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Review Article

STATE OF TELEMEDICINE AND TELEDERMATOLOGY IN IRAN: A REVIEW OF LITERATURE

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ABSTRACT

Background: Telemedicine is a new experience of delivering healthcare services, mainly for retrieving the information, transferring them to a remote physician, interpreting them, and transferring them to the patient side again. For each case, some parts of this process are done remotely, usually using the internet. This approach can generally solve the accessibility problem due to the unfair distribution of experts in the country. On the other hand, by reducing the time, travels, and visits, telemedicine can reduce costs. Besides, as a developing country, studying Iran's experiences and current state in this scope can be beneficial for further investigations.

Methods: We performed a systematic review regarding telemedicine and teledermatology to evaluate the promising aspects and threatening areas of this technology in Iran. The Medline and Scopus databases were searched to determine the research related to telemedicine or teledermatology and Iran. After extracting the findings, they were categorized and studied to extract their content and core findings to clarify various aspects of telemedicine and teledermatology in this country.

Results: Current state of telemedicine in Iran is described as a political and knowledge state, specialties and subspecialties studied for this purpose, and telemedicine application's positive and negative experiences. The current teledermatology state is also investigated separately, looking current legal, infrastructural, and practical state of teledermatology in Iran. The majority of the Literature consists of surveys studying the feasibility of telemedicine and teledermatology in governmental and private sectors among different healthcare stakeholders. Of the subspecialties, radiology, dermatology, and pathology were among the most promising fields in having benefited from telemedicine. The legal gaps and insufficient ICT infrastructure in some rural areas were among the most critical barriers mentioned.

Conclusion: There are various promising and threatening areas in telemedicine in Iran. The cultural and organizational support is convenient for the purpose, but most of the population are dubious for the required

infrastructure. The stakeholders believe that telemedicine can help the healthcare system in both expenditure and accessibility. However, the ICT infrastructure needs to be developed in rural areas to provide high-quality Internet access the way it is in the country's cities. Some legal issues, especially about the insurance, should also be handled to catalyze the spread of telemedicine experiences.

In addition to general telemedicine, teledermatology has a promising future, especially in the outpatient setting, by providing an accurate diagnosis, reducing the costs and unnecessary travels, and improving access. The issues, such as legal considerations about responsibilities in teleconsultation, lack of Internet access in out-of-reach areas, and insufficient knowledge of patients and organizations, should be solved by stakeholders to reach its benefits.

Keywords: Telemedicine, Teledermatology, Iran, Information Communication Technology

INTRODUCTION TO TELEMEDICINE

Medicine has evolved parallel to the evolution of technology. Telemedicine is an example of it, as the Bergen radio was used after radio invention to consult from a distance between ships and the hospital in 1920. The first time[1] the word "telemedicine" has occurred in the dictionary was in 1920. However, Einthoven used teleconsultation while he wanted to publish his work on electrocardiography in 1906. Also, information about the bubonic plague was transmitted by heliograph previous then it and telegraph were used to order medical supplies in the Civil war, the telephone was also used from 1900 to provide health services for about 50 years[2].

During World War I, radio communication was the next telecommunication technology tool for telemedicine. Numerous information technology such as video conferences, remote health parameter control systems, and related mobile applications are helping practitioners diagnose and treat patients from a distance. Many systems that can quickly transmit extensive volume complex data in fixed or mobile settings are spreading around the world exclusively[1,2].

Telemedicine reduces the cost of health care and improves health outcomes and access to health care. Telemedicine can be categorized based on the time and place of the participants into three classes: store-and-forward (asynchronous), remote monitoring, and (real-time) interactive services (synchronous). A combination of them may be used based on clinical needs and organizational factors[3].

There are various types of online and offline software and supports that are used in telemedicine. Stone-and-Forward (eConsults) is an example of offline support used to acquire and send images and bio signals[3].

Remote monitoring is another fascinating part of telehealth. Remote monitoring in disease management is crucial for controlling the chronic disease status of a patient[4,5]. Remote monitoring in home health is the fast popularity-gaining trend in telehealth, which is used for primary health characteristics daily basis[3,6]. Medical and economic benefits of remote monitoring of ICUs are under pilot studies, which showed promising results[6,7]. Astronauts and athletes are regularly monitored for their physiological parameters as the National Aeronautics and Space Administration (NASA) has started using telemedicine since 1960.

Interactive telemedicine, a remote real-time interaction between the patient and the clinician, is proved to provide similar health outcomes compared to face-to-face or telephone care delivery[8]. A general overview of telemedicine tools and services is demonstrated in (Figure 1).

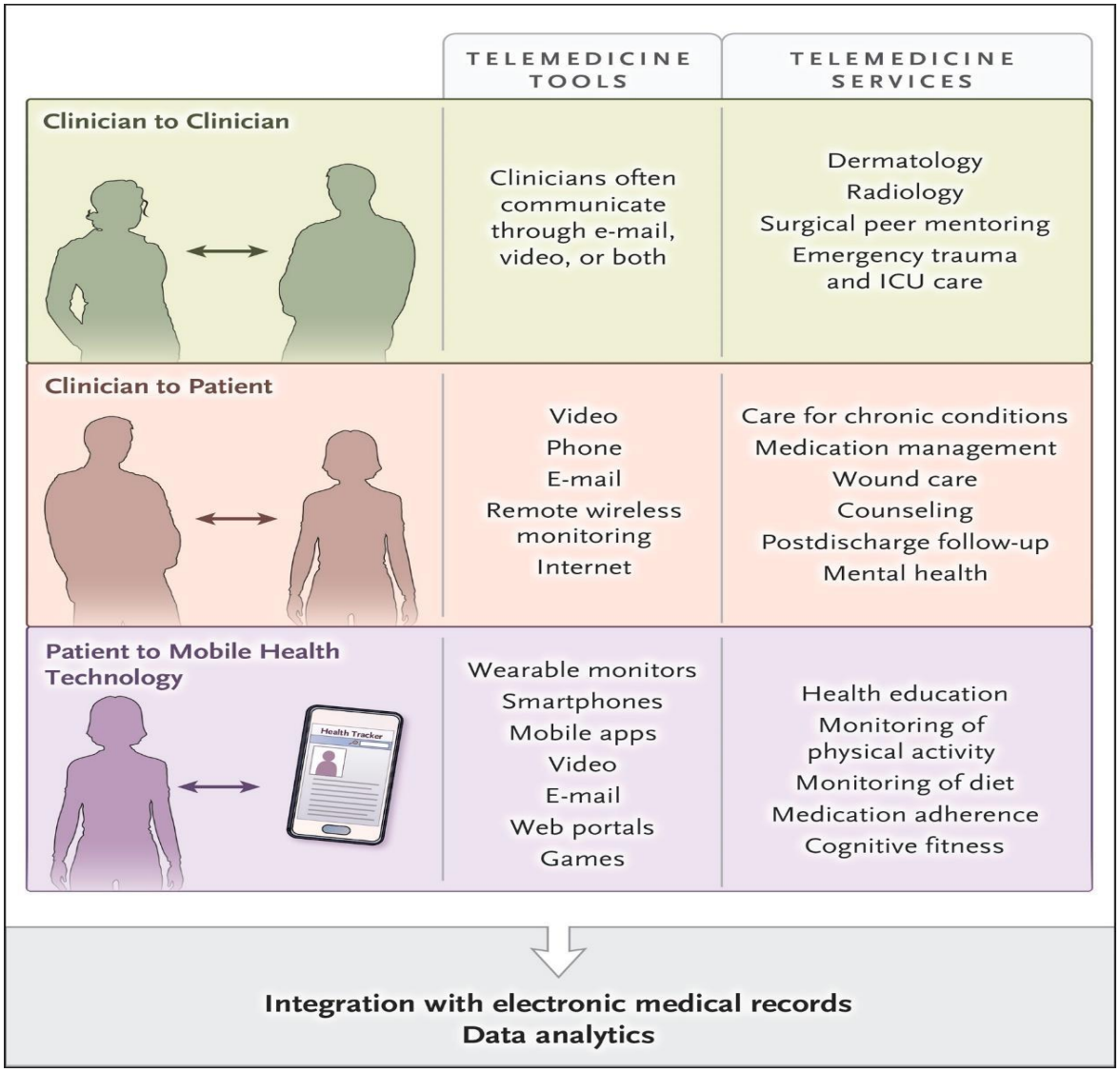

Figure 1: The ways doctors usually use telemedicine tools and the ways patients gain benefit[9]

Like any innovation, various educational needs and opportunities occur with telemedicine, both for the patients and the doctors. Most healthcare providers will work with at least one aspect of telemedicine in the future, regardless of their speciality[10]. The trend of training all types of healthcare providers in the field of telemedicine is growing significantly. This process is undertaken even from university curricula level to hospital level[11,12]. Attendings use telehealth to supervise their trainees to improve education process[11,13] and reduce the risk of making faults by the trainees[14]. Professionals can educate some underskilled operators in the ICU setting remotely to perform point-of-care ultrasound examination[15]. Telemedicine is also used for online conferences, simulations for trainees, education videos, minimally invasive surgeries, patient education,

teleconsultation, and education for pediatric complaints[16-21]. These telehealth visits are becoming more appealing to parents and even for adults with minor complaints[22], reducing the amount of time and money paid for this process[23]. Educating patients in telemedicine is a hot topic, with different opportunities in each specialty. A sample overview of educating nephrology patients using telemedicine is shown in Figure 1.

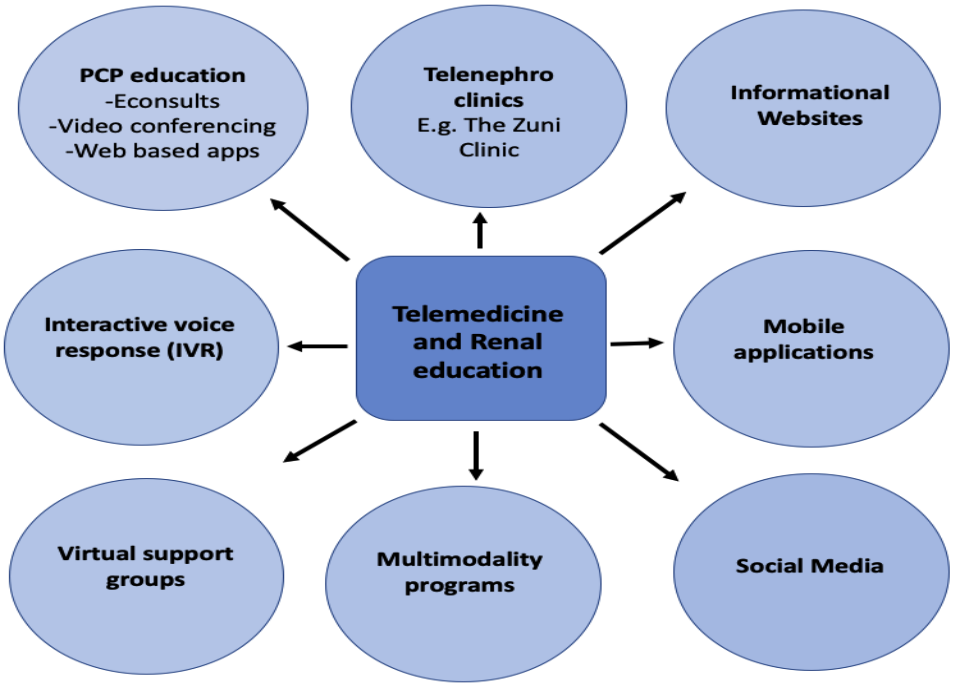

Figure 2: Aspects of telemedicine in nephrology patients' education[24]

Telemedicine in screening: The values of telemedicine, reducing the costs and improving the accessibility, and increasing the penetration rates of intervention to out-of-reach areas, provide a perfect opportunity for running telescreening programs. Telescreening programs are mainly conducted almost for every diabetic retinopathy patient[25]; however, 10% of these patients are missed in poor societies[26]. In-place trained healthcare providers carry out these screening programs by sending the data to a remote database, which is then interpreted by experts[27-30]. Overall, a broad comparison of telehealth and telemedicine is viewed in Figure 3.

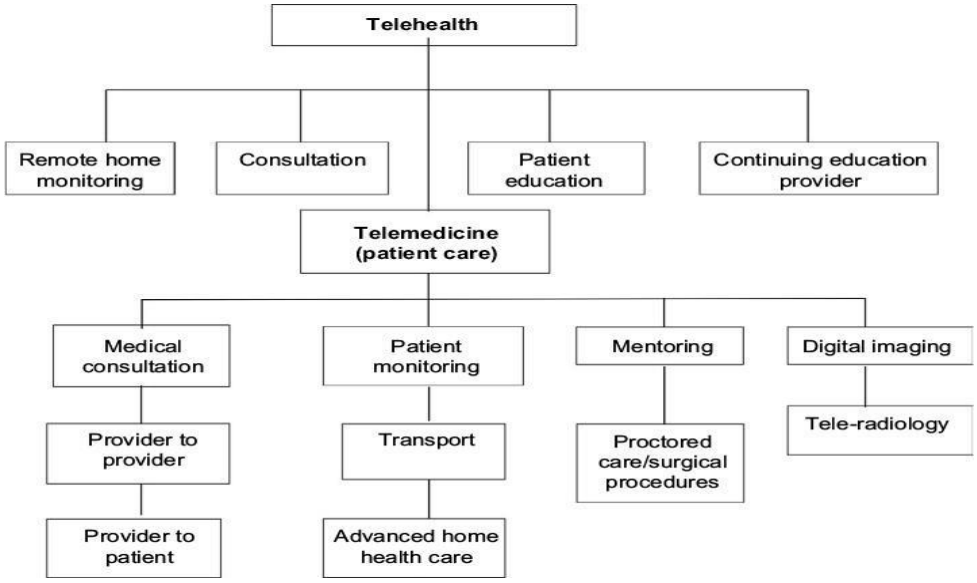

Figure 3: Telehealth and Telemedicine[31]

Telemedicine in different specialties: In psychiatry, Telepsychiatry, Telemental health, or e-mental health is growing inclusively, and studies show that video-conferencing is one of its essential modalities[32]. Video-conferencing therapy and internet-based psychotherapy are essentially used in cognitive behavior therapy (CBT)[33].

Teleradiology is among the pioneers of telemedicine, mainly due to the analog to digital imaging revolution. The primary teleradiology modalities are X-ray, CT-scans, Ultrasound figures, MRI images, and nucleic scans[34].

Telepathology is a promising field of telemedicine. The telepathology experiment's core part is recoding microscopic images of the slides, transferring them to the destination, and getting an expert's opinion or providing an educational discussion [35]. Based on Literature, twelve various classes of telepathology are currently in use[36].

In the field of teledermatology, investigating skin lesions is the most exciting field for dermatologists. The main techniques used for teledermatology are store-and-forward and live interactions. Due to the controversies in the accuracy of teledermatology[37-39], we need to investigate various factors to gain the chain's weak point.

Teleconsultation plays a significant role in telecardiology, especially in reducing ST-elevated myocardial infarction (STEM) accident to percutaneous coronary intervention (PCI). Tele-ECG has a potential role in this process and affects the prognosis of the patient[5,40]. Other cardiac conditions such as heart failure can be managed well via telemonitoring[41].

Telemedicine in Iran:

Political and legal situations:

The attitudes and beliefs of stakeholders are essential factors affecting the growth and the direction of telemedicine in a country. With various obstacles, benefits, and restrictions, those mentioned more by the experts or the decision-makers, usually shows the general figure of telemedicine in one country.

Decision-makers in Isfahan province are passionate about telemedicine's potential in resolving the problem of inappropriate distribution of expert human resources. They acknowledged the lack of global or nationwide standards for data transferring in Iran[42]. Overall, there is a lack of knowledge and awareness of telemedicine in healthcare providers in Iran. Less training and legal issues are contributing factors. However, their promotion programs are underway to tackle these obstacles[43] even though telemedicine is believed to be the distance barriers and regional differences, lack of international framework and regulations concern factors about patient confidentiality.

Studies in specialties:

Decreased face-to-face visits due to telemedicine usage can affect the accuracy of diagnosis and treatment, especially in the case of teledermatology, as some unusual skin lesions need to be examined. However, teledermatology is believed to have as high as 98% accuracy, but low network speed and coverage, lack of accurate imaging tools, and lack of infrastructure are the main barriers affecting the accuracy of teledermatology[44].

As Iran has a high rate of road injury and accident-related burns, telemedicine plays a crucial role in the early work-up of burned patients by calculating the severity of the burn and triaging the patients in the site of injury[45-46]. In addition to the triage system, the accurate examination is also essential. Teleradiology is reported to be useful and accurate more than 90% in Iran, as various teleradiological modalities are used[47]. The remote analysis is not limited to teleradiology but has a glorious opportunity in pathology. The accuracy of telepathology in Iran is 86%-89% for remote analysis of the slide than glass slide analysis[48].

Telemedicine and telesurgery in cancer care (TTCC) were thoroughly evaluated in five hospitals by the Tehran University of medical sciences. By evaluating multiple factors, internet access was the least concern of the doctors and other staff. In the era of cultural factors, doctors' acceptance had the best status, and clear rules had the worse one. Access to the internet was the best technical factor, but the lack of high-resolution cameras and remote medical reception were the worst factors. The private sector was highly equipped compared to university level[49]. An overview of the fields studied for telemedicine in Iran is demonstrated in **Table 1**.

Specialty	Current Scientific Background
Dermatology	• It is believed that teledermatology can reduce unnecessary visits. • Recent studies have reported similar accuracy for face-to-face visits and teledermatology visits • As high-quality images and videos are needed, low network speed or coverage are significant barriers, especially in out-of-reach areas.
Emergency	• Using smartphones and their cameras, telemedicine has the opportunity of performing remote trauma triage. Using the best transportation method is a considerable benefit of this in-place triage. • Preliminary evaluation of the burned patients can also be performed using smartphones, reducing unnecessary admissions to burn centers.
Radiology	• Examining chest X-rays are now believed to be possible using routine images, even with high compression rates.
Pathology	• Capturing images and sending the slides to remote pathologists take considerable time, with current tools and network speed. However, its accuracy is not inferior to the accuracy of conventional slide examinations.
Cancer Management	• Internet access is the least concern of the doctors, and doctors already have a high acceptance rate in using telemedicine tools for managing cancer patients. • Surveys showed that being equipped with high-resolution cameras and remote medical reception are the weaknesses in implementing telemedical care for cancer patients.

Table 1: An overview of specialties studied in Iran and their current status

Teledermatology in Iran:

Teledermatology is defined as "dermatology in the distance," which is the interpretation of images and clinical history to reach an accurate diagnosis and prescribe therapy at any part of the world. Teledermatology and teledermatopathology make a significant change in the delivery of dermatology services to remote areas and primary care doctors to get dermatologists' opinions without referring the patients through the usual referral pathway. Teledermatology is a branch of telemedicine that has been defined as the role of medicine at a distance[50]. Furthermore, the visual nature of the dermatology and its examination is well suited for telemedicine. The skin covers the entire surface of the human body, and its visual features such as color, texture, boundaries, and eruptions provide critical information for diagnosis and treatment. Therefore, the challenge to diagnose accurately on dermatology, which is dependent on the skills of specialists, can be solved by telemedicine.

The dermatologist can view the images of skins during video-conferencing or offline platforms. There are three formats for teledermatology. Primary teledermatology is direct communication between the patient and dermatologist for the first diagnosis or referral. Secondary teledermatology is the most common type that the general practitioner exchange medical history with the dermatologist. Tertiary teledermatology is about the collaboration of dermatologists. The tertiary teledermatology can be used for expert panel and consultation about complex cases or resident training and ongoing medical education (Figure 5). Teledermatology can be divided into some subspecialties, including teledermatopathology, teledermoscopy, and tele-wound care[51].

To explain the state of teledermatology in Iran and other countries, compare the limitations and challenges, and determine the critical factors for implementing dermatology in Iran, we used the search term "teledermatology" in PubMed by filters of systemic review.

The modern history of teledermatology has started in the 20th century, which first begun within military telemedicine[53]. Nowadays, teledermatology is performed by three main routes[54].

- online platforms such as video-conferencing,
- store-and-forward method which images and texts are sent via e-mail or other social media,
- hybrid, which combines features from both real-time and store-and-forward modalities.

Concerning the current state of teledermatology in Iran, only a few studies have been conducted on teledermatology in this country. Weak infrastructure and insufficient internet service were the main obstacles, and designing a teledermatology web-based system is the trend[55]. The establishment of teledermatology was influenced by high-speed internet, remote medical hardware, service providers, patient satisfaction, economic and cultural factors. On the other hand, lack of infrastructure for telecommunications, security, patient identification, legal and ethical issues, absence of direct skin palpation are some of the barriers in teledermatology in Iran[55,56].

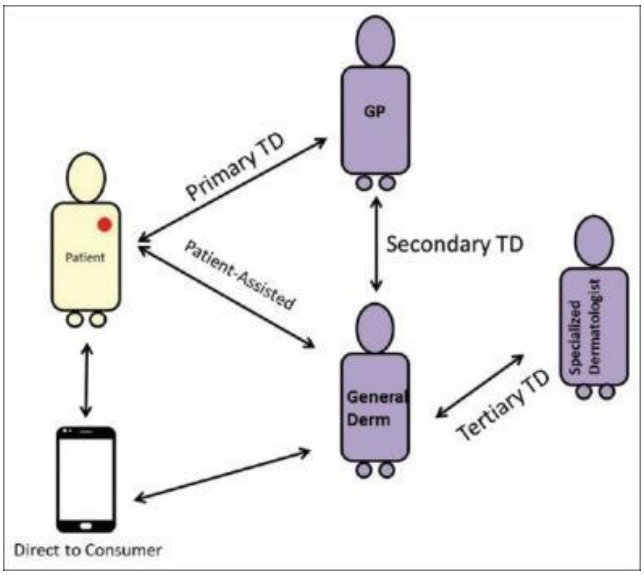

Figure 5: Teledermatology Formats[52]

DISCUSSION

There are multiple aspects of telemedicine in Iran. Some of them are being handled currently, and some others need further considerations. The highest proportion of published papers on telemedicine in Iran are the surveys analyzing different aspects of telemedicine, its feasibility, available and unavailable infrastructures, and other barriers[43].

In a general view, the healthcare stakeholders, especially doctors, nurses and other healthcare staff, and policymakers, are so passionate about telemedicine, and most of them are aware of a part of the benefits of telemedicine. The majority of the stakeholders believe that telemedicine's main benefit is patients' more satisfaction and solving unfair specialist distribution in the country[42,43].

On the other hand, the awareness of the healthcare sections and their realistic views are significantly different, and the main concern is about the university employees and decision-makers. However, studies show no difference in the knowledge or attitude toward telemedicine in different genders, ages, or work experiences[43]. A barrier is noticed in most of these surveys is legal issues. As a new phenomenon, there are multiple legal considerations, should be clarified.

On the other hand, the ICT infrastructure is a bipolar aspect of telemedicine in Iran. There is approximately no concern about Internet access and network speed in most of the cities in Iran. However, as telemedicine brings specialists and expert opinions to the out-of-reach lands, there is a significant concern about Internet access in most rural areas. Access and Internet speed are a significant barrier, especially in specialties, which need video-conference and live communication[42-44].

Teledermatology was consistent across the studies. According to the Botswana study, teledermatology is considered an appropriate alternative modality for HIV positive patients. Needs for dermatologic care is underserved in many communities as it is affected by several factors. In developing countries, teledermatology can be useful as the population grows and specialists are not balanced. Furthermore, teledermatology can provide better healthcare services in urban areas and cost less for low socio-economic income. Another advantage of the application of teledermatology services is faster access and reduce waiting time[57].

In Iran and neighboring countries, skin disease prevalence causes a considerable burden and the need for specialty services more[58]. Teledermatology has captured the attention by reducing the expenses and deducing the quality. It seems to make access to dermatologists feasible and reachable. However, as mentioned before, the infrastructure in developing countries is the primary boundary for telehealth. Technology and internet services are the leading indicators, which affect the establishment of teledermatology[59].

Teledermoscopy on a large scale of outpatient settings can help identify the skin cancer patients among clinically underserved patients[60]. The best way to diagnose skin cancer is to monitor and observe changes in the lesion (color, shape, size, texture) closely during the time passes[61].

To our knowledge, no studies have yet been conducted to systematically review the state, challenges, limitations, satisfactions of teledermatology in Iran. Teledermatology plays a crucial role in managing the

population, which is getting older and numerous. Health services and health delivery can be fairer due to ignoring the distance. A generalized overview of teledermatology models is demonstrated in Figure 6.

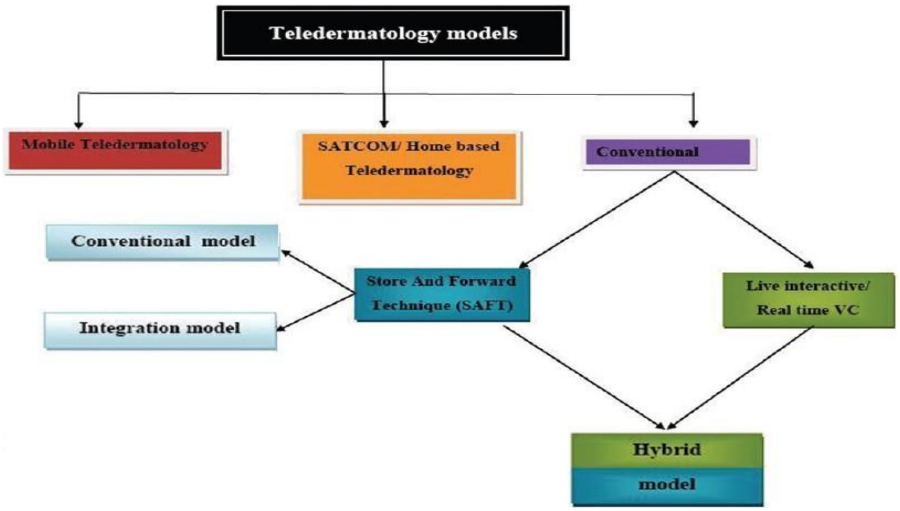

Figure 6: various models applied for teledermatology[62]

CONCLUSION

There are various promising and threatening areas in telemedicine in Iran. The cultural and organizational support is convenient for the purpose, but most of the population are dubious for the required infrastructure. As telemedicine is supposed to solve two major healthcare issues (accessibility and costs), it is vital to develop ICT infrastructures to out-of-reach regions to have stable, high-quality Internet access, the way it is in the cities. On the other hand, the logical issues need to be resolved, especially in health insurance.

There are multiple promising fields in telemedicine, especially those related to taking and sharing pictures, such as teleradiology, remote triage, and telepathology.

Moreover, teledermatology in the outpatient setting has been demonstrated a good impression by reliable and accurate diagnosis, reduction of wait times, increase access, and improving patient satisfaction and quality of life. Teledermatology can reduce the cost in developing countries, though there are several obstacles. Some of them can be solved by teaching, making awareness, patient-physician communications. Some of them need policymakers and more monetary funds from governmental or non-governmental organizations to make appropriate infrastructures. Teledermatology can vanish the leveling of regional differences. Nowadays, the development of new technologies such as smartphones, portable computers, and internet services in rural areas makes telemedicine more reachable.

Interest of Conflict: None

List of abbreviations:

ICU: Intensive Care Unite

CBT: Cognitive Behavior Therapy

ECG: Electrocardiography

ICT: Information Communication Technology

STEM: ST-elevated myocardial infarction

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