Sciences (ZAUMS) in the southeast of Iran in 2016. The statistical population of the study included all physicians working in Teaching Hospitals of ZAUMS (Imam Ali, Khatam, ophthalmology, Baharan, Ali Asghar, and Bu Ali hospitals). As the results of confirmatory factor analysis showed, the minimum sample size was determined based on the constructs; therefore, 20 samples were required for each factor. In this study, according to the research conceptual model, 180 individuals were selected as the final sample based on the random sampling method. 150 out of 180 individuals participated in the study. A researcher-made questionnaire based on the variables of TAM2 and TAM3 was used for data collection. The questionnaire had two parts; the first section was dedicated to questions on demographical features (5 questions), and the second section with 52 questions was on the research aspects. Moreover, in this question, five-point Likert scale (strongly disagree=1, disagree=2, no idea=3, agree=4, strongly agree=5) was used. Content and face validity were used to confirm the validity of the questionnaire. The questionnaire was given to 10 experts of Health Information Technology and Medical Informatics and its validity was confirmed by their comments. The reliability of the questionnaire was confirmed by test re-test with the correlation coefficient of 80%. The compiled questionnaires were analyzed by descriptive statistical methods (mean, standard deviation) and analytical ones (linear and multiple regression) through IBM® SPSS® version 21 software. Since the structural equations modeling methods such as AMOS, LISREL, and EQS are appropriate for exploratory and confirmatory analyses, it is worth mentioning that a powerful theory is required as to this. On the other hand, covariance-based structural equation modeling is appropriate to test the theory and causal relations. Therefore, a theory was considered to be tested. However, according to Livari's study (15), these cases may be small for covariance-based structural equation modeling. Therefore, regarding the sample size, confirmatory factor analysis with Smart PLS 3.2 was used to evaluate the model measurement. Additionally, the reliability and validity of each variable were computed by composite reliability index, convergent validity (Average Variance Extracted), and Cronbach's alpha to measure the reflection power of the measurement model. It is notable that moral considerations such as volunteering, confidentiality, and people's removal and their replacement with similar samples were also observed in this research. It should be mentioned that researcher were faced with methodological limitations including the limitedness of the research population, inconsistency of the level of professional knowledge of the population about the given technology and also impossibility of the implementation of the research model pilot test in real environment.

Results

Most respondents (112, or. 74.4%) of the study were female and 84 individuals (56%) were less than 30 years old. About 32.3% of the respondents had lower than 10 years of work experience, and all the respondents used Smartphones.

Mean, SD and measurement model indices are presented in Table 2. According to the Table, the values of Cronbach's alpha coefficients in all constructs were more than the standard value (0.07), which represents the reliability of the measurement model. Furthermore, the values of Composite Reliability (CR) and Average Variance Extracted (AVE) coefficients for the given model were respectively lower than 0.07 and 0.5 standard values (the validity was confirmed). Descriptive information of the study indicated that most of the respondents tend to use and accept mobile health so that most means in perceived usefulness, behavioral intention, perceived enjoyment, subjective norm, perceived ease of use, image, volunteering, and objective usability constructs were more than 3, indicating a desirable level. Moreover, the means of result demonstrability and use of behavior constructs were lower than 3, representing the average level of mobile health services acceptance in the before-mentioned aspects. The results of data analysis are presented and demonstrated in Table 3 and Figure 2.

Table 2. Descriptive data of the constructs and measurement model indices

Constructs	Mean±S.D.	Cronbach alpha	Average Variance Extracted	Composite Reliability
Perceived Usefulness (PU)	3.07±0.70	0.83	0.64	0.95
Behavioral Intention (BI)	3.50±0.88	0.85	0.55	0.71
Image	3.54±0.82	0.72	0.59	0.82
Result Demonstrability (DM)	2.50±0.78	0.85	0.57	0.76
Perceived Enjoyment (ENJ)	3.06±0.76	0.89	0.61	0.91
Objective Usability (OU)	3.09±0.98	0.81	0.72	0.89
Subjective Norm (SN)	3.44±0.70	0.87	0.89	0.94
Perceived Ease of Use (PEOU)	3.70±0.70	0.82	0.52	0.90
Voluntariness (VT)	3.60±0.71	0.91	0.53	0.88
Use Behavior	2.96±0.95	0.79	0.61	0.85

Table 3. Structural model measurement

Model 1 (Use)		Model 2 (BI)		Model 3 (PEOU)		Model 4 (PU)		Model 5 (Image)	
P	**Independent variable**	**P**	**Independent variable**	**P**	**Independent variable**	**P**	**Independent variable**	**P**	**Independent variable**
<0.001	BI	<0.001	SN	<0.001	ENJ	>0.05	SN	<0.001	SN
		<0.001	PU	<0.05	OU	<0.05	IM		
		<0.05	PEOU			>0.05	DM		
						<0.05	ENJ		
						<0.05	OU		
						<0.05	PEOU		
		<0.001	SN×EX						Interaction
		>0.05	SN×VT						
0.89		0.83		0.79		0.68		0.89	R2
0.69		0.65		0.60		0.56		0.66	Adjusted R2

Multiple linear regression and T-vale test were used to determine, respectively, the structural model and the correlation among constructs based on the determined models. The relation among constructs and relation among the dependent variables are depicted in figure 2. The results showed that subjective norm has a significantly positive relation with image (P<0.001, T>1.96), while the former has a negative impact on the perceived usefulness (P>0.05, T<1.96). In the third hypothesis also image has a significantly positive relation with perceived usefulness (P<0.05, T>1.96). The results of fourth hypothesis are representative of the fact that experience construct has a negative impact on the perceived usefulness and subjective norm (P<0.05, T>1.96). Moreover, result demonstrability fails to have a positive impact upon the perceived usefulness (P>‹0.05, T<1.96). The results indicated that perceived enjoyment has a positive impact on perceived usefulness (P<0.05, T>1.96). Furthermore, it was shown that objective usability has a positive impact on the perceived usefulness (P<0.05, T>1.96). Also, according to the eighth hypothesis, perceived ease of use

has a positive impact on the perceived usefulness (P<0.05, T>1.96). In relation to the ninth hypothesis, the results revealed that perceived enjoyment has a negative impact on the perceived ease of use (P<0.05, T>1.96). Likewise, in tenth hypothesis, a negative impact of objective usability on the latter was reported (P<0.05, T>1.96). In relation to the eleventh hypothesis, the results revealed the positive impact of subjective norm on the behavioral intention (P<0.001, T>1.96). About the thirteenth hypothesis, the results indicated the negative impact of experience on the subjective norm and behavioral intention as well (P<0.001, T>1.96). In relation to the fourteenth hypothesis, volunteering was reported to have no negative impact on the relation between subjective norm and behavioral intention (P>‹0.05, T<1.96). In fifteenth hypothesis, perceived ease of use was indicated to have a significantly positive relation with the behavioral intention (P<0.05, T>1.96). And ultimately in the final hypothesis, the results were representative of the positive impact of behavioral intention on the usage (P<0.001, T>1.96).

Figure 2. The estimated model and the T-values for its constructs
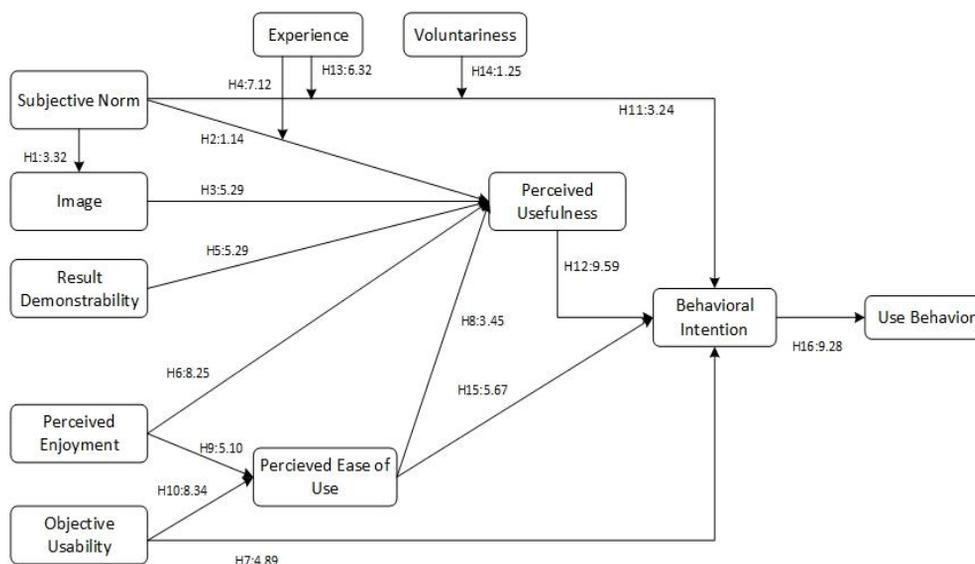
Discussion

The main objective of the present study was to investigate the attitudes of physicians towards the positive and negative factors of mobile health and its acceptance by the physicians. Regarding the findings, the rate of mobile health acceptance among physicians was moderate. Most physicians tended to use mobile phone to provide health care services. This shows that MH technology is a highly significant tool in improving the provision of health care services. In this regard, Abdekhoda also observed that there was an average level of Electronic Health Record (EHR) acceptance among the physicians based on the technology acceptance model and factors such as perceived usage, perceived ease of use, and compliance of important factors may have a significant role in the formation of positive attitudes of physicians towards this technology (16). Also in another study, the acceptance of new technologies by the physicians was evaluated to have a good condition and its usage among this group was reported to be increasing (17). The study done by Hsiao also confirmed the findings obtained in the present study (18). Basak also stated that acceptance of this technology by the physicians in Turkey was more than 70%; he also considered the perceived ease of use as one of the most important factors in this respect (19). Another point worth mentioning is that Khazaie, in his study, suggested that there was a significantly positive relationship between emotional intelligence and dependency on the mobile phone. Therefore, increased emotional intelligence of the physicians and other health service providers could increase the level of using this technology (20). According to his findings, Frühauf also concluded that the acceptance level of mobile phone by the dermatologists was 74%. As he pointed out, mobile phone is an easy and comfortable device for monitoring patients (21). Regarding this matter, health system managers are recommended to have a special look at this technology to facilitate the provision of health care services, particularly in rural and remote regions and marginal towns as well.

The results of the study indicated that the constructs of the model had a positive impact on the mobile phone usage among physicians. Therefore, the more enrichment of these constructs may lead to increased acceptability of this technology for service provision.

Zamani et al. also argued that perceived ease of use, perceived usefulness, students' attitudes towards the usage or decision to use this technology were considered to be effective attitudinal factors positively influencing the acceptance and use of mobile phone in learning (22).

Given that, nowadays, using mobile phone is one of the effective ways of learning, particularly among the students due to its portability –increased limitation of learning due to its portable potential, it is a significant device since it can be used at any time and in any place with ample accessibility to the materials. Moreover, today, medical education systems all over the world extremely require ITC to provide learning atmosphere for the students (23). Therefore, using such a device may have effective impacts upon the quality of health care services provided to the patients.

Zamani put forth the claim that the structural model of learning technology adoption through mobile phone among students of Isfahan University of Medical Sciences had the possibility of being applied in the society (22). Moreover, manifold studies have indicated the relationship among the study variables as the factor affecting the IT adoption, particularly, mobile phone (24-29).

Regarding the findings of the study, it could be mentioned that technical properties of mobile phone, its accessibility, and its portability may provoke the physicians to use this technology. Therefore, it could be claimed that the more the perceived usefulness of mobile phones in the mind of physicians, the more decisive the use of this device by the physicians to. Hung asserts that various factors may affect the adoption of mobile phone technology by the physicians, perceived usage, perceived ease of use, trust, interaction, external effects, inter-personal effects, self-efficacy, and facilitating potential are seemed to be the most significant factors (30). Likewise, the results presented by Bidmon may provide ample support for the results presented in this study(31).

One of the limitations of the present study was that merely the physicians of Zahedan University of Medical Sciences were investigated; therefore, the results fail to be generalized over the physicians working at other hospitals of the country. Consequently, more studies in other universities are recommended to be done.

In most studies in the field of electronic health, theories of information technology and in particular the theory of technology acceptance of TAM have been used; in fact, this is the most common model for understanding the effective factors in technology acceptance. In the present study, the rate of acceptance of mobile health among physicians was moderate. Also, internal variables had a positive and direct effect on the external variables of the model. Also, according to the results, the predictive power of the model was high in determining the factors influencing the use of mobile health services by physicians. In order for the health community of the country to gain from electronic health services, it is proposed to upgrade the existing hardware, launch a massive network infrastructure for data transmission. The structure of laws for the use of information technology in health care centers has been modified and compared to approval of mandatory laws by law enforcement agencies for the development of electronic health and, in particular, mobile health in the country. Finally, it is suggested that nationwide training programs should be developed to improve the knowledge of electronic health of the

healthcare staff, in particular of physicians, in order to see more willingness to use e-health services.

Conclusion

In most studies in the field of electronic health, theories of information technology, and in particular the theory of technology acceptance of TAM, have been used; in fact, this is the most common model for understanding the effective factors in technology acceptance. In the present study, the rate of acceptance of mobile health among physicians was moderate. Also, internal variables had a positive and direct effect on the external variables of the model. Also, according to the results, the predictive power of the model was high in determining the factors influencing the use of mobile health services by physicians. In order for the health community of the country to gain from electronic health services, it is proposed that the existing hardware should be upgraded, and a massive network infrastructure should be launched for data transmission; the structure of laws for the use of information technology in health care centers has been modified and compared to approval of mandatory laws by law enforcement agencies for the development of electronic health, in particular mobile health in the country. Finally, it is suggested that nationwide training programs should be developed to improve the knowledge of electronic health of the healthcare staff, in particular of physicians, in order to see more willingness to use e-health services.

Acknowledgement

Conflict of Interest
None declared.

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