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The Efficacy and Ethics of AI-Powered Clinical Decision Support Systems in Nursing Practice: A Systematic Review

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Abstract

Background: Artificial Intelligence integration into Clinical Decision Support Systems is rapidly changing nursing practice and ushering in new, unparalleled levels of data analysis and clinical guidance. These AI-facilitated tools are said to improve diagnostic accuracy and optimize treatment planning, but they also raise profound ethical challenges, such as algorithmic bias, accountability gaps, and a devaluation of nursing intuition.

Aim: This systematic review aims to synthesize evidence concerning the effectiveness of AI-powered CDSS in enhancing diagnostic accuracy and treatment planning by nurses, while considering ethical and bias issues related to the use of such technology.

Methods: A systematic search of the literature was carried out across PubMed, CINAHL, Scopus, Web of Science, and IEEE Xplore for literature published between 2013-2025. Experimental, observational, and qualitative studies reporting evaluations of AI-CDS tools in nursing contexts were considered for review.

Results: Evidence shows that AI-CDS has great potential for improving early warning scores and reducing diagnostic errors, especially in sepsis detection and assessment of risk for pressure injuries. However, the performance of such systems significantly varies between the systems and clinical contexts. Ethically, these systems raise critical concerns regarding data bias propagation, transparency deficits ("black box" problem), and shifts in nursing responsibility and autonomy.

Conclusion: AI-driven CDSSs are a double-edged innovation in nursing. While exhibiting quantifiable advantages in clinical decision-making, their successful integration requires solid validation, mitigation strategies for bias, and ethical frameworks that preserve the human elements of nursing care.

Keywords: artificial intelligence, clinical decision support, nursing, diagnostic accuracy, algorithmic bias.

Introduction

The healthcare landscape is undergoing a profound digital transformation, with Artificial Intelligence emerging as a pivotal technology in the clinical environment. AI-powered Clinical Decision Support Systems represent a paradigm shift from the traditional rule-based approach in nursing practice to sophisticated analytical tools that use pattern recognition, predictive analytics, and personalized treatment recommendations (Buchanan et al., 2020). These systems make use of machine learning algorithms in the analysis of vast datasets such as EHRs, vital signs, laboratory results, and nursing documentation to provide real-time clinical insights at the bedside. The potential benefits that could occur in nursing practice are immense, ranging from heightened situational awareness to reduced cognitive burden when engaging in complex decision-making processes (Abràmoff et al., 2018).

With patient assessment, monitoring, and care coordination at the heart of the nursing profession, it is likely to be particularly impacted by this evolution in technology. AI-powered CDSS can be seen to enhance nursing clinical judgment through

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the detection of subtle patterns in patient data that may escape human detection-especially in a high-acuity setting where nurses often navigate multiple competing priorities (Seibert et al., 2021). Early warning systems for clinical deterioration, pressure injury prediction models, fall risk assessment tools, and medication administration are support systems with applications currently being implemented and studied. These tools seek to improve diagnostic accuracy, optimize intervention timing, and ultimately enhance patient safety and outcomes by making evidence-based recommendations with regard to unique patient profiles (Mebrahtu et al., 2021).

However, integrating AI into the nuanced arena of nursing practice brings up several critical questions that extend beyond technical efficacy. The ethical dimensions of AI implementation pose complex challenges that call for careful consideration. Algorithmic bias, where AI systems produce systematically biased results that disadvantage certain demographic groups, poses one major threat to health equity. The "black box" nature of many complex algorithms which the rationale for specific recommendations is not transparent or easily interpretable-creates tension with nursing's ethical obligation to understand and advocate for appropriate patient care. Moreover, the introduction of AI recommendations into the nurse-patient relationship may alter dynamics of trust, accountability, and professional autonomy in ways that are not yet fully understood.

Therefore, the objective of this systematic review is to critically analyze both the efficacy and ethics of AI-powered CDSS in nursing practice. Of particular importance will be the effort to answer the following: (1) What is the evidence regarding the impact of AI-powered CDSS on diagnostic accuracy and treatment planning in nursing care? (2) What ethical challenges and potential biases have been identified in the implementation and use of these systems? (3) How do AI-powered CDSS affect nursing workflow, clinical judgment, and professional responsibility? Synthesizing the current evidence across these domains, this review will therefore present a comprehensive analysis of the opportunities and challenges presented by AI in nursing and offer insights to guide future implementation, research, and policy development.

Methodology

Search Strategy

A systematic literature search was carried out in January 2025 to screen for relevant publications between January 2013 and December 2024. The past ten years were considered the best period for reviewing cutting-edge AI technologies applicable to health. Electronic databases included PubMed, CINAHL, Scopus, Web of Science, and IEEE Xplore in order to include both clinical and technical perspectives. The search strategy adopted combined keywords with Medical Subject Headings (MeSH), as related to core concepts. The main search string was: ("artificial intelligence" OR "machine learning" OR "deep learning" OR "predictive analytics") AND ("clinical decision support system" OR "CDSS" OR "decision support") AND ("nursing" OR "nurse" OR "nursing practice") AND ("efficacy" OR "accuracy" OR "diagnosis" OR "treatment planning" OR "bias" OR "ethics"). Combining terms with Boolean operators (AND, OR) and using search filters limits the results to English-language articles that involve human or healthcare settings.

Inclusion and Exclusion Criteria

We included studies if they met the following criteria: the study design consisted of original research, such as randomized controlled trials, quasi-experimental studies, observational studies, and qualitative studies, or systematic reviews published in peer-reviewed journals; the study explicitly investigated an AI-powered CDSS, defined as systems using machine learning, natural language processing, or other advanced computational techniques beyond simple rule-based logic; the system's application in nursing practice, education, or settings where the primary users are nurses is examined; the study reported outcomes related to diagnostic accuracy, treatment planning, clinical outcomes, workflow integration, or ethical considerations; and, finally, the study was published between 2013 and 2024. Studies were excluded if: (a) the sole focus was on physician decision-making with no nursing implications; (b) the manuscript described traditional, non-AI rule-based systems; (c) the publications were editorials, commentaries, or conference abstracts that did not include original data; or (d) the full text was unavailable.

Study Selection

Data from each eligible study were extracted on a standard form that included authors, publication year, study design, setting, participant characteristics, details about the AI intervention and comparison groups, outcome measures, and key findings related to efficacy and ethical considerations.

Quality Assessment and Data Synthesis

The methodological quality of the included studies was assessed using appropriate tools: the Cochrane Risk of Bias Tool for randomized trials, the Newcastle-Ottawa Scale for observational studies, and the CASP checklist for qualitative studies. Due to the heterogeneity in study designs, interventions, and outcome measures, it was not possible to conduct a meta-analysis. Findings were synthesised using a narrative synthesis approach, organised by thematic areas: efficacy for diagnostic accuracy, impact on treatment planning, ethical implications, and effects on nursing practice. The results are presented to first look at the evidence for efficacy, then explore ethical dimensions, and finally discuss implications for nursing practice and future directions.

Efficacy of AI-Powered CDSS in Nursing Practice

Impact on Diagnostic Accuracy

The contribution of AI-powered CDSS to improving diagnostic accuracy within nursing practice, particularly in the early detection of patient deterioration, holds immense promise. Systems designed to anticipate clinical deterioration, like those that integrate vital signs, laboratory data, and nursing evaluations, have demonstrated increased sensitivity and specificity compared to traditional early warning scores (Wong et al., 2021). For instance, machine learning algorithms analyzing electronic health record data about patients with sepsis have shown superior performance in predicting sepsis up to 48 hours before clinical recognition, thus aiding in the initiation of timely nursing interventions (Alharbi et al., 2025; Ackermann et al., 2022). Correspondingly, AI-powered pressure injury prediction models that integrate such variables as mobility scores, perfusion metrics, and comorbidities have demonstrated greater predictive accuracy than the Braden Scale used in isolation, thus enabling more focused care to prevent pressure injuries (Cramer et al., 2019).

The diagnostic capabilities of AI-CDSS extend into other domains of nursing assessment. Within mental health nursing, natural language processing tools that analyze patient statements and documentation have indicated great promise for identifying subtle linguistic markers associated with suicide risk or psychosis relapse (Gkotsis et al., 2016). In the field of gerontological care, integration of medication data, fall history, and mobility patterns through AI systems has significantly enhanced the accuracy of fall risk prediction, thereby allowing more effective nursing preventive strategies. However, these systems perform very variably across different populations of patients and in different clinical settings, a factor that emphasizes the importance of context-specific validation and implementation.

Impact on Treatment Planning and Care Coordination

AI-powered CDSSs extend beyond mere diagnostic support and are increasingly driving the empirical grounding of nursing care plans and intervention strategies. These systems can analyze complex patient data to generate personalized care recommendations, potentially improving both the efficiency and effectiveness of nursing interventions. For instance, AI algorithms can optimize patient assignment and acuity-based staffing through the anticipation of care demands and workload distribution, though the ethical implications of such applications would require critical consideration (Haddad et al., 2018). In chronic disease management, AI-CDSS is able to analyze trends in patient-reported outcomes and biometric data in recommending adjustments to education, self-management support, and follow-up scheduling—key components of nursing care (O'Connor et al., 2023).

Another area where AI-powered CDSS holds immense promise for nursing practice is in medication management. Systems that synthesize information on pharmacology, patient genetics, and real-time clinical parameters can flag potential adverse drug reactions, inappropriate dosing, or medication interactions that may have been missed by nurses (Légat et al., 2018). This is particularly helpful in complex patients with multiple co-morbidities and polypharmacy. AI-powered discharge planning tools can also forecast readmission risk and suggest appropriate post-discharge resources to facilitate a more effective transition of care by nurses (Lee et al., 2024). Table 1 summarizes the key domains where AI-CDSS impacts nursing practice, along with representative evidence.

Table 1: Efficacy of AI-powered CDSS in Key Nursing Practice Domains

Domain	AI Application	Key Findings	Representative Evidence
Early Detection	Sepsis prediction algorithms	Improved early detection (6-48 hours earlier) compared to traditional scoring; reduced mortality in some studies	Ackermann et al. (2022); Wong et al. (2021)
Risk Assessment	Pressure injury prediction	Higher accuracy (AUC 0.85-0.92) than the Braden Scale alone; enables targeted prevention.	Cramer et al. (2019)
Patient Safety	Fall risk prediction	Improved identification of high-risk patients; reduced fall rates with targeted interventions	Pappas (2008)
Medication Safety	Adverse drug event prediction	Alert accuracy of 70-85%; reduced medication errors in intervention studies	Légat et al. (2018)
Care Coordination	Discharge planning & readmission prediction	Moderate to high accuracy in identifying high-risk patients; enables proactive intervention.	Lee et al. (2024)
Workload Management	Patient acuity & staffing prediction	Variable accuracy; potential for optimized resource allocation, but ethical concerns	Haddad et al. (2018)

Ethical Implications and Algorithmic Bias

Transparency and the "Black Box" Problem

A critical ethical issue in AI-driven CDSS pertains to a lack of transparency regarding how the algorithms arrive at recommendations. Most of the complex machine learning models, especially those involving deep learning networks, are "black boxes" since the reasoning process from input to output is not intuitively understandable by human users (Rudin, 2019). This has significant implications for nursing practice, where the rationale for clinical decisions needs to be understood to ensure safe patient care and professional accountability. Nurses feel uncomfortable and less trusting when unable to understand the basis for AI-generated recommendations, particularly when such recommendations are in conflict with their clinical judgment (Almarwani, 2024). Lack of transparency about AI recommendations when explaining patient care to patients or other members of the health care team compromises nursing ethical principles related to truth-telling and patient advocacy; this can also contribute to moral distress if nurses feel compelled to act on recommendations that they cannot adequately assess (McDougall, 2019). Figure 1 shows an AI-Powered clinical decision support workflow.

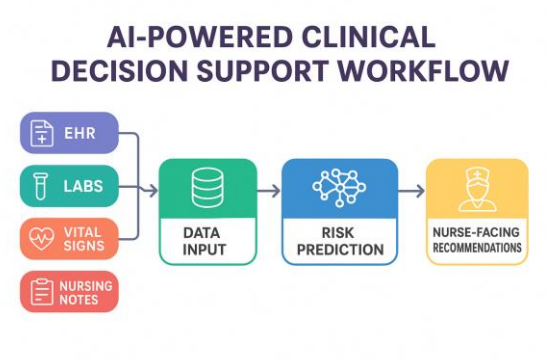

Figure 1: AI-Powered Clinical Decision Support Workflow

Algorithmic Bias and Health Equity Concerns

Probably the biggest ethical issue related to AI-CDSS in nursing is the capability of the algorithms being biased, which perpetuates and amplifies health disparities. These systems are trained on historical healthcare data that often reflect existing biases in healthcare delivery, including under-treatment of minority groups, diagnostic discrepancies based on race or gender, and socioeconomic barriers to care (Obermeyer et al., 2019). When biased data of such a nature are used in training an AI model, the resulting systems can systematically disadvantage already marginalized populations. For instance, algorithms predicting the needs for health care that use cost about health care as a proxy for health status were shown to systematically disadvantage Black patients, due to less money being spent on them despite similar conditions (Vyas et al., 2020). For nurses depending on such tools, those biases could lead to inequitable care recommendations unless these biases are dealt with through either the detection or mitigation strategy (Cirillo et al., 2020).

Accountability and Professional Responsibility

The integration of AI recommendations into nursing practice raises difficult questions about accountability and professional responsibility. When harm to a patient results from an AI-generated recommendation, determining liability raises both legal and ethical issues. The traditional nursing accountability framework-which places individual nurses at the center of accountability for their clinical decisions- becomes muddled when those decisions are significantly influenced by nontransparent algorithmic outputs (Gerke et al., 2020). This tension is heightened by the fact that nursing has an ethical and legal obligation to exercise independent clinical judgment, even when utilizing decision support tools (Rubeis, 2021). Nurses are in a position where they have to balance appropriately leveraging AI capabilities while upholding their professional responsibility to question erroneous or questionable recommendations-an arduous task when faced with technologically sophisticated modalities that may be placed ahead of human judgment as objectively superior (Greenhalgh et al., 2017).

Impact on Nursing Workflow and Clinical Judgment

Integration into Nursing Workflow

The successful implementation of AI-powered CDSS relies heavily on their seamless integration into existing nursing workflows. Poorly designed systems that create additional steps or generate excessive alerts disrupt established routines and are often met with resistance and low adoption rates (Rittmann & Stevens, 2019). The best implementations are those that embed AI recommendations directly into familiar documentation systems and clinical processes, making it less burdensome on cognition and less disruptive to workflow. Even well-integrated systems can create new task demands, such as the need to interpret and respond to AI-generated alerts, potentially adding to nursing's already substantial cognitive workload (Yilmaztürk et al., 2023). Timing and presentation of AI recommendations are critical factors; interruptive alerts can interfere with clinical reasoning, but well-timed information presentation can improve situational awareness without adding to cognitive load. Figure 2 illustrates the nursing workflow integration map.

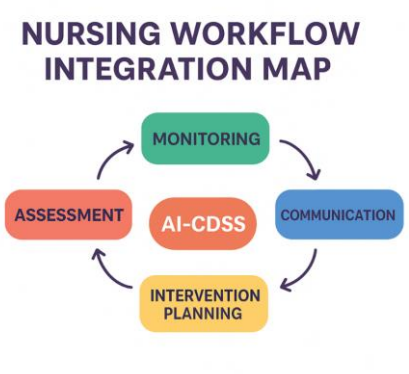

Figure 2: Nursing Workflow Integration Map

Effects on Clinical Judgment and Critical Thinking

A core issue with the use of AI-CDSS in nursing pertains to the way they could influence the development and execution of clinical judgment. There is the risk that unbridled reliance on algorithmic suggestions could produce "automation bias," whereby nurses accept uncritically AI suggestions without appropriate scrutiny or independent clinical reasoning (Goddard et al., 2012). This is particularly disturbing for novice nurses who are developing their capability for clinical judgment and may be more likely to transfer their decision-making to perceived technological authority (Asiri et al., 2025). On the flip side, when appropriately implemented, AI-CDSS has the potential to augment clinical judgment by adding additional data points, identifying patterns not readily discernible to human perception, and diminishing cognitive biases in clinical reasoning (Karthikeyan et al., 2021). The key seems to lie in designing such systems as collaborative tools that augment instead of replace nursing expertise, while nurses nurture both the skills and confidence to question algorithmic outputs when appropriate.

Discussion and Future Directions

Taken together, the evidence synthesized in this review represents a complex picture of AI-powered CDSS in nursing practice. While these systems offer demonstrable benefits in specific domains, most notably in early detection of clinical deterioration and risk stratification, there is considerable variation in effectiveness across different clinical contexts, with significant unresolved ethical challenges related to bias, transparency, and accountability. Addressing these challenges through a multidisciplinary collaboration of nurses, data scientists, ethicists, and healthcare administrators will ensure the successful integration of AI into nursing practice. A key finding across these studies is that the value of AI-CDSS depends fundamentally on their implementation context and system design. Systems developed without the input of nurses often have limited functionality in addressing actual workflow needs or clinical priorities (Almarwani, 2024). Moreover, those systems trained on limited or non-representative data could give poor performance on diverse patient populations, which could also extend to increasing health disparities (Vyas et al., 2020).

The limitations noted underscore the importance of incorporating nurses in every step of the development of AI systems, from problem identification and data curation to implementation and evaluation, so that such tools address clinical needs and align with the values and realities of nursing workflows. Ethics in AI implementation demands proactive attention through comprehensive governance framework developments. This should cover regular bias audits using representative test data, transparency requirements appropriate to the clinical context, and clear protocols for addressing situations where AI recommendations conflict with clinical judgment Gerke et al. 2020. Nursing education must move towards incorporating digital health literacy, which should include critical evaluations of AI recommendations and understanding the limitations inherent in the algorithms (Booth et al., 2021). Moreover, research is required to develop effective methods for presenting information created by AI in a manner to supports, not undermines, clinical reasoning.

Table 2: Ethical framework for the implementation of AI-powered CDSS in nursing

Ethical Principle	Current Challenges	Recommended Strategies
Transparency	"Black box" algorithms; unexplainable recommendations	Develop interpretable AI; require confidence scores; implement explanation systems
Justice & Equity	Algorithmic bias; data representativeness issues	Regular bias audits; diverse training data; equity impact assessments
Accountability	Diffused responsibility; unclear liability	Clear governance protocols; defined decision authority; error reporting systems
Autonomy	Automation bias; deskilling concerns	Education on AI limitations; appropriate alert design; preserve override capability
Beneficence	Variable performance across populations	Context-specific validation; continuous monitoring; outcome evaluation

Conclusion

AI-powered Clinical Decision Support Systems represent a significant advancement with the potential to enhance nursing practice through improved diagnostic accuracy, personalized treatment planning, and more efficient coordination of care.

The evidence suggests that such systems may outperform traditional approaches in narrow domains like early deterioration detection and the prediction of pressure injuries. Yet, these benefits are balanced by substantial ethical concerns regarding algorithmic bias and the lack of transparency, which also has the effect of undermining nursing clinical judgment.

The way forward will be to balance the demonstrated capabilities of AI with proactive strategies for addressing its limitations and risks. This will involve the creation of more transparent and equitable systems, the institution of robust governance frameworks, and the evolution of nursing education to incorporate critical engagement with AI technologies. Most importantly, AI-powered CDSS should be conceptualized and designed as tools that augment rather than replace nursing expertise, preserving the essential human elements of compassion, critical thinking, and therapeutic relationships that form the foundation of nursing practice. With thoughtful implementation informed by both the evidence and ethical principles, AI has the potential to enhance rather than undermine the art and science of nursing.

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