DEVELOPING A MODEL FOR ESTABLISHMENT OF TELE-DERMATOLOGY IN IRAN

Sakineh Beygom Kazemi,
PhD Student, Department of Health Management, North Tehran Branch, Islamic Azad University, Tehran, Iran
ORCID ID: 0000-0002-7122-1535
Mehrnoosh Jafari, Seyed Mojtaba Hosseini,
Assistant Professor, Department of Health Management, North Tehran Branch, Islamic Azad University, Tehran, Iran
ORCID ID: 0000-0002-3653-5491
Ali Maher,
Assistant Professor, School of Management and Medical Education Management, Economics and Health Policy, Shahid Beheshti University of Medical Sciences, Tehran, Iran
ORCID ID: 0000-0002-0029-4622
Mohammad Karim Bahadori
Associate Professor, Health Management Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran
ORCID ID: 0000-0002-7157-9908
Corresponding author: Mehrnoosh Jafari
Department of Health Services Management, Islamic Azad University, North Tehran branch, Tehran, Iran. Tel: 09015760885

Abstract
Background and aim: Establishing telemedicine and teledermatology is quite challenging despite their numerous benefits. It requires an in-depth study of the key factors in this process using a valid and reliable instrument that is tailored to the culture of the target population. Therefore, the purpose of the present research was to develop a model for establishment of teledermatology in Iran.
Methods: A mixed-methods descriptive design was utilized in this study. Data were collected using a custom questionnaire. A sample of 384 IT managers/experts and dermatologists completed the questionnaire. Also, a panel of experts in the fields of healthcare management, health policy, and dermatology completed the pairwise comparison matrix. To verify the validity and reliability of the instrument, Cronbach's alpha and exploratory factor analysis with varimax rotation were used in LISREL 8.80 and SPSS 24.
Findings: Based on the results of factor analysis, the key factors in the establishment of teledermatology in Iran included: provider (8 components), recipient (11 components), economic (8 components), structural (6 components), technological (9 components), policy (5 components), legal (6 components), and cultural (5 components) factors. Cultural factors had the greatest impact and economic factors had the least impact on the establishment of teledermatology in Iran.
Conclusion: The proposed model can serve as a useful and comprehensive decision-making and policy guide on how to establish teledermatology. The shift toward teledermatology plays a key role in improving patients, expediting treatment, and reducing costs.

Keywords: Telemedicine; Teledermatology.

DOI:10.9756/INTJECSE/V14I5.87 ISSN: 1308-5581 Vol 14, Issue 05 2022

Introduction

Rapid developments in information and communication technology have revolutionized every aspect of human life, including medicine [1]. Telemedicine is the use of telecommunication and information technology to provide healthcare services at a distance [2]. A telemedicine network is essential for providing services to remote and rural areas, especially in the event of an emergency [3]. Telemedicine can be used for disease control, diagnosis, treatment, follow-up, consultation, and education. In this method, all the components of the health system are interconnected [4]. In general, telemedicine increases the quality and access to health care in deprived and rural areas, enhances communication between rural and urban physicians, reduces costs, facilitates information sharing, increases productivity, reduce mortality and disability, and promotes health equity [5]. Another benefit of telemedicine is the increased access to dermatological expertise [6]. Although dermatology is primarily an outpatient specialty, the value of dermatologists as consultants in hospital settings is increasing, given that 20% of the general population have skin disease, regardless of the circumstances leading to hospitalization. A prospective study evaluated 313 applications for dermatological consultations in a hospital over a period of 4 months. The results showed that for 169 consultations (54%), complaints were resolved in one visit and only 39% of patients needed follow-up after discharge, suggesting that most of them have common diseases and a clinical diagnosis was sufficient for treatment by a specialist [7].

Teledermatology enables quicker access to specialized medical services regardless of geographical location, reduces waiting time, and reduce costs (visit, travel, and accommodation costs) [8]. Despite the many advantages of teledermatology, there are certain challenges to its implementation and application. Secure access, encryption, privacy, authentication, and data integrity are the most important aspects to consider [9]. Hearing or visual impairment, psychological and social status, and the potential effects of these factors on patients' perceptions of physicians and consultants are other problems in the implementation of tele dermatology [10]. Telecommunication infrastructure and equipment, their expensive costs, policies of the health care facilities involved, and the level of intersectoral collaboration are key factors in the development of teledermatology networks. Economic considerations are also an important aspect of the planning and implementation of a telemedicine medical program that must be taken into account along with the patient's perspective, fixed versus variables costs, labor costs, and effectiveness [11]. Iran is a country with numerous rural areas and shortage of specialists in various fields of medicine, which makes it imperative to implement technologies such as telemedicine to remove these obstacles. Considering the importance, advantages, features, and challenges of this technology, the purpose of the present study is to develop a model for teledermatology deployment in Iran.

Materials and Methods

The present study uses a mixed methods design with triangulation of quantitative and qualitative data. This study was conducted in 2018. The population consisted of all the specialists and managers in the Iranian health system, including all medical universities in the country. Stratified random sampling with proportional allocation was used to select the sample. The population was divided into ten strata corresponding to the ten medical zones in Iran. Krejcie and Morgan's (1970) table and Cochran's formula were used to determine the required sample size. Cochran's formula was calculated with 50% response rate, 5% margin of error, and 95% confidence (p = 0.5, d = 0.05), and a sample size of 384 was obtained.

$$n_{384} = \frac{z^2pq}{d^2}$$

The following formula was used to select sample individuals from each stratum, taking into account its proportion to the population. Thus, 6 individuals are randomly selected from each university in each stratum.

$$n_h = N_h\left(\frac{n}{N}\right)$$

The research setting was the Iranian health system and the population consisted of key stakeholders, including IT managers/experts and dermatologists. The participants were selected by reviewing the documents and organizational charts of the entities involved in the establishment of teledermatology, including the Ministry of Health (Public Health Department, Treatment Department, Policy Council, and affiliated medical universities) and the Ministry of Cooperatives, Labor and Social Welfare (Health Insurance Organization).

In this study, a four-stage approach adopted from Waltz et al. (2010) was used to develop the measurement instrument.

Stage 1: Specifying the conceptual model of the instrument

First, the dimensions of the subject under study was determined through a systematic review of the literature. All the articles, reviews and meta-analyses on telemedicine and teledermatology that were published between 2000 and 2018 in both Persian and English were included. Exclusion criteria were: articles without the full text available in the database, articles written in any language other than Persian or English, conference papers, reports, and short communications. To find relevant articles, a title and abstract search was conducted in Magiran, SID, MedLib, Iran Medex, ProQuest , Elsevier, Ovid, PubMed, CINAHL, Google Scholar, ScienceDirect, Web of Science, and Scopus using the keywords 'Telemedicine', 'Telemedicine Dermatology', 'Tele Dermatology', and 'Remote Dermatology' with appropriate Boolean operators. In addition, the reference lists of the extracted articles were reviewed to identify additional papers. Finally, the Google search engine was used to validate search results. The articles whose full text was not available, as well as studies that discussed or examined attitudes in other unhealthy groups and students were excluded.

Databases were searched independently by each of the authors and the results were compared. The number of full-text articles extracted from each database was as follows: 4 from Magiran, 7 from SID, 3 from MedLib, 5 from Iran Medex, 18 from PubMed, 3 from Ovid, 14 from Web of Science, 3 from ProQuest, 11 from Google Scholar, 8 from ScienceDirect, 8 from Scopus, and 2 from CINAHL. 49 studies remained after removing the duplicates. Moreover, 2 additional articles were found by reviewing the reference lists of the articles and through Google search, with the total number of articles reaching 51. After a careful review of the articles, the extracted information were first summarized in a data extraction table and then manually analyzed. EndNote X5 was used to organize the articles, review titles and abstracts, and identify duplicates, and Excel 2007 was used to create the graphs.

Stage 2: Specifying of the instrument

International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.87 ISSN: 1308-5581 Vol 14, Issue 05 2022

In this stage, questionnaire items were developed based on the review of the documents, articles and questionnaires available in Iran and other countries. The initial version of the questionnaire contained 73 items.

Stage 3: Preparing a preliminary draft of the instrument

After preparing the questionnaire items, face, content and construct validity of the instrument was evaluated. For qualitative face validity, a panel of 10 experts (3 IT managers, 2 dermatologists, 3 professors of healthcare management, and 2 and members of research centers) were asked to examine the questionnaire items in terms of f relevance, clarity, simplicity, and accuracy. Then, expert opinions were collected and recorded in two group discussions for final analysis. At the end of session and interview, the transcripts were checked with the participants to ensure the consistency and accuracy of the data, and finally, content analysis was performed.

In addition, impact scores were used to determine the instrument's quantitative face validity. To do so, the 10 participating experts were asked to use the preliminary draft of the questionnaire to weight each item on a 3-point Likert scale. After calculating the impact score for each item, quantitative face validity was calculated using the following formula. Items with an impact score of 1.5 or higher were retained for further analysis.

$$\text{Impact Score} = \text{Weight} \times \text{Frequency}$$

Content validity was assessed using content validity index (CVI) and content validity ratio (CVR) were used to confirm the content validity. Using Lawshe's (1975) table, a CVR of 0.62 was considered for the 10 experts. CVI was calculated in terms of three criteria: simplicity, relevance, and clarity of the items.

Exploratory factor analysis (EFA) was used to assess the construct validity of the instrument. The questionnaire was distributed among the 384 participants and principal component analysis with varimax rotation was used to analyze the data. A minimum factor loading was specified for items that remain in the analysis. In order to determine the final score of the instrument, the minimum and maximum scores of each item are calculated and then a minimum score and a maximum score are defined for the whole scale based on the final number of questions. The following formula is used to calculate the normalized scale score:

$$\text{Normalized Scale Score} = \frac{\text{Minimum Scale Score} - \text{Maximum Scale Score}}{\text{Number of Scale Points}}$$

Stage 4: Constructing the instrument

This stage involved determining scoring use rules and procedures, developing the pool of items, and determining the reliability of the instrument. Cronbach's alpha was used to assess the internal consistency of the questionnaire, and the test-retest method was used to assess its external consistency. Accordingly, the questionnaire was provided to 50 experts in two phases, one week apart. Then, the approved and finalized version of the questionnaire was distributed among the sample. Due to the dispersion of the statistical sample across the country, the questionnaires were sent to the participants though online forms and were returned likewise. In cases where the person's e-mail was available and they wished to receive and complete the questionnaire that way, the electronic format of the questionnaire was sent to them via e-mail. A maximum of three reminders were sent via phone, email, or text message.

DOI:10.9756/INTJECSE/V14I5.87 ISSN: 1308-5581 Vol 14, Issue 05 2022

Data analysis was performed in SPSS 21. Descriptive statistics such as the mean and standard deviation were used to describe the data. Normality was assessed using the Kolmogorov-Smirnov test. Cronbach's alpha was calculated to determine the internal consistency of the questionnaire. EFA (principal component analysis with varimax rotation) was used for data reduction, and confirmatory factor analysis (CFA) was used to assess the validity of the instrument. A minimum factor loading was specified for items that remain in the analysis. Spearman's rank correlation coefficient and Chi-square test were used to determine the relationship between quantitative and qualitative variables, respectively. In addition, t-test and one-way ANOVA test were used to calculate mean differences for binary and categorical variables, respectively. Finally, effective domains were ranked using the Friedman test.

Findings

The mean age of the participants was 42.2 ± 6.9 years (IQR = 11), ranging from 26 to 57 years. Most participants were in the 36-40 age group (n = 104; 27.1%) and female (n = 226; 58.9%), had a master's degree (n = 192; 50%), 10-15 years of work experience (n = 161; 41.9%), and less than 5 years of management experience (n = 208; 54.2%). The mean work experience was 14.6 ± 8.7 years (IQR = 8), ranging from 3 to 26 years, and the mean management experience was 8.3 ± 4.6 years (IQR = 7.5), ranging from 2 to 15 years.

The instrument used for data collection was inspired by available documents and questionnaires in Iran and other countries. 58 items were analyzed in order to find the appropriate factor structure. The value of the KMO test statistic was 0.932, indicating the adequacy of the sample, and the significance level of Bartlett' test of sphericity was close to zero, indicating that the proposed factor structure was appropriate. The results of KMO and Bartlett's tests are shown in Table 1.

Table 1. Results of KMO and Bartlett's tests

KMO test	**Bartlett's test**	df	**Sig.**
0.932	19820	1653	0.00

As shown in Table 2, eight factors were identified using EFA with varimax rotation, which is consistent with the scree plot generated by the software (Figure 1).

Table 2. Statistics related to the extracted factors

Factor	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	22.079	38.067	38.067	22.079	38.067	38.067	8.635	14.889	14.889
2	5.798	9.996	48.063	5.798	9.996	48.063	6.539	11.274	26.163
3	3.198	5.513	53.576	3.198	5.513	53.576	5.211	8.984	35.147
4	2.503	4.315	57.891	2.503	4.315	57.891	4.482	7.727	42.874
5	2.052	3.538	61.429	2.052	3.538	61.429	4.284	7.387	50.261
6	1.865	3.216	64.645	1.865	3.216	64.645	4.237	7.305	57.565
7	1.650	2.845	67.490	1.650	2.845	67.490	3.726	6.424	63.989
8	1.182	2.038	69.528	1.182	2.038	69.528	3.213	5.539	69.528

International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.87 ISSN: 1308-5581 Vol 14, Issue 05 2022

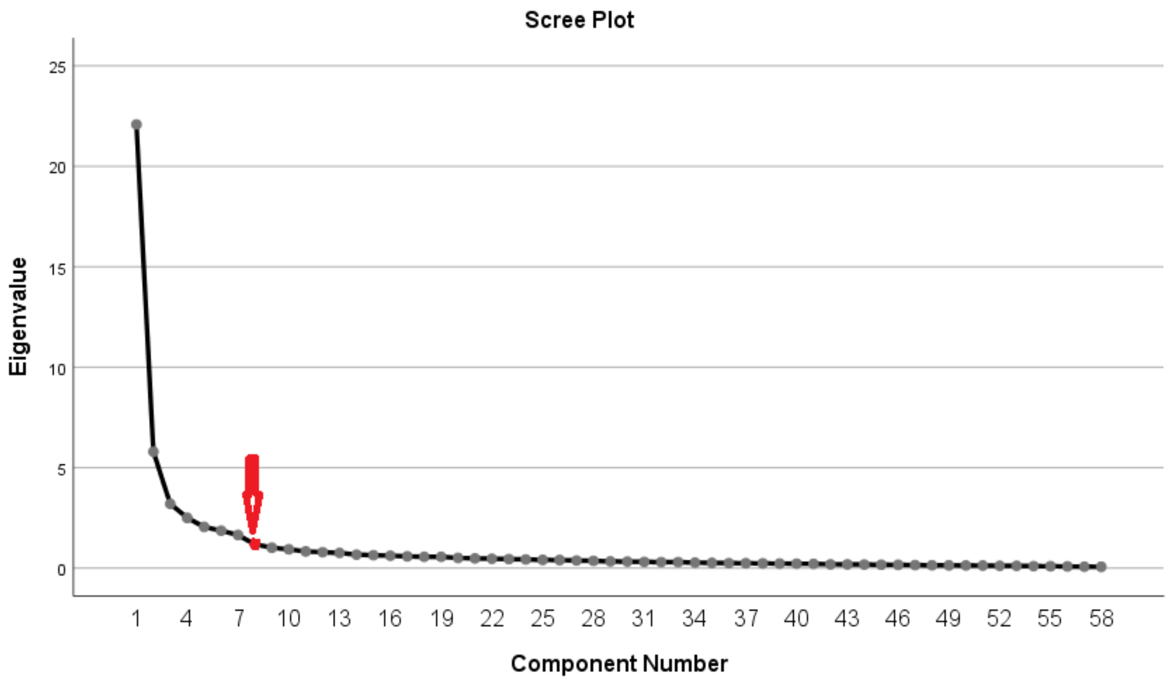

Figure 1. Scree plot of the questionnaire.

Therefore, eight factors were identified as the key components of teledermatology deployment, and the validity of these factors was assessed using CFA. The results are provided in Table 3.

Table 3. Matrix of extracted factor loadings after varimax rotation

Items	Extracted Factors							
	Recipient	Economic	Provider	Technological	Structural	Legal	Policy	Cultural
EQ1	.159	.748	.204	.097	.145	.131	.112	.099
EQ2	.158	.745	.270	.203	.124	.105	.176	.091
EQ3	.111	.811	.100	.047	.059	.176	.176	.175
EQ4	.110	.778	.129	.195	.106	.207	.135	.107
EQ5	.131	.714	.113	.141	.215	.104	.159	.105
EQ6	.165	.804	.136	.112	.201	.141	.102	.032
EQ7	.162	.815	.149	.195	.097	.109	.158	.080
EQ8	.138	.804	.138	.092	.077	.100	.159	.181
ER1	.105	.404	.654	.077	.220	-.010	.046	.034
ER2	.211	.274	.635	.087	.249	.256	.078	.099
ER3	.147	.099	.714	.175	-.045	.189	.222	.078
ER4	.190	.088	.561	.314	.118	.180	.169	.087
ER5	.178	.186	.565	.164	.165	.132	.395	.282
ER6	.195	.217	.692	.149	.216	.197	.187	.123
ER7	.200	.252	.669	.166	.118	.078	.209	.067
ER8	.143	.089	.759	.242	.098	.078	.209	.110
FA1	.187	.211	.430	.475	.298	.202	.157	.136
FA2	.081	.099	.343	.523	.324	.232	.193	.194

DOI:10.9756/INTJECSE/V14I5.87 ISSN: 1308-5581 Vol 14, Issue 05 2022

FA3	.196	.208	.181	.631	.184	.312	.229	.138
FA4	.156	.256	.230	.740	.193	.145	.051	.121
FA5	.107	.240	.213	.661	.170	.355	.036	.140
FA6	.092	.129	.173	.681	.182	.232	.037	.202
FA7	.086	.214	.110	.642	.067	.112	.150	.407
FA8	.145	.308	.254	.448	.233	.175	.073	.221
FA9	.196	.124	.376	.550	.295	.273	.092	.082
FR1	.174	.215	.115	.256	.159	.045	.164	.698
FR2	.109	.264	.056	.141	.050	.213	.187	.681
FR3	.194	.134	.198	.195	.255	.199	.008	.656
FR4	.108	.035	.289	.322	.147	.306	.060	.482
FR5	.120	.129	.094	.146	.131	.169	.105	.802
GA1	.206	.262	.069	.226	.189	.617	.144	.204
GA2	.175	.240	.184	.246	.179	.679	.133	.098
GA3	.117	.138	.210	.183	.189	.699	.189	.160
GA4	.117	.090	.120	.322	.024	.636	.147	.165
GA5	.189	.240	.102	.119	.200	.758	.109	.149
GA6	.153	.161	.222	.197	.187	.668	.128	.107
GI1	.838	.103	.092	.101	.077	.058	.042	.059
GI2	.821	.136	.128	.081	.013	.070	.149	.064
GI3	.794	.149	.110	.098	.097	.134	.042	.041
GI4	.815	.117	.126	.080	.100	.108	.052	.052
GI5	.849	.128	.108	.054	.125	.028	.110	.041
GI6	.844	.087	.080	.063	.091	.052	-.014	.102
GI7	.872	.100	.066	.075	.051	.091	.028	.128
GI8	.822	.133	.120	.082	.128	.103	.051	.079
GI9	.803	.107	.107	.093	.015	.082	.065	.093
GI10	.862	.032	.087	.074	.021	.095	.010	.067
GI11	.846	.073	.141	.040	.112	.143	.122	.039
SA1	.065	.164	.226	.119	.562	.319	.227	.073
SA2	.162	.186	.208	.110	.704	.145	.150	.186
SA3	.109	.233	.163	.072	.755	.161	.029	.134
SA4	.102	.140	.038	.219	.761	.040	.065	.104
SA5	.118	.157	.082	.205	.661	.182	.307	.077
SA6	.147	.095	.181	.258	.727	.163	.196	.097
SI1	.078	.251	.148	.110	.223	.145	.669	.094
SI2	.071	.191	.079	.085	.155	.107	.736	.095
SI3	.110	.179	.281	.124	.120	.194	.705	.084
SI4	.116	.182	.270	.085	.150	.099	.699	.169
SI5	.081	.188	.256	.058	.087	.138	.759	.043

As shown in Table 4, χ^2/df is less than 3 and RMSEA is below 0.08, indicating good model fit. Other goodness-of-fit indices such as NFI, NNFI, IFI, and CFI all have values above 0.9, and GFI is close to 0.9, which indicates a very good model fit compared to other possible models. In addition, GFI is close to 0.9, indicating that the model fits the data well (Table 4).

Table 4. Goodness-of-fit indices for CFA models

GoF Indexes	Cut-off Value	Estimated Value
Chi-square to degree of freedom ratio (χ^2/df)	< 3	2.73
Root mean square error of approximation (RMSEA)	< 0.08	0.067
Normed fit index (NFI)	> 0.9	0.95
Non-normed fit index (NNFI)	> 0.9	0.97
Comparative fit index (CFI)	> 0.9	0.97
Incremental fit index (IFI)	> 0.9	0.97
Goodness of fit index (GFI)	> 0.8	0.72

Discussion

Due to the importance of teledermatology, the present study was conducted to develop a model for the establishment of teledermatology in Iran. The results of this study showed that structural, technological, provider, recipient, economic, cultural, policy, and legal factors affect the establishment of teledermatology. However, cultural factors were the most critical and economic factors were the least critical factors.

Consistent with the present research, Oikonomou (2009) argued that the rapid development of communications technology has led to a decrease in equipment costs and the rise in popularity of teledermatology, which allows for the delivery of dermatologic services to remote areas, more accurate triage of patients with skin disease, and provision of consultation services [12]. Campagna et al. (2017) consider teledermatology a cost-effective way to provide dermatological healthcare. The results of this study showed that teledermatology is effective in reducing in-person visits and allows for quicker delivery of care [13]. Rao and Lombardi (2009) examined the current state of telemedicine in developed countries and found that many developed countries, including the United States, have made it a priority to incorporate telemedicine into their health care system. Telemedicine is being pursued by countries around the world in an effort to provide better health care to people in rural areas. In particular, teledermatology expedites the diagnosis and treatment of patients in remote areas, helps connect medical facilities, facilitates specialty and subspecialty consultation, reduces waiting time and costs, and can be used for educational and research purposes [14]. Cheung et al. (2018) investigated the role of teledermatology in reducing hospital consultation in dermatology clinics in London showed that this method was effective in reducing face-to-face consultations. 51 to 68% of referrals did not require face-to-face appointments and could be treated in primary care. They found that 35% of referrals did not have good image quality for specialist assessment and argued that image quality is an important factor in the effectiveness of teledermatology service [15].

Consistent with the present findings regarding stakeholder perception of teledermatology, Hebert and Korabek (2004) showed that tele homecare can be a cost-effective way to deliver services to clients at home [16]. A study by Warshaw et al. (2010) showed that patient satisfaction and preferences were comparable and that teledermatology reduced time to treatment and clinic visits [17].

Ilahi and Ghannouchi (2013) applied business process management (BPM) to teleconsulting and remote diagnosis processes and reported improvements in efficiency and patient satisfaction [18]. Batalla et al. (2016) found that diagnostic agreement between one dermatologist who evaluated a virtual consultation and another who evaluated a face-to-face consultation was 89%, but the level of agreement was 66% between the pediatrician who made the virtual consultation and the dermatologist who evaluated it. Moreover, they found that teledermatology reduces face-to-face consultations, the time between referral and intervention, and travel time [19].

Hebert and Korabek (2004) highlighted the need for managers and physicians to focus on the overall system structure, system evaluation, ethics, and sustainability of telemedicine, and on the effective use of time in delivery of care rather than travel [16]. Dargahi and Razavi (2005) showed that organizational structure has a significant effect on the implementation and successful operation of telemedicine technology in hospitals. Similarly, McNeill et al. showed that, by developing a governmental telemedicine program to build the necessary technical infrastructure, each network member could interact with other members to provide clinical telemedicine services and medical education programming. Cost recovery through membership fees and other centralized cost recovery enabled by the model could offset 45% of total cost of operating the statewide infrastructure [28].

Amirani (2016) studied the provision of rehabilitation services through the Internet and communication networks and found two important areas in the research on telerehabilitation: determining the equivalency of remote and in-person rehabilitation, and establishing a data collection system to digitize information that for therapists to use in the rehabilitation process [3]. Sophia and Anitha (2015) listed several advantages of telemedicine applications, including access over time, travel and expense, health provider collaboration, enhanced communications, increased patient confidence, and reduced need for patient travel. They argued that telemedicine can be effectively accelerated through image compression, but warned against irretrievable image data loss during compression [21]. Rajda et al. (2018) showed that store-and-forward teledermatology programs have great potential for improving access, reducing waiting times, and increasing patient satisfaction [22]. One of the major policy concerns regarding the development of telemedicine is its effects on overall costs, especially the cost of care [23]. Dargahi and Rezaei (2005) showed that the success of telemedicine lies in the clarity of organizational rules and regulations and the existence of two-way organizational communication [20]. Sophia and Anitha (2015) highlighted the importance of developing strategies for cost-effective handling of medical images in a telemedicine environment [21].

Sharma et al. (2016) identified reimbursement, medical liability, and technical issues (e.g., wireless functionality) as the most common concerns in teledermatology [24]. In the present study, clarity of rules and regulations was identified as a legal factor. Overall, telemedicine can significantly increase access, reduce costs for providers and patients, and decrease waiting time as well as the need to travel. As a result, proper investment in this telemedicine, including the development of appropriate technical infrastructure and legal framework and protection of patients' rights, is crucial to the success of this branch of medicine. A 2004 study on the role of organizational culture in implementation of telemedicine in health care facilities affiliated with Tehran University of Medical Sciences showed that organizational culture and national culture play a key role in the adoption and success of this technology, and that it is necessary to reconsider the structure and design of organizations with respect to the existing cultural orientation [20]. In addition, Yeung et al. (2018) examined teledermatology and teledermatopathology as educational tools for international dermatologists. They found that the training program improved core competencies and increased resident awareness of the sociocultural determinants of skin health [25].

In sum, the results of the present study showed that all the identified factors in the implementation of teledermatology in Iran were statistically significant, including provider, recipient, structural, technological, economic, policy, legal, and cultural factors.

Conclusion

While infrastructural factors were identified as one of the key elements in the establishment of teledermatology in Iran, the dependence of teledermatology on these factors is quite expected. However, this process may be hindered by a variety of factors such as the lack of low-cost yet high-quality services, lack of proper Internet culture, absence of a governing body for telemedicine, and underdeveloped legal framework.

Acknowledgments

We would like to express our sincere gratitude to all the authors who contributed to this research.

Conflict of Interest

The authors have no conflicts of interest to declare.

References

1. Mehdizadeh H, Ayatollahi H, Esmaeili N, Kamkar M. Designing and Building a Teledermatology System. J Mazandaran Univ Med Sci. 2015; 25(123): 170-184.
2. Weinstein RS, Lopez AM, Joseph BA ,Erps KA. Telemedicine, Telehealth, and Mobile Health Applications That Work: Opportunities and Barriers. Am J of Med 2014; 127(3): 183-187.
3. Amirani H. Principles and requirements of telemedicine. Journal of noandish e sabz 2016; 9(34): 5-11.
4. Ahmadi M, Meraji M, Mashoof E. Evidence on Telemedicine in Iran - Systematic Review. Mashhad Journal of Paramedical Sciences and Rehabilitation. 2017; 7(1): 112-124.
5. Nematolahi M, Abhari Sh. Assessing the Information and Communication Technology Infrastructures of Shiraz University of Medical Sciences in order to Implement the Telemedicine System in 2013. Journal of hospital 2014; 5(2): 44-51.
6. Coates, S.J., J. Kvedar, and R.D. Granstein, Teledermatology: from historical perspective to emerging techniques of the modern era: part I: history, rationale, and current practice. Journal of the American Academy of Dermatology. 2015; 72(4): 563-574.
7. Okita AL, Molina Tinoco LJ, Patatas OH, Guerreiro A, Criado PR, Gabbi TV, Ferreira PS, Neto CF. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. Telemed J E Health. 2016; 22(9):755-60.
8. Snoswell C, Finnane A, Janda M, Soyer HP, Whitty JA. Cost-effectiveness of store-and-forward teledermatology. JAMA. Dermatology. 2016; 152(6):702–708.
9. Lee, J.J. and J.C. English, Teledermatology: A review and update. American journal of clinical dermatology. 2018; 19(2): 253-260.
10. Finnane, A., et al., Teledermatology for the diagnosis and management of skin cancer: a systematic review. JAMA dermatology. 2017; 153(3): 319-327.
11. Wanat, K.A., et al., Teledermatology education: current use of teledermatology in US residency programs. Journal of graduate medical education. 2016; **8**(2): 286-287.

12. Oikonomou S. Teledermatology: digital revolution in the management of skin disease. Proceedings of the 2nd WSEAS international conference on Biomedical electronics and biomedical informatics; 2009: World Scientific and Engineering Academy and Society (WSEAS).
13. Campagna M, Naka F, Lu J. Teledermatology: An updated overview of clinical applications and reimbursement policies. International journal of women's dermatology. 2017; 3(3):176-9.
14. Rao B, Lombardi, A. Telemedicine: current status in developed and developing countries. Journal of drugs in dermatology: JDD. 2009; 8(4):371-5.
15. Cheung C-mM, Muttardi K, Chinthapalli S, Ismail F. Pilot Teledermatology Service for Assessing Solitary Skin Lesions in a Tertiary London Dermatology Center. Journal for healthcare quality: official publication of the National Association for Healthcare Quality. 2018.
16. Hebert M, Korabek, B. Telehealth success: evaluation framework development. *Telemedicine Journal and e-Health*. 2004;10:85-92.
17. Warshaw E, Greer N, Hillman Y, Hagel E, MacDonald R, Rutks I, et al. Teledermatology for Diagnosis and Management of Skin Conditions: A Systematic Review of the Evidence. 2010.
18. Ilahi L, Ghannouchi SA. Improving telemedicine processes via BPM. Procedia Technology. 2013;9:1209-16.
19. Batalla A, Suh-Oh HJ, Abalde T, Salgado-Boquete L, de la Torre C. Teledermatology in Paediatrics. Observations in daily clinical practice. Anales de Pediatría (English Edition). 2016;84(6):324-30.
20. Dargahi H, Razavi M. An Investigation About Attitude Of Clinical Physicians In The Implementation Of Telemedicine Technology In TUMS Hospitals 2003-2004. Tehran University Medical Journal. 2005;63(2):99-107.
21. Sophia PE, Anitha J. A systematic review on advances and perspectives of image compression in telemedicine. *International Journal of Advanced Intelligence Paradigms*. 2015;7(2):136-55.
22. Rajda J, Seraly MP, Fernandes J, Niejadlik K, Wei H, Fox K, et al. Impact of Direct to Consumer Store-and-Forward Teledermatology on Access to Care, Satisfaction, Utilization, and Costs in a Commercial Health Plan Population. Telemedicine and e-Health. 2018;24(2):166-9.
23. Bashshur RL. Telemedicine effects: Cost, quality, and access. *Journal of Medical Systems*. 1995;19(2):81-91.
24. Sharma P, Kovarik CL, Lipoff JB. Teledermatology as a means to improve access to inpatient dermatology care. *Journal of Telemedicine and Telecare*. 2016; 22(5):304-10.
25. Yeung H, Sargen MR, Luk KM, Berry EG, Gurnee EA, Heuring E, et al. Teledermatology and teledermatopathology as educational tools for international dermatology: a virtual grand rounds pilot curriculum. *International Journal of Dermatology*. 2018.
26. Waltz CF, Strickland OL, Lenz ER. *Measurement in Nursing and Health Research*. 4th Edition, Springer Publishing, 2019.
27. Lawshe CH. A quantitative approach to content validity. *Personnel Psychology*. 1975; 28, 563-575.
28. McNeill KM, Barker GP, McElroy J. Experience using an ASP model to expand a state-initiated telemedicine program. *International Congress Series*. 2001; 1230:824-829.