JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

TELEMEDICINE IN NEUROLOGICAL CARE: A FOCUSED REVIEW ON PARKINSONISM AND MULTIPLE SCLEROSIS

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ABSTRACT:

Telehealth, driven by rapid technological innovations, represents a transformative method for delivering medical care at a distance. This remote healthcare model is especially valuable for managing chronic neurological disorders such as Parkinson's disease and multiple sclerosis, where continuous monitoring and timely interventions are critical. Utilizing the Internet of Things (IoT) devices and artificial intelligence (AI)-powered tools, healthcare professionals can remotely track patients' symptoms, assess disease progression, and make data-driven decisions to tailor individualized treatment plans. These technologies not only facilitate early diagnosis and proactive care but also empower patients to engage more actively in managing their conditions. Despite existing barriers, such as high implementation costs, technological complexity, and potential disparities in digital access, telehealth demonstrates a promising potential to redefine neurological care. It offers enhanced accessibility, lowers the overall burden on healthcare systems, and ultimately contributes to improved clinical outcomes and quality of life for patients with neurological diseases.

Keywords: Telemedicine, Parkinsonism, Multiple Sclerosis.

INTRODUCTION:

A new introduction to patient-care services from a distance is powered through a technology-centered approach called telehealth/telemedicine. Telecommunication technology enables a new way to deliver focused care for patients suffering from minor ailments to manage major illnesses. (1). Telehealth is vastly applied in primary healthcare services (2) The target population can vary from pediatrics (3) to geriatrics. Technological advancements grant opportunities such as video calls, mobile health applications, remote monitoring systems &

several other routes bridging the gap to provide healthcare services remotely. (4) Various areas of employing telehealth services are assessing, diagnosing, and treating patients, and especially aiming at underserved areas can promise to increase healthcare delivery (5). Telemedicine has been practiced since the 1960s in various fields such as neurology, cardiology, dermatology, and psychiatry (6). A study notes that telemedicine consultations were 25% longer than in-person consultations (6) Telemedicine has been shown to provide promising results, although many articles highlight its inconsistent evidence (7)

A Study was conducted to evaluate the patient's experience of telemedicine which achieved a high satisfaction level, and was recorded in a research study aimed at learning about the patient's telehealth experience. According to this survey, about one-third of patients preferred telehealth visits over traditional in-person appointments. Meanwhile, nearly 60% of respondents found telehealth equally effective as conventional visits. The main reason for choosing telehealth was the shorter wait times, which was cited by over half of the respondents (8)

Telemedicine comes with its own set of advantages and disadvantages in society, some patients find it to be convenient, and there's also a population avoiding it altogether. Most patients found telehealth video visits to be user-friendly and were pleased with the communication during their appointments. Approximately 40% of patients expressed a preference for telehealth over traditional in-person clinic visits. (9) In this adherence study, Overall adherence was 76.7% for the video visit group and 72.5% for the control group, with no statistically significant difference (9) Patients without disabilities, chronic diseases, or handicaps were more likely to prefer face-to-face (F2F) appointments over video consultations (9). A population that was reluctant or denied the application of telemedicine belonged to older age and rural residents. (9)

In this review article, the effectiveness of telemedicine in various neurological diseases such as Parkinsonism, and Multiple sclerosis is discussed. Neurological diseases are conditions that affect the nervous system, which includes the brain, spinal cord, and nerves. These diseases can cause a wide range of symptoms, from mild to severe. After a period of diagnosis and initiation of treatment, regular follow-ups can be performed via telehealth.

TELEHEALTH IN PARKINSONISM:

Parkinsonism is a general term used to describe a group of neurological conditions that share similar symptoms to Parkinson's disease. These conditions can be caused by various factors, including Idiopathic Parkinson's disease & Drug-induced Parkinsonism. (10) A study compared the effectiveness of virtual reality (VR) and telerehabilitation (TR) in improving postural balance. Both VR and TR were found to be beneficial, with similar improvements to conventional therapy. However, high costs and the need for specialized equipment may limit their accessibility. Virtual Reality and Telerehabilitation, particularly when combined with video conferencing, allowed patients to continue balance training at home, even during the COVID-19 pandemic. This extended rehabilitation beyond the clinic, potentially leading to long-term benefits. While these technologies are effective, their accessibility may be hindered by financial and technological constraints. (11)

Virtual Reality telerehabilitation offers a promising option for PD patients, particularly those in rural areas or with limited access to in-person rehabilitation services, helping reduce healthcare

costs while maintaining effective postural rehabilitation at home. The study was a multicenter, single-blind, randomized controlled trial involving 76 Parkinson's disease (PD) patients. Participants were divided into two groups: one received in-home VR-based balance training using the Nintendo Wii Fit, while the other obtained in-clinic sensory integration balance training (SIBT). Both groups showed significant improvements in balance, as measured by the Berg Balance Scale (BBS). However, the VR group demonstrated slightly greater improvements compared to the SIBT group. While both VR and SIBT were equally effective in enhancing postural control, VR training provided the additional benefit of being more cost-effective, as it reduced the need for transportation and required fewer resources. The study suggests that home-based VR training can be a viable alternative to in-clinic therapy, especially during periods when in-person treatments may be limited, such as during a pandemic.

Machine learning and deep learning algorithms can analyze data from sensors to help diagnose Parkinson's disease (PD), track its progression, and personalize treatment plans. These algorithms can identify patterns in the data that may be missed by healthcare professionals, leading to more accurate diagnoses and treatments. Integrating AI and IoT into routine clinical care also presents challenges due to cost and complexity. However, the future holds potential for these technologies to transform PD care by enabling remote monitoring and personalized treatment plans (15)

TELEHEALTH IN MULTIPLE SCLEROSIS:

Multiple Sclerosis (MS) is a chronic autoimmune disease that affects the central nervous system, which includes the brain and spinal cord. In MS, the immune system attacks the myelin sheath, the protective covering that surrounds nerve fibers. This damage can disrupt communication between the brain and the rest of the body, leading to a wide range of symptoms.

Telehealth facilitates remote disability assessments and ongoing clinical research (16) Tools like accelerometers and gyroscopes are used to monitor mobility and track disease progression remotely (17,18) Telehealth was found to be effective in managing follow-up care and diagnosing MS relapses, with no significant delay in detecting disability progression (19) Multiple sclerosis care interventions can be made by incorporating a range of motion exercises into your routine. These exercises help maintain mobility and reduce complications like muscle stiffness and pain. Additionally, combining aerobic and resistance training can enhance overall health and quality of life. Aerobic exercises improve cardiovascular health, while resistance training preserves muscle strength. Telehealth can be a valuable tool for supervising these exercise programs, ensuring proper form and technique. (19) This telehealth can be accessed through Wearable devices like heart rate monitors, pulse oximeters, and spirometers.

The need to implement telemedicine in chronic neurological disorders spiked due to the vastly known global COVID-19 pandemic (20) This change brought Patient empowerment and adaptation, with long-term benefits highlighting the potential of telehealth efficacy in managing chronic illnesses. (21) However, barriers to telehealth create a major gap between the patient's needs and the care provided (22) These matters must be looked into to better the health care status (23)

DISCUSSION:

The integration of telehealth into the management of chronic neurological conditions like Parkinsonism and Multiple Sclerosis (MS) has gained significant momentum in recent years, particularly in response to the COVID-19 pandemic. This shift toward remote care delivery has opened up new opportunities to enhance patient engagement, accessibility, and clinical outcomes. The evidence presented in this review supports the growing role of digital tools such as virtual reality (VR), telerehabilitation (TR), artificial intelligence (AI), and wearable devices in managing these complex disorders.

In Parkinsonism, VR and TR have shown comparable efficacy to traditional in-clinic therapies in improving postural balance. Notably, home-based interventions using accessible gaming technology like the Nintendo Wii Fit provided not only clinical benefits but also logistical and economic advantages—especially relevant for patients living in remote or underserved areas. These findings emphasize the need to reframe rehabilitation as a flexible, home-centered practice rather than one confined to physical clinics.

Meanwhile, AI and IoT technologies offer promising avenues for advancing Parkinson's care through real-time monitoring, early diagnosis, and treatment personalization. These tools can process large amounts of patient-generated data, identifying subtle clinical trends that may escape human observation. However, their full integration into clinical practice remains hindered by challenges related to cost, data security, and clinician training.

For MS patients, telehealth has enabled more consistent monitoring of disease progression and better continuity of care, particularly through the use of sensors and wearable devices. Furthermore, supervised home-based exercise programs—delivered via telehealth—support both symptom management and quality of life. Despite the clear benefits, gaps in access to technology and digital literacy persist, limiting the scalability of these interventions across diverse populations.

The pandemic has served as a crucial inflection point, forcing healthcare systems to adopt telemedicine platforms rapidly. This transition highlighted both the strengths and shortcomings of digital healthcare infrastructure. While patient empowerment and increased access to care were notable positives, disparities in internet access, digital tools, and socioeconomic resources remain substantial barriers to equitable care.

Overall, the evidence suggests that while telehealth and emerging technologies are effective and increasingly indispensable in neurological care, their success depends heavily on systemic support, infrastructure development, and eliminating barriers to access. Future efforts must prioritize refining these technologies, training healthcare providers, and policy development to support widespread, sustainable implementation.

CONCLUSION:

Telehealth, enabled by technology, provides a convenient and accessible way to deliver healthcare services remotely. It's especially beneficial for neurological conditions like Parkinson's and MS. By using devices like IoT sensors and AI algorithms, healthcare providers can monitor patients, diagnose conditions, and personalize treatment plans. While there are

challenges to overcome, telehealth has the potential to improve access to care, reduce costs, and enhance patient outcomes.

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