

Artificial Intelligence-Based Clinical Decision Support Systems in Nursing Practice: Applications, Benefits, and Challenges. A Narrative Review

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ABSTRACT

Background: Artificial intelligence-based clinical decision support systems (AI-CDSS) are increasingly used in healthcare to support data-informed clinical decisions. In nursing practice, these systems may assist with risk assessment, medication safety, early recognition of patient deterioration, documentation, and care planning.

Objective: This narrative review examines the applications, potential benefits, implementation challenges, and ethical and legal considerations associated with AI-CDSS in nursing practice.

Methods: Literature published between 2017 and 2025 was identified from PubMed, CINAHL, Scopus, Web of Science, and World Health Organization publications. Sources addressing AI-CDSS applications, clinical or workflow outcomes, ethical issues, and implementation barriers in nursing-related contexts were synthesized thematically. No formal quality appraisal or meta-analysis was undertaken because this was a narrative review.

Results: AI-CDSS are used in medication-related decision support, early warning and deterioration detection, intensive-care monitoring, nursing documentation, and community-based care. Their potential benefits include more timely access to clinical information, support for guideline-concordant care, improved prioritization of patients at risk, and reduced administrative workload. However, effectiveness depends on reliable and interoperable data, integration with nursing workflow, usability, staff competence, and ongoing clinical oversight. Key barriers include high implementation costs, inadequate digital infrastructure, privacy and cybersecurity risks, algorithmic bias, limited transparency, and variable AI literacy among nurses.

Conclusion: AI-CDSS should be regarded as tools that support, rather than replace, nursing clinical judgment. Safe and equitable implementation requires robust digital infrastructure, nurse education, local evaluation of system performance, multidisciplinary governance, and clear safeguards for privacy, transparency, accountability, and bias mitigation.

Keywords: artificial intelligence; clinical decision support systems; nursing practice; patient safety; digital health; nursing informatics.

INTRODUCTION

Artificial intelligence (AI) is reshaping healthcare delivery by enabling faster, data-driven, evidence-based clinical decisions. Clinical decision support systems (CDSS) integrate patient data with scientific knowledge to help clinicians make accurate, timely decisions; when enhanced with AI, these systems (hereafter AI-CDSS) offer predictive analytics, pattern recognition, and personalized recommendations that extend beyond the capabilities of traditional rule-based systems (Sutton et al., 2020; Topol, 2019).

Healthcare systems generate vast volumes of patient data daily, and traditional clinical decision-making is often time-consuming, prone to human error, and subject to variability in judgment. AI offers a means of supporting early diagnosis and risk stratification, predictive analytics for patient deterioration, medication safety and interaction checking, and continuous patient monitoring through early warning systems, representing a shift from reactive to proactive, data-informed nursing care (Jiang et al., 2017; World Health Organization [WHO], 2021).

In nursing practice specifically, AI-CDSS have demonstrated potential to improve patient safety, reduce medical errors, enhance workflow efficiency, and promote evidence-based care; however, their adoption also raises ethical, legal, and practical challenges that must be addressed to ensure safe and equitable implementation (Bates et al., 2021). This paper reviews current applications, benefits, and challenges of AI-CDSS in nursing, together with ethical and legal considerations and recommendations for future practice and policy.

MATERIALS AND METHODS

This narrative review synthesizes peer-reviewed literature, international guidelines, and empirical studies published between 2017 and 2025. Sources were identified through PubMed, CINAHL, Scopus, Web of Science, and World Health Organization (WHO) publications, using the search terms “artificial intelligence,” “clinical decision support systems,” “nursing practice,” “patient safety,” and “digital health,” combined using Boolean operators.

Studies reporting applications, patient or workflow outcomes, ethical considerations, or implementation challenges of AI-CDSS in nursing contexts were included; sources not directly relevant to nursing practice or clinical decision support, and non-peer-reviewed or commercial sources, were excluded. As a narrative rather than systematic review, no formal quality-appraisal protocol or meta-analysis was applied; findings are synthesized thematically. No animal or human subject research was conducted for this review, and ethical approval was therefore not required.

RESULTS

Artificial intelligence technologies used in nursing

AI refers to computer systems capable of performing tasks that typically require human intelligence, including learning, reasoning, pattern recognition, decision-making, and problem-solving Russell, et al.,(1995). The principal AI technologies applied in nursing include machine learning (predicting clinical outcomes from data patterns), deep learning (enabling image and complex pattern recognition), natural language processing (interpreting clinical notes and documentation), expert systems (providing rule-based clinical recommendations), and robotics (assisting with procedural and logistical tasks).

Clinical decision support systems and their components

A CDSS is a computerized system designed to assist clinicians in making evidence-based decisions at the point of care. Core functions include alerts and reminders, drug–drug and drug–allergy interaction checks, diagnostic and differential support, care-planning assistance, and risk-prediction and stratification models

(Sutton et al., 2020). The principal components of an AI-CDSS include a patient database (storing structured patient data), a knowledge base (encoding clinical guidelines and best evidence), an inference engine (applying logic to support decision-making), a user interface (facilitating nurse–system interaction), and AI algorithms (enabling learning, prediction, and adaptation).

The general workflow of an AI-CDSS in nursing practice proceeds from patient assessment and data collection, through data extraction from the electronic health record, AI algorithm processing and pattern recognition, clinical analysis and risk stratification, system-generated recommendations and alerts, nurse decision-making and clinical judgment, to implementation of patient care interventions. This workflow illustrates that an AI-CDSS functions as a decision-enhancement tool rather than a replacement for nursing expertise, since the nurse retains responsibility for interpreting system output and enacting the final clinical decision (Bates et al., 2021).

Current applications in nursing practice

AI-CDSS support diverse nursing functions across care settings, including medication administration safety, pressure-ulcer prevention, fall-risk prediction, sepsis detection and early warning, intensive care unit (ICU) monitoring and deterioration alerts, emergency triage optimization, and care planning and documentation (WHO, 2021).

- **Medication safety.** AI systems can detect wrong-drug errors, dosage errors, allergy conflicts, and harmful drug interactions, thereby reducing medication errors and enhancing patient safety (Bates et al., 2021).
- **Early warning systems.** AI models have been used to predict cardiac arrest, sepsis onset, respiratory failure, and general clinical deterioration; integrating AI with early-warning tools such as the National Early Warning Score 2 has been reported to improve both prediction accuracy and response times in some settings (Jiang et al., 2017).
- **Nursing documentation.** Applications include automated documentation and speech-to-text recognition, which can reduce administrative burden and allow nurses to spend more time in direct patient care.
- **Intensive care and community nursing.** In the ICU, applications include ventilator monitoring, mortality prediction, infection surveillance, and deterioration alerts; in community settings, applications include telehealth, chronic-disease monitoring, remote consultations, and home-care support (WHO, 2021).

Benefits of AI-CDSS in nursing

Reported benefits of AI-CDSS in nursing practice include improved diagnostic accuracy, reduced errors and increased patient safety, faster decision-making in emergency and critical care, workflow efficiency and reduced administrative load, and support for higher-quality, guideline-concordant, evidence-based practice (Sutton et al., 2020; Topol, 2019).

Some studies report high diagnostic accuracy for machine-learning models supporting specific nursing tasks, although these figures are typically drawn from a single methodological study and should not be generalized as broad improvements in patient safety or workflow efficiency. For example, Türk et al. (2025) developed and evaluated several machine-learning models to support standardized nursing-diagnosis classification, reporting 96.33% classification accuracy for a Naive Bayes model using the full set of 176 defining characteristics, and 82.94% accuracy for a Gradient Boosting model using a reduced set of only 50 top-ranked characteristics. This finding is clinically relevant because it suggests that nursing-diagnosis accuracy can be reasonably preserved even when the number of characteristics nurses must document is substantially reduced, which could ease documentation burden without a large loss of diagnostic precision. However, this evidence derives from a single methodological development study rather than a prospective clinical deployment, has not yet been independently replicated, and reports diagnostic-classification accuracy specifically rather than downstream patient-safety or workflow-efficiency outcomes; broader claims about AI-CDSS improving

patient safety or workflow efficiency by a comparable margin are not supported by this source and should be evaluated separately against studies that directly measure those outcomes.

Challenges to implementation

Despite this potential, AI-CDSS implementation faces several barriers: poor data quality and interoperability between systems; high implementation and maintenance costs; limited information and communication technology infrastructure, particularly in low-resource settings; cybersecurity and data-privacy risks; resistance to change and workflow disruption; algorithmic bias and lack of transparency (the “black box” problem); and limited AI literacy and competency among nurses (WHO, 2021; Jiang et al., 2017).

Ethical and legal considerations

Ethical considerations include patient privacy and confidentiality, data ownership and informed consent, algorithm transparency and explainability, accountability for AI-assisted decisions, and equity and bias mitigation in algorithm design (WHO, 2021). Legal considerations include compliance with data-protection regulations such as the Nigeria Data Protection Regulation and the European Union’s General Data Protection Regulation, professional liability and clinical responsibility, regulatory approval and oversight of AI tools, and the broader legal frameworks governing AI in healthcare (Jiang et al., 2017).

Illustrative case: AI-CDSS for sepsis prediction

A real-world implementation of a nurse-facing AI-CDSS for early sepsis detection illustrates the potential clinical and operational impact of these systems when well integrated into clinical workflows. Boussina et al. (2024) evaluated a deep-learning sepsis-prediction model (COMPOSER) integrated into the electronic health record as a nurse-facing alert across two emergency departments, in a before-and-after quasi-experimental study of 6,217 adult patients with sepsis. Deployment of the model was associated with a statistically significant 1.9 percentage-point absolute reduction (a 17% relative decrease) in in-hospital sepsis-related mortality, a 5.0 percentage-point absolute increase (a 10% relative increase) in sepsis-bundle compliance, and a significant reduction in organ-dysfunction progression at 72 hours after sepsis onset. When nurses escalated a high-risk alert to the physician immediately, patients received antibiotics significantly sooner. Secondary trends toward fewer ICU admissions and more ICU-free days were observed but did not reach statistical significance. This example should be treated as an illustrative case rather than definitive evidence of effectiveness: the study was a non-randomized, before-and-after design at a single US academic health system, evaluated only a nurse-facing alert workflow (not the underlying model in isolation), and its findings on ICU-related outcomes specifically were not statistically significant; generalization to other settings, workflows, and patient populations should not be assumed without further corroborating studies.

DISCUSSION

The evidence reviewed suggests that AI-based clinical decision support systems (AI-CDSS) can function as decision-enhancement tools within nursing practice, but their value is highly context-dependent. Systems that align closely with nursing workflows, are embedded in usable interfaces, and rely on reliable, interoperable data are more likely to be adopted and to produce meaningful effects than systems that operate as isolated add-ons (Sutton et al., 2020; Bates et al., 2021).

The reported advantages of AI-CDSS- such as earlier recognition of patient deterioration, more consistent medication checks, and reduced documentation time- are plausible given the capacity of these systems to process large volumes of data and apply pattern recognition. However, improvements in intermediate process measures (for example, faster alerts or more complete documentation) do not automatically translate into better patient outcomes unless they are accompanied by appropriate staffing, timely responses, and clear escalation pathways. In high-acuity settings, even small reductions in time to intervention may be clinically important, whereas in resource-constrained environments the same system may add cognitive load without

improving care if alerts are frequent, poorly calibrated, or disconnected from available resources (WHO, 2021; Jiang et al., 2017).

Implementation challenges identified in this review- data quality, interoperability, cost, infrastructure, cybersecurity, algorithmic bias, and limited AI literacy among nurses- should be understood as determinants of safe and equitable use, not merely technical obstacles. Poor data quality and fragmented information systems undermine the validity of algorithmic recommendations, while weak infrastructure and high costs restrict access to better-resourced institutions, potentially widening existing disparities in care. Algorithmic opacity and bias further complicate trust and accountability: when nurses cannot understand how a recommendation was generated, they may either over-rely on the system or disregard useful alerts, and bias in training data can lead to systematically poorer performance for under-represented groups (WHO, 2021; Topol, 2019).

Limited AI literacy among nurses is both a practical and an ethical issue. Without a foundational understanding of how AI-CDSS work, their limitations, and appropriate ways to integrate them into clinical reasoning, nurses may be ill-equipped to critique system outputs, report problems, or participate in governance processes. Competency development should therefore extend beyond basic training to include critical appraisal of AI tools and participation in local evaluation and policy-making (Russell & Norvig, 2021).

Ethical and legal concerns highlighted in this review- privacy, consent, transparency, accountability, and regulatory compliance must be operationalized through concrete governance mechanisms. This includes clear policies on data access and sharing, audit trails for AI-influenced decisions, processes for investigating adverse events involving AI-CDSS, and mechanisms for patient and staff feedback. Accountability should be framed as shared and layered: nurses retain professional responsibility for clinical judgment, but institutions, developers, and regulators also bear responsibility for ensuring that systems are safe, transparent, and fit for purpose. Legal frameworks such as data-protection regulations set minimum standards, but local policies and professional guidelines determine how these standards are enacted in daily practice (WHO, 2021; Jiang et al., 2017).

Emerging developments- generative AI for documentation and education, explainable AI to improve transparency, and integration with wearables, robotics, and remote monitoring - may expand the scope of AI-CDSS beyond acute care into community and home-based nursing. These advances could support more personalized and continuous care, but they also raise new questions about data ownership, consent for continuous monitoring, and the risk of further automating tasks without adequate human oversight (Topol, 2019; Mesko, 2018). To harness these opportunities while managing risks, healthcare systems should prioritize context-sensitive implementation, robust pre- and post-deployment evaluation, workforce development in AI literacy and critical informatics, and participatory governance that involves nurses, patients, IT specialists, ethicists, and administrators in the design and oversight of AI-CDSS.

This review has several limitations. As a narrative rather than systematic review, it did not apply a formal quality-appraisal protocol, structured risk-of-bias assessment, or meta-analysis, and it was limited to English-language sources published between 2019 and 2025. The findings should therefore be interpreted as a thematic overview of current developments rather than a definitive assessment of effectiveness. Several quantitative claims in the results section derive from single studies or reports and require verification against primary sources and, where possible, independent replication before being presented as robust evidence.

Implications for Practice

The findings of this review have several implications for nursing practice, health informatics, and applied-science implementation:

- **Treat AI-CDSS as decision-enhancement tools, not replacements for nursing judgment.** AI-CDSS should augment not substitute for professional clinical reasoning. Nurses should interpret system outputs

in relation to clinical assessment, patient preferences, local protocols, and available evidence. This recommendation is consistent with the established view that CDSS are intended to support clinicians while their use requires attention to risks, implementation, and human oversight (Bates et al., 2021; Sutton et al., 2020).

- **Prioritize workflow integration and usability.** Systems that generate frequent, poorly calibrated, or non-actionable alerts may contribute to alert fatigue and workflow disruption. Procurement and implementation should therefore involve frontline nurses in needs assessment, usability testing, training, and iterative refinement. Sutton et al. (2020)
- **Invest in data quality and interoperability.** The validity and usefulness of AI-CDSS recommendations depend on the quality, completeness, consistency, and accessibility of the underlying data. Institutions should standardize clinical documentation, strengthen interoperability between electronic health records and AI tools, and conduct routine data-quality audits. This recommendation is consistent with the broader literature on AI in healthcare (Jiang et al., 2017).
- **Develop AI literacy and critical informatics competencies.** Nursing education and continuing professional development should address basic AI concepts, data literacy, algorithmic bias, limitations of predictive systems, and the ethical use of decision support. These competencies would help nurses critically appraise system outputs and identify situations in which recommendations require further verification.
- **Embed AI-CDSS within governance frameworks.** Clear policies are needed on data access, privacy, consent, transparency, audit trails, incident reporting, and accountability for AI-influenced decisions. Multidisciplinary oversight committees should include nursing, clinical, information-technology, ethics, legal, administrative, and, where feasible, patient representatives. These recommendations are directly consistent with the World Health Organization's principles concerning autonomy, safety, transparency, accountability, inclusiveness, and equity (World Health Organization, 2021).
- **Evaluate locally and iteratively.** Before wide-scale adoption, AI-CDSS should undergo local pilot testing using predefined measures of safety, usability, equity, nursing workload, alert burden, and patient outcomes. Ongoing monitoring should be used to identify performance drift, unintended consequences, and differences in performance across patient groups. CDSS implementation and evaluation are recognized as continuing processes rather than one-time technical deployments (Sutton et al., 2020).
- **Address equity and access.** Implementation strategies should consider whether AI-CDSS could widen or reduce disparities in care, particularly in low-resource settings. Inclusive design, representative training data, bias monitoring, transparent performance reporting, and attention to infrastructure constraints are necessary to promote fair distribution of benefits (World Health Organization, 2021).

CONCLUSION

AI-based clinical decision support systems are becoming integral to modern nursing practice, but their role should be understood as decision enhancement rather than decision replacement. The evidence reviewed suggests that AI-CDSS can support nursing judgment by providing timely, data-driven recommendations, yet their impact on patient and workflow outcomes is contingent on data quality, system design, workflow integration, and the capacity of nurses to critically interpret and act on system outputs (Sutton et al., 2020; Topol, 2019).

While challenges related to ethics, cost, data quality, infrastructure, and workforce readiness remain, responsible implementation of AI-CDSS holds considerable potential to transform nursing and healthcare delivery. Realizing this potential in applied-science terms requires more than technical deployment: it demands robust ICT infrastructure, targeted AI literacy and competency development for nurses, context-

sensitive adaptation of tools to local practice environments, and governance frameworks that address privacy, transparency, accountability, and equity (WHO, 2021; Jiang et al., 2017).

Future work should focus on rigorous pre- and post-deployment evaluation of AI-CDSS in diverse nursing settings, co-design of systems with nurses and other end-users, and development of explainable and bias-aware algorithms that align with clinical needs and ethical standards. With these measures in place, AI-CDSS can contribute meaningfully to safer, more efficient, and more equitable nursing care within broader smart-health ecosystems (Mesko, 2018; Russell & Norvig, 2021).

Declarations

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