Artículo de revisión
Acta Pediatr Mex 2024; 45 (1): 41-59.

https://doi.org/10.18233/apm.v45i1.2702

The applications of the Telemedicine in Neonatology and Pediatrics. A narrative revision.

Aplicación de la telemedicina en Neonatología y Pediatría. Una revisión narrativa

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Abstract

BACKGROUND: "Telemedicine" was born from the combination of new communication technologies with traditional personal medical examination modalities, thus configuring a new service.

METODOLOGY: All clinical trials, meta-analyses, and randomized controlled trials on PubMed were selected through March 30, 2023, for a useful total of 62 studies, for the purpose of narrative revision.

RESULTS: In neonatology and pediatrics, there has been an increase in the last decade, especially in Italy, of remote telemedicine consultation activities (via messaging, televisiting, telemonitoring, coaching, and telehealth), especially in terms of follow-up; however, these the advantages come up against a number of limitations: a) the lack of technical knowledge of the tools used for applied telemedicine; b) the costs of supporting, operating and maintaining the material instrumental network; c) the subjective cognitive distortions of the user and/or his or her family, related to the complication or uselessness of the new technologies compared to traditional methods of health care consultation and delivery; d) the non-applicability of the new technological measures related to telemedicine in the case of medical visits that require physical contact; e) a good part of the published studies have structural errors in the construction phase of the research design, effectively vitiating the final result, as happens in the hypotheses of reduced or insufficient population sample with respect to representativeness, conflict of interest with respect to the hypotheses of publicity of the specific IT tool devised and used by the research team, and satisfaction questionnaires of dubious statistical usefulness.

CONCLUSIONS: 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.

KEYWORDS: Telemedicine; Teleconsultation; Telepediatrics; Telemonitoring; Televisit.

Resumen

ANTECEDENTES: La "telemedicina" se origina de la combinación de las nuevas tecnologías de comunicación con las modalidades tradicionales de examen médico personal, configurando así un nuevo servicio.

METODOLOGÍA: Se seleccionaron ensayos clínicos, metaanálisis y estudios controlados aleatorizados en Pubmed publicados hasta el 30 de marzo de 2023.

RESULTADOS: Para efectos de este estudio, se revisaron en total 62 artículos. En neonatología y pediatría existe un aumento en la última década, especialmente en Italia, de las actividades de consulta de telemedicina a distancia (a través de mensajería, televisiting, telemonitorización, coaching, y telesalud), sobre todo en términos de seguimiento; sin embargo, estas ventajas se enfrentan a una serie de limitaciones: *a)* falta de conocimiento técnico de las herramientas utilizadas para la telemedicina

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Received: 27 de mayo de 2023

Accepted: 10 de noviembre de 2023

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This article has been cited as: Perrota G. The applications of the Telemedicine in Neonatology and Pediatrics. A narrative revision. Acta Pediatr Méx 2024; 45 (1): 41-59.

aplicada; *b)* costos de soporte, operación y mantenimiento de la red instrumental material; *c)* distorsiones cognitivas subjetivas del usuario y/o su familia, relacionadas con la complicación o inutilidad de las nuevas tecnologías en comparación con los métodos tradicionales de consulta y prestación de asistencia sanitaria; *d)* no aplicabilidad de las nuevas medidas tecnológicas relacionadas con la telemedicina en el caso de visitas médicas que requieran contacto físico; *e)* la mayor parte de los estudios publicados muestran errores estructurales en la fase de construcción del diseño de investigación, viciando de hecho el resultado final, como ocurre en las hipótesis de muestra poblacional reducida o insuficiente en cuanto a representatividad, conflicto de intereses respecto a las hipótesis de publicidad de la herramienta informática específica ideada y utilizada por los investigadores, y cuestionarios de satisfacción de dudosa utilidad estadística.

CONCLUSIONES: Surgen evidencias significativas de la importancia de la utilización de las nuevas tecnologías de la información al servicio de la medicina, aunque con varias criticidades prácticas, para garantizar la eficiencia, eficacia y calidad del servicio de salud, tanto en lo que se refiere al contexto social como económico, para los servicios de Neonatología y Pediatría.

PALABRAS CLAVE: Telemedicina; Teleconsulta; Telepediatría; Telemonitorización; Televisita.

BACKGROUND

"Telemedicine" was born from the combination of new communication technologies with the traditional modes of personal medical examination, thus configuring a new service; it can thus contribute to improving the quality of health care, enable the usability of treatment, diagnostic services, medical advice at a distance, and allow the constant monitoring of vital parameters, to reduce the risk of the onset of complications in people at risk. The key concept is precisely that of "distance", which is the very essence of Telemedicine. Moreover, this discipline fosters multidisciplinary confrontation and better continuity between different hospital activities, thanks to innovative technologies, which facilitate a continuous computerized exchange of data, texts, communications (in voice and on-screen) and digital images, leading to net savings in terms of personal (and family) costs incurred by the patient and his or her caregivers and in terms of health and social costs incurred (including psychological ones) by the bureaucratic machine of the public sector of Health Care. Telemedicine is then the future and is an important innovation in the exercise of the medical ars because it makes it possible to support new paths of diagnosis and treatment through the digitization of clinical data and the provision of professional services that can be carried out remotely with appropriate digital technologies.[1]

Historical and legal profiles

Historically, the development of Telemedicine can be associated with the evolution of demographic dynamics and the consequent change in the health needs of the population, which registers an increasing share of the elderly and chronic diseases, since the early years of mechanical and electronic applications in healthcare; however, recently, applications in other clinical areas as well, such as COVID-19

https://doi.org/10.18233/apm.v45i1.2702

emergency management and precisely pediatrics, have enabled new assessments in terms of economic and welfare impact, opening the door to a new way of experiencing the morbid condition, especially when it is chronic and disabling. Telemedicine, however, also means taking care and attention to the legal profiles related to service delivery, the transmission of sensitive data and the rights/obligations arising from the fiduciary relationship with the health professional. And therefore, services are tailored to the case, based on specific needs, according to precise terminologies (often mistakenly confused): a) we speak of "teleconsultation" when the health act is put in place that intervenes in connection with the patient, who interacts remotely with the health professional, either for reasons of support or prescription of therapy or assistance on therapy and symptoms, or between professionals concerning a team or professional confrontation on a specific issue; b) we speak of "telehealth" when assistance is put in place in a general sense, and the consultation is aimed at the management of the therapeutic relationship or organizational relationship.[2]

Telemedicine tools and their various applications

The literature[3-5] documents that services offered and deliverable with the use of telemedicine systems have the following characteristics:

1. "Synchronous (real-time) and asynchronous (delayed) messaging", by which the user can interact with the professional, team, or health facility by exchanging short messages.
2. "Televisit" (real-time interaction), with which the user can make a medical examination with the individual professional or the team, and hand over the documentation before the appointment unless the health care service to be performed does not require physical contact.
3. "Telemonitoring" (deferred monitoring), whereby the user is monitored over a certain period for scheduled functions (e.g., cardiac reveal plus, for analysis of potential arrhythmic episodes);
4. "Teleconsultation" (real-time interaction between professionals and the user for therapy or management of the health issue), with which the user or the professional can interact to perform the service, including because of a complex assessment involving the intervention of two or more professionals, whether it is to schedule specialized care, therapy, or rehabilitation intervention.
5. "Remote coaching" (real-time interaction between professionals and user to teach knowledge and management of the health care issue), whereby the user or professional can interact to schedule the lesson related to the health care service, including because of a complex assessment involving the intervention of two or more professionals, to facilitate the user in learning what is needed.
6. "Teleassistance / Psychological telesupport" (real-time interaction between user and professional in the psychological field), with which the user or professional can interact to carry out the psychological and/or psychiatric service, also because of a complex assessment involving the intervention of two or more professionals.

It is possible then, in this way, an exchange of clinical information, interaction and collaboration between patients and professionals, mentoring and rehabilitation activities, and psychological support therapy administered online. Telephone contact with the patient then allows for dialogue, organizational nursing triage to direct in the most appropriate course of care, and health education, precisely because

contact makes it possible to maintain the human relationship, always personalized and to help the patient become independent and more aware.

Applied telemedicine

Telemedicine experiences have been implemented in many healthcare sectors and for specific medical issues. Recurring themes in the literature concern aspects of complex patient management, critical social and economic issues, the most recurrent and naturally impactful diseases such as metabolic, cardiac, neurological, genetic, immunological, and oncological disorders, to psychological and psychiatric issues.

Applied telemedicine (I): The complex management of the surgical and problematic patient

The tools used in telemedicine with surgical[6-7] and complex[8-9] patients were in particular video telephony (to obtain interim results and history), wearable devices (tablets), remote videotaping of clinical data, and post-visit survey (for satisfaction index), demonstrating that post-hospital follow-up by telematics in pediatric surgery provides a cost-effective alternative that saves time for patients and improves the quality of service and hospital care.[10] Telerobotics then represents a well-established reality, which allows for reducing postoperative complications and improving the quality of patient recovery,[11], as well as telemedicine applied to home hospitalizations, which can improve the quality, efficiency, and effectiveness of care.[12]

Applied telemedicine (II): the critical social and economic issues

The issues related to this topic mainly refer to ancillary patient services such as the use of technology during patient transport,[13] patient management during hospital discharge,[14] and caregiver management of the patient during admission to the neonatal intensive care unit, [15] and any other clinical issues that have a social impact, such as tobacco addiction and misbehaviour to the detriment of the child,[16] alcohol and substance abuse,[17] pregnancy and the entire postpartum period,[18-20] chronic pain management,[21] and vaccine immunization. [22] Each of these issues, in the literature, has been addressed through the use of telemedicine tools, such as broadband audio-video transmissions, messaging, video telephony, and teleconsultation, demonstrating the clear and positive impact on service quality, user satisfaction, and even unnecessary economic health care costs.[23]

Applied telemedicine (III): the metabolic disorders

The issues related to the subject under review mainly relate to obesity,[24-25] diabetes,[26-27] celiac disease,[28] and thyroid dysfunction,[29] demonstrating that the use of videophone, wearable devices (tablets), remote videotaping, and post-visit questionnaires increase user and family member satisfaction, as well as the quality, efficiency, and effectiveness of the service provided, especially in terms of increased understanding and knowledge of the clinical phenomenon.

Applied telemedicine (IV): the cardiac disorders

Recurring themes include the premature risk of death from arrhythmic disorders and cardiac arrest,[30] congenital heart disorders,[31-32] and cardiovascular risk,[33] and even in these hypotheses, the importance of using telemedicine tools such as video telephony, tablets, and teleconsultation emerges to ensure the efficiency and effectiveness of health care intervention for better user satisfaction.

https://doi.org/10.18233/apm.v45i1.2702

Applied telemedicine (V): the neurologic disorders

Telemedicine systems such as messaging, video telephony, and teleconsultation, also find particular application in disorders of neurological origin, such as migraines,[34] brain trauma,[35] epilepsy,[36] and neurodevelopment in general,[37] as well as in pediatric neurodegenerative forms,[38] demonstrating as in previous cases the positive impact on patients and the health care system, in terms of improved quality, services, and subjective satisfaction.

Applied telemedicine (VI): other medical conditions

Telemedicine, according to the literature, also has applications in other disorders, such as genetic diseases,[39] oncological diseases[40] and the palliative care pathway,[41] sepsis and systemic infections,[42] inflammatory states of the gastrointestinal tract,[43] cystic fibrosis[44] juvenile rheumatoid arthritis,[45] allergies and asthma,[46] up to dermatological,[47] otolaryngological[48] and sensory[49] diseases, always with the same aims of positively impacting patients and the health care system, in terms of improving quality, services and subjective satisfaction.

Applied telemedicine (VII): the psychological and psychiatric conditions

Again, telemedicine systems, such as messaging, video telephony, and teleconsultation, have found wide application in the clinical hypotheses of autism[50-51] and many other psychological and psychiatric disorders, such as psychological trauma resulting from early exposure to drugs or sexual misconduct,[52] obsessive-compulsive disorder[53] attention deficit hyperactivity disorder (ADHD),[54] gestational depression,[55] anxiety and depressive states[56-57] although results are mixed, ICT, [58] and behavioral disorders, [59] to positively impact patients and the health care system, in terms of improving quality, services, and subjective satisfaction.

This paper aims to verify the state of the art of telemedicine applied to Neonatology and Pediatrics healthcare facilities.

METHODOLOGY

We searched in Pubmed until March 30, 2023, for meta-analyses, clinical trials and randomized controlled trials, using the keyword "telemedicine", selecting 8,523 useful results. Based on the inclusive criteria, such as telemedicine, preterm, infant, and pediatric, 54 publications were selected, to which an additional 3 systematic reviews and 5 books were added. Simple reviews, opinion contributions, or publications in popular volumes were excluded because they were irrelevant or redundant for this paper, and publications that did not present results or statistical samples but only research protocols and proposals, those that did not specifically address the topic of investigation, those with contradictory data, unreliable data, or otherwise with a deficient research design. The search was not limited to English-language articles. No limit was placed on the year of publication, covering the time window from 1996 to the present period. **Figure 1**

RESULTS

In the literature **Table 1**, new communication technologies applied to traditional modes of personal medical examination configure a new way of performing health care service, to help improve the quality of care, and the satisfaction of the user and his or her family and achieve a net benefit in social and economic terms.[60]

In Neonatology and Pediatrics, in particular, there has been an increase in the last decade, especially in Italy, of these activities, having felt the need for new dimensions of care, es-

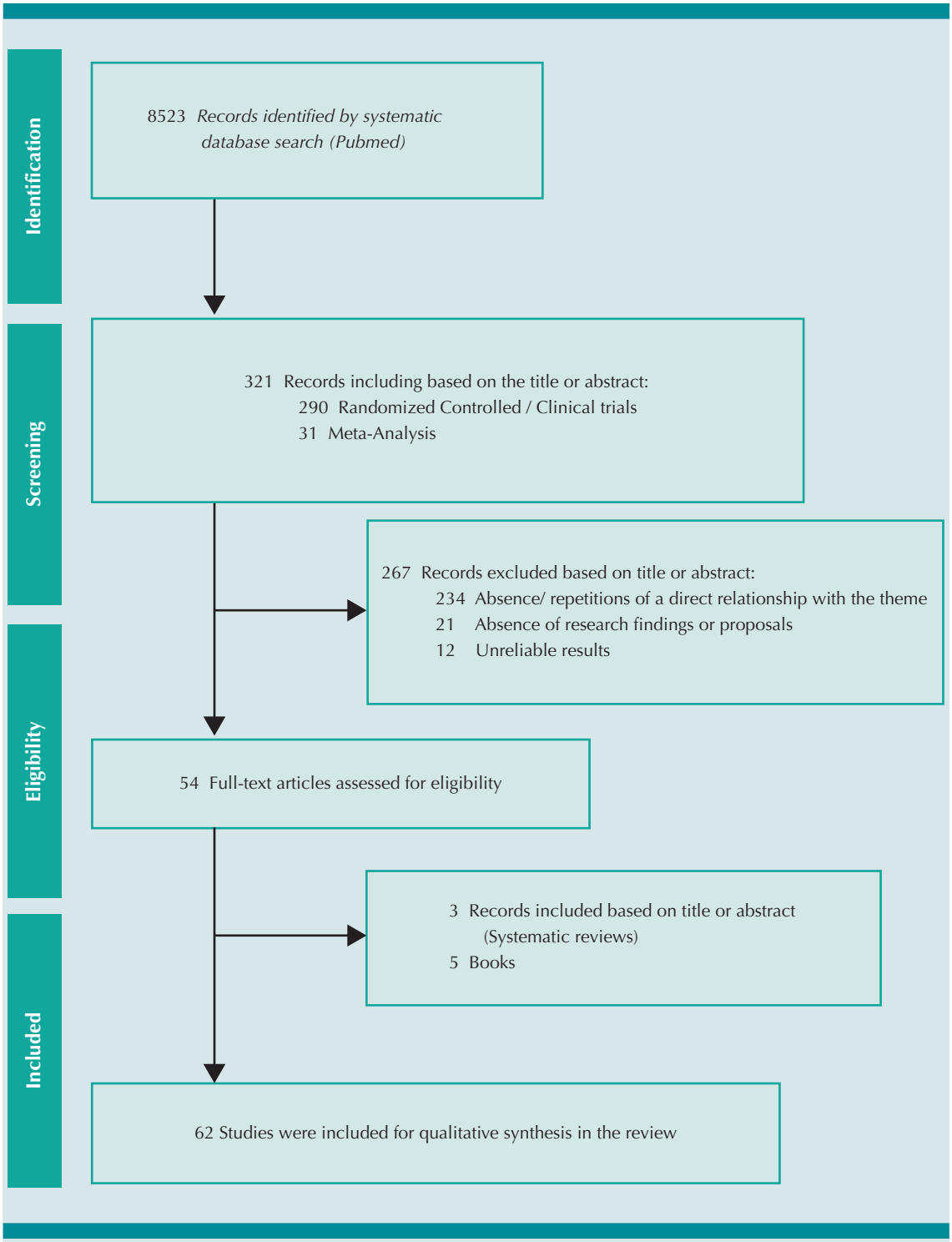

Figura 1. PRISMA flow diagram template for systematic reviews. Adapted from Matthew J. Page, et al. BMJ 2021; 372 (71).[59]

https://doi.org/10.18233/apm.v45i1.2702

Table 1. Cohort studies. Meta: Meta-analysis. Sys = Systematic review. R = Randomized Study. Only R considers the total study participants; Meta and Sys refer to the number of studies (continued on the next page)

Author (year)	Objectives	Type: N	Key results and conclusions
Yoo B-K, et al. (2022)[23]	Economic Evaluation of Telemedicine Consultations to Reduce Unnecessary Neonatal Care Transfers	R: 33	Providing telemedicine and making available consultations to rural hospitals providing level I neonatal care are likely to reduce medical expenditures by reducing potentially avoidable transfers of newborns to level III and IV NICUs, offsetting all telemedicine-related costs.
Boles RW, et al. (2022)[28]	Expanded use of telemedicine for thyroid and parathyroid surgery	R: 94	Many patients undergoing thyroid and parathyroid surgery may be safely treated using comprehensive telemedicine.
Schmidt M, et al. (2022)[34]	Usage Patterns of a mHealth Symptom Monitoring App Among Adolescents With Acute Mild Traumatic Brain Injuries	R: 34	Adolescents with higher socioeconomic status and those managing their emotions using active engagement spent more time on both components of the Self-Monitoring Activity Regulation and Relaxation Treatment (SMART) program.
Butler S, et al. (2022)[45]	Effectiveness of eHealth and mHealth Interventions Supporting Children and Young People Living With Juvenile Idiopathic Arthritis	Meta: 301	Evidence supporting the inclusion of e-health and mHealth interventions in the management of JIAs is increasing. However, this evidence must be considered with caution because of the small sample size, large CIs, and moderate to high statistical heterogeneity. More rigorous research is needed on the longitudinal effects of real-time monitoring, pediatric-child and youth web-based rheumatologist interactions, comparison of different self-management programs, and use of wearable technologies as an objective measure for physical activity monitoring before recommendations informing current practice can be provided.
Raffa LH, et al. (2022)[49]	"Smart Optometry" phone-based application as a visual acuity testing tool among the pediatric population	R: 100	The "Smart Optometry" telephone application was found to be an acceptable tool for home VA testing with good inter-rater reliability for young children, showing good sensitivity in detecting subnormal VA, but lower sensitivity in detecting amblyopia.
Mosquera RA, et al. (2021)[10]	Telemedicine for Children With Medical Complexity	R: 422	The addition of telemedicine to complex care has likely reduced out-of-home care days, serious illness, other adverse outcomes, and health care costs for clinically complex children.
Rosenthal JL, et al. (2021)[15]	Virtual Family-Centered Rounds in the Neonatal Intensive Care Unit	R: 74	A randomized trial to compare virtual FCR with the standard of care in neonatal subjects is feasible and has the potential to improve outcomes for patients and caregivers.
Silang K, et al. (2021)[17]	eHealth Interventions to Treat Substance Use in Pregnancy	Meta: 9	eHealth interventions offer a promising and accessible treatment option to reduce substance use during pregnancy

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Author (year)	Objectives	Type: N	Key results and conclusions
Ybarra M, et al. (2021)[19]	A mHealth Intervention for Pregnancy Prevention for LGB Teens	R: 799	Girl2Girl appears to be associated with an increase in pregnancy prevention behaviors for LGB+ girls, at least in the short term. Comprehensive text message-based interventions could be used more widely to promote adolescent sexual health behaviors in the United States.
Shaygan M, et al. (2021)[21]	The effect of a smartphone-based pain management application on pain intensity and quality of life in adolescents with chronic pain	R: 128	In the context of chronic pain management, a mobile application that incorporates psychological and physical pain management can help adolescents with chronic pain reduce the negative impact of pain on their lives.
Miller LE, et al. (2021)[48]	Reliability and Accuracy of Remote Fiberoptic Nasopharyngolaryngosco-py in the Pediatric Population	R: 16	A telemedicine device for NPL use demonstrates strong diagnostic accuracy across providers and good overall evaluation. It has the potential for use in remote environments.
Corona LL, et al. (2021)[50]	Parent Perceptions of Caregiver-Mediated Telemedicine Tools for Assessing Autism Risk in Toddlers	R: 54	Tele-assessment procedures in which remote psychologists observe the administration of interactive screening instruments by trained on-site practitioners have been used in the past. Although promising, this approach relies on two clinicians, limiting its efficiency and scalability. The present study examined parents' use, acceptability, and perceptions of two caregiver-mediated tools for assessing ASD risk in children, in which remote clinicians guided parents to complete interactive screening activities with their children. Most parents found the tele-assessment comfortable, and many reported that they appreciated the parent-guided nature of these tools. Parents also offered constructive feedback, which was used to modify the teleassessment process for future studies.
Gold MS, et al. (2021)[22]	Consumer acceptability and validity of m-Health for the detection of adverse events following immunization	R: 1139	Overall, attitudes toward SMS surveillance were very favorable. The experience of SMS surveillance has the effect of reducing opposition to an SMS surveillance system and at the same time increasing the likelihood of a preference for prior consent. The detection of a vaccine safety signal may be hindered demographic groups that are non-compliant, and we should undertake further research to understand why these groups are noncompliant and how the situation can be improved.

https://doi.org/10.18233/apm.v45i1.2702

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Author (year)	Objectives	Type: N	Key results and conclusions
Park IT, et al. (2021)[29]	Effectiveness of mHealth-Safe Kids Hospital for the prevention of hospitalized children safety incidents	R: 124	The use of the SKH app is easy to attract the interest of preschoolers and is also easy for nurses to use in clinical trials; therefore, it is considered a useful educational intervention to prevent future safety incidents in clinical settings.
Meyer M, et al. (2021)[30]	E-Health Exercise Intervention for Pediatric Patients with Congenital Heart Disease	R: 61	We found that 24 weeks of web-based exercise intervention with a targeted volume of 60 minutes of exercise per week was safe but did not improve HRPF and HRQoL in children with moderate or complex CHD (congenital heart disease).
Hershey AD, et al. (2021)[33]	Remote electrical neuromodulation for acute treatment of migraine in adolescents	R: 39	REN (Israeli telemedicine medical device) may offer a safe and effective non-drug alternative for acute treatment in adolescents.
Choi SA, et al. (2021)[35]	Impact of mobile health application on data collection and self-management of epilepsy	R: 99	Mobile health technology would help patients and caregivers record their health data and facilitate self-management. Mobile health technology could provide influential clinical validity in epilepsy care when users actively engage and maintain records on the app.
Pappalardo M, et al. (2021)[42]	Telemedicine in Pediatric Infectious Diseases	Sys: 70	Telemedicine increasingly represents the future and the beginning of a new healthcare system that also will redefine medical care for the treatment of infectious diseases, both acute and chronic.
McAlearney, AS et al. (2021)[61]	Examining Patients' Capacity to Use Patient Portals	R: 1081	Based on a questionnaire that investigated 4 dimensions of the Engagement Capacity Framework: self-efficacy, resources, willingness, and capacity) it was determined that patients with fewer resources, less capacity, lower willingness, and lower overall ability to use patient portals used the portal less; conversely, those with lower perceived self-efficacy used the portal more. Providing patients with targeted training in the use of telehealth tools can be particularly beneficial.
Golinelli D, et al. (2020)[1]	Adoption of Digital Technologies in Health Care During the COVID-19 Pandemic	Meta: 124	Digital solutions that integrate with traditional methods, such as diagnostic algorithms based on artificial intelligence and clinical data, appear to be promising. For surveillance, digital apps have already proven their effectiveness; however, privacy and usability issues remain. For other patient needs, various solutions have been proposed, such as telemedicine or telehealth tools.

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Author (year)	Objectives	Type: N	Key results and conclusions
Colbert GB, et al. (2020)[2]	Utility of telemedicine in the COVID-19 era	Sys: 21	Telehealth allows health services to reach patients in their homes, keeping other patients safe through social distancing and maintaining self-quarantine. As part of this health administration, TH allows healthcare providers to focus more resources on pandemic use while continuing to care for the health of non-COVID patients-19.
Dennis C-L, et al. (2020)[18]	Telephone-based nurse-delivered interpersonal psychotherapy for postpartum depression	R: 241	Nurse-provided telephone IPT is an effective treatment for diverse urban and rural women with postpartum depression and anxiety that can improve disparities in access to treatment.
Dol J, et al. (2020)[20]	Impact of mobile health interventions during the perinatal period on maternal psychosocial outcomes	Meta: 130	The predominant results suggest that there are insufficient data to conclude that mHealth interventions can improve self-efficacy and anxiety. Potential benefits of social support were related to interventions targeting postnatal behaviors. Postpartum depression was the most reported outcome. Results comparing pre-post and intervention versus control outcomes showed that mHealth interventions targeting postpartum depression were associated with a reduction in postpartum depression.
Patton SR, et al. (2020)[26]	Intervention to reduce hypoglycemia fear in parents of young kids using video-based telehealth (REDCHiP)	R: 36	Our new video-based telemedicine intervention appears to reduce fear of hypoglycemia and parental stress and may help parents of very young children with T1D to better achieve optimal glycemic control of the child when children are above target.
Lindgren S, et al. (2020)[51]	Functional Communication Training via Telehealth for Young Children with Autism Spectrum Disorder	R: 38	For children with ASD and moderate to severe behavioral problems, parent implemented FCT using telemedicine significantly reduced problem behavior while current interventions generally did not.
DeAntonio JH, et al. (2019)[7]	Utilization of a handheld telemedicine device in postoperative pediatric surgical care	R: 24	Safe and effective care, with high satisfaction of physicians and caregivers, can be provided using the TM (portable device) in the postoperative care of pediatric surgical patients.
Hammersley ML, et al. (2019)[24]	An Internet-Based Childhood Obesity Prevention Program for Parents of Preschool-Aged Children	R: 172	A parent-focused eHealth childhood obesity prevention program can provide support to improve dietary practices and self-efficacy but has failed to reduce BMI.
Huang J-W, et al. (2019)[25]	The effectiveness of telemedicine on body mass index	Meta: 25	Both patients with chronic diseases and overweight/obese people could benefit from telemedicine interventions. We suggest that an effective telemedicine approach should last more than six months and emphasize the importance of post-intervention follow-ups.

https://doi.org/10.18233/apm.v45i1.2702

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Author (year)	Objectives	Type: N	Key results and conclusions
Huang X, et al. (2019)[46]	Allergy and Asthma Care in the Mobile Phone Era	Meta: 24	Strategies to improve patient adherence to treatment are essential to reduce the large health and economic burden of allergic rhinitis and asthma. Cell phone applications (apps) for better management of allergic diseases are increasing in number, but their usefulness for physicians and patients is still debated. Most studies have also pointed out some shortcomings and limitations of telemedicine, especially concerning safety and cost-effectiveness. The use of smartphones and apps for personalized asthma and allergy care needs to be further evaluated and optimized before conclusions can be drawn about its usefulness.
Prado G, et al. (2019)[52]	Rationale and design for eHealth Familias Unidas Primary Care	R: 456	This study will determine whether the intervention, as opposed to prevention, as usual, is effective in reducing drug use, unprotected sex, and STI incidence in Hispanic youth through improved family functioning. In addition, the cost-effectiveness of deploying eHealth Familias Unidas within primary care settings will be determined. The effectiveness of eHealth Familias Unidas Primary Care will further inform the need to integrate effective behavioral health interventions into primary care settings.
Thabrew H, et al. (2019)[56]	Comparison of YouthCHAT, an Electronic Composite Psychosocial Screener, With a Clinician Interview Assessment for Young People	R: 129	This study provides preliminary evidence on the shorter administration time, detection rates, and acceptability of YouthCHAT as a school-based psychosocial screening tool for youth. Although further research is needed to confirm its effectiveness in other age and ethnic groups, YouthCHAT shows promise for aiding the early identification and treatment of common psychosocial problems in youth, including its possible use as part of an annual holistic health screening at school.
Andrén P, et al. (2019)[58]	Therapist-guided and parent-guided internet-delivered behavior therapy for paediatric Tourette's disorder	R: 23	BT (behavioral therapy) delivered via the Internet has the potential to greatly increase access to evidence-based treatment for young people with TD/PTD (ICT/Tourette). Further evaluation of the effectiveness and cost-effectiveness of this treatment modality is needed.
Goedeke J, et al. (2018)[6]	Telemedicine for pediatric surgical outpatient follow-up	R: 224	Posthospital follow-up by telematics in pediatric surgery provides a cost-effective, time-saving alternative for patients and caregivers that is well received and accepted.

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Author (year)	Objectives	Type: N	Key results and conclusions
Auger KA, et al. (2018)[14]	Effects of a 1-Time Nurse-Led Telephone Call After Pediatric Discharge	R: 966	Although contact with the nurse after discharge did not decrease the rate of reuse of urgent health care services after discharge, this method shows promise for strengthening post-discharge education.
Vriezinga S, et al. (2018)[27]	E-Healthcare for Celiac Disease	R: 304	Online consultations for children and young adults with celiac disease save costs, increase specific HRQOL (health index), and are satisfactory for most participants.
Simone M, et al. (2018)[37]	Computer-assisted rehabilitation of attention in pediatric multiple sclerosis and ADHD patients	R: 16	Our data suggest that an attention-focused cognitive rehabilitation program is a suitable tool for improving global cognitive functioning in patients with childhood-onset multiple sclerosis, whereas it has a less pronounced transfer effect in ADHD patients.
McDuffie A, et al. (2018)[38]	Distance delivery of spoken language intervention for school-aged and adolescent boys with fragile X syndrome	R: 20	The intervention taught mothers to use a variety of language facilitation strategies while interacting with their children in the context of shared storytelling. Mothers in the treatment group significantly improved their use of the targeted intervention strategies. Children in the treatment group increased the duration of engagement in the shared storytelling activity and the use of utterances that maintained the topic of the story. Children also showed an increase in lexical diversity, but not in grammatical complexity.
Kalichman SC, et al. (2018)[41]	Mobile Health Intervention to Reduce HIV Transmission: A Randomized Trial of Behaviorally Enhanced HIV Treatment as Prevention	R: 500	Theory-based mobile behavioral health interventions can simultaneously improve cART adherence and sexual health in people living with HIV. Programs that aim to eliminate HIV transmission by reducing HIV infectiousness should be combined with behavioral interventions to maximize their impact and increase the chances of success.
Kohara EK, et al. (2018)[47]	Telemedicine and occlusal caries lesions	R: 119	Photographic diagnosis with smartphone images is feasible and accurate for distinguishing healthy tooth surfaces from extensive karyotic lesions; however, photographic images are not a good method for accurately detecting early and moderate karyotic lesions.
McKissick HD, et al. (2017)[8]	The Impact of Telehealth and Care Coordination on the Number and Type of Clinical Visits for Children With Medical Complexity	R: 163	Coordination of telehealthcare by an advanced practice registered nurse can facilitate the transition from unplanned to planned use of healthcare services among CMC patients (children with medical complexity).

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Author (year)	Objectives	Type: N	Key results and conclusions
Dang S, et al. (2017)[32]	Mobile Phone Intervention for Heart Failure in a Minority Urban County Hospital Population	R: 42	A cellphone-based disease management program is feasible in a minority county hospital population and offers a way to help reduce ethnic disparity.
Carlsen K, et al. (2017)[43]	Self-managed eHealth Disease Monitoring in Children and Adolescents with Inflammatory Bowel Disease	R: 53	The use of eHealth in children and adolescents with IBD is feasible, does not result in reduced disease control, and can be managed by patients without the risk of increased disease activity.
Comer JS, et al. (2017)[53]	Internet-delivered, family-based treatment for early-onset OCD	R: 22	VTC (video teleconferencing) methods can offer solutions to overcome traditional barriers to early-onset OCD care by extending the reach of real-time expert services regardless of children's geographic proximity to quality care.
Forsell E, et al. (2017)[55]	Internet-delivered cognitive behavior therapy for antenatal depression	R: 42	Pregnancy-adapted ICBT (cognitive behavioral therapy via the Internet) for prenatal depression is feasible, acceptable, and effective. These findings need to be replicated in larger studies to validate these promising results.
Whittaker R, et al. (2017)[57]	A mHealth intervention to prevent the onset of depression in adolescents	R: 855	There was no evidence of benefit from CBT intervention on cell phones compared with a control program. Universal prevention of depression remains a challenge.
Finkelstein SM, et al. (2016)[9]	Strategies to Maximize Data Collection Response Rates in a Randomized Control Trial Focused on Children with Medical Complexity	R: 163	High return rates can be achieved for HCSU calendars and health-related surveys, but a flexible and staff-intensive approach to collection methods is needed. Family preference for the approach to data collection should be obtained at enrollment, should be modified as needed, and requires flexible options, training, intensive staff-family interaction, and patience.
Patel S, et al. (2015)[13]	Use of Telemedicine During Pediatric Transport	R: 25	Video conferencing seems as easy to complete as the telephone, with equivalent quality and connectivity. The duration of videoconferencing was found to be equivalent to that of telephone conferencing. The MCOs interviewed felt that videoconferencing improved assessment and dispositions. iPad-based videoconferencing provided significant savings compared to conventional cart- or robot-based units. Further evaluation of videoconferencing during interhospital transport is warranted.

Table 1. Cohort studies. Meta: Meta-analysis. Sys = Systematic review. R = Randomized Study. Only R considers the total study participants; Meta and Sys refer to the number of studies (continued on the next page)

Author (year)	Objectives	Type: N	Key results and conclusions
Ciccia AH, et al. (2015)[36]	Identification of neurodevelopmental disabilities in underserved children using telehealth (INvesT)	Research design	Children living in poverty are at high risk for delays in language and behavioral development and have a discrepancy in diagnosis and access to intervention services. This gap is in part caused by access barriers and the specific characteristics of each child and family. The results of the INvesT study will provide evidence for the use of a telehealth service delivery model to improve access to neurodevelopmental disabilities care for high-risk, low-income children.
Daniel CL, et al. (2015)[39]	Advancing Survivors' Knowledge (ASK) about skin cancer study	R: 24	The current study addresses barriers to screening in this population by providing educational and motivational information to both survivors and physicians about the value of periodic skin examinations. It also uses innovative mobile health technology to encourage and motivate (i.e., activate) survivors to conduct skin self-exams, seek medical examinations, and seek treatment when lesions of concern are found. Finally, as a comparative effectiveness study, this study isolates the effects of adding specific components to the patient activation intervention to test the most effective intervention for increasing vigilance on skin examinations in this high-risk group.
Murgia F, et al. (2015)[44]	Telemedicine Home Program in Patients with Cystic Fibrosis	R: 16	The data are encouraging for a possible role of Telemedicine as a tool for home care of patients with chronic diseases, such as CF. However, reliable data on the long-term efficacy of THC use in treating CF patients are still lacking. It is time to obtain reliable data through a multicenter collaborative study, also to standardize international Telemedicine protocols.
Hipple B, et al. (2013)[16]	Distance-based training in two community health centers to address tobacco smoke exposure in children	R: 647	Through a fully remote intervention, we were able to train pediatricians who visit low-income children to ask their parents whether they smoke, whether they comply with smoke-free rules at home and in the car, and whether other family member's smoke. Implementing a system to routinely ask about tobacco use in the family and smoke-free norms in the home and car is a first step in effectively addressing pediatric smoking. By knowing which family members use tobacco, pediatricians can take the next steps to help families become completely tobacco-free.

https://doi.org/10.18233/apm.v45i1.2702

Table 1. Cohort studies. Meta: Meta-analysis. Sys = Systematic review. R = Randomized Study. Only R considers the total study participants; Meta and Sys refer to the number of studies (Continuation)

Author (year)	Objectives	Type: N	Key results and conclusions
Bradford N, et al. (2012)[40]	A pilot study of the effectiveness of home teleconsultations in paediatric palliative care	R: 14	Palliative care is complex and multiple interventions and supports are needed if home care is to be managed. Telemedicine home consultations are a feasible and acceptable means of facilitating a palliative care consultation that can reduce the burden on families at a distressing time.
McGrath PJ, et al. (2011)[60]	Telephone-based mental health interventions for child disruptive behavior or anxiety disorders	R: 243	Compared with usual care, telephone treatments have led to a significant decrease in diagnosis among children with disruptive behavior or anxiety. These interventions hold promise for increasing access to mental health services.
McCrossan B. et al. (2007)[31]	Assisting the transition from hospital to home for children with major congenital heart disease by telemedicine	R: 220	Videoconferencing not only offers the family the opportunity to have visual and audio contact with staff but also allows physicians to visually assess the patient.
Najmaldin A, et al. (2007)[11]	Early experience of telerobotic surgery in children	R: 40	In children, robotic surgery is safe and applicable to a wide range of surgical conditions.
Nicolas L, et al. (2005)[12]	Videophone assistance and home hospitalization	R: 32	Communication via videophone is feasible and acceptable and could be a useful tool for improving the quality, efficiency, and effectiveness of care.

pecially for pathological conditions that lend themselves well to telematic and remote consultations (via messaging, televisit, telemonitoring, coaching and telehealth), especially in terms of follow-up.[61] In particular, thanks to the 20-year experience of the Italian Society of Telemedicine (SIT), it has been possible to spread the use and importance of telemedicine in health care, with emphasis on the lack of digital skills on the part of professional staff; in particular, in the pediatric setting: "[...] for large-scale development of telemedicine on a large scale, it is necessary to create confidence in the services it can offer and to promote its acceptance by health care professionals and patients. by health care professionals and patients. In this context, patient information on the use of telemedicine, the benefits that can be derived from it, and the training of health professionals and patients in the use of the new tools. professionals and patients in the use of the new technologies are key aspects. [...] For the present and future of digital health care, there is a need for professionals' skills growth and a continuous learning approach throughout their professional lives. Therefore, information and training actions are important to ensure the necessary professionalism and knowledge of the tools, as well as a good understanding of the interactive context in which they are used. In addition, medical skills can be integrated with those of different professional figures (engineers, physicists, statisticians, and mathematicians) to give rise to a new category of health professionals responsible for building new semiotics, identifying criteria for predictive models to be integrated into clinical practice, standardizing clinical and research databases, defining the boundaries of social networks and new communication technologies within health services".[62]

DISCUSSION AND LIMITATIONS

Technology, over the past three decades, has been able to guarantee high performance in terms of efficiency, effectiveness and cost-effectiveness, and digital skills undoubtedly represent the central theme of innovation in the national health service, and not only in the pediatric theme, both for the system-country and for all the actors involved: patients, physicians, technicians, IT specialists and managers. It is clear, however, that, as in any other health and care pathway, training tools are at the heart of innovation, and for the current present and the imminent future (of digital health care), exponential growth in professionals' skills and a continuous learning approach throughout professional life is required. Progress, therefore, positively impacts both the system country and individuals, but it must be aided with continuous training and information actions to ensure the necessary professionalism and knowledge of the tools, as well as a good understanding of the interactive context in which they are used continuously and functionally for public and private health objectives. And while, on the one hand, information follows communication and social channels, training must be concerned above all with educational profiles, both concerning new technical and technological knowledge and concerning the practical part, that is, new information acquisition equipment and data transmission technologies. Therefore, it is essential that learning becomes a systematic action and not just an extemporaneous proposal aimed at the short-term goal. In pediatrics, the focus must be more maintained at a higher level, as patients are by their nature considered "fragile"; to date, however, there are several implementation limitations to the active regime of telemedicine in pediatrics and neonatology: *a)* the lack of technical knowledge of the instruments used for applied telemedicine;[63] *b)* the costs of supporting, operating and maintaining the material instrumental network; *c)* the subjective cognitive distortions of the user and/or his or her family, related to the complication or uselessness of the new technologies compared to traditional methods of health consultation and delivery; *d)* the non-applicability of the new technological measures related to telemedicine in the hypothesis of medical examination that requires physical contact or other physical modality; *e)* a good part of the published studies have structural errors in the construction phase of the research design, effectively vitiating the final result, as happens in the hypotheses of reduced or insufficient population sample with respect to representativeness, conflict of interest with respect to the hypotheses of publicity of the specific IT tool devised and used by the research team, and approval questionnaires of dubious statistical usefulness. These reported limitations, however, should not discourage the hypothesis that technology can be used constructively and functionally to foster a better approach to the issue, to achieve the social and economic benefit, for the individual user and the entire community.

CONCLUSION

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 in social and economic contexts, for Neonatology and Pediatrics departments.

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