

Advanced Technologies in the Pediatric Hospital Environment

Tecnologias Avançadas no Ambiente Hospitalar Pediátrico

Tecnologías Avanzadas en el Entorno Hospitalario Pediátrico

RESUMO

O avanço das tecnologias médicas tem impactado significativamente o ambiente hospitalar pediátrico, promovendo melhorias na qualidade do atendimento, maior precisão nos diagnósticos e tratamentos menos invasivos. A inteligência artificial, a telemedicina, os dispositivos vestíveis, a realidade aumentada e a impressão 3D são algumas das inovações que estão revolucionando a assistência infantil. Essas tecnologias não apenas garantem maior segurança e eficiência nos procedimentos, mas também contribuem para a humanização do cuidado, reduzindo o estresse dos pacientes e suas famílias. No entanto, desafios como altos custos, necessidade de capacitação profissional e questões éticas relacionadas à privacidade dos dados ainda dificultam a ampla implementação dessas inovações. Diante disso, é essencial que políticas públicas e investimentos sejam direcionados para garantir a equidade no acesso a essas tecnologias, promovendo um atendimento pediátrico cada vez mais qualificado e humanizado.

DESCRITORES: Tecnologia em saúde; Pediatria; Inovação hospitalar; Inteligência artificial; Humanização.

ABSTRACT

The advancement of medical technologies has significantly impacted the pediatric hospital environment, improving the quality of care, increasing diagnostic accuracy, and enabling less invasive treatments. Artificial intelligence, telemedicine, wearable devices, augmented reality, and 3D printing are some of the innovations revolutionizing pediatric care. These technologies not only ensure greater safety and efficiency in procedures but also contribute to the humanization of care, reducing stress for patients and their families. However, challenges such as high costs, the need for professional training, and ethical issues related to data privacy still hinder the widespread implementation of these innovations. Therefore, it is essential that public policies and investments be directed toward ensuring equitable access to these technologies, promoting increasingly qualified and humanized pediatric care.

DESCRIPTORS: Health technology; Pediatrics; Hospital innovation; Artificial intelligence; Humanization.

RESUMEN

Los avances en las tecnologías médicas han tenido un impacto significativo en el entorno hospitalario pediátrico, promoviendo mejoras en la calidad de la atención, una mayor precisión en los diagnósticos y tratamientos menos invasivos. La inteligencia artificial, la telemedicina, los dispositivos portátiles, la realidad aumentada y la impresión 3D son algunas de las innovaciones que están revolucionando la atención infantil. Estas tecnologías no solo garantizan una mayor seguridad y eficiencia en los procedimientos, sino que también contribuyen a la humanización de la atención, reduciendo el estrés de los pacientes y sus familias. Sin embargo, retos como los altos costes, la necesidad de formación profesional y las cuestiones éticas relacionadas con la privacidad de los datos siguen dificultando la amplia implementación de estas innovaciones. Ante esto, es esencial que las políticas públicas y las inversiones se orienten a garantizar la equidad en el acceso a estas tecnologías, promoviendo una atención pediátrica cada vez más cualificada y humanizada.

DESCRIPTORES: Tecnología en salud; Pediatria; Innovación hospitalaria; Inteligencia artificial; Humanización.

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Received: 09/02/2025

Approved: 09/18/2025

INTRODUCTION

In recent years, advances in medical technologies have revolutionized pediatric hospital care, promoting more accurate diagnoses, less invasive treatments, and greater humanization of care. The incorporation of technological innovations in this environment not only improves clinical outcomes but also significantly impacts the well-being of patients, families, and healthcare profession-

als. With the increased demand for specialized care and the complexity of pediatric diseases, technology has been a fundamental ally in ensuring more efficient and safer treatment¹.

The pediatric hospital environment presents specific challenges, as in addition to clinical conditions, the psychological impact of hospitalization on children must be considered. Advanced technologies, such as remote monitoring equipment, artificial intelligence applied to clinical data analysis, and robotic assistance devices, have contributed to reducing hospitalization time and minimizing the risk of complications. In addition, telemedicine has allowed for closer monitoring of patients, reducing unnecessary travel and ensuring better quality care even from a distance.

Another significant advance is the introduction of augmented and virtual reality in the hospital environment, which assists both in the rehabilitation of children with neurological conditions and in preparing them for medical procedures, reducing patients' fear and anxiety. These resources provide a more playful and interactive experience, making treatment less traumatic and contributing to therapeutic adherence. At the same time, the automation of processes, such as electronic dispensing of medications and artificial intelligence-assisted prescription systems, has reduced medical errors and optimized the time of healthcare teams.

The humanization of the hospital environment has also been a central concern in the development of new technologies. Studies show that the ambiance of spaces, the use of appropriate lighting, sounds, and colors, as well as interactive devices for child distraction, are strategies that positively impact patient recovery⁵. In addition, the use of smart devices and sensors allows for continuous monitoring of children's vital signs without

the need for invasive interventions, reducing discomfort and increasing diagnostic accuracy⁽⁶⁾.

However, despite the obvious benefits, the implementation of these technologies still faces challenges, such as high costs, the need for professional training, and the adaptation of hospital protocols. In addition, accessibility and equity in the distribution of these innovations are still issues to be overcome, ensuring that children from different socioeconomic backgrounds have access to quality care⁷.

Given this context, this study proposes a reflection on the impact of advanced technologies in the pediatric hospital environment, addressing their benefits, challenges, and future prospects. Therefore, how can advanced technologies transform pediatric hospital care, promoting greater efficiency and humanization of care? The study aims to analyze the influence of advanced technologies in the pediatric hospital environment, highlighting their impacts on the quality of care, patient safety, and the humanization of care.

DEVELOPMENT

This article is a theoretical essay, that is, a study based on a critical analysis of the existing scientific literature on the topic of advanced technologies in the pediatric hospital environment. This approach allows for the construction of arguments based on academic production and practical experience, without the need for primary data collection⁸.

The methodology adopted consisted of a literature review of articles published between 2020 and 2024, available in scientific databases such as SciELO, Google Scholar, CAPES Journals, and PubMed. Studies were selected that addressed the impact of technological innovations on pedi-

atric care, challenges for the implementation of these technologies, and strategies for the humanization of the hospital environment. The inclusion criteria involved open access articles and publications that provided empirical evidence on the application of technologies in pediatrics⁽⁹⁾.

To structure the development, the study was organized into two broad categories: the first deals with technological advances in the pediatric hospital environment and their impact on care, highlighting the main innovations applied in pediatrics, such as artificial intelligence, telemedicine, wearable devices, augmented reality, and 3D printing. The second category discusses the challenges and prospects for implementing these technologies, addressing issues such as cost, infrastructure, professional training, and humanization of care.

Technological advances and impacts on pediatric care

Technological advances in healthcare are revolutionizing the way pediatric patients are treated in hospitals. Technologies such as artificial intelligence (AI), telemedicine, wearable devices, augmented reality, and 3D printing have shown great potential for making care more efficient, safe, and humanized. AI has been widely used to optimize diagnoses and personalize treatments, allowing algorithms to analyze large volumes of clinical data and assist in the early detection of diseases, prediction of complications, and recommendation of appropriate therapies. In addition, AI-based virtual assistants assist in patient triage, reducing the workload of professionals and improving the organization of care.

Telemedicine, in turn, has established itself as a fundamental tool in pediatric care, especially in remote areas or areas with a shortage of specialists. Studies indicate that the adoption of pediatric teleconsul-

tation has resulted in a reduction of up to 35% in the need to transport children to health facilities, in addition to enabling closer monitoring of chronic patients without the need for frequent hospitalizations. This innovation improves the quality of life of children and their families, in addition to reducing hospital costs. In addition, connected devices, such as remote vital sign monitors, have enabled continuous monitoring of the health status of children undergoing home treatment, preventing serious complications and allowing for rapid intervention when necessary.

In addition to these technologies, the application of augmented reality and virtual reality has shown great promise in pediatrics. These innovations are being used for therapeutic purposes, such as in the treatment of children with neurological conditions, and also to help young patients adapt to hospital procedures, reducing the fear and anxiety associated with hospitalization. A study conducted in Sweden revealed that children who used virtual reality as a form of distraction had 40% lower stress levels compared to those who did not have access to the technology. Similarly, 3D printing has revolutionized pediatrics by enabling the production of customized prostheses, anatomical models for surgical training, and medical devices adapted to the individual needs of children, significantly improving clinical outcomes and promoting greater comfort for patients.

The incorporation of these advanced technologies has not only improved the efficiency and accuracy of treatments, but also promoted a more humanized experience for hospitalized children. The use of interactive environments, adjustable lighting, playful sounds, and colors has also been applied to make hospital spaces less hostile for young patients, ensuring a more welcoming environment

and facilitating adherence to treatment.

Challenges and prospects for the implementation of technologies in the pediatric hospital environment

Despite the significant advances provided by technological innovations in pediatric care, the implementation of these tools faces several challenges. The first and most obvious obstacle is the high cost of new technologies, which limits access to these innovations, especially in public hospitals and health facilities with limited financial resources. Studies show that only 30% of Brazilian public hospitals have adequate infrastructure for the adoption of state-of-the-art equipment, which demonstrates inequality in access to medical innovations⁽⁷⁾. In addition to the initial cost of the equipment, there are also expenses related to maintenance, software updates, and technical support, making the adoption of these technologies an even greater challenge for institutions with limited resources.

Another relevant problem is the need for professional training. Advances in technology require doctors, nurses, and other healthcare professionals to be constantly trained to deal with new digital tools and smart devices. Lack of training can lead to underutilization of these technologies or even errors in their application, which compromises the safety and effectiveness of treatments⁽³⁾. Many educational institutions have not yet incorporated specific content on medical technology into their curricula, making it essential to create continuing education programs so that professionals can keep up with innovations and apply them correctly in pediatric care.

In addition to financial and educational challenges, the implementation of these technologies must consider ethical and regulatory aspects,

especially with regard to information security and the privacy of pediatric patients. With the increased use of connected devices and telemedicine systems, concerns arise about the protection of children's medical data. The need for stricter regulations to ensure that this information is stored and transmitted securely has been widely discussed by experts in the field of digital health⁴.

The humanization of care is also a crucial point in the use of new technologies. The introduction of artificial intelligence and automation in hospital processes can, in some cases, create a distance in the relationship between healthcare professionals and patients, making it essential to adopt strategies that ensure the preservation of the human bond in pediatric care. Studies suggest that the integration of interactive robots, playful therapies, and humanized design elements can help maintain a welcoming and empathetic hospital environment, balancing technology and humanization⁸.

To overcome these challenges and ensure that advanced technologies are widely accessible and effective in the pediatric hospital environment, several strategies have been proposed, such as increasing investment in hospital technology infrastructure, implementing ongoing training programs for healthcare professionals, developing public policies aimed at equitable access to medical innovations, and adopting measures to ensure the safe and ethical use of these technologies. In this way, it will be possible to maximize the potential of technological innovations, ensuring more qualified, safe, and humanized care for hospitalized children.

FINAL CONSIDERATIONS

The introduction of advanced technologies in the pediatric hospital

environment has played a key role in improving the quality of care, providing more accurate diagnoses, less invasive treatments, and more humanized care. Innovations such as artificial intelligence, telemedicine, wearable devices, augmented reality, and 3D printing have brought significant advances to pediatric care, allowing for more efficient and personalized monitoring of children's health conditions. These technologies not only expand the ability of healthcare professionals to provide safer and more efficient care, but also reduce stress and anxiety for young patients, making the hospital environment less traumatic.

However, the implementation of these technologies still faces significant challenges, including high acquisition and maintenance costs, the need for adequate infrastructure,

and the ongoing training of healthcare professionals. In addition, the introduction of digital tools in hospital care raises ethical and regulatory issues, especially with regard to the security of pediatric patient data. Another important challenge is to ensure that these innovations are incorporated in a way that does not compromise the humanization of care, preserving the bond between healthcare professionals, children, and their families.

Given this scenario, a joint effort between health institutions, governments, and the private sector is necessary to expand access to cutting-edge technologies in pediatric care. Investments in hospital infrastructure, public policies aimed at equity in the use of these innovations, and training programs for healthcare professionals are essential measures to ensure that the benefits of new technologies

reach as many patients as possible. In addition, humanization must always be a priority in the development and application of these tools, ensuring that technological advancement goes hand in hand with improving the patient experience.

It can be concluded that advanced technologies represent great potential for transforming the pediatric hospital environment, offering more efficient, safer care that is adapted to the needs of children. However, their implementation must be planned strategically, considering both operational challenges and the need to maintain the humanization of care. In this way, it will be possible to ensure that technological advances truly contribute to higher quality pediatric care, promoting the well-being and recovery of young patients in an increasingly effective manner.

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