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EXPLORING THE ROLE OF TELEMEDICINE IN MODERN HEALTHCARE SERVICES: A REVIEW

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ABSTRACT

Objective: Telemedicine, defined as the distribution of health-related services and information via telecommunication technologies, has rapidly evolved from a niche solution into a central component of modern healthcare systems. As healthcare systems around the world contend with the challenges of aging populations, a rise in chronic diseases, and a growing shortage of healthcare professionals, telemedicine could be an effective solution, offering innovative ways to expand access to care, enhance patient outcomes and optimize resource use. The aim of this review is to critically explore and evaluate the role of telemedicine in modern healthcare services, with a specific focus on its applications in managing chronic diseases, acute care, and mental health services. This study seeks to analyze the benefits, challenges, and limitations associated with the widespread adoption of telemedicine.
Methods: The article is the result of review of recent scientific literature using PubMed database. Literature was reviewed using keywords.
Key findings: In recent years, telemedicine has demonstrated significant benefits in enhancing healthcare delivery, particularly in chronic disease management, acute care, and mental health services. Evidence shows improved patient outcomes, reduced hospitalizations, and greater accessibility for underserved populations. The COVID-19 pandemic accelerated telemedicine adoption, highlighting its value in ensuring continuity of care and fostering technological innovation, such as AI-driven diagnostics and remote monitoring. Despite these advantages, barriers such as the digital divide, regulatory challenges, and limitations in conducting physical examinations persist.
Conclusion: Telemedicine has rapidly become an integral component of modern healthcare, offering significant benefits in chronic disease management, acute care, and mental health services. The flexibility and accessibility it provides have proven invaluable, particularly during the COVID-19 pandemic, where it ensured continuity of care while minimizing risks. With continued innovation and thoughtful integration, telemedicine is poised to play a crucial role in the future of healthcare, enhancing patient outcomes and expanding access to essential services, despite its challenges.

KEYWORDS

Telemedicine, Chronic Disease Management, COVID-19, Telehealth, Acute Care, Mental Health

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Introduction

Telemedicine, defined as the distribution of health-related services and information via telecommunication technologies, has rapidly evolved from a niche solution into a central component of modern healthcare systems. Telemedicine enables long-distance interaction between patients and clinicians, offering services such as care, advice, reminders, education, interventions, monitoring, and remote admissions. While telemedicine is often used interchangeably with telehealth, it typically refers more specifically to remote clinical services like diagnosis and monitoring. In situations where access to care is limited - due to rural locations, transportation issues, mobility challenges, outbreaks, epidemics, pandemics, reduced funding, or staffing shortages - telehealth can help close the gap. It also supports distance learning, facilitates meetings, supervision, and presentations among practitioners, and aids in managing online health information and integrating healthcare systems. When properly implemented, telemedicine technologies can be both cost-effective and convenient. The COVID-19 pandemic has significantly boosted its popularity, leading to the development of innovative applications aimed at improving health outcomes, reducing costs, and ensuring that each patient receives high-quality care. During the pandemic, telemedicine has become an essential tool for ensuring healthcare access and is being widely adopted in innovative ways while minimizing the risk of spreading infections, promoting safety of patients and essential clinical staff. [4, 5]

The significance of telemedicine goes beyond the pandemic. As healthcare systems around the world contend with the challenges of aging populations, a rise in chronic diseases, and a growing shortage of healthcare professionals, telemedicine offers an effective solution. This review seeks to explore the complex role of telemedicine in today's healthcare, analyzing its benefits and challenges.

Historical Background and Evolution of Telemedicine

Telemedicine has come a long way since its early days, evolving in response to technological advancements and changing healthcare needs. Its roots date back to the 1960s when NASA, as part of the Mercury program, developed technologies that allowed doctors on Earth to monitor the vital signs of astronauts in real-time. This was one of the first practical applications of telemedicine, aimed at providing remote care in extreme conditions. An early telemedicine initiative, known as STARPAHC (Space Technology Applied to Rural Papago Advanced Health Care), was carried out in the 1970s to explore the use of technology in delivering enhanced healthcare services to a remote population in southern Arizona. This project was a collaborative effort involving NASA, the Papago Tribe (now the Tohono O'odham Indian Nation), the Lockheed Missile and Space Company, the Indian Health Service, and the Department of Health, Education and Welfare. STARPAHC demonstrated the feasibility of collaboration between public and private sector partners in delivering medical care to remote communities using telecommunication technologies. [23]

The rise of the internet and mobile technology in the late 20th and early 21st centuries revolutionized telemedicine. With the availability of high-speed internet, affordable mobile devices and advances in video conferencing, it became possible to conduct virtual consultations, monitor patients remotely, and provide healthcare services to individuals around the world. [18]

A significant milestone in the evolution of telemedicine was the global outbreak of COVID-19 in 2020. The pandemic forced healthcare systems to adopt telemedicine on a large scale to ensure continuity of care while minimizing the risk of virus transmission. The adoption of telemedicine surged during the pandemic, with healthcare providers rapidly integrating telehealth solutions to manage both COVID-19 and non-COVID-19 patients. This period also saw significant innovation in telemedicine technologies, including the integration of artificial intelligence and machine learning for diagnostics and treatment planning. [4]

The historical evolution of telemedicine highlights its growing importance in addressing healthcare challenges, particularly in times of crisis. As we move forward, the lessons learned during the COVID-19 pandemic will likely shape the future trajectory of telemedicine, driving further innovation and adoption.

Telemedicine in Chronic Disease Management

One of the most promising applications of telemedicine is in the management of chronic diseases. Chronic conditions such as diabetes, hypertension, and chronic obstructive pulmonary disease (COPD) require ongoing monitoring and regular consultations, which can be challenging for patients who live far from healthcare facilities or have mobility issues.

Chronic diseases are the leading cause of death worldwide, responsible for approximately 70% of all fatalities. These conditions often impair patients' functional abilities and overall living capacity, leading to a decline in their general health and health-related quality of life (HRQoL). When patients with chronic diseases fail to adhere to prescribed medication guidelines, it results in poor clinical outcomes and a further reduction in HRQoL, which in turn generates additional healthcare costs. A significant challenge in managing chronic diseases is the difficulty in maintaining long-term self-management, including consistent medication adherence. Patients with chronic conditions living in remote rural areas face considerable challenges in accessing hospital care, increasing the likelihood of worsening health outcomes and reducing HRQoL. The lack of specialized care services, physician shortages, and geographic isolation in these regions present significant challenges for managing chronic diseases. In recent decades, telemedicine has been adopted to effectively treat and manage patients with chronic diseases residing in remote rural locations. [24]

Telemedicine is applied to the management of chronic heart diseases, such as heart failure, hypertension, and coronary artery disease with the use of remote monitoring devices that allow patients to regularly track key health indicators, including blood pressure, heart rate, and weight. These devices transmit data to healthcare providers, who can monitor the patient’s condition in real-time and make necessary adjustments to treatment plans. Continuous monitoring allows for early detection of deteriorations in the patient’s condition, which can lead to timely interventions and prevent hospitalizations. Usage of remote systems is also enhancing patients’ engagement and self-management. Patients are encouraged to actively participate in their care by using telemedicine tools to monitor their health, follow treatment plans, and communicate with their healthcare providers. Telehealth interventions have been associated with improved control of cardiovascular risk factors, such as blood pressure and cholesterol levels, in patients with chronic heart diseases. [10]

Between December 31, 2019, and July 26, 2020, during the COVID-19 lockdown in Italy, a telehealth platform was utilized to manage patients with chronic diseases. Patients' health status was remotely monitored

through various tools, including ambulatory blood pressure monitoring (ABPM), resting or ambulatory electrocardiograms (ECG), spirometry, sleep oximetry, and cardiorespiratory polysomnography conducted in community pharmacies or general practitioners' offices. Additionally, patients tracked their blood pressure (BP), heart rate (HR), blood oxygen saturation (SpO2), body temperature, body weight, waist circumference, blood glucose, and lipid levels at home using a dedicated smartphone app. The number of patients engaging with telemedicine services increased significantly during the lockdown, with home monitoring becoming particularly prevalent. This led to an enhanced exchange of data between patients and healthcare providers via the telehealth platform. The study observed a notable reduction in abnormal blood pressure and oxygen saturation readings during the lockdown period. However, after the lockdown, there was an observed increase in abnormal body weight and waist circumference, likely due to decreased physical activity and poor dietary habits during home lockdown [7]. This review underscores the critical role that telemedicine can play in managing chronic diseases, especially during crises, and highlights the need to scale up telehealth solutions to improve patient outcomes. Nevertheless, the study also pointed out the necessity for further research to refine telemedicine practices, particularly in ensuring the accuracy of self-reported data and more effectively integrating telehealth into existing healthcare systems. The study also recognized that telemedicine cannot fully substitute for all elements of traditional care. It highlighted challenges like the inability to perform comprehensive physical examinations and the potential for reporting biases due to manual data entry.

Diabetes mellitus (DM) currently impacts 463 million people globally, within the age group of 20 to 79 years. Hypertension and hyperlipidemia are frequently observed comorbidities in individuals with type 2 diabetes, with a rising trend in their co-occurrence. The risk of complications related to diabetes can be reduced through consistent management of blood glucose levels, blood lipid profile and reduction of blood pressure. [29]

Telemedicine has shown significant advancements and positive impacts in the management of diabetes, particularly highlighted during the COVID-19 pandemic when traditional healthcare delivery faced disruptions. Research has shown that telemedicine supports effective diabetes management by enabling remote patient monitoring, decreasing the necessity for in-person visits, and improving patients' ability to manage their condition independently. A cross-sectional survey was conducted to assess patients' perceptions and satisfaction with telemedicine services offered for consultations with the Public Diabetes Clinic of the ULSS 6 District Health Unit in Padua, Italy, during the COVID-19 lockdown. The study involved adult patients with a history of type 2 diabetes (T2DM) who had telemedicine consultations with a diabetologist between March and May 2020. During telephone interviews, patients were asked about their experience with the teleconsultation. Many patients identified numerous strengths, expressing relief that they could still communicate with their diabetologist. They often described the teleconsultations as being comparable to an in-person visits [25].

Research has shown that telemedicine interventions can be effective in managing blood glucose levels and enhancing HbA1c indices in diabetic patients. A systematic meta-review by Eberle C. and Stichling S. [30] indicated that telemedical interventions could enhance diabetes management in both T1DM and T2DM patients overall, likely leading to improvements in HbA1c levels. Several studies have reported that telemedicine interventions significantly reduced HbA1c values in pooled T1DM and T2DM patients, with a mean difference of up to - 0.64%. However, the impact of the intervention on lowering HbA1c levels was notably less pronounced in patients with T1DM compared to those with T2DM. Additionally, the use of telemedicine services has been associated with positive trends in body weight management.

Telemedicine has been shown to be an effective tool for managing hypertension, particularly in controlling systolic blood pressure over long-term monitoring. Studies have demonstrated that telemedicine interventions can maintain the standard of care for chronic diseases such as hypertension, without any inferiority in recorded outcomes compared to traditional care methods. A meta-analysis of sixteen randomized clinical trials found that telemedicine-based (TM-based) interventions were effective in managing blood pressure (BP) in populations with chronic diseases, leading to significant reductions in both systolic blood pressure (SBP) and diastolic blood pressure (DBP). These interventions appeared to be more effective for patients with hypertension and cardiovascular diseases when implemented for six months or longer and when data were delivered through a device system. However, TM-based interventions did not prove effective in lowering BP in patients with diabetes mellitus (DM) [26].

The 5-year telemonitoring program "ValCrònic", implemented in four health centers in the Valencia Region of Spain from 2011 to 2016, achieved significant results. During the first year of monitoring, the program reduced the proportion of patients with HbA1c levels ≥8% by 44%. Additionally, the ValCrònic program decreased the percentage of participants with poorly controlled systolic and diastolic blood pressure

by 10% and 44%, respectively. The program also resulted in a 51.9% reduction in primary care emergency department visits and a 32.3% decrease in hospital emergency department visits. Furthermore, emergency admissions dropped by 33.2%, and admissions due to the worsening of monitored conditions were reduced by 23%. Individuals with at least one of four chronic diseases (hypertension, diabetes mellitus, COPD, or heart failure) who were at high risk for rehospitalization or emergency department visits and participated in the ValCrònic telemonitoring program had better weight control, reduced blood pressure and blood sugar levels, and made fewer visits to primary care and hospital emergency services. [27]

A large-scale study conducted in England examined the effects of remotely exchanging data through various devices and monitoring systems for patients with congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes. During the 12-month clinical trial, patients in the intervention group were significantly less likely to be hospitalized and had a lower mortality rate compared to those in the control group. The study concluded that the telemedicine intervention could serve multiple purposes: improving patients' ability to manage their chronic conditions, changing their perceptions of when to seek additional support, and assisting healthcare professionals in making decisions about when to refer or admit patients. [31]

Telemedicine has become increasingly valuable in managing chronic obstructive pulmonary disease (COPD), providing benefits such as continuous monitoring and early detection of symptoms. A multicenter, prospective, single-arm feasibility cohort study involving Japanese patients with COPD or asthma-COPD overlap was conducted between September 26, 2019, and June 21, 2021. The study aimed to assess the feasibility and acceptability of telemedicine among COPD patients, physicians, and facility staff in Japan. 84 patients aged 40 years or older were trained to use YaDoc, a telemedicine smartphone app, which included seven daily symptom questions and weekly COPD Assessment Test questions. 72 patients completed the one-year study. After a year, 84% of participants found the platform easy to use, 59% believed it positively impacted their condition management, and 54% were satisfied with their experience. Among the 26 physicians and facility staff who used the platform, 79% expressed an intention to use telemedicine in the future, 67% felt that telemedicine simplified patient care, and 67% agreed that the platform improved communication between physicians and patients. The use of the YaDoc platform highlights the significant role telemedicine can play in the ongoing management of chronic conditions, particularly by ensuring consistent monitoring and support for patients. The study concludes that telemedicine is a feasible and acceptable approach to managing chronic diseases, but emphasizes the importance of maintaining patient engagement and optimizing telehealth practices for long-term success. [35]

Telemedicine has been shown to reduce healthcare costs by minimizing the need for in-person visits and hospitalizations. Telemedicine was effective in maintaining and, in some cases, improving the management of chronic diseases during the pandemic. Key health indicators such as blood pressure and glucose levels remained stable or improved for most patients. Usage of remote systems allowed for more frequent monitoring and quicker interventions, which contributed to better disease control and reduced the risk of complications. Telemedicine systems can help healthcare providers to maintain close contact with their patients, despite the challenges posed by extreme conditions such as pandemic. During the COVID-19 pandemic, telehealth systems effectively managed chronic conditions, reducing the burden on healthcare systems and ensuring that patients received continuous care despite lockdowns and social distancing measures. [9]

There are several practical challenges in continuously and comprehensively monitoring chronic diseases such as diabetes and hypertension from a distance, without physical examinations, laboratory tests, or the use of essential diagnostic and therapeutic interventions, which could negatively impact effective disease management. This may be one of the main reasons why approximately 40% of patients and 33% of healthcare workers who participated in a large survey in the UK expressed that, although new digital approaches were useful during the pandemic, they remain inferior to traditional models of care and should be applied selectively in the future. [28]

Potential benefits from telemedicine systems in chronic disease management are significant. As technology continues to advance, and as more patients and providers become accustomed to telehealth, telemedicine is likely to play an increasingly important role in managing chronic diseases.

Telemedicine in Acute Care and Emergency Services

The role of telemedicine in acute care and emergency services has grown significantly, especially in response to the challenges brought by the COVID-19 pandemic. Traditionally, these services have depended heavily on face-to-face interactions between patients and healthcare providers. However, the necessity for social distancing and the increased strain on healthcare facilities during the pandemic highlighted the potential

of telemedicine to deliver effective care in acute and emergency situations. Healthcare providers had to transition from in-person to virtual care to continue delivering essential services. This transition, although challenging, was crucial in maintaining continuity of care. In many cases, virtual care proved to be an effective alternative to in-person visits. Patients appreciated the convenience and safety of telehealth systems, and many providers found that they could deliver quality care remotely.

Telemedicine was effectively used to improve acute care during the COVID-19 pandemic. In March 2021, the Critical Care Telemedicine Program was launched in Tashkent, Uzbekistan, by the Republican Research Centre for Emergency Medicine (RRCEM) to address the difficulties faced by healthcare providers in treating severe COVID-19 cases. Through this initiative, doctors in Uzbekistan connected to a telemedical "hub" at Charité University Hospital in Berlin, Germany. The telemedicine setup involved a "hub-and-spoke" model where the telemedical hub in Berlin provided remote consultations, training, and support to clinicians in Uzbekistan. This model enabled real-time, interdisciplinary collaboration between healthcare professionals in both countries, facilitating the exchange of knowledge and expertise in managing critically ill patients. From March 2021 to December 2022, RRCEM and Charité conducted over 500 joint telemedical rounds, involving nearly 200 patients. These sessions resulted in significant improvements in patient management at RRCEM, including the implementation of an antibiotic stewardship program, a guideline-based approach to delirium management, and enhanced mechanical ventilation strategies. This project has demonstrated significant potential for telemedicine programs in international settings. [34]

Telemedicine systems has been utilized to enhance emergency medical services (EMS). Transmitting electrocardiogram (ECG) data to hospitals in real-time enables cardiologists to assess the patient’s condition before arrival, allowing for immediate initiation of treatment upon the patient’s arrival at the hospital. Usage of telemedicine systems has been shown to reduce the time to treatment and improve survival rates in patients experiencing heart attacks. The authors also note that telemedicine can reduce the need for hospital readmissions, which is particularly important for patients with heart failure. [10]

A matched cohort study conducted from April to August 2016 at a single urban academic ED compared the performance of remote real-time telescreening with in-person screening. Emergency Department used telescreening for 315 hours and in-person screening for 337 hours over the same period to assess the performance of each method. Out of 3430 individuals screened, 1497 (43.64%) underwent telescreening and 1933 (56.36%) received in-person screening. Initially, telescreening was less efficient, with telescreeners evaluating fewer patients per hour compared to in-person screeners. However, as the study progressed, the efficiency of telescreening improved, eventually equaling that of in-person screening. The use of telemedicine services significantly decreased the number of patients who left the ED without being seen, particularly during the 1-3 am time slot on weekdays, where the rate dropped from 25.1% to 4.5%. The study also reported high levels of patient satisfaction with telescreening, showing that patients were generally satisfied with their telemedicine experiences. Telemedicine services were found to be effective in telescreening within emergency departments, providing a safe and efficient alternative to in-person screening. [36]

Telemedicine has also proven effective in delivering high-intensity care for acute illnesses within senior living communities, where it helps prevent unnecessary emergency department visits and is highly appreciated by residents. Recognizing the challenges older adults face in accessing timely medical care, an innovative telehealth program was developed within a primary care geriatrics practice to provide acute care through telemedicine. This program was launched in 2010 in the Rochester, New York metropolitan area, where the University of Rochester's Strong Health Geriatrics Group offers primary care to residents of Senior Living Communities (SLCs).This program was designed to supplement traditional primary care by offering urgent acute care services that fall between regular outpatient visits and those requiring emergency department (ED) intervention. During the first two years of the program, 93.4% of requests for assistance were successfully addressed, and 94% of residents reported satisfaction with the care they received. The program significantly reduced the need for ED visits, as most cases that would have required such visits were effectively managed through telemedicine.This model has demonstrated that telemedicine services can successfully replace more resource-intensive care options, such as ED visits, leading to reduced healthcare costs and improved patient outcomes. The success of this telemedicine approach in SLCs suggests that it is a valuable tool for managing acute illnesses, particularly in vulnerable populations. [32]

In pediatric care, telemedicine has proven to be highly effective for managing both acute and chronic conditions, significantly reducing the likelihood of visits to the emergency department. In response to the COVID-19 pandemic in 2020, three academic pediatric primary care offices affiliated with Cincinnati Children’s Hospital Medical Center in Cincinnati, Ohio, quickly implemented and expanded access to

telemedicine for addressing both acute and chronic health conditions. The study revealed that 62% of telehealth visits were for acute issues - rash, eye drainage/redness, constipation and cough, while 38% were focused on managing chronic conditions like ADHD and asthma. This highlights telemedicine's versatility in handling a broad spectrum of health problems. The study also highlighted that telemedicine effectively reduced unnecessary visits to the emergency department and urgent care. Many families reported that without the option of telemedicine, they would have sought care in the emergency department (ED) or urgent care (UC), or in some cases, might have avoided seeking care altogether, potentially leading to higher costs or worsening health outcomes. Telemedicine's availability ensured that children received the necessary care promptly and in a cost-efficient manner. However, despite its success, the study also pointed out concerns, particularly regarding the potential for telemedicine to widen existing racial disparities in healthcare access. [33]

Potential advantages of telemedicine in acute care and emergency services are significant. By increasing access to specialist care, boosting the efficiency of emergency services, and allowing for real-time monitoring, telemedicine holds the promise of transforming the delivery of acute care.

Telemedicine in Mental Health Services

The field of mental health services has seen significant advancements with the integration of telemedicine, often referred to as telepsychiatry. Telemedicine has transformed the way mental health care is delivered, making it more accessible, especially in areas where there is a shortage of mental health professionals.

One of the major benefits of telepsychiatry is the increased accessibility it provides to patients in remote or underserved areas. Traditional barriers to mental health care, such as geographical distance, stigma, and scheduling difficulties, are impaired by telemedicine. Patients can receive therapy and psychiatric consultations from the comfort of their homes, which has been particularly beneficial during the COVID-19 pandemic when in-person visits were restricted. Experts suggest that telemedicine is poised to enhance care in rural areas by supporting and maintaining the education of rural healthcare providers in the specific health conditions targeted by telehealth initiatives. [12,5]

Experts highlight that the implementation of telehealth within U.S. healthcare systems has the potential to significantly enhance the management of behavioral health at a population level. With rising rates of mental illness and the fragmented nature of mental health resources across communities in the United States, there has been a notable increase in the number of patients seeking behavioral health treatment in U.S. emergency departments (EDs). Alarmingly, about 96% of U.S. counties face a shortage of psychiatrists to adequately address the mental health needs of their populations. In response, telehealth-based behavioral health care is increasingly being recognized as an effective solution to mitigate the shortage of mental health care providers in both rural and urban areas facing provider shortages. [12]

Videoconferencing, as a tool for delivering mental health services has become increasingly relevant due to its ability to expand access to care, especially in areas where mental health professionals may be scarce. Building and maintaining a therapeutic relationship is essential in mental health care, and this can be more challenging in a virtual setting. That’s why creating a comfortable and safe environment for the patient, even when interacting through a screen is crucial for enhancing therapeutic engagement in videoconferencing-based telepsychiatry. Not all patients may be suitable for remote care, especially those with severe psychiatric conditions that require close monitoring or those who lack access to reliable technology. Clinicians need to evaluate the patient’s suitability for tele-mental health services. They should consider factors such as the patient’s comfort with technology, the severity of their condition, and any potential risks associated with remote care. Obtaining informed consent is a critical component of tele-mental health practice. There are specific elements that should be included in the informed consent process for videoconferencing, such as explaining the limitations and risks of remote care, discussing confidentiality concerns, and ensuring that patients understand the nature of the technology being used. Clinicians need to document the informed consent process thoroughly and to revisit the discussion if there are any significant changes in the patient’s condition or treatment plan. Technical aspects of videoconferencing are also important, including the selection of appropriate hardware and software, ensuring a secure and stable internet connection, and optimizing the videoconferencing environment to maintain a private and confidential setting for both the patient and the provider. [6]

Telemedicine has been shown to be particularly effective in managing common mental health disorders such as depression, anxiety and post-traumatic stress disorder (PTSD) in the veteran population. Many veterans face geographic and health-related challenges when trying to access care within the Veterans Health Administration (VHA). To address these barriers and improve access to mental health services, the VHA has

implemented telehealth interventions. In 2016, the VHA launched a program to provide video-enabled tablets to veterans who faced geographic, clinical, or social obstacles to in-person care, allowing them to receive services from their homes or other convenient locations. Veterans with mental health conditions who received these tablets experienced an increase in psychotherapy and medication management visits. The provision of tablets was linked to improved continuity in mental health care and a reduction in missed or canceled appointments. However, receiving a tablet did not seem to impact veterans' use of emergency department or urgent care services for mental health conditions. [8]

Telehealth interventions can substantially decrease the time patients in underserved rural areas wait to receive care. The article by Fairchild R. et al. explored the effects of telehealth on the delivery of behavioral health care in rural emergency departments (EDs). The study was conducted across four critical access hospitals (CAHs) in Indiana, focusing on adult patients with behavioral health conditions such as mood disorders, anxiety, suicide and intentional self-inflicted injury, and substance abuse. This observational matched cohort study compared patients who received telehealth-based interventions from 2015 to 2017 with a control group of patients treated prior to the implementation of telehealth, from 2005 to 2013. The findings revealed that the average time for a patient to be seen by a provider (time-to-provider) in the ED was significantly shorter for the telehealth group (12 minutes) compared to the nontelehealth group (27 minutes). Despite the reduced wait times, the overall length of stay in the ED was longer for telehealth patients (318 minutes) compared to those in the nontelehealth group (147 minutes). This increase in length of stay was partly due to the extra time required for telehealth consultations and the complexities inherent in managing behavioral health cases.Additionally, the total cost of ED care was higher for telehealth patients, especially for those with substance abuse-related conditions, likely due to the need for additional interventions. The study demonstrated that integrating telehealth into rural EDs led to improved operational efficiency, particularly in the timely delivery of care. However, the longer overall length of stay and higher costs associated with telehealth interventions underscore the need for further optimization of telehealth workflows and protocols.[12]

Additionally, telemedicine has enhanced the delivery of mental health services during emergencies. For example, telepsychiatry has been employed in emergency departments to conduct rapid psychiatric evaluations for patients in crisis. Through synchronous video consultations, telepsychiatry has improved access to specialized health care services, thereby increasing system capacity and facilitating the delivery of appropriate care in geographically dispersed areas. In pediatric emergency settings, telepsychiatry notably reduced the median length of stay in the ED (5.5 hours compared to 8.3 hours) and lowered total patient charges ($3,493 compared to $8,611) when compared to children who received standard care. It also enhanced clinical and operational efficiency, expanded access to specialized care, and received high satisfaction ratings from both providers and patient caregivers. [13]

Individuals with chronic conditions are two to three times more likely to experience concurrent mental health issues compared to the general population. As the prevalence of physical chronic conditions increases, so does the incidence of mental health problems. The coexistence of chronic and mental health conditions results in higher overall healthcare costs, greater utilization of services, and diminished quality of life and health outcomes. Telehealth interventions can be effective in detecting or managing mental health issues in individuals with pre-existing chronic conditions. A rapid review of systematic reviews by Maxime Sasseville et al. found that internet-based cognitive behavioral therapy (CBT) is effective and comparable to traditional face-to-face interventions. Digital mental health interventions have shown positive impacts on depression, anxiety, distress, and psychosocial outcomes for individuals with various chronic diseases. The review also highlighted that digital mental health interventions are particularly effective in improving depression, anxiety, distress, quality of life, and mood regulation in people affected by cancer, with teleconsultations and web-based interventions being the most effective. In pediatric populations, web-based CBT has shown positive effects, but only in children and adolescents with anxiety and depression, without other coexisting conditions. This review demonstrated that digital technologies could play a valuable role in preventing and managing mental health problems in individuals living with chronic conditions. [11]

However, the effectiveness of telepsychiatry depends on various factors, including the quality of the technology used, the patient’s comfort with virtual interactions, and the specific mental health condition being treated. While telemedicine can be highly effective for managing common mental health disorders, it may not be appropriate for more severe cases that require intensive in-person care or physical intervention. For example, despite the Australian government's funding to support online mental health services for those affected by the bushfire crisis, the impact has been minimal - data shows only four telehealth visits were conducted in the first three months. Outside of emergency situations, the overall adoption of telehealth has been slow and uneven.

In Australia, even with the introduction of substantial financial incentives for specialist video consultations, telehealth accounted for less than 1% of all specialist consultations provided. [16]

Some studies have found that there is insufficient evidence to definitively demonstrate the effectiveness or efficiency of telepsychiatry in managing mental illness, highlighting the need for more comprehensive research. While current evidence supports the effectiveness of telehealth interventions for specific conditions, there is limited evidence regarding the impact of telehealth on overall service utilization. Despite this lack of conclusive evidence, some research suggests that telehealth interventions, which could replace office visits, may actually lead to an overall increase in the use of both in-person and telehealth services. [15]

In summary, telemedicine holds significant potential to enhance access to mental health services, particularly for individuals in rural or underserved areas who may struggle to access mental health professionals. It also offers a convenient option for those who may find it challenging to attend in-person appointments due to work, childcare responsibilities, or mobility issues, potentially leading to higher patient satisfaction and better adherence to treatment plans. However, several challenges must be addressed to fully realize these benefits. As technology advances and both patients and providers become more comfortable with telemedicine, the role of telepsychiatry is expected to expand, offering new opportunities for more effective and efficient delivery of mental health services.

Technological Innovations in Telemedicine

Technological advancements have been the driving force behind the expansion of telemedicine. The continuous evolution of telecommunications, mobile technology, and digital health tools has enabled telemedicine to offer a wide range of services that were previously only possible through in-person visits. One of the key technological innovations in telemedicine is the development of high-quality video conferencing platforms that allow healthcare providers to conduct virtual consultations with patients. This solution holds great promise, particularly for patients in remote areas. Medical streaming applications, can help physicians diagnose and manage patients more effectively. Through telemedicine, physicians can treat more patients without needing to hire additional staff or expand their office space. While the introduction of video conferencing has drawn many providers to telehealth, the new wave of telemedicine technologies promises to offer even more. [5]

In addition to video conferencing, wearable devices and remote monitoring tools have revolutionized telemedicine by enabling continuous patient monitoring. Remote monitoring in telehealth involves using telemonitoring systems to track vital and non-vital signs, manage chronic conditions, and monitor real-time emergencies through devices like personal computers, smartphones, or tablets. Data collected from these devices are transferred to a server host, analyzed, and made available to patients and authorized physicians for continuous health management and support [7]. Remote monitoring utilizes sensors that can be attached to the patient, embedded in their home environment, or activated on devices like watches or phones to track specific symptoms such as tremors, gait, and falls. This monitoring can be passive, happening in the background, or active, requiring patients to complete scheduled tasks at specific intervals. A successful example of passive monitoring was demonstrated in patients with Parkinson's disease, where body-worn sensors effectively monitored falls within the home setting. [17]

Artificial intelligence (AI) and machine learning (ML) are becoming increasingly significant in telemedicine. AI-powered tools are now being used to support diagnostics, treatment planning, and patient monitoring. The latest developments in telemedicine technology include AI to enhance the effectiveness of physicians. This technology keeps patients informed through wearables and other remote monitoring tools, and even utilizes robots to provide specialized care in areas where it was previously unavailable [5]. For example, AI systems can examine medical images like X-rays and CT scans to identify abnormalities with remarkable accuracy, sometimes exceeding the performance of human radiologists in specific tasks. Researchers have created a deep learning model known as the COVID-19 detection neural network (COVNet), which distinguishes between COVID-19 and community-acquired pneumonia by analyzing visual 2D and 3D features extracted from volumetric chest CT scans. [19]

Between February and April of 2020, numerous internet hospitals managed by public hospitals were rapidly established across various provinces and cities in China to prevent cross-infection and in-hospital transmission. These online healthcare platforms offered a range of services, including consultations for secondary health issues, telemedicine and medical imaging teleconsultations, general practice services such as online prescriptions, prescription renewals, and drug delivery, as well as medical assistant robots that alleviated the workload of nurses and minimized their contact time with suspected and confirmed COVID-19 cases. [9]

A significant advancement in telehealth technology, offering a scalable solution for managing chronic diseases effectively in both professional and home environments is represented by Tholomeus® web-based telehealth platform. The name Tholomeus® stands for "Telemedicine and Home teleMonitoring for Medical Surveillance of chronic diseases" . This platform supports the screening and management of common chronic conditions such as cardiovascular, pulmonary, metabolic, and respiratory sleep disorders. It collects and analyzes data from various medical devices, which can be uploaded through a web app or mobile app, providing real-time feedback and medical reports to both users and healthcare professionals. Clinically validated and utilized in multiple settings, including pharmacies, general practices, and hospitals, Tholomeus® has demonstrated its effectiveness in chronic disease management. The platform's usefulness in managing hypertensive patients through Ambulatory Blood Pressure Monitoring (ABPM) in a hospital setting has been confirmed by two different observational studies. The ARTEMIS project aimed to evaluate the prevalence of blood pressure control in daily life among hypertensive patients and to explore the added value of ABPM beyond conventional office-based BP measurement. The VASOTENS Study is a large registry of ABPM recording performed with an automated BP measuring device which determines central hemodynamics and stiffness during the 24-hours by a clinically validated technology of pulse wave analysis of oscillometric BP measurements [14]. The platform's flexibility, interoperability, and ease of use make it a promising tool for improving chronic disease management, particularly in a future where the prevalence of chronic diseases is expected to rise significantly. Its continuous validation and potential for further advancement indicate that it could play a crucial role in the future of chronic disease management. Overall, technological innovations have greatly expanded the potential of telemedicine, making it a more viable and effective option for delivering healthcare services. As technology continues to evolve, telemedicine is likely to become even more integrated into mainstream healthcare, offering new opportunities to improve patient outcomes and reduce healthcare costs.

Challenges and Limitations of Telemedicine

While telemedicine offers numerous benefits, its widespread adoption and integration into healthcare systems are hindered by several challenges and limitations. These challenges must be addressed to ensure that telemedicine can be effectively used to improve healthcare access and outcomes.

A major challenge is the digital divide, which highlights the disparity between individuals who have access to modern information and communication technology and those who do not. Patients in rural regions, low-income communities, or older adults may lack access to essential technology, such as smartphones, computers, or high-speed internet, needed to engage in telemedicine. This gap in access can worsen existing health inequalities, as those already underserved by traditional healthcare systems may also be unable to take advantage of telemedicine services. Additionally, virtual visits may not be suitable for individuals requiring a higher level of care or for those needing in-person physical examinations or diagnostic testing [2]. Participating in telemedicine initiatives may be difficult for some individuals, requiring them to undergo training in using new technologies and internet-connected software [22]. For example, a recent study involving multiple smartphone-enabled sensors required patients to set up and log into a third-party portal. One of three participants submitted help-desk requests, which suggests that the system was not consumer-friendly and was unnecessarily burdensome [1].

Technical issues, such as unreliable internet connections or equipment malfunctions, can hinder the effectiveness of telemedicine in emergency situations. One of the primary challenges is the difficulty in conducting thorough physical examinations using telemedicine. Certain conditions, particularly in orthopaedics, require a hands-on physical examination for accurate diagnosis and treatment planning. The inability to perform these examinations can lead to misdiagnosis or incomplete assessments. There are several limitations of visual assessments through video consultations such as poor video quality, lighting conditions, and the patient's ability to position the camera correctly. These can impact the accuracy of visual examinations. Also non-verbal cues, which play an important role in patient-provider communication, are often lost or diminished in virtual consultations. This can affect the provider’s ability to assess the patient’s condition fully and may lead to misunderstandings or a lack of rapport. The lack of physical presence may also lead to patients feeling less engaged or comfortable asking questions, which can affect the quality of care. Technological challenges such as poor internet connectivity, software glitches, and incompatibility of devices, which can disrupt consultations and lead to frustration for both patients and providers. Legal and regulatory issues are another area of concern - providers must be aware of the regulatory requirements for telemedicine in their region, including licensure, patient consent, and data privacy laws. Providers must take steps to ensure that they are compliant with all relevant regulations to protect both themselves and their patients. [21]

Disadvantages of telehealth include limitations with performing comprehensive physical examinations. Some critics express concerns that telehealth might negatively impact continuity of care, arguing that online interactions can be impersonal and risky, as the virtual provider lacks the advantage of a full medical history and physical examination to support accurate diagnosis and treatment. Face-to-face examinations are necessary in many circumstances in which auscultation or palpation is necessary [20]. It is important that clinician training highlights the limitations of telehealth and educates on alternative information-gathering methods that can be employed in such scenarios [16]. A potential barrier to effective telehealth practice is the accuracy of data transmission. A study investigating the precision of physical function measurements found that internet bandwidth can impact the validity and reliability for fine motor task measurements. If healthcare practitioners are unaware of the differences in technological systems, they may make clinical decisions and recommendations based on potentially inaccurate patient data [20].

Data privacy and protection are also crucial to the success of telemedicine. Ensuring the security of patient data is essential, and this issue has been highlighted as a key challenge by both scholars and practitioners in the telemedicine field [22]. Not all publicly accessible videoconferencing tools meet internationally accepted standards for safeguarding participant confidentiality, which is crucial for both patients and medical professionals providing remote services. A concerning example of this is Zoom-bombing, where unknown individuals can intrude on and disturb teleconferences. Clinicians planning to provide remote services to patients must take all necessary measures to ensure the privacy of participants is protected [17].

Additionally, there are regulatory and legal barriers to the widespread adoption of telemedicine. Telehealth faces large variations in rules, regulations and guidelines for practice. Different countries, and even different states within countries, have varying regulations regarding the use of telemedicine. This creates unclear understandings regarding standards and guidelines among health care organizations and groups. The rapid expansion of telehealth creates increased potential for liability and legal issues [20].

One of the most notable disadvantages is the lack of availability and affordability. Establishing and managing telemedicine services can be expensive for providers, making it potentially prohibitive for smaller healthcare facilities [5]. Funding poses a major challenge for sustainable telehealth programs. Typically, government funds are allocated to the acquisition and maintenance of telemedicine infrastructure, leaving minimal or no investment for operational costs and formal evaluations. Unfortunately, there are numerous examples of telemedicine failures around the world where large telemedicine networks have been built but remain underutilised. [18].

While the future of telemedicine is promising, it is essential to address the challenges and barriers that currently limit its adoption. Collaboration among healthcare providers, technology companies, policymakers, and patients will be key in overcoming these challenges. By working together, stakeholders can develop strategies and solutions that ensure telemedicine is accessible, effective, and equitable for all patients.

Conclusions

Telemedicine has had a significant impact on modern healthcare, especially in managing chronic conditions, acute care and mental health services. Telehealth services, by enabling remote monitoring, reducing the need for in-person visits and improving access to essential healthcare services, has greatly enhanced patient care. Implementation of telemedicine services faces several challenges, including the digital divide, regulatory barriers, data privacy concerns and limitations of virtual care in scenarios requiring physical examinations. Full potential of telemedicine can be realized by adressing these challenges. Ongoing innovations will likely expand its influence, potentially revolutionizing healthcare delivery on a global scale. As telemedicine becomes more integrated into mainstream healthcare, it is set to play crucial role in shaping the future of healthcare services, offering solutions to current challenges and creating new opportunities for improving patients outcomes worldwide.

Disclosure

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REFERENCES

1. Tuckson, R. V., Edmunds, M., & Hodgkins, M. L. (2017). Telehealth. The New England journal of medicine, 377(16), 1585–1592. https://doi.org/10.1056/NEJMsr1503323
2. Koonin, L. M., Hoots, B., Tsang, C. A., Leroy, Z., Farris, K., Jolly, T., Antall, P., McCabe, B., Zelis, C. B. R., Tong, I., & Harris, A. M. (2020). Trends in the Use of Telehealth During the Emergence of the COVID-19 Pandemic - United States, January-March 2020. MMWR. Morbidity and mortality weekly report, 69(43), 1595–1599. https://doi.org/10.15585/mmwr.mm6943a3
3. Kruse, C. S., Krowski, N., Rodriguez, B., Tran, L., Vela, J., & Brooks, M. (2017). Telehealth and patient satisfaction: a systematic review and narrative analysis. BMJ open, 7(8), e016242. https://doi.org/10.1136/bmjopen-2017-016242
4. Liu, N., Huang, R., Baldacchino, T., Sud, A., Sud, K., Khadra, M., & Kim, J. (2020). Telehealth for Noncritical Patients With Chronic Diseases During the COVID-19 Pandemic. Journal of medical Internet research, 22(8), e19493. https://doi.org/10.2196/19493
5. Haleem, A., Javaid, M., Singh, R. P., & Suman, R. (2021). Telemedicine for healthcare: Capabilities, features, barriers, and applications. Sensors international, 2, 100117. https://doi.org/10.1016/j.sintl.2021.100117
6. Shore, J. H., Yellowlees, P., Caudill, R., Johnston, B., Turvey, C., Mishkind, M., Krupinski, E., Myers, K., Shore, P., Kaftarian, E., & Hilty, D. (2018). Best Practices in Videoconferencing-Based Telemental Health April 2018. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 24(11), 827–832. https://doi.org/10.1089/tmj.2018.0237
7. Omboni, S., Ballatore, T., Rizzi, F., Tomassini, F., Panzeri, E., & Campolo, L. (2021). Telehealth at scale can improve chronic disease management in the community during a pandemic: An experience at the time of COVID-19. PloS one, 16(9), e0258015. https://doi.org/10.1371/journal.pone.0258015
8. Jacobs, J. C., Blonigen, D. M., Kimerling, R., Slightam, C., Gregory, A. J., Gurmessa, T., & Zulman, D. M. (2019). Increasing Mental Health Care Access, Continuity, and Efficiency for Veterans Through Telehealth With Video Tablets. Psychiatric services (Washington, D.C.), 70(11), 976–982. https://doi.org/10.1176/appi.ps.201900104

9. Wang, H., Yuan, X., Wang, J., Sun, C., & Wang, G. (2021). Telemedicine maybe an effective solution for management of chronic disease during the COVID-19 epidemic. Primary health care research & development, 22, e48. https://doi.org/10.1017/S1463423621000517
10. Escobar-Curbelo, L., & Franco-Moreno, A. I. (2019). Application of Telemedicine for the Control of Patients with Acute and Chronic Heart Diseases. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 25(11), 1033–1039. https://doi.org/10.1089/tmj.2018.0199
11. Sasseville, M., LeBlanc, A., Boucher, M., Dugas, M., Mbemba, G., Tchuente, J., Chouinard, M. C., Beaulieu, M., Beaudet, N., Skidmore, B., Cholette, P., Aspiros, C., Larouche, A., Chabot, G., & Gagnon, M. P. (2021). Digital health interventions for the management of mental health in people with chronic diseases: a rapid review. BMJ open, 11(4), e044437. https://doi.org/10.1136/bmjopen-2020-044437
12. Fairchild, R. M., Ferng-Kuo, S. F., Laws, S., Rahmouni, H., & Hardesty, D. (2019). Telehealth Decreases Rural Emergency Department Wait Times for Behavioral Health Patients in a Group of Critical Access Hospitals. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 25(12), 1154–1164. https://doi.org/10.1089/tmj.2018.0227
13. Thomas, J. F., Novins, D. K., Hosokawa, P. W., Olson, C. A., Hunter, D., Brent, A. S., Frunzi, G., & Libby, A. M. (2018). The Use of Telepsychiatry to Provide Cost-Efficient Care During Pediatric Mental Health Emergencies. Psychiatric services (Washington, D.C.), 69(2), 161–168. https://doi.org/10.1176/appi.ps.201700140
14. Omboni, S., Campolo, L., & Panzeri, E. (2020). Telehealth in chronic disease management and the role of the Internet-of-Medical-Things: the Tholomeus® experience. Expert review of medical devices, 17(7), 659–670. https://doi.org/10.1080/17434440.2020.1782734
15. Shigekawa, E., Fix, M., Corbett, G., Roby, D. H., & Coffman, J. (2018). The Current State Of Telehealth Evidence: A Rapid Review. Health affairs (Project Hope), 37(12), 1975–1982. https://doi.org/10.1377/hlthaff.2018.05132
16. Smith, A. C., Thomas, E., Snoswell, C. L., Haydon, H., Mehrotra, A., Clemensen, J., & Caffery, L. J. (2020). Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). Journal of telemedicine and telecare, 26(5), 309–313. https://doi.org/10.1177/1357633X20916567
17. Bloem, B. R., Dorsey, E. R., & Okun, M. S. (2020). The Coronavirus Disease 2019 Crisis as Catalyst for Telemedicine for Chronic Neurological Disorders. JAMA neurology, 77(8), 927–928. https://doi.org/10.1001/jamaneurol.2020.1452
18. Smith, A. C., & Gray, L. C. (2009). Telemedicine across the ages. The Medical journal of Australia, 190(1), 15–19. https://doi.org/10.5694/j.1326-5377.2009.tb02255.x
19. Arora, N., Banerjee, A. K., & Narasu, M. L. (2020). The Role of Artificial Intelligence in Tackling COVID-19. Future Virology, 15(11), 717–724. https://doi.org/10.2217/fvl-2020-0130
20. Gajarawala, S. N., & Pelkowski, J. N. (2021). Telehealth Benefits and Barriers. The journal for nurse practitioners : JNP, 17(2), 218–221. https://doi.org/10.1016/j.nurpra.2020.09.013
21. Iyengar, K., Jain, V. K., & Vaishya, R. (2020). Pitfalls in telemedicine consultations in the era of COVID 19 and how to avoid them. Diabetes & metabolic syndrome, 14(5), 797–799. https://doi.org/10.1016/j.dsx.2020.06.007
22. Leite, H., Hodgkinson, I. R., & Gruber, T. (2020). New development: 'Healing at a distance' - telemedicine and COVID-19. Public Money & Management, 40(6), 483–485. https://doi.org/10.1080/09540962.2020.1748855
23. Freiburger, G., Holcomb, M., & Piper, D. (2007). The STARPAHC collection: part of an archive of the history of telemedicine. Journal of telemedicine and telecare, 13(5), 221–223. https://doi.org/10.1258/135763307781458949
24. Kwak, M. Y., Hwang, E. J., & Lee, T. H. (2021). Effects of the Physician-Primary-Healthcare Nurse Telemedicine Model (P-NTM) on Medication Adherence and Health-Related Quality of Life (HRQoL) of Patients with Chronic Disease at Remote Rural Areas. International journal of environmental research and public health, 18(5), 2502. https://doi.org/10.3390/ijerph18052502
25. Sartore, G., Caprino, R., Ragazzi, E., & Lapolla, A. (2023). Telemedicine and its acceptance by patients with type 2 diabetes mellitus at a single care center during the COVID-19 emergency: A cross-sectional observational study. PloS one, 18(2), e0269350. https://doi.org/10.1371/journal.pone.0269350
26. Gao, W., Lv, X., Xu, X., Zhang, Z., Yan, J., Mao, G., & Xing, W. (2022). Telemedicine interventions to reduce blood pressure in a chronic disease population: A meta-analysis. Journal of telemedicine and telecare, 28(9), 621–631. https://doi.org/10.1177/1357633X20959581
27. Orozco-Beltran, D., Sánchez-Molla, M., Sanchez, J. J., Mira, J. J., & ValCrònic Research Group (2017). Telemedicine in Primary Care for Patients With Chronic Conditions: The ValCrònic Quasi-Experimental Study. Journal of medical Internet research, 19(12), e400. https://doi.org/10.2196/jmir.7677
28. Stachteas, P., Stachteas, C., Symvoulakis, E. K., & Smyrnakis, E. (2022). The Role of Telemedicine in the Management of Patients with Chronic Diseases in Primary Care During the COVID-19 Pandemic. Maedica, 17(4), 931–938. https://doi.org/10.26574/maedica.2022.17.4.931
29. Timpel, P., Oswald, S., Schwarz, P. E. H., & Harst, L. (2020). Mapping the Evidence on the Effectiveness of Telemedicine Interventions in Diabetes, Dyslipidemia, and Hypertension: An Umbrella Review of Systematic Reviews and Meta-Analyses. Journal of medical Internet research, 22(3), e16791. https://doi.org/10.2196/16791

30. Eberle, C., & Stichling, S. (2021). Clinical Improvements by Telemedicine Interventions Managing Type 1 and Type 2 Diabetes: Systematic Meta-review. Journal of medical Internet research, 23(2), e23244. https://doi.org/10.2196/23244
31. Bashshur, R. L., Shannon, G. W., Smith, B. R., Alverson, D. C., Antoniotti, N., Barsan, W. G., Bashshur, N., Brown, E. M., Coye, M. J., Doarn, C. R., Ferguson, S., Grigsby, J., Krupinski, E. A., Kvedar, J. C., Linkous, J., Merrell, R. C., Nesbitt, T., Poropatich, R., Rheuban, K. S., Sanders, J. H., … Yellowlees, P. (2014). The empirical foundations of telemedicine interventions for chronic disease management. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 20(9), 769–800. https://doi.org/10.1089/tmj.2014.9981
32. Shah, M. N., Gillespie, S. M., Wood, N., Wasserman, E. B., Nelson, D. L., Dozier, A., & McConnochie, K. M. (2013). High-intensity telemedicine-enhanced acute care for older adults: an innovative healthcare delivery model. Journal of the American Geriatrics Society, 61(11), 2000–2007. https://doi.org/10.1111/jgs.12523
33. Walters, J., Johnson, T., DeBlasio, D., Klein, M., Sikora, K., Reilly, K., Hutzel-Dunham, E., White, C., Xu, Y., & Burkhardt, M. C. (2021). Integration and Impact of Telemedicine in Underserved Pediatric Primary Care. Clinical pediatrics, 60(11-12), 452–458. https://doi.org/10.1177/00099228211039621
34. Boklage, E., Weiss, B., Hanefeld, J., Steinecke, K., Jansen, A., Anvarov, K., Valihanov, A., Alimov, A., Seybold, J., Spies, C., & Sabirov, U. (2023). Telemedicine in emergency responses: reflections from a critical care telemedicine programme between Uzbekistani and German clinicians during COVID-19. BMJ health & care informatics, 30(1), e100675. https://doi.org/10.1136/bmjhci-2022-100675
35. Shinoda, M., Hataji, O., Miura, M., Kinoshita, M., Mizoo, A., Tobino, K., Soutome, T., Nishi, T., Ishii, T., Miller, B. E., Tal-Singer, R., Tomlinson, R., Matsuki, T., Jones, P. W., & Shibata, Y. (2022). A Telemedicine Approach for Monitoring COPD: A Prospective Feasibility and Acceptability Cohort Study. International journal of chronic obstructive pulmonary disease, 17, 2931–2944. https://doi.org/10.2147/COPD.S375049
36. Rademacher, N. J., Cole, G., Psoter, K. J., Kelen, G., Fan, J. W. Z., Gordon, D., & Razzak, J. (2019). Use of Telemedicine to Screen Patients in the Emergency Department: Matched Cohort Study Evaluating Efficiency and Patient Safety of Telemedicine. JMIR medical informatics, 7(2), e11233. https://doi.org/10.2196/11233