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Review Article

From clinic to screen: A narrative review of telehealth in pediatric chronic disease management

Shamsi Atefeh

Ph.D. of Research Center, School of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran

*Correspondence: Shamsi Atefeh, Email: noor13500@yahoo.com

Abstract:
Background: Telehealth integrates traditional hospitalization into modern healthcare by utilizing digital devices, especially for pediatric chronic diseases. This new approach has promoted convenient home care by providing individualized support to healthcare providers, children, and their families to facilitate constant management of physiological follow-up, prevention of complication and cost-effective services.
Objectives: This paper investigated the studies of Iranian telehealth concerning pediatric chronic diseases and aimed to explore the benefits and challenges of telehealth and provided recommendations to improve implementation.
Methods: We identified fifteen relevant studies through comprehensive database searches. These studies were analyzed in terms of different types of pediatric chronic diseases and the characteristics, outcomes, benefits and challenges of telehealth.
Results: Telehealth could potentially transform pediatric care by facilitating home-based, personalized assistance. It enabled continuous physiological follow-up, complication prevention, and cost-effective services that bridge the frequent face-to-face follow up gaps in healthcare. Telehealth studies identified technological, regulatory and infrastructure challenges as the direct factors that inhibit the growth of telehealth services.
Conclusion: Telehealth integration to traditional care offered advantages, including enhanced access, personalized care and cost-effectiveness. However, it was crucial to overcome challenges of technology, regulation and infrastructure. Investing in telehealth enhancement and developing strategies to address these obstacles can significantly improve healthcare outcomes for children with chronic diseases and reshape pediatric care.

Keywords: Telehealth challenges, Chronic diseases, Children, Benefit assessment

Introduction

The rise of modern life diseases in communities is accelerating the revolution in healthcare structure and care models to new technological approaches. Telehealth has emerged as a new supportive approach to overcome the barriers for accessing healthcare services, improving quality of life and decreasing expenses, especially in vulnerable populations. The ability to monitor the physiological situation of patients, make a rapid diagnosis and intervene early to control the consequences facilitates the availability of healthcare resources for populations suffering from chronic diseases. On the other hand, telehealth can realize the equity and fairness in access to healthcare for low-level socioeconomic groups and marginalized residents [1, 2].

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Children and their families are underserved groups who have numerous unpleasant experiences during chronic disease engagement. According to WHO reports, approximately fifteen percent of children worldwide suffer from a chronic disease. Asthma, diabetes, cancer and other disabilities are the prevalent chronic diseases that limit children's normal lifestyle, cause regular discomfort and result in frequent rehospitalization during the long-term management of diseases. On the other hand, it is the frequent use of health services, high cost of health services and the risk of morbidities that make it necessary to provide long-term care for children. They need immediate and sustained management to track their situation in order to modify the consequence of diseases and strengthen their access to health care services. To realize these aims, telehealth can offer specialized care, improve disease management and ensure the health of children till adulthood periods with the provision of opportunities to reduce costs and improve the quality of life for children and their families. Telehealth provides a platform for the delivery of remote healthcare services, including consultations, monitoring, education and support, which can substantially improve the management of chronic diseases [3-6].

However, despite the positive prospects of telehealth, there is a need to clarify the different aspects of telehealth implementation in pediatric chronic diseases and identify the challenges, benefits and recommendations to strengthen the integration between the hospital system and technology, adoption, and enhancement of telehealth usage in children's health. Hence the study aims to investigate telehealth in pediatric chronic diseases by considering its challenges and benefits.

Materials and methods

Different databases, including PubMed, Scopus, Web of Science and ProQuest were searched to find relevant studies. The inclusion criteria were original research articles conducted in Iran, written in English, with the main concepts of assessment on telehealth and pediatric chronic diseases. The pediatric age was set as three to eighteen years old and the studies that focused on children under three years old and over eighteen years old were excluded. In addition, short communications, letters to editors, book reviews, review papers, and those could not be viewed in full text were excluded. The review process was performed to identify suitable keywords using Mesh, Embase, and other related literature. The researcher received advice from medical librarians on a specific search strategy for the aforementioned databases. Databases were searched by combining keywords with Boolean operators (AND, OR) and parentheses, including "(telehealth OR telepractice OR telerehabilitation OR telemedicine OR web-based intervention OR mobile app) AND "(pediatric OR children OR paediatric) AND "(chronic diseases OR stuttering OR autism spectrum disorder OR Cancer OR Diabetes OR palliative care OR cerebral palsy). To narrow down the search, the publication date in the current eight years was considered to obtain the most recent studies. A three-stage review process was used to determine the final studies. The first step was to review the title, abstract and text, select the literature and collect the data. The inclusion or exclusion of studies that did not match the review results was decided after reading the entire text and deciding on the selection of a study in an in-depth discussion with two expert researchers who worked together to determine the criteria for accepting or rejecting the topics [7, 8]. Following the removal of duplicates, fifteen retrieved papers remained for a final review (Figure 1). The study considered the author, publication time, purpose, study design, variables, results, and benefits and challenges of telehealth.

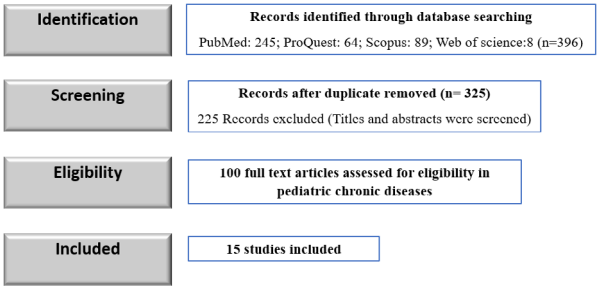

Figure 1. The reviewing process

Results

Important components and findings of the final included articles are shown in Table 1. The assessment of this article demonstrated different dimensions associated with telehealth management of pediatric chronic diseases, which could be classified into seven domains: stuttering [9-11], autism [12-16], cerebral palsy [17-19], cancer [20] and palliative care [21], coagulation factor deficiencies [22], diabetes [23], and Covid pandemic [11, 14, 19, 21]. The variables and outcomes were grouped into three categories: children's, parents' and healthcare providers' perspectives. Satisfaction [9, 14, 20], the usability and acceptance of telehealth [17, 20], caregiver burden [19, 22], caregiver training and support [9, 11, 13-18, 21, 23], quality of life [12, 18], and mental health including measurement of anxiety, depression, stress, social adjustment [13, 19, 20], and musculoskeletal pain [18] were considered to examine the catagorization of telehealth in parents. Physiological and psychological criteria were considered in the domain of pediatric health. Physiological criteria that were examined included control of severity and percentage of stuttering [10], frequency of acute pain and bleeds in coagulation factor deficiencies [22], glycosylated hemoglobin levels in diabetes [23],

and gross motor skills in autism [15, 18]. Self-care scores [16, 23], occupational performance [12], and behavioral problems [12-14] were investigated as psychological criteria. On the other hand, knowledge, attitude and practice regarding telepractice by parents, patients and health providers [11, 16, 21] were another aspects reported in the studies. The study also investigated outcomes, benefits, and challenges of telehealth to clarify various areas of telehealth implementation in pediatric chronic diseases.

Table 1. Important components and findings of the final included articles

Author	Title	Aim	Study design	Methods	Results	Outcomes	Benefits or challenges
Samzadeh et al (2021)	Evaluation of Telehealth Efficacy in Improving Maintenance Phase of Stuttering Children	To investigate the effectiveness of telehealth in improving its treatment and its effect on the maintenance phase of stuttering children	Interventional study	All 6 -12-year-old stuttering children were divided into two groups experiment and control. The children received a three-month course of treatment with a speech and language pathologist (SLP) weekly session and 8 sessions of 30 minutes over a period of six months in the maintenance phase in the form of audio and video files through the WhatsApp software	According to the total score of the questionnaire,17% of the parents were satisfied at a low rate, 33% of parents were satisfied with the average and 50% of parents were very satisfied.	Telemedicine can be a viable alternative to traditional in-person physician-based care for stuttering.	Benefit Ability to remove barriers for both patients and healthcare professionals
Mehdizadeh et al (2023)	A Mobile Self-Management App (CanSelfMan) for Children With Cancer and Their Caregivers: Usability and Compatibility Study	To evaluate the usability of CanSelfMan, a self-management app between healthcare providers and children with cancer.	Usability and Compatibility Study	The study performed debugging and compatibility tests in a simulated environment to identify possible errors. In the 3-week period of using the app, children and their parents/ caregivers filled out the User Experience Questionnaire (UEQ) to evaluate the usability of the CanSelfMan app and their level of user satisfaction.	According to the children's evaluations, attractiveness (mean 1.956, SD 0.547) and efficiency (mean 1.934, SD 0.499) achieved the best mean results compared with novelty (mean 1.711, SD 0.481). Parents/caregivers rated efficiency at a mean of 1.880 (SD 0.316) and attractiveness at a mean of 1.853 (SD 0.331). The lowest mean score was reported for novelty (mean 1.670, SD 0.225).	Improvement of communication between health care providers and children with cancer and their parents/ caregivers, Facilitating remote monitoring and promoting medication adherence.	Benefit The app was well-received by both children and their parents/ caregivers.

Jamali et al (2021)	Randomized controlled trial of occupation performance coaching for families of children with autism spectrum disorder by means of telerehabilitation	To examine the effectiveness of occupational performance through telerehabilitation, in autism spectrum disorders (ASD) on behavioral problems, parental self-efficacy, and quality of life.	Randomized controlled trial	Telerehabilitation occupational performance in coaching group in comparison of waitlist group.	Greater promotion in the teleoccupational performance group was reported including enhancement of specified goals and improvement of behavioral problems. Parental quality of life improvement was not maintained after the follow-up phase.	Occupation performance coaching, which was delivered through telerehabilitation, was effective on children with ASD occupational performance and parental self-efficacy	Not specified
Sadeghi et al (2021)	Internet-based versus face-to-face intervention training for parents of young children with excessive screen-time and autism spectrum disorder-like symptoms: a comparative study	To compare treatment outcomes of an internet-based intervention with a face-to-face intervention for young children with excessive screen time and ASD-like symptoms.	Comparative study	Mothers of young children with excessive screen time and ASD-like symptoms dyads were assigned to the Internet-based (n=20) and to the face-to-face intervention (n=20) involving 7 sessions of training	No significant between-group difference for any of the pre- to post-intervention measurements. At post-intervention, both intervention conditions revealed significant symptom changes compared to before the intervention.	Internet-based parent training was equally beneficial to regular face-to-face parent training intervention.	Benefit Having potential in parent training.
Sabzevari et al (2023)	Artificial intelligence evaluation of COVID-19 restrictions and speech therapy effects on the autistic children's behavior	To quantify the effects of COVID restrictions and speech treatment approaches during lockdowns on autistic children using a neuro-fuzzy artificial intelligence method in children with autism spectrum disorders (ASD)	Not specified	The influences of three treatment approaches of in-person, telehealth, and public services along with no-treatment conditions during lockdown were the main factors of the investigation.	The results indicate that restrictions alleviate externalizing problems while intensifying internalizing problems. It was concluded that in-person speech therapy is the most effective and satisfactory approach to dealing with ASD children during stay-at-home periods.	Internet-based parent training intervention for young children with excessive screen time and ASD-like symptoms and their parents is equally beneficial to regular face-to-face parent training intervention.	Challenge In-person therapy provides a more personal and interactive experience for the children and their parents/ caregivers.

Nobakht et al (2018)	A Web-Based Caring Training for Caregivers of Children with Cerebral Palsy: Development and Evaluation	To develop a user-friendly web-based intervention for training parents of children with CP	Not specified	It was done in four main steps including determining the needs of users, content development, design, operational development, and evaluation.	The website for caregiver training had the possibility that the caregivers could determine their educational priorities. The users could share their experiences with other users and could ask questions from an expert.	The website has possibilities including registering caregivers of children with CP, the possibility to confirm registration with an SMS, and the possibility to determine the caregiver's educational priorities	Benefit The website has usability for training caregivers of children with CP.
Nobakht et al (2020)	A web-based daily care training to improve the quality of life of mothers of children with cerebral palsy: A randomized controlled trial	To evaluate the effectiveness of a developed web-based intervention for daily care training of children with CP on their mother's quality of life (QOL), anxiety, depression, stress, and musculoskeletal pain.	Single-blind randomized controlled trial	Mothers of children with CP with Gross Motor Function Classification System (GMFCS) levels III, IV, and V were assigned to the intervention and control groups. Mothers in the control group received their routine face-to-face occupational therapy intervention and mothers in the intervention group received 12 weeks of web-based intervention	The mean score of pretests of pain, and the mean score of post-tests in the intervention and control groups were significantly different ($P<0.05$). The mean scores of physical health and total QOL scores of post-tests in the intervention group were significantly higher than the control group with controlling pretest scores.	Web-based intervention affects the caregivers' QOL and pain significantly.	Benefit Web-based intervention can be used to provide daily care training for mothers of children with CP.
Rohani Ravari et (2022)	The Effect of Distance Delivery of Lidcombe Program on The Severity of Stuttering in Preschool Children: A Single-Subject Study	To investigate the extent of the stuttering effect in telepractice programs on preschool children	Single-subject study	The Lidcombe program was implemented through live video communication between the therapist in a clinic and the subjects at home for 15 weekly sessions	After 15 sessions, two subjects approached the final criteria of the first phase of the Lidcombe program Other subjects did not achieve the final criteria in the first phase either, in spite of the diminished severity and percentage of stuttering.	This research suggested the effects of the Lidcombe telepractice program on the reduction of stuttering in the subjects.	Benefit Telepractice programs had a positive effect on the reduction of stuttering severity

Hasanpour et (2021)	Challenges of pediatric palliative care in the intensive care unit during the COVID-19 Pandemic	To identify the challenges of palliative care in the pediatric intensive care unit during COVID-19 through the experiences of healthcare providers.	A qualitative study with a content analysis approach	Physicians' and nurses' experiences were explored by semi-structured, in-depth interviews	Ten main categories were extracted from data analysis, including "caring in COVID-19", "communication and family center care", "breaking bad news", palliative care training', "pain and symptom management", "support of the child, family, and clinical team", "physical environment", "guidelines", "specialized staff"' and "home-based palliative care".	Palliative care in the PICU faces several challenges, especially during COVID-19, but the clinical team is making every attempt to improve the comprehensive care of children and their families. Telehealth is important in COVID-19, and education is also a key component to improving palliative care in the PICU in Iran.	Benefit Telehealth is important in COVID-19 for improving palliative care in the PICU.
Mansuri et al (2021)	Effect of telephone follow-up by Nurses on Self-care in Children with Diabetes	To evaluate the effectiveness of telephone follow-up by a nurse on total self-care and glycosylated hemoglobin in patients with type I diabetes.	Quasi-experimental study	The study population consisted of 70 children 10–18 years of age with type I diabetes (35 patients in the experimental group and 35 in the control group). The experimental group received 12 weeks of telephone follow-up training from the center, whereas the control group received no follow-up.	After the intervention, the total mean score of self-care in all aspects of diabetes care for children was significantly higher in the experimental group ($p < 0.001$). In addition, a statistically significant difference was observed between the experimental and control groups in terms of mean glycosylated hemoglobin after the intervention ($p = 0.030$).	Telephone follow-up by a nurse can improve total self-care and glycosylated hemoglobin in patients with type I diabetes.	Not specified
Aqdassi et al (2021)	A Family-based Telerehabilitation Program for Improving Gross Motor Skills in Children With High Functioning Autism Spectrum Disorder	Investigation of the non-attendant family-centered Sports, Play and Active Recreation for Kids (SPARK) motor program intervention in the development of gross motor skills in children with a high-function ASD	A quasi-experimental study with a pretest-posttest design	Families of children with high-functioning ASD received telerehabilitation of the SPARK motor program involving exercising and playing performed for 8 weeks	Family-based telerehabilitation of the SPARK program significantly improved gross motor skills in children with high-functioning ASD ($P<0.05$)	It seems that the telerehabilitation of SPARK can be helpful for families who do not have access to rehabilitation centers	Benefit Overcoming geographical barriers to receiving psychoeducation, accessibility, convenience

Langarizadeh, et al (2020)	Data Requirements and Technical Capabilities of Educational Mobile Application for Parents with Autistic Child	Determination of data requirements and technical capabilities of an educational system for parents of children with an autism spectrum disorder	A descriptive developmental study	The first step was to determine the data elements and technical capabilities of the educational system by searching the databases of PubMed, Scopus, Google Scholar, Web of Science and Guidelines about Autism. In the second step, psychiatrists and pediatric neurologists were asked about the requirements and data elements of the educational system with a questionnaire	Three categories of requirements, including demographic, clinical data elements, and technical capabilities for system design, were determined. Data elements included demographic information of the child and parents Including 7 items (78%), clinical information including autism training, self-care, and anxiety and worry reduction, and rehabilitation strategies, including the presentation of interventional techniques including 10 items (83%). The system's technical capabilities also included presenting reminders for in-person visits, introducing specialists and medical centers, receiving parental problems, and providing motivational messages including items (50%)	Parents' training rehabilitation and self-care skills were the most important data elements of the educational application. Identifying the technical capabilities and data requirements of an educational application can help educate and enhance the self-care and rehabilitation skills of parents of autistic children and reduce their parents' problems and concerns	Benefit Mobile applications are one of the new ways to teach parents with an autistic child
Farajzadeh et al (2021)	Predictors of mental health among parents of children with cerebral palsy during the COVID-19 pandemic in Iran: A web-based cross-sectional study	Investigation of the psychological health of Iranian caregivers of children with CP and associated risks during a lockdown period	A web-based cross-sectional study	160 caregivers of children with CP participated in this web-based cross-sectional study	Mental health problems were prevalent; (depression = 45.0% and anxiety = 40.6%). Significant correlations were found between CDS and HADS-Anxiety ($r = 0.472$, $P < 0.001$), HADS-depression ($r = 0.513$, $P < 0.001$), and perceived stress (PSS) related to COVID-19 ($r = 0.425$, $P < 0.001$)	During the COVID-19 outbreak, the mental health of caregivers of children with CP is affected by the burden of care	Benefit A comprehensive web-based plan including psychological consultation, remote education, or in-person handouts for the self-care or handling of the children and adequate distance support may enable better mental health for these caregivers
Rambod et al (2022)	The effect of a virtual child disease management programme on burden and social adjustment of caregivers of children with coagulation factor deficiencies	Determination the effect of a virtual child disease management programme on burden and social adjustment of caregivers of children with coagulation factor deficiencies	clinical trial	The study was conducted on 80 caregivers of children with coagulation factor deficiencies that were randomly assigned into the intervention and control groups. A comprehensive virtual child disease management program was conducted for 8 weeks	A significant difference was observed between groups in concern to caregivers' burden ($P < .001$), women's and men's social adjustment, and children's acute pain and bleeds ($P < .001$) after the virtual disease management program	Virtual child disease management programs reduced the burden and improved the social adjustment of caregivers of children This intervention decreased the frequency of acute pain and bleeds in children	Benefit Reduction of burden and improved social adjustment for caregivers of children with coagulation factor deficiencies as well as decreased frequencies of acute pain and bleeds in children

Discussion

Categorization of telehealth usage in different pediatric chronic diseases

Efficacy of telehealth in improving stuttering in children

It was inferred through various studies that telehealth had a significant role in speech therapy for children who stutter and their parents. This method yielded promising results in reducing stuttering symptoms in children. In particular, live video communication between therapists and preschool children was effective in the treatment of stuttering. Telepractice programs showed a capacity to mitigate stuttering symptoms. Moreover, the COVID-19 pandemic highlighted the importance of telehealth for speech and language pathologists, who showed a favorable attitude towards telepractice, as well as a need for adequate training under challenging circumstances. By leveraging telecommunication technologies, therapists could remotely communicate with children who stutter and their parents, which could lead to significant improvements in stuttering symptoms. The convenience and accessibility of telehealth services made it a practical option for delivering speech therapy, particularly when in-person sessions were not possible. With telehealth communication, therapists could interact with children in real time and provide targeted interventions and strategies to reduce stuttering symptoms. This method enabled therapists to closely monitor the child's progress and tailor therapy techniques accordingly. Ultimately, telehealth demonstrated its efficacy and potential for enhancing speech therapy outcomes in the context of pediatric stuttering [9-11].

Efficacy of telehealth in autism children

With the advent of telehealth, families with children with autism spectrum disorder could access a powerful tool to support their children. Telemedicine offered autism individuals and their caregivers a wealth of options and services that were previously unavailable. Telehealth interventions consistently enhanced various aspects of the lives of children and their parents. With benefits such as improved occupational performance and increased ability to engage in daily activities, telehealth services offered consistency in the care plan, greater opportunities for parent involvement and training, and the ability to focus on training in the natural environment. The integration of traditional and telehealth interventions showed significant changes in symptoms and a reduction in parental stress levels. Internet-based interventions could be equally beneficial compared to face-to-face interventions. Telehealth sessions could also add a fun to behavior analysis for children with autism spectrum disorder or developmental disabilities. Telehealth was a resource for families to describe their needs by telehealth's potential to support [11, 16, 21].

Efficacy of telehealth in cerebral palsy children

Telehealth was an innovative and practical method of providing healthcare services remotely. It received significant attention for its effectiveness in supporting children with autism. One of its notable applications in childhood disabilities was web-based caring training for caregivers of children with cerebral palsy. This method enabled parents to receive training and support from the comfort of their homes. By utilizing this intervention, caregivers could prioritize their educational needs, share their experiences and seek guidance from experts in the field. This personalized approach empowered them to enhance their knowledge and skills. Consequently, they could express their concerns and seek professional advice, which can result in the well-being of themselves and their children. The studies reported a wide range of benefits from the web-based interventions, such as improved quality of life, better psychological well-being, reduced anxiety, depression, stress and pain for caregivers. Telehealth could provide remote access to mental health services such as counseling and therapy sessions to help individuals cope with anxiety, depression, and stress. Mothers could access a variety of resources at their convenience, such as therapy sessions, support groups and educational materials. Their needs for mental health could be satisfied while participating actively in the care of their child. These services could improve mental health, foster resilience and optimize care for children with disabilities. The efficacy of telehealth in supporting children with autism and their caregivers emphasized its potential to revolutionize the delivery of healthcare and to improve the lives quality of those whom affected by autism spectrum disorders [17-19].

Efficacy of telehealth in pediatric cancer and palliative care

In pediatric cancer and palliative care, telehealth could help children and their families receive comprehensive and accessible healthcare services. Medical staff and patients could benefit from remote monitoring and tracking of medication adherence in children with cancer. Moreover, it also provided accurate and up-to-date insights into the disease, available therapies, probable side effects, and strategies for managing cancer in youngsters, their guardians, and caregivers. Telehealth had a beneficial influence on communication, education, the alleviation of pain and symptoms, and support for families in pediatric palliative care, especially in the intensive care unit. Providing opportunities for virtual counseling sessions or group meetings facilitated effective pain and symptom management and enhances family support [20, 21].

Efficacy of telehealth in children with coagulation factor deficiencies

Telehealth was applied as a beneficial tool to meet the

needs of children with coagulation factor deficiencies. The studies reported that the challenges of frequent medical appointments, specialized care, and limitations in daily activities could be very demanding for caregivers and could have a significant impact on their emotional well-being and social life. This emphasized the significance of ongoing telehealth support. Virtual consultations and remote educational resources could help children feel empowered and more in control of their care by promoting their independence. Thus, they felt more self-assured, less isolated and more willing to socialize. In addition to addressing the physical aspects of their condition, telehealth interventions facilitated social adaptation and inclusion, which also could promote their emotional well-being. Telehealth could improve the general health and life quality of caregivers and children with coagulation factor deficiencies [22].

Efficacy of telehealth in children with diabetes

Telehealth studies showed promising results in improving outcomes for individuals with diabetes. It enhanced accessibility, convenience and patient engagement by allowing remote monitoring of blood glucose levels, virtual consultations, educational resources and personalized care. Telehealth promoted patient empowerment and shared decision-making, leading to improved patient self-efficacy and overall satisfaction. It also helped prevent complications and achieve better glycemic control. With advances in technology, telehealth had a vital role in improving the quality of life and long-term health outcomes for individuals with diabetes. Follow-up by nurses over the phone had been found to be effective in improving the self-care of children with type 1 diabetic and their glycosylated hemoglobin levels. This approach employed telecommunication technology to continuously monitor and support children struggling with this chronic disease, resulting in better outcomes. The primary goal of this program was to maintain regular communication between the child and their caregivers with a nurse. Regular phone calls are made to evaluate the child's self-care practices, address any concerns, reinforce education, and provide guidance on diabetes management. This proactive approach ensured that the child and their family receive the necessary support to navigate the complexities of managing type 1 diabetes [23].

Telehealth and COVID-19

Amidst the COVID-19 pandemic, a telehealth model called "Contactless" had been introduced to aid children with chronic diseases and disabilities. This model provided a range of remote services that were organized based on complexity to ensure thorough diagnostic procedures and the continuous monitoring of disease progression in pediatric patients. Telehealth was a crucial element in the management of chronic illnesses, which offered services in areas such as pediatric palliative care, speech-language pathology (SLP) knowledge, attitudes, practice, as well as mental health for parents of children with cerebral palsy. Telehealth emerged as a valuable resource in pediatric palliative care. For children with chronic diseases, the use of telehealth platforms enhanced the delivery of supportive care and symptom management. It was possible to conduct virtual consultations with parents and caregivers to work out treatment options, pain management strategies, and emotional support. Furthermore, telehealth made it possible to remotely monitor and adjust medication so as to reduce unnecessary hospitalizations. As a result of COVID-19 pandemic, telehealth impacted the knowledge, attitudes and practices of speech-language pathologists. In order to treat patients with chronic speech and language disorders, speech therapists modified their approach to provide virtual assessment and therapy sessions. By selecting appropriate tools for assessment and modifying techniques for therapy, they gained expertise in the use of telepractice platforms. Telehealth adoption by SLPs not only increased access to their services but also provided benefits such as the reduction of travel time for patients and the possibility to include the patient's family in therapy sessions. Furthermore, telehealth was helpful in supporting the mental health of parents of cerebral palsy children. In the face of caring for a child with a chronic disease, telehealth provided a lifeline for parents to get access to mental health services, counseling, and support groups. There was reported a significant reduction in parental stress, anxiety, and depression relating to their child's diseases when parents participated in teletherapy sessions. Parents were empowered to navigate the complexities of caring for a child with cerebral palsy by remote support from mental health professionals, especially during the COVID-19 pandemic. Providing patients and families with access to telehealth revolutionized the management of chronic diseases [11, 14, 19, 21].

Studies variables

The categorization of variables can provide valuable insight into the needs, challenges and outcomes of parental satisfaction, child assessment and perspectives on healthcare practices for healthcare professionals, policymakers and researchers. As a result, parents and children could benefit from improved interventions, which in turn could enhance their well-being. The categorization of variables was based on the research objectives and the main focus of the studies. The variables were categorized into three parts, namely caregiver variables, children variables that examine various types of physiological and psychological criteria, and qualitative variables that assessed the telehealth perspective.

Variables related to caregivers

Various variables related to caregivers were considered to determine the impact and effectiveness of telehealth in pediatric care. Parents' satisfaction rate [9, 14, 21],

training and support provided to caregivers [9, 11, 13-18, 21, 23], mental health of parents [13, 19, 20], caregivers' burden [19, 22], and social adjustment [22] were investigated to examine the telehealth effectiveness in pediatric chronic diseases. According to the degree of satisfaction with offered services, the satisfaction of parents with the care received was assessed. On the other hand, support and training were provided to parents as the telehealth option to help them recognize and meet the needs of their children. It was vital for parents to be psychologically and mentally healthy so they could make informed decisions about their children's health. Measuring caregivers' physical, emotional and financial burdens was essential to identify their challenges. A family's overall well-being was impacted by how well parents integrate and adapt to their social environment, as well as how readily resources are available.

Variables related to children's assessment

The studies utilized various variables to access the effects of diseases, conditions, or interventions and monitor advancements, create personalized interventions, and make informed decisions regarding treatment and management strategies. An examination of physiological and psychological factors could offer a thorough comprehension of pediatric health, resulting in better outcomes and an enhanced quality of life for children. The variables were categorized into two parts of physiological and psychological Criteria. When assessing children's health, it was important to consider both their physical and mental states. This comprehensive approach provided a better understanding of their overall well-being and the relationship between their physiological and psychological factors. Several physiological factors were considered to examine the integration of telehealth in the management of chronic pediatric illnesses. According to the studies, speech disorders such as stuttering require the measurement of severity control and percentage of stuttering. The assessment of the extent of speech disruptions was necessary to determine the severity of the condition, evaluate the effectiveness of treatments, and measure the impact of interventions on speech fluency. These were the variables that were considered for measurement [10]. In coagulation factor deficiencies, it was essential to assess the frequency of acute pain and bleeding [22]. A Glycosylated Hemoglobin Levels (HbA1c) study measured a long-term blood glucose control in diabetics [23]. To understand children's ability to coordinate and control large muscle groups for activities such as walking, running, and jumping, gross motor skills were tested. Examining these skills helped measure the impact of autism on motor development, design appropriate interventions, and track progress in motor skill acquisition over time [15, 18]. In this regard, children's engagement performance relates to their ability to engage in meaningful activities, such as schoolwork, playing, and social interaction was considered to assess the impact of telehealth interventions. Psychological criteria were another categorization in children with chronic diseases. Self-care scores focus on a child's ability to perform activities of daily living to evaluate a child's functional independence, identify difficulties, and design interventions to promote self-care skills [16, 23]. Investigating behavioral problems [12-14] was also crucial to assess emotional and behavioral difficulties in pediatric health. Understanding behavioral problems helped identify potential underlying causes, guide appropriate interventions, and monitor the effectiveness of behavioral interventions or treatments by telehealth implementation.

Variables related to perspective examination

It was essential to study the knowledge, attitude and practice of telepractice among parents, patients, and healthcare providers in pediatric healthcare [11, 16, 21]. Parents, patients, and healthcare providers must thoroughly understand telepractice. Addressing worries and ensuring the provision of precise information could be accomplished through specialized training. The studies reported different variables, including usability and acceptance of telehealth [17, 20], revealing the ease of use and acceptance of telehealth technologies. Challenges of pediatric palliative care in the intensive care unit were considered as qualitative criteria to explore the challenges associated with providing palliative care to children in intensive care units by telehealth. Comparative effectiveness of internet-based interventions versus face-to-face interventions was a method to achieve deep perspective by telehealth [13]. Key data elements and technical capabilities were also necessities to plan education and support for parents [9, 11, 13-18, 21, 23].

Telehealth methods

There were various telehealth methods being utilized to provide healthcare services in different settings including training exercises through WhatsApp, live video communication between therapists and children, mobile apps for children with cancer, and web-based interventions for parents.

One way telehealth was used, which involved providing children with training exercises through WhatsApp, using audio and video files [9]. This method utilized messaging apps and smartphones for the convenience of users. Healthcare professionals or therapists could develop and send audio and video files that contain instructions or exercises for children to complete. This method allowed for virtual attractive communication so that children could participate in the exercises at their own pace and convenience. Additionally, it also allows therapists to monitor progress remotely and offer feedback. Therapists could use a method that involves real-time video communication [9, 10] with children at home. This approach enabled therapists to provide immediate support and guidance to children remotely. During

therapy sessions, therapists could assess the progress of children and address any issues or challenges they may encounter. Through video conferencing platforms or specialized telehealth apps [16-20], therapists could interact with children face-to-face without having to be physically present. Children undergoing cancer treatment received vital support through mobile apps. These apps were tailored to meet the specific needs of children with cancer, offering access to educational resources, emotional assistance, medication reminders, symptom monitoring and communication channels with healthcare providers. Regardless of their locations, mobile apps kept children and their families engaged and informed throughout their healthcare journey. To make the experience more enjoyable and engaging for children, many of these apps incorporated interactive features and gamification. Web-based interventions [17-19], such as parent training and support, were a common method of telehealth. Through web applications or platforms, these interventions offered educational resources, counseling and guidance to parents of children with various health conditions. Online counseling enabled parents to gain more knowledge about their child's condition, available treatments and support groups. Web-based interventions could help parents become more involved in their child's healthcare and boost their self-confidence [9, 10, 12-17, 19, 20].

Telehealth implementation time

The studies focused on three different time periods, including six months [9], and a period of three or four weeks [10, 17]. The duration of implementing telehealth varied depending on the treatment plan and individual needs of patients. With a longer duration of six months, patients could easily integrate their treatment into their daily routine without feeling overwhelmed. This approach also allowed for a methodical progression and reinforcement of therapeutic interventions. Moreover, the longer time frame enabled healthcare providers to closely monitor the progress of patients and make modifications to the treatment plan as needed, resulting in better outcomes. An intensive treatment approach were appropriate for patients who require immediate intervention or who had acute conditions that need frequent monitoring. Using this approach, the patient's specific needs were addressed more effectively and progress is faster made. However, it is important to note that maintaining this level of intensity can lead to fatigue or burnout in patients and healthcare providers. It was vital that the patient and healthcare provider maintain regular contact and communication in order to ensure the effectiveness of treatment. Interventions are typically implemented within a time frame of three to four weeks, which is particularly beneficial for acute conditions. These interventions were limited by time and aimed to provide temporary relief or enhance treatment during a short period of time. For patients who were in crisis situations or need immediate intervention, these techniques could be helpful. In time analysis of telehealth, it was inferred that the effects of interventions used may not be permanent, and ongoing care and support may be necessary to help the patient maintain the progress made during the intervention. Additionally, the success of telehealth depends on various factors, such as the quality of treatment and the specific condition being treated, not just the duration of its implementation. [24-26].

Outcomes

In the maintenance phase of stuttering therapy, successful results achieved with telehealth interventions. Therapists could remotely provide children and their parents with effective consultations and guidance via video conferencing. Telehealth ensured continuous care during the maintenance phase by remotely monitoring progress, adjusting therapy techniques and providing regular feedback. It was observed that utilizing telehealth interventions can help to maintain the progress made in earlier stages of therapy and prevent relapses in children suffering from stuttering. According to studies, teletherapy sessions could reduce the severity of stuttering and the percentage of stuttered syllables in children. Telehealth technology allowed therapists to concentrate on specific speech techniques, offer instant feedback and address specific obstacles. The convenience of teletherapy enabled more frequent and consistent therapy sessions, which significantly improved the success of therapy. Through virtual platforms, therapists could modify their methods based on the child's response and provided customized strategies to manage stuttering. Parents were a crucial factor in supporting their child's progress during pediatric therapy, making their satisfaction a critical aspect. Studies showed that telehealth interventions to maintain stuttering therapy are highly approved by parents. The convenience and flexibility of telehealth eliminated the need for travel and allows parents to actively participate in therapy sessions from the comfort of their homes. Additionally, telehealth offered parents the opportunity to learn and practice therapeutic techniques together with their children, promoting a collaborative approach to treatment. The high level of satisfaction among parents led to increased adherence to therapy and positive outcomes of treatment [9, 11].

Studies showed that pediatric care professionals, particularly speech and language pathologists (SLPs) have a positive attitude toward telehealth. Telepractice increased convenience and facilitates continuous monitoring and support, ensuring consistent care and follow-up. The optimistic outlook toward telepractice emphasized its potential for seamless integration into pediatric care. SLPs had a moderate understanding of telepractice and mentioned that it was essential to continually improve their knowledge. Providing adequate care remotely required specialized training and expertise. SLPs might be well-versed in traditional in-person

therapy, but they needed additional training and resources to excel in telepractice. Studies indicated that telepractice is seldom used in the context of treating stuttering children. During investigating the factors resulting to this limited implementation, we could gain insights both into the challenges and opportunities associated with integrating telepractice into pediatric chronic diseases. The aforementioned barriers are being addressed through collaborative efforts made by healthcare providers, policymakers and technology developers [11, 16, 21].

The studies demonstrated that Apps developed for pediatric cancer care have consistently received high ratings from children regarding their attractiveness. Developers of mobile apps for children incorporate interactive features, age-appropriate content and visually appealing interfaces to create a positive user experience. These elements contributed to the enjoyment and engagement of children during using the app. Apps that helped manage pediatric cancer care were highly rated by children who value their efficiency. These apps provided various functions, such as tracking symptoms, reminding patients to take medications, offering educational resources and enabling communication with healthcare providers. By simplifying processes and delivering timely information, apps could enhance treatment management, reduce stress and encourage children to take an active role in their treatment. Children found app-based interventions convenient and empowering, which contributes to their positive opinions on app efficiency [20, 21].

In the same way, caregivers and parents provided favorable ratings for the app's performance and appeal within the realm of pediatric cancer care. Apps offered an easy-to-use platform for caregivers and parents to obtain educational resources, monitor their child's symptoms, interact with healthcare professionals, and stay updated on treatment progress. The app's efficiency was enhanced by its user-friendly interfaces, precise guidelines and customized features, which assist caregivers and parents in navigating and utilizing its functions. Additionally, the app's appealing design and engaging content contributed to a favorable experience for caregivers and parents, enhancing their overall satisfaction and commitment to their child's care. According to studies, caregivers have found online interventions for cerebral palsy to be beneficial and easy to use. These interventions offered educational materials, instructional videos, and interactive modules that assist caregivers in comprehending and implementing appropriate care techniques for their children. The user-friendly interfaces, clear instructions, and customized content improved the practicality of these interventions, making it easier for caregivers to access the information they require. This assistance empowered caregivers and boosts their confidence in dealing with their child's condition. Equipped with knowledge and skills offered by telehealth interventions, caregivers could provide a better care, encourage their child's development, and overcome obstacles more effectively. In addition to mental health care, caregivers could also receive emotional support. Telehealth interventions reduced caregiver isolation, increase satisfaction, and improved caregivers' self-efficacy despite specific challenges and stressors. By treating the physical and emotional components of pain, caregivers could be relieved, and their functioning could be improved [9, 11, 13-18, 21, 23].

The psychological investigation of telehealth effectiveness in children with autism reported the enhancement of balance, coordination, strength, and overall motor proficiency of children. Improvements in gross motor skills could positively impact children's functional abilities and independence, allowed them to participate in physical activities and sports more easily and navigate their environment more effectively. Enhanced balance and coordination could also contribute to a better motor planning and execution, which in turn could help with daily tasks and promote independence [12-16].

The studies displayed that telehealth interventions with an emphasis on total self-care have positive effects on children with type 1 diabetes. In addition to education, telehealth interventions affected counseling, goal setting, and self-monitoring [16, 23]. By providing children with the necessary knowledge, skills, and support, they can manage their diabetes more effectively. Self-care behaviors, such as regular blood glucose monitoring, medication adherence, healthy diet, and physical activity improve diabetes control and self-management. HbA1c levels reduced significantly in patients with type 1 diabetes through self-care and diabetes management interventions. Better glycemic control could be achieved by promoting self-care behaviors like medication adherence, diet choices, and physical activity. With telehealth services, diabetes management and complications associated with uncontrolled blood glucose levels could be managed more effectively, which resulted in lower HbA1c levels.

Children with coagulation factor deficiencies [22] displayed varying levels of acute pain and bleeds, with significant differences observed between groups. This highlighted the potential impact of different conditions or treatments on the frequency and severity of these symptoms. Identifying these disparities could enable healthcare professionals to develop tailored interventions and management approaches that address the unique needs of each group. By providing targeted support and employing effective techniques for pain management, the lives quality of these children could be improved. These outcomes demonstrated the potential of telehealth and tailored interventions to improve outcomes, empower caregivers, and enhance the well-being of children with chronic diseases.

Benefits of telehealth in children with chronic diseases

The studies highlighted the positive impact of telehealth in reducing stuttering severity and emphasized how telehealth facilitates reliable information, promotes communication, enables remote monitoring, and encourages medication adherence. The studies mentioned that telepractice offers convenience and accessibility, particularly for families in remote areas or those facing transportation challenges. This increased accessibility led to earlier intervention and consistent therapy, thus could improve outcomes of treatment [9, 10, 13, 15-22]. Additionally, children and their families could suffer significantly from long-term diseases. A telehealth platform allowed virtual counseling sessions, support groups, and educational resources to be easily accessed. As a result, chronic condition management could be less stressful but more enjoyable by providing access to resources and support from home. Telehealth platforms offered peer support groups, which could be valuable for children with chronic illnesses to connect with others who share similar experiences. These children needed a safe space to communicate with others who understand their struggles and offer mutual support, which is crucial for them. The studies mentioned how telehealth authorizes caregivers, allows them have access to information and guidance remotely, and improves their knowledge and skills in caring for their children [24-28]. The findings demonstrated that telehealth could facilitate effective communication between healthcare providers and families and encourage them to exchange information conveniently. Through video conferencing and secured messaging platforms, families could ask questions, discuss concerns, and obtain reliable information. Direct communication helped parents and caregivers understand their child's care more easily, resulting in a better decision making and a more positive experience. Caregivers could specify their educational priorities, access information at their convenience, and share experiences with other users facing similar challenges. Virtual support groups and online communities provided a platform for caregivers to connect, exchange knowledge, and learn from one another's experiences [29-33].

Challenges of telehealth in children with chronic diseases and solution strategies

According to studies, the main obstacles encountered by telehealth were the requirement for specialized knowledge and skills, and the need for continuous engagement with telehealth applications to effectively adapt traditional therapy techniques to the digital environment. In order to provide high-quality care to children, healthcare providers must receive training in telepractice tools, communication strategies, and assessment methods specifically designed for remote care [11, 14]. For healthcare providers who were speech and language pathologists, they must be trained in telepractice tools, as highlighted by Mansuri et al study [11]. Sabzevari et al mentioned that autistic children and their parents or caregivers preferred in-person therapy due to its personalized and interactive nature to telehealth [14]. To overcome this challenge, comprehensive training programs should be developed, which include both the technical aspects of telehealth and the adaptation of therapy techniques for virtual delivery. These skills were crucial for navigating the digital environment, communicating effectively with children and their families, and conducting remote assessments [34, 35]. Another challenge in telehealth for children was ensuring sustained engagement with telehealth applications. To keep children engaged in telehealth applications, it was important to provide telehealth care with interactive features that capture their attention. Though telehealth was convenient and accessible, children may lose interest in therapy sessions delivered through digital platforms, which could impact the effectiveness of treatment and hinder progress. Gamification, interactive exercises, and virtual rewards systems could be integrated into telehealth platforms to make therapy sessions more engaging and enjoyable for children. In addition, incorporated age-appropriate content, colorful visuals, and multimedia elements could further enhance the appeal of telehealth applications for children. Regular feedback and communication between health providers, children, and their families could also help maintain motivation and foster a sense of connection and accountability [29, 36, 37]. Furthermore, it was crucial to actively involve parents and caregivers in the telehealth process. They could contribute significantly to supporting and strengthening therapy objectives and activities beyond the scheduled sessions. Telehealth services could expand beyond virtual sessions and facilitate continuous progress by providing parents with direction, resources, and techniques to actively participate in their child's therapy [38, 39].

Future research

Examining the long-term effectiveness and sustainability of telehealth interventions would be a valuable addition to the knowledge garnered from previous studies. A comparison between telehealth and traditional in-person interventions can provide insights into the benefits and limitations of each approach. Developing guidelines or protocols to optimize implementation, figuring out the facilitators and barriers for telehealth implementation in various settings, and evaluating its effectiveness by comparison to traditional models of service delivery are key to telehealth's acceptability and engagement. The feedback from patients and healthcare providers is essential for improving telehealth platforms' design and enhancement.

Limitation of study

The research was focused on children who had long-term illnesses with particular afflictions, which limits the adaptability to apply the results of this research to other groups or ailments. Additional studies are necessary to further investigate the relevance and efficacy of these treatments across a more diverse range of individuals and health issues. This study did not explore telehealth applications beyond pediatric chronic disease management in Iran, subsequent studies could compare with international contexts and enrich the understanding of telehealth practices.

Conclusion

The study displayed the incorporating technology into pediatric healthcare interventions is crucial. Utilizing telehealth can overcome geographical limitations, enhance treatment outcomes for patients, and improve access to healthcare. Nevertheless, subsequent research and development are needed to perfect these interventions, assure their effectiveness, and tackle any obstacles that may arise.

Declaration of interest

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Ethics approval

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