

# Challenges of Implementing Telemedicine Technology: A systematized Review

## Abstract

**Background:** Today, the technologies in the world are rapidly evolving, and global infrastructure of information is spreading rapidly. The health system of different countries is facing a variety of challenges in order to apply telemedicine services. The aim of this study was to determine the challenges facing the health system of different countries in the application of telemedicine. **Method:** The present research was conducted in 2022 as a systematized review of studies related to challenges of telemedicine. In this study, Preferred Reporting Items for Systematic Reviews (PRISMA) and Critical Appraisal Skills Program (CASP) guidelines were used to assess the articles. The keywords “telemedicine,” “telehealth,” “E-health,” and “tele care” were used in combination with the Boolean operators OR and AND. The ISI Web of Science, PubMed, Scopus, Science Direct, Ovid, Pro Quest, Wiley, and Google Scholar were searched. **Results:** In this study, based on the search strategy, databases were searched from January 2012 to January 2022, and in the final stage, analysis was performed on 27 selected identified articles. The use of telemedicine technology faced major formality and legality, required bandwidth, development of multilingual systems, economic efficiency, available patterns, payment for services, moral barriers, social status, differences and national and legal contradictions in the world, lack of insurance coverage challenges, and so on. Recognizing gaps and challenges can provide a way to fill these gaps and create opportunities for improvement. **Conclusions:** Utilizing telemedicine technology can be considered as an effective step in the health system. This technology has weaknesses that may challenge it. Successful application of telemedicine technology cannot be very effective without removing these barriers.

**Keywords:** E-Health, health systems, tele care, telemedicine, telehealth

## Introduction

Telemedicine is one of the emerging technologies that can transform healthcare delivery system. It encompasses a range of services, including health care, healthcare delivery, executive services, and even home care.<sup>[1,2]</sup> And that is why today providers and researchers know the development of telemedicine as an integral part of healthcare management and health information systems' management.<sup>[3]</sup> Many countries are implementing comprehensive telemedicine programs in their healthcare systems. Countries such as the United Kingdom, Norway, and the United States have the most success in the production and development of telemedicine. In addition, India, as a developing country, has done significant work on telemedicine projects.<sup>[4]</sup> Apollo Hospital Group, Second Heart Institute, and Fortis Medical Care are

among the specialized telemedicine service centers in India.<sup>[5]</sup> These centers have been able to cover a wide range of geographical areas using the country's telemedicine network. On the other hand, Iran is financially unable to establish hospitals equipped with high beds.<sup>[6]</sup>

At the same time, doctors, especially experts, have no desire to go to deprived areas. The healthcare system can therefore use their knowledge and services in these areas by means of telemedicine and counseling among physicians, rather than the necessity of the physical presence of specialist physicians in deprived areas.<sup>[7]</sup> Currently, a number of hospitals in Iran use telemedicine technology, including the hospitals of the Oil Company, Masih Daneshvari, Imam Khomeini Hospital, and Jask Hospital in Bandar Abbas.

The future of medical care is concerned with improving the organization and providing

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health services to health professionals, including medical ability to increase public access to medical professionals, reduce patient expectations, increase the quality of referral system, and improve communication between service providers, second and third.<sup>[8]</sup> Interestingly, the medical system has covered many geographical distances and surprisingly improves the provision of services in urban and rural hospitals. Telemedicine technology encompasses a variety of levels; that is, the WHO, as one of the leading organizations in this field, provides the following three levels for treatment.<sup>[9]</sup>

Telemedicine has become an integral part of healthcare system services in developed countries, and it is not possible to provide healthcare services in these communities without the use of telemedicine.<sup>[10]</sup> At the same time, telemedicine has been used to a lesser extent in developing countries, including Iran. Therefore, telemedicine can be useful in all aspects, especially the emerging medical sciences and medical engineering, and save lives from danger with the right and timely guidance. As well as in the country's fifth development plan, medical technology has been mentioned as one of the opportunities to increase community access to services and improve the quality of services in health system. According to applications and many benefits of telemedicine in the health system, this study aimed to review studies in relation to telemedicine challenges.

## Method

This study is a systematized review of publications related to the challenges of telemedicine. This systematize review attempts to include elements of systematic review process while stopping short of systematic review.<sup>[11]</sup> The study was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and Critical Appraisal Skills Program (CASP) for articles and AACODS (authority, accuracy, coverage, objectivity, date, significance) for gray literature (provides five criteria for judging the quality of gray information).<sup>[11-13]</sup>

## Information sources

This study was conducted from December 1, 2012, to January 20, 2022, and reviewed published papers in English and Persian language on the topic of challenges of telemedicine. In addition to the published articles, some unpublished reports, programs, and documents have also been included in the study. These are referred to as "the gray studies." For this purpose, we studied databases including ISI Web of Science, PubMed, Scopus, Science Direct, Ovid, and ProQuest, and for the gray studies, some reliable websites such as WHO website.

## Eligibility criteria

We searched papers that (1) mentioned challenges of telemedicine and based on it the screening of CASP criteria and ACCODS criteria was corrected, (2) papers in English

or Persian language, (3) papers with full-text accessibility, and (4) papers published since 2012.

## Selection of articles and documents

Independent reviewers (MH and MGH) screened abstracts and titles for eligibility. When the reviewers felt that the abstract or title was potentially useful, full copies of the article were retrieved and considered for eligibility. If discrepancies occurred between reviewers, the reasons were identified and a final decision was made based on the third reviewer (SMH) agreement. Two authors (MH and MGH) assessed the methodological quality and grade of evidence of the included studies with the CASP tools. The CASP tools use a systematic approach to appraise different study designs from the following domains: study validity, methodology quality, presentation of results, and external validity and all the items from the checklists were judged with yes (low risk of bias, score 1), no (high risk of bias), or cannot tell (unclear or unknown risk of bias, score 0). Total scores were used to grade the methodological quality of each study assessed [Figure 2].<sup>[11]</sup>

## Study of the quality assessment

Quality assessment of the included studies was done using the "CASP" for an article and "ACCORDS" tools for gray literature. The score of the quantitative studies ranged from two to nine. The majority of the quantitative studies did not provide any ethical statement, study design, sampling, and reflexivity related to the research process.

## Database search

The initial electronic database search of the literature resulted in a total of 2104 documents. In the next step, duplicate documents were eliminated and the number decreased to 684 articles. Using systematic screening, the titles were reviewed to find those related to telemedicine challenges and 399 documents were selected. In the next step, abstracts of the documents were studied and 98 documents were selected to be fully reviewed. In this step, 77 documents were excluded. After that, all of the selected documents were studied in details and on the basis of the inclusion criteria, only 27 documents were selected. Figure 1 shows the strategy for searching and selecting the documents.

## *The concept of telemedicine*

E-health, telemedicine, and telemedicine are modifications that are often used interchangeably if these concepts have commonalities.<sup>[9]</sup> Telemedicine refers extensively to the use of information and communication technology to assist in the provision of health services through the transmission of images, audio, and other data over short and long distances. A telemedicine system can consist of three different parts: providers and users, application technology, and network connections.<sup>[8]</sup>

Electronic health includes a wide range of modern services of the health system such as telemedicine, telemedicine,

and telemedicine. The term is often used for a wide range of distance learning technology applications and other applications where information technology is used to support healthcare services.<sup>[14]</sup> Telemedicine refers to the use of telecommunication equipment to provide medical information and services. Telemedicine uses information technology to transmit medical information for diagnosis, treatment, and education. The equipment used can include simple devices such as telephones or fax machines, but in most cases, a computer system is used to communicate.<sup>[15]</sup> The information sent by this equipment can include photos, voice communication, live video, and audiovisual aids related to patients' medical information. Transmission of information can also involve audiovisual communication between the patient and a specialist or consulting physician.<sup>[16]</sup>

*Telemedicine goals and stimuli*

The goals of telemedicine based on studies are to reduce the time of diagnosis, improve patient care, improve access to medical care for people in rural areas, better access to physicians for counseling, and make available facilities for

physicians to conduct examinations: Automated, reduced medical care costs, reduced transportation of patients to medical centers, increased patient satisfaction, and increased community health created a managed care environment in hospitals and medical centers.<sup>[17]</sup> Telemedicine also has many socio-economic benefits, including health education for the community, providing universal and accessible medical facilities for rural and other centers. The expansion of technology and advanced science on a large scale, the ability to provide services regularly in remote areas and even on a mobile basis improve the health standards set and pursued by the World Health Organization and improve the overall image of a country in the world. Electronic patient information transmission is now a definite part of the treatment process, and telemedicine technology has expanded as a new way of performing medical tasks rapidly around the world, reflecting the convergence of social, economic, technological, and scientific factors.<sup>[18]</sup> Telemedicine enables high-speed remote consulting and information management through computer communications. Telemedicine stimuli are divided into technological advances and nontechnological advances. Computing and information technology, network and telecommunications infrastructure, and technology-led society are the three main technological drivers.<sup>[19]</sup>

*Telemedicine methods*

Telemedicine and telehealth can be used in all areas of application used to improve health services. Telemedicine is most effective in cases where time and place barriers impede the transfer of information between patients and healthcare providers, as well as when the availability of information plays a key role in accurate medical diagnoses.<sup>[20]</sup>

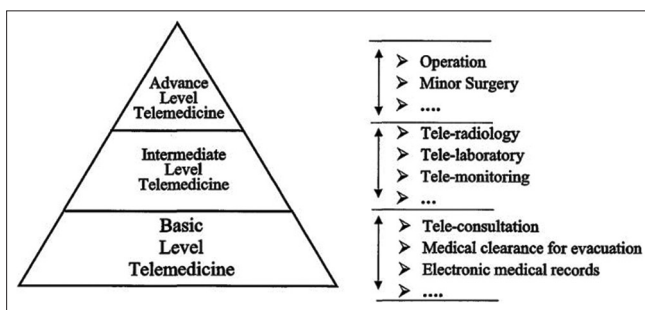


Figure 1: Level of telemedicine technology

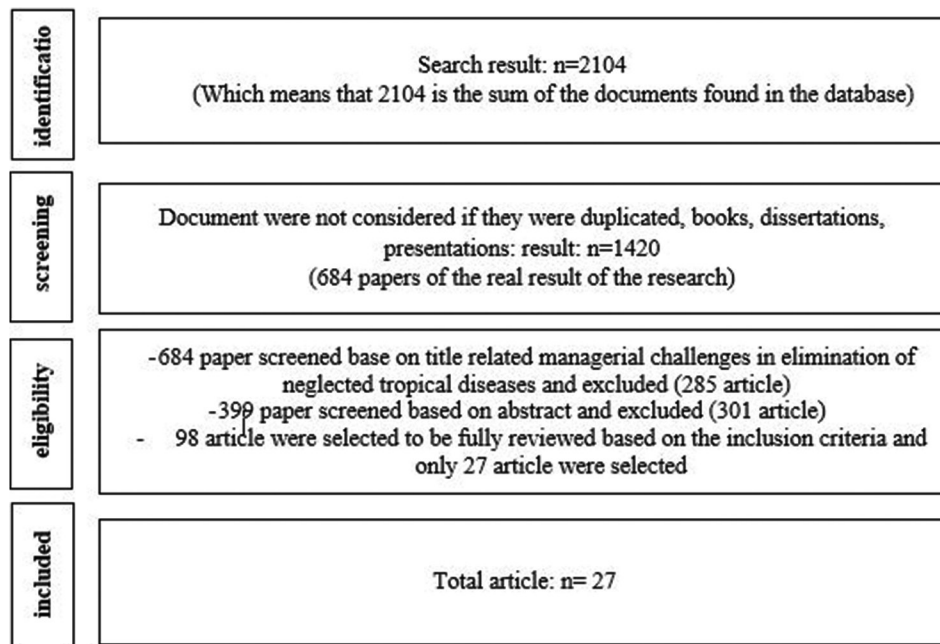


Figure 2: Selection process

Telemedicine services are divided into three groups: data information, information and voice services, and information and data services [Table 1]. Information and data services provide online access to databases and keeping patient information up to date.

Telemedicine is divided into two categories: hospital or office care and home care. In hospital or office care, both parties (patient and doctor) are in the hospital or office, and medical services are provided between the hospital or doctor’s office [Table 2]. But in home care, the patient communicates with the treating physician from home. Telemedicine is also divided into three categories in terms of time (simultaneous remote saw treatment, asynchronous remote treatment, and remote method sets).<sup>[21]</sup>

In concurrent telemedicine therapy, this method is used when face-to-face counseling seems necessary or requires surgery, which is usually the relationship between the patient and the treating physician.<sup>[22]</sup> This method is suitable for accepting patients who need immediate medical care. In asynchronous telemedicine treatment, the referring physician, consultant, and surgeon are not required to coordinate their work schedule with the telemedicine system. Teletherapy is in the form of storing and sending information and is used for cases that are not very urgent. This method allows for more efficient and flexible use of expert time.<sup>[23]</sup>

In a hybrid method, for example in a rural telemedicine center, a patient uses a dermatologist to diagnose a skin condition at a telemedicine center using a camera at the same time. One week after the treatment of the condition, the patient’s skin improves and the employee takes a new photographic image of the patient’s skin; the photographic image is sent to the dermatologist for further follow-up and examination.<sup>[24]</sup>

*Telemedicine applications*

The scope and classification of telemedicine practice has changed with the development of technology. At present, all types of telemedicine services include remote counseling, distance education, distance pathology, remote skin disease diagnosis, telemedicine, telemedicine, emergencies, military medicine, and crises. And remote monitoring and ... are

**Table 1: Types of telemedicine methods**

Telemedicine methods	Example
Data distribution	- Electronic patient record - Medical information
Audio	- Face-to-face interview - Transmit heart sound via electronic phone
Images	- Teleconsultation - Medical education - Community-based healthcare programs - Tele radiology

classified, which are presented below in its applications in medicine.<sup>[25]</sup>

**Tele-consultation**

Telemedicine is one of the applications of telemedicine. Counseling is usually between two or more physicians or between the patient and the treating physician. This technology has the largest share of telemedicine due to its simplicity and wide range of applications. In remote consulting, it is possible to use communication facilities such as telephone, fax, e-mail, and Internet chat. By participating in telemedicine counseling, patients can access timely diagnosis and treatment as soon as possible, saving on travel and time savings.<sup>[26,27]</sup>

Telemedicine counseling has many benefits and advantages, which can include reducing costs, reducing waiting lists, reducing travel, improving counseling, using secondary points of view, and so on. Also, with the application of distance counseling in the healthcare system, the need to establish a new hospital is significantly reduced, which saves a lot of financial and human resources of the health system.<sup>[16]</sup>

**Tele-learning**

Online sources of information are now often available on the Internet. These resources can provide higher education

**Table 2: Telemedicine challenges**

Telemedicine challenges	Formality and legality <sup>[12,15]</sup> Required bandwidth <sup>[13,18]</sup> Development of multilingual systems <sup>[1,3,7]</sup>  Economic efficiency <sup>[24,25]</sup> Available patterns <sup>[24,16,12]</sup> Payment for services <sup>[29-31]</sup> Moral barriers <sup>[1]</sup> Social status <sup>[5,7]</sup> Differences and national and legal contradictions in the world <sup>[31]</sup> Lack of insurance coverage <sup>[2]</sup> Problems with information confidentiality <sup>[14]</sup> Ambiguity and complexity of IT infrastructure <sup>[20,22]</sup> Lack of familiarity with telemedicine <sup>[30,34]</sup> Lack of technical standards <sup>[1-3]</sup> Specify the financing mechanism <sup>[12]</sup> Weakness in determining the criteria for interactions between patient and physician <sup>[15]</sup> Weakness in matching the technology used with the standard and quality <sup>[17]</sup> Dangers of replacing humans with robots <sup>[14]</sup> Inability of health workers to define their training needs <sup>[13]</sup> Low level of information literacy of users in the field of telehealth, especially in rural areas <sup>[5]</sup> The need to make fundamental changes in the structure of the service delivery system <sup>[6-7]</sup>
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materials with the benefits of low cost and easy access through a computer. Tele-education is classified according to the recipient and the purpose of what is transmitted in the classes of clinical education through distance counseling, clinical education through the Internet, university study through the Internet, and general education through the Internet.<sup>[28]</sup> Wherever outpatient counseling is provided by a healthcare professional, for example, a general practitioner or a nurse with specialist counseling, which provides an opportunity for training, some form of outpatient clinical counseling is provided. In normal telemedicine practice, the nonspecialist caregiver is in the same patient room and the specialist consultant is at the other end of the link at a distance. The nonspecialist can similarly interpret an expert diagnosis and treatment recommendations and reassure the patient.<sup>[29]</sup>

### Tele-imaging

Tele-imaging has several uses as follows:

(1) Photographs taken of the patient by a radiologist can be sent or received by the radiologist's personal computer using a remote imaging system. (2) It is possible to provide radiology consultations abroad. (3) General practitioners who practice in remote areas can, after taking the patient's stereotype, send them to prepare a more accurate report to the radiologist in the more remote areas. (4) A radiologist can consult a physician with another radiologist or radiologist who is present in more remote areas. The types of images produced and transmitted in the radiology departments include MRI, X-ray, sonography, nuclear medicine, thermography, fluoroscopy, angiography, and tele-pathology.<sup>[30]</sup>

### Tele-monitoring

Tele-monitoring is the use of a telecommunication link to collect routine and frequent data on a patient's condition. The process of data acquisition may be manual, in which case the patient records the information and transmits it by telephone or a fax or computer system. Alternatively, access may be fully automated so that sequential data can be provided to the person in real time.<sup>[31]</sup>

### Telediagnosis of skin diseases

This technique is one of the most useful and best telemedicine applications, because skin diseases are very common. A quarter of all patients seeking medical help use telemedicine as a result of skin conditions. For more than a decade, remote diagnosis of skin diseases has been considered as a potential alternative to face-to-face examinations. Increasing the reliability and accuracy of remote diagnosis of skin diseases depends on factors such as image quality, clinical information, differential diagnoses, consulting with other colleagues, and obtaining secondary opinions. It seems that providing sufficient clinical information about patients will help improve the

reliability and accuracy of remote skin disease diagnoses.<sup>[32]</sup> In this case, this method can be used to provide health care in remote areas and deprived populations. Diagnosis of skin diseases is made through medical records, examination, and biopsy. In the case of these types of diseases, real-time interaction between specialist and patient is not necessary.<sup>[33]</sup>

### Tele-surgery

Remote surgery is broadly defined as the ability to perform surgery remotely using modern surgical skills and overcoming temporal and spatial barriers. Remote surgery is in its early stages of development. This is done in two ways: remote recommendation and remote presence. In remote counseling, specialists describe the assistance of surgeons in performing surgery in a remote location. In the remote approach surgical approach, robotic arms are used to perform the surgery.<sup>[34]</sup>

### Tele-pathology

Tele-pathology is the study of changes in cells and tissues caused by disease. The pathologist does the same thing when he sees the tissue on the screen that he does when he looks at the tissue directly under a microscope. In this method, the camera is mounted on a microscope to use a digital video microscope to send a slide or slide image to the desired center.<sup>[33]</sup> This phenomenon can be used to ensure early diagnostic services. There are two ways to perform a remote pathology test: one by microscopic study of images and the other by testing motion pictures. In some cases, through a robotic control process, the sample is subjected to microscopic studies.<sup>[34]</sup>

### Telemedicine challenges

Despite rapid growth, there are still significant barriers that affect the normal use of telemedicine. Here are some of the obstacles:

### Discussion

Based on the results of this study, the challenges and obstacles to medical technology are far away. The most important of which are information infrastructure, e-commerce, legal and ethical considerations, security, health infrastructure, standards, laws and regulations, and education. The beneficial and successful development of telemedicine in the health system of countries requires the continuous efforts of researchers in this field at the global level in order to produce general evidence that the diagnostic-therapeutic processes based on this technology are effective and accurate.

Only then can e-commerce become more pervasive in the global arena and accelerate the provision of communication and information infrastructures and e-commerce, while finding appropriate answers to questions arising from legal, ethical, economic, cultural, and social considerations;

security, health, standards and laws, and regulations and education in all developed and developing countries. Otherwise, one cannot hope for the uninterrupted development of telemedicine and its pervasive applications in all fields of medicine without having credible evidence.<sup>[13]</sup>

In a study by Stanberry entitled “Telemedicine: Barriers and opportunities in the 21<sup>st</sup> century,” the findings show that problems with bandwidth, poor telecommunications and health structures, lack of widespread access to computers and software, poor alignment, and adjustment of software to organizational goals and user expectations are among the challenges in telemedicine, which is consistent with the findings of this study.<sup>[6]</sup>

In another study by Takahashi, entitled “The present and future of telemedicine in Japan,” the findings show that the weak information infrastructure of health, the difficulty of evaluating systems in terms of cost-effectiveness, the imperfect nature of human-machine communication or Software, low internet speed, unclear audio and video communication, lack of portable platforms such as tablet, personal digital assistant, and mobile phones, poor condition of equipment and clinical devices in client counseling centers, including challenges in Telemedicine.<sup>[14]</sup> In a study by Whitten entitled “Addressing telehealth’s foremost barrier: provider as initial gatekeeper,” the weakness in determining the criteria for patient-physician interactions, the weakness in determining legal protocols when possible problems occur, the lack of authentication centers, the lack of digital signatures, the complexity of financial considerations among multiple telemedicine partners, the weakness in gaining political support, the privatization of the health system, the disappearance of patients’ choice, the lack of comprehensive control and supervision, the use of complementary medicine, ethical, legal and culture were many challenges, which were consistent with the findings of this study.<sup>[26]</sup>

In a study conducted by Nematollahi entitled “Assessing the information and communication technology infrastructures of Shiraz University of Medical Sciences in order to implement the telemedicine system in 2013,” the findings showed that the problems related to bandwidth for services, weak telecommunications and health structures, and lack of widespread access to computers are among the challenges of telemedicine,<sup>[18]</sup> which is consistent with the findings of this study.

Opportunities for telemedicine in this study include cost-effectiveness, the pervasiveness of technology development, changing the approach to care in countries, increasing exchanges between countries, and more.

Given these challenges, especially in developing countries, it can be expected that by providing challenges and creating opportunities, the provision of health services will be accompanied by a reduction in costs and an increase in quality for service providers and consumers.

## Conclusions

In the last decade, many advances have been made in the development of telemedicine technology as a method of telemedicine care supported by modern digital media communications.

In many countries, the medical care system is getting closer to the patient, especially telemedicine in countries such as Iran, where the transportation network is less developed, the dispersion of the population in some parts of the country and mountainous and impassable areas, lack of access to specialized medical centers in many parts of the country, and increasing the elderly and needy population. Intensive medical care greatly aids in the rapid diagnosis of the disease, the adoption of correct treatment tactics, the reduction of time wasted (which in some cases is critical, such as heart disease), and the reduction of related costs (direct and indirect). The relentless growth of technology and public access to communication and computer systems have opened new horizons in medicine and made the impossible possible. Benefiting from telemedicine technology can be considered as an effective step in the health system. This technology has weaknesses such as the need for strong and high-speed information systems, the provision of which may become a major challenge in some rural areas of the country. Despite having a clear vision of telemedicine technology in the future, the application of this technology in the health system of countries before any action requires a comprehensive and accurate study of the opportunities and challenges facing the health system according to the specific conditions and characteristics of the system, because the successful use of telemedicine technology cannot be very effective without removing these barriers.

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## Conflicts of interest

There are no conflicts of interest.

## Code of Ethics

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## Ethical Consideration

Nil.

## Authors' Contributions

MH,SMHD: conception and Design MH,ZKhJ: Data gathering MJK, PA, ASA: Data Analysis, data interpretation. MH: Preparing draft of the work SMHD, ASA: Revising the draft.

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