



## Review article

# Telemedicine for pediatric patients with chronic conditions

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### Abstract

Telemedicine is the use of information and communication technologies to provide remote medical care. This narrative review was conducted to evaluate the use of telemedicine in children with chronic diseases. A randomized clinical trial reported that the use of telemedicine in pediatric patients reduced days of care outside the home by 24%, complications from serious illnesses by 32%, and annual costs per child by 15%. Its implementation has generated satisfaction among professionals, patients, and caregivers. A literature search was conducted in PubMed, Hinari, and SciELO for articles published between 2020 and 2025; original studies, review articles, and systematic reviews with and without meta-analyses were included. The evidence shows that telemedicine contributes to continuous care, improves treatment adherence, reduces hospitalizations, and offers economic benefits. It also strengthens continuing medical education and fosters the creation of collaborative networks; however, obstacles exist, such as the high cost of technological equipment and limitations in internet access. It is necessary to promote research and develop strategies to ensure equitable and effective access to pediatric telemedicine in resource-limited settings.

### Keywords

Telemedicine, Pediatrics, Chronic Disease.

### Resumen

La telemedicina es el uso de tecnologías de información y comunicación para brindar atención médica a distancia. Un estudio clínico aleatorizado reportó que utilizar la telemedicina, en pacientes pediátricos, redujo un 24 % los días de atención fuera del hogar, un 32 % complicaciones de enfermedades graves y un 15 % el costo anual, por niño. Se realizó esta revisión narrativa para evaluar el uso de la telemedicina en población infantil con enfermedades crónicas. La implementación de esta herramienta ha generado satisfacción entre profesionales, pacientes y cuidadores. Se realizó una búsqueda bibliográfica en PubMed, Hinari y SciELO de artículos publicados entre los años 2020 y 2025; se incluyeron estudios originales, artículos de revisión, y revisiones sistemáticas con y sin metaanálisis. La evidencia muestra que la telemedicina contribuye a una atención continua, mejora la adherencia al tratamiento, reduce hospitalizaciones y representa beneficios económicos. Asimismo, fortalece la educación médica continua y fomenta la creación de redes de colaboración; sin embargo, existen obstáculos como el alto costo de los equipos tecnológicos y las limitaciones en el acceso a internet. Es necesario impulsar la investigación y desarrollar estrategias para garantizar un acceso equitativo y eficaz a la telemedicina pediátrica en entornos con recursos limitados.

### Palabras clave

Telemedicina, Pediatría, Enfermedad crónica.

## OPEN ACCESS

### La telemedicina en pacientes pediátricos con enfermedades crónicas

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## Introduction

The World Health Organization defines telemedicine as the provision of remote health services through the use of information and communication technologies, aimed at the diagnosis, treatment, and prevention of diseases, as well as research

and continuing education for health professionals, with the goal of optimizing individual and collective health. In the Salvadoran context, the use of digital tools and technological systems plays a crucial role in enabling more people to receive medical care, thereby improving the efficiency and quality of services.<sup>1,2</sup>

This tool supports pediatric care, increases patient satisfaction, reduces costs, and decreases emergency unit visits. It is used in specialties such as dermatology, intensive care, neonatology, cardiology, and psychiatry, among others.<sup>2</sup> Likewise, telemedicine has proven effective in the management of chronic childhood diseases such as asthma, epilepsy, and diabetes, where virtual consultations provide continuous care that benefits the management of these conditions.<sup>3</sup> Furthermore, it improves access for patients, particularly those living in marginalized rural areas far from tertiary care hospitals, allowing general practitioners to provide care with specialist support and optimize resources.<sup>4</sup>

Through information and communication technologies, telemedicine helps address challenges in the healthcare system, such as staff shortages, limited access to care, disparities, costs, and communication barriers. Although its use has grown in areas like mental health and subspecialties, its use in pediatrics remains limited.<sup>5</sup>

During the COVID-19 pandemic, telemedicine emerged as a necessity in response to the global health crisis, particularly for developing countries, as it offers an alternative to conventional medicine. Against the backdrop of resource shortages and overwhelmed healthcare services, information and communication technologies were successfully implemented. These facilitate the management of follow-up care for patients and communication with family members during home quarantines.<sup>6</sup> Healthcare providers and patients adapted to a new reality in which communication began to take place through various technological tools.<sup>7</sup>

In 2020, Mexico conducted nearly six million teleconsultations across 20 institutions, while Costa Rica reported that, prior to COVID-19, the Costa Rican Social Security Fund handled more than 13 000 teleconsultations; that number increased by more than 75 % during the pandemic.<sup>8</sup>

Telemedicine offers practical benefits, such as increased treatment adherence, a reduction in missed medical appointments, and more frequent visits, thereby optimizing the management of acute and chronic diseases.<sup>9</sup> In the case of chronic diseases, telemedicine enables effective remote monitoring and facilitates timely interventions.<sup>10</sup>

Synchronous telemedicine consultations represent an efficient strategy for improving access to health services in resource-constrained settings.<sup>11</sup> Studies have shown that integrating these technologies can ensure that more patients, including those in rural and remote areas, receive adequate care.<sup>12</sup>

A literature review was conducted in Hinari, PubMed, and Scielo. Original studies, systematic reviews (with and without meta-analyses), and clinical trials published between 2020 and 2025 were included. Duplicate studies, opinion pieces, and studies focused exclusively on the adult population were excluded. The search was conducted in English and Spanish, using keywords such as "Telemedicine," "Pediatrics," "Chronic disease," and the Boolean operators "AND" and "OR." The objective of this review is to evaluate the use of telemedicine as a medical tool in pediatric patients with chronic diseases.

## Discussion

Overview of the Application of Telemedicine in Children with Chronic Diseases Telemedicine has established itself as a strategic tool and pillar in pediatric care, key to the management of chronic diseases. This tool facilitates access to specialists and enables continuous follow-up through telemonitoring and teleconsultation, thereby optimizing healthcare resources. For effective implementation, emphasis is placed on the need for standardized models, data interoperability, training for professionals, family members, and caregivers, and on ensuring the security and privacy of information. Telemedicine has positioned itself as an indispensable structural component for improving the quality of care.<sup>13</sup>

Telemedicine is classified into two modalities, depending on the type of transmission and the form of interaction with patients: synchronous and asynchronous. The first requires that the physician and patient be connected simultaneously, as in a live videoconference. The second does not require real-time interaction; in this case, information is gathered from medical records, laboratory tests, and images, which is subsequently reviewed by healthcare personnel via a digital platform, to then provide the appropriate treatment recommendation or, if necessary, advise an in-person consultation.<sup>14</sup>

Due to mobility restrictions and the risk of transmission during the COVID-19 pandemic, remote communication technologies were incorporated to ensure the continuity of pediatric care, as children are a high-risk group for developing complications.<sup>15</sup>

Telemedicine allows for more accurate identification of which patients require an in-person consultation and which can be treated remotely, facilitating the management of chronic diseases in the pediatric population. Furthermore, the experience gained during the COVID-19 pandemic

demonstrated the potential of this tool to transform pediatric care and offer a more accessible and efficient model.<sup>16</sup> A randomized clinical trial reported that telemedicine for medically complex children reduced days away from home by 24 %, the incidence of serious illness by 32 %, and annual costs per child by 15 %, demonstrating significant clinical and economic impact.<sup>17</sup> In comparison, another study found that post-discharge telemedicine consultations reduced hospitalizations and emergency room visits.<sup>18</sup> Together, both studies support the effectiveness of this tool.

Nieblas *et al.*, assessed perceptions regarding the use of telemedicine in Latin America during the COVID-19 pandemic and found that approximately 70 % of the opinions expressed about telemedicine services were positive. Additionally, it was reported that 30 % considered this tool effective, while less than 20 % of users rated it as ineffective or expressed uncertainty about its impact.<sup>19</sup>

The rapid adoption of telemedicine highlighted a shortage of trained and up-to-date personnel in this new modality within pediatrics. This underscores the importance of developing training programs that promote comprehensive, safe, and more accessible care. Such programs increase the confidence of healthcare personnel and caregivers to remotely detect warning signs or symptoms in infants.<sup>20,21</sup> In this context, countries such as Chile have implemented initiatives like the Reference Competency Model for Digital Health. This model establishes the skills necessary to efficiently address challenges arising from the digital transformation and prepares professionals in the field to effectively manage these challenges.

Despite the advantages of telemedicine, significant barriers remain, such as a lack of internet connectivity in rural areas. Given this limitation, a viable strategy involves equipping primary care facilities and training health professionals in using digital platforms. This approach not only facilitates access to specialized care but also promotes parental involvement. This especially important when children have complex chronic conditions and provides greater security and support throughout the care process.<sup>22</sup>

From a global perspective, the World Health Organization considers universal connectivity a key principle for digital transformation in the health sector, with the goal of achieving it by 2030. Having connectivity not only improves access to and the quality of health services but also allows countries to recognize it as a social determinant of health, reinforcing its role in equity and inclusion.<sup>23</sup> El Salvador presents

a promising scenario for this transformation. According to data from the Central Reserve Bank, by 2024, 80 % of the population over the age of three was using the internet; that is, more than 4.49 million people. These figures demonstrate the potential for implementing telemedicine in an inclusive and sustainable manner in the country.<sup>24</sup>

This modality benefits physicians in areas such as continuing education, teleconsultation, research, and clinical practice through audiovisual and interactive tools, facilitating professional development, collaboration, and connections with patients and caregivers.<sup>25</sup>

### **The usefulness of telemedicine tools in the medical follow-up of pediatric patients with chronic diseases**

A recent study reports that 79 % of parents feel comfortable using telemedicine and 80 % trust the quality of care received. Additionally, they showed a preference for communicating via email, followed by medical apps and video calls, suggesting a preference for asynchronous methods; however, synchronous methods were very helpful in emergencies.<sup>26</sup> Heimbuch *et al.*, also found high acceptance and satisfaction among parents, highlighting the usefulness, time savings, and convenience of remote consultations.<sup>27</sup> Both studies agree that, while caregivers value the accessibility and efficiency of telemedicine, the main limitation remains the lack of physical contact, underscoring the importance of integrating strategies that combine asynchronous and synchronous methods depending on the clinical situation.

The advantages of telemedicine for patients and their families include time savings by reducing travel to appointments, easing the family's burden, and lowering costs through savings on patient transportation, while providing timely specialized care and equal access to healthcare, especially in remote areas.<sup>28,29</sup>

Pooni *et al.*, evaluated the patient and professional perspectives on the use of telemedicine, including pediatric subspecialties (endocrinology, nephrology, orthopedics, and rheumatology), and identified innovative uses of telemedicine, such as guided examinations and procedures, access to clinical metrics (laboratory results, growth charts), and exploration of confidentiality issues in adolescent patients (substance use, suicide risk, and sexual health). Furthermore, it was established that physicians could obtain the necessary information to perform a focused physical examination and an adequate clinical assessment.<sup>30</sup>

In the educational setting, telemedicine facilitates the management of conditions such as childhood asthma; for example, a study conducted in schools affiliated with the telehealth program at the Medical University of South Carolina, United States, reported that this strategy brings pediatric care closer to patients, particularly in rural and underserved areas, and reduced transportation and time barriers for families.<sup>31</sup>

A meta-analysis that included 34 studies, with a total of 13 269 patients-of whom approximately 50 % received some form of telemedicine intervention-reported that remote monitoring combined with telemedicine consultations reduced mortality and hospitalization due to cardiovascular causes in patients with heart failure, compared to conventional care.<sup>32</sup>

During the COVID-19 pandemic, pediatric surgery adopted telemedicine to ensure the continuity of pre- and postoperative care, thereby minimizing the risks associated with in-person visits. This approach proved to be effective and well-received by physicians and families, thereby establishing telemedicine as a valuable complementary tool, the future integration of which could be optimized to maximize its utility in pediatric surgical care.<sup>33</sup> The implementation of telemedicine in the management of children with severe neurological damage has demonstrated numerous clinical benefits and improvements in families' quality of life by facilitating follow-up from home and establishing better communication with healthcare professionals.<sup>34</sup>

A retrospective study on video call visits integrated into a structured complex care program showed that telemedicine is a feasible and safe tool for the follow-up of children with complex medical conditions, allowing for the detection of clinical problems, adjustment of treatments, and coordination of care following hospital discharge.<sup>35</sup> The tools reviewed and described in this section demonstrate the usability and relevance of telemedicine tools for the management of follow-up in chronic diseases among the pediatric population.

### **Health outcomes of pediatric patients with chronic diseases receiving In- person follow-up compared to telemedicine care**

In pediatrics, the limited availability of specialists, especially in remote regions or those with limited healthcare infrastructure, restricts access to specialized care.<sup>36</sup> In this context, telemedicine constitutes a strategy that helps overcome geographical barriers,

facilitating remote access to specialists, promoting continuity of care, and reducing the need for lengthy travel to receive care.<sup>37</sup>

Ray *et al.*, analyzed the use of telemedicine in consultations with pediatric subspecialists among more than 12 million children; their findings showed that only 16.8 % consulted with subspecialists, and of these, 0.3 % used telemedicine. The use of this tool was more common among children living in rural areas or far from specialists; overall, it remained low and did not reduce geographic or socioeconomic disparities in access to specialized care.<sup>38</sup>

Telemedicine provides avenues to reduce geographic barriers, particularly for patients with special needs, by reducing the need for frequent travel. For example, in hematological diseases where patients undergo hematopoietic stem cell transplantation, the monitoring of therapies and response to treatment can be assessed via telemedicine. In a study on this topic, it was reported that patients who used telemedicine achieved similar or better outcomes compared to those who received in-person care.<sup>39</sup>

In pulmonary diseases, such as cystic fibrosis, relapses due to exacerbations are recurrent; therefore, telemedicine allows for their monitoring by assessing signs and symptoms to monitor patients over the phone. It was shown that this strategy improves adherence to therapy, prevents pulmonary deterioration, and reduces the need for hospitalizations.<sup>40</sup>

Another lung disease, common in pediatrics, is asthma; in these cases, favorable responses have been observed to virtual methods for monitoring children, through questionnaires, phone calls, and video calls. These resources allow for treatment follow-up to monitor adherence, reduce the need for visits to healthcare centers, and provide the same level of satisfaction as an in-person consultation. However, there are limitations, as these follow-ups are indicated for stable patients with mild to moderate exacerbations, a situation where treatment information is provided to parents.<sup>41,42</sup>

Telemedicine is emerging as a valuable tool in the care of children with complex medical conditions, particularly patients with chronic diseases requiring constant monitoring. According to Ferro *et al.*, the implementation of tele-visits, telemonitoring, and other digital tools helps reduce hospitalizations and unnecessary clinic visits while optimizing costs and increasing caregiver satisfaction. Despite this, evidence regarding the impact on patients' quality of life remains limited.<sup>43</sup>

In addition to using telemedicine as a tool for clinical follow-up, it can also be employed as a prevention strategy. A systematic review, which included 40

clinical trials with over 6400 participants, reported that telemedicine-based lifestyle interventions could be effective in reducing weight, body mass index, and body fat in children and adolescents.<sup>44</sup>

### **Limitations of telemedicine use in pediatric patients with chronic diseases**

While telemedicine has expanded access to healthcare services, its implementation among pediatric populations faces significant structural limitations in Latin America. The digital divide is one of the main obstacles, as unequal access to electronic devices, stable connectivity, and high-quality broadband disproportionately affects low-income households and rural areas. Added to this are the costs associated with remote monitoring and internet data usage, which exacerbate the preexisting inequity in access to specialized care.<sup>45</sup>

Due to the urgency caused by the COVID-19 pandemic, the use of simple technologies was prioritized over technically adequate and secure solutions. Furthermore, the lack of sustainable financial models, adequate legal frameworks, and long-term strategic planning has limited the effective implementation of telemedicine in various countries. The hasty adoption of technologies, without well-structured projects and with little rigorous evidence regarding their impact, has contributed to many initiatives remaining as pilot projects, failing to become firmly established in the long term.<sup>46</sup> This points to the variety of possible solutions that emerged during the pandemic and that do not require the rigor and standards necessary to sustain technological innovations that opened the possibility of improving access to and opportunities for health services through virtual means.

Lack of awareness of the advantages and benefits offered by telemedicine and mistrust regarding the quality of care provided through virtual means lead some people to prefer conventional in-person medical care.<sup>47</sup> This cultural and digital literacy gap highlights the need for comprehensive strategies that, in addition to strengthening technological infrastructure, promote digital education and clear regulations, ensuring that telemedicine helps reduce, rather than perpetuate, inequalities in access to health services.

The absence of specific regulations on privacy, data protection, and interoperability creates uncertainty for both professionals and patients. Digital platforms handle personal and clinical information, as well as

additional personal data such as location, social interactions, and emotions, which require robust protection frameworks and effective oversight mechanisms.<sup>48</sup> To ensure security and confidentiality in the use of telemedicine, health systems must promote cross-sectoral regulations with government support, ensuring that personal and health data are used ethically and securely. Some well-known successful examples include Uruguay, with the development of the National Electronic Health Record (HCEN), implemented by presidential decree that requires public and private providers to integrate it, accompanied by interministerial planning and coordination,<sup>49</sup> and the United States of America, where HIPAA (Health Insurance Portability and Accountability Act) establishes privacy and security standards for health information, regulating the use and disclosure of data by covered entities and granting patients' rights of access and correction.<sup>50</sup> These experiences shed light for governments, ministries, policymakers, and health care providers on the use of information and communication technologies and their secure application, reducing uncertainty and strengthening the trust of patients and professionals, while also helping to reduce inequalities in access to medical care.

### **Conclusion**

The available evidence indicates that telemedicine has established itself as an effective tool for the continuous monitoring of pediatric patients with chronic diseases. Studies have demonstrated its effectiveness in the clinical management of these diseases, reporting outcomes comparable to in-person care and satisfaction levels comparable to in-person care among caregivers and healthcare personnel.

Among its benefits are caregiver satisfaction, reduced travel, cost savings, and better disease management attributed to comprehensive, continuous virtual monitoring. Telemedicine still faces significant limitations, including a lack of access to technological devices, connectivity issues in rural areas, insufficient training of medical staff, and the need for clear regulations to ensure privacy and data security. Short-term studies with heterogeneous designs predominate, limiting the generalizability of results and making it difficult to draw definitive conclusions about long-term clinical and economic impacts. Furthermore, significant structural barriers persist, such as the digital divide, lack of staff training, and the need for regulatory frameworks that ensure data security and confidentiality.

Although telemedicine already represents a promising and viable tool, its consolidation as a sustainable model of care requires future research to evaluate long-term outcomes and conduct cost-effectiveness analyses that measure the impact on out-of-pocket expenses among vulnerable populations. More robust evidence is needed to more accurately gauge the true extent of its potential to reduce health inequities.

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