Effectiveness of Telemedicine in Managing Chronic Conditions Such As Diabetes and Hypertension: A Systematic Review

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Effectiveness of Telemedicine in Managing Chronic Conditions Such As Diabetes and Hypertension: A Systematic Review

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Abstract

Background: Telemedicine, the practice of using telecommunication technology to provide remote medical care, has become a crucial tool in the healthcare sector. It allows patients to receive medical consultations and monitoring from the comfort of their homes, bridging the gap between care providers and patients. Telemedicine has proven particularly useful in treating chronic diseases, which are among the leading causes of death worldwide and require regular monitoring and effective management. According to Crossen, chronic conditions are increasingly prevalent due to factors such as poor lifestyle behaviors. These diseases often require continuous medical attention to prevent severe complications, making it challenging for patients to maintain good health without frequent visits to healthcare facilities. Patients with chronic conditions, such as heart disease, face a high risk of rapid disease progression, potentially leading to permanent damage or death. Before the pandemic, these patients often had to exert significant effort to stay close to their healthcare providers. As noted by Ma et al., the need for regular monitoring and management means that these patients spend a considerable amount of time in medical facilities.

Objective: This study assesses the effectiveness of telemedicine in managing chronic health conditions, particularly diabetes and hypertension, focusing on health outcomes, patient engagement, and cost-effectiveness.

Methods: The study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards.
I conducted a thorough search of databases such as PubMed and Google Scholar. Over 200 abstracts were screened for relevance and timeliness before we settled on 15 articles for the final review.

Results: We found that telemedicine greatly improved clinical outcomes as well as risk factor control in diabetes (10 out of 15 articles) and hypertension (8 out of the 15 articles) patients. Telemedicine also significantly enhanced patient engagement and satisfaction (7 out of 15 articles), to the extent that patients reported greater satisfaction with telemedicine than the traditional forms of medical management. However, technological barriers and the need for tailored interventions pose challenges to patient engagement and satisfaction.

Conclusions: Telemedicine has been proven to significantly improve health outcomes and patient satisfaction when it comes to the management of chronic conditions such as diabetes and hypertension. However, further research is needed to address the challenges associated with telemedicine. Clinical Trial: n/a

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Main Outcome Measures: The main outcome measures were improved chronic conditions, patient engagement, patient satisfaction, and cost-effectiveness.

Results: We found that telemedicine greatly improved clinical outcomes as well as risk factor control in diabetes (10 out of 15 articles) and hypertension (8 out of the 15 articles) patients. Telemedicine also significantly enhanced patient engagement and satisfaction (7 out of 15 articles), to the extent that patients reported greater satisfaction with telemedicine than the traditional forms of medical management. However, technological barriers and the need for tailored interventions pose challenges to patient engagement and satisfaction.

Conclusion: Telemedicine has been proven to significantly improve health outcomes and patient satisfaction when it comes to the management of chronic conditions such as diabetes and hypertension. However, further research is needed to address the challenges associated with telemedicine.

Keywords: telemedicine, chronic diseases, diabetes management, hypertension management, patient satisfaction, patient engagement, cost-effectiveness, health outcomes

Introduction

Telemedicine, the practice of using telecommunication technology to provide remote medical care, has become a crucial tool in the healthcare sector. It allows patients to receive medical consultations and monitoring from the comfort of their homes, bridging the gap between care

providers and patients. Telemedicine has proven particularly useful in treating chronic diseases, which are among the leading causes of death worldwide and require regular monitoring and effective management. According to Crossen, chronic conditions are increasingly prevalent due to factors such as poor lifestyle behaviors.[4] These diseases often require continuous medical attention to prevent severe complications, making it challenging for patients to maintain good health without frequent visits to healthcare facilities. Patients with chronic conditions, such as heart disease, face a high risk of rapid disease progression, potentially leading to permanent damage or death. Before the pandemic, these patients often had to exert significant effort to stay close to their healthcare providers. As noted by Ma et al., the need for regular monitoring and management means that these patients spend a considerable amount of time in medical facilities.[11]

The COVID-19 pandemic posed additional challenges, making it difficult for patients to access healthcare services due to increased demand and the risks associated with the virus. Citoni found that the inability to maintain proximity to healthcare providers during this time resulted in poor management of chronic conditions, further exacerbating patients' health issues.[2] Accordingly, telemedicine proved to be a vital service during this period, offering patients with chronic diseases a way to receive continuous care and monitoring without the need for frequent in-person visits. This approach not only ensured better disease management but also helped reduce the burden on healthcare facilities. As the world continues to face a high prevalence of chronic diseases, the role of telemedicine in providing timely and effective care remains indispensable.

The pandemic made it crucial for care providers, patients with chronic conditions, and other health stakeholders to find ways of monitoring and managing these conditions without exposing the patients to more risks. While telemedicine existed before COVID-19, it only came to light as one of the best alternatives to traditional methods of managing chronic conditions thanks to the pandemic.[4] Telehealth interventions emerged as a great relief for patients, allowing them to monitor and manage their conditions from the comfort of their homes.[5] Telemedicine has many benefits, especially for

patients in remote areas, who would normally spend considerable time, resources, and energy just to get the care services they need. It was also a relief, since these patients did not have to worry about choosing to either compromise their health by going to the hospital amidst the pandemic or by failing to carry out proper monitoring and management. Telemedicine presented a third option that the world did not know it needed. While telemedicine has become a critical tool across various health sectors, its role in the management of chronic conditions is particularly invaluable.[5] However, there are still gaps in its implementation, such as unequal access to technology, varying levels of digital literacy among patients, and the need for more robust data security measures.

The primary objective of this study was to evaluate the existing literature on telemedicine and its effectiveness in managing chronic conditions, focusing principally on clinical outcomes, patient engagement, and the cost-effectiveness of these telehealth services. While various researchers have set out to determine the impact of telemedicine on chronic conditions, their studies have yielded mixed results, necessitating the need for a comprehensive review that will help synthesize the findings from these previous studies, while identifying areas for future research. The effectiveness of telemedicine was evaluated using quality measures such as patient engagement and satisfaction, health outcomes, and cost-effectiveness.

Methods

A comprehensive search was performed in databases such as PubMed, ScienceDirect, and Google Scholar to identify the most suitable peer-reviewed articles to study in this systematic review. The search was performed using the keywords such as “telemedicine,” “telehealth interventions,” “hypertension management,” “diabetes management,” and “chronic disease management.” In these databases, “telehealth” is not a very common term, and searching for telehealth interventions mainly brought up articles on telemedicine which worked perfectly for this study. More than 200 articles were extracted out after combining some of these key terms to bring out more relevant articles (see **Fig 1**). These articles were filtered to ensure that only the papers that fit the eligibility criteria were

included.

Eligibility Criteria

To be eligible, the articles must have:

- focused on telemedicine applications
- been published between August 2019 and March 2024
- focused on the management of chronic conditions, particularly diabetes and hypertension
- recruited participants aged 18 years and above who were diagnosed with chronic diseases such as diabetes and hypertension.
- In terms of outcomes, the included had to measure at least one of the following outcomes quantitatively: improved chronic conditions, patient engagement, patient satisfaction, chronic disease management, or cost-effectiveness.

Exclusion Criteria

Studies were excluded from this systematic review for any of the following reasons:

- Unavailability of full-text
- Non-randomized controlled trial (RCT) study design was used, including study protocols, secondary analyses of RCT results, scoping analyses, systematic reviews, or meta-analyses.
- Chronic condition management interventions were conducted that did not meet the Telehealth Chronic Disease Management System standards. This mainly included studies that did not use remote monitoring or other health management functionalities.
- The studies reported insufficient outcome data.
- The studies recruited an ineligible patient populations.

Data Extraction

The data were extracted from these articles based on several key criteria.

Study Characteristics: The data first key features of the the authors, year of publication, and

study design. It was important to include articles that used various study designs such as the systematic reviews, RCTS, retrospective studies, and longitudinal studies. . This was done to help ensure that the findings of the study were sufficiently comprehensive. In addition, data were extracted from articles published between 2019 and March 2024, since telemedicine was not widely known or embraced as a vital health tool before then.

Participant demographics: The articles were chosen based on the kinds of participants included in the research. For this review, the participants had to be 18 years old and above. The participants also had to be patients who suffered from chronic conditions such as diabetes and hypertension, which are the focus of the study. These participants also had to have some experience with telemedicine. However, gender, race/tribe, and cultural background were not considered when choosing articles for this review.

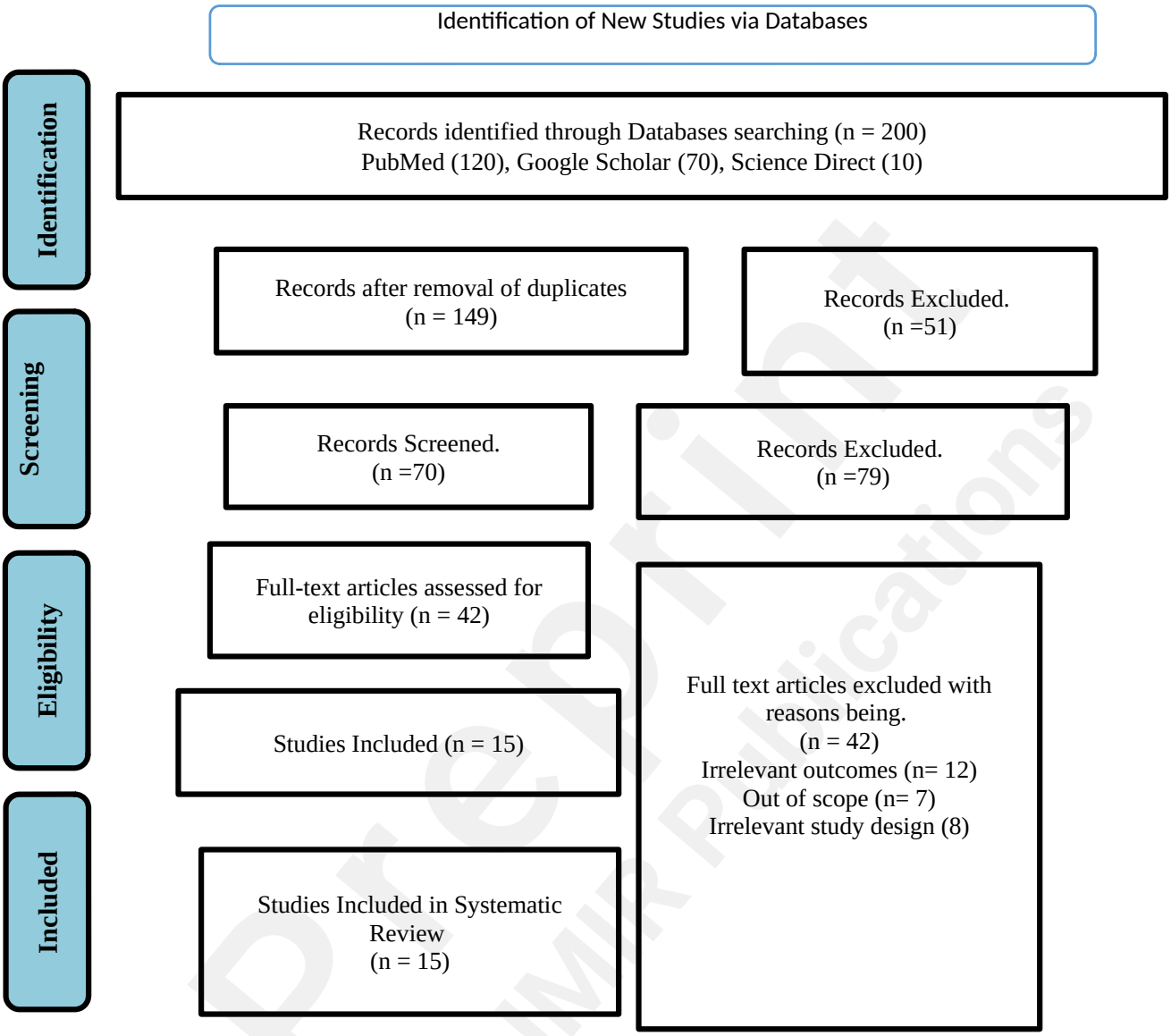
Telemedicine techniques used: The articles were chosen based on the different telehealth techniques employed. These include remote monitoring devices and video consultations.

Outcomes measured: The outcomes measured were considered when choosing the articles.. These outcomes included blood pressure (BP) control (for hypertensive patients), glycemic control (for diabetic patients), evolution in treatingf chronic diseases, and patient adherence. Potential discrepancies were minimized by strictly adhering to the inclusion and exclusion criteria. Any uncertainties and ambiguities encountered during the data extraction process were documented and reviewed to ensure consistency in the extracted information.

Quality Assessment

The quality of the findings from the chosen articles was evaluated using well-established criteria appropriate for each study design. For instance, the Cochrane Risk of Bias tool was used for the RCTs while the Newcastle-Ottawa Scale was used for cohort studies. The quality assessment considered the study design used, selection of the participants, and data collection and analysis methods. Fifteen peer-reviewed articles were ultimately selected after filtering and screening search

results. Below is a summary of the selected sources.



Results

The PRISMA diagram illustrates the process of identifying, screening, and selecting studies for inclusion in the review. Initially, 236 records were identified through database searches. After removing 18 duplicate records218 papers were screened. Of these, 143 were excluded based on the title and abstract review, leaving 75 full-text articles to be assessed for eligibility. Following the full-text review, 62 articles were excluded for various reasons, resulting in 15 studies that met the criteria

and were included in the final review. Fifteen articles were chosen after manually going through every abstract to ensure that only the relevant articles were chosen. These studies used different study designs such as RCTs [15, 12], observational studies [3], retrospective analyses [6,9,13] as well as systematic reviews [11,14]. The selected studies were carried out in diverse geographical locations such as North America[4,5,6,8], Latin America[1], and Asia [7,9,11,14]. These articles therefore reflect the global diversity in healthcare settings andpatient populations. Out of the 15 articles, 67% showed that clinical outcomes in diabetes improved significantly with the use of telemedicine solutions compared to traditional solutions.[1,4,5] Fifty-three percent n= of these articles found that telemedicine improved clinical outcomes, patient engagement, and even risk factor control for patients with hypertension.[2,8],[15]Forty seven percent of the studies noted that patients with chronic conditions were quite satisfied with telehealth services.[3,7,11] However, all of the articles suggested that these services are not without challenges, with the two main challenges being technological barriers and a lack of tailored interventions.

Telemedicine interventions

The 15 studies included in this review. The main tool used in these articles was remote monitoring. Some studies utilized remote monitoring to show the effectiveness of telemedicine solutions in the management of chronic diseases.[12,15] One study showed how the use of various devices to track BP can make major difference, especially in high-risk situations.[12] Remote monitoring has proven to be quite effective in ensuring that patients have stable BP and glucose levels, not only by measuring these levels but also by providing the patient with ways to maintain this stability.[15]

For instance, a wireless upper-arm BP monitor is a device used to measure and record BP readings.[4] The data transmitted can either be connected to an app or sent directly to healthcare providers. Such apps not only record these readings but also interpret them and even offer helpful feedback, such as suggesting calming techniques when one’s heart is racing. Since the data collected

are shared with care providers in real-time, providers can more easily intervene before raised BP escalates into a life-threatening situation. Thus, remote monitoring can be used to effectively manage BP. During the COVID-19 pandemic, among 13,613 patients, BP control improved significantly, despite an increase in abnormal Electrocardiogram readings.[12] The number of home users and exchanged readings increased, showing that remote devices with medication and activity prompts can enhance patient compliance better than traditional visits.

In addition to remote monitoring, video consultations are a key telemedicine intervention. Video consultations are a big part of telemedicine since they grant patients direct interaction with their care providers without having to go to the hospital. Gauer incorporated video consultations into their study, noting that more patients were satisfied with this kind of consultation since it meant that they could keep up with their routine check-ups, and medication adjustments, and they could even receive lifestyle counseling without having to step foot in a physical healthcare facility.[6] This proved to be quite beneficial, especially for people living in remote areas or patients with tight schedules that did not allow them to physically attend their routine check-ups. Ward found that patients with prediabetes and uncontrolled diabetes benefitted from video consultations, as these meetings helped them minimize the complications that come with this condition.[13]

Remote monitoring helps facilitate continuous monitoring of chronic conditions like diabetes and hypertension, by using digital technologies such as blood pressure monitors, glucometers, and wearable tech. In these studies, remote monitoring was implemented via real-time data sent to healthcare providers via apps or cloud platforms.[7,9] Feedback and alerts from remote monitoring are based on the patient's readings. Video consultations enable direct interaction with healthcare providers via video calls through software tools such as Zoom, Skype, or telehealth-specific platforms. Video consultations are also facilitated by devices such as smartphones, tablets, and computer cameras.[6] These interventions were implemented through online portals with links provided for scheduled video calls. Consultations were done through visual assessments, symptom

discussion, and medication adjustments.[15] For both interventions, the target populations included, elderly patients, and chronic conditions, and those in remote areas or with busy schedules.[4,15]

One of the major challenges facing telemedicine interventions is the technological barrier. Individuals with higher educational levels tend to have better technological literacy, which potentially influences their ability to effectively utilize telemedicine services compared to those with lower educational attainment, highlighting the importance of digital literacy initiatives in addressing disparities.[11] Patients from low-income backgrounds or countries may not have access to certain devices used in telehealth.[8] Such patients may also not have internet access, making it quite difficult to have effective online consultations. Idris understood this and chose to use telephone-based support for routine checkups.[8] These researchers found out that telephone-based techniques worked best in undeveloped and developing countries with limited internet access, making it easier for them to get their routine follow-ups without the need to go to a physical healthcare facility.[8] While developed and developing countries differ in their approaches to telehealth especially when it comes to the modes of communication implemented, it is clear that telemedicine interventions are here to stay and will continue influencing chronic conditions management.

Diabetes Management

Diabetes management is one of the health sectors that has greatly benefited from the implementation of telehealth interventions. Diabetic patients who manage to attend regular consultations are more likely to remain stable and even be able to participate actively in society as compared to those who do not. A retrospective study found that patients who received regular teleconsultations were more likely to keep their glycosylated hemoglobin levels stable compared to those who did not.[1] Crossen highlighted diabetes as particularly suitable for telemedicine because it allows for the collection of patient-generated health data facilitating improved remote monitoring and management of the condition.[4]

Patient-generated health data enable patients with diabetes to actively participate in managing

their condition by tracking metrics such as blood glucose levels, physical activity, and diet habits. This continuous data collection empowers patients to make informed decisions about and adjustments to their treatment plans with remote guidance from healthcare providers, reducing the reliance on frequent physical examinations typically required for other health conditions. Unlike Casas, Crossen compared clinical outcomes achieved by using telehealth interventions and by sticking to the traditional physical interventions, coming to the conclusion that patients who used various telemedicine solutions had better clinical outcomes despite the challenges that come with such telemedicine solutions.[1,4] Ward went a step further, choosing to observe the use of telemedicine for diabetes management in an urban population.[13] The researchers in this study found that telemedicine interventions had better clinical outcomes than traditional in-person hospital visits, especially among patients with uncontrolled diabetes. This is because such patients need access to timely care and failure to get such care can have devastating effects.

Studies have investigated whether telemedicine solutions help improve clinical outcomes for patients with diabetes but they have also been carried out to determine whether patients were satisfied with the kind of care they received. Lee found that patients were highly satisfied with the telehealth interventions, mainly citing the ability to get healthcare services in the comfort of their homes as the number one reason for their satisfaction.[9] Lee carried out the research in 2019, a time when telemedicine interventions were only beginning to be known by most people.[9] Regardless of that, the researchers found out that patients with type 2 diabetes were more satisfied with the telemedicine solutions as compared to the traditional, face-to-face consultations for care management. Lee faced challenges in fully assessing the benefits of telehealth services for patients in low and middle income countries due to barriers like limited technological infrastructure, which hindered comprehensive findings on their access and utilization of telehealth benefits.[9]

Haque's findings also agreed with Lee's in that patients were quite happy with telemedicine solutions.[7,9] They found that patients who experienced work disturbances during the pandemic were

more likely to embrace telehealth services because they understood the importance of being able to access healthcare without worrying about visiting a healthcare facility. Additionally, their findings indicated that patients with high levels of education were more likely to embrace telehealth services, mainly because they have interacted with and embraced various technological advancements such as smartphones, telehealth platforms, health apps, digital communication tools, and wearable devices. These studies found that most patients were more likely to embrace telehealth services, something that various stakeholders can use as a sign that they should incorporate various telemedicine solutions into health systems.[12,15]

Telehealth services are essential not only for managing diabetes but also for enhancing the assessment and control of risk factors associated with this condition. While the studies analyzed so far have shown that telemedicine has played a critical role in diabetes management, it is also critical to discuss the areas in diabetes management that telemedicine has not done as effectively. A study showed that the use of telemedicine solutions led to fewer patients having their risk factors assessed as compared to when using traditional in-person hospital visits.[6] This shows that there is still a lot of work that needs to be done to ensure that telemedicine solutions are as effective as they possibly can. It also shows that telemedicine should be used to supplement traditional diabetes management services instead of completely replacing them.

Hypertension management

Patients with hypertension are one major group that has highly benefited from the implementation of telehealth services. This is because hypertension is one of the chronic conditions that requires regular monitoring and management.[3] Patients whose hypertension is not properly managed might end up developing conditions such as cardiovascular disease.[2] Hypertension was responsible for at least 8.5 million deaths in just one year.[8] Since hypertension does not have a cure yet, it becomes increasingly critical to monitor and manage this condition. Mismanagement of this condition can also lead to poor quality of life or even death. Telehealth services are, therefore, quite

critical when it comes to hypertension monitoring and management as they allow patients to attend consultations in the comfort of their homes, thereby staying ahead of this condition without having to physically travel to a healthcare facility.[8]

One of the areas in which telemedicine solutions have proven effective is in blood pressure control. Telemedicine has made it quite easier for most hypertensive patients to monitor their blood pressure at home.[2] This is especially beneficial for the elderly since they do not have to waste time and efforts attending physical consultation. They can easily monitor their blood pressure from home and even get access to a physical if the blood pressure is worrying. Citoni found that telemedicine offers significant benefits for monitoring BP, despite some limitations.[2] These limitations can be effectively managed, suggesting that they should not deter the broader adoption of telemedicine within healthcare systems.

Idris also found that telemedicine has had a positive impact on hypertension management in primary care settings.[8] T researchers found that 69% of the interventions in a primary healthcare context used telemedicine solutions.[8] Teleconsultation made it easier for patients and care providers since it limited the need for face-to-face consultations. The use of telehealth also reduces the number of referrals by healthcare professionals in remote settings. Idris also found that telemonitoring might be more effective than traditional care when it comes to measuring blood pressure as this telemonitoring greatly helped reduce blood pressure in hypertensive patients.[8] In particular, Idris found that the use of asynchronous technology was quite efficient since it is a technology that is not only easy to operate but it is also quite reliable and it has been designed to work in areas with limited resources and poor internet access.[8]

Asynchronous communication can be used for hypertension management to secure messaging platforms for patient-provider communication, mobile health applications, and remote monitoring devices to transmit data to healthcare providers asynchronously. Such technology is a solution to the greatest telehealth challenge, technological barriers, especially in developing areas.

However, the researchers incorporated data from before telemedicine became known as a vital healthcare tool by most people, meaning that the patients' perceptions might have changed considerably.[9] The lack of a longitudinal approach in these studies makes it difficult to assess the long-term effectiveness of telemedicine solutions and the impact of implementing asynchronous technology in chronic disease management.

Community impact of telehealth

Telehealth services have t been beneficial not just to patients with chronic conditions but also to care providers, families, and the society at large. A study by Omboni found that telemedicine made it quite easy to determine when a patient's health was deteriorating and how to take the necessary measures.[12] This was especially critical in a place like Italy as the devastating number of COVID-19 cases and deaths made it critical for patients with chronic conditions to stay at home, where their conditions worsened. Telehealth allowed such patients to still access chronic conditions management in the safety of their homes. In an observational study conducted by Omboni the findings indicated that telehealth services during the pandemic helped reduce the number of times that patients with chronic conditions such as diabetes and hypertension.[12] Sought out care management services from pharmacies and physical health facilities.[12] These services also made it easier for families and caregivers to monitor the conditions of these patients and seek help when their health seemed to deteriorate.

Casas found that telemedicine solutions such as virtual consultations, remote monitoring, mobile health applications, and telemedicine platforms, have a positive impact on the Latin American community.[1] Latin Americans are one of the marginalized communities that often struggle with unequal access to quality healthcare services. As a result, the number of Latin Americans struggling with chronic conditions such as diabetes continues to increase drastically, especially among urban dwellers.[1] The implementation of various telemedicine solutions has made it easy for patients from this community who are struggling with chronic conditions to gain access to timely and

quality care, thereby improving their health outcomes. Thus, further research needs to be done to show whether the use of telemedicine changes the prevalence of chronic conditions in the Latin American community.

Measured Outcomes

Improvements in chronic disease control

Synthesizing key findings from the 15 articles revealed that telemedicine solutions have been quite effective in improving chronic disease control. Yatabe found that the use of videoconferencing for routine checkups and other remote monitoring devices has greatly improved BP control compared to traditional management practices.[15] The researchers found out that for patients with uncomplicated hypertension, telemedicine solutions were not only quite effective but also safe, allowing patients to easily manage their conditions. Yatabe found that 85.3% of patients using telemedicine solutions had better blood pressure control, compared to 70.0% of patients using traditional management practices.[15] These traditional management practices include in-person appointments, manual BP monitoring, paper records, and periodic lab tests. This indicates that a higher percentage of patients achieving improved blood pressure control through telemedicine compared to traditional methods.

Casas concluded that diabetic patients using telemedicine were able to maintain more stable glycosylated hemoglobin levels as compared to those using conventional care management practices.[1] Ma also found out that telemedicine helped improve Systolic Blood Pressure (SBP) for hypertensive patients.[11] This suggests that while further research is needed, telemedicine shows potential for improving the management of chronic conditions, particularly among patients whose conditions are relatively straightforward or uncomplicated. Uncomplicated conditions are characterized by stable vital signs, low medication complexity, a SBP that is consistently below 140 mmHg in hypertension, and absence or organ damage or secondary conditions. However, for complicated cases, it is still critical for them to utilize traditional management solutions, only using

telemedicine solutions to complement the conventional methods, at least until further research is performed on how to make telemedicine safer for such cases.

Improved patient engagement and satisfaction

All of the included studies show that patients with chronic conditions report high satisfaction with telemedicine solutions for the management of their chronic conditions. Perhaps it is the fact that telehealth became a reality at a dark time when people with chronic conditions were unable to access the vital monitoring and disease management designed to help ensure that their conditions did not become life-threatening.[5] Or maybe it is that telehealth services were introduced at a time when the world was going digital, withs more and more services being transferred online. Whatever the case, the implementation of telehealth, especially during and after the pandemic has been eagerly embraced by patients suffering from chronic conditions. This is mainly because telemedicine solutions help reduce hospital admissions and emergency visits. These solutions have also helped patients and families stay on top of their chronic conditions, empowering them to take an active role in their health.

Corbett called telemedicine a revolutionary development as it is a health tool with the ability to revolutionize the treatment of chronic diseases.[3] What makes it such an invaluable tool in healthcare is that it not only benefits patients, but also benefits care providers, health institutes, and other health stakeholders.[10] This means that all these stakeholders can come together and ensure that the barriers impeding access to and implementation of telehealth services are dealt with. Telehealth services have helped reduce the hours, resources, and energy spent on physical hospital visits. While there is still a need for more research on the effectiveness of telemedicine in managing chronic conditions, the convenience and accessibility offered by these solutions are clearly more significant than any challenges patients may encounter when using telemedicine.

Increased adherence to treatment

While there are so many people suffering from chronic conditions such as diabetes and

hypertension (diagnosed or not), only a small number of these patients adhere to treatment as they should. Patients can live with chronic conditions and still be active members of society if their condition is closely monitored and well managed. Lewinski found that telemedicine plays a crucial role not only in the short-term management of chronic conditions but also in long-term adherence to treatment.[10] Telemedicine solutions such as wristbands BP and glucose monitors and mobile apps have reminders to the patients to take their medication on time.[5] They also have reminders for the patients to walk around, do some physical activities, or even take a break. This is quite crucial since it can help promote lifestyle changes which in turn help improve quality of life. While physicians are able to remind their patients to take their medication every visit, this is not the same, since patients (especially elderly patients) are more likely to forget or simply ignore such sentiments the minute they leave the physician's office.

Ma found out that patients are more likely to adhere to treatment when using telemedicine solutions since such solutions help the patients avoid the negative emotions that can come with in-person visits.[11] This is especially true when patients feel judged for their lifestyle choices that contribute to their challenges, such as obesity. If a patient feels judged during a routine check-up, perhaps because they are not doing as well as they should be, they are less likely to trust in the medication prescribed to them, making their condition even worse. This is a reality that is experienced by many people from marginalized communities as they come face to face with implicit bias from care professionals who are supposed to help them get better. Xiao and Han found that telehealth solutions for chronic disease management reduced hospitalizations by 25% and lowered anxiety levels among patients by 30%, underlining their positive impact on both physical and mental health outcomes.[14] This means that telehealth services are more effective when it comes to support in encouraging long-term patient engagement.

Cost-effectiveness

Omboni and Casas observed that telehealth services are verycost-effective in various ways.[1,

[12] First, these services help reduce hospital admissions and emergency visits. This means that hospitals now spend less labor powerand resources onr such visits, redirecting these resources to getting better technologies and improving the quality of care. Physicians can spend less time carrying out repetitive tasks, and instead, they can spend their time increasing their knowledge and providing better care to patients.[13] The reduced number of hospital visits also helps patients with chronic conditions save money and time.

Casas found that since telemedicine was introduced, only 42.9% of the patients using telehealth have been admitted to the hospital, compared to 95% of those using conventional healthcare services.[1] This means that telehealth is teaching patients how to take better care of themselves, ensuring that these patients do not end up in a hospital bed unless it is necessary. The researchers found out that telehealth made it easier for patients and their care providers to identify and handle early complications.[1] This is especially quite beneficial for patients who live in remote areas. For such patients, attending a routine check-up is a challenging activity for them. This cost-effectiveness is an indication that telehealth services are more effective than traditional healthcare approaches. Cost-effectiveness can be described using quality adjust life yearsThis is a metrics of cost-effectiveness helped measure the need for hospitalization after the implementation of telehealth services in the study done by Casas.[1] This study found out that telemedicine greatly reduced the number of patients admitted to hospitals, with this number dropping from 95% to 42.9% after the implementation.[1]

Discussion

The review highlights that telehealth services are highly effective in managing chronic conditions such as diabetes and hypertension, improving clinical outcomes by facilitating patient adherence to treatment plans.[14] However, challenges remain, particularly for the populations most affected by chronic diseases, such as the elderly. Many elderly individuals may face barriers stemming from technological literacy, which can hinder their ability to effectively use telemedicine

services.

For instance, older adults may struggle with using digital devices, navigating telehealth platforms, or understanding instructions for remotely monitoring of health metrics like blood glucose or blood pressure. This technological gap can lead to challenges in accessing and utilizing telemedicine effectively, potentially impacting the quality of care they receive. Addressing these challenges requires the following targeted strategies.

- Simplified Interfaces: Designing telehealth platforms with intuitive interfaces and clear instructions to accommodate users with limited technological proficiency.
- Training and Support: Providing training sessions or user guides tailored to older adults to enhance their confidence and competence in using telemedicine tools.
- Caregiver Involvement: Involving caregivers or family members in the telemedicine process to assist elderly patients with technology use and ensure adherence to treatment plans.

Implications of the findings for policy and practice

Policy Development: Policymakers should prioritize integrating telehealth into healthcare systems, ensuring that reimbursement policies support its use for chronic disease management. This can encourage healthcare providers to adopt telemedicine as a standard practice. Developing clear guidelines and regulations for telehealth services to ensure patient privacy, data security, and quality of care across different settings and jurisdictions is paramount.

Healthcare Delivery: Promoting telehealth can improve access to healthcare services, especially for underserved populations in rural or remote areas where access to specialists and healthcare facilities is limited. Emphasizing patient engagement and empowerment through telemedicine, fostering partnerships between patients and healthcare providers in managing chronic conditions is also crucial.

Technological Infrastructure: Policies should support investments in robust technological infrastructure to ensure reliable connectivity and usability of telehealth platforms, addressing

technological barriers faced by older adults and other populations. Implementing educational programs to enhance digital literacy among patients and healthcare providers, ensuring they can effectively utilize telehealth tools.

Limitations

The major limitations identified in the reviewed studies include technological barriers, lack of tailored interventions, and short follow-up periods. Technological barriers such as lack of access to reliable internet and the needed devices make it quite difficult for patients with chronic conditions to take part in virtual routine check-ups. This challenge is especially biting for low-income patients as well as the developing countries that are yet to invest heavily in technology. Since this is still a fairly new phenomenon, most of the telemedicine solutions available are quite general. This means that patients do not have access to interventions that have been personalized for them. Most of these studies also had short follow-up periods, meaning they could not investigate the long-term effects of telemedicine on chronic conditions management. Xiao and Han is the only study that shows that long-term management of chronic conditions using telehealth can help improve quality of life in the long run.[14] As De Kreutzenberg puts it, the use of telemedicine to manage conditions such as diabetes was quite limited before COVID-19.[5] This study found that only 20% of the participants were aware of telemedicine before COVID-19.[5] There are still questions that need to be answered before this topic can be declared closed. For instance, what does the loss of regular physical contact with the care providers mean for the patients and their long-term health outcomes? The study designs and patient populations used by some of the studies also made it quite difficult to draw generalized conclusions while small sample sizes limited the robustness of the findings.

The reviewed studies highlighted several challenges, including short follow-up periods that limit understanding of long-term telemedicine effects, generalized interventions that may not meet individual patient needs, and significant technological barriers such as limited internet access and device availability, particularly affecting low-income and developing country populations. These

limitations underscore the need for future research to address these disparities, improve study designs with longer-term perspectives, and develop more personalized telemedicine solutions to enhance effectiveness and accessibility for diverse patient groups.

Comparison to prior work

This systematic review builds on previous research done by various researchers in the recent past. Earlier reviews in this area indicated that telemedicine had a promising future in the world of medicine. However, these reviews also noted that there was a need for more empirical evidence to ascertain this future. This review is a confirmation that telemedicine has had a positive impact on chronic condition management. The review also highlights the need to overcome technological and implementation barriers if telemedicine is to achieve its potential.

Conclusion

People with chronic conditions need regular check-ups to ensure that the treatment they are in is working and to ensure that their conditions do not escalate to something worse or to death. Telemedicine is an invaluable tool where chronic pain management is concerned. The 15 articles reviewed in this study present evidence showing why integrating telemedicine into routine care protocols can greatly help improve patient engagement as well as clinical outcomes, especially for patients struggling with diabetes and hypertension. Despite the technological problems and lack of tailored telehealth interventions, it is clear that telehealth is quite effective in managing chronic conditions.

Future research direction

There is still a need for more research to investigate:

- Long-term outcomes of telemedicine interventions for chronic conditions management
- Cost-effectiveness of telemedicine in various healthcare settings
- Strategies to overcome technological barriers

- Effectiveness of tailoring telehealth interventions to meet needs of individual patients in chronic disease management.

Abbreviations

BP-Blood pressure

ECG-electrocardiogram

SBP-Systolic blood pressure

RCTs-randomized controlled trials

PGHD-Patient-generated health data

TCDMS-Telehealth Chronic Disease Management System

PRISMA-Preferred Reporting Items for Systematic Reviews and Meta-Analyses

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