

Telemedicine Acceptance and Implementation in Developing Countries: Benefits, Categories, and Barriers

Mohammad Reza Hassibian,^{1,*} and Sepideh Hassibian²

¹Medical Informatics Department, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, IR Iran

²Bio-technology Department, Islamic Azad University, Mashhad, IR Iran

*Corresponding author: Mohammad Reza Hassibian, Medical Informatics Department, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, IR Iran. Tel: 98-51138002440, E-mail: hasibianmr@mums.ac.ir

Received 2016 April 09; Revised 2016 May 31; Accepted 2016 June 18.

Abstract

Context: Distributing health care services in remote and rural areas have become a major health problem for many developing countries. Telemedicine presents solutions to developing countries for better disease prevention, disease management, emergency services and practicing medicine in areas with limited access to healthcare services and facilities. Although the willingness of developing countries to accept telemedicine and incorporate it into their health care systems is rising, due to multidisciplinary and complicated characteristics of telemedicine, they will face challenges and barriers which will slow down their progress. This literature review attempts to explain the benefits, categories and barriers for acceptance and implementation of telemedicine in developing countries.

Evidence Acquisition: This study was conducted in 2016. The main question was how is the general attitude to the acceptance and use of telemedicine in developing countries and what problems they are facing for the use of telemedicine. To find the solutions, we searched articles in two main databases, PubMed and Scopus, with the keywords and expressions related to the subject of the study (developing countries, telemedicine, tele-health, barriers, challenges, adoption, and acceptance). Totally, 103 articles were extracted. Duplicate articles and articles published before 1998 were eliminated and the remaining ones were screened for eligibility in accordance with subject of the study. The result was 47 articles from PubMed and 5 articles from Scopus. This review is based mainly on preliminary results, opinions and predictions. As limitations of our study, we limited ourselves to PubMed and Scopus databases and also reviewed articles only in English language.

Results: The study did not find any article that totally disagrees with the implementation of telemedicine in developing countries. Most of the articles contain positive points associated with the use of telemedicine with respect to the barriers and challenges.

Conclusions: Despite hopeful progresses in telemedicine, developing countries are facing many problems in their way toward successful application of telemedicine. High cost and cultural resistance are considered as the main barriers for developing countries in their approach to apply telemedicine. Developing countries must be fully aware that investment in telemedicine will not inevitably yield clinical or economic benefits in short time. They must consider barriers and various outcomes of telemedicine before accepting and applying it.

Keywords: Telemedicine, Developing Countries, Acceptance, Advantages, Barriers, Challenges

1. Context

The world health organization (WHO) defines telemedicine as “the delivery of health care services, where distance is a critical factor, by all the health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing health of individuals and their communities” (1).

Telemedicine uses Information technology to deliver medical services and health information from one loca-

tion to another, overcome geographical barriers, and increase access to health care services for people living in rural and remote areas. Telemedicine may vary from a simple dialogue between patient and physician, to highly professional tasks such as remote surgery which are organized through internet, phone, or other communication facilities (2).

An acceptable health care provision is challenging due to the costs required as well as various social, cultural, political, geographical, and economic conditions. Health provision for developing countries is incredibly complex. Because of this complexity, No unique solution for providing health care in developing countries can be expressed.

Developing countries have many problems related to provision of equitable health care services for every individual, especially for those living in rural and remote areas. Telemedicine will facilitate the early disease detection, successful disease management, lowering mortality rate, and medical consultation which will tremendously improve the outcomes and decrease the health care expenditure. In many developing countries, shortage of health care specialists has led to the high mortality of patients suffering from various diseases (3). One study shows that using telemedicine can lower infant mortality (4). Another study indicates that telemedicine can lower the myocardial infarction mortality in developing countries (5). Another study indicates that telemedicine in ICU lowers mortality and length of stay in intensive care unit (6).

Telemedicine concept has been adopted by many countries in effort to provide better health care for those living in rural areas where health care services are far away. Previous studies and reports have shown that the use of telemedicine is an inexpensive method for providing care for countries with weak financial resources, social, and environmental problems. Developing countries are faced with many other problems. One major problem is the limited financial resources and the second one is the shortages of skilled physician especially those who are not interested living in remote areas. According to WHO report, the ratio of physicians per thousand individuals in Tanzania and Chad is 0.02 and 0.04 respectively while this rate is 2.14 and 2.56 in Canada and the United States (7).

Developing countries also face additional problem of unequal distribution of resources between the urban and rural areas. According to a study done at 2005, approximately 75% of the Indian populations are living in villages and rural areas while nearly 75% of Indian physicians are based in big cities (8). Also, More than 60 million people in India, Mostly living in poor rural areas, have diabetes and this number will reach 101 million by 2030. Most of diabetes patients living in rural areas are poor and have to travel long distances to the nearest health care centers. It is also estimated that by 2030, there will be at least 552 million diabetes patients globally which 80% of this number living in developing countries (9).

2. Telemedicine Categories

Telemedicine can be divided into two main distinct categories which are “store-and-forward”, and “real-time”. Both developed and developing countries can use SF real time telemedicine.

2.1. Store and Forward Telemedicine (SF)

SF telemedicine surpasses the need for a face to face meeting between physician and patient. Instead, a collection of data such as clinical and medical images can be collected and then transmitted to a physician or medical specialist at a convenient time for evaluation.

2.2. Real Time Telemedicine

Or sometimes called Interactive telemedicine, can provide immediate advice to patients live in remote areas and require medical attention. Real time telemedicine allows patient and physician to send and receive information almost instantly without seeing each other (10).

3. Telemedicine Benefits

The main benefits of telemedicine are reducing the patient's cost and the time to get the health care services. There are studies indicating that a significant portion of patients who live in the rural and urban areas travel several times to hospital and physician's offices for medical services which are usually consultations or refilling their medications which can be done by a simple phone call (11, 12).

3.1. Bridge the Rural-Urban Divide

Telemedicine can help to bring many specialized health care services to the remotest areas of the country. A successful experience in the use of telemedicine to provide health services to people who live in remote areas was conducted by the Indian space research organization (ISRO). In this project, 22 specialty hospitals with 78 rural remote hospitals across the country were linked. The project will enable villagers and farmers to receive consulting services in the fields of ophthalmology and other common diseases (8, 13)

3.2. Home Based Health Care Services

Usually called “Tele-homecare”, involves the provision of advice and consultation to patients with chronic diseases such as diabetes mellitus, hypertension, and heart diseases. Tele-homecare has the best performance if the patients are motivated to manage their health problems (14-16).

3.3. Reducing Health Care Cost

Telemedicine will reduce the healthcare costs by monitoring patients for early disease detection, disease management, educating people with basics of health, and providing health consultation for all people specially those living in rural and remote areas (17).

3.4. Improving Medical Education

Telemedicine can enhance educational opportunities for health professionals and continuous education on the latest medical achievements. Tele-education can also improve clinical outcomes and reduce hospital admission rate by increasing the people's health awareness through remote learning (18, 19). As an example, the "pacific open learning network project" which is supported by WHO enables all type of health professionals in pacific island countries to have online access to medical courses and health information through internet (20). Another successful example is the Kosovo Telemedicine Program (TMPK) with emphasis on continuous medical education.

3.5. Enhancing Health Care Quality

Institute of Medicine (IOM) has set six major indexes for health promotion. Effectiveness, timeliness, equity, patient-centeredness, safety, and efficiency are the indexes set by IOM. Many studies indicate that telemedicine is able to meet the criteria set by the IOM. The american medical association (AMA) believes that the use of telemedicine to provide healthcare services to patients can be associated with better health care quality and improvement of their safety (21). In contrast, there are studies that don't believe the telemedicine potential in improving health care and reducing costs for both the patients and health care providers (22, 23).

3.6. Affecting Clinicians' Workload

Some studies indicate that physicians can save more time when they are providing remote health care services for certain patients (24). The american medical association (AMA) states that 70% of physician's office visits can be handled over the phone and 50% of emergency room visits are non-emergencies (25).

3.7. Reducing Medical Errors

According to IOM reports, medication errors are most common type of error in health care. A study done at the University of California Davis Children's hospital indicates that phone consultation greatly reduced the mortality rate and the medical errors of seriously ill and injured children transferred to rural emergency departments (26).

3.8. Changing the Relation Between Physician and Patient

Up to now, there is little research to measure the effect of telemedicine on physician-patient relationship (27). Many studies indicate using videoconferencing and remote monitoring can increase efficiency and convenience for both physicians and patients. Patients who can be seen by a physician remotely will not have to spend as much time traveling and waiting to be seen by a physician (28).

3.9. Improving Access to Information

Telemedicine can be used for providing information to the general public as part of health promotion or health education. This could turn out to be the most cost-effective way of improving knowledge about health and diseases, and the relationship between lifestyle and the quality of life (29).

4. Telemedicine Types

4.1. Tele-Dermatology

The primary aim of Tele-dermatology is to provide specialized dermatological care to patients in remote areas by enabling the dermatologist to see the skin lesion through webcam or mobile phone for determining the type of disease (30).

Previous studies and reports have shown that tele-dermatology has proven to be an inexpensive method for providing care to people living in rural areas. In a store and forward Tele-dermatology study, thirty patients with common skin diseases in Cairo, Egypt, were given a diagnosis by face-to-face consultation. They were then given a diagnosis independently by local senior dermatologists using Tele-consultation with a software-enabled mobile telephone. Diagnostic concordance rates between face-to-face and Tele-consultation were almost the same (31).

4.2. Tele-Pathology

Pathology is very important field in medicine. It is concerned with the study of the nature and causes of diseases (32). Patients with cancer symptoms living in countries with the shortages of pathology specialists may suffer a lot. For them, time is of great importance and prompt pathology diagnosis has a very crucial role. Tele-pathology is a good way to compensate for the shortage of pathology specialist (33-35).

4.3. Tele-Radiology

European Society of Radiology (ESR) defines Tele-radiology as "electronic transmission of radiographic images from one geographic location to another for the purpose of interpretation and consultation". For this process to be implemented, three essential components are required, an image taking station which requires the patient's presence, a transmission network, and a receiving image station to review and interpret the image (36).

4.4. Tele-Ophthalmology

Tele-medicine capabilities associated with eye diseases has been largely approved. The capability of telemedicine in transmitting images, videos, and audio data, make it a good choice for provision of ophthalmology services in rural and remote areas. Some countries, such as India, has used the capabilities of Tele-ophthalmology to provide better services for people how live in villages and are suffering from eye diseases (37).

4.5. Tele-Home Care

Tele-homecare is a branch of telemedicine which help elderly people, Patients how had surgeries and need to be followed up, and patients with chronic diseases and prefer to receive healthcare services at home (38, 39).

4.6. Tele-Surgery

Tele-surgery is the performance of surgical procedures where the surgeon is not physically in the same location as the patient is. In fact, Tele-surgery can be done by a robot as a remote operator controlled by the surgeon. Tele-surgery is a good solution for certain conditions where the shortage of surgeons could jeopardize the patient's health. Advances in robotics, computer graphics, and virtual reality technology have opened up new possibilities in surgery era. There are several critical limitations for Tele-surgery. One of the main limits is the latency and reliability of the communication system between the surgeon and the patient. Tele-surgery without a fast and reliable communication facility is not recommended. The Da Vinci surgical robot is a sample of Tele-surgical device approved by the food and drug administration (FDA) for general surgery.

4.7. Tele-Nursing

Tele-nursing facilitates remote monitoring and consultations for patients and elderly people living in remote areas. Tele-nursing is achieving significant growth rates in many countries. One important reason for this fast growth is due to growing elderly and chronically ill population (40, 41).

5. Why Developing Countries need Telemedicine ?

Most developing countries have weak economy which forces them to spend their limited financial resources very carefully specially in costly areas such as healthcare services. Countries where most of the population live in the countryside, have realized that telemedicine can be considered as a good solution for them to overcome most of

their problems in healthcare delivery services such as establishing large number of hospitals and other health care facilities in rural and remote areas.

Even though, the potential applications of telemedicine in developing countries particularly those which are related to ethical and social issues, can't be compared to that in the developed world, But there are studies indicating that telemedicine may have a more profound impact on developing countries than on developed ones (42, 43).

Poor healthcare is a severe risk factor for development of developing countries. Diseases such as malaria, respiratory infections, HIV/AIDS, diarrheal diseases, and maternal mortality result in high mortality and morbidity. An extensive network of remote hospital, expert health care professionals, and much more expensive health facilities are needed to reduce the Impact of such diseases (44, 45).

6. Barriers

Telemedicine challenges and barriers in one developing country may differ from another one, but there can be some common issues which have major role in the successful acceptance and implementation of telemedicine applications. Some of these barriers may cause the total failure and some slowing down the acceptance and implementation of telemedicine (46).

6.1. The High Cost

The initial cost of applying telemedicine is very high. It is directly associated with the development of telemedicine applications for which it is intended. Telecommunication expenses, training of both patients and medical professionals, and the need for new advanced technologies are among main cost of telemedicine. In general, the cost of telemedicine varies directly with the application intended for it (47).

6.2. Cultural

There is a lack of confidence in patients about the outcome of telemedicine. It is hard for them to believe that they can receive health care services without visiting physicians face to face. It is the responsibility of governments to change the cultural attitudes through public education (48).

6.3. Unreliable and Low Wideband Internet and Other Network Communication Systems

Many applications of telemedicine need a high speed and reliable communication facilities. Tele-surgery, real time Tele-ophthalmology, real time Tele-radiology, and

emergency consultation are some examples of such applications. Telemedicine requires reliable communication system to motivate users (49).

6.4. Shortage of Expert Technical Manpower

It is an acceptable fact that many physicians and ordinary people are not able to fix problems arising in their computer systems and networks. Trained and expert manpower is needed to establish a stable and continuous communication between physicians and patients (50).

6.5. Linguistic Differences

In some developing countries such as India and Iran there is a great diversity of languages, cultural aspects, and dialects. The diversity of languages and dialects makes it difficult to build an acceptable verbal communication between physician and patient (51).

6.6. Perspective of Medical Practitioners

Physicians are not fully convinced about the efficacy of telemedicine in the health care services. Un-familiarity with telemedicine and its efficiency in health care services is a big barrier for acceptance of telemedicine in developing countries. Telemedicine successful acceptance is obtainable if both physicians and patients have sufficient confidence in effectiveness of telemedicine (52).

7. Results

From total of 103 potential articles, 52 relevant articles identified. There were very few articles that did not look quite positive to the usage of telemedicine. The majority of articles believed the high performance of telemedicine in health care area, especially, for developing countries with high population living mostly in rural areas. Many articles refer to the importance of careful planning for the acceptance and use of telemedicine. It is highly recommended to developing countries that without accurate and comprehensive study of the barriers and the basic needs of health care services which telemedicine can be of help, they must not consider using telemedicine.

8. Discussions

Telemedicine undoubtedly has many potentials in improving health outcomes in both developed and developing countries. The growth of high-speed internet and communication networks and their ability to transmit higher-quality imaging and other clinical information indicates a promising future for telemedicine. Telemedicine offers

great opportunity as an alternative method of health service delivery to rural and remote communities.

Developing countries willing to use telemedicine to increase access to healthcare services for everyone specially people living in remote and rural areas, must have a good financial and expert human resources, efficient organizational and management capability, and reliable information technology infrastructure.

Developing countries must realize that adopting telemedicine does not easily solve all their existing health problems. Financial, cultural, and other factors play a major role in the defeat or success of telemedicine. Involvement and support of governments is crucial for the successful implementation of telemedicine. Many challenges and barriers must be solved at the government level. In that case, there will be wider acceptance of telemedicine.

Developing countries by incorporating telemedicine on their health care systems, faces many problems. Telemedicine implementation is costly and requires fundamental changes to conventional methods of health care services. Therefore, there should be a clear reason for applying telemedicine, such as a proven clinical problem where telemedicine may be helpful for delivering a reasonable and acceptable service. To conduct telemedicine successfully, it is recommended to start with small scale applications such as Tele-Ophthalmology, Tele-pathology and Tele-dermatology. Also, due to infrastructure problems most developing countries are face with, SF telemedicine is a convenient method for most telemedicine applications in developing countries.

Acknowledgments

This study was supported and encouraged by Dr. SM. Tara, Dr. K. Etminani, and Dr. S. Eslami of medical informatics department at Mashhad University of Medical Sciences.

Footnotes

Financial Disclosure: There is no financial interest to disclose.

Funding/Support: There was no funding support for this study.

References

1. Organization WH. Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth. World Health Organization; 2010.
2. Praveen KB, Ali SS. Telemedicine in primary health care: the road ahead. *Int J Prev Med*. 2013;4(3):377-8. [PubMed: 23626897].

3. Kifle M, Solomon A, Okoli C, Mbarika V. Critical success factors for telemedicine in Ethiopia. International Conference IT Management in Healthcare', In Information Resources Management Association (IRMA 2004). New Orleans. .
4. Kim EW, Teague-Ross TJ, Greenfield WW, Keith Williams D, Kuo D, Hall RW. Telemedicine collaboration improves perinatal regionalization and lowers statewide infant mortality. *J Perinatol*. 2013;**33**(9):725–30. doi: [10.1038/jp.2013.37](#). [PubMed: [23579490](#)].
5. de Waure C, Cadeddu C, Gualano MR, Ricciardi W. Telemedicine for the reduction of myocardial infarction mortality: a systematic review and a meta-analysis of published studies. *Telemed J E Health*. 2012;**18**(5):323–8. doi: [10.1089/tmj.2011.0158](#). [PubMed: [22468983](#)].
6. Lilly CM, Cody S, Zhao H, Landry K, Baker SP, McIlwaine J, et al. Hospital mortality, length of stay, and preventable complications among critically ill patients before and after tele-ICU reengineering of critical care processes. *JAMA*. 2011;**305**(21):2175–83. doi: [10.1001/jama.2011.697](#). [PubMed: [21576622](#)].
7. Organization WH. The world health report: 2006: working together for health. 2006
8. Bagchi S. Telemedicine in rural India. *PLoS Med*. 2006;**3**(3):82. doi: [10.1371/journal.pmed.0030082](#). [PubMed: [16509768](#)].
9. Vijayakumar G, Arun R, Kutty VR. High prevalence of type 2 diabetes mellitus and other metabolic disorders in rural Central Kerala. *J Assoc Physicians India*. 2009;**57**:563–7. [PubMed: [20209716](#)].
10. Wootton R. Realtime telemedicine. *J Telemed Telecare*. 2006;**12**(7):328–36. doi: [10.1258/135763306778682387](#). [PubMed: [17059648](#)].
11. Shimmura S, Shinozaki N, Fukagawa K, Shimazaki J, Tsubota K. Real-time telemedicine in the clinical assessment of the ocular surface. *Am J Ophthalmol*. 1998;**125**(3):388–90. [PubMed: [9512159](#)].
12. Weiner M, Schadow G, Lindbergh D, Warvel J, Abernathy G, Dexter P, et al. Secure Internet video conferencing for assessing acute medical problems in a nursing facility. *Proc AMIA Symp*. 2001:751–5. [PubMed: [11825286](#)].
13. Pal A, Mbarika VW, Cobb-Payton F, Datta P, McCoy S. Telemedicine diffusion in a developing country: the case of India (March 2004). *IEEE Trans Inf Technol Biomed*. 2005;**9**(1):59–65. [PubMed: [15787008](#)].
14. Gagnon MP, Duplantier J, Fortin JP, Landry R. Implementing telehealth to support medical practice in rural/remote regions: what are the conditions for success?. *Implement Sci*. 2006;**1**:18. doi: [10.1186/1748-5908-1-18](#). [PubMed: [16930484](#)].
15. Kristensen GB, Nerhus K, Thue G, Sandberg S. Results and feasibility of an external quality assessment scheme for self-monitoring of blood glucose. *Clin Chem*. 2006;**52**(7):1311–7. doi: [10.1373/clinchem.2006.068114](#). [PubMed: [16690732](#)].
16. Doolittle GC. A cost measurement study for a home-based telehealth service. *J Telemed Telecare*. 2000;**6 Suppl 1**:S193–5. [PubMed: [10794017](#)].
17. Woodend AK, Sherrard H, Fraser M, Stuewe L, Cheung T, Struthers C. Telehome monitoring in patients with cardiac disease who are at high risk of readmission. *Heart Lung*. 2008;**37**(1):36–45. doi: [10.1016/j.hrtlng.2007.04.004](#). [PubMed: [18206525](#)].
18. Conde JG, De S, Hall RW, Johansen E, Meglan D, Peng GC. Telehealth innovations in health education and training. *Telemed J E Health*. 2010;**16**(1):103–6. doi: [10.1089/tmj.2009.0152](#). [PubMed: [20155874](#)].
19. esh Mangrulkar R, Athey B. Telemedicine and medical/health education. 49. University of Michigan: Contracting organization; 2001.
20. Wootton R, Bonnardot L. In what circumstances is telemedicine appropriate in the developing world?. *JRSM Short Rep*. 2010;**1**(5):37. doi: [10.1258/shorts.2010.010045](#). [PubMed: [2103129](#)].
21. Hersh WR, Helfand M, Wallace J, Kraemer D, Patterson P, Shapiro S, et al. Clinical outcomes resulting from telemedicine interventions: a systematic review. *BMC Med Inform Decis Mak*. 2001;**1**:5. [PubMed: [11737882](#)].
22. Cartwright M, Hirani SP, Rixon L, Beynon M, Doll H, Bower P, et al. Effect of telehealth on quality of life and psychological outcomes over 12 months (Whole Systems Demonstrator telehealth questionnaire study): nested study of patient reported outcomes in a pragmatic, cluster randomised controlled trial. *BMJ*. 2013;**346**:f653. doi: [10.1136/bmj.f653](#). [PubMed: [23444424](#)].
23. Marcolino MS, Maia JX, Alkmim MB, Boersma E, Ribeiro AL. Telemedicine application in the care of diabetes patients: systematic review and meta-analysis. *PLoS One*. 2013;**8**(11):79246. doi: [10.1371/journal.pone.0079246](#). [PubMed: [24250826](#)].
24. Schopf TR, Bolle R, Solvoll T. The workload of web-based consultations with atopic eczema patients at home. *BMC Res Notes*. 2010;**3**:71. doi: [10.1186/1756-0500-3-71](#). [PubMed: [20226049](#)].
25. Davalos ME, French MT, Burdick AE, Simmons SC. Economic evaluation of telemedicine: review of the literature and research guidelines for benefit-cost analysis. *Telemed J E Health*. 2009;**15**(10):933–48. doi: [10.1089/tmj.2009.0067](#). [PubMed: [19954346](#)].
26. Dharmar M, Romano PS, Kuppermann N, Nesbitt TS, Cole SL, Andrada ER, et al. Impact of critical care telemedicine consultations on children in rural emergency departments. *Crit Care Med*. 2013;**41**(10):2388–95. doi: [10.1097/CCM.0b013e31828e9824](#). [PubMed: [23921273](#)].
27. Pemberton PJ, Goldblatt J. The Internet and the changing roles of doctors, patients and families. *Med J Aust*. 1998;**169**(11-12):594–5. [PubMed: [9887903](#)].
28. Whitten P, Love B. Patient and provider satisfaction with the use of telemedicine: overview and rationale for cautious enthusiasm. *J Postgrad Med*. 2005;**51**(4):294–300. [PubMed: [16388172](#)].
29. Gulliford SM, Schneider JK, Jorgenson JA. Using telemedicine technology for pharmaceutical services to ambulatory care patients. *Am J Health Syst Pharm*. 1998;**55**(14):1512–5. [PubMed: [9676298](#)].
30. O'Mahony D, Banach L, Mahapa DH, Lancaster EW, Van der Linde GD, Williams BH, et al. Teledermatology in a rural family practice. *South African Family Practice*. 2002;**25**(6):4–8.
31. Tran K, Ayad M, Weinberg J, Cherng A, Chowdhury M, Monir S, et al. Mobile teledermatology in the developing world: implications of a feasibility study on 30 Egyptian patients with common skin diseases. *J Am Acad Dermatol*. 2011;**64**(2):302–9. doi: [10.1016/j.jaad.2010.01.010](#). [PubMed: [21094560](#)].
32. Sawai T, Uzuki M, Kamataki A, Tofukuji I. The state of telepathology in Japan. *J Pathol Inform*. 2010;**1** doi: [10.4103/2153-3539.68327](#). [PubMed: [20922030](#)].
33. Ford JC. If not, why not? Reasons why Canadian postgraduate trainees chose or did not choose to become pathologists. *Hum Pathol*. 2010;**41**(4):566–73. doi: [10.1016/j.humpath.2009.09.012](#). [PubMed: [20004951](#)].
34. Harrison P. Laboratory medicine needs higher profile with medical students, MDs, pathologists say. *CMAJ*. 1995;**153**(6):805–8. [PubMed: [7664233](#)].
35. Nakhleh RE, Bekeris LG, Souers RJ, Meier FA, Tworek JA. Surgical pathology case reviews before sign-out: a College of American Pathologists Q-Probes study of 45 laboratories. *Arch Pathol Lab Med*. 2010;**134**(5):740–3. doi: [10.1043/1543-2165-134.5.740](#). [PubMed: [20441505](#)].
36. Burute N, Jankharia B. Teleradiology: The Indian perspective. *Indian J Radiol Imaging*. 2009;**19**(1):16–8. doi: [10.4103/0971-3026.45337](#). [PubMed: [19774131](#)].
37. Lamminen H, Voipio V, Ruohonen K, Uusitalo H. Telemedicine in ophthalmology. *Acta Ophthalmol Scand*. 2003;**81**(2):105–9. [PubMed: [12752046](#)].
38. Bowles KH, Baugh AC. Applying research evidence to optimize tele-homecare. *J Cardiovasc Nurs*. 2007;**22**(1):5–15. [PubMed: [17224692](#)].
39. Finkelstein SM, Speedie SM, Lundgren JM, Ideker M. TeleHomeCare: connecting the home and the home care agency. *Caring*. 2000;**19**(7):32–5. [PubMed: [11010440](#)].
40. Jensen BT, Kristensen SA, Christensen SV, Borre M. Efficacy of tele-nursing consultations in rehabilitation after radical prostatectomy: a randomised controlled trial study. *Inter J Urological Nurs*. 2011;**5**(3):123–30.

41. Russo H. Window of opportunity for home care nurses: telehealth technologies. *Online J Issues Nurs*. 2001;**6**(3):5. [PubMed: [11936944](#)].
42. Edworthy SM. Telemedicine in developing countries. *BMJ*. 2001;**323**(7312):524-5. [PubMed: [11546681](#)].
43. Wootton R. Telemedicine support for the developing world. *J Telemed Telecare*. 2008;**14**(3):109-14. doi: [10.1258/jtt.2008.003001](#). [PubMed: [18430271](#)].
44. Laouyane A. Telemedicine and developing countries. *J Telemed Telecare*. 1998;**4**.
45. Latifi R, Merrell RC, Doarn CR, Hadeed GJ, Bekteshi F, Lecaj I, et al. "Initiate-build-operate-transfer"-a strategy for establishing sustainable telemedicine programs in developing countries: initial lessons from the balkans. *Telemed J E Health*. 2009;**15**(10):956-69. doi: [10.1089/tmj.2009.0084](#). [PubMed: [19832055](#)].
46. Kuszler PC. Telemedicine and integrated health care delivery: compounding malpractice liability. *Am J Law Med*. 1999;**25**(2-3):297-326. [PubMed: [10476332](#)].
47. Moffatt JJ, Eley DS. Barriers to the up-take of telemedicine in Australia-a view from providers. *Rural Remote Health*. 2011;**11**(2):1581. [PubMed: [21385004](#)].
48. Jang-Jaccard J, Nepal S, Alem L, Li J. Barriers for delivering telehealth in rural australia: a review based on Australian trials and studies. *Telemed J E Health*. 2014;**20**(5):496-504. doi: [10.1089/tmj.2013.0189](#). [PubMed: [24801522](#)].
49. LeRouge C, Garfield MJ. Crossing the telemedicine chasm: have the U.S. barriers to widespread adoption of telemedicine been significantly reduced?. *Int J Environ Res Public Health*. 2013;**10**(12):6472-84. doi: [10.3390/ijerph10126472](#). [PubMed: [24287864](#)].
50. Alverson DC, Shannon S, Sullivan E, Prill A, Effertz G, Helitzer D, et al. Telehealth in the trenches: reporting back from the frontlines in rural America. *Telemed J E Health*. 2004;**10** Suppl 2:S-95-109. [PubMed: [23570220](#)].
51. Steele RE. Telemedicine in Greenland: the case for and against implementation. *Int J Circumpolar Health*. 1998;**57** Suppl 1:686-8. [PubMed: [10093368](#)].
52. Saghaeiannejad-Isfahany S, Jahanbakhsh M, Shayan A. Telemedicine operational feasibility in selected hospitals of Isfahan University of Medical Sciences in 1393. *Inter J Health System Disaster Manage*. 2015;**3**(4):189.