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A model for the expansion of telemedicine technology in the field of treatment

Mohsen Moslemiafar*, Kamran Feizi, Mohammad Taghavifard, Seyed Mohammad Ali Khatami Firouzabadi

Faculty of Management, Allameh Tabataba'i University, Tehran, Iran

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Abstract

Telemedicine is considered to be the result of the combination of rapid developments in the two specialized fields of information technology and medicine, and observing the favorable and rapid effects of this technology has encouraged the managers of health systems in many countries, including Iran, to expand it. However, despite the advantages that this technology can have for a country like Iran, this technology did not have the expected expansion in Iran, and for this reason, the current research sought to formulate a model for the expansion of telemedicine in the field of treatment. Previous researches, with much more limited areas, have focused more on Davis's technology acceptance model and the theory of logical action. In this research, which was conducted with a user-centred approach, using the opinions of experts and the fuzzy Delphi method (in the first part) and the validation of the resulting model by operational experts (in the second part), finally, a model for expanding this technology with 4 main factors effective and 14 components of those factors were obtained and the validity of the resulting model was also confirmed by several different criteria, including the goodness of fit criterion. The results showed that the component of resistance to use among cultural and social factors has the most significant impact on the development of this technology, and this resistance was observed mostly on the side of doctors and treatment service providers. After that, the amount and type of allocation of financial resources and government policies are in the next ranks. The least significant impact was attributed to the perceived risk. The results showed that the components of attitude and the expected performance had no significant effect on the development of telemedicine and the most important factors affecting the development of this technology are in the area of authority of the government and policymakers of the health system.

Keywords: telemedicine, information technology, technology expansion model, health data, health system, electronic health
2020 MSC: 62B86

1 Introduction

Medical science is considered one of the oldest and at the same time the most complex human sciences, which throughout history has tried to use all available tools and facilities for the health and treatment of a complex structure called the human body. In our era, this science has taken on a new face with the introduction of various electronic and computer technologies and is rapidly using these technological tools for progress and development. Now, to a large

*Corresponding author
Email addresses: moslemifarmohsen@gmail.com (Mohsen Moslemiafar), kamfeizi@yahoo.com (Kamran Feizi), dr.taghavifard@gmail.com (Mohammad Taghavifard), a.khatami@atu.ac.ir (Seyed Mohammad Ali Khatami Firouzabadi)

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extent, electronics and computers are mixed with health and treatment and are forming new interdisciplinary fields, the most important of which is "telemedicine". Telemedicine usually deals with the provision of care and healthcare services from a distance using information technology tools that are based on two-way communication [8].

Tools and systems such as: video conference, multimedia channels, smart messaging software or even mobile video calls. In addition to that, other more advanced cases such as remote diagnosis or remote surgery are also proposed in this field. Remote medicine has a high potential for providing medical services in remote and inaccessible areas. It is also considered a suitable choice during natural disasters, such as floods and earthquakes, as well as for providing medical services to people in poor or underprivileged areas. It is considered to improve clinical results and increase the number of patients covered by specialized medical care [9].

The review of the research literature shows that there is a study gap in order to provide a suitable model that matches the conditions of the country's treatment system for the development of telemedicine. This research believes that the model and method of accepting a technology is effective on the reaction of users and the type of spread of that technology in society and is important for understanding and predicting the behavior of users of that technology, while examining and including basic models such as the technology acceptance model (TAM), the theory of planned behavior (TPB) and the integrated theory of technology use (UTAUT) as well as the specific model of telemedicine presented by (Kiefel) tries to answer the question why despite the advantages The great nature of this technology and its great compatibility with the current state of the country's treatment system, especially in the discussion of reducing the costs imposed on patients, this technology has not spread much in Iran, and what could be the main factors or obstacles to the expansion of this technology in the treatment sector. By adopting a user-centered approach, the present research tries to realistically extract the reasons and analyze the relationships that cause the encouragement or reluctance of doctors and patients to use this technology in the existing environment of the country's health and treatment system, and looks for a suitable model. With the current cultural and social conditions of the country, it is to expand and popularize this technology. In addition to the above general cases, some currents and events in Iran's current health and treatment system have special relevance. Currents such as the change in the demographic structure and the movement of the average age of society towards the elderly, which increases the need for remote care, as well as the spread of pandemics such as Covid-19, in which telemedicine can play an important role in its control and treatment, among others. There are subjects in which the results of this research will be effective.

2 Research literature

2.1 Electronic health

Electronic health is one of the most important symbols of the entry of information and communication technology in the field of medical science. The purpose of electronic health is to facilitate the access of patients and applicants of health services to specialists or medical services. In addition, scientific exchanges, the use of common knowledge bases, expert consultations, the formation of online medical councils between specialists who are not located in a single place, and remote monitoring of patients are also desired here [12].

If we want to have a list of the most important advantages of electronic health, we can include such things as: creating wider communication and more geographical coverage, faster identification of diseases, treatment and prevention of diseases, increased interaction between doctor and patient, quick reactions For treatment, he pointed out, creating a healthy competitive environment between health agents and practitioners, providing more appropriate health services, and creating a logical connection between experts and citizens without time and place restrictions. Electronic health is seen as a set of different components, services and specialties, which is supposed to cover the various sides of inadequacies and deficiencies or weaknesses of the traditional treatment system with internal coordination and synergy [17]. Some of the most important main parts of the electronic health structure are: electronic health record, mobile health, health knowledge management and telemedicine, which in this research, among the different parts of electronic health, only the "telemedicine" part is considered [18].

2.2 Structure of telemedicine

The World Health Organization, in the final report of its second global survey on e-health in 2010, defined telemedicine as the provision of health care services when distance is an important factor, by health care professionals using information and communication technology to exchange It defines correct information for diagnosis, treatment, prevention of disease and injury, research and evaluation as well as for continuous training of health care providers, taking advantage of the latest achievements in the field of medical services in order to ensure the health of people as much as possible [16].

Although technologies in every society are the result of the production, expansion and application of knowledge at different levels, there is a lot of evidence that shows that there is a strong and meaningful relationship between the development and use of different technologies and the level of social progress in a society. and even these new technologies may cause changes in the lifestyle of that society [7].In his studies, MacFarlane [10] refers to telemedicine technology as "the best way to bring medical services to people, in a native, familiar and stress-free environment". The use of information and communication technology (ICT) in The field of medicine and treatment is known as one of the important factors in reducing discrimination in access to health services and healthcare. The important advantage of telemedicine is its ability to directly support prevention, diagnosis, management and patient care. Is. Telemedicine improves the provision of medical care services through the use of information and communication technology support. Some of the most important and widely used branches of remote medical technology are: remote monitoring, remote consultation, remote training, remote treatment and remote surgery. Of course, other cases, such as cardiology, radiology, emergency medicine, remote rehabilitation and psychiatry, as well as teledialysis, telenursing, telepathology, etc., have been discussed in this section. The World Health Organization has given a general and preliminary classification for various services that can be provided under the title of telemedicine [6], which is as follows:

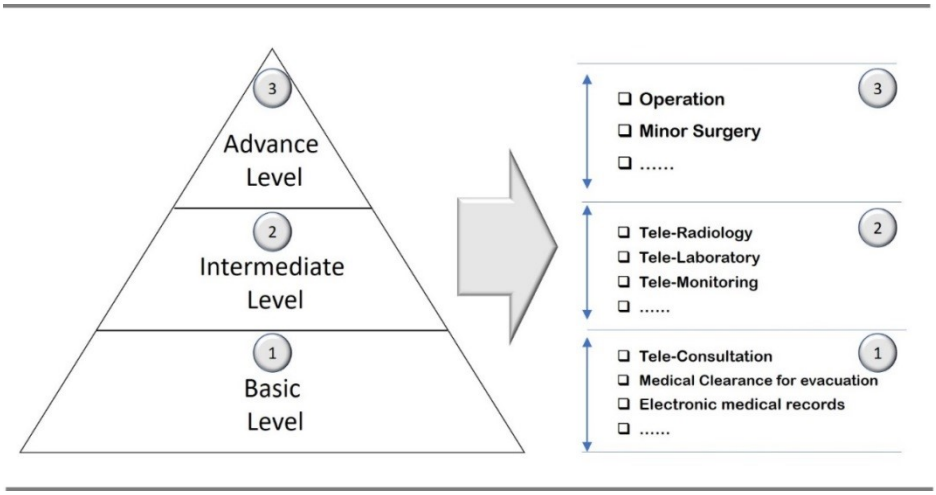

Figure 1: Classification of telemedicine technology from the perspective of the World Health Organization

According to the point of view of this division, as we move from lower levels to higher levels of telemedicine, the amount of direct intervention of the doctor in the process of treating the patient increases, and of course, along with that, the responsibility of the telemedicine doctor is also related to being effective. The treatment plan that is being presented and carried out is increasing. But the more we move to the lower and elementary levels of this technology, other doctors and other diagnostic and treatment staff will also participate in doing it, and in this way, the participation of the remote doctor in the treatment plan and performing the treatment will decrease.

2.2.1 Opportunities and challenges of telemedicine

Every new technology, after being established and expanded in the target society, has advantages and disadvantages that should be proportional to the needs of the society and the specific state of acceptance of the technology in that society; He took advantage of its advantages and tried to reduce its disadvantages. The most important advantages of telemedicine in a nutshell are: improving patient care, especially for deprived and remote rural areas, increasing the geographical scope of providing health services so that by pressing a button, all patients and doctors can get advice and information from other doctors around the world. will benefit, management of possible crises in natural disasters and wars and development of health in hard-to-reach areas, control of chronic diseases such as diabetes or diseases with rapid spread such as Covid-19, prevention of misdiagnosis and increasing the accuracy of specialized differential diagnosis By providing access to specialists in a specific field, helping to distribute medical specialties in the country and sharing medical statistics and experiences. But in addition to these important and effective cases, telemedicine also faces challenges that in some cases may become a threat to the expansion and generalization of telemedicine in the society [15]. Things like: high initial cost in the establishment phase, differences between the culture of origin and culture of destination, break in doctor-patient relationship and legal issues [9].

2.2.2 Communication channels and telemedicine

Various remote medical services are transferred to the patient or the applicants of healthcare services through a technological channel, and for this reason, the communication channel will have an effect on the efficiency of this technology [4]. At the beginning of the life of telemedicine technology, usually a technological channel was considered first and efforts were made to find appropriate medical services for it, and the most important factor that was paid attention to was efficiency and not ease of use [9]. In fact, telemedicine was both (technology-oriented) and (single-channel) in the beginning. But nowadays, with the great and increasing growth of information technology, remote medicine is moving towards being (problem-oriented) and (multi-channel). Considering the many individual differences among people in the society, it is not very desirable to prescribe a specific service or treatment consistently and equally for all people through a fixed channel, and it is important which service or treatment method is given through which channel. What kind of person does it reach?

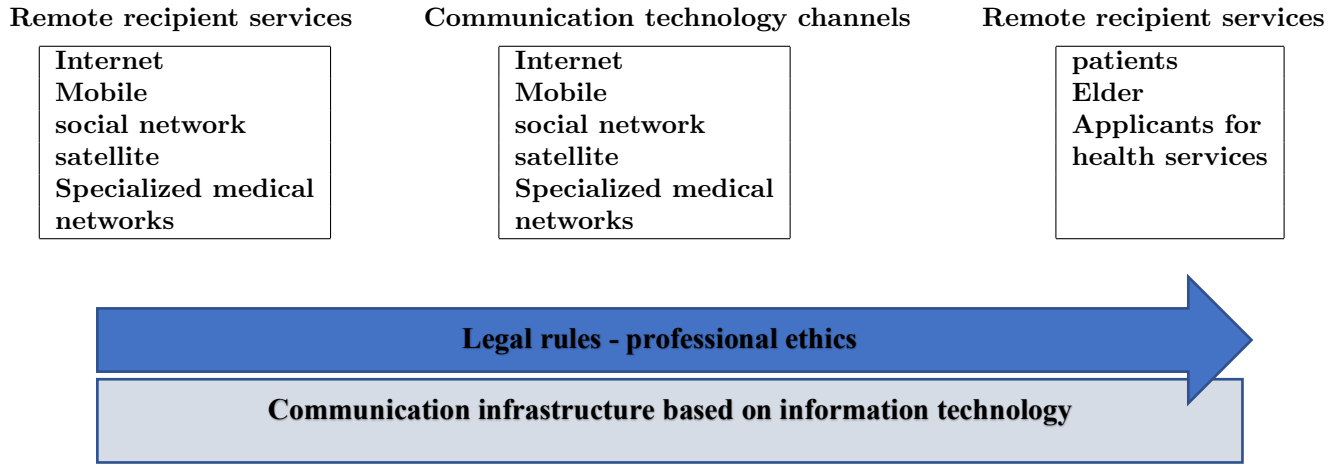

Figure 2: The role of technology channels in telemedicine

2.2.3 Suitability of Iran's current conditions for the expansion of telemedicine

Every new technology is inherently more capable in some fields and cases, and the progress and improvement it can create is more specific and more in those specific fields. As mentioned before, telemedicine technology is more successful and effective in countries and regions that have or have suffered from the following conditions, according to its technological nature:
Having a large population with a high geographical distribution (unbalanced population density)

- High rate of occurrence of natural and unexpected events (earthquakes, floods, etc.)
- Having common borders with crisis or war-torn countries
- Concentration of medical specialists and sub-specialists in specific and limited areas
- High treatment costs, so that it is difficult for the middle class of society to pay for it [18].

By paying close attention to the above, it can be seen that almost all of them exist in our country, in exact or approximate form. Now, theoretically, Iran is a very suitable candidate for the implementation, expansion, establishment and exploitation of the benefits of telemedicine technology. Because it has covered almost all the subjects in which telemedicine works more successfully, and there is hope that without the need of making exorbitant costs, simply by combining the facilities available in the country and preparing a model. Optimal and local implementation, some of the problems of health and treatment and the health of the society have been reduced and with these existing facilities, higher productivity has been achieved.

3 Technology acceptance models

Predicting the adoption and use of technology has long been one of the key concepts of interest to many researchers [1]. The main goal of research in this field is to investigate and discover the main factors that affect the spread of

a technology and its use in society. Thus, many theoretical frameworks were developed over time. Some of these frameworks were more favored and accepted and tested in various application areas. Various models for accepting a new technology in society have been presented so far. The purpose of these study models is to measure the efficiency and effectiveness of a technology or to examine the impact of various factors on the acceptance or expansion of that particular technology [17].

Among these models and among those based on a theory. A clear, distinct and well-defined basis has emerged, it can be the TAM technology acceptance model presented by Davis, the DIT innovation expansion theory introduced by Rogers [13], and the causal action theory TRA based on the theoretical studies of Ajzin and Fishbein. It was, he pointed out. Each of these models, according to their goals, have examined the acceptance of technology in one of three levels: individual, organizational and national.

3.0.1 Exclusive model of telemedicine technology (Kiefel model)

Another famous model that exists specifically for telemedicine technology is presented by Kiefel. In this model, he deals with the factors affecting the transfer of remote medical technology at both national and organizational levels. At the national level, it refers to the environment and macro issues, such as politics, information technology infrastructure, cultural beliefs and values, and the cultural acceptance of technology. At the organizational level, factors related to the organization's environment, processes and technology life cycles are mentioned. He also added that factors at the individual level can affect the transfer of technology, which are related to the personal characteristics of users to use new technology. But in his proposed model, the emphasis on cultural and technical factors is only at the national and organizational levels [5].

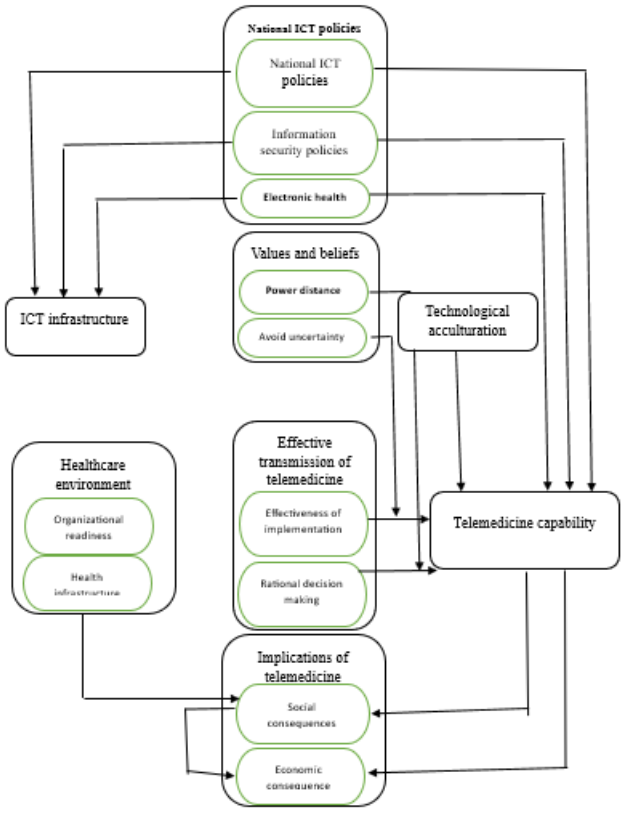

Figure 3: Kifel model in telemedicine technology

4 Research method

This research is based on the purpose; It is considered to be of the development-application type. Also, in terms of the general method of data collection, the form of their analysis and the type of research findings, it is placed in the descriptive-survey research group, and from the point of view of the research method, it is of mixed type. To carry

out this research, initially, to identify the structures and the relationship between them, after reviewing the literature, fuzzy Delphi method was used to identify the dimensions of the initial model. Then, in the second part, to validate the model and verify the relationship between the extracted structures in the target society, the structural equation modeling method has been used. The data collection tool was a researcher-made questionnaire with 82 items. The current research includes the following sections:

1- Fuzzy Delphi section (identification of factors, indicators and model components): In this section, the results extracted from the research literature are provided to the experts in this field, and then, using the fuzzy Delphi method, the desired model is modified. The necessary results were obtained.

2- Model Validation Section: In this section, the model extracted from the research literature and the compilation of experts' opinions in the form of a proposed model and for validation, is distributed among the respondents (a sample of the statistical population of the research) and analyzed and validated. it placed.

The statistical population of the model design department in this research are experts in the field of telemedicine, including policy makers in the Ministry of Health and its affiliated universities, specialist and subspecialist doctors with specialized experience in the field of telemedicine, and senior managers of information technology companies that provide services. have been telemedicine. Also, the statistical population of this research in the model validation section includes general practitioners (especially the triage department) and specialists in government hospital departments, medical staff (nurses, technicians, paramedics, etc.), information technology experts with experience in the field of telemedicine and They were the policy makers of the Ministry of Health and the managers of the support and financial departments of the Ministry of Health. The sampling method in the first part of the research (Fuzzy Delphi) was purposeful and judgmental and was completed with the participation of 17 experts in the Delphi panel. In the validation section of the model in this research, the snowball sampling method was used, and finally, 87 correct samples were obtained. A 5-point Likert scale was used to measure the variables in both stages of the research. In the fuzzy Delphi part of the research, to determine the validity (validity) of the questionnaire, from content validity and construct validity, as well as in the model validation section, from construct validity and convergent validity tools to check the validity (validity) of the questionnaire and from Cronbach's alpha, composite reliability and coefficient Correlation was used to check the reliability of this part of the research. The method used in this research was first fuzzy Delphi and then structural equation method. In order to descriptively analyze the collected data, SPSS version 23 statistical software was used, and partial least squares method and Smart PLS version 3 software were used to test the conceptual model.

5 Research findings

5.1 Descriptive data analysis

This research has been done in 2 parts. In the first part (Fuzzy Delphi), there were a total of 17 experts participating in the Delphi panel, 12 of whom were men and 5 of whom were women. In this way, the frequency of male experts (71%) and female experts (29%) was that 65% of the respondents were experts in the field of medicine and 35% were experts in the field of information technology and technology. 41% of the respondents were specialists and sub-specialists/doctors (Ph.D.), 24% were general practitioners/professional doctors and 35% were senior experts. In the second part (validation of the model), a total of 87 people participated, 72.4% of respondents were male and 27.6% were female. In terms of education, 43.7% of the respondents had a bachelor's degree, 34.5% had a master's degree/general physician, and 21.8% had a doctorate/specialist doctor. Also, in terms of the specialized field of the target community, 19.5% of the respondents were doctors, 41.4% were specialists and experts in the triage department, and 20.7% were technology experts familiar with telemedicine.

5.2 Measurement model

A questionnaire containing 82 extracted indicators regarding the factors affecting the development of telemedicine was given to the members of the expert panel, which were categorized into 16 groups related to the respective components, and the experts were asked to rate the importance and impact of each indicator on the component. (in the form of a 5-point Likert scale). Based on the resulting Likert spectrum, the raw results were converted into fuzzy numbers, and then the fuzzy average was extracted from the scores, and finally the fuzzy average was converted into a definite number. In this research, the threshold number (0.7) was considered and the indicators below the threshold (0.7) were excluded from the research process. In the next round, the definitive average of the first round was provided

to the experts to know the average value of each index in the previous round, and they were asked to score the indices once again according to the information of the first round. The work continued until a relative consensus was reached. In accordance with the theory [2], the basis for reaching a relative consensus in this research was that the difference between the two stages (first and second step) of the survey was less than the very low threshold (0.1) in all the calculated indicators. In this way, based on the results of this stage, 8 indicators were eliminated. Then, in the second part, the remaining 74 indicators were provided to 87 members of the second group, which included operational and field experts in various fields of medicine and information technology and experts in the triage department of hospitals, and they were asked to look at the indicators and their relationship with the variables. Rate and comment. During this stage, 11 numbers of the existing indicators were removed and in two cases, due to the removal of all the indicators of a variable, it led to the total removal of that component. Finally, a model with 4 main factors and 14 components of those factors, Was obtained.

Table 1: Descriptive findings of research indicators

Component	Indicator	Average	standard deviation	Variance
Social influence	Q1	4.02	.902	.813
	Q2	4.02	.835	.697
	Q3	3.93	.873	.763
perceived value	Q4	3.95	1.044	1.091
	Q5	3.86	.990	.981
	Q6	3.92	1.014	1.028
Resistance to use	Q7	3.68	1.051	1.105
	Q8	3.66	1.021	1.043
	Q9	3.86	.851	.725
	Q10	4.02	.862	.744
	Q11	3.99	.896	.802
	Q12	3.84	.861	.741
	Q13	3.91	.858	.736
	Q14	3.61	1.016	1.032
health culture	Q15	3.85	.995	.989
	Q16	3.71	1.066	1.137
	Q17	3.94	.920	.845

5.3 Statistical analysis and model test

For statistical analysis in the model validation part of this research, factor analysis approach and structural equation method were used. The software used in this method is Smart PLS software, which seems suitable for this purpose due to the small size of the statistical sample and the possibility of non-normal data. The output of data processing and analysis by Smart PLS software is a model in the path coefficient estimation mode, the results of which can be seen in figure no. The acceptable limit for the factor loading between indicators and variables in each micromodel is defined as 0.7.

Then, the output of the model is examined in the second part, which is the significance of the coefficients. In this section, the important measure that is considered and investigated is the statistic (t) or t-value. The acceptable limit for t-value is 1.96, which here and according to the output form of the software, the resulting number for all variables is higher than this number. Therefore, all variables are considered acceptable in terms of t-value. Considering the acceptability of all variables and indicators in terms of t-value, the only detection parameter for removing or remaining variables in the further steps of data analysis and model validation is their factor load in the estimation of path coefficients, which results in the final model The following figure was obtained.

5.4 Validity and reliability

Table 2 shows the validity and reliability indices for all research variables. With the help of Average Variance Extracted (AVE) index, it was found that all the studied constructs have an extracted average variance higher than 0.5, that is, the validity of the divergence of the research variables is confirmed. Combined reliability indices (CR), Cronbach's alpha and Rho coefficient are used to check the reliability of the questionnaire and it is necessary to confirm

Component	Indicator	Average	standard deviation	Variance
Expected performance	Q18	3.65	1.093	1.195
	Q19	3.53	.975	.950
	Q20	3.92	.910	.829
	Q21	3.77	.978	.957
	Q22	3.61	1.060	1.125
attitude	Q23	3.67	.900	.810
	Q24	3.38	1.014	1.029
	Q25	3.74	1.039	1.080
	Q26	4.05	.999	.998
	Q27	4.02	.849	.720
intent to use	Q28	3.78	.975	.951
	Q29	3.61	1.049	1.101
	Q30	4.00	.868	.753
Perceived usefulness	Q31	4.20	.905	.819
	Q32	3.94	.925	.855
	Q33	3.79	.909	.826
	Q34	3.92	1.081	1.168
	Q35	4.03	1.005	1.010
	Q36	4.10	.915	.838
the trust	Q37	4.09	.897	.805
	Q38	4.22	.958	.917
	Q39	4.28	1.042	1.086
Perceived risk	Q40	3.90	.994	.989
	Q41	3.87	.998	.995
	Q42	3.84	.963	.927
	Q43	4.06	.867	.752
	Q44	3.97	.982	.964
Worry/uncertainty	Q45	3.68	.982	.965
	Q46	3.66	.860	.740
	Q47	3.83	1.014	1.028
	Q48	3.70	1.058	1.119
	Q49	3.69	1.049	1.100
	Q50	3.59	.971	.943
	Q51	3.74	.960	.922
Facilitating factors	Q52	3.99	1.006	1.011
	Q53	3.63	1.024	1.049
	Q54	3.70	1.036	1.072
	Q55	3.74	.996	.993
	Q56	3.53	1.010	1.020
	Q57	3.71	.901	.812
	Q58	3.77	.973	.947
Perceived ease of use	Q59	3.70	.934	.872
	Q60	3.63	1.047	1.096
	Q61	3.72	.996	.993
	Q62	3.53	1.044	1.089
	Q63	3.54	1.032	1.065
Efficacy	Q64	3.85	1.177	1.384
	Q65	3.86	1.025	1.051
	Q66	3.84	1.022	1.044
	Q67	3.76	1.171	1.371
government policy	Q68	3.89	1.005	1.010
	Q69	3.81	.833	.694
	Q70	3.95	1.044	1.091
Funds	Q71	3.87	1.009	1.019
	Q72	3.83	1.048	1.098
	Q73	3.70	1.047	1.096
	Q74	3.74	.970	.941

the reliability of these indices higher than 0.7. All these coefficients are higher than 0.7 and show the reliability of the

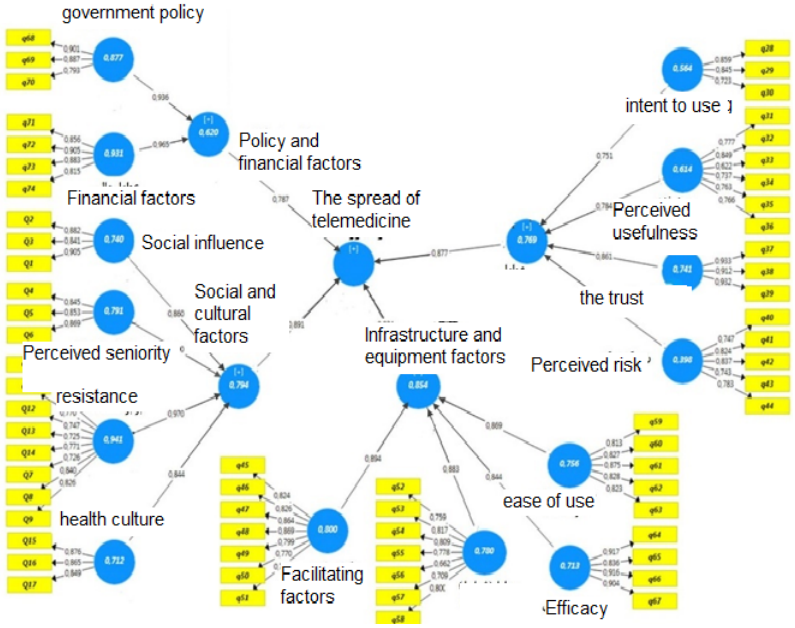

Figure 4: The resulting model in standard estimation mode

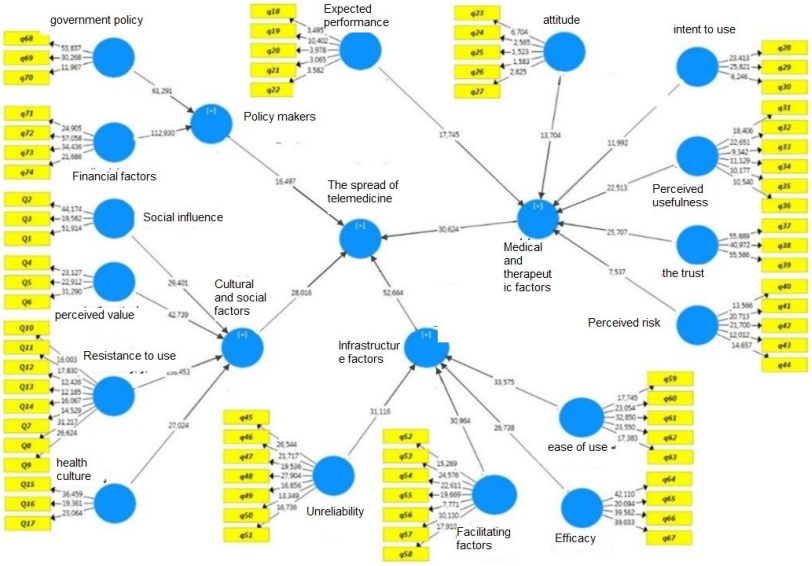

Figure 5: The resulting final model in the case of significant coefficients

measurement tool.

5.5 Divergent validity and correlation coefficient of the model

In order to measure the ability of the measurement model to differentiate hidden variables in the model, the method of calculating the divergent validity and correlation coefficient of the model was used. The following table calculates the correlation coefficient between the latent variables and their divergent validity. On the main diameter of this table, the square root of the average variance obtained (AVE) is obtained. The requirement to confirm the divergent validity is that the value of the square root of the average variance obtained from all the correlation coefficients of the relevant variable with other variables is greater. Below the main diameter of the correlation coefficient is obtained, a positive (direct) coefficient indicates a direct relationship and a negative coefficient indicates a negative (inverse) relationship between the variables. All coefficients are significant at the 95% confidence level.

Table 2: Validity and reliability indicators

	Average Variance Extracted (AVE)	Composite Reliability	Rho_A	Cronbach's Alpha
perceived value	0.732	0.891	0.817	0.817
the trust	0.858	0.948	0.917	0.917
Efficacy	0.799	0.941	0.918	0.916
Perceived risk	0.621	0.891	0.850	0.846
Perceived ease of use	0.695	0.919	0.891	0.890
Perceived usefulness	0.649	0.902	0.917	0.871
government policy	0.743	0.896	0.830	0.825
Facilitating factors	0.622	0.906	0.880	0.875
health culture	0.745	0.898	0.832	0.829
intent to use	0.658	0.852	0.745	0.737
Resistance to use	0.595	0.922	0.904	0.902
Funds	0.749	0.923	0.889	0.888
Social influence	0.768	0.908	0.850	0.848
Worry/uncertainty	0.669	0.934	0.920	0.917

5.6 Goodness of fit test

The most important model fit index in partial least squares technique is the GOF index. This index can be calculated using the geometric mean of the R2 index and the average of the redundancy indices. The obtained values of the indicators of this criterion in the current research were according to the table below.

Table 3: R2 and COMMUNALITY results

COMMUNALITY	R^2	
0.732	0.792	perceived value
0.858	0.726	the trust
0.799	0.717	Efficacy
0.621	0.577	Perceived risk
0.514	0.879	Infrastructure and equipment
0.695	0.751	ease of use
0.649	0.473	Perceived usefulness
0.743	0.876	government policy
0.677	0.668	Policy and finance
0.622	0.751	Facilitating factors
0.745	0.712	health culture
0.559	0.774	cultural and social
0.658	0.525	intent to use
0.595	0.940	Resistance to use
0.749	0.932	Funds
0.768	0.741	Social influence
0.669	0.815	Unreliability
0.516	0.625	Medicine and treatment
0.508	-	The spread of telemedicine
0.667	**0.773**	**GOF**
0.718		

Considering that the obtained value of goodness of fit index is 0.773 (more than 0.36), it can be said that the model has a strong fit.

5.7 The resulting final model

The final model was obtained as follows.

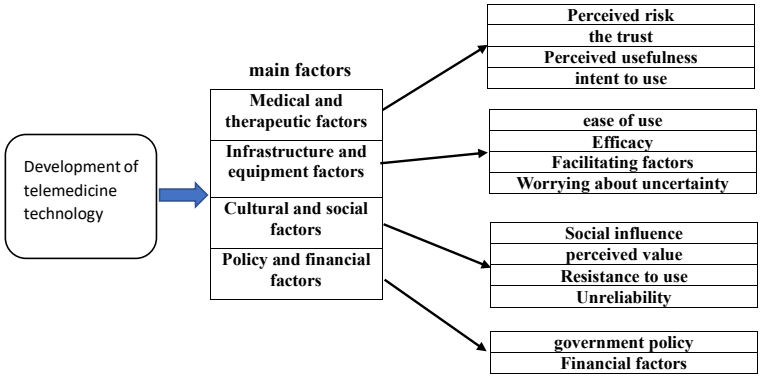

Figure 6: The resulting final model

6 Conclusions and suggestions

Several factors in different societies, according to the interaction of the culture and social structure of that society with a category such as (technology), have mutual effects on the acceptance and expansion of an emerging technology. In this research, the effective factors and components on the expansion of telemedicine technology, based on the knowledge and perspective of the current users of this technology in Iran, have been specifically addressed in the field of treatment in Iran, and using the opinions of experts and individuals. Experts in this field and analyzing their experiences and opinions at different stages and adapting it to the range of needs and satisfaction of patients, a model for the expansion of telemedicine technology in the field of treatment in Iran has been proposed. Based on the results, four main factors were identified for the "expansion of telemedicine" in the field of treatment in Iran. These factors include:

- Medical and therapeutic factors
- Infrastructural factors, equipment and technology
- Cultural and social factors
- Policy and financial factors

The results of this research showed that medical and therapeutic factors have a significant impact on the spread of telemedicine. The most important components obtained for this factor were perceived risk, trust, perceived usefulness and intention to use. Of course, medical factors include a wide range (including care, control, education, prevention, examination, drug treatment, surgery, etc.) And there is an assumption that the beginning of a person's relationship with telemedicine technology begins with a disease or discomfort and with the purpose of treatment. Therefore, here, according to the scope defined for this research, only the components that are significant or effective in this specific and limited area have been discussed. The results also indicated that the discussion of "human life" is a non-negotiable issue and the closer we get to the practical action (drug-surgery-radiotherapy, etc.), the importance of components such as The possible risk or trust (due to the irreplaceability of human lives) has increased and it goes so far that it strongly affects other parallel components. Just as important factors such as the cost spent or the time spent also lose their importance for this reason. The findings of the research showed that information technology (equipment and infrastructure) has a positive and significant effect on the development of telemedicine, and the most important components obtained for it in this research are perceived ease of use, self-efficacy, concern and uncertainty, and Facilitating factors have been side. This technology used in equipment and infrastructure, since it is the channel of reaching and applying medical knowledge to the patient, and also considering the importance and irreplaceability of human life, it must be both exclusive and specialized. Dedicated because the entire capacity of that channel is limited to the treatment of that specific patient without any other interfering factor during the entire treatment period, and specialized because the characteristics and structure of each of its departments exactly match the type of efficiency and

performance of that service. The specific treatment that is to be applied remotely to the patient must be developed. Also, the results of the research showed that cultural and social factors have a significant impact on the development of telemedicine. The most important components obtained for this factor in the research were social influence, perceived value, health culture and resistance to use. If this technology, as a constantly evolving factor, can meet the needs of people in that society (patients it has (value) in the eyes of the people of the society and its estimated value is measured by the group of applicants (patients) with the amount of its costs. In this way, a spectrum is considered for (value) and (cost) of this technology, which different people will choose different places and methods to use this mutual spectrum (value-cost) according to cultural and social characteristics, which is the factor The main factor in choosing this spectrum is the culture of that society. The result of the sum of cultural and social factors determines the level of public trust or the influence of this technology in the body of society, and non-specialist factors (such as the opinion of famous or popular people) with the help of cultural and social levers, have an equal effect on more tangible things such as the efficiency or effectiveness of this technology in Society shows. And finally, the last factor that had a significant and positive effect on the expansion of telemedicine in this research was the financial and policy factor, with the calculated components of the type of laws enacted and the provision of financial resources, which was necessary in the field of It is the authority of governments and national health systems. One of the factors that increase the value and efficiency of telemedicine is its level of coverage and penetration in society, which is directly related to the laws and policies approved by governments and governments, as well as the amount of financial resources spent on it. has it. In other words, no matter how telemedicine has countless advantages and merits in the society, if the general policies of the medical system do not decide to expand and support it with laws and financial resources, the expansion of this technology It is not tangible in the society and one cannot expect social efficiency from it. The findings of this research, with previous studies conducted with the paradigm of examining the dimensions of technology acceptance [3], examining the effect of a specific system in the treatment system [11], the feasibility of implementing telemedicine or comprehensive studies [4], relatively and with a relatively high share It has similar results [14], and some of the results that are specific to this research and are the result of its innovative approach in counting the opinions of different users of telemedicine, are not inconsistent with the results obtained in the researches and studies of other researchers.

If we rank all the final components of the research (regardless of which factor they are) according to the factor load, it can be seen that four components among all the components of the model have a higher factor load than the other components. These four components are:

- resistance to use (141.9)
- Financial resources (112.9)
- Government policies (62.8)
- Value perceived by the user (42.7)

According to the findings of the research, the component of resistance to use is more concerned by the treatment providers (doctors, treatment staff, health insurance) and this part of the spectrum of users has the most important contribution to resistance to use, due to many occupational reasons and either financially or professionally, and if we are going to have suggestions for the expansion of telemedicine, we must first go to this group and analyze their professional actions and professional ethics. On the other hand, according to the results of this research, cases such as (the patient's lack of knowledge about the results of this method) and (the patient's concern about the limitations of this method to communicate with the doctor) are the cases that, contrary to the initial expectation, have the lowest factor load. and have had the lowest rank in the constructive indicators of the resulting final model, which confirms that the concerns and problems that may appear on the part of patients are expected and considered as limiting factors of telemedicine. has the lowest probability of occurrence or impact. As a result, it seems that on this side of the spectrum, that is, patients and telemedicine requesters, there are fewer problems in the way of the expansion of this technology. Other findings that confirm the same issue are related to the ranking of "government policies" and "providing financial resources" components in this model, both of which have the highest path coefficients. In this way, the obtained results show that the key to the expansion of telemedicine should be sought in the eyes of the policy makers of the country's health and medical education system. This is strengthened when, according to the findings of this research, the infrastructure and equipment factor with the highest participation rating in the formation of this expansion model is seen, which incidentally, the management and expansion of this field is also exclusively in the hands of the government and the governance of the health system and It is the general treatment of the country. Also, components such as "attitude" and "expected performance" during the research process were not recognized as having a significant impact on the development of this technology and were removed from the components affecting the model.

Due to the simultaneous existence of several effective factors that can double the productivity of telemedicine technology in our country, Iran has a very favorable environment for the expansion of this technology and has many necessary technological foundations, potentially or actually. be So far, in order to use this technology, only the limited import of some special telemedicine equipment has been limited. There is a need for a comprehensive and user-oriented model. A model that is fully compatible with the needs and realities of the Iranian society and its goal is to optimize the use of medical facilities and knowledge in the country. According to the existing findings, while presenting the model resulting from this research as a basis for developing executive guidelines, it is suggested that for the expansion of telemedicine, by allocating part of the budget of the treatment department to telemedicine, the conditions of using The same facilities available in hospitals and medical centers (both in terms of equipment and in the use of doctors' expertise) should be provided for a much wider range of patients (both in terms of number and geographical distribution). Also, since according to the findings of this research, one of the important obstacles in the expansion of this technology is the resistance of doctors and the treatment structure of the country, it is suggested to include the necessary explanatory materials and items of the advantages and techniques of using this technology in the educational chapters of doctors. and the treatment staff, familiarize them with the positive results obtained by the health systems of other countries of the world and solve their mental and financial concerns in using this technology more. It is even possible to propose the creation of a specialized field called (telemedicine specialist) in the medical education system, whose task is to create, manage and coordinate various medical infrastructures and specialties for remote treatment of patients. Of course, for the expansion of telemedicine, a reliable and strong communication infrastructure is also needed, and its provision is the responsibility of the policy makers of the health sector in the government and parliament as a cross-sectoral issue. One of the most important of these future infrastructures is the expansion of 5G technology in the public. parts of the country, as a necessary and reliable infrastructure.

Perhaps the most important result and finding of this research can be briefly stated as follows: "The expansion of telemedicine provides the possibility for the treatment system that with the same treatment facilities and available human resources and with the least cost, the number of To bring many more people of the society under the cover of specialized medical services or to prevent the occurrence of many acute problems in the future (with preliminary screenings) and now with the same facilities in the country's treatment system, it is possible to start and expand it. It only needs the understanding, decision and responsible and compassionate action of the managers and policy makers of the health system so that its results and blessings can be enjoyed by many people in the society.

References

[1] A. Burton-Jones and G.S. Hubona, *Individual differences and usage behavior: Revisiting a technology acceptance model assumption*, ACM SIGMIS Database: DATABASE Adv. Inf. Syst. **36** (2005), no. 207, 58–77.

[2] C.H. Cheng and Y. Lin, *Evaluating the best main battle tank using fuzzy decision theory with linguistic criteria evaluation*, Eur. J. Oper. Res. **142** (2002), 74–86.

[3] V. Ghorbanzadeh, S. Hasan Nangir and H. Roudsaz, *Meta-analysis of factors affecting the acceptance of information technology in Iran*, Manag. Res. Iran **17** (2012), no. 2.

[4] D. Jayasinghe, R.M. Crowder and G. Wills, *Model for the adoption of telemedicine in Sri Lanka*, SAGE Open **6** (2016), no. 3.

[5] M. Kifle, V. Mbarika and R. Bradley, *Global diffusion of the internet X: The diffusion of telemedicine in Ethiopia: Potential benefits, present challenges, and potential factors*, Commun. Assoc. Inf. Syst. **18** (2006), no. 1, 30.

[6] R.N. Kowitlawakul, *The technology acceptance model: Predicting nurses' intention to use telemedicine technology (eICU)*, Comput. Inf. Nurs. **29** (2011), no. 7, 411–418.

[7] M. Leigh-Ann and P.R. Murphy, *MicroRNA: Biogenesis, function and role in cancer*, Curr Genomics **11** (2010), no. 7, 537–561.

[8] T. Lewis, Ch. Synowiec, G. Lagomarsino and J. Schweitzer, *E-health in low- and middle-income countries: Findings from the center for health market innovations*, Bull. World Health Organ. **90** (2012), no. 5, 332–340.

[9] P.Y. Sh. Manoranjan Dash and R.P. Sunil Kar, *A conceptual model for telemedicine adoption: An examination of technology acceptance model*, Int. J. Recent Technol. Engin. **8** (2019), no. 2, 2277–3878.

[10] E. McFarlane, J. Thornton, S. Chalmers, E. Whittingham, T. Sharma, and P. Alderson, *DECIDE: Survey on awareness of NICE guidelines and their implementation*, G-I-N Int. Conf., Berlin, 2012, 22–25.

[11] H. Mehdizadeh, H. Ayatollahi, N. Esmaeili and M. Kamkar, *Designing and building a teledermatology system*, J. Mazandaran Univ. Med. Sci. **25** (2015), no. 123, 170–184.

[12] M. Milutinovic and B. De Decker, *Ethical aspects in eHealth–design of a privacy-friendly system*, J. Inf. Commun. Ethics Soc. **14** (2016), no. 1, 49–69.

[13] E.M. Rogers, *Diffusion of Innovations*, 4th Edition, the Free Press, New York, 1995.

[14] F. Sadoughi, M. Sadeghi, M. Langarizadeh, and E. Gozali, *Survey Of telepathology implementation feasibility in the teaching hospitals affiliated to Tehran University of Medical Sciences*, **8** (2014), no. 4, 343–353.

[15] C. Scott Kruse, Sh. Bouffard, M. Dougherty, and J. Stewart Parro, *Telemedicine use in rural native American communities in the era of the ACA: A systematic literature review*, J. Med. Syst. **40** (2016), no. 6.

[16] Y.T. Shen, L. Chen, W.W. Yue, and H.X. Xu, *Digital technology-based telemedicine for the COVID-19 pandemic*, Front Med (Lausanne) **8** (2021), 646506.

[17] R. Tavallaei and M.M. Ahmadi, *Factors influencing acceptance of E-health: An interpretive structural modeling*, J. Inf. Technol. Manag. **10** (2018), no. 3, 106–126.

[18] WHO. (2018), `www.who.int/hdp/en`.

[19] M. Zargar, H. Alizadeh Otaghvar, A. Danaei, and M. Babaei, *Factors affecting of telemedicine technology acceptance among technology specialists in Iranian hospitals*, RJMS **24** (2017), no. 161, 88–98.