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Artificial Intelligence in Clinical Decision-Making: Challenges, Gaps, and Research Directions

Problem Statement:

Artificial intelligence (AI) is key to facilitating clinical decision-making in diagnostics, treatment planning, triage, and predictive analytics in the fast-paced sector of healthcare technology. Still, despite the prevalence of AI systems in healthcare, limitations still remain from reliability and transparency to integration into clinical practice. Studies such as Bajwa et al. (2021) and Chusteki et al. (2024) identify challenges associated with interpretability, fragmented data ecosystems, ethical concerns, and the limited real-world deployment of AI tools. One of these critical issues is the opaque nature of most AI-based Clinical Decision Support Systems (CDSS), which makes it difficult for clinicians to trust the system's decision-making capabilities, maintain accountability, and comprehend the processes used to generate a decision (Magrabi et al., 2019). These considerations limit adoption of AI in the care or decision-making environments where patient safety and decision accuracy are fundamental.

This is an alarming problem because clinical decision-making is so sensitive. In an age of technology in which AI systems are becoming a core part of or a supplement for physicians, the absence of transparency and insufficient evaluation frameworks may undermine trust between professionals and patients and make physicians unwilling to adopt AI solutions (Khosravi et al., 2024). The existing literature recognizes a number of solutions, including diagnostic AI models, CDSS platforms, predictive algorithms, and AI-supported educational tools to improve clinical reasoning (Alowais et al., 2023; Gomez-Cabello et al., 2024). Nevertheless, these solutions are still imperfect — limited by inconsistent validation, workflow misalignment, and the lack of standardized performance measures.

These broader implications extend beyond individual diagnostic tasks, affecting clinical workflows, resource allocation, and patient outcomes. This creates an urgent need for research that systematically analyzes AI limitations in clinical decision-making, evaluates current solutions, and identifies gaps that must be addressed to support safe, transparent, and effective adoption of AI within healthcare systems. This research aims to respond to this need by examining existing challenges, synthesizing evidence from the literature, and proposing directions aligned with identified gaps to enhance the reliability and trustworthiness of AI in clinical decision-making.

Research Objectives:

1. To examine in an exhaustive way the problems, boundaries, and prospects in clinical decision-making that involve artificial intelligence:
 - To find the major challenges of AI-based CDSS and diagnostic models.
 - To consider ethical, transparency-related, and clinical safety issues.
 - To evaluate workflow, interoperability, and data-governance limitations affecting adoption.
2. To compare current AI-driven solutions and clinical support frameworks:
 - To evaluate the advantages and disadvantages of different existing AI-enabled CDSS tools.
 - To examine the value of AI-assisted training and educational simulations.
 - To examine the literature-based primary care and clinical workflow integration challenges.
3. To propose research-aligned directions for improving AI reliability and integration:
 - To synthesize insights across the reviewed studies to determine existing gaps.
 - To provide recommendations that align AI design with clinical needs.
 - To outline future research pathways that support trustworthy and explainable AI adoption.

Literature Review:

Artificial intelligence in healthcare: transforming the future of connected and AI augmented care (Bajwa et al., 2021)

The aim of this paper is to explain how artificial intelligence (AI) is reshaping contemporary health care systems toward the current practice by increasing the precision of diagnosis, customization of treatment, and improving the operational efficiency in all aspects. It touches on AI's adoption in radiology, predictive analytics, and patient management. The role of high-quality data and interoperability matters, the study highlights. But it notes challenges including ethical restrictions, data fragmentation, and constrained real-world implementation.

Artificial Intelligence in Clinical Decision Support: Challenges for Evaluating AI-enabled CDSS (Magrabi et al., 2019). The objective of this study was to summarize the challenges encountered during AI CDSS evaluation. Key issues discussed include dataset shift, model opacity, automation bias and lack of standardized metrics. A description of a lifecycle evaluation model introducing a pre-deployment, post-market, and human-factor model approach is elaborated. The paper highlights that existing CDSS evaluation approaches are not adequate for adaptive AI systems.

Revolutionizing healthcare: the role of artificial intelligence in medical education (Alowais et al., 2023) To this end, this paper analyses and expands on its contributions in the field of AI and healthcare education, how it can enrich diagnostic skills, clinical reasoning and patient care. It explains the benefits of using AI-assisted simulations and virtual tutors for medical training. It further discusses AI's potential role in support of clinicians, specifically advanced decision-making by expanding the assessment skills of healthcare workers, in helping to support an advance of doctors' decision-making. It is restricted in that the evidence base is conceptual rather than empirical.

[Benefits and Risks of AI in Health Care: Narrative Review \(Chustecki et al., 2024\)](#)

This narrative review tries to reconcile the benefits and risks of artificial intelligence on healthcare, from the efficiency, better patient outcomes and diagnostic accuracy, and the risks, the negative: bias, data breaches and over-reliance. It focuses on robust governance, openness and constant auditing of AI tools. But no quantitative aspects and mainly secondary literature.

[Artificial Intelligence Based Clinical Decision Support Systems in Primary Care: A Scoping Review \(GomezCabello et al., 2024\)](#). This scoping review explores AI Decision Support Tools for Primary Healthcare. AI is used primarily for diagnostic support, risk prediction, and triage systems. This paper suggests that usability and incorporation with current clinical workflows are crucial for adoption. Key limitations include absence of standard outcome reporting and scant longitudinal evaluations.

[Artificial Intelligence and Decision Making in Healthcare \(Khosravi et al., 2024\):](#)

This article reviews the impact of AI in clinical and administrative decision-making within healthcare. It examines models for data-driven decision-making in diagnostics, treatment planning, and resource allocation. The paper calls for human oversight, data governance, and ethical AI frameworks. Limitations are a conceptual orientation and few real-world exemplars.

References

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