"Rage Against the Machine?": The Impact of Clinical Decision Support Systems on Hospital Nursing Decision-Making, Workflow Efficiency, and Patient Outcomes: A Rapid Review

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Clinical Decision Support Systems (CDSS) are increasingly developed for hospital nursing practice, yet their impact on decision-making, workflow efficiency, and patient outcomes remains complex. This rapid review synthesizes findings from 21 studies, highlighting both the benefits and challenges of CDSS implementation focused on three key areas. CDSS can enhance nursing decision-making by reducing variability and improving standardization, but there are concerns about system usability and the tendency to override recommendations. While CDSS improve workflow efficiency by prioritizing tasks, issues such as alert fatigue and poor interoperability with hospital systems hinder their potential. Patient outcomes benefit from CDSS-driven medication safety and risk prevention, yet adherence to recommendations varies among nurses. These findings underscore the need for user-centered CDSS that align with nursing values. Future research should explore long-term effectiveness, implementation strategies and best practices for integrating CDSS into nursing workflows.

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1 Introduction

In the evolving landscape of healthcare, Clinical Decision Support Systems (CDSS) have become essential tools designed to enhance clinical decision-making by providing healthcare professionals with evidence-based knowledge in real-time (Chen et al., 2023; Sutton et al., 2020). The integration of CDSS into healthcare settings has been associated with improved clinical practices and patient outcomes (Roshanov et al., 2013; Sutton et al., 2020; Taheri Moghadam et al., 2021). Typically embedded within Electronic Health Records (EHRs), CDSSs facilitate the access to patient data and clinical guidelines, allowing healthcare providers to make more informed decisions (Chen et al., 2023).

While CDSS have been broadly studied in the context of physician decision-making, their specific impact on nursing practice remains underexplored (Chen et al., 2023; Meunier et al., 2023). Nurses play a critical role in patient care, as a first contact to patients, engaging in (complex) decision-making processes that encompass medication administration, patient monitoring, and risk assessment (Kwon & Lee, 2024). Nurses also interact with CDSSs differently than physicians, often facing unique challenges that can affect adoption and effectiveness. Unlike physicians, whose primary focus is on diagnosing diseases and formulating treatment plans, nurses are responsible for executing these plans while continuously monitoring patient conditions (Deshpande, 2009). The dynamic nature of nursing workflows, particularly in high-acuity settings, adds further complexity to CDSS implementation. For instance, in intensive care units, nurses frequently override CDSS alerts because many systems rely on static algorithms that fail to account for rapidly evolving patient conditions (Stevens et al., 2024).

CDSS have the potential to support nursing decision-making by improving efficiency and patient safety, however, their implementation presents several challenges. Nurses encounter issues such as alert fatigue, workflow disruptions, and usability concerns, which can hinder the effective utilization of these systems (Shah et al., 2022). A systematic review analyzing CDSS use in intensive care units found that while these systems show promise in enhancing care quality, their integration into nursing workflows remains difficult due to poor usability and misalignment with real-world clinical needs (Sarıköse & Şenol Çelik, 2024). Earlier studies show that CDSS hold promise for improving key aspects of nursing practice, particularly in

three critical areas identified by earlier studies: the decision-making process, workflow efficiency, and patient outcomes (Chen et al., 2023; Kwon & Lee, 2024; Sutton et al., 2020).

However, the integration of CDSS into nursing practice involves not only technical and procedural aspects, as defined by regulatory frameworks such as the Medical Device Regulation, but also socio-technical factors that influence everyday clinical use. Therefore, it is also connected to professional values. Patient-centered care, clinical autonomy, and ethical responsibility shape how nurses interact with decision-support technologies. A fundamental challenge in CDSS adoption is ensuring that these systems support, rather than undermine or take over, these core values. Transparency in how CDSSs generate recommendations is critical, as nurses must trust the system to make informed decisions without feeling that their professional judgment is being replaced (Elgin & Elgin, 2024; MacIntyre et al., 2023). Ethical considerations, such as bias in algorithmic recommendations and accountability for decision-making, further highlight the need for CDSS to align with nursing principles. Understanding how these values influence CDSS effectiveness is essential for evaluating its impact on hospital nurses' decision-making, workflow efficiency, and patient outcomes. This study does not evaluate CDSS compliance or certification but instead examines real-world outcomes and challenges in nursing use.

Therefore, an exploration into the role of CDSS in nursing practice is warranted to find better integration and utilization strategies. This study seeks to address the following research question: *How does the use of Clinical Decision Support Systems (CDSS) impact the decision-making processes, workflow efficiency, and patient outcomes in hospital nursing practice?*

The remainder of this paper proceeds as follows. The next section provides the methodology of the study. The third section describes the included papers. Section four presents the discussion of the results. The final section concludes the study and presents relevant future research directions.

2 Methodology

This study follows a rapid review methodology, applying systematic review principles while optimizing time and resource constraints (Hamel et al., 2021). The methodology adheres to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, with modifications to accelerate the review process while maintaining rigor and transparency (Page et al., 2021). To give structure to the aim of the review, we used the PICO framework (Richardson et al., 1995), as seen in Table 1. With the created PICO we built our search strategy.

Table 1: PICO framework

Population	Hospital Nurses (including Registered Nurses, Nurse Practitioners, and other nursing professionals).
Intervention	CDSS
Comparison	Nurses without CDSS or pre-implementation vs. post-implementation studies.
Outcomes	Nursing decision-making, workflow efficiency, and patient outcomes.

1

Search Strategy

This review followed a rapid review methodology, which necessitates prioritization of high-yield databases. We selected PubMed, Embase, and CINAHL due to their comprehensive indexing of nursing and healthcare, literature, domains most relevant to our PICO framework. The following search terms were used for each database: "Clinical Decision Support System" and alternatives, "Nursing" and alternatives, and decision making, Workflow Efficiency, and patient outcomes. The specific search strings for each database can be found in Appendix A. We also found that the volume of nursing CDSS studies increased since 2014, with an average of 154 publications indexed in Pubmed alone per year (compared with an average of 70 per year from 2000-2013) (Akbar et al., 2021). Therefore, we chose to only search for publications after 2014.

Inclusion & Exclusion Criteria

Table 2: Inclusion & Exclusion criteria

Inclusion Criteria	Exclusion Criteria
- Population: Hospital Nurses using CDSS in clinical practice. - Intervention: Studies examining CDSS use for nursing decision-making. - Outcomes: Nursing decision-making, workflow efficiency, patient safety, or patient outcomes. - Study Types: peer reviewed academic journal papers, peer reviewed academic conference papers - Language: English-language studies. - Publication Date: 2014–2024 (last 10 years). - Settings: Hospitals, ICU, emergency departments.	- Focused only on physicians or other healthcare professionals without nurse involvement. - Examined CDSS used exclusively by patients (e.g., patient-facing decision aids).

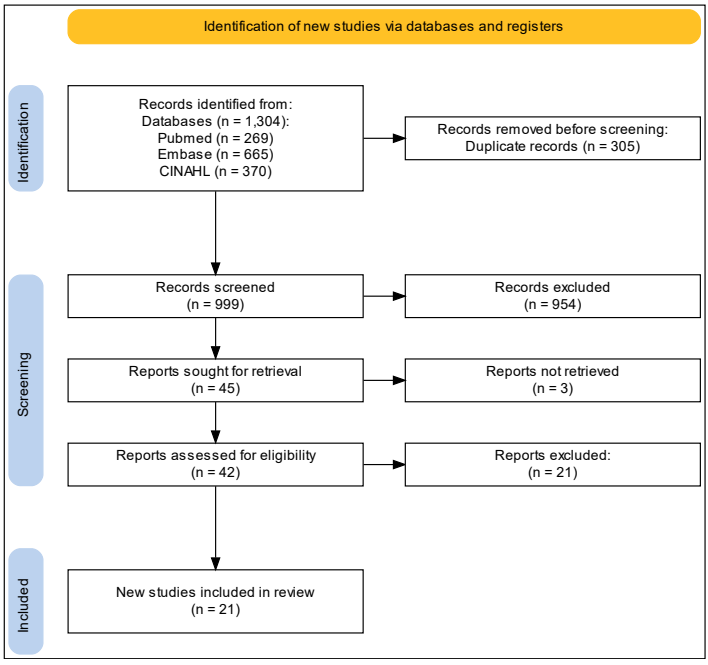

Figure 1: PRISMA flowchart (created in PRISMA Flow Diagram tool (Haddaway et al., 2022))

The PICO was also used to create inclusion and exclusion criteria for the found articles. The inclusion and exclusion criteria can be found in Table 2.

The study selection followed the PRISMA framework. First, a Title & Abstract Screening was performed. After that, the full text of the papers was screened for final inclusion. The included papers were examined to extract key variables related to CDSS usage, nursing decision-making, workflow efficiency, and patient outcomes. The PRISMA flow diagram documented the number of records identified, screened, excluded, and included in the final analysis, see Figure 1.

2 Findings and Synthesis

This synthesis integrates findings from 21 included studies to provide an analysis of how the use of CDSS impacts nursing practice. The results are categorized into three main themes: Nursing Decision-making, Workflow Efficiency, and Patient Outcomes.

2.1 CDSS & Nursing Decision-making

Effective clinical decision-making in nursing requires rapid assessment, prioritization, and risk evaluation, often under conditions of uncertainty. CDSS have been introduced to reduce variability in clinical judgment, ensuring that decision-making is standardized and based on established protocols. Studies have demonstrated the effectiveness of CDSS in triage and emergency decision-making. Chang et al. (2017) and Agnihotri et al. (2021) found that CDSS-assisted triage systems improved the accuracy of patient prioritization, leading to more timely treatment for high-risk patients. Their findings indicated that CDSS reduced inconsistencies in triage classifications between different nursing staff, suggesting an improvement in standardization. In these settings, CDSS facilitated the identification of critical cases through algorithmic risk assessments, which were found to enhance clinical workflow and optimize resource allocation.

Beyond emergency care, CDSS have been shown to contribute to risk assessment and preventative care. Dos Santos Diogo et al. (2023) examined the role of CDSS in diagnostic support and reported that nurses using these systems demonstrated higher diagnostic conformity. Their study highlighted that CDSS-assisted clinical

assessments were more consistent across multiple practitioners, reducing variability in risk identification. Similarly, Jacobsohn et al. (2022) investigated the use of CDSS in fall-risk detection, reporting that automated alerts enabled earlier interventions and a reduction in patient falls. Their findings indicated that CDSS-supported risk assessments aligned with existing prevention protocols, improving adherence to intervention strategies. CDSS have also been evaluated in the context of clinical protocol standardization and guideline adherence. Mebrahtu et al. (2021) found that nurses using CDSS demonstrated higher compliance with infection control protocols, medication safety procedures, and ICU workflows. Their study reported that CDSS improved the consistency of protocol adherence by integrating clinical guidelines into real-time decision-making processes. Kim et al. (2023) examined CDSS-guided pressure ulcer prevention programs and found that their implementation improved adherence to patient repositioning schedules and skin integrity monitoring, leading to a measurable reduction in pressure ulcer incidence rates.

Despite these observed benefits for decision-making, studies have also identified challenges in CDSS implementation for decision-making. Liberati et al. (2017) and Schwartz et al. (2022) reported that nurses frequently overrode CDSS recommendations. Their findings attributed this to a lack of alignment between CDSS-generated alerts and nurses' clinical assessments, leading to a lower rate of system adherence. Hants et al. (2023) analyzed instances in which CDSS recommendations conflicted with nurses' evaluations and found that these conflicts influenced decision-making patterns, sometimes leading to a preference for manual assessments over automated guidance.

2.2 CDSS and Workflow Efficiency

Efficiency in nursing workflows is fundamental for trying to reduce the cognitive overload, optimizing time management, and prioritizing patient care. CDSS have shown promising results in automating documentation, reducing workload, and streamlining care coordination by integrating evidence-based recommendations into clinical workflows. One of the key areas where CDSS have proven effective is reducing administrative redundancy and cognitive burden. Sarıköse & Çelik (2024) found that CDSS implementation in ICUs reduced documentation time, allowing nurses to allocate more time to direct patient care rather than data entry. Their study

reported that automated data entry and structured clinical templates within CDSS contributed to a more efficient documentation process. A similar effect was observed in general hospital workflows, where electronic nursing care plans integrated with CDSS helped eliminate redundant administrative tasks, creating more available time for direct patient interactions (Wong et al., 2015). The study suggests that CDSS can facilitate workflow optimization by automating routine documentation and ensuring that relevant patient information is easily accessible.

Beyond administrative efficiency, CDSS have demonstrated effectiveness in optimizing clinical task prioritization. Akbar et al. (2021) found that CDSS-driven automation enabled nurses to identify and prioritize high-risk patients more effectively, ensuring that urgent situations were addressed in a timely manner. Their study highlighted that automated decision-support algorithms helped reduce delays in intervention by directing nursing attention to the most critical cases. Similarly, Jacobsohn et al. (2022) reported that CDSS-generated fall-risk alerts led to earlier interventions, reducing manual workload and allowing nurses to allocate their time better. These findings indicate that CDSS not only streamline workflow but also support patient management by ensuring that high-risk cases receive prompt attention. CDSS have also been shown to improve workflow coordination within surgical and emergency settings. Quindroit et al. (2024) found that CDSS-supported perioperative workflows led to better coordination between surgical teams, reducing post-operative complications and enhancing overall surgical efficiency. In trauma care, Sanderson et al. (2023) reported that CDSS-assisted transfusion protocols reduced the response times, facilitating faster access to blood transfusions. Similarly, Donsa et al. (2016) found that CDSS-supported diabetes medication management reduced dosage errors, contributing to better treatment accuracy and reducing the time required for dosage adjustments.

Despite these benefits, workflow integration challenges have been identified. Stevens et al. (2024) reported that high alert frequencies within CDSS contributed to alert fatigue, leading to instances where nurses overlooked or overrode critical alerts. This issue was caused to lots of system notifications that disrupted the workflow. Furthermore, Gartrell et al. (2023) found that interoperability issues between separate CDSS and existing EHRs led to workflow disruptions, requiring additional training and adaptation to ensure seamless system use. Additionally, Hants et al. (2023) highlighted that nursing workflows often involve complex, holistic

decision-making processes that cannot always be fully captured by a CDSS, limiting the system's ability to fully align with nursing practice. Both implemented within an EHR as well as in a separate system.

2.3 CDSS and Patient Outcomes

The integration of CDSS in nursing practice has been associated with improvements in patient outcomes, particularly in medication safety, early risk detection, and surgical recovery. One of the most significant impacts of CDSS regarding patient outcomes is in medication safety and error reduction. Stevens et al. (2024) found in a case study that CDSS-driven antibiotic stewardship programs led to a measurable reduction in medication errors, ensuring appropriate dosing and improved adherence to treatment guidelines. Their study highlighted that CDSS-supported prescribing reduced deviations from recommended protocols, minimizing adverse drug reactions. Similarly, Kim et al. (2023) demonstrated in a quasi-experimental study that CDSS-assisted medication administration led to fewer adverse drug events. Their findings suggested that automated medication verification systems improved administration accuracy and reduced human error in high-acuity settings.

CDSSs has also been evaluated in preventative care and early risk detection. Jacobsohn et al. (2022) and Insook Cho et al. (2023) found that CDSS-enabled early warning systems for fall prevention led to a reduction in patient injuries. Their studies reported that real-time alerts allowed nurses to intervene before falls occurred, improving patient safety in hospital environments. In ICU settings, Zhang et al. (2023) explored the role of CDSS-assisted delirium risk assessments and found that the use of these systems helped identify high-risk patients earlier, leading to preventive measures for patients. In surgical and emergency care, CDSS has been found to optimize treatment pathways and reduce complications.

Despite these observed benefits, compliance with CDSS recommendations varies. Paulsen et al. (2021) found that patient adherence to CDSS-generated recommendations was higher than nurse adherence. Their study reported that patients found CDSS guidance motivational in managing their health, whereas nurses sometimes viewed CDSS as an additional task rather than an integral part of workflow processes. These findings suggest that while CDSS can contribute to

improved patient outcomes, its effectiveness is influenced by user engagement and integration into clinical practice.

3 Discussion

The findings of this rapid review illustrate the potential benefits and challenges of CDSS in hospital nursing practice, specifically on the decision-making process, the workflow efficiency and patient outcomes.

Balancing Automation with Clinical Judgment in Decision-Making

Several studies, including those by Agnihotri et al. (2021) and Chang et al. (2017), have reported that CDSS can support more standardized decision-making in specific clinical contexts such as triage and emergency care.

However, this review also highlights a persistent issue, nurses frequently override CDSS recommendations due to a misalignment between system-generated alerts and real-time clinical assessments (Liberati et al., 2017; Schwartz et al., 2022). This raises concerns about the balance between automation and professional judgment. CDSS must be designed to support rather than replace clinical expertise, particularly in high-acuity settings where nursing assessments evolve rapidly. The reluctance to rely fully on CDSS suggests a need for systems that incorporate adaptive learning mechanisms, allowing recommendations to align with patient-specific contexts rather than static algorithms. Moreover, training programs should focus on enhancing nurses' ability to critically evaluate CDSS outputs rather than relying solely on the technology.

Workflow Efficiency: Resolving Disruptions and Enhancing Usability

CDSS have demonstrated the potential to streamline documentation and optimize task prioritization, yet efficiency gains are often hindered by alert fatigue and interoperability issues (Akbar et al., 2021; Sarıköse & Şenol Çelik, 2024). High-alert frequencies, as reported by Stevens et al. (2024), disrupt workflow and reduce adherence to critical notifications, undermining the intended benefits of CDSS. This indicates a need for prioritization algorithms that filter alerts based on clinical urgency rather than generating excessive notifications. Furthermore, the integration

of CDSS with existing EHR systems remains inconsistent, leading to workflow fragmentation (Gartrell et al., 2023). The literature suggests that CDSS effectiveness is highly dependent on seamless interoperability, meaning that future implementations should focus on harmonization with current hospital IT infrastructures to avoid creating additional burdens for nursing staff.

Patient Outcomes

The review findings reinforce that CDSS can contribute to improved patient safety, particularly in medication administration and risk prevention (Kim et al., 2023; Stevens et al., 2024). However, improved decision accuracy or workflow efficiency does not necessarily translate into better clinical outcomes unless these systems are integrated meaningfully into daily practice. For instance, Jacobsohn et al. (2022) found that fall-risk alerts enabled earlier interventions, yet their effectiveness ultimately depended on nurses' adherence to the recommendations. Paulsen et al. (2021) further identified discrepancies in adherence, with patients being more likely to follow CDSS-generated guidance than nurses. This suggests that CDSS success is contingent not only on technical accuracy but also on user engagement. To bridge this gap, further research should explore behavioral and organizational factors that influence CDSS adoption in the long term.

Implications for Nursing Practice and Future Research

Our findings suggest that CDSS will not reach their full potential in nursing practice unless they are further refined to align with the needs, workflows, and values of nurses. Future research should focus on understanding the contextual factors that determine the success or failure of CDSS implementations.

Another area for further exploration is why CDSS succeed in some contexts but fail in others. Differences in organizational culture, training, and system design likely play a role, but further research is needed to identify the specific mechanisms behind these variations. Additionally, the findings showed that many studies focus on how nurses use CDSS, but fewer have examined the fundamental characteristics that define an effective CDSS for nursing practice.

Another area for future research is the nature of CDSS recommendations and how they align with nursing practice. The question arises that a CDSS may be perceived as too rigid or detached from the clinical realities nurses face, particularly in high-acuity or rapidly changing environments.

Finally, future studies should explore how nurses perceive their role in relation to CDSS. Do nurses see CDSS as collaborative tools that support decision-making, or do they view them as systems that dictate actions, reducing clinical autonomy? Understanding this dynamic will be crucial for developing CDSS that nurses trust, use effectively, and integrate seamlessly into patient care.

Limitations

This study has its limitations. One key limitation of the chosen method, a rapid review design, is that it does not assess the methodological quality of the included studies in detail. While the findings suggest that CDSS improve nursing decision-making and workflow efficiency, the reliability of these outcomes is dependent on the rigor of the primary studies. We did not check for potential biases, study design flaws, or long-term patient outcome tracking. Checking the reliability can be important when evaluating patient outcomes.

Another limitation is the variability in CDSS types, nursing teams, and implementation strategies. Some studies examined triage-based CDSS (Agnihotri et al., 2021; Chang et al., 2017), while others focused on medication safety (Stevens et al., 2024) or perioperative care (Quindroit et al., 2024). This makes it hard to compare the CDSSs. The heterogeneity of CDSS applications makes it also difficult to determine generalizable best practices, as not all systems operate with the same level of integration, automation, or clinical relevance. Additionally, the effectiveness of CDSS is influenced by the experience and professional maturity of nurses, as their ability to interpret, adapt, and integrate system recommendations varies across different levels of clinical expertise.

4 Conclusion

This review suggests that CDSS may contribute to improvements in nursing decision-making, optimize workflow efficiency, and enhance patient safety. However, their success in clinical practice depends on proper system design, integration, and acceptance among nurses.

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Appendix A:

Pubmed
("Clinical Decision Support Systems"[MeSH] OR "Decision Support Systems" OR "Clinical Decision Support" OR "CDSS")
AND
("Nursing"[MeSH] OR "Nurses"[MeSH] OR "Nursing Care" OR "Nurse" OR "Nursing Practice" OR "Nursing Informatics")
AND
("Decision Making"[MeSH] OR "Clinical Reasoning" OR "Efficiency" OR "Workflow" OR "Patient Outcome Assessment"[MeSH] OR "Patient Safety" OR "Quality of Care")

Embase
('clinical decision support system'/exp OR 'decision support system' OR 'clinical decision support' OR 'CDSS')
AND
('nursing'/exp OR 'nursing care' OR 'nurse'/exp OR 'nurses' OR 'nursing practice' OR 'nursing informatics')
AND
('clinical decision making'/exp OR 'workflow' OR 'efficiency' OR 'patient outcome'/exp OR 'patient safety' OR 'quality of care')

CINAHL
("Clinical Decision Support Systems" OR "Decision Support Systems" OR "Clinical Decision Support" OR "CDSS" OR "Computerized Decision Support")
AND
("Nursing" OR "Nurses" OR "Nursing Care" OR "Nurse" OR "Nursing Practice" OR "Nursing Informatics")
AND
("Decision Making" OR "Clinical Reasoning" OR "Efficiency" OR "Workflow" OR "Patient Outcome Assessment" OR "Patient Safety" OR "Quality of Care")