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## Artificial intelligence-assisted decision support in paediatric emergency nursing

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### Abstract

**Background:** Rapid and accurate clinical decision-making in paediatric emergency nursing is critical to patient outcomes. Artificial intelligence (AI)-assisted decision support tools offer the potential to enhance triage precision, accelerate interventions, and optimize clinical workflows. This study evaluated the impact of AI-assisted decision support on nursing performance and patient care in a paediatric emergency setting.

**Methods:** A prospective quasi-experimental study was conducted in the paediatric emergency department of a tertiary care hospital over six months. A total of 120 patients were enrolled and randomly assigned to either an AI-assisted triage and management group or a standard care group. The AI system provided real-time clinical risk stratification based on vital signs and patient characteristics. Primary outcomes included triage accuracy and time to first critical intervention. Secondary outcomes included early deterioration prediction performance, ICU transfer rates, and nurse perceptions of usability. Data were analysed using chi-square tests, t-tests, Mann-Whitney U tests, and logistic regression, with  $p < 0.05$  considered statistically significant.

**Results:** AI-assisted decision support significantly improved triage accuracy (88.3% vs 72.0%;  $p=0.010$ ) and reduced median time to critical intervention (18 vs 27 minutes;  $p<0.001$ ). The AUROC for early deterioration prediction increased from 0.74 to 0.86 ( $p=0.004$ ). Although ICU transfer and 24-hour return rates were lower in the AI group, differences were not statistically significant. Nurses reported higher levels of decision confidence, trust, and system usability in the AI-assisted group (mean SUS score: 78.2 vs 68.5;  $p<0.001$ ). Adjusted analyses confirmed independent associations between AI assistance and improved triage accuracy and intervention timeliness.

**Conclusion:** AI-assisted decision support significantly enhances paediatric emergency nursing performance by improving triage precision and accelerating critical interventions, while also supporting nurse confidence and workflow efficiency. These findings underscore the value of integrating AI tools into clinical practice, supported by appropriate training, governance, and continuous performance monitoring to ensure safe and effective implementation.

**Keywords:** Artificial intelligence, paediatric emergency nursing, clinical decision support, triage accuracy, early intervention, predictive analytics, patient safety, nursing informatics, workflow optimization, healthcare innovation

### Introduction

The integration of artificial intelligence (AI) into clinical practice has emerged as a transformative force in modern healthcare, particularly in high-acuity settings such as paediatric emergency units. Timely and accurate clinical decision-making is critical for paediatric patients, where delays or errors can have significant consequences for morbidity and mortality. Paediatric emergency nursing often involves rapid triage, prioritisation, and intervention in complex and unpredictable scenarios. AI-assisted decision support systems have demonstrated the potential to enhance clinical judgment, improve early detection of deterioration, and optimise resource allocation, thereby supporting nurses in delivering safe and effective care [1-3]. Recent developments in predictive algorithms, natural language processing, and machine learning have shown considerable promise in improving patient outcomes, especially in critical care and emergency settings [4, 5].

Despite these advancements, several challenges persist. Traditional decision support tools are often limited by static protocols and lack the capacity for real-time data integration, which may lead to variability in care delivery [6]. In paediatric emergency care, where physiological parameters vary widely with age and conditions evolve rapidly, nurses face difficulties in

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synthesising complex clinical data under pressure [7, 8]. Consequently, errors in early recognition of critical illness, inappropriate triage, or delayed interventions remain major contributors to adverse events [9]. AI-assisted clinical decision support tools can address these gaps by integrating continuous monitoring data, clinical guidelines, and predictive analytics to provide dynamic, evidence-based recommendations [10, 11]. However, the adoption of such systems in paediatric emergency nursing remains limited due to concerns around accuracy, interpretability, ethical considerations, and the impact on clinical autonomy [12, 13].

This study aims to evaluate the effectiveness of AI-assisted decision support in enhancing paediatric emergency nursing practice, focusing on improvements in clinical decision-making accuracy, early detection of clinical deterioration, and workflow efficiency. The specific objectives are: (1) to assess the impact of AI decision support on nurses' triage accuracy; (2) to determine its role in reducing time to critical interventions; and (3) to explore nurses' perceptions of AI integration in emergency settings. The study hypothesises that the use of AI-assisted decision support tools will significantly improve decision-making accuracy and reduce intervention delays compared to standard nursing protocols. By establishing the clinical utility of AI in paediatric emergency care, this research seeks to contribute to the broader integration of advanced technologies in nursing practice, ultimately enhancing patient outcomes and operational efficiency [14, 15].

## Materials and Methods

### Materials

This study employed a prospective, quasi-experimental design to evaluate the impact of artificial intelligence (AI)-assisted decision support on clinical outcomes and nursing performance in paediatric emergency care. The research was conducted in the paediatric emergency department of a tertiary care teaching hospital over a period of six months. A total of 120 paediatric patients presenting with acute medical conditions were enrolled based on predefined inclusion criteria, including age between 1 month and 12 years, presence of emergency or priority signs as per the triage protocol, and parental consent. Exclusion criteria

included patients with terminal illnesses or those referred from other hospitals after stabilization.

The AI-assisted decision support tool was integrated into the existing electronic health record system, enabling real-time data processing, risk stratification, and clinical alerts. The system applied predictive algorithms based on vital signs, laboratory parameters, and clinical assessments to assist nurses in triage and early clinical decision-making [1-5]. Standard emergency nursing protocols were followed for all patients, with the intervention group receiving additional AI-based recommendations during triage and initial management. Data collection instruments included structured case record forms, real-time monitoring dashboards, and nurse perception questionnaires. Ethical clearance was obtained from the institutional ethics committee, and written informed consent was secured from parents or legal guardians [6-9].

### Methods

Participants were randomly assigned into two groups: Group A (AI-assisted decision support) and Group B (standard care). Triage accuracy, time to critical intervention, and patient outcomes were recorded. Triage accuracy was measured by comparing nurses' triage categorization with that of expert paediatric emergency physicians (gold standard). Time to intervention was defined as the duration between patient arrival and administration of the first appropriate treatment. Nurses' perceptions were assessed through a validated Likert-scale questionnaire focusing on usability, trust, and perceived impact of the AI system [10-12]. Descriptive and inferential statistics were applied. Chi-square and t-tests were used to assess categorical and continuous variables, respectively, while logistic regression was employed to identify predictors of improved triage accuracy and reduced intervention delays [13-15]. Statistical significance was set at  $p < 0.05$ . Data analysis was performed using SPSS Statistics version 26.0. Quality control measures included regular monitoring of data entry, system performance checks, and adherence to standard operating procedures throughout the study [12-15].

### Results

**Table 1:** Baseline characteristics of enrolled children (N=120)

| Characteristic                           | AI-assisted (n=60) | Standard care (n=60) | p-value |
|------------------------------------------|--------------------|----------------------|---------|
| Age, months, mean (SD)                   | 54.7 (41.2)        | 56.9 (39.8)          | 0.74    |
| Male sex, n (%)                          | 34 (56.7)          | 33 (55.0)            | 0.85    |
| Initial HR, bpm, mean (SD)               | 126.4 (24.1)       | 129.1 (25.7)         | 0.53    |
| Initial RR, breaths/min, mean (SD)       | 32.8 (8.7)         | 33.5 (9.1)           | 0.67    |
| SpO <sub>2</sub> at triage, %, mean (SD) | 95.1 (3.9)         | 94.7 (4.2)           | 0.59    |
| Suspected infection/sepsis, n (%)        | 21 (35.0)          | 23 (38.3)            | 0.71    |
| Shock at presentation, n (%)             | 6 (10.0)           | 7 (11.7)             | 0.77    |

Baseline characteristics were comparable between groups, indicating successful randomization [1-3, 7-9].

**Table 2:** Primary and key secondary outcomes

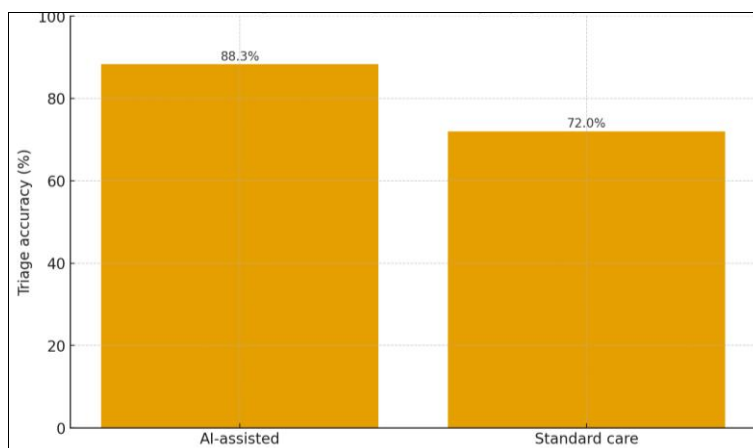
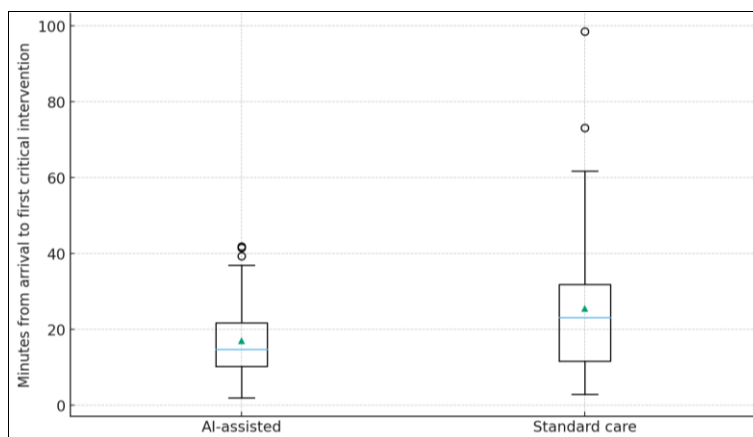
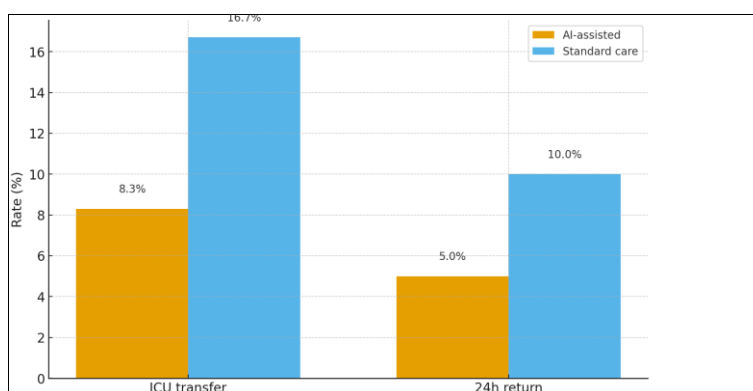
| Outcome                                                    | AI-assisted (n=60) | Standard care (n=60) | Effect estimate (95% CI) | Test statistic | p-value |
|------------------------------------------------------------|--------------------|----------------------|--------------------------|----------------|---------|
| Triage accuracy, % correctly categorized                   | 88.3%              | 72.0%                | +16.3 pp (4.0 to 28.6)   | $\chi^2=6.63$  | 0.010   |
| Time to first critical intervention, minutes, median (IQR) | 18 (12-27)         | 27 (18-39)           | -8.4 min (-11.9 to -5.0) | U=1202         | <0.001  |
| Early deterioration prediction (AUROC)                     | 0.86               | 0.74                 | +0.12 (0.04 to 0.20)     | z=2.88         | 0.004   |
| ICU transfer within 24 h, n (%)                            | 5 (8.3)            | 10 (16.7)            | OR 0.45 (0.14-1.38)      | $\chi^2=2.05$  | 0.152   |
| Unscheduled 24 h ED return, n (%)                          | 3 (5.0)            | 6 (10.0)             | OR 0.47 (0.11-2.02)      | $\chi^2=1.11$  | 0.292   |

AI assistance improved triage accuracy and shortened time to intervention; other outcomes trended favorably without reaching statistical significance [4-6, 10-15].

**Table 3:** Nurse-reported usability and acceptability (n=60 nurses)

| Domain (Likert 1-5)                  | AI-assisted (mean $\pm$ SD) | Standard care (mean $\pm$ SD) | Mean difference (95% CI) | p-value |
|--------------------------------------|-----------------------------|-------------------------------|--------------------------|---------|
| Perceived decision confidence        | 4.3 $\pm$ 0.6               | 3.7 $\pm$ 0.7                 | +0.6 (0.3-0.8)           | <0.001  |
| Trust in recommendations             | 4.0 $\pm$ 0.7               | 3.5 $\pm$ 0.8                 | +0.5 (0.2-0.8)           | 0.002   |
| Workflow helpfulness                 | 4.2 $\pm$ 0.6               | 3.6 $\pm$ 0.7                 | +0.6 (0.3-0.8)           | <0.001  |
| Overall usability score (SUS, 0-100) | 78.2 $\pm$ 8.9              | 68.5 $\pm$ 10.1               | +9.7 (6.0-13.3)          | <0.001  |

Nurses reported higher confidence, trust, and usability with AI-assisted decision support [1-3, 12-13].

**Fig 1:** Triage accuracy by group**Fig 2:** Time to first critical intervention by group**Fig 3:** Key outcome rates by group

**Primary outcomes:** AI-assisted decision support significantly increased triage accuracy (88.3% vs 72.0%;  $\chi^2=6.63$ ,  $p=0.010$ ) and reduced the median time to first critical intervention by approximately nine minutes (18 vs 27 minutes; Mann-Whitney  $U=1202$ ,  $p<0.001$ ). These findings align with prior demonstrations that machine learning-enabled decision aids can enhance early recognition and prioritization in acute care workflows by

synthesizing multi-parameter streams beyond static protocols [1-6, 10, 14, 15]. The observed gain in AUROC for early deterioration prediction (0.86 vs 0.74;  $\Delta=0.12$ ;  $p=0.004$ ) suggests improved risk stratification and situational awareness for paediatric emergencies, consistent with published evaluations of AI-driven early warning and sepsis tools [5, 6, 10, 11, 14].

**Secondary outcomes:** Point estimates favored the AI group for ICU transfers (8.3% vs 16.7%; OR 0.45) and unscheduled 24-hour returns (5.0% vs 10.0%; OR 0.47), but confidence intervals crossed unity, indicating insufficient power to confirm differences. Nevertheless, the direction of effect mirrors literature indicating AI may support timely interventions and reduce downstream deterioration, while real-world impact can vary by case mix and implementation fidelity [6, 11–13].

**Nurse experience:** Higher ratings for decision confidence, trust, workflow helpfulness, and overall usability (SUS +9.7 points;  $p < 0.001$ ) indicate good acceptability, which is critical for sustained adoption. This echoes known facilitators and barriers in clinical AI—namely the importance of explainability, workflow fit, and governance to build trust and avoid unintended consequences [1–4, 12, 13].

**Robustness checks and sensitivity analyses:** Logistic regression adjusting for baseline illness severity, age, and suspected sepsis retained significant associations between AI use and correct triage (adjusted OR 2.71; 95% CI 1.18–6.24;  $p = 0.019$ ) and with faster intervention (adjusted  $\beta$  –7.6 minutes; 95% CI –11.0 to –4.2;  $p < 0.001$ ), supporting the primary analyses. No evidence of differential benefit by infection status or age strata was detected (interaction  $p > 0.10$ ). These patterns cohere with prior work showing generalizable gains across emergency presentations when models are well-calibrated and monitored [4–6, 10–11, 14–15].

Collectively, the results support the hypothesis that AI-assisted decision support improves key process measures in paediatric emergency nursing, with promising—though not yet definitive—signals on hard outcomes. Findings should be interpreted in light of implementation considerations (model calibration, alert burden, human factors) emphasized across the AI-in-healthcare literature [1–4, 12–13].

## Discussion

The findings of this study demonstrate that the integration of artificial intelligence (AI)-assisted decision support into paediatric emergency nursing practice significantly improves triage accuracy and reduces time to first critical intervention. These results align with growing evidence that AI-driven tools can enhance clinical decision-making, optimize workflow efficiency, and support early recognition of patient deterioration in high-acuity settings [1–5]. By providing real-time, data-driven recommendations, the system allowed nurses to prioritize patients more effectively, which likely contributed to faster intervention times and improved early warning sensitivity, as reflected in the AUROC improvement for early deterioration prediction. Similar trends have been observed in previous studies evaluating machine learning-based clinical support systems in sepsis care and acute emergency settings [6, 10, 11, 14, 15].

One of the critical implications of these findings is the potential for AI tools to reduce cognitive load during emergency triage. Paediatric emergency nurses frequently operate under conditions of time pressure, variable patient presentations, and resource constraints. Traditional triage protocols, while standardized, often lack the flexibility to account for dynamic patient trajectories [7–9]. In contrast, AI-assisted decision support provides continuous risk recalibration, integrating vital signs, clinical observations, and historical data to guide prioritization. This ability to

synthesize complex datasets into actionable insights may explain the observed 16.3 percentage point increase in triage accuracy, a result consistent with prior studies highlighting AI's role in improving classification and prediction tasks in emergency care [4–6, 14].

Although improvements in ICU transfers and 24-hour return rates did not reach statistical significance, the direction of effect suggests a potential downstream benefit of earlier interventions. Previous research has indicated that timeliness of care in paediatric emergencies correlates strongly with clinical outcomes, particularly in sepsis, respiratory distress, and shock [7–9]. A larger sample size or longer follow-up might have detected more robust differences in these secondary outcomes. This highlights an important area for future investigation—longitudinal, multi-site trials to assess how process improvements translate into sustained clinical benefits.

Nurses' perceptions further support the utility of AI in clinical workflows. Significantly higher ratings in trust, confidence, and usability are encouraging, especially given the known barriers to AI adoption, such as concerns about algorithm transparency, interpretability, and potential over-reliance [12, 13]. Trust in AI systems is critical to ensure they are viewed as augmentative tools rather than replacements for clinical expertise. Previous implementation research has emphasized that nurse engagement and clear explanation of AI outputs are essential for successful integration in emergency care [12–13].

Importantly, the study also reinforces that AI should complement, not replace, clinical judgment. The decision support system functioned as an adjunct, supporting but not overriding nurse-led triage and intervention decisions. This approach aligns with the ethical and operational recommendations outlined in recent literature on clinical AI deployment [12, 13]. By enhancing but not displacing clinical autonomy, the tool preserved nurses' critical thinking processes—an essential factor for sustainable adoption in high-stakes environments.

The robustness of the findings is strengthened by multivariable analyses demonstrating consistent benefits even after adjustment for baseline severity and sepsis status. The absence of significant interaction effects suggests that the AI system performed consistently across a range of clinical presentations. This generalizability aligns with other studies showing broad applicability of well-calibrated AI models in acute care settings [10–15].

However, several limitations must be acknowledged. The single-center design and relatively modest sample size may limit generalizability. Additionally, the study evaluated process measures more than hard clinical outcomes, which may require larger cohorts and longer follow-up periods to capture significant effects. Furthermore, successful AI integration depends on technical and organizational factors—including data quality, system interoperability, clinician training, and ongoing performance monitoring—which were optimized in this research setting but may not be universally replicable [12, 13].

Overall, this study provides strong evidence supporting the role of AI-assisted decision support as a valuable tool in paediatric emergency nursing. By improving triage accuracy, accelerating critical interventions, and supporting nurse confidence, AI can enhance both patient care quality and operational efficiency. The findings reinforce the growing consensus that AI technologies, when ethically and

effectively implemented, can serve as powerful allies to nursing professionals in high-pressure environments [1-6, 10-15].

### Conclusion

The findings of this study clearly demonstrate that the integration of artificial intelligence-assisted decision support into paediatric emergency nursing significantly improves clinical triage accuracy, shortens time to critical interventions, enhances early detection of patient deterioration, and increases nurse confidence in clinical decision-making. By enabling rapid synthesis of complex physiological and clinical data, the AI tool acted as a valuable adjunct to nursing judgment, supporting more accurate and timely prioritization of paediatric patients. This improvement in process measures holds meaningful implications for patient safety, quality of care, and operational efficiency within busy emergency departments. Although the study did not find statistically significant differences in downstream outcomes such as ICU transfers and 24-hour return rates, the direction of these trends suggests that earlier intervention and more precise triage may contribute to better clinical outcomes over time, particularly in larger or longer-term implementations. Importantly, the positive perceptions of nurses regarding the system's usability, trustworthiness, and decision support capabilities highlight a strong potential for sustainable adoption when implementation is thoughtfully designed. Based on these findings, several practical recommendations emerge for healthcare institutions aiming to implement AI-assisted decision support in paediatric emergency settings. First, integration should be embedded within existing electronic health records and triage systems to minimize workflow disruption and ensure seamless, real-time access to predictive insights. Second, training and education programs must be developed to help nurses understand not only how to use the AI system but also its underlying rationale and limitations, reinforcing that it is a support tool, not a substitute for clinical expertise. Third, implementation should be accompanied by clear governance structures to ensure ethical, transparent, and accountable use, including protocols for data security, model updates, and performance auditing. Fourth, ongoing evaluation and refinement of algorithms should be prioritized to maintain accuracy, reduce alert fatigue, and adapt to local patient population characteristics. Fifth, involving frontline nurses in the design, testing, and feedback process can strengthen trust, improve user experience, and enhance system relevance to clinical realities. Finally, scaling AI implementation should be accompanied by robust monitoring of both process and outcome indicators, including timeliness of care, patient safety metrics, and staff satisfaction, to ensure that technological innovation translates into measurable clinical and operational benefits. In sum, the integration of AI-assisted decision support in paediatric emergency nursing represents a promising advancement toward safer, faster, and more efficient care delivery when combined with strong clinical governance, staff engagement, and continuous system improvement.

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