

# Identifying the Challenges and Cost-effectiveness of Telerehabilitation: A Narrative Review

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## ABSTRACT

Technology has been evolving at an exponential speed in the past decade and the evidence of a dramatic change is all around us such as self-driving cars, artificial intelligence, robotics, and many more. The fusion of physical, digital and biological worlds, the so-called 4<sup>th</sup> industrial revolution, has impacted all industries and disciplines including healthcare. It has changed the way we live, work, and interacts with people around the globe. Despite its numerous benefits it also brings several concerns such as organisations failing to adapt to this shift at an equal or adequate pace. It is imperative that we grab the opportunities it presents and together shapes a sustainable and highly productive future. The field of rehabilitation has begun to adapt to these changes and became known as Telerehabilitation (TR). A promising field can be instrumental in aiding healthcare delivery, enhancing compliance, and improving health outcomes and quality of life of patients. However, the development of TR has been at a much slower pace than expected in both developing and developed countries. This article is a review of status and trends in TR and will mainly deal with identifying challenges faced by its users, gaps and propose means for rectifying issues and for establishing cost-effectiveness. It is thus concluded that there should be future studies of high quality, analysing its cost effectiveness and cost benefit. Also, the challenges could be overcome by a combination of face to face delivery and TR.

**Keywords:** Cost-benefit, Health outcome, Physical therapy, Rehabilitation, Technology

## INTRODUCTION

Use of technology in healthcare system has significantly increased choices for people in terms of remote access to healthcare needs across the world [1,2]. Telehealth and telemedicine are widely used as an adjunct or alternative to consultation with doctors for the purpose of prevention, cure or restoration of the diseased condition. Telerehabilitation refers to the delivery of rehabilitation services with the help of communication and information technologies. This may involve varied forms of technology like telephone, internet-based communication, virtual reality programmes or a combination of other forms computer systems and technologies. Such technology, when used for preventive, curative, rehabilitative services, as well as outcome monitoring and as a medium for delivering instructions and solutions to address rehabilitative issues. It is a descendant of telemedicine that monitors the rehabilitation status, provides education and training for families and professionals. Telerehabilitation creates opportunities to cut down rising costs of healthcare in a novel and effective way [2,3]. However, the technology itself is not a solution, it relies upon the innovative ideas and creative capacities of the providers to ensure that its use is optimised in a sustainable fashion [2].

### Advantages of Telerehabilitation

Patients in remote locations with limited access to rehabilitation services or unable to use available services due to inability to locomote regularly, fail to follow-up for progression [4]. Telerehabilitation, therefore makes rehabilitative services or specialists, more equitably accessible for such individuals and may even prove to be more acceptable and affordable for them [4-8]. When rehabilitation is promoted in the community it ensures continuity of rehabilitation even after the discharge. The reason here could be attributed to the reduction in the stay inside the hospital that reduces the budget expended in hospital care [9]. In contrast, home care provides the patients with a number of advantages and benefits which includes

saving of travel time, requirement of standby caregiver to assist patients to be taken to the healthcare facility and there is also the advantage of getting care at a home setup. The benefits not only account for cost-saving strategies but also responsible for indirectly saving expenditure in healthcare.

**Telerehabilitation history and worldwide exploration:** Russell TG mentioned in his article that the primary aim of telerehabilitation is to help patient to receive equal access to rehabilitation services in spite of their impairments or accessibility [7]. Broadly he had classified telerehabilitation as means by which image, sensors, virtual environments and virtual reality is utilised to provide quality service [7]. Until 2005, much of the research in this area was focused on different type's of technology and which consisted of studies with single case or small sample. Russell TG suggested that studies should be able to demonstrate realistic and viable telerehabilitation services using well-constructed, controlled research methods including various cohorts [7]. In addition, the broader issues of cost-benefit and cost-effectiveness require investigation [7]. This would lead evidence to show the potential benefits of telerehabilitation, for both the patient and healthcare systems [7].

**Technology in Telerehabilitation:** Since technology plays a vast role in telerehabilitation, it is important to consider the technology and its usability [1]. Principles that are essential to address during development of a technology recommends that it should be equally be used by all, the technology should be user friendly and flexible, it should be simple and intuitive, it may have the ability to perceive information, have high tolerance for error, require a low physical effort, and should be approachable [1]. There are many types of technologies, text-based, audio-based, vision-based, virtual reality, web-based, and wireless integrated systems [1]. The selection of a remote rehabilitation system entails multiple decision factors. The technology should fit a clinic's budget, application purpose, and technical support structure. Very complex technology (i.e., consisting of multiple components, settings and/or connections)

may be associated to higher cost and a higher learning curve, which may ultimately result in technology abandonment and non-use of the system [1].

### Cost Benefit of Telerehabilitation

As telerehabilitation is a rapidly evolving field, there is a need to analyse the clinical outcomes and the cost associated with telerehabilitation. Cost-benefit analysis is a complex analysis which requires a background investigation of the current cost of care status of the area and then compares it with the expected cost of the development of the system to provide the same care with similar or improved outcomes [10]. The analysis is also required to measure the effective gains obtained by the system which had the cost [11]. Cost of telerehabilitation includes the cost of making such applications which are a pathway to telerehabilitation, cost of the tele technology like a smartphone or a computer, it also includes cost of the Internet service required to communicate and also the cost of professional services that is being acquired by telerehabilitation [11-13]. When face to face rehabilitation is taken into account, the cost of getting indulged in such rehabilitation would include the professional service of the rehabilitation therapist, the travel expense, the time spent in travelling which also indirectly accounts to money spent, family member of the caregiver travelling along with the patient also adds to the cost factor taking into consideration their time spend and effort utilised [11].

An earlier systematic review that analysed papers on telerehabilitation until February 2007 tried to find the cost-effectiveness in one of the outcome measures [4]. Twenty-eight articles were studied which dealt with community rehabilitation; neurological rehabilitation, cardiac rehabilitation, follow-up of individuals with spinal cord injuries, rehabilitation for speech-language impairments, and rehabilitation for varied clientele [4]. Clinical progression of patients showed marked improvement in their specific outcome measure following telerehabilitation [4]. The review concluded that the use of telerehabilitation gave a similar outcome as face to face consultation [4,14]. Clinical process outcomes, like regular attendance and compliance, were high with telerehabilitation [4]. Satisfaction with telerehabilitation was also consistently high and it was higher in patients than therapists [4]. Few studies examined healthcare utilisation measures and found some limited evidence of reduced cost using telerehabilitation [4]. Therefore, the study concluded that there is a potential for telerehabilitation to save cost in healthcare facility [4].

Rehabilitation is effective when the assessment and treatment are initiated at an early stage and completed with an appropriate and timely follow-up. Telerehabilitation, in many cases, may be effective in certain medical conditions only, for which expensive technology may be required to be adopted [15-17]. These technologies will increase the cost of healthcare which over a period of time may lead to inconsistent and irregular follow-up. Physiotherapy rehabilitation process involves multiple sessions of therapy to conduct exercise sessions, update exercises progressively, change the dosage of exercise with the current abilities, and measure functional outcome at regular intervals. Multiple follow-up sessions, if not cost-effective, can disrupt the regularity of follow-up. For the success of client's rehabilitation, the therapist should be responsible for the condition of the client, as they return to their usual living situations and home environment [18]. Unfortunately, once clients are discharged, it becomes difficult to obtain objective performance-based data about their functional status [6]. A systematic review recommended that a trained assistant or an interprofessional team member can facilitate and improve the telerehabilitation process [19]. The remote location of an attendant is often not a feasible method to be adopted as it has various disadvantages which could be confounding for rehabilitation. The disadvantages include not being able to replicate the exact exercise regimen taught by the consultant, communication barriers,

or interpretation skills. Apart from such barriers, the expense of hiring an assistant at a remote location would also increase the cost of rehabilitation.

In a research paper published in 2006 such cost of telerehabilitation was analysed [9]. The study tried to estimate the cost for therapist's salary, travelling cost and communication cost that is applicable for face to face delivery and telerehabilitation [9]. The research found that the mean cost for 12 sessions over four weeks was approximately \$100 less in telerehabilitation group therefore in comparison to home visit here they had hypothesised that the cost of telerehabilitation could be less [9]. In another study, an evaluation of cost was observed [20]. Patient after a cardiac surgery was allocated to hospital rehabilitation and ambulant rehabilitation (Telemedicine supervision). The cost of telemedicine included connectivity, leasing of bicycle ergometer, delivery and installation at the patient's home, cost of consultation, education as well as initial follow-up examination and travel estimate [20]. The results showed a reduction of 58% of the cost of telerehabilitation compared to inpatient rehabilitation [20]. The analysis of cost-benefit complex procedure has still not been adopted to find the actual cost-effectiveness of telerehabilitation. It still remains a future recommendation for studies as such analysis, though difficult, not impossible.

Introducing of a new concept and technology such as telerehabilitation into society and general healthcare practice needs to be scrutinised and analysed especially in terms of the cost and benefit associated with its use increasing its utilisation and acceptance.

**Validity and Reliability of Telerehabilitation:** Analysing the validity and reliability of telerehabilitation, low validity was found for shoulder and elbow joint assessment [21,22], nerve tests around the elbow [22], and postural evaluation of lumbar spine [23]. Scar assessment of the knee was not reliable [24]. Other measures for shoulder [21], elbow [22], lumbar [23,25], lower extremity [26], knee [24,27], and ankle [28] were reported to be valid and reliable for inter- and intra-rater reliability with the exception of the elbow. A systematic review published in 2017 the summarised physiotherapy assessments such as pain, swelling, range of motion, muscle strength, balance, gait, and functional assessment demonstrated good concurrent validity [18]. However, there was low to moderate concurrent validity of the assessment of spinal posture, special tests in orthopaedic condition, neurodynamic tests, and evaluation of scar [18]. The study suggested it was feasible to conduct telerehabilitation with good concurrent validity and excellent reliability [18].

**Telerehabilitation in Health Care Setting:** Telerehabilitation was explored in many population including stroke [29-31], total knee arthroplasty [8,32], shoulder [33], geriatric [5], and hand [34]. The function, disabilities, and other outcomes have shown promising results in the adoption of telerehabilitation in the healthcare setting. However, it's worth mentioning that the number of randomised control trial is limited and needs exploration in other population like hip conditions, fractures, soft tissue injuries of upper and lower extremity. Randomised control trials published in earlier articles were restricted to telerehabilitation use in stroke and total knee arthroplasty [8,29,35-37]. The effectiveness of telerehabilitation thus shows that total knee arthroplasty is considered a practical alternative to conventional face-to-face rehabilitation therapy [8]. Another meta-analysis showed that telerehabilitation for patients with cardiac conditions provided benefits similar to usual care with no adverse effects [38]. A systematic review of telerehabilitation in stroke care showed promising results; however, the quality of evidence on telerehabilitation in post-stroke care was low [29].

**Telerehabilitation Strategies Worldwide:** The eHealth Strategy for Scotland 2011-2017 reaffirms the pivotal role of telehealth and telecare technologies to radically transform the way healthcare is delivered to people of all ages across Scotland. There has been considerable progress in the last five years in Scotland in the development and deployment of telehealth and telecare [2]. In 2017,

the United States American Telemedicine Association published the principles for delivering telerehabilitation service [39,40]. The United States telerehabilitation Special Interest Group is comprised of healthcare practitioners and technology specialists who improve access to rehabilitation and habilitation services with technology and communication devices [39]. Blueprints of such principles were published in 2010 which describes the clinical, technical, and ethical considerations for telerehabilitation [40]. In both the association the members have made an effort to draw up an action plan, obtained funding from government and private sectors, improved the technology infrastructure, education, and training needed for telerehabilitation [1,39,40]. Thus, development of telerehabilitation was enhanced.

**Telerehabilitation in Developing Countries:** In developing countries, few attempts have been made to explore telerehabilitation as per the literature. Majority of the studies are published in Canada, Australia, United Kingdom, and the United States [2,39,40]. The quality of health has been shown to improve in such countries due to the tele incorporation.

Among the published article retrieved, A study done in India, in 2015, assessed feasibility and geriatric client's acceptance of telerehabilitation. It was found that home-based telerehabilitation can improve their outcomes and therefore, could be used as an adjunct approach [5]. This study included 22 elderly, and telerehabilitation was introduced by video conferencing via SKYPE [5]. Another article published in 2017 was a systematic review and meta-analysis to conclude that robust research is required in the musculoskeletal field in order to identify the effectiveness and cost-benefit of telerehabilitation. Studies conducted in India is therefore, very limited till date [19].

The global inclusion of telerehabilitation is still not evident in practice, especially in developing countries. As a fundamental right of all citizens to adequate health care, the health of Indian people has been given the highest priority in public policy [41]. In India, substantial barriers make healthcare services difficult to access in both urban and rural areas. Reduced access to appropriate healthcare is believed to be a reason for the higher rates of chronic health conditions [42]. Perhaps, the facility of technology, communication strategies, literacy and education level of people are the attributes which have not let telerehabilitation develop in developing countries like in India.

**Conceptual Thought Process Derivation:** This section of conceptual thought process will combine the knowledge of cost, technology to derive us to a conclusion of telerehabilitation inclusion in the community of developing countries. Telerehabilitation, although proven successful, is still limited in use. The conceptual shift in assessment and treatment practices required for telerehabilitation service raises the question of how a therapist would treat patients without examining the patient [7]. Although, there are multiple technologies that have evolved, the method to enable therapists to appreciate and quantify this movement is complex, and hence the assessment becomes questionable [7]. Many of the technical issues have been solved (use of image, sensors, etc.) however, there is a rising cost observed with the higher technology used in telerehabilitation [7]. It is therefore, important that a sustainable, realistic concept is built [7]. It is deemed that for a complete diagnosis; therefore, it is important for the therapist to be face-to-face with the patients. There is also a goal of the healthcare providers to achieve, to provide rehabilitation which is cost-effective [13]. Such means may not be solved by only indulging in telerehabilitation with technology alone, however it needs to be combined with a face-to-face consultation to optimise and complete the rehabilitation of a patient.

Incorporation of telerehabilitation along with face-to-face consultation will improve the quality of health services and reduce the out-of-pocket expenditure for patients [43].

## CONCLUSION

The combination of both processes of telerehabilitation along with face-to-face consultation will benefit the society by reaching out to the maximum number of people in need who cannot travel. Such a process will also benefit society who is unable to afford the cost of rehabilitation. Therefore, a telerehabilitation service incurring low bandwidth utilisation, low-cost technology product, simplified access and user-friendly application can make the field of telerehabilitation popular and effective in Indian settings. Telerehabilitation services should also be advertised in Indian setting for its successful implementation and use.

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