

Artificial Intelligence Tools and Methodologies in Medical Research – A Review

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Abstract

Background: The growing volume and complexity of biomedical data have increased the need for advanced computational support in medical research. Artificial intelligence (AI) technologies have gained attention for their ability to process large datasets, identify complex patterns, and support knowledge discovery. AI-based approaches are increasingly applied across multiple stages of the medical research lifecycle, including data analysis, literature synthesis, and hypothesis generation. This study aims to explore current and emerging applications of AI tools in medical research, with a focus on their benefits, limitations, and implications for research practice. *Methods:* A structured exploratory literature review was conducted using major bibliographic databases, including PubMed, Scopus, and Web of Science. Search strategies combined AI-related terms (e.g., machine learning, deep learning, natural language processing, large language models) with medical research activities. Studies were selected based on predefined inclusion and exclusion criteria, focusing on AI tools that support medical research processes rather than direct clinical decision-making. Data were extracted using a standardized framework capturing AI tool types, research contexts and reported outcomes or limitations. Applications were categorized according to stages of the research lifecycle, and a qualitative synthesis was performed with attention to transparency and ethical considerations. *Results:* The review identified a broad range of AI applications across medical research activities. AI methods were most frequently used for data analysis and interpretation, including pattern recognition, feature extraction, and predictive modeling. Significant use was also observed in literature-related tasks such as automated screening, summarization, and evidence synthesis. Reported benefits included improved efficiency and scalability, while recurring challenges involved transparency, data quality, reproducibility, and ethical concerns. *Conclusions:* AI tools show substantial potential to enhance medical research efficiency and analytical capacity, but their effective adoption requires standardized evaluation frameworks, clear methodological guidance, and appropriate governance structures.

Keywords: Artificial Intelligence (AI); Medical research; Data analysis.

