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Advancements in Artificial Intelligence and Wearable Devices in Pediatric Clinical Care: A scoping review protocol

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ADMINISTRATIVE INFORMATION

Support - N/A.

Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 25 October 2025 and was last updated on 25 October 2025.

INTRODUCTION

Review question / Objective The objective of this review is to synthesize existing evidence on wearable devices used in pediatric hospital and outpatient care, examining their sensors, biosignals, and clinical applications; the extent and quality of AI integration; and barriers to clinical translation, including design, regulatory, workflow, and ethical challenges. The review focuses on pediatric populations—neonates, infants, children, and adolescents—and their use of wearables for continuous, noninvasive physiologic monitoring. These devices exist in multiple form factors, including belt-type trackers, adhesive biosensors, and textile-based sensors, offering varying balances of comfort, usability, and signal fidelity. Commonly measured signals include electrocardiography (ECG), photoplethysmography (PPG), and accelerometry, among others. Clinical applications span inpatient, perioperative, critical care, and ambulatory settings, with emerging roles in diagnosis, risk prediction, and monitoring of recovery and chronic disease.

Background Wearable devices are transforming how continuous physiological data are collected and applied in healthcare. Consumer technologies such as smartwatches and fitness trackers have familiarized the public with passive health monitoring, while medical-grade systems—including adhesive biosensor patches and textile-based sensors—enable high-resolution measurement of signals such as electrocardiography (ECG), photoplethysmography (PPG), accelerometry, temperature, and skin conductance.

In pediatric populations, however, these technologies face distinct physiological and developmental challenges. Children differ from adults in heart and respiratory rates, body proportions, skin sensitivity, and disease profiles. As a result, devices must be adapted for smaller and more delicate bodies, ensuring comfort,

safety, and accuracy through pediatric-specific validation and design.

Artificial intelligence (AI) and machine learning (ML) have shown promise in leveraging continuous wearable data streams for automated detection and prediction of adverse events in adults. Yet, pediatric evidence remains limited and requires rigorous validation. Models trained on adult data are often unsuitable for children, necessitating redevelopment or retraining for pediatric use. Moreover, pediatric wearable studies typically involve smaller sample sizes and are often restricted to single-center datasets, further underscoring the need for multicenter collaboration and standardized frameworks.

This review synthesizes current evidence on wearable devices in pediatric hospital and outpatient care, with particular emphasis on AI-enabled applications. We categorize device types, biosignals, and clinical use cases; evaluate the extent and quality of AI integration; and highlight key barriers to clinical translation. By positioning pediatric wearables within the broader context of biosignal analytics and AI, this review provides a critical assessment of current progress and outlines priorities for future development.

Rationale Wearable monitoring has the potential to extend pediatric care beyond hospital walls. After surgery, for instance, continuous home monitoring could support earlier discharge and detect complications sooner. In emergency departments, wireless devices could help clinicians monitor more patients in crowded settings by flagging changes in vital signs in real time. Outside of acute care, wearables may support long-term management of chronic illnesses, rehabilitation, and preventive health by tracking trends in activity, sleep, and other physiological indicators.

This approach is particularly valuable for infants and young children, who often cannot express discomfort or symptoms clearly. Objective, passively gathered data can fill that gap—offering clinicians a window into a child's health status between visits.

Artificial intelligence adds further promise by making sense of complex, high-frequency biosignals. By integrating wearable data with other clinical information, machine learning can reveal subtle patterns or early warning signs that might otherwise go unnoticed. Together, AI and wearable technologies could shift pediatric monitoring from reactive observation to proactive, personalized care—helping clinicians intervene earlier and track development more precisely.

METHODS

Strategy of data synthesis Databases: PubMed/MEDLINE, Web of Science Core Collection, IEEE Xplore, Scopus.

Coverage window: January 1, 2014 to August 31, 2025.

Languages: English at screening.

Queries:

A. PubMed (MEDLINE)

Search string (Boolean, with date filter in PubMed 'Advanced' builder): ((child*[tiab] OR pediatric*[tiab] OR paediatr*[tiab] OR "Child"[Mesh] OR "Infant"[Mesh] OR "Adolescent"[Mesh]) AND (wearable device*[tiab]) AND (hospital*[tiab] OR inpatient[tiab] OR ward*[tiab] OR ICU[tiab] OR "intensive care"[tiab] OR PICU[tiab] OR NICU[tiab] OR "emergency department"[tiab] OR ED[tiab] OR "operating room"[tiab] OR "Hospitals"[Mesh] OR "Inpatients"[Mesh] OR "Intensive Care Units"[Mesh] OR "Intensive Care Units, Pediatric"[Mesh] OR "Intensive Care Units, Neonatal"[Mesh] OR "Emergency Service, Hospital"[Mesh] OR "Operating Rooms"[Mesh] OR "Wards, Hospital"[Mesh])) AND ("2014/01/01"[Date - Publication] : "2025/08/31"[Date - Publication])

B. Web of Science Core Collection

Timespan: 2014-2025; Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI TS=((child* OR pediatric* OR paediatr*) AND ("wearable device*" OR (wearable NEAR/1 device*)) AND (hospital* OR inpatient OR ward* OR "hospital ward*" OR ICU OR "intensive care" OR PICU OR (pediatric NEAR/3 "intensive care") OR NICU OR (neonatal NEAR/3 "intensive care") OR ("emergency" NEAR/3 department) OR ("operating" NEAR/2 room) OR "operating theatre"))

C. Scopus

TITLE-ABS-KEY((child* OR pediatric* OR paediatr*) AND ("wearable device*" OR (wearable W/1 device*)) AND (hospital* OR inpatient OR ward* OR ICU OR "intensive care" OR PICU OR NICU OR "emergency department" OR ("operating" W/2 room))) Publication Years: 2014-2025

D. IEEE Xplore

Query: ((("All Metadata":"child*" OR "All Metadata":"pediatric*" OR "All Metadata":"paediatr*") AND ("All Metadata":"wearable device") AND ("All Metadata":"hospital" OR "All Metadata":"inpatient" OR "All Metadata":"ward" OR "All Metadata":"ICU" OR "All Metadata":"intensive care" OR "All Metadata":"PICU" OR "All Metadata":"NICU" OR "All Metadata":"emergency department" OR "All

Metadata":"ED" OR "All Metadata":"operating room"))) Publication Years: 2014-2025
Number of retrieved studies: Scopus=133, PubMed=67, Web of Science Core Collection=79, IEEE Explore=25.
Perform de-duplication, inclusion/exclusion criteria.

Eligibility criteria We included original clinical studies that evaluated the feasibility, validation, or clinical outcomes of wearable devices used in hospital or outpatient pediatric populations. Pediatric populations were defined as patients younger than 18 years; however, studies enrolling participants up to 21 years were also included if conducted within pediatric clinical settings or explicitly identified as pediatric by the investigators. Both consumer- and medical-grade wearables were eligible, provided they were deployed in real patients and capable of capturing physiological signals. Studies were excluded if they focused exclusively on adults, combined adult and pediatric participants without pediatric-specific reporting, used only simulation data, involved non-clinical prototypes, lacked clear pediatric evidence, or were reviews or conference abstracts without full peer-reviewed publications.

Source of evidence screening and selection From an initial pool of titles screened (n=304), duplicates were removed (n=82). Following this title/abstract screening was manually performed to exclude studies (n=142) not meeting inclusion criteria. Remaining texts were reviewed in detail and studies not meeting inclusion criteria (n=43) were further removed. This category included studies that mentioned pediatric participants but primarily analyzed adult data, combined pediatric and adult results without stratified reporting, or discussed pediatric applications only theoretically without presenting child-specific findings. Ultimately, 37 studies met inclusion criteria.

Data management In the first stage, only titles and abstracts were retrieved and manually reviewed for inclusion criteria. Selected final studies were downloaded and reviewed in detail and studies not meeting criteria were removed.
Each was abstracted into an evidence table in Excel, capturing year, title, device type, age range, disease focus, clinical setting, AI involvement, data modalities, whether hospital-deployed, and outcomes of interest.

Reporting results / Analysis of the evidence Analysis demonstrated that pediatric wearables have progressed from novelty to credible clinical tools, but evidence still centers on feasibility and validation. However, a growing number of studies have demonstrated how AI/ML can transform high frequency biosignals into predictive tools, especially in postoperative recovery, sepsis detection, epilepsy monitoring, cardiac rhythm classification, and respiratory assessment. Collectively, they show how wearable-derived data can move pediatrics from descriptive monitoring toward proactive, data-driven decision support.

Presentation of the results The results are analyzed and presented in a manuscript for submission. We present a detailed evidence table capturing study year, title, device type, age range, disease focus, clinical setting, AI involvement, data modalities, whether hospital-deployed, and outcomes of interest. Additional figures show heatmaps corresponding to 1) device type and associated sensors and signals, and 2) clinical domains and associated sensors and signals.

Language restriction English language was restricted at screening.

Country(ies) involved United States.

Keywords Pediatrics; Wearable Devices; Artificial Intelligence; Wearables; Biosignals; Healthcare; Scoping review.

Contributions of each author
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