

AI-DRIVEN E-HEALTH INNOVATIONS: IMPACTS ON PEDIATRIC HOSPITAL MANAGEMENT - A LITERATURE REVIEW

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ABSTRACT

Artificial intelligence (AI) is transforming pediatric hospital management by improving clinical decision support, diagnostic accuracy, operational efficiency, and patient engagement. This literature review aims to synthesize evidence on the impacts of AI-driven e-health innovations within pediatric hospital settings. A literature search of PubMed, ScienceDirect, and Google Scholar was performed for peer-reviewed studies from the last decade, focusing on AI applications for inpatient and operational pediatric care. Studies were screened based on relevance, language, and pediatric scope (0-18 years old). Analyses encompassed clinical, operational, and ethical impacts, with an emphasis on diagnostic tools, decision support, predictive analytics, and telemedicine. Findings highlight that AI augments early disease detection, supports individualized interventions, and streamlines hospital administration through automation and data-driven forecasting. Enhanced family engagement and remote monitoring expand care accessibility for chronic and geographically dispersed pediatric populations. However, challenges remain, including limited pediatric datasets, algorithmic bias, ethical concerns, and barriers to system integration. In conclusion, AI-driven innovations offer substantive improvements in pediatric hospital management, but realizing their full potential requires collaborative efforts to address safety, transparency, regulatory alignment, and pediatric-specific issues. It is recommended that future research prioritize explainable AI, multicenter data initiatives, and stronger ethical frameworks to guide safe and equitable adoption.

Keywords: artificial intelligence; hospital management; e-health; child health

INTRODUCTION

Artificial Intelligence (AI) has become an important innovation in healthcare by improving diagnostic accuracy, treatment planning, and hospital efficiency (Abusamra et al., 2025). In pediatric hospitals, AI is especially valuable because children often experience complex and rapidly changing conditions that require fast and precise clinical decisions. Traditional healthcare systems frequently struggle to manage large amounts of patient data and provide individualized care, while AI can analyze extensive datasets and identify patterns that may not be easily recognized by clinicians (Al Meslamani et al., 2023).



Figure 1. Variables for AI in healthcare

AI is widely applied in pediatric diagnostic support through machine learning algorithms that analyze electronic health records, medical imaging, and genetic data to detect diseases earlier (Al-Sofyani et al., 2025). AI-based imaging systems have been used to identify congenital heart defects and pediatric cancers, enabling earlier intervention and improved long-term outcomes. AI also supports Clinical Decision Support Systems (CDSS) by providing predictive analysis and personalized treatment recommendations, reducing medical errors

and improving patient safety, particularly in pediatric care that requires age-specific treatment considerations (Chaddad et al., 2022).

Beyond clinical care, AI improves hospital operations through predictive analytics that optimize staffing, patient flow, and resource allocation. In pediatric hospitals, AI-assisted planning helps manage fluctuating demands in emergency and intensive care units while reducing overcrowding and waiting times (Children’s Hospitals and Clinics of Minnesota, 2025). AI integration in telemedicine and remote monitoring also expands healthcare access, especially for children with chronic diseases in rural or underserved areas (Ching et al., 2025).

Despite these benefits, AI implementation faces several challenges, including data privacy, ethical concerns, limited pediatric datasets, and system integration barriers (Davenport, 2019; Karrar et al., 2025). Hospitals also require trained healthcare professionals who can effectively use AI tools within clinical workflows (Muralidharan et al., 2024). Future developments such as explainable AI and federated learning aim to improve transparency and protect patient privacy (Naseef et al., 2025). Overall, AI-driven e-health innovations have significant potential to improve pediatric hospital management, patient outcomes, and healthcare efficiency (Park et al., 2025).

METHOD

This study used a literature review approach to examine the impact of AI-driven e-health innovations on pediatric hospital management. Relevant articles were collected from databases including PubMed, ScienceDirect, and Google Scholar using keywords such as “Artificial Intelligence,” “E-Health,” “Pediatric Hospital Management,” “Clinical Decision Support Systems,” “Telemedicine,” and “Healthcare Operations.”

The review included full-text English articles published within the last ten years that focused on AI applications in pediatric healthcare, particularly their impact on clinical outcomes, operational efficiency, and patient management. Studies focused mainly on adult populations or unrelated topics were excluded.

The selection process involved identifying articles, screening titles and abstracts, and conducting full-text evaluations. After the screening process, seven relevant articles were included in the review. Data from these studies were analyzed descriptively to identify the benefits, challenges, and future potential of AI-driven e-health innovations in pediatric hospital management.

RESULTS AND DISCUSSION

AI-driven e-health innovations are transforming pediatric hospital management by improving clinical care, operational efficiency, and patient engagement. AI applications support diagnostics, risk prediction, hospital administration, and personalized treatment, helping pediatric hospitals address the complex demands of child healthcare (Naseef et al., 2025).

Table 1. Major outcomes from AI integration in healthcare

Domain	Key findings/results
Clinical practice	AI enhances diagnostic accuracy in medical imaging and pathology analysis
	AI integration improves decision-making in chronic disease management and drug discovery
	AI improves early detection of malignant tumors in mammography
	AI predicts kidney function decline via total kidney volume analysis
	AI-designed inhibitor for hepatocellular carcinoma enters clinical trials
Hospital management	Combines simulation models and ML to optimize resource allocation and staff scheduling
	AI automates administrative tasks (scheduling, billing), reducing errors and workload
	AI-driven patient flow optimization reduces hospital stays and improves throughput
	Improves EHR security and identifies compliance risks through predictive analytics
Health policy	AI reshapes policy formulation through predictive modeling and data-driven insights
	Identifies ethical risks in AI healthcare implementation, including data privacy and algorithmic bias
	Enables pandemic response through AI-optimized vaccine distribution and policy simulations
	Identifies healthcare disparities using ML to promote equitable policies

AI, artificial intelligence; EHR, electronic health record; ML, machine learning.

Transforming Pediatric Clinical Care: Diagnosis, Prediction, Prevention and Precision

AI technologies, particularly machine learning (ML) and deep learning (DL), improve diagnostic accuracy and disease management by analyzing patient data such as vital signs, genetic information, and medical

imaging. AI-based systems can detect conditions including sepsis, cardiac abnormalities, and neurodevelopmental disorders earlier than conventional methods, enabling faster intervention and better patient outcomes (Park et al., 2025). In pediatric intensive care units (PICUs), predictive systems help identify patient deterioration before critical events occur.

AI also supports personalized medicine by combining imaging, genetic, and clinical data to predict treatment responses in specialties such as oncology, cardiology, and neurology. Automated image analysis improves the interpretation of MRI, CT scans, ultrasound, and radiography while reducing diagnostic errors. In addition, AI-powered Clinical Decision Support Systems (CDSS) assist clinicians in optimizing ventilation, nutritional support, and antibiotic management, particularly in high-volume or resource-limited pediatric settings (Park et al., 2025).

Operational Impacts: Hospital Management, Efficiency, and Financial Sustainability

AI contributes significantly to hospital management through predictive analytics and automation. Hospitals use AI to forecast admissions, manage bed capacity, optimize staffing, and improve resource allocation, reducing bottlenecks and enhancing service quality (Wang et al., 2025). AI-integrated Hospital Management Information Systems (HMIS) combine operational, clinical, and financial data to support strategic decision-making and performance monitoring.

Administrative efficiency is further improved through robotic process automation (RPA), which automates billing, scheduling, claims processing, and record management. Natural language processing (NLP) also enhances clinical documentation and identifies gaps in care. AI-powered chatbots and digital patient portals improve communication, provide medication reminders, and support patient education for children and families.

Financially, AI helps reduce operational costs by improving billing accuracy, minimizing fraud, and streamlining hospital workflows. Reduced medical errors and shorter hospital stays also contribute to long-term financial sustainability for pediatric institutions (Park et al., 2025).

Table 2. Summary of approved AI-based medical devices (pediatric applications)

Device/software name	Category	Technology domain	Intended purpose	Regulatory status
HeRO Infant ICU Monitor (MPSC) ^{35,36}	Prevention	Predictive analytics on vital signs (proprietary statistical/ML "heart rate characteristics" algorithm)	Monitors NICU patients' heart rate variability in real time to generate a HeRO score that indicates risk of sepsis or clinical deterioration	FDA-cleared as Class II (Circa 2009)
Owlet Dream Sock ³⁷	Prevention	Wearable sensor with algorithmic monitoring (pulse oximetry analysis)	Continuous at-home surveillance of infant vital signs to help prevent SIDS/infant distress	FDA De Novo clearance (2023)
Empatica Embrace2 ³⁷	Prevention	Wearable ML-based physiological analysis (accelerometer/EDA)	Real-time seizure detection using accelerometer and electrodermal data	FDA 510(k) cleared as Class II (ages 6+); CE Mark for home or hospital use
Etiometry iVCO2 Index ³⁸	Prevention	ICU analytics software	Analyzes ventilator, vital signs, and lab data to detect risk of hypercapnia in critically ill infants/children	FDA 510(k) cleared (Class II)—first for pediatric ICU (2019), extended for neonates <2 kg (2023); CE Marked in EU
BoneXpert (Visiana) ³⁹	Diagnosis	Computer vision-based radiograph analysis	Automatically calculates pediatric bone age from hand x-rays	CE Mark (Class I medical software) in Europe; not FDA-cleared in US
Gleamer BoneView ⁴⁰	Diagnosis	Deep learning computer vision (fracture detection)	Flags possible fractures, dislocations, or lesions in trauma radiographs	FDA 510(k) cleared in 2023 for adult and pediatric fracture detection (age >2)
AZmed Rayvolve ⁴¹	Diagnosis	Deep learning computer vision (fracture detection)	Automates x-ray fracture detection and highlights suspicious findings	CE Mark (Class IIa) under EU MDR (2021); FDA 510(k) in 2022
Canvas Dx ⁴²	Diagnosis	Machine learning diagnostic algorithm (multisource data fusion)	Integrates parent surveys, clinician input, and short home videos to help diagnosis of autism spectrum disorder	FDA De Novo authorized (2021), Class II with special controls
Eko Murrur Analysis Software (EMAS) ⁴³	Diagnosis	Audio signal AI (digital stethoscope analyzed with ML algorithm)	Analyzes heart sounds (± ECG) to detect and classify heart murmurs	FDA 510(k) cleared in 2022; integrated under FDA's "Electronic Stethoscope" category (Class II)
BrightHeart Prenatal Cardiac AI ⁴⁴	Diagnosis	Deep learning image analysis (obstetric ultrasound AI)	Examines prenatal ultrasound to identify fetal congenital heart defects	FDA 510(k) cleared (late 2024); CE Mark pending
PainChek Infant ⁴⁵	Diagnosis	Computer vision (facial expression analysis)	Utilizes facial microexpression recognition to infer infant pain level	CE Marked in EU; not FDA-cleared
Tandem Control IQ ⁴⁶	Treatment	Predictive glucose control (insulin pump automation)	Adjusts insulin delivery continuously based on glucose trend predictions	FDA De Novo clearance (2019); classified as Class II
Akili EndeavorRx ⁴⁷	Treatment	Digital therapeutic (video game with adaptive cognitive training)	Prescription game-based therapy targeting children with ADHD	FDA De Novo authorization (2020); Class II digital therapeutic
Luminopia One ⁴⁸	Treatment	VR-based therapy (computer-vision-modified binocular content)	Delivers VR content to treat amblyopia in children by balancing visual input to each eye	FDA De Novo clearance (2021); Class II
Da Vinci Surgical System – AI enhancement	Treatment	Robotic surgical system with AI-driven automation	Uses AI-driven feedback, force sensing, and computer vision-assisted positioning for enhanced precision	FDA-cleared since 2000; AI features (e.g., force sensing) cleared via iterative 510(k) submissions
CergenX Ltd. ⁴⁹	Prognosis	AI-driven EEG analysis in neonates	Real-time screening for abnormal newborn brain activity to enable early interventions (antiseizure meds, therapeutic hypothermia, etc.)	FDA Breakthrough Device (2025), TAP fast-track program (not yet cleared)
i-ROP DL (ROP Prognosis) ⁵⁰	Prognosis	Deep learning analysis of retinal images	Detects and stages retinopathy of prematurity to prevent blindness in preterm infants	FDA Breakthrough Device (2020); under clinical validation, not yet marketed

CE, Conformité Européenne; EDA, electrodermal activity; FDA, Food and Drug Administration; MDR, Medical Device Regulation; ML, machine learning; NICU, neonatal intensive care unit; TAP, Total Product Lifecycle Advisory Program; HeRO, heart rate observation; SIDS, sudden infant death syndrome; ICU, intensive care unit; US, United States; AI, artificial intelligence; ADHD, attention-deficit/hyperactivity disorder; VR, virtual reality; EEG, electroencephalogram.

E-Health, Patient, and Family Engagement

AI-driven telemedicine and remote monitoring systems extend healthcare access beyond hospitals, especially for children with chronic conditions. Wearable devices and AI algorithms enable real-time monitoring of vital signs, early detection of complications, and personalized treatment adjustments (Park et al.,

2025). These technologies help reduce hospital readmissions and improve continuity of care.

Patient portals, virtual assistants, and NLP-based chatbots also strengthen communication between healthcare providers and families by simplifying medical information, supporting treatment adherence, and encouraging active participation in healthcare decisions.

Impacts on Hospital Management: Strategic, Economic, and Competitive Dimensions

AI creates long-term strategic and economic advantages for pediatric hospitals. By improving efficiency, reducing unnecessary procedures, and minimizing diagnostic errors, AI contributes to substantial cost savings and better patient outcomes (Santamato et al., 2024). Predictive analytics also help hospitals prepare for disease outbreaks and changing resource demands more effectively.

Furthermore, AI supports innovation and strengthens hospital competitiveness by enabling more advanced and cost-effective healthcare services. Pediatric hospitals increasingly use AI as part of their digital transformation strategies to enhance service quality and strengthen their position within the healthcare industry (Karrar et al., 2025).

Table 3. Potential long-term economic impacts of AI in healthcare

Categories	Subcategories	Example
Cost Savings	Diagnostic efficiency	AI-powered imaging tools that instantly analyse and interpret X-rays, MRIs, or CT scans, reducing the need for multiple radiologists to review images and thus reducing costs.
	Operational efficiency	AI-driven appointment scheduling systems that optimize patient flow and reduce waiting times. Such systems can predict no-shows and overbook accordingly, resulting in fewer wasted slots and maximizing revenue for clinics.
	Treatment efficiency	Personalized treatment plans generated by AI, based on a patient's genetics, medical history, and other relevant data. This can lead to more effective treatments that have a higher likelihood of success, reducing the need for prolonged or multiple treatments.
	Preventive care	Wearable devices integrated with AI algorithms that monitor vital signs and predict potential health issues before they become serious.
Cost avoidance	Compliance and Litigation	AI-powered systems that ensure medical practices and procedures strictly adhere to established guidelines, decreasing the chances of non-compliance. This not only avoids financial penalties but also reduces the likelihood of malpractice incidents.
	Readmission Penalties	AI-driven clinical pathways, such as Clinical Decision Support Systems (CDSSs), can be implemented to monitor and manage chronic ailments.
	Waste Reduction	AI systems can be utilized to analyse vast amounts of patient and procedural data to recommend or de-prioritize certain tests and procedures based on their anticipated value for a specific patient.
	Resource Optimization	AI can aid in refining resource utilization, ensuring that equipment and human resources are used to their utmost potential and avoiding unnecessary expenditures.
Long-term Health Outcomes	Quality of Life	AI-powered remote monitoring tools allow patients with chronic conditions like diabetes to continuously monitor their glucose levels without frequent hospital visits.
	Population Health Management	A decrease in healthcare expenses due to proactive management, and a reduction in economic downturns which often accompany large-scale disease outbreaks because of decreased productivity and increased healthcare costs.
	Longevity	AI can analyse molecular structures and predict their potential impact on human longevity, leading to the faster discovery of anti-aging compounds. The economic impact of increased longevity means a longer productive life for citizens, potentially extending their time in the workforce and their contributions to the economy.
Innovation and Research	Technological Breakthroughs	AI-driven laboratories that can automate and expedite drug discovery processes, leading to faster introduction of new therapeutic agents, which leads to cost savings
	Spin-off Innovations	AI innovations initially designed for healthcare, such as wearable health monitors, can find applications in other industries, like sports or fitness.
	Economic Ripple Effects	The development and commercialization of AI-driven healthcare tools can stimulate local economies by creating jobs in tech, manufacturing, and distribution sectors.
Market Competition Dynamics	Differentiated Services	Hospitals using AI-driven diagnostic tools can offer more precise treatment plans, differentiating themselves from competitors.
	Enhanced Patient Choice	AI can provide personalized treatment options, giving patients the ability to choose the best fit for their needs.
	Cost-effective Healthcare Models	AI-driven telemedicine platforms can provide expert consultations at a fraction of traditional costs, making healthcare more affordable.

Challenges: Ethics, Regulation, and Pediatric-Specific Issues

Despite its benefits, AI integration in pediatric healthcare faces several challenges. Pediatric datasets are often limited, making it difficult to validate AI models and ensure reliable performance across diverse patient populations. In addition, algorithms trained on adult data may not accurately reflect children's physiological differences, creating potential risks (Jamil et al., 2025).

Ethical and regulatory concerns also remain significant. Data privacy, algorithmic bias, and the lack of transparency in "black box" AI systems can reduce trust among clinicians and caregivers. Questions regarding liability for AI-related errors further complicate implementation (Muralidharan et al., 2024). Therefore, pediatric AI systems require strong regulatory oversight, continuous evaluation, and interdisciplinary collaboration among clinicians, data scientists, ethicists, and policymakers to ensure safe and effective use in hospital settings (Chng et al., 2025).

CONCLUSION

AI-driven e-health innovations are transforming pediatric hospital management by improving diagnostic accuracy, optimizing clinical and operational workflows, and supporting personalized care. Technologies such as predictive analytics, clinical decision support systems, and automated administration help hospitals allocate resources efficiently, reduce costs, improve patient safety, and strengthen proactive healthcare management. In pediatric settings, AI supports early disease detection, individualized treatment planning, and outcome prediction, enabling more effective and holistic child healthcare. AI also enhances family engagement through better communication tools and remote monitoring systems. However, challenges related to data privacy, algorithmic bias, limited pediatric validation, and accountability require strong regulation and interdisciplinary collaboration to ensure safe and equitable implementation. Overall, AI integration offers significant potential to improve both pediatric patient outcomes and hospital management efficiency.

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