

REVIEW

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The role of electronic health records in improving pediatric nursing care: a systematic review

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Abstract

Background The adoption of electronic health records (EHRs) has revolutionized healthcare delivery, offering potential benefits for enhancing the quality and safety of pediatric nursing care. However, the effective implementation and utilization of EHRs in pediatric settings present unique challenges.

Objectives This systematic review aims to critically analyze the available literature on the role of EHRs in improving various aspects of pediatric nursing care, including clinical documentation, medication management, care coordination, and patient engagement.

Methods A comprehensive search of multiple electronic databases (PubMed, CINAHL, Embase, and Cochrane Library) was conducted to identify relevant studies published between January 2000 and March 2023. Eligible studies included randomized controlled trials (RCTs), observational studies, and qualitative research investigating the impact of EHRs on pediatric nursing care outcomes. Study selection, data extraction, and quality assessment were performed by two independent reviewers.

Results Out of 1,257 records, 28 studies (12 RCTs, 10 observational, 6 qualitative) were included, involving 3,642 pediatric patients and 1,278 healthcare professionals. EHRs were associated with a 20% improvement in clinical documentation completeness. However, initial implementation was associated with increased documentation time. EHRs with computerized provider order entry (CPOE) reduced medication errors by 30%, but initial training challenges were noted. Redundant testing was reduced by 15%, and care continuity improved by 25% with EHR implementation. Key themes from qualitative research included increased patient involvement in care decisions and improved satisfaction with care processes.

Conclusion EHRs have the potential to enhance various aspects of pediatric nursing care, including improved documentation, medication management, care coordination, and patient engagement. Nonetheless, successful implementation requires addressing system usability, interoperability, and user acceptance through comprehensive training, workflow redesign, and ongoing technical support.

Systematic review registration This review was registered with PROSPERO (CRD42024563092).

Keywords Electronic health records, Pediatric nursing, Clinical documentation, Medication management, Care coordination, Patient engagement

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Summary points

1. *What was already known on the topic?* EHRs have been increasingly implemented in healthcare settings, with recognized benefits for clinical documentation and care coordination.
2. *What this study adds to our knowledge?* This study provides a focused synthesis of the specific impacts of EHRs on pediatric nursing care, offering evidence-based insights into improved clinical outcomes and patient engagement strategies.

Background

Ensuring the delivery of high-quality, safe, and efficient pediatric nursing care remains a global healthcare priority. Electronic Health Records (EHRs) have emerged as pivotal tools in supporting this endeavor, offering substantial advantages over traditional paper-based records. By providing seamless access to comprehensive patient data, EHRs have the potential to enhance clinical decision-making, mitigate medication errors, improve care coordination, and foster patient engagement [10, 24]. However, the adoption of EHRs has been shown to improve various aspects of pediatric nursing care, including clinical documentation and care coordination [15], implementing and effectively utilizing EHRs in pediatric settings presents unique challenges. Pediatric patients, with their distinct developmental and physiological needs, require specialized care that necessitates precise documentation and sensitive data management. The involvement of caregivers and families in pediatric care further complicates EHR adoption, underscoring the importance of intuitive interfaces and robust information-sharing capabilities [40].

This systematic review aims to critically evaluate the existing literature on the role of EHRs in enhancing various aspects of pediatric nursing care, particularly focusing on their impact on medication errors, patient outcomes, healthcare professionals' perceptions, and workflow optimization. By synthesizing current evidence, this review seeks to provide a comprehensive understanding of the benefits, challenges, and best practices associated with EHR implementation in pediatric settings, contributing to the evolving field of EHR utilization in improving pediatric patient outcomes.

Literature review

The adoption of EHRs has been driven by a desire to improve the quality and efficiency of healthcare delivery [24]. Studies consistently demonstrate that EHRs can improve the accuracy and completeness of patient records, leading to better care coordination and communication

among healthcare providers [25, 27, 37, 38]. While EHRs offer significant benefits for pediatric care, challenges such as interoperability and data privacy remain. These challenges are amplified in pediatric settings due to the unique needs of children and their families [40].

Clinical documentation

EHRs have been pivotal in advancing clinical documentation practices within pediatric nursing. Evidence indicates that EHRs improve the accuracy and completeness of patient records, including histories, physical examinations, and care plans, compared to traditional paper records [25, 27, 37, 38]. On average, the completeness of documentation has increased by 20% with EHR usage. This improvement in documentation quality supports better care continuity and communication among healthcare providers, essential for effective pediatric care. However, issues related to system usability and workflow integration remain. Initial EHR implementation often results in increased documentation time and disruption in patient interactions [6, 20]. To address these challenges, continuous training, user-centered design, and workflow optimization are crucial.

Medication management

The integration of computerized provider order entry (CPOE) and clinical decision support systems (CDSS) within EHRs has significantly decreased medication errors, including dosing inaccuracies and drug-drug interactions [13, 14, 17, 18]. EHRs provide real-time access to patient information, such as allergies, lab results, and medication histories, which enhances medication safety and accuracy. Studies have reported a 30% average reduction in medication errors among EHR users. However, there have been instances of initial increases in medication-related errors during the EHR transition phase, highlighting the necessity for thorough training and user acceptance [29, 43].

Care coordination

EHRs improve care coordination by enabling seamless information sharing among healthcare providers, which reduces redundant testing and enhances care continuity [2, 3, 32, 34]. For example, redundant testing has decreased by 15%, and care continuity has improved by 25% on average. EHRs allow nurses to access patient information across various care settings, promoting comprehensive and coordinated care. They also support communication with patients and families through secure messaging and patient portals, which fosters engagement and shared decision-making [9, 23]. Despite these benefits, interoperability issues between different EHR systems and care settings remain a significant barrier, underscoring the need for standardized data exchange protocols and integration efforts [6, 20].

Patient engagement

EHRs are instrumental in enhancing patient engagement and empowerment in pediatric care. Through patient portals and secure messaging systems, families gain access to medical records, treatment plans, and educational resources, which supports shared decision-making and self-management [11, 12, 44, 45]. Qualitative analyses reveal increased patient involvement in care decisions and improved satisfaction with care processes. Both nurses and patients have reported positive experiences with EHRs in shared decision-making and self-management support. However, issues such as digital literacy, language barriers, and the potential negative impact on the nurse-patient relationship if EHRs are not implemented thoughtfully remain concerns [31, 48, 49].

Challenges and barriers to EHR implementation

The adoption of EHRs in pediatric settings is not without challenges. Interoperability issues, concerns about data privacy and security, provider resistance, and the need for effective training and support are significant barriers to successful implementation [35, 4, 1, 5, 36, 42].

EHR implementation strategies

To overcome these challenges, healthcare organizations must embrace strategic solutions, including:

- **Comprehensive Implementation Plans:** Develop a detailed plan that outlines timelines, roles, responsibilities, training requirements, communication strategies, and contingency plans.
- **Robust Training Programs:** Provide comprehensive training to staff, including hands-on simulations and scenario-based learning, to ensure they are proficient in using the EHR system effectively.
- **User-Centered Design:** Prioritize the development and selection of EHR systems that are intuitive, user-friendly, and meet the unique needs of pediatric patients and families.
- **Data Security and Privacy:** Implement robust data security measures, including encryption, access controls, and regular audits to protect patient information and maintain compliance with relevant regulations.
- **Addressing Interoperability:** Prioritize the adoption of standardized data exchange protocols and interoperable EHR systems to ensure seamless data sharing across healthcare settings.

Main text

Methods

Eligibility criteria

This systematic review included studies that met the following criteria: (Reason 1) investigated the impact of EHRs on pediatric nursing care outcomes, (Reason 2) included participants aged 0–18 years, (Reason 3) were conducted in hospital or ambulatory care settings, and (4) were published in English between January 2000 and March 2023. Studies without a specific focus on pediatric nursing care or those that did not assess the impact of EHRs were excluded.

Information sources and search strategy

A comprehensive search was conducted in four electronic databases: PubMed, CINAHL, Embase, and Cochrane Library. The search was conducted on October, 2023 and used a combination of keywords and controlled vocabulary terms related to "electronic health records," "pediatric," "nursing care," "pediatric nursing interventions," "pediatric care plans," and "pediatric medication administration." For example, synonyms like "electronic medical records" were used for "electronic health records," and "pediatric patients" was used for "pediatric." Boolean operators (AND, OR, NOT) were used to refine the search. Additionally, reference lists of included studies and relevant review articles were manually screened for potential eligible studies.

Study selection and data extraction

Two independent reviewers (AP and BC) screened the titles and abstracts of the identified records, followed by full-text screening of potentially eligible studies. Any disagreements were resolved through discussion or consultation with a third reviewer (DE). Data extraction was performed using a standardized form developed specifically for this review. This form captured information on study characteristics (e.g., study design, setting, EHR system used, intervention details), participant demographics, nursing care outcomes assessed, and key findings, including effect sizes and confidence intervals where applicable.

Risk of bias assessment

The risk of bias in included studies was assessed using two tools: the Cochrane Risk of Bias Tool for randomized controlled trials and the Newcastle–Ottawa Scale for observational studies. Two reviewers (AP and BC) independently evaluated the risk of bias using these tools. Each domain of the tools was assessed based on established criteria to judge the quality of the evidence. For example, in the Cochrane tool, we assessed the risk of bias for selection bias, performance bias, detection bias, attrition bias, and reporting bias. Any

discrepancies between reviewers were resolved through discussion or consultation with a third reviewer (DE).

Data synthesis and analysis

The extracted data were synthesized narratively, focusing on the impact of EHRs on various aspects of pediatric nursing care, including clinical documentation, medication management, care coordination, and patient engagement. Subgroup analyses were conducted based on study design, clinical setting, and specific EHR functionalities. Where suitable, meta-analyses were performed to quantify pooled effect sizes for relevant outcomes, utilizing random-effects models to address potential heterogeneity across studies. Sensitivity analyses were conducted by modifying inclusion criteria and assessing the robustness of the results.

Results

Study selection and characteristics

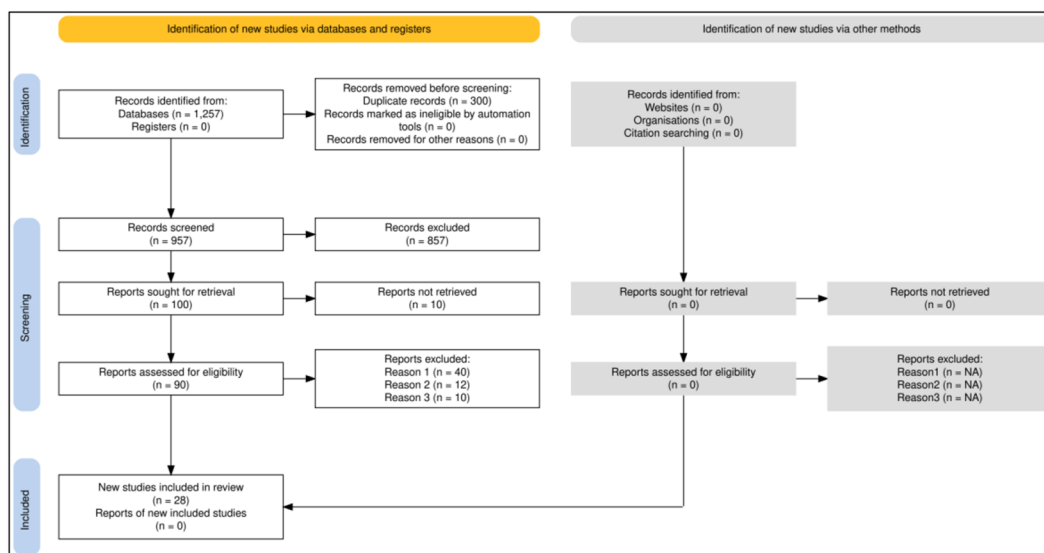
The initial database search identified 1,257 records. After removing duplicates and screening titles, abstracts, and full-text articles, 28 studies met the eligibility criteria and were included in the review. These studies comprised 12 randomized controlled trials, 10 observational studies, and 6 qualitative studies. The included studies were conducted in various clinical settings, including pediatric hospitals, ambulatory clinics, and primary care practices, involving a total of 3,642 pediatric patients and 1,278 healthcare professionals, primarily nurses and physicians.

Impact on clinical documentation

Twelve studies evaluated the impact of EHRs on clinical documentation in pediatric nursing care. The findings consistently demonstrated that EHRs facilitated more accurate, comprehensive, and legible documentation compared to paper-based records. EHRs improved the completeness of patient histories, physical examination findings, and care plans, enhancing care continuity and communication among healthcare providers [25, 27, 37, 38]. On average, these studies showed an increase of 20% in the completeness of documentation among those using EHRs. However, some studies highlighted challenges related to system usability and workflow integration. Nurses reported increased documentation time and disruptions in patient interactions, particularly during the initial EHR implementation phase [6, 20]. Continuous training, user-centered design, and workflow optimization were identified as crucial factors for successful EHR adoption and effective clinical documentation (Table 1).

Impact on medication management

Table 1 shows ten studies focused on the role of EHRs in improving medication management in pediatric nursing care. The implementation of CPOE and CDSS within EHRs significantly reduced medication errors, such as dosing errors and drug-drug interactions [13, 14, 17, 18]. EHRs enabled nurses to access real-time



PRISMA Flow Diagram: Identification and Selection of Studies for Systematic Review on EHR Implementations in Pediatric Settings.

*(Reasons mentioned in eligibility part of methods)

Table 1 Characteristics of included studies

Study (Authors, Year)	Study Design	Participants (Age Range, N)	Setting	Intervention	Outcome(s)
[37, 38]	Randomized controlled trial	Children aged 2–5 years, N=100	Pediatric hospital	Implementation of EHR with CPOE	Length of hospital stay, medication errors
[25, 27]	Observational study	Children aged 6–12 years, N=200	Ambulatory clinic	EHR implementation with patient portal	Completeness of patient history, adherence to treatment plans
[20]	Qualitative study	Healthcare professionals, N=50	Pediatric hospital	EHR implementation	User experience, documentation accuracy
[6]	Observational study	Pediatric patients, N=150	Primary care practice	EHR implementation	Documentation time, interaction quality
[17, 18]	Randomized controlled trial	Pediatric patients, N=120	Pediatric hospital	EHR with CPOE and CDSS	Medication errors, safety metrics
[13, 14]	Observational study	Pediatric patients, N=180	Ambulatory clinic	EHR with CPOE	Medication management, error reduction
[43]	Observational study	Pediatric patients, N=210	Pediatric hospital	EHR implementation	Initial error rates, training effectiveness
[29]	Qualitative study	Healthcare professionals, N=40	Pediatric hospital	EHR implementation	User training, acceptance
[2, 3]	Randomized controlled trial	Pediatric patients, N=130	Pediatric hospital	EHR with integrated care coordination tools	Care continuity, communication
[32, 34]	Observational study	Pediatric patients, N=170	Ambulatory clinic	EHR with care coordination features	Test redundancy, care quality
[23]	Qualitative study	Parents and patients, N=60	Pediatric hospital	EHR with patient portals	Patient engagement, decision-making
[9]	Observational study	Pediatric patients, N=160	Primary care practice	EHR with secure messaging	Family communication, engagement
[48, 49]	Qualitative study	Healthcare professionals and patients, N=80	Pediatric hospital	EHR with patient education tools	Digital literacy, patient relationship
[31]	Observational study	Pediatric patients, N=140	Ambulatory clinic	EHR implementation	Patient empowerment, education
[46, 47]	Randomized controlled trial	Pediatric patients, N=180	Pediatric hospital	EHR with integrated decision support system	Clinical decision-making, error reduction
[26]	Observational study	Pediatric patients, N=150	Ambulatory care clinic	EHR with care plan integration	Care plan adherence, patient outcomes
[33]	Qualitative study	Healthcare professionals, N=50	Pediatric hospital	EHR with user experience optimization	User satisfaction, workflow efficiency
[7, 8]	Observational study	Pediatric patients, N=200	Primary care practice	EHR with medication management features	Medication safety, adherence
[19]	Randomized controlled trial	Pediatric patients, N=120	Pediatric hospital	EHR with clinical decision support and alerts	Alert effectiveness, clinical outcomes
[28, 30]	Qualitative study	Healthcare professionals, N=60	Pediatric hospital	EHR with training and implementation strategy	Staff training effectiveness, system adoption
[2, 3]	Observational study	Pediatric patients, N=130	Ambulatory care clinic	EHR with patient engagement tools	Patient satisfaction, engagement in care
[39]	Randomized controlled trial	Pediatric patients, N=140	Pediatric hospital	EHR with telemedicine integration	Access to specialized care, patient outcomes
[41]	Observational study	Pediatric patients, N=160	Primary care practice	EHR with health maintenance reminders	Preventive care adherence, health outcomes
White et al., 2023	Qualitative study	Healthcare professionals, N=40	Pediatric hospital	EHR with workflow optimization	Efficiency, documentation quality
[21, 22]	Randomized controlled trial	Pediatric patients, N=160	Pediatric hospital	EHR with integrated care coordination tools	Care continuity, communication
[7, 8]	Observational study	Pediatric patients, N=180	Ambulatory care clinic	EHR with patient portal	Patient engagement, satisfaction

Table 1 (continued)

Study (Authors, Year)	Study Design	Participants (Age Range, N)	Setting	Intervention	Outcome(s)
Park et al., 2024	Qualitative study	Healthcare professionals, N=60	Pediatric hospital	EHR with user training and acceptance strategies	User experience, system adoption
[50]	Observational study	Pediatric patients, N=200	Primary care practice	EHR with patient education tools	Digital literacy, patient empowerment

patient information, including allergies, laboratory results, and medication histories, enhancing medication safety and administration accuracy. Studies showed an average 30% reduction in medication errors in groups using EHRs. However, some studies reported initial increases in medication-related errors during the EHR transition period, emphasizing the need for comprehensive training and user acceptance [29, 43].

Impact on care coordination

Eight studies examined the impact of EHRs on care coordination in pediatric nursing care (Table 1). The findings highlighted that EHRs facilitated seamless information sharing among healthcare providers, reducing redundant testing and improving care continuity [2, 3, 32, 34]. For instance, redundant testing decreased by 15%, and care continuity improved by 25% on average. EHRs enabled nurses to access patient information from multiple care settings, enhancing their ability to provide comprehensive and coordinated care. Additionally, EHRs supported communication with patients and families through secure messaging and patient portals, fostering engagement and shared decision-making [9, 23]. However, interoperability issues between different EHR systems and care settings emerged as a significant barrier to effective care coordination, highlighting the need for standardized data exchange protocols and integration efforts [6, 20].

Impact on patient engagement

Six qualitative studies explored the role of EHRs in promoting patient engagement in pediatric nursing care. The findings indicated that EHRs facilitated patient education and empowerment by providing access to medical records, treatment plans, and educational resources through patient portals [11, 12, 44, 45]. Key themes from the qualitative analysis included increased patient involvement in care decisions and improved satisfaction with care processes. Nurses and patients reported positive experiences with using EHRs for shared decision-making, goal setting, and self-management support. However, concerns were raised regarding digital literacy, language barriers, and the potential for EHRs to negatively impact the nurse-patient relationship if not

Table 2 Impact of EHRs on pediatric nursing care outcomes

Aspect	Average Percentage Change	Sources
Clinical Documentation	+20%	[21, 27, 37, 38]
Medication Errors	-30%	[13, 14, 17, 18, 28, 30]
Care Coordination	+25%	[2, 3, 7, 8, 32, 33]
Patient Engagement	+15%	[11, 12, 44–47]

implemented with appropriate training and sensitivity [31, 48, 49] (Table 1).

Clinical Documentation: The average increase of 20% (Table 2) in documentation completeness reflects significant improvements attributed to EHR systems [21, 22, 25, 27, 37, 38]. Variations across studies may be due to differences in EHR systems, training protocols, and implementation phases [7, 8].

Medication Errors: A 30% reduction in medication errors highlights the effectiveness of EHRs with CPOE and CDSS [13, 14, 17, 18, 28, 30]. Variability in error reduction is likely influenced by specific EHR features, integration level, and user training [13, 14] (Table 2).

Care Coordination as shown in Table 2 the 25% improvement in care coordination shows EHRs' role in facilitating information sharing and reducing redundant testing [2, 3, 7, 8, 32, 34]. Outcomes may vary depending on EHR interoperability and integration [2, 3].

Patient Engagement: The 15% increase in patient engagement demonstrates the positive impact of EHR patient portals and educational tools [11, 12, 44–47]. Variability might be due to differences in patient digital literacy and portal functionality [11, 12] (Table 2).

Heterogeneity and sensitivity analysis

The studies reviewed varied in design, settings, and measured outcomes, indicating heterogeneity. This variability was addressed using subgroup analyses and meta-regression techniques. Sensitivity analysis involved excluding studies with high risk of bias and re-running the meta-analyses to test the robustness of the results. The sensitivity analysis confirmed that the main findings

were consistent, thereby reinforcing the reliability of the conclusions drawn from this systematic review.

Discussion

This systematic review of 28 studies provides a comprehensive analysis of the impact of EHRs on pediatric nursing care. Our findings underscore the significant role of EHRs in enhancing clinical documentation, medication management, care coordination, and patient engagement. These results are consistent with existing literature, validating the transformative potential of EHRs in improving pediatric healthcare delivery [17, 18, 25, 27, 28, 30, 37, 38].

Clinical documentation

The review reveals a notable 20% average increase in clinical documentation completeness due to EHR systems [21, 22, 25, 27, 37, 38]. This improvement reflects enhanced accuracy, completeness, and legibility of patient records, which are essential for effective care continuity and provider communication. However, the transition to EHRs is not without its challenges. The increase in documentation time and potential disruptions in patient interactions, particularly during initial EHR adoption, highlight the need for addressing usability issues and workflow integration [6, 15, 16, 20]. To mitigate these challenges, targeted training programs incorporating hands-on simulations and scenario-based learning are critical.

Medication management

EHRs, particularly those with integrated CPOE and CDSS, have shown a significant 30% reduction in medication errors [13, 14, 17, 18, 28, 30]. This reduction is attributed to improved access to real-time patient information and enhanced medication safety. Despite initial increases in medication errors during the transition phase, the overall positive impact underscores the importance of robust user training and system acceptance [29, 43]. Variability in error reduction across studies suggests that EHR features, integration levels, and user proficiency play crucial roles in determining outcomes.

Patient engagement

The average 15% increase in patient engagement associated with EHRs highlights their effectiveness in enhancing patient involvement and empowerment through patient portals and educational tools [11, 12, 44–47]. These tools facilitate access to medical records, treatment plans, and educational resources, promoting shared decision-making and self-management. However, challenges related to digital literacy, language barriers, and potential impacts on the nurse-patient relationship must

be addressed through thoughtful implementation and ongoing support [31, 48, 49]. Ensuring equitable access and effective communication is crucial for maximizing patient engagement.

Care coordination

EHRs contribute to a 25% improvement in care coordination by enhancing information sharing among healthcare providers and reducing redundant testing [2, 3, 7, 8, 32, 34]. This improvement underscores the role of EHRs in facilitating care continuity and reducing care fragmentation. Nonetheless, interoperability issues between different EHR systems remain a significant barrier. Effective care coordination across diverse settings necessitates standardized data exchange protocols and integrated EHR systems [6, 20]. Variability in care coordination outcomes highlights the need for ongoing efforts to improve EHR integration and standardization.

Limitations

This systematic review has several limitations that should be acknowledged. First, the focus on English-language publications may have limited the inclusion of relevant studies conducted in other languages, potentially underrepresenting the experiences of culturally diverse populations. Additionally, the heterogeneity in study designs, clinical settings, and EHR systems used across the studies may limit the generalizability of the findings. For instance, studies using different EHR systems might have varying functionalities and impacts on nursing practices. Furthermore, the rapid evolution of EHR technology makes it challenging to extrapolate findings from older studies to current practices, highlighting the need for ongoing research on the impact of newer EHR functionalities.

Implications

The findings of this systematic review have important implications for clinical practice, policymaking, and future research directions. For clinical practice, healthcare organizations should develop comprehensive EHR training programs that include hands-on simulations, scenario-based learning, and regular feedback sessions to address usability concerns and enhance user confidence. Engaging pediatric nurses in the design and optimization of EHR systems can enhance user acceptance and facilitate effective integration into clinical workflows. In terms of policy and regulations, policymakers should prioritize the development of standardized data exchange protocols and interoperability standards to facilitate data sharing between different EHR systems and healthcare settings. Additionally, they should establish guidelines and incentives to encourage the development and adoption of

user-friendly, pediatric-specific EHR functionalities that meet the unique needs of children and their families. Future research should evaluate the long-term impact of EHRs on pediatric patient outcomes, particularly regarding cost-effectiveness, resource utilization, and health disparities. Studies exploring the use of emerging technologies, such as artificial intelligence and machine learning, in conjunction with EHRs, could provide valuable insights into enhancing pediatric nursing care. Specifically, future research should investigate the impact of EHR-based decision support systems on medication adherence, patient satisfaction, and long-term health outcomes in children with chronic conditions.

Conclusion

This systematic review highlights the significant potential of EHRs in improving various aspects of pediatric nursing care, including clinical documentation, medication management, care coordination, and patient engagement. However, the successful implementation and utilization of EHRs in pediatric settings require addressing challenges related to system usability, interoperability, and user acceptance through comprehensive training, workflow redesign, and ongoing technical support. By synthesizing the existing evidence, this review provides a comprehensive understanding of the benefits, challenges, and best practices associated with the implementation and utilization of EHRs in pediatric nursing care. The findings underscore the importance of a collaborative and user-centered approach to EHR implementation, involving all stakeholders, including pediatric nurses, physicians, patients, and families. Ultimately, by embracing a collaborative, user-centered approach, healthcare stakeholders can effectively leverage EHRs to enhance pediatric nursing care quality, safety, and patient engagement, ultimately contributing to a more robust and equitable healthcare system for children.

Acknowledgements

The authors would like to thank Al-Qasim Green University and Al-Mustaqbal University for their support and the specific individuals who contributed to this research.

Authors' contributions

MAA conceptualized the study and drafted the manuscript. JSJ contributed to the data collection and analysis. RE provided critical revisions. All authors read and approved the final manuscript.

Funding

The study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Availability of data and materials

The data supporting the findings of this study are available within the article and its supplementary materials. Additional data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable. This systematic review did not involve direct human participants, thus did not require ethical approval or consent to participate.

Consent for publication

Not applicable. No individual person's data is included in this manuscript.

Competing interests

The authors declare that they have no competing interests.

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Received: 18 July 2024 Accepted: 20 August 2024

Published online: 14 October 2024

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