JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Artificial Intelligence (AI) in Medical Libraries: Shaping the Future of Healthcare Information System in the European Union (EU), Fact, Finding and Implementations

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Abstract:

The study investigates how the integration of artificial intelligence in medical libraries has significantly transformed health care information systems across the European Union. Artificial intelligence, machine learning, natural language processing, and data analytics technologies fundamentally alter the paradigm for accessing, processing, and disseminating medical information. The paper approaches the position that artificial intelligence can enhance the attributes of the medical library to be at par with its influence on healthcare information management, knowledge discovery, and decision-making. Hence, AI enhances efficiency and speed in information retrieval, accelerates research processes, enables personalized medicine, and leads to clinical decision-making for high-quality patient care. AI-powered medical libraries bridge the gap between these heterogeneous health data repositories in the member states of the EU and help cross-border collaboration in medical research. The current paper reviews the AI tools and platforms that the EU's medical libraries currently use, ranging from automated cataloguing and indexing to high-level data mining in the evidence-based medicine domain. It also aspires to challenges in areas like data privacy and ethics, as well as the development of an overall standardization framework that will ensure the interoperability of systems using AI across the region. The integration of artificial intelligence in medical libraries is necessary, given the growing importance of digital health technologies in the health systems of the European Union. Therefore, technologists, health professionals, and policymakers must collaborate immediately. In this way, artificial intelligence has the potential to drive significant advancements in healthcare information systems, thereby playing a crucial role in efforts to enhance access, quality, and equity to healthcare information across the European Union. Therefore, we hope this paper will contribute to the ongoing discussion about the future direction of healthcare information systems and the application of artificial intelligence in advancing medical knowledge and patient care.

Keywords: ***Medical Libraries, Artificial Intelligence, Healthcare Information System, European Union, Library Decision-Making, Library Technology.***

1. Introduction.

Over the past five years, the health field has grown so complex that it heavily relies on sophisticated technologies. These technologies have proven invaluable in addressing the challenge of service delivery and facilitating access to pertinent medical information. These technologies include what can be considered the single most important transformative evolutionary force: artificial intelligence, as it changes almost all aspects of operations, including how medical libraries serve the European Union. Consequently, libraries will play an important and irreplaceable role in the efficient gathering of information, ensuring the dissemination of relevant health information. Such dissemination would enable clinicians in their continuing quest to get timely, accurate, and critical information, which forms the basis of excellence in patient care. These are merely a few of the numerous diverse facets; however, artificial intelligence can yield significant benefits such as data management, information retrieval, and the enhancement of user experience. Indeed, the integration of AI technologies presents numerous significant challenges, including moral dilemmas, the ongoing need to eliminate bias, and the urgent need to comply with new rules and regulations that will oversee this technology. This paper motivation critically examines the necessity of integrating artificial intelligence into medical libraries, ensuring that it supports with moral standards, advances individual health goals, and enhances workflow efficiency. The primary objective of this paper is to critically adopt and integrate advanced artificial

intelligence technologies into medical libraries to enhance their functionalities and adapt to the constantly evolving landscape of health information systems.

2. Objective.

This initiative aims to enhance the functionality, accuracy, and accessibility of health information by implementing artificial intelligence in every medical library across the entire health system of Europe. Patient-orientated care will receive significant attention, particularly in the development of systems for data management and retrieval. AI-powered advanced search enables health professionals to navigate through literature, clinical guidelines, and research findings to make informed treatment decisions. More importantly, an artificial intelligence system can mitigate some of the risks associated with the deployment of medical AI tools by identifying the operational conditions that support patient safety and liability, while considering continuous performance monitoring and bias analysis. As pointed out by García-Gómez et al. (2023) [33], this focus is closely related to risk management, which will help a lot with the problems that could come up because AI systems aren't always accurate or fair, which makes people less likely to trust and rely on AI-driven healthcare tools. AI fosters semantic interoperability in medical libraries, whereby several different systems and datasets can coexist within one framework. In fact, the outcome creates an ecosystem that enhances the ability of diverse health professionals to exchange ideas and innovations. The medical libraries have implemented explainable AI methodologies, which make the rationale behind AI decisions regarding medical recommendations transparent. This process helps the health professionals to understand from where these suggestions emanate and enhances their abilities to make beneficial use of AI tools responsibly. As the European Union continues with the development of regulations related to artificial intelligence within the context of the healthcare sector, integrating this technology into the medical libraries will make it less burdensome to meet those regulations, building increased effort toward achieving better patient outcomes through increased access to information and collaboration methodologies.

3. Methodological Framework.

The implementation of artificial intelligence in a medical library represents not only a significant advancement in technology use, but also a significant shift in the dissemination of information within the healthcare industry. Various studies, such as Mehdi Rahmani's work in 2023 [71], further demonstrate this phenomenon by utilizing interviews and thematic analysis. Semi-structured interviews with library experts and clinical health providers would provide detailed insights into how AI tools can enhance user interaction and operational activities in medical libraries. The provided information will highlight several challenges arising from technical obstacles and the requirement for personnel training, which impede effectiveness. The ethics of research methodologies also carry significant implications. Artificial intelligence in medical libraries should be presented with a statement on regulatory compliance and transparency of recommendations developed by AI, which requires exhaustive testing of models working in these libraries. Since the European Union is working on the development of regulations related to the use of artificial intelligence in the healthcare industry, one can only imagine that such calls for compliance will influence future research methodologies. Researchers should discuss the implications of explainable AI methodologies to ensure health professionals can use these tools responsibly. (García-Gómez et al., 2023) [33], Only a really holistic methodological approach, comprising qualitative and quantitative methods with regard to ethical issues, gives insight into the new role that AI plays within medical libraries.

3.1. Current State-run of Medical Libraries.

Medical libraries within the EU work under the most complicated conditions at the moment, driven by fast technological development and the unfinished problems of the COVID-19 pandemic. As digitization accelerates, there is a growing need for libraries to adapt their service offerings accordingly. The pandemic-induced shift to work-from-home has prompted institutions such as Spain's Library of Donostialdea Integrated Health Organisation to establish collaborations to address the information gaps that have emerged during these times (Ansuategi et al., 2020). [9]. This shift shows that open access information is becoming more and more important and, by extension, that libraries need innovative strategies for information retrieval and dissemination. Additionally, the integration of AI into library services presents both opportunities and ethical challenges, as the development of AI technologies necessitates libraries to adhere to regulatory norms, promoting transparency and fostering confidence in AI recommendations. (García-Gómez et al., 2023) [33]. The ethical issues discussed here are quite fundamental, as they significantly impact how researchers and clinical workers interact with AI tools. Medical libraries also encounter unique challenges, particularly in managing their collections: they must not only acquire high-quality research materials, but also ensure timely access to evidence-based information, particularly in emergency situations. The delivery of trustworthy evidence in a timely manner may be critical in clinical decision-making and levels of care. In addition to the dual pressures of maintaining traditional library services and fostering technological innovation, libraries must foster the development of new skills in their employees and ensure ongoing professional growth. In

other words, medical libraries in the EU are in a unique position where technology and ethics collide, enabling them to challenge conventional concepts related to knowledge management and information services.

3.2. AI Technologies in Healthcare Libraries.

The development of artificial intelligence will significantly impact health and medical libraries in the near future, potentially bringing tremendous transformation to information management and patient care. When applied in health organizations, artificial intelligence offers hope for improved diagnosis and treatment, particularly in regions with a shortage of qualified professionals. Image recognition technologies, which allow for the rapid identification of medical conditions in diagnostic systems improved by artificial intelligence, are an important prerequisite for any health-related intervention. More importantly, artificial intelligence-based telemedicine enables remote consultations, saving patients much travel time and thus improving access to specialized healthcare (Bhatt, 2024) [13]. Above all, these changes have indeed improved clinical practices and ensured positive patient outcomes through timely medical interventions. Libraries have initiated the integration of artificial intelligence-based technologies to improve the quality and increase the quantity of services they offer. Natural language processing and chatbots are among the technologies that make access to information easy and allow users to navigate large databases more easily. This relieves the librarian from the traditional tasks and challenges him/her to complex ones that require human involvement (Bakiri et al., 2024) [11]. Moreover, AI can automate routine tasks, freeing up librarians to provide more comprehensive support for customised research and the creation of learning materials. However, the adoption of AI by libraries raises serious ethical concerns about privacy and bias. Libraries must ensure that their implementation of AI applications does not perpetuate bias in information retrieval or violate user privacy. In light of this, continuous professional development and training programs to enable staff remain an imperative for the successful application of such technologies in ways consistent with ethical standards. AI technologies in health and medical libraries will finally bring a shift toward better efficiency, timeliness, and equal access to services in support of scholarly communication within the ever-evolving digital world.

3.3. Impact of AI on Information Retrieval.

Artificial intelligence enhances the information retrieval processes of medical libraries, hence making all operations more effective and improving the ways of connecting people with information systems. In due course, it frees the professional with routine work to attend to the higher-order skills required of a human being—for instance, to provide value-added services like specialized research and the development of educational content. Indeed, (Bakiri et al. 2024) [24] Research demonstrates that AI technologies, capable of processing large volumes of data at a faster pace, can assist in delivering more relevant resources in response to user inquiries. Healthcare professionals can use the typical algorithm for AI applications to process and analyze images within medical libraries, simplifying the management of medical imaging data. (Ismail & Gunawan, 2023) [48]. Importantly, the role of AI in noise reduction and enhancement of image quality directly impinges on the quality and use of the medical images, which in turn enhances diagnostic practices by healthcare professionals. However, the integration of AI raises ethical concerns related to privacy and bias. Therefore, libraries must initiate procedures for protection strategies to safeguard users' information and promote fairness in information access. It is crucial to provide continuous training to library personnel to help them overcome challenges and apply AI resources responsibly, taking into account ethical values. Medical libraries are more and more orientated towards added-value, adaptive, and fair services due to their heavy integration of artificial intelligence technologies into the rapid modifications expected from the digital environment. Artificially intelligent integrated health systems are an exceptional opportunity to understand how this technology may provide better access to information, leading to superior outcomes and operational efficiencies in medical facilities.

3.4. User Experience and AI.

In fact, medical libraries are increasingly utilizing artificial intelligence technologies, indicating a paradigm shift towards more effective, interactive, and inclusive services that adapt to the rapidly changing digital landscape. The methods of retrieving or making information available within the medical library will undergo a significant shift due to the influence of artificial intelligence. For instance, AI can personalize search results and recommendations based on user behavior and preference, ensuring that health professionals can access the most relevant information quickly. (Rahmani, 2023) [71]. Additionally, the incorporation of AI in the management of extensive medical literature can greatly minimize the time practitioners dedicate to data retrieval, enabling them to concentrate more effectively on patient care. However, beyond these benefits, there are ethical dilemmas that necessitate careful consideration; issues pertaining to user privacy and data security hold paramount importance. Libraries are required to establish strong protective measures to safeguard sensitive patient data and to guarantee that AI-based systems do not reinforce biases in the retrieval of information (Rahmani, 2023) [71]. Therefore, continuous training of librarians is crucial as it prepares them for the challenges of responsibly using AI tools by promoting the consideration of ethical standards. In this regard, such training supports librarians to consciously choose ethical uses of AI, which guarantee equal service

provision through inclusiveness. Furthermore, the collaboration of libraries and technology partners will enhance the user experience through the creation of optimal AI applications to meet their needs. By means of strategic integration, medical libraries will accomplish more than merely enhancing their service provisions; they will also solidify their position as essential knowledge and community hubs within the healthcare sector.

3.5. Data Management and AI.

In this respect, the AI technologies substantially contribute to the enhancement of data management practices within medical libraries through automation and increased efficiency. Such AI-powered systems might enable libraries to establish principles for organizing, storing, and retrieving large volumes of information with due diligence and precision with respect to sensitive patient information. AI can perform many tasks related to organizing and categorizing the medical literature, saving the librarians from doing the same and giving them more time to focus on the core aspects of providing services. Similarly, AI tools provide improved accuracy in the search results so that the user may get the appropriate information as quickly as possible (Bakiri et al., 2024) [11]. These are basic enhancements in a health setting, as timely access to accurate information lays the basis for patient care and research. When integrating AI, medical libraries must guarantee the security of sensitive patient information. This would entail stringent measures against possible breaches and measures that would ensure AI systems do not perpetuate biases in the retrieval of information (Rahmani, 2023) [71]. Continuous professional development of the library staff is very desirable so that they can manage such an application of AI knowledge both responsibly and ethically. At the same time, close cooperation between the libraries and technology providers can lead to tailored AI solutions according to the needs of the medical libraries, making user experiences truly inclusive for all users. Despite this, medical libraries should play crucial roles in disseminating knowledge and facilitating community engagements in healthcare, particularly as artificial intelligence becomes a normative tool for improving data management practices.

3.6 AI use for Evidence-Based Practice.

The application of artificial intelligence in medical libraries can streamline the process of evidence-based practice in health care by simplifying facilitation, facilitating easy access to information, and bolstering clinical decision-making. In the wake of increased application of XAI in clinical decision support systems, the medical library will be well positioned to provide resources that enable explanations of the underlying reason for recommendations made by AI to practitioners. Establishing transparency is crucial as it fosters trust among practitioners, enabling them to make decisions grounded in reliable data (Aziz et al., 2024) [10]. More importantly, artificial intelligence technologies are able to help libraries deal with large collections of medical literature, automate the process of conducting literature reviews, and keep practitioners up to date with the latest research findings. These capabilities make information search quick, hence improving the ability of professionals to attend to more patients. Moreover, artificial intelligence can assist in pinpointing pertinent studies that align more closely with specific patient cases, thereby enhancing individualized treatment plans. Medical libraries also face challenges in integrating AI into various aspects, including data security and other ethical concerns. This is because information safeguarding is very important, and any breach will undermine the fundamental basis of clinical trust (Rahmani, 2023) [71]. Libraries have a critical role in developing regular training activities to ensure the competency of their employees to use these AI technologies ethically and responsibly, in accord with the norms of data protection. Collaboration between libraries and technology suppliers could facilitate the deployment of tailored artificial intelligence technologies in healthcare, thereby enhancing inclusivity and improving services. Consequently, this would significantly boost the efficiency of medical libraries, while also reinforcing their fundamental role as knowledge hubs in the evolving healthcare landscape through the deliberate incorporation of cutting-edge technologies.

3.7. Ethical Considerations.

The integration of AI technologies in medical libraries raises several ethical concerns that require further examination to ensure their responsible deployment. First among them would be the protection of patient information. Given that AI systems handle sensitive health-related information, a violation could result in a significant loss of trust between patients and carers (Rahmani, 2023) [71]. This underlines the importance of comprehensive data protection and additional training of library staff in order to successfully address the challenges in ethical AI. Among other challenges in medical libraries are concerns about biased algorithms in AI. Without sensitive design that incorporates diversity in data and ethics, such systems do have the potential to make the disparities in health care access and treatment choices worse than they already are, further harming the most vulnerable populations. In response to this challenge, libraries should also focus on inclusive development and implementation of artificial intelligence tools, making sure that such tools respond to the diverse needs of all users. Collaboration between libraries and technology providers promises custom-made AI solutions, with a particular view towards the specific needs of health settings. In this way, both parties will collaborate to create an environment where artificial intelligence enhances service delivery while adhering to ethical considerations. Furthermore, it should be important for libraries to continuously monitor their AI activities with regard to ethical standards and community expectations. By taking this approach, libraries can

identify potential pitfalls and make any necessary adjustments well in advance. With AI deployment, libraries cannot afford to be negligent about the societal impact on equity in access and representation through their digital offerings or risk aggravating biases (Cox & Mazumdar, 2022) [25]. By addressing these ethical issues, medical libraries could enhance their core role as information hubs in healthcare advancement, all while maintaining integrity and dependability.

3.8. Collaboration Between AI and Librarians.

This implies a heightened level of collaboration among librarians as they utilize AI technologies to enhance the development of healthcare information systems. Librarians understand the structure of information and the requirements of users, which puts them in a unique position to determine how to tailor AI to address specific needs in the healthcare environment. For example, AI aids in retrieving medical literature, hence improving access to the best available information by health practitioners and patients. With artificial intelligence developers, through collaboration, libraries can provide custom-designed solutions that are ethical and efficiently address community needs (Rahmani, 2023) [71]. Moreover, the development of continuous assessments of AI practices is required. This involves planned investigations into the performance and implications of AI technologies in health settings to ensure their compliance with ethical and community expectations. This level of awareness aids in identifying potential bias and taking proactive measures to modify it, thereby enhancing trust in AI-enabled services. (Cox & Mazumdar, 2022) According to [25], as the usage of AI increases, libraries must prioritize staff training in these emerging technologies to improve their preparedness and foster stronger relationships with patrons. By providing their personnel with the necessary skills to use AI technologies, libraries have the potential to create a setting in which technology improves service provision while simultaneously meeting the distinct requirements of marginalized communities (Rahmani, 2023) [71]. Consequently, librarians assume the dual role of information facilitators and champions for fair access to resources. Conclusion with the adoption and correct implementation of AI technologies, libraries could expand their potential to become key knowledge centres on health issues, contributing to their development without compromising the integrity and care of their services (Cox & Mazumdar, 2022) [25]. This cooperative endeavor establishes libraries as indispensable collaborators in the continued development of healthcare information systems.

4. Case Studies.

More libraries are now incorporating artificial intelligence technologies into their service provision, which presents excellent opportunities for significant improvements. Different medical libraries have integrated several case studies to enhance the operational process and enhance user engagement. For instance, several libraries have already implemented AI chatbots to support patrons' queries 24/7, thereby reducing waiting times and allowing staff to focus more on complex queries. Rahmani (2023) [71] points out that the use of AI-powered inventory systems, which automate resource management and reduce manual workloads traditionally handled by library staff, increasingly reflects this shift toward improved operational efficiency. The better the access to information is, the more complex applications of artificial intelligence will help carry out the operational duties smoothly and, overall, improve the quality of the services that the library offers to its users. Other challenges that have arisen with the adaptation of service models using artificial intelligence include technological limitations and the need for staff retraining. This suggests that for most libraries, personnel training should also be at the core of their activities since a well-trained staff can significantly influence the attitude of users and their satisfaction. (Rahmani, 2023) [71]. Another big challenge is financial, especially when the inability to keep pace with ongoing evolution is often due to smaller organizations' limited budgets. Regardless, we can address these challenges by employing strategic planning that aligns with the active communities involved and concentrates on ethical concerns related to user security and data privacy in ongoing artificial intelligence projects. Addressing such challenges within this scope, therefore, aids the role of libraries in acting as the fundamental parts of health information systems and thus becoming knowledge centers. These innovations suggest that artificial intelligence could significantly transform library services, leading to overall improvements in the health sector.

4.1. Training and Education.

Such training should equip librarians not only with the technical competencies but also with methodologies for interacting effectively with users. Libraries will be required to engage in comprehensive staff development that involves more than just the operational dimensions of these emerging AI technologies but also the new ethical dimensions, such as the protection of user privacy and security of user data. The study conducted by Rahmani in 2023 [71] provided compelling evidence that well-trained personnel can significantly impact user satisfaction and involvement in implementing artificial intelligence in their home libraries. In other words, it's a matter of not only training in how to work in AI tools but also of how librarians present the benefits and services derived from those technologies to society in general. Clarification of finance-related issues is also necessary, particularly for small-scale libraries that lack the budget to invest in such intensive technologies. We expect the library to take significant steps in strategic planning and community engagement to overcome these obstacles and successfully integrate AI into their

service delivery. (Rahmani, 2023) [71]. In addition to technical trainings, continuous professional development should explore the evolving use of artificial intelligence in libraries to foster a flexible and lifelong learning environment, enabling staff to stay abreast of technological advancements and evolving user needs. Embedding AI into the services will enhance information access and operational effectiveness; therefore, librarians must be aware of the broader implications for lifelong learning and digital literacy, not just the tools themselves. Similarly, once librarians acquire the necessary skills and knowledge, they will be able to fully utilize AI's potential in fulfilling their fundamental role as knowledge hubs and significant community partners.

4.2. Anticipated Development in AI and Health Libraries.

Artificial intelligence in the medical library will soon undergo changes aimed at improving the user's overall experience by automating all internal processes. For instance, we can utilize AI chatbots to provide users with immediate assistance when accessing specific medical information or resources. This will be consistent with the trend toward the use of artificial intelligence applications in the enhancement of service delivery—a concept that has also been captured in the literature on the role of AI in libraries (Rahmani 2023) [71]. Machine learning algorithms might further assist in managing resources so that the libraries can assess the users' needs more correctly and make collections accordingly. Personnel training and professional development play a crucial role in keeping up with technological advancements, enabling librarians to utilize AI technologies in their daily work. This proactive approach will ensure that libraries transition from passively adapting to changes to actively driving innovative ways to provide access to information and digital literacy for healthcare-related education and research. Given the ethical dilemmas and financial constraints that arise when integrating artificial intelligence into patient care, it is crucial to plan more critically and involve the community in finding effective solutions. By forming alliances with information technology experts and healthcare professionals, a medical library leverages their shared knowledge and expertise to address these challenges, all while taking into account the ethical application of AI technologies. Further, nascent technologies such as virtual reality have the potential to further enhance user experience—for instance, by allowing interactive learning environments that enhance engagement with medical material. As these technologies progress, medical libraries are likely to play increasingly important roles as key collaborators in healthcare, advancing the dissemination of knowledge at a time when technology is significantly shaping both information access and educational opportunities.

4.3. Policy Implication.

This uniquely positions medical libraries at the forefront of the rapidly evolving healthcare landscape, ready to facilitate the integration of artificial intelligence technologies. The full realization of the potential of AI will require policy changes that address both the ethical and financial barriers that impede its use. For instance, medical libraries must prioritize strategic planning and implement comprehensive training programs for their staff to ensure their proficiency in utilizing AI technologies and comprehending data privacy concerns (Rahmani, 2023) [71]. This training increases efficiency and promotes ethical use of AI, which is important for continuing users' trust in libraries and protecting the confidentiality of health information. Moreover, creating alliances between medical libraries and information technology experts can harvest the best of both knowledge areas, coming up with novel approaches that enhance user engagement and digital literacy within the healthcare environment (Rahmani, 2023) [71]. To really bring community stakeholders, healthcare providers, and patients into the decision-making process, libraries can sync their artificial intelligence strategies with user needs, thereby building an enabling environment for collaborative learning and resource sharing. Moreover, since virtual reality and other technologies that actually change how education is delivered are still in development, a policy focused on researching those technologies provides flexibility toward any changes that may be brought by emerging technologies. Such flexibility may result in enhancements in information delivery and could place medical libraries in a position to be leading in healthcare education and research. Such policy changes would enable these libraries to deliver state-of-the-art services and promote health informatics, thereby enhancing access to essential health information. These changes would also facilitate the development of infrastructure and the financing of projects related to artificial intelligence.

4.4. User Demographics and AI Utilization.

Knowing the user demographics and their influence on the adoption of AI in medical libraries is important in designing services to meet the diverse needs of users. Many users of libraries include healthcare professionals and patients with different needs and comfort levels regarding technology. This type of discrepancy may involve demographic factors, such as the perceived usefulness and ease of use of artificial intelligence. For instance, younger medical practitioners are more likely to embrace AI technologies due to their exposure to rapid technological advancements, whereas older physicians may require more guidance and validation. Also, the age, level of education, and digital skills of patients have a big impact on how they interact with AI technologies. Because of this, programs that provide enough support and training for this group are necessary for the successful implementation of AI (Rahmani, 2023) [71]. To accommodate these differences, medical libraries should adopt an all-inclusive approach,

incorporating several user categories into the design process and implementation strategy for AI applications. By integrating the contributions of users representing a wide variation, libraries can thus develop AI models that better meet specific needs and thus foster ownership, allowing wider acceptance. It is also worth considering an alternative approach, where libraries collaborate with a technology vendor to develop an AI application tailored to the specific needs of their users. This will clearly ensure that the AI tools developed turn out to be workable and relevant for the respective users within their given contexts of operation and ambitions. As more libraries push for funding and policy changes that improve AI infrastructure, knowing the types of people who use their services will help them make strong cases for investing in resources that improve health informatics and make it easier for people to get to important medical information (Rahmani, 2023) [71]. This implies that, in the long run, medical libraries will play a pivotal role in enhancing knowledge in healthcare strategies and ensuring equal access to AI-supported services.

5. Comparative Analysis of Library Services.

In the fast-evolving landscape of library services, the use of artificial intelligence keeps becoming more critical for libraries, especially medical libraries, because of the absence of geographical barriers. While most libraries across Europe have joined the contemporary state of affairs with regard to the introduction of AI technologies into their workflow, the scope and nature may be quite different from libraries in other parts of the world. Some libraries in the European Union have already used AI-enhanced resources to facilitate users' engagements and operational tasks, thereby significantly enhancing information access and user experiences, as discussed in research into public libraries by Rahmani, 2023 [71]. This transition is representative of a general trend where libraries use new technologies not only to respond to current patron needs but also to predict what those needs will be and shape their services accordingly. Challenges faced by medical libraries in the European Union, however, are similar to those in other parts of the world, including ongoing budget pressures and the imperatives for staff development. Smaller libraries, due to financial constraints, struggle to keep up with emerging technologies, which further hinders the adoption of advanced AI technologies. Rahmani, 2023 [71]. It inhibits the ability of larger institutions, because of economies of scale, to invest more in advanced AI systems that could actually enhance library services. The scenario raises questions of equality in access to AI-embedded library resources, especially in disadvantaged communities. Libraries alone cannot solve this problem; libraries and technology vendors must collaborate to find a solution. Collaboration between libraries and technology vendors could facilitate the modification of AI applications to cater to diverse user groups, thereby improving usability and user experience. By advocating for funding and policy changes that will further support AI infrastructure, medical libraries position themselves as fundamental participants in healthcare knowledge dissemination and in furthering equity in access to information that benefits their communities. (Rahmani, 2023) [71].

5.1. Limitations in the Current Usage of AI.

Generally, the major areas of application of artificial intelligence in medical libraries are those that a few constraining factors impose on the libraries: resource allocations, technical challenges, and ethical considerations. As a matter of fact, most medical libraries, because of their small and monetary sizes, cannot afford to integrate advanced artificial intelligence solutions (Rahmani, 2023) [71]. In contrast to larger institutions, which may allocate substantial resources toward sophisticated AI systems capable of revolutionizing library services, only a limited number possess the requisite assets to pursue such endeavors. This means that some libraries may not have the necessary resources to access increased AI resources, thereby exacerbating the knowledge gap between well-funded and underfunded libraries. The integration of AI technologies into the library's work process is accompanied by technical challenges, including inadequate infrastructure, an acute shortage of adequately trained personnel, and a lack of such training. For instance, personnel training is essential to equip library staff with the skills necessary for utilizing such tools (Rahmani, 2023) [71]. A larger array of ethical concerns arises from the increasing incorporation of artificial intelligence in libraries, particularly regarding user privacy, data security, and the biases that are intrinsic to AI algorithms. To ensure the construction of trustworthy artificial intelligence, it is necessary to define a comprehensive set of guidelines and policies. Other, more promising approaches to handle these challenges involve library and technology provider partnerships. This type of collaboration allows for the specific positioning of deployment to cater to various user types, significantly boosting the potential for both effectiveness and usability. Medical libraries can position themselves as critical players in the dissemination of healthcare information by advocating for financial support and changes in policy toward improving infrastructure to support artificial intelligence. Such a situation would not only promote equal access to information, but also assist in overcoming some of the current challenges that prevent medical libraries from effectively integrating AI into their services. (Rahmani, 2023) [71].

6. Research Gate.

Libraries are increasingly adopting artificial intelligence technologies, but significant research lacunae persist regarding their adoption within medical libraries. Critical components include the need for the integration of AI tools with existing services and assessments of user needs and expectations. Researchers focused specifically on the unique benefits that AI applications specific to telemedicine and diagnostic tools create. Nonetheless, there has been limited investigation into the precise ways in which these technologies may integrate to enhance library services. (Bhatt, 2024) [13]. Significantly, the field of rural health did not adequately examine the long-term functionality of artificial intelligence systems, thereby necessitating an immediate reassessment of the scalability issues of these advances in diverse environments. (Bhatt, 2024) [13]. Furthermore, despite the significant hype surrounding AI's potential for operational efficiency, there should be a greater emphasis on staff training and ethical and data protection concerns. For instance, libraries are particularly concerned about user confidentiality and data protection, as well as potential algorithmic biases that could undermine the credibility of AI-powered services. (Rahmani, 2023) [71]. Finding ways to respond to such challenges would go a long way toward building trust among users in the ethical use of AI technologies. Future partnerships between libraries and vendors could facilitate the customization of artificial intelligence applications to meet the unique needs of medical libraries, thereby enhancing efficiency and enhancing user satisfaction. Future research should also focus on how AI would affect access to information and further development of outreach programs within the community for medical libraries. Once identified, these shortages may prompt special research efforts by medical libraries to address the gaps, enhancing their role as key players in the dissemination of health knowledge. This includes ensuring equal access to information for all users and potentially reducing barriers associated with the introduction of artificial intelligence.

6.1 Future and Research Directions.

The section on further research into developing applications of artificial intelligence in medical libraries will discuss a number of important areas relevant to helping these institutions make full use of their potential. Especially important for exploration is the knowledge of ethical issues arising in the use of AI regarding users' privacy and confidentiality. As medical libraries deal with sensitive health information, how to reduce such algorithmic biases has to do with gaining and maintaining user trust (Rahmani, 2023) [71]. Academics' perspectives on artificial intelligence applications that integrate transparency and equity principles to assist users in comprehending the use of their data and the algorithms used to present services will be intriguing to observe. Therefore, the research could focus on exploring how AI can serve as an ideal mechanism for finding and retrieving information to meet the needs of health professionals. Such studies will enhance the user experience by simplifying the process for patrons to identify relevant medical literature and information through the integration of Natural Language Processing (NLP) (Shahzad et al., 2024). [77]. Present an important area of further research: the area of collaboration between medical libraries and technology vendors. We should focus on developing customised AI applications that cater to the needs of users in medical libraries. Such collaboration may result in fine-tuning AI-based services for improved functionality to offer increased end-user satisfaction. The contribution of the research to an understanding of how medical libraries can most effectively support the efforts of underserved populations in acquiring health information focuses on the impact of AI on community outreach. By addressing these deficiencies and conducting special studies, researchers can further advance the growing body of evidence demonstrating the importance of medical libraries in providing access to health-related information, ultimately promoting equal access for all user categories.

7. Conclusions and Recommendations.

In such a scenario, the use of artificial intelligence in medical libraries presents a unique set of possibilities and issues, particularly raising questions about their future use. One thing that artificial intelligence can do is extend user services in ways that will make access to relevant medical literature and resources easier for its users. This aligns with the broader trend of medical libraries utilizing artificial intelligence to enhance the effectiveness of their various services and procedures. Therefore, such medical libraries that collaborate with technology providers could eventually foster the development of newer, more tailor-made AI solutions that engage their targeted clientele effectively. Therefore, the creation of more relevant services based on artificial intelligence could potentially enhance both operational efficiency and user satisfaction. Most importantly, an exploration into the impacts of artificial intelligence on community outreach services will demonstrate how medical libraries can assist in achieving a wider dissemination of services to underserved communities. Medical libraries are at the forefront in equal advocacy for access to health-related information. Because of this, future research shouldn't just look at how AI is used in medical libraries. It should also look at ethical concerns, operational difficulties, and issues of inclusion that have been brought up in libraries in general (Bakiri et al. 2024) [11]. To fully realize the potential benefits of artificial intelligence, medical libraries must train their personnel, conduct strategic planning, and enforce strict policies related to the service. By implementing these steps, medical libraries can maintain their position as essential information hubs in the digital age, while also fostering ongoing learning and skill development in the access and delivery of life health information. By

overcoming these challenges and leveraging the transformative potential of artificial intelligence, medical libraries can enhance their reputation as essential contributors to improving health outcomes and service delivery quality.

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