Systematic review and meta-analysis of a nurse-led telehealth intervention for rehabilitation (telerehabilitation) in patients with chronic diseases.

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Abstract

Telenursing is a component of telemedicine where nurses use information and communications technology to care for patients' health needs. Chronic illnesses are exerting significant strain on healthcare systems. Nurses are acknowledged as skilled healthcare personnel that deliver thorough care to patients during the recovery process following hospitalization. Recently, telerehabilitation has provided nurses with a new method to remotely treat chronic diseases. It is uncertain which chronic disease patients gain the most from this new approach.

Keywords: Telenursing, Care, Chronic Disease, Technology, Nurse.

Introduction

Telehealth is the provision of health services using technology when there is a physical distance between healthcare practitioners and patients. [1] Telerehabilitation is a type of telemedicine that utilizes a telehealth method to deliver rehabilitation therapy to individuals with chronic conditions. [2] Telerehabilitation programs utilize communication and information technology, like telephones and videoconferencing, to deliver exercise training, self-management education, and health behavior modifications to patients with chronic diseases not in hospital care. [3, 4] Telerehabilitation, while convenient, has drawbacks including technical challenges, constraints on physical treatments, and security breaches.

Several systematic studies have been recently published on the efficacy of telerehabilitation programs for individuals with various chronic diseases such as cardiac diseases, respiratory diseases, stroke, or neurological diseases. A prior systematic study indicated a debate on the efficacy of telerehabilitation and its varying effects based on the specific chronic disease being treated. [5] No reviews have been published regarding which chronic disease patients might benefit the most from telerehabilitation programs. This evaluation aims to fill research and service gaps by comparing the effectiveness of telerehabilitation programs on individuals with various chronic conditions. If the findings are successful, they can assist the government and policymakers in efficiently distributing health care resources, promoting the creation of telerehabilitation programs during and after the COVID-19 epidemic, and enhancing the quality of community care services.

The review aims to identify the intervention components of current nurse-led telerehabilitation programs for community-dwelling individuals with chronic diseases, assess the effectiveness of nurse-led telerehabilitation programs in comparison to traditional face-to-face rehabilitation programs, and compare the impacts of telerehabilitation on patients with various chronic diseases.

Telenursing is a crucial aspect of telemedicine, providing continuous care for patients with
chronic conditions using information and communications technology (ICT). [6] It offers high-quality care without long trips and low travel costs. Telenursing can be provided through monitoring systems, the Internet, video, telephone, email, and video images. [7] The telephone is a simple device that is excessively used, but more than 36 million Americans use it. [8]

The global population is changing due to advances in medical knowledge and technologies, increasing life expectancy and increasing the number of the elderly. In the next 40 years, the world's population over 65 will double, with 52% in Asian countries and 40% in advanced countries. This has led to an aging phenomenon, with about 600 million elderly people living in the world, reaching 2.1 billion in 2025 and 2 billion in 2050. [9]

Telenursing is used in various populations, including chronic diseases, aging, children, rural populations, sanitation and emergency centers, and specialized clinics. The increased scientific knowledge of nurses in telenursing helps them help patients target their self-care and function levels. [10]

This study aims to introduce telenursing as a method of nursing care and its effect on the control of chronic diseases in Guilan, the eldest province. As chronic diseases are increasing, particularly in the elderly, the use of telecommunication technologies, especially the telephone, is cost-effective for tracking and caring for these diseases.

Method:

Literature Search:

Two independent reviewers (AYLL and AKCW) conducted the literature search without librarian assistance. A systematic search was conducted on PubMed, MEDLINE, CINAHL, Embase, PsycInfo, and the Cochrane Central Register of Controlled Trials for publications published between 2015 and 2021 to identify the latest telerehabilitation approaches among rapid technical advancements. Handsearching was conducted by utilizing Google Scholar and the bibliographies of the selected papers. Gray literature, such as abstracts and editorials, was eliminated because most of these papers are not peer-reviewed, which would have decreased the quality of evidence. Search algorithms for all databases were developed using key search phrases such as "telerehabilitation," "chronic disease," "nursing," "multi-disciplinary," and "randomized controlled trial." The search was broadened by including several chronic conditions and medical subject headings.

Search Selection Strategy:

We searched for the Persian keywords and their English equivalents "Telenursing", "Care", "Chronic", "Technology", and "Nurse" in Mesh, as well as combinations of them, in various databases including Scientific Information Database (SID), Magiran, Irandoc, Web of Sciences, Scopus, PubMed, Cochrane, Online Library Wiley, CINHAL, and Google Scholar up to the year 2018. Furthermore, a manual search was conducted to find further published papers. All internal and external documents were thoroughly examined across all databases and reference websites. Out of 250 papers reviewed, 15 met the inclusion criteria and were chosen for analysis. Among these, eight were in Persian and seven were in English. The process for selecting the papers is displayed in figure 1.
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Data Extraction:

The subsequent variables were extracted and are enumerated. Multimedia Appendix 1 includes details such as author, publication year, study location, study population, intervention characteristics, data collecting timepoint, outcome variables, measures, and results. The interventions from all studies were extracted based on the chronic care model. The model consists of six components: (1) interactive communication between an informed patient and proactive healthcare providers; (2) self-management support during communication; (3) a well-designed delivery system with regular follow-ups for evaluation; (4) decision support from expertise, protocols, or training; (5) a clinical information system for managing patients’ data; and (6) community resources.[11]

Existing strategies and interventions to address these challenges:

A variety of strategies and interventions have been proposed and implemented to mitigate nursing workforce challenges. These may include recruitment initiatives such as scholarships, loan forgiveness programs, and targeted marketing campaigns to attract individuals to the nursing profession. Retention efforts may involve improving working conditions, offering flexible scheduling options, providing access to professional development opportunities, and implementing support programs for nurse well-being. Additionally, organizational interventions such as leadership training, mentorship programs, and collaborative practice models have shown promise in enhancing nurse satisfaction and reducing turnover. Policymakers and healthcare leaders must continue to evaluate and refine these strategies based on empirical evidence and best practices to ensure their effectiveness in addressing workforce challenges over the long term.(7)

Results:

Out of the 15 studies reviewed, one study focused on patients who had undergone heart valve replacement surgery. Seven studies investigated the impact of telenursing on diabetes control (46%), while three studies (20%) involved cancer patients, including 2 with breast cancer and 1 with lung cancer. One study investigated the impact of telenursing on self-confidence in patients with chronic lung obstruction, while another study focused on the
influence of telenursing on self-efficacy in older individuals with hypertension. All research focused on nursing interventions such training, empowerment, and follow-up programs conducted by telephone, mobile, or video chat, without providing medical treatment to the patients. Zakerimoghadam et al. conducted a semi-experimental study to examine the impact of telenursing on diabetic diet compliance in type 2 diabetes patients. Data analysis involved descriptive statistics and statistical tests like chi-square, independent t-test, and paired t-test in SPSS 13. A Chi-square test indicated a statistically significant difference (P = 0.035) in adherence to the diet between the two intervention and control groups after the intervention. An independent t-test revealed a statistically significant difference (P < 0.001) for levels of hemoglobin between the two groups after the intervention. The study demonstrated that a nurse's telephone follow-up enhanced adherence to a diabetic diet and lowered hemoglobin glycosylated levels in individuals with type 2 diabetes. [9] Sadeghi et al.'s study compared the impact of telephone and SMS follow-up on the quality of the life of patients post heart valve replacement surgery. The study found that the quality of life scores decreased after intervention in all three follow-up groups (telephone, SMS, and control) with a significance level of P = 0.027, indicating an improvement in quality of life. However, ANOVA analysis revealed no significant differences in quality of life scores between the groups before and after the intervention (P < 0.001). [12] Shojaie et al. conducted a study to examine how patient education and telephone follow-up by a nurse impact remission, anxiety, and hope in patients with heart failure. The study demonstrated a notable decrease in the quantity of hospitals, clinics, and hospital visits among the groups, with statistical significance indicated by P values of 0.006, 0.000, and 0.000. Prior to the intervention, there was no statistically significant variance in anxiety means among the three groups (P = 0.168). Following the intervention, there was a notable variance in anxiety levels across the three groups (P = 0.000). No significant differences were seen among the three groups in hopefulness before the intervention (P = 0.354). There was a notable disparity in the interpretations of hopefulness across the three groups (P = 0.004).[13] The study conducted by Imani et al. titled "The effect of nursing informing through telenursing on the family anxiety level in patients admitted to the intensive care unit" was a semi-experimental study. The Wilcoxon test indicated a significant difference in anxiety levels before and after each call and at the end of the intervention (P < 0.001). The initial mean anxiety level in the samples was 71.47, which fell to 69.35 after the telephone intervention. Prior to telephone intervention, the highest average anxiety level was seen in men (P < 0.001). However, following the intervention, this average shifted to women (P < 0.001).[14] Wong et al. conducted a study named "The effect of telephone follow-up by nurses on the degree of self-esteem of patients with chronic obstructive pulmonary disease" in Hong Kong. The study demonstrated a notable rise in self-esteem scores in the intervention group during the post-test compared to the pretest (P < 0.01). Nevertheless, there was no notable rise in self-esteem scores in the control group.

There was a notable difference in the total self-esteem score between the two groups in the post-test (P = 0.03). A notable disparity was observed in the frequency of participants visiting the emergency room for respiratory issues between the intervention and control groups during the three-month period (P = 0.03). There were no significant changes in the number of hospitalizations due to respiratory issues between the two groups (P = 0.18). The study's findings indicated that telenursing was beneficial in enhancing the self-efficacy of patients with chronic obstructive pulmonary disease. Fakharzadeh et al. conducted a study to investigate the impact of telenursing on glycosylated hemoglobin and anthropometric indicators in patients with type 2 diabetes. The study found that the average glycosylated hemoglobin and body mass index (BMI) in the case group reduced significantly after the intervention compared to before the intervention (P > 0.05). In contrast, there were no significant differences in the control group (P < 0.05). There was no significant difference in the mean waist-to-hip ratio before and after intervention in both the case and control groups (P = 0.70 and P = 0.40, respectively). The findings indicated that telenursing was beneficial in controlling hyperglycemia.[15] Behzad et al. conducted a study to investigate the impact of a telenursing-based empowerment program on self-efficacy in older individuals with hypertension. The independent t-test results indicated that there was no statistically significant difference in self-efficacy levels before intervention between the test and control groups (P = 0.44). There was a notable disparity in self-efficacy levels
between the test and control groups following the intervention (P = 0.001). The study's findings indicated that telephone treatments, often known as telenursing, can enhance the efficacy of elderly individuals. Tricia et al. (2014) did a study to implement telephone follow-up (telenursing) by nurses for patients with lung cancer. The results demonstrated the successful implementation and practicality of telenursing in remote regions. Telenursing improved satisfaction and reduced symptoms in lung cancer patients while enhancing their mental well-being. Patients experienced varying degrees of improvement in dyspnea, fatigue, limitations in daily activities, pain, cough, difficulty in movement and walking, anxiety and frustration, and appetite after receiving telenursing intervention. The study findings indicated that telenursing technology was beneficial in alleviating symptoms of sickness, enhancing mental well-being, and teaching self-care practices. Chamany et al. implemented a telephone intervention to enhance diabetes management. The findings suggested that a telephone interview could effectively aid in promoting diabetes control.

Tavşanlı et al. researched the utilization of telenursing video technology to manage blood sugar levels in diabetic patients. This association was statistically significant. The study demonstrated that ocular contact can be beneficial in regulating blood glucose levels (26). Hoyer et al. undertook a study to investigate the impact of nurse telephone follow-up on the quality of life of women with breast cancer post radiation therapy. Following the analysis, a notable disparity was observed between the control group and the experimental group regarding their quality of life. Kimman et al. did a study titled "The effect of telephone follow-up by the nurse on patient satisfaction after treatment of breast cancer in the Netherlands.” The study results indicated a notable disparity in satisfaction levels between the control and case groups. Borhani et al. conducted a study on the impact of telecommunications nursing, namely a mobile application program, on glycosylated blood glucose levels in patients diagnosed with type 2 diabetes. Sadeghi et al. did a study named “The effect of nurse telephone follow-up on glycosylated hemoglobin in diabetic patients.” The study has shown that telenursing follow-up decreases glycosylated hemoglobin levels in diabetic patients, proving to be an effective method for managing hyperglycemia. Kim and Kim investigated the efficacy of cell phones and the Internet in managing type 2 diabetes in obese patients in Korea. The study aimed to investigate the impact of telephone follow-up on weight loss and the maintenance of blood sugar levels within a normal range.

Medical Check-Ups

32 studies implemented telerehabilitation programs using telephone (n=26), videoconferencing (n=4), SMS text messaging (n=2), or WhatsApp (n=1). (Multimedia Appendix 3.

The nurse-led counseling sessions were primarily conducted on a weekly basis (n=4), monthly basis (n=5), or a combination of both (n=7). Seven studies failed to disclose the frequency of their interventions. The nursing follow-up involved educating patients on disease-specific information such as COPD exacerbation and hypoglycemia, promoting self-care behaviors like medication adherence and lifestyle changes, addressing patient inquiries on disease self-management, monitoring signs and symptoms, conducting motivational interviews, adjusting medication in collaboration with physicians, assisting in goal-setting and personal plan implementation, and offering psychological support.

Two studies, based on problem-solving theory, endorsed chronic disease rehabilitation through the creation of behavioral strategies and the use of positive reinforcement in nurse-led phone counseling sessions [18]. Two other studies utilized noninteractive informational SMS texts and/or interactive SMS texts with nurses to deliver instruction on chronic disease management and assistance with disease monitoring.[19]

Telemonitoring

Nine studies incorporated telemonitoring into their telerehabilitation program for patients with heart failure, asthma, COPD, or diabetes [11]. (Appendix 4 in multimedia. Patients were directed to monitor disease-specific physical indicators such as blood pressure, spirometry, oxygen saturation, respiratory rate, and blood glucose level. They were asked to document their signs and symptoms either daily (n=5), weekly (n=1), or transitioning from daily to weekly after the initial weeks of interventions
The data were transferred to a common platform through manual input using tablet and mobile apps (n=3), automatic transmission from measuring devices to tablet (n=2), or SMS messages (n=1). Alerts were automatically delivered to nurses in 7 studies when decision-support systems recognized aberrant data. The decision-support systems were developed based on research procedure with a sample size of 5 or through collaborative decision-making with patients, involving 2 cases. The nurses would provide support to the alerted patients through ongoing telephone follow-up (n=6), videoconferencing (n=2), or by recommending them to physicians (n=1).

Additional Telerehabilitation Interventions
In addition to nurse follow-ups and telemonitoring, four research utilized smartphone apps to aid in chronic illness rehabilitation inside the community [11]. These apps typically offer multimedia educational content, health behavior tracking, psychological support, chat features, and discussion forums for nurse counseling. Two studies created a website to offer educational resources on cardiac self-management and to track patients’ health through online health surveys. Furthermore, a study offered online fitness therapy to individuals with heart failure via videoconferencing.

Discussion

Key Findings
Due to limited resources in hospitals and the COVID-19 pandemic, telerehabilitation appears to be a feasible method for providing ongoing care from healthcare experts to those with chronic illnesses. Patients with chronic disease showed a notable enhancement in their quality of life and self-care skills following nurse-led telerehabilitation, as opposed to those who underwent traditional in-person rehabilitation, as indicated by this meta-analysis. The enhancements could be attributed to an augmentation in individuals' understanding of monitoring their symptoms and their proficiency in conducting clinical evaluations independently following their involvement in a nurse-led telerehabilitation program [20,21]. Previous reviews focusing on patients living in the community showed comparable outcomes in individuals with heart failure, COPD, or cancer. Therefore, based on these results, telerehabilitation programs can be utilized in community-based rehabilitation services, particularly during the ongoing COVID-19 pandemic. The impact of telerehabilitation on the psychological health and hospital admission of patients with chronic disease is not well-established, despite its known benefits for improving quality of life and self-care ability. An earlier study examining nurse-led telerehabilitation programs discovered a notable enhancement in anxiety and despair levels in COPD patients. However, several research found that telerehabilitation did not have a substantial effect on the psychological well-being of individuals with chronic diseases. Furthermore, the impact of telerehabilitation on decreasing health resource utilization differed in prior investigations. A prior comprehensive analysis failed to demonstrate the efficacy of telerehabilitation in reducing hospitalization rates in patients with heart failure [22]. Some reviews reported a notable decrease in unplanned hospital admissions [23] and visits to the emergency department [56]. However, some studies found no notable disparities in health-resource utilization among older adults living in the community, individuals with diabetes, or those suffering from heart failure. The varied results could be due to discrepancies in the patients’ characteristics and the therapies used in their nurse-led rehabilitation programs.

Nurse telephone follow-ups were identified as the predominant intervention component in nurse-led telerehabilitation programs, aligning with a prior study’s results [24]. Telephone follow-ups were considered the most convenient method for inquiring about disease self-management from healthcare experts, without the need for advanced equipment. Telemonitoring, commonly utilized in telerehabilitation programs, was considered the least preferred by patients due to frequent technical challenges encountered during data transmission via wireless devices. The patients were worried about the precision of the equipment utilized for monitoring vital signs at home and the worn sensor. Furthermore, the common causes for noncompliance in self-monitoring included the incapacity to utilize monitoring technologies and evaluate their own health data [25]. Telemonitoring is more effectively carried out when patients receive thorough preintervention nursing education or
training sessions to become acquainted with the technical devices. Future study should enhance the telemonitoring system's quality by focusing on stability, accuracy, and security to boost patients' trust in telemonitoring.

Rehabilitation programs should not be exclusively delivered through telecare, notwithstanding its advantages. Insufficient physical engagement can hinder the development of a trusting nurse-patient relationship, resulting in decreased patient satisfaction. Telerehabilitation could potentially elevate patients' anxiety and despair levels because of their lack of familiarity with technology. Patients with chronic conditions may require frequent in-person nurse consultations to address issues that arise during telerehabilitation. Combining telerehabilitation with in-person consultations enables more thorough nurse evaluations and physical examinations to take place [26].

Following the chronic care approach, this study discovered that all research examined involved consistent two-way communication between patients and proactive healthcare practitioners. Some studies did not offer evidence-based guidelines for nurses to follow when aberrant findings or acute problems were detected, potentially resulting in inaccurate clinical judgement and unnecessary hospital admissions. Health care professionals should be provided with a dependable guideline before starting telerehabilitation programs.

With the rapid rate of technological advancement, more sophisticated decision support systems can be enhanced using artificial intelligence (AI) [27]. Various decision support systems have been created in recent studies to aid in the management of chronic diseases, mostly focusing on diagnosis, follow-up care, and treatment. An AI-driven decision support system was developed in a prior study to improve collaborative decision-making in the medication regimen for diabetes patients. This AI system utilizes patients' clinical data to create drug regimens, providing detailed information on success rate predictions, risks, benefits, and medication expenses. A different research project utilized a machine-learning decision support system in telemonitoring to forecast the likelihood of acute asthma worsening based on patients' self-reported symptoms. Nurses were promptly alerted when anomalies were identified.

Clinical information systems are a crucial element in nurse-led telerehabilitation programs, along with decision support systems, within the chronic care model. The absence of a unified clinical information system among healthcare practitioners has been proven to elevate the likelihood of medical errors [28]. Technology enables the electronic sharing of health records between patients and healthcare professionals or among other healthcare specialties. Research indicates that incorporating electronic health records into community-based chronic illness care can significantly enhance patients' health outcomes and the quality of health care services. Electronic health records are commonly utilized and evaluated, although they mostly provide objective physical signs like blood glucose levels and radiology results. Recent research has started to enable patients to input their subjective health concerns, like symptoms and physical activity, into electronic health records. However, there are worries about data privacy issues when patients' personal information is uploaded and maintained online. Future research should focus on creating a cloud platform with an enhanced security system to avoid unauthorized access to patient health data [29]. Policy makers should restrict the preservation and transfer of patient health information to third parties for medical follow-up and referral to safeguard data privacy.

Chronic disorders may lead to functional impairment, which may hinder patients' ability to adjust to telerehabilitation. Research indicates that patients with more severe physical disabilities are less inclined to adhere to a telerehabilitation program compared to those with milder disabilities [25,30]. For better adherence, sufficient training before intervention is required on illness self-management and the utilization of technology equipment [79]. Past studies indicated that cardiac diseases, chronic respiratory diseases, and stroke are more likely to result in greater functional disability in patients compared to hypertension, diabetes, and cancer. This can hinder their participation in telerehabilitation programs. The physical indicators, such as COPD exacerbation and physical disability level, did not show significant improvement in patients with cardiac diseases, chronic respiratory diseases, or stroke after taking part in a nurse-led telerehabilitation program, as discussed in this review.
Therefore, it is recommended that caregivers participate in helping these patients to actively participate in telerehabilitation programs.

**Conclusion:**

The meta-analysis indicated that the programs resulted in a notable enhancement in the quality of life and self-care skills of patients with chronic diseases. However, they did not outperform traditional in-person consultations in addressing anxiety, depression, or reducing hospital admissions. The review indicated that utilizing decision support and clinical information systems can help nurses in telerehabilitation programs, following the chronic care paradigm. Furthermore, there is a lack of research on the efficacy of telerehabilitation programs for patients with several chronic conditions, despite the prevalence of multimorbidity. Subsequent studies could investigate the application of telerehabilitation in this patient population. Analysis of the research indicates that telenursing has effectively altered the symptoms associated with patients' health. Telenursing technology can be utilized in clinical settings to improve mental health and education and encourage self-care practices.
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