

Transforming Medical Libraries: Opportunities, Challenges, and Strategies for Integrating Artificial Intelligence

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Abstract - This study examines the role of Artificial Intelligence (AI) in transforming medical libraries, focusing on identifying opportunities, challenges, and strategies for effective integration. Medical libraries, essential resources for healthcare professionals, are increasingly leveraging AI to improve information retrieval, data management, and user services. The study aims to analyze the benefits AI brings to medical libraries, the obstacles to its adoption, and best practices for implementation. To achieve this, three specific objectives guided the study. A qualitative approach was applied, using a systematic review of literature from databases such as Scopus, Web of Science, and Google Scholar. Articles published between 2020 and 2024 were included, with non-English publications excluded. Findings indicate that AI offers substantial benefits, including enhanced information retrieval, automated data management, and improved user engagement through personalized services and research support. However, challenges such as ethical issues, data privacy concerns, infrastructure needs, and staff training remain. The study concludes that, while AI holds great potential for advancing medical libraries, overcoming these challenges will require strategic planning, investment in infrastructure, and the use of transparent, explainable AI solutions.

Keywords: Artificial Intelligence (AI), Medical Libraries, Information Retrieval, Data Management, Challenges

I. INTRODUCTION

Medical libraries have historically been vital centers for healthcare professionals, students, and researchers, providing access to critical knowledge, resources, and services essential for the advancement of medical science and practice. Traditionally, these libraries offered a wide range of resources, including textbooks, journals, and specialized databases, all tailored to meet the unique information needs of the health sector. Over the past few decades, the digital revolution has reshaped the functions and operations of medical libraries, introducing new formats, search tools, and services to manage the vast and ever-expanding volume of medical information. Now, with the rapid emergence of Artificial Intelligence (AI) in healthcare, medical libraries stand at the threshold of a new era of transformation (Dave *et al.*, 2023).

AI has made substantial strides in healthcare, contributing to advancements in diagnostic accuracy, personalized treatment

planning, and operational efficiencies within clinical environments. In fields such as medical imaging, drug discovery, and disease prediction, AI has shown remarkable capabilities for processing large datasets with exceptional speed and precision. In medical libraries, AI can be harnessed for a range of functions - enhancing information retrieval, streamlining data management, and supporting research activities - positioning it as a transformative tool that could redefine library services (Olawade *et al.*, 2024; Mukhopadhyay, 2024). By integrating AI-driven tools such as machine learning algorithms, natural language processing, and predictive analytics, medical libraries have the opportunity to significantly enhance their capacity to manage complex biomedical information and provide more dynamic, user-responsive services.

As AI continues to reshape information management, medical libraries face both unprecedented opportunities and complex challenges. While AI holds promise for improving data organization, personalized information access, and evidence-based research support, it also presents significant hurdles. Concerns surrounding data privacy, the need for AI literacy among library professionals, and potential disruptions to traditional library functions underscore the challenges of AI integration. This study examines the dual impact of AI on medical libraries, seeking to understand how these institutions can leverage AI to improve their services while addressing the accompanying challenges. The primary aim of this research is to explore how medical libraries can effectively integrate AI technologies to enhance their operations and user services and to identify the strategies necessary to overcome the challenges inherent in this integration process.

This study explores both the opportunities and challenges that AI presents for medical libraries. As AI continues to influence healthcare practice and research, medical libraries are poised to benefit from these technologies in various ways, including more efficient data organization, improved access to personalized medical information, and advanced support for evidence-based practice. However, along with these opportunities come significant challenges, such as ethical concerns regarding data privacy, the need for AI literacy

among library professionals, and potential disruptions to traditional roles within the library. The purpose of this study is to (1) identify the opportunities AI presents for enhancing the operations and services of medical libraries; (2) assess the challenges associated with the integration of AI technologies in medical libraries; and (3) determine the strategies and best practices that medical libraries can implement to effectively integrate AI technologies.

II. LITERATURE REVIEW

This paper reviews studies aligned with the study's specific objectives, covering (a) the opportunities Artificial Intelligence presents for enhancing the operations and services of medical libraries; (b) the challenges associated with the integration of AI technologies in medical libraries; and (c) the strategies and best practices that medical libraries can implement to effectively integrate AI technologies.

A. Opportunities Artificial Intelligence Presents for Enhancing the Operations and Services of Medical Libraries

Artificial Intelligence (AI) has significantly impacted various sectors, and medical libraries are no exception. As repositories of crucial healthcare knowledge, these libraries are increasingly integrating AI to enhance their operations and services. One of the most prominent opportunities AI presents to medical libraries is the enhancement of information retrieval and data management. AI technologies, particularly natural language processing (NLP) and machine learning algorithms, enable more sophisticated and efficient search functionalities. AI-powered search engines can interpret complex medical queries and provide more relevant and precise results, thereby improving the user experience. According to Afzal *et al.*, (2020), AI can help tailor search results to specific needs, facilitating a more efficient and personalized approach to information retrieval. By analyzing large datasets, AI can identify patterns and relationships that might be missed by traditional search methods, thus enhancing the discovery of relevant medical information.

Moreover, AI can assist in organizing and curating vast amounts of medical literature and data. Medical libraries often face the challenge of managing an ever-growing volume of information. AI technologies like machine learning can automate the categorization of resources, streamline indexing processes, and maintain up-to-date collections. This automation reduces the administrative burden on library staff, allowing them to focus on more strategic tasks. Manickam *et al.*, (2022) highlight that AI systems can help sort and tag documents based on their content, making it easier for users to find relevant materials. Another significant opportunity is the improvement of user services through AI-driven tools.

Chatbots and virtual assistants, powered by AI, can provide 24/7 support to library users, answering queries, assisting with resource navigation, and guiding users through complex research tasks. The use of AI in creating interactive and

responsive support systems can greatly enhance user engagement and satisfaction. Dave *et al.*, (2023) discuss how AI chatbots in medicine can handle a variety of queries, from simple informational requests to complex research inquiries, thus improving the accessibility and efficiency of library services.

AI also offers opportunities to advance research support in medical libraries. AI tools can assist in systematic reviews, meta-analyses, and other research methodologies by automating data extraction and analysis processes (Okwu *et al.*, 2024). This capability can significantly reduce the time required to complete research tasks and increase the accuracy of findings. For instance, AI algorithms can analyze vast amounts of research data to identify trends, correlations, and gaps in the literature, providing valuable insights to researchers and clinicians (Ranschaert *et al.*, 2019). The integration of AI in research support can lead to more robust and evidence-based medical research. Furthermore, AI can enhance the personalization of services offered by medical libraries (Olawade *et al.*, 2024). By leveraging data analytics and user behavior analysis, AI can tailor recommendations and alerts based on individual user preferences and needs. This personalization can improve the relevance of the information provided and increase user satisfaction. According to Gupta *et al.* (2024), AI-driven systems can analyze user interactions to offer customized content recommendations, thereby enhancing the overall user experience and engagement.

B. Challenges Associated with the Integration of AI Technologies in Medical Libraries

The integration of Artificial Intelligence (AI) into medical libraries offers promising enhancements in information management and user services. However, it also introduces a set of complex challenges that must be addressed to fully realize its potential. These challenges range from ethical and privacy concerns to the need for adequate infrastructure and staff training. One of the foremost challenges in integrating AI into medical libraries is ensuring the ethical use of data and maintaining user privacy. AI systems often require access to large volumes of sensitive data, which raises significant concerns about data security and privacy (Olawade *et al.*, 2024). The risk of data breaches and unauthorized access to personal health information can undermine user trust and violate privacy regulations. Abiodun *et al.*, (2022) highlight that while AI has the potential to enhance healthcare delivery, it also necessitates robust mechanisms to safeguard sensitive information. Implementing stringent data protection measures and ensuring compliance with privacy laws are essential to mitigate these risks.

It is noted that AI algorithms rely on high-quality, representative data to function effectively. However, biases in data can lead to skewed results and perpetuate existing inequalities. Chin-Yee and Upshur (2019) discuss how biases in big data and AI systems can affect medical decision-making, potentially leading to inequitable outcomes. In

medical libraries, biased AI systems may misrepresent or inadequately cover certain medical conditions or populations, affecting the accuracy of information provided to users. Addressing data quality issues and ensuring diverse and representative datasets are crucial for developing fair and effective AI solutions (Ponera & Kyumana, 2024; Saraswat *et al.*, 2022).

The successful integration of AI technologies requires significant investment in infrastructure and technological readiness. Many medical libraries may lack the necessary hardware, software, or network capabilities to support advanced AI systems. As noted by Alhasan and Hasaneen (2021), the deployment of AI in medical imaging and other areas necessitates advanced technological infrastructure that might be beyond the reach of some institutions. Libraries must assess their current technological capabilities and invest in upgrades to accommodate AI tools effectively.

Another significant challenge is the need for staff training and skill development. AI technologies can be complex and require specialized knowledge to manage and operate effectively. According to Dave *et al.*, (2023), the implementation of AI tools such as chatbots and data analytics systems necessitates that library staff acquire new skills and expertise. Without adequate training, staff may struggle to utilize AI technologies to their full potential, hindering the effectiveness of these tools. Training programs and ongoing professional development are essential to ensure that library personnel can manage and leverage AI technologies effectively.

Furthermore, integrating AI technologies with existing library systems can be challenging. Many medical libraries use legacy systems for managing collections and services, which may not be compatible with new AI tools. Ranschaert *et al.*, (2019) discuss the difficulties associated with integrating AI into established medical imaging systems, a challenge that can extend to other library systems. Ensuring seamless integration and interoperability between AI technologies and existing systems is crucial to avoid disruptions and maximize the benefits of AI adoption.

However, the explainability of AI systems is another critical issue. Users and library staff need to understand how AI algorithms make decisions to trust and effectively use these tools. Tjoa and Guan (2020) emphasize the importance of explainable AI (XAI) in medical applications, noting that transparent and interpretable AI systems can help build trust and facilitate better decision-making. In medical libraries, providing clear explanations of how AI tools function and how they generate recommendations can enhance user confidence and acceptance.

Lastly, the ethical use of AI in research support within medical libraries presents a challenge. AI tools can assist in data analysis and research processes, but their use must adhere to ethical standards and avoid potential misuse. Gupta *et al.*, (2024) highlight the importance of ethical

considerations in AI-driven research, emphasizing the need for guidelines and oversight to ensure responsible use.

C. Strategies and Best Practices for Integrating AI Technologies in Medical Libraries

The integration of Artificial Intelligence (AI) into medical libraries promises to revolutionize the way these institutions manage information and support healthcare professionals. One of the foremost strategies is to establish a clear vision and strategic plan for AI integration. As highlighted by Abiodun *et al.*, (2022), a well-defined strategy is crucial for guiding the adoption of AI technologies. This involves assessing the specific needs of the library, identifying potential AI applications, and setting clear goals for how AI can enhance library operations and services. Libraries should engage stakeholders, including library staff, healthcare professionals, and IT experts, to develop a comprehensive plan that aligns with the institution's overall mission and objectives.

Another critical aspect is investing in the necessary infrastructure and technological capabilities. AI integration often requires substantial upgrades to existing systems and the acquisition of new hardware and software. Alhasan and Hasaneen (2021) emphasize that the deployment of AI in digital imaging and other areas necessitates advanced technological infrastructure. Medical libraries must ensure they have the required computing power, data storage, and network capabilities to support AI tools. This may involve upgrading servers, improving network connectivity, and implementing robust cybersecurity measures to protect sensitive data.

Training and upskilling library staff are essential for successful AI integration. AI technologies can be complex and require specialized knowledge to operate effectively. Dave *et al.*, (2023) note that library staff need to be well-versed in the functionalities and applications of AI tools to maximize their potential. Libraries should invest in ongoing professional development programs that cover AI concepts, data management, and the use of specific AI applications relevant to their operations. This will enable staff to utilize AI tools effectively and adapt to evolving technological advancements.

Furthermore, ensuring data quality and addressing biases are crucial considerations in the integration of AI technologies. AI systems rely on high-quality, representative data to function optimally. Chin-Yee and Upshur (2019) discuss the potential for biases in big data and AI systems, which can lead to skewed results and affect the accuracy of information provided. Medical libraries should implement rigorous data management practices to ensure the accuracy and diversity of datasets used by AI tools. This involves regular data validation, addressing data imbalances, and incorporating diverse datasets to prevent biases.

Implementing explainable AI (XAI) is another best practice that can enhance user trust and acceptance. As Tjoa and Guan (2020) highlight, explainable AI aims to make AI systems' decision-making processes transparent and understandable. In medical libraries, providing clear explanations of how AI tools generate recommendations or make decisions can help users trust and effectively use these technologies. Libraries should prioritize the adoption of AI systems that offer transparency in their operations and provide users with comprehensible insights into AI-driven processes.

In addition, ethical considerations and data privacy are paramount when integrating AI into medical libraries. According to Olawade *et al.*, (2024), safeguarding user data and ensuring the ethical use of AI technologies are critical to maintaining trust and compliance with regulations. Medical libraries must establish robust data protection policies, implement secure data handling practices, and ensure compliance with privacy laws such as the General Data Protection Regulation (GDPR). Additionally, libraries should develop ethical guidelines for AI use, addressing concerns such as data security, consent, and the responsible use of AI-generated insights (Oyighan *et al.*, 2024). Finally, fostering collaboration and partnerships can greatly enhance the effectiveness of AI integration. Manickam *et al.*, (2022) suggest that collaboration with technology vendors, academic institutions, and healthcare organizations can provide valuable resources, expertise, and support for AI initiatives. Medical libraries should seek opportunities for collaboration to access cutting-edge technologies, share best practices, and stay abreast of the latest developments in AI.

III. METHODOLOGY

This study employed a qualitative research design. The literature search was conducted over a period of six months and involved sourcing articles from three major academic databases: Scopus, Web of Science, and Google Scholar. The search focused on identifying peer-reviewed articles published between 2019 and 2024 to ensure the relevance and timeliness of the information. Articles published before 2020 were excluded from the review to focus on the most recent developments and insights in the field. Additionally, only articles written in English were included, as language barriers could affect the accuracy and comprehensibility of the research. Studies that did not specifically focus on the integration of AI technologies in medical libraries or lacked relevance to the research objectives were also excluded.

The researcher conducted a thorough search across the selected databases using relevant keywords related to AI in medical libraries. The search strategy was designed to capture a wide range of studies addressing various aspects of AI integration, including opportunities, challenges, and best practices. After identifying potential articles, the researcher screened them based on the inclusion and exclusion criteria. Relevant articles were then selected for detailed review and analysis. The selected articles were analyzed using thematic analysis, a qualitative method that involves identifying and

analyzing patterns or themes within the data. This approach allowed for an in-depth understanding of the opportunities, challenges, strategies, and best practices for integrating AI technologies in medical libraries.

Throughout the research process, the researcher adhered to all ethical considerations. This included ensuring the accuracy of data collection and analysis, respecting intellectual property rights, and avoiding any form of bias or misrepresentation in the review. The systematic review was conducted in accordance with ethical standards for academic research, ensuring the integrity and reliability of the findings.

IV. DISCUSSION OF THE FINDINGS

The findings from the literature on the opportunities AI presents for enhancing the operations and services of medical libraries align with the perspectives of previous studies while also highlighting new insights. AI's potential to improve information retrieval through advanced search functionalities corroborates Afzal *et al.*, 's (2020) assertion that AI enhances the personalization of search results, making information retrieval more efficient. This is supported by Gupta *et al.*, (2024), who emphasize the role of AI in providing tailored content recommendations.

Additionally, the ability of AI to automate data management and curation, as noted by Manickam *et al.*, (2022), reflects a consensus in the literature about reducing administrative burdens and improving resource organization. AI's impact on user services, particularly through chatbots and virtual assistants, aligns with Dave *et al.*, (2023) and Ranschaert *et al.*, (2019), who highlight the benefits of AI-driven support systems in enhancing user engagement and research support. The ability of AI to support research methodologies by analyzing large datasets and identifying trends further supports Ranschaert *et al.*, 's (2019) and Olawade *et al.*, 's (2024) observations on the advantages of AI in research efficiency and personalized services.

The challenges associated with integrating AI technologies in medical libraries reveal areas of concern that both align with and extend the findings of prior research. Ethical and privacy issues are central challenges, echoing Abiodun *et al.*, (2022) and Olawade *et al.*, (2024), who stress the importance of safeguarding sensitive data and ensuring compliance with privacy regulations. This is consistent with the broader concerns highlighted by Chin-Yee and Upshur (2019) about biases in AI systems, which can lead to inequitable outcomes. The need for substantial infrastructure and staff training, as noted by Alhasan and Hasaneen (2021) and Dave *et al.* (2023), reflects the practical difficulties of implementing AI technologies. This aligns with Ranschaert *et al.*, (2019) regarding integration challenges with existing systems. Furthermore, the importance of explainable AI, emphasized by Tjoa and Guan (2020), resonates with the need for transparency and user trust in AI systems, a critical issue in the integration process as supported by Gupta *et al.*, (2024).

Regarding strategies and best practices for integrating AI technologies, the findings underscore several key approaches that are consistent with and expand upon previous research. Establishing a clear strategic plan, as recommended by Abiodun *et al.*, (2022), is crucial for guiding AI adoption, reflecting the need for a well-defined vision in aligning AI technologies with library goals. The necessity for robust infrastructure and technological upgrades, as noted by Alhasan and Hasaneen (2021), highlights the importance of investing in the necessary resources to support AI tools, aligning with previous observations about infrastructure requirements. Training and upskilling staff, discussed by Dave *et al.*, (2023), aligns with the need for specialized knowledge to effectively manage AI technologies, supporting the view that ongoing professional development is essential. Addressing data quality and biases, as emphasized by Chin-Yee and Upshur (2019) and Saraswat *et al.*, (2022), reflects the importance of ensuring accurate and diverse datasets to prevent skewed results. The emphasis on explainable AI, highlighted by Tjoa and Guan (2020), aligns with the need for transparency to build user trust, and the focus on ethical considerations and data privacy, as discussed by Olawade *et al.*, (2024), underscores the importance of safeguarding user data and adhering to regulations. Lastly, fostering collaboration with external partners, as suggested by Manickam *et al.*, (2022), reflects the benefit of leveraging external expertise and resources to enhance AI integration.

V. CONCLUSION

This study highlights the transformative potential of Artificial Intelligence (AI) in medical libraries, emphasizing both the opportunities and challenges associated with its integration. The findings affirm that AI can significantly enhance medical library operations by improving information retrieval through advanced search functionalities and personalized content recommendations. AI's ability to automate data management and curation also streamlines library operations, reducing administrative burdens and enhancing resource organization. Additionally, AI-driven tools such as chatbots and virtual assistants have been shown to improve user engagement and research support, providing 24/7 assistance and facilitating complex research tasks. Furthermore, AI's capacity to analyze large datasets supports research methodologies, offering valuable insights and enhancing the efficiency of medical research. However, the study also identifies critical challenges in integrating AI into medical libraries. Ethical and privacy concerns are prominent, with the need for robust data protection measures to ensure user trust and compliance with privacy regulations. The study highlights the risks of biases in AI systems and the necessity for diverse and representative datasets to prevent skewed results. The challenges associated with infrastructure and staff training are also significant, requiring libraries to invest in technological upgrades and ongoing professional development. Moreover, the need for explainable AI to build transparency and user trust is emphasized, alongside the importance of developing ethical guidelines and fostering collaboration with external partners to enhance AI

integration. This study contributes novel insights by integrating recent literature and emphasizing the need for a comprehensive approach to AI adoption in medical libraries. It provides practical recommendations for addressing both the opportunities and challenges of AI, ensuring that medical libraries can effectively harness the benefits of these technologies while mitigating potential risks.

VI. IMPLICATIONS OF THE FINDINGS

The findings have implications for practice and policy in the area of medical librarianship. In terms of practice, the findings underscore the importance of implementing AI technologies in medical libraries to enhance information retrieval, streamline data management, and improve user services. Libraries should prioritize investments in infrastructure and staff training to support the effective integration of AI tools. Practical steps include developing clear strategic plans for AI adoption, upgrading technological resources, and providing ongoing professional development for library staff. Additionally, ensuring the accuracy and diversity of datasets used by AI systems is crucial to prevent biases and enhance the quality of information provided to users.

On the other hand, the study highlights the need for policy development in the area of medical librarianship to address ethical and privacy concerns associated with AI. Policies should include guidelines for data protection, compliance with privacy regulations, and the ethical use of AI technologies. Furthermore, policies should promote transparency in AI systems by encouraging the adoption of explainable AI and fostering collaboration between libraries, technology vendors, and other stakeholders. This approach will help ensure that AI integration in medical libraries aligns with ethical standards and enhances the overall effectiveness and trustworthiness of AI-driven services.

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