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# Teleconsultation in Neonatology e Pediatrics: A narrative review.

## Teleconsulta en Neonatología y Pediatría: Una revisión narrativa

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**Abstract**

In the medical field, teleconsultation is a mode of medical consultation using telemedicine. This modality has been known for three decades but has received a propulsive boost in the pandemic triennium 2020-2022, in which there was a need to increase and facilitate the use of this technology especially in some strategic areas of the clinical area such as Neonatology and Pediatrics. There are critical issues related to the use of teleconsultation in this area and need to be clarified. Literature demonstrates the strategic importance of using teleconsultation with neonatology and pediatric patients, but several critical elements emerge that do not allow a wide diffusion of this valuable technological and innovative modality. The reasons for these difficulties focus on the knowledge of the technology used, on the prejudices against in-person visits, on the limitation of non-serious cases and on the economic costs related to the maintenance of the system. This review aims to analyze the strengths and weaknesses, to evaluate the real potential of this healthcare IT tool.

**KEYWORDS:** Telemedicine, Teleconsultation, Costs, Pediatrics, Neonatology.

**Resumen**

En el ámbito médico, la teleconsulta es una modalidad de consulta médica que utiliza la telemedicina. Esta modalidad se conoce desde hace tres décadas, pero ha cobrado un impulso durante el trienio pandémico 2020-2022, cuando surgió la necesidad de incrementar y facilitar el uso de esta tecnología, especialmente en áreas estratégicas del ámbito clínico como la neonatología y la pediatría. Existen problemas críticos relacionados con el uso de la teleconsulta en este ámbito que requieren aclaración. La literatura demuestra la importancia estratégica del uso de la teleconsulta con pacientes neonatológicos y pediátricos, pero surgen varios elementos críticos que impiden una amplia difusión de esta valiosa e innovadora modalidad tecnológica. Las razones de estas dificultades se centran en el conocimiento de la tecnología utilizada, en los prejuicios contra las visitas presenciales, en la limitación de casos leves y en los costes económicos relacionados con el mantenimiento del sistema. Esta revisión tiene como objetivo analizar las fortalezas y debilidades para evaluar el potencial real de esta herramienta informática sanitaria.

**PALABRAS CLAVE:** Telemedicina, Teleconsulta, Costes, Pediatría, Neonatología.

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### The use of teleconsultation in Neonatology and Pediatrics. General and defining profiles

Telemedicine originated in the military and commercial sectors in the second half of the last century in response to the need to juxtapose new communication technologies with traditional modes of personal medical examination. Thus, a new mode of service was configured, which became public knowledge only a couple of decades later, even with the advent of the Internet and personal computers[1].

Historically, the development of telemedicine can be primarily associated with the demographic and social dynamics of the specific geographic area, resulting in changes in the health needs of the population[2].

The increasing proportion of elderly individuals and chronic, oncological and psychiatric illnesses have also contributed to the exponential growth in the use of telemedicine since the early years of mechanical and electronic applications in health care[3].

Recently, applications in other clinical settings as well (such as COVID-19 emergency management and use in neonatology and pediatrics) have enabled new assessments in terms of economic, social, and care impact, opening the door to a new way of experiencing and learning about morbid conditions[4,5].

Teleconsultation is characterized by the completion of the healthcare act between two professionals in the sector who consult each other on a specific case to best manage it. It differs from other forms of telemedicine, such as televisit, teleassistance, telemonitoring and telerehabilitation, precisely because the main actors are exclusively healthcare personnel, who can intervene individually or in groups. This innovative service modality is particularly used in cardiology, neurology, surgery and especially in neonatology-pediatrics[1,5].

This review aims to analyze the strengths and weaknesses to the clinical use of teleconsultation in neonatology and pediatrics departments, according to the literature to verify the state of the art on the topic, to evaluate the real potential of this healthcare IT tool and understand whether or not it can contribute to an improvement in the delivery of care or the economic management of the system.

## MATERIALS AND METHODS

A search was conducted on Pubmed from 1 January 2004 to 30 December 2024, selecting systematic reviews, meta-analyses and randomized clinical trials.

The keyword "teleconsultation" combined (AND) with "neonatology" was used.
One thousand seven hundred and eleven useful results were identified.

The exclusion criteria for selecting manuscripts were: a) manuscripts reporting absence or thematic repetition of teleconsultation in the neonatal-pediatric setting already selected (e.g., two or more manuscripts having the same scope of study, with the same conclusions); b) manuscripts reporting only the research proposals or not delving into the study topic; c) manuscripts reporting small population samples or results not adhering to the study object.

There were 29 manuscripts selected and included in this narrative review.

Contents of editorial publications, opinion articles, or journalistic contributions were excluded because they are considered irrelevant or redundant to this scientific research.

The search was not limited to English language articles.
**Figure 1** shows the selection process.

## RESULTS

In the literature **Table 1,** teleconsultation in neonatology and pediatrics is considered the new communication technology applied to traditional personal medical examination modalities most likely to contribute to improved quality of care and user and family satisfaction[1].

It is estimated to be capable of bringing about a net benefit in terms of both clinical and health management and economic-social[2], as demonstrated by several studies conducted during and after the pandemic period by Covid-19 in which there were several restrictions to reduce or avoid infection and its spread[3-6].

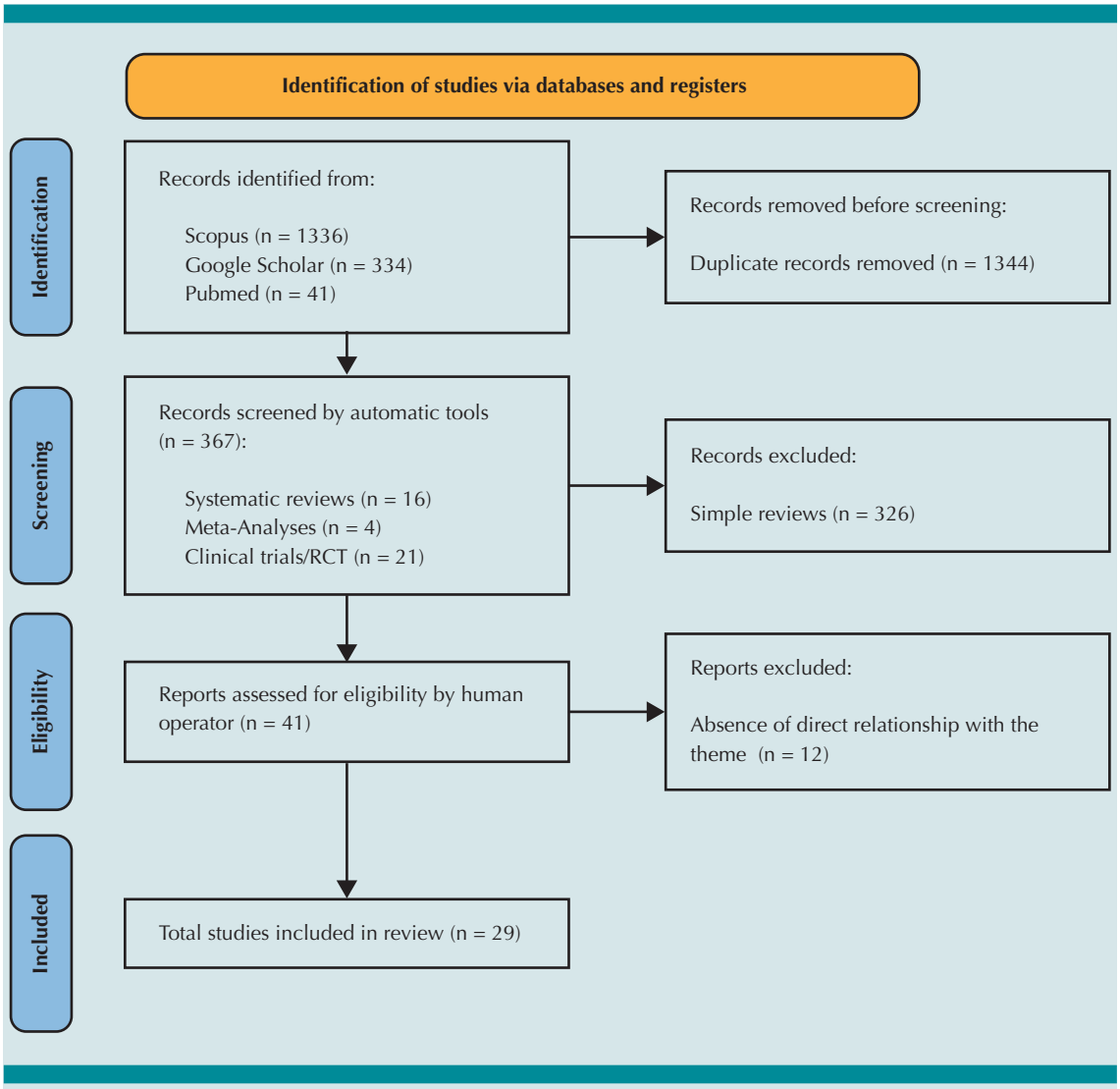


**Figura 1.** *PRISMA flow diagram template for systematic reviews*. Adapted from Matthew J. Page et al. (2021).


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**Table 1.** *Cohort studies*. Type: Meta: Meta-analysis. RS = Randomized Study. R = Review and Systematic. N(RS): quantity of patients involved in the study (continúa en la siguiente página)

| Author (Year) | Objectives | Type: N(RS) | Key Results and Conclusions |
|---|---|---|---|
| Dev et al. (2024) | Cost analysis of telemedicine use in paediatric nephrology-the LMIC perspective | RS: 112 | The use of telemedicine as a follow-up method helps save significant costs and distances travelled by patients. |
| Melot et al. (2024) | Paediatric antibiotic prescribing in a nationwide direct-to-consumer telemedicine platform in France, 2018-2021 | RS: 37587 | Despite current recommendations, pediatric patients were frequently prescribed antibiotics during acute teleconsultations. Specific antibiotic stewardship campaigns should target pediatric teleconsultations. |
| Perrotta (2024) | The applications of the Telemedicine in Neonatology and Pediatrics | R | Significant evidence emerges concerning the importance of using new information technology in the service of medicine, albeit with several practical criticalities, to ensure efficiency, effectiveness, and quality of health service, both concerning social and economic contexts, for Neonatology and Pediatrics departments |
| Sbruzzi et al. (2024) | Assessment of the usability of teleconsultations during the COVID-19 pandemic at a children's hospital | RS: 290 | The usability of a telemedicine system directly affects the efficiency and effectiveness of remote health care. Regardless of the modality, the usability of teleconsultations by caregivers of children aged 1 month to 12 years was adequate. |
| Al-Jadiry et al. (2023) | Comprehensive global collaboration in the care of 1182 pediatric oncology patients over 12 years: The Iraqi-Italian experience | RS: 500 | The exchange of knowledge and expertise across continental boundaries meaningfully improved the diagnoses and management of pediatric cancer at the Oncology Unit at Children's Welfare Teaching Hospital (CWTH). |
| Dahake et al. (2023) | Teleconsultation for Children with Developmental Disabilities During the Coronavirus Pandemic: Caregivers' Experience | RS: 540 | Teleconsultation was found to effectively support the treatment and rehabilitation of children with disabilities during the COVID-19 lockdown, although direct face-to-face consultation was preferred by caregivers of children with physical ailments. The use of modern mobile/digital technologies creates new opportunities to improve the quality and accessibility of such services. |
| Gupta et al. (2023) | Is telemedicine a holy grail in healthcare policy: clinicians' and patients' perspectives from an Apex Institution in Western India | RS: 134 | Although there were some challenges in the implementation of telemedicine, healthcare personnel and users said they had positive perceptions about teleconsultation services. Registration difficulties, lack of communication and an entrenched mentality of physical consultations were the main concerns of patients. |
| Coffey et al. (2022) | Telemedicine Consultation to Assess Neonatal Encephalopathy in Rural Community Hospitals and Tertiary Care Centers | RS: 53 | Infants born in rural hospitals are teleconsulted, for assessment of neonatal encephalopathy, more than 60% later than infants born in a primary or secondary care center. Teleconsultation can significantly reduce this difference by being a feasible, accessible, and reliable way to bring high-level care to outlying rural hospitals. |
| Kesicka et al. (2022) | Fever as the Only First Sign of Crohn's Disease-Difficulties in Diagnosis during the COVID-19 Pandemic | RS: 1 | The diagnostic difficulties associated with the atypical course of Crohn's disease, especially in the context of the ongoing COVID-19 pandemic, were overcome through the use of teleconsultation and observation over the six-week time frame. |

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| Author (Year) | Objectives | Type: N(RS) | Key Results and Conclusions |
|---|---|---|---|
| Mancheron et al. (2022) | Strengths and limitations of a policy for handling and following up suspected pediatric cases of SARS-CoV-2 infection | RS: 131 | To compensate for the limited initial knowledge about pediatric SARS-CoV-2 infections and limited access to nonemergency medical care during the blockade, a local telephone follow-up program was established to remotely monitor children with confirmed or suspected SARS-CoV-2 infection at the pediatric emergency department of a French tertiary care hospital. This telephone follow-up program was simple and seemed necessary in the early phase of the pandemic with an emerging pathogen. However, it was time-consuming and should be improved for further use. |
| Miller et al. (2022) | Updated Review of the Pacific Asynchronous Telehealth System's Impact on Military Pediatric Teleconsultations | RS: 2448 | The extensive use of the integrated military medical teleconsultation (PATH) system by pediatric providers in the Military Health System has led to substantial cost reductions (about $1 million per year). This asynchronous telemedicine platform has proven to be a vital resource in places with limited access or travel restrictions for medical specialists, such as during pandemics. |
| Florea et al. (2021) | Lights and Shadows of the Perception of the Use of Telemedicine by Romanian Family Doctors During the COVID-19 Pandemic | RS: 420 | This study showed the positive perception of primary care physicians on the use of telemedicine. Its adoption in CP shed light on the shadows of the pandemic. The time-consuming nature of teleconsultations, uncertainty in tele-decisions, and patients' difficulties in using the technology were seen as shadows of telemedicine. However, most primary care physicians interviewed agreed with the need for further reimbursement. Future work should focus on innovative solutions for integrating telemedicine as a complementary form of PC, the need for telemedicine-based training for primary care physicians to improve capacity, and patient perceptions of virtual care, helping to build trust and satisfaction. |
| Lapadula et al. (2021) | Evaluating Patients' and Neonatologists' Satisfaction with the Use of Telemedicine for Neonatology Prenatal Consultations During the COVID-19 Pandemic | RS: 35 | Despite patient inexperience with teleconsultations, the quick implementation of telemedicine, and the sensitive reason for the visit, patients and physicians were highly satisfied with virtual visits. Telemedicine is a safe, effective alternative for providing neonatology prenatal consultations for pregnant women with the diagnosis of fetal anomalies during the pandemic. |
| Marques de Valois Lanzarin et al. (2021) | Teleconsultations at a Pediatrics Outpatient Service in COVID-19 Pandemic: First Results | RS: 75 | A teleconsultation service via real-time chat has been launched in the state of Santa Catarina, Brazil. It is the first service to offer this telemedicine modality in the Brazilian public health system, and both patients and healthcare staff have reported satisfaction with it. |


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| Author (Year) | Objectives | Type: N(RS) | Key Results and Conclusions |
|---|---|---|---|
| Tully et al. (2021) | Barriers and Facilitators for Implementing Paediatric Telemedicine: Rapid Review of User Perspectives | R | The most important challenges highlighted from the perspective of healthcare providers included ICT competency issues, lack of confidence in the quality/reliability of the technology, connectivity issues, concerns about legal issues, increased administrative burden, and/or fear of not being able to conduct thorough examinations by relying on subjective descriptions. Facilitators included clear disclosure of the goals of ICT services, staff involvement during planning and implementation, sufficient training, and cultivation of telemedicine champions. Families often expressed their preference for in-person visits, but those who had tried teleconsultations lived far from clinics or perceived greater convenience with technology viewed telemedicine more favorably. Parents' concerns included the responsibility of describing the child's condition in the absence of an in-person visit. |
| Chong et al. (2020) | Creating a Learning Televillage and Automated Digital Child Health Ecosystem | R | This review explores the impact of digital technologies, including telehealth, teleconsultation, wireless devices and chatbots, in pediatrics, showing that automated digital health care finds benefit from improved real-world data collection and the use of artificial intelligence with predictive analytics will, in turn, drive evidence-based decision support systems. |
| Kuchenbuch et al. (2020) | An accelerated shift in the use of remote systems in epilepsy due to the COVID-19 pandemic | RS: 172 | The COVID-19 pandemic has dramatically altered how academic epileptologists carry out their core missions of clinical care, medical education, and scientific discovery and dissemination. Close attention to the impact of these changes is merited. |
| Soriano Marcolino et al. (2020) | Development and Implementation of a Methodology for Quality Assessment of Asynchronous Teleconsultations | RS: 576 | Among medical specialties, pediatrics received proportionately the most discrete ratings for the use of a teleconsultation service. |
| do Carmo Barros de Melo et al. (2018) | Belo Horizonte Telehealth: Incorporation of Teleconsultations in a Health Primary Care System | RS: 500 | The purpose of the present study is to analyze opinions on the obstacles, difficulties, and suggestions on the use of teleconsultations. The main suggestions for increasing the number of teleconsultation requests included information dissemination and prioritization by management; improving infrastructure; organizing the ICU professional's time and schedule; training professionals to use it; and preconditioning referral to secondary level care to a previous teleconsultation. Teleconsultations should be incorporated into the daily routine of intensive care units by all health care professionals of any grade or job description to ensure its use and improve the quality of care. |

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| Author (Year) | Objectives | Type: N(RS) | Key Results and Conclusions |
|---|---|---|---|
| Bagayoko et al. (2017) | The delegation of tasks in the era of e-health to support community interventions in maternal and child health: lessons learned from the PACT-Denbaya project | RS: 8359 | The PACT-Denbaya (Community Access Program for Family Telemedicine) project aimed to help improve the health of mothers and children in rural communities through the delegation of obstetric-gynecological and pediatric tasks, supported by teleconsultation. Task delegation, when supported by teleconsultation, does not meet resistance from specialists and contributes to significant improvements in maternal and child health in remote areas. |
| Deldar et al. (2016) | Teleconsultation and Clinical Decision Making: A Systematic Review | R | Although there are positive impacts of teleconsultation as improving patient management, still gaps that need to be repaired: Specific staff training, infrastructure, technical assistance and funding to ensure service. |
| Lin et al. (2016) | The Health Experts online at Portsmouth (HELP) system | RS: 585 | Health Experts onLine at Portsmouth, in just one-year, improved access and quality of care for service members and their families throughout the Eastern Navy Medicine region, and helped avoid nearly $600,000 in unnecessary costs. |
| Cloutier et al. (2014) | Telepediatric cardiology practice in Canada | RS: 26144 | Telemedicine was introduced into Canadian pediatric cardiology practice in 1987 in the Maritime provinces with real-time echocardiography transmissions. This early experience was gradually adopted by other provinces, and with technological advances, many different applications are now available. Telemedicine has now become an essential tool for providing access to one of 15 pediatric cardiology centers to the entire Canadian population from coast to coast. Indeed, 16 years after its introduction, telemedicine has become an essential component in the provision of pediatric cardiology. |
| Smith et al. (2014) | A review of paediatric telehealth for pre-and post-operative surgical patients | R | Telehealth has the potential for other specialist consultations which require periodic assessment and review. |
| Bertani et al. (2012) | Teleconsultation in paediatric orthopaedics in Djibouti: evaluation of response performance | RS: 48 | Teleconsultation resolved diagnostic uncertainties in 90% of cases, in this study that able to establish the feasibility and usefulness of pediatric orthopedic teleconsultations in Djibouti. The introduction of telemedicine has changed our approach to the challenges posed by patients in remote locations or precarious situations. Expert input is of great benefit to patient management. |
| Lasierra et al. (2012) | Lessons learned after a three-year store and forward teledermatology experience using the internet: Strengths and limitations | RS: 82 | A high degree of diagnostic accuracy both for pediatric and adult consultations was achieved using the teledermatology system with affordable technical requirements. Its usefulness for filtering dermatological referrals was also demonstrated in the study. Nevertheless, other factors such as the reorganization required for the physicians' schedule, remuneration issues, absence of EHR (electronic health record) integration and lack of interaction with the HCO were important limiting factors. |


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| Author (Year) | Objectives | Type: N(RS) | Key Results and Conclusions |
|---|---|---|---|
| Zachariah et al. (2012) | Practicing medicine without borders: tele-consultations and tele-mentoring for improving paediatric care in a conflict setting in Somalia? | RS: 3920 | The introduction of telemedicine significantly improved the quality of paediatric care in a remote conflict setting and was of high added value to distant clinicians. |
| Mahnke et al. (2011) | The Pacific Asynchronous Tele-Health (PATH) system | RS: 300 | PATH provided patient access to pediatric subspecialty expertise via provider-to-provider asynchronous teleconsultation. Internet-based pediatric subspecialty teleconsultation provides fast, convenient, cost-effective, quality pediatric care to populations of patients who might otherwise require transfer to a distant medical facility for more advanced care. |
| Dowie et al. (2007) | Telemedicine in pediatric and perinatal cardiology: economic evaluation of a service in English hospitals | RS: 117 | Telemedicine was perceived by cardiologists, district clinicians, and families as reliable and efficient. The equivocal 6-month cost results indicate that investment in the technology is warranted to enhance pediatric and perinatal cardiology services. |

In the literature, the application of teleconsultation in neonatology and pediatrics has improved health care in terms of efficiency and effectiveness, made data collection more rigorous and systematic (as was already the case in academia and health research centers), and facilitated a better exchange between the knowledge and clinical experiences of two or more geographically distant centers[7-14].

The application of teleconsultation in neonatology and pediatrics has also positively impacted in terms of economic savings related to expenses incurred by users and governmental bodies of the health care sector, both in terms of organization of time and personnel authorized to perform the telemedical service, and in relation to follow-ups provided for the chronic or recovering patients[15-18].

The use of teleconsultation in neonatal and pediatric settings, in the cases allowed by the clinical circumstances and relevant regulations, was perceived by health care personnel and users in almost all cases reported in the literature as positive, confident, and satisfactory[19-23], as shown in **Table 2**, while in some cases perplexities were raised that could diminish the general emphasis and suggest a more cautious and systematic approach[19-20, 24-28].

These concerns have been specifically identified as shown in **Table 3**.

## DISCUSSION

The most common criticisms voiced by healthcare personnel focus mainly on technical-managerial, operational, and legal aspects.

Insufficient technical training in the use of information systems and resistance to approaching technological innovation belong more to mature generations of health care professionals, while across the board there is a shared opinion that the infrastructure is obsolete, inadequate or too costly for a system that already anticipates cost-cutting and understaffing.

Just as much concern is raised by the administrative-management, legal and fiscal issues associated with teleconsultation, which could

**Table 2**. Outline of the strengths and weaknesses of using teleconsultation in neonatal and pediatric settings

| TELECONSULTATION in Neonatology-Pediatrics | | |
|---|---|---|
| **Areas of investigation** | **Strengths** | **Weaknesses (critical issues)** |
| Methodology | Connects two or more neonatologist-pediatrician professionals to facilitate or improve care | Communication may occur between professionals who have different and not always adequate training and experience |
| Effectiveness | Allows medical consultations to be conducted quickly and able to fill knowledge gaps determined by lack of experience | Speed depends on the availability of staff assigned to perform the teleconsultation and the use of IT and management infrastructure |
| Efficiency | Allows medical consultations while saving time | The time spent on medical consultations is reduced by the time spent on patients in their referring hospital |
| Cost-effectiveness | Enables medical consultations by decreasing personal, business, and management costs | The staff assigned to perform teleconsultations and the management information technology infrastructure has a fixed cost to be considered |
| Satisfaction | Enables facilitating health relationships between colleagues, avoiding unnecessary logistical transportation and wasted collateral time | Lack of IT knowledge or IT problems could be a limitation for medical staff not skilled in IT and engineering dynamics |

**Table 3**. Concerns expressed by the target audience regarding the use of teleconsultation in neonatal and pediatric settings

| Weaknesses (critical issues) of using teleconsultation in the neonatal-pediatric setting | |
|---|---|
| **Target audience** | **Concerns expressed** |
| Health personnel | insufficient technical training in the use of computer and telematics systems;<br>the demand for specific reimbursements over and above the salary stipulated in the employment contract;<br>the resistance to approach innovation due to inability determined by lack of experience or mature age nearing retirement;<br>the inadequate and obsolete infrastructure;<br>the reduction of funding to the health sector;<br>the administrative-management, legal, and tax issues related to telemedicine activities;<br>the absence of an adequate and integrated management plan to the IT system currently in place in the department. |
| Health care users (population) | the difficulties of registration for telematics profiles and in general the use of information technology and telematics communications,<br>the irrational belief that the consultation is better in presence despite the positive opinion of the health care provider;<br>the lack of confidence in the specific clinical skills of health professionals located in the most disadvantaged and isolated territorial regions despite the support of more trained or specialized colleagues. |

undermine the quality of service and expose the health professional to even severe penalties.

On the other hand, the most common criticisms voiced by the users who benefit from the service (e.g., inpatients and their family members) focus on the fear that specific training is insufficient and widespread among professions in "central" versus peripheral hospitals, as well as difficulties with the use of technology and the general and widespread distrust of an innovation that might not bring such obvious benefits compared to the in-person visit, despite the health professional's positive opinion.

These concerns appear to be legitimate and should be taken into consideration before envisaging the implementation of a teleconsultation


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system in the public and/or private health sector, to avoid flooding the health care system[29], especially in those countries where health care is free or at least guaranteed with a minimum subjective contribution, as is the case in Italy[1] and a few other nations in the world.

Many of the concerns listed could be resolved by organizing at the policy and corporate level a series of structural activities aimed at verifying the technical-organizational and IT compatibility of the systems used, and a series of educational activities aimed at training health care professionals to the best of their ability, instituting periodic practice audits and training courses to reinforce what has been learned.

Still, the development of an internal communication network could be tested for its effectiveness and efficiency, also by virtue of economic savings for both the health sector and users' families, but also for a better environmental impact brought about by the reduction of the carbon dioxide ($CO_2$) emissions from the use of public and private means of transportation.

### Limitations and future prospects

This research clarifies the strengths and weaknesses in relation to the use of teleconsultation in the neonatal-pediatric field; however, it is structured as a narrative review of the readings and therefore some rigorous selection processes of the readings are missing that could alter the final result. This criticality does not affect the conclusions, as the focus of the work is the general application of teleconsultation in this specific field, without considering the various specializations of interest (for example, between the surgical field and the diagnostic-clinical field).

Future prospects are geared toward the implementation of an Integrated Telemedicine System that is increasingly organized and structured according to individual needs, to meet the needs of users but also of the healthcare personnel engaged in this complex but stimulating challenge.

## CONCLUSION

Significant evidence is emerging in the literature on the importance of using teleconsultation in neonatology-pediatrics departments. However, concerns arising from the critical issues of the system (such as the fear of healthcare professionals of not being able to best manage the technology used, the complexity of clinical cases, excessive workload and the fear of users who are not familiar with technology) are issues that have not yet been fully addressed and clarified, and there is a lack of universally recognized practical and functional solutions. If these potential critical issues were resolved at a corporate and political level, the results would guarantee economic savings, a positive impact on the environment and an improvement in the efficiency, effectiveness and quality of the health service, both from a social and economic point of view. Greater attention to the issue is desirable.

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