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The Impact of Artificial Intelligence on Clinical Research and Healthcare: A Systematic Review

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Abstract

Introduction: Artificial intelligence (AI) is revolutionizing healthcare by enhancing clinical research and patient care. AI employs techniques such as machine learning and deep learning to process extensive datasets efficiently. This enables early diagnoses, personalized treatments, and efficient resource management. AI and its applications extend to drug development, diagnostic imaging, operational efficiency, and public health surveillance. The COVID-19 pandemic further showcased AI's potential in vaccine development and outbreak monitoring, emphasizing its integral role in reshaping healthcare systems globally.
Objective: The objective of this review is to evaluate the methodologies, findings, and challenges in studies on AI applications in healthcare and resource management. It aims to identify trends, gaps, and barriers to successful AI integration and implementation.

Methods: This study used a systematic literature review to assess the impact of AI on healthcare management from 2019 to 2024. The process involved defining a strategy, applying inclusion and exclusion criteria, and screening studies systematically. Searches were conducted in databases like PubMed, ScienceDirect, and Scopus using terms such as "artificial intelligence" and "healthcare." The PRISMA framework guided study selection, with duplicates removed using software and manual checks. Data was extracted and categorized into key themes for analysis. The methodology ensured transparency, rigor, and a comprehensive review of AI's role in improving healthcare administration.

Results: The review identifies significant findings, noting a surge in research activity from 2021 to 2022, indicative of increasing interest in AI's healthcare applications. Methodologically, most studies employed literature reviews, systematic reviews, and data-driven techniques, with AI models and emerging technologies prominently featured. International collaboration was notable, with contributions from China, Italy, and the United States leading global efforts. Critical findings demonstrated AI's impact on diagnostic precision, disease management, and healthcare efficiency. However, challenges such as privacy concerns, ethical dilemmas, integration complexities, and data security issues persist, especially in emerging applications like IoHT (Internet of Healthcare things) and blockchain. These findings emphasize the transformative potential of AI while underscoring the need for robust frameworks to address its multifaceted challenges.

Conclusion: The review demonstrates AI's transformative potential in improving diagnostic precision, resource management, and patient care across healthcare domains.

Keywords: Artificial intelligence, clinical research, healthcare, deep learning, blockchain, healthcare management

Introduction

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Artificial intelligence (AI) is an evolving field of computer science aimed at developing machines capable of performing tasks that typically require human intelligence. It is revolutionizing in clinical research and health care by offering many opportunities to enhance patient care and increase new therapies, and medical processes. The machines are programmed by stimulating human intelligence and they can learn, think, and make decisions. Deep learning, natural language processing, and machine learning are the various AI techniques [1,2].

The ability of AI to process large amounts of data with high accuracy and speed makes it a potential tool in healthcare and clinical research. By predicting the outcomes of patients and early diagnosis, personalizing the treatment plan, and improving the clinical trial design, AI reshapes the healthcare practice and how it is studied. As healthcare systems struggle with growing expenses, a shortage of workers, and an aging world population, artificial intelligence (AI) presents a way to increase accessibility and efficiency while upholding high standards of care [2,3].

Figure 1: Applications of Artificial Intelligence in Healthcare and Clinical Research

AI in healthcare

Development of drugs is a more complex process, and AI can be used in this process. For example, AI models can be utilized to determine how chemical compounds' structures impact their functionality in biological organisms. They are also utilized in developing new drugs and aid in the prediction of the physiological process of drugs [2, 3].

AI demonstrates remarkable diagnostic accuracy, often surpassing radiologists in identifying anomalies in MRIs, CT scans, and X-rays. They can even analyze health records and detect chronic diseases, that help in early diagnosis and management of the disease [4].

Personalized medicine was developed by AI in treatment planning, where the treatment is based on lifestyle, genetic factors, and previous history. It helps clinicians by reducing errors and improving treatment outcomes. Additionally, AI is revolutionizing operational facets of healthcare, like improving hospital operations, forecasting patient admissions, and allocating resources optimally [3,4].

AI plays an important role in public health by monitoring disease outbreaks, analyzing health trends, and supporting the vaccine campaign. Because machine learning algorithms were used to track virus alterations, predict case surges, and expedite vaccine development, the COVID-19 pandemic highlighted the importance of AI in healthcare [5].

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AI in clinical research

Gathering of information for testing: The major challenge in conducting clinical research is to manage and analyze the huge amount of data collected. The patient must provide the data voluntarily, and the quality of the data is assessed by AI and determine whether it meets the inclusion criteria of the trial which helps in reducing incomplete or poorly constructed submissions. Using electronic health records and demographic data, AI can identify the eligible patients for the study and include them in the clinical trial with high precision. It enables the collection and analysis of data thereby increasing the efficiency of the trial and ensuring the safety of patients. AI has an impact on post-market surveillance as well, helping to keep an eye on the effectiveness and safety of licensed treatments. AI assists with detecting possible safety issues early on by examining adverse event reports and facts, guaranteeing that patient outcomes from interventions continue to be favorable [5, 6].

Patient education is one of the emerging technologies of AI. AI-driven chatbots are available in numerous healthcare contexts like cessation of smoking, dietary recommendations, and cognitive therapy. An integral part of healthcare is patient education as it helps in understanding medical diagnosis, preventive strategies, and management [7, 8].

Method

Research Design

This study conducted a systematic literature review to examine how artificial intelligence affects healthcare administration and how it varies by time and place. The methodological process includes developing the study strategy, applying inclusion and exclusion criteria, screening investigations, and extracting and analyzing data. The process is clear, transparent, and reproducible because this document includes each step.

Search Strategy

To conduct this study, it used electronic databases for peer-reviewed studies that were published from 2019 to 2024, a period of global health challenges. The databases chosen were Google Scholar, ScienceDirect, Scopus, PubMed, IEEE Xplore, and Springer. The search terms were “artificial intelligence”, “healthcare”, and “hospital management” with AND and OR. The search criteria included article titles, abstracts, and keywords. This multi-database strategy was implemented to reduce the likelihood of excluding pertinent studies and adhering to established procedures in systematic research within healthcare information systems.

Inclusion and Exclusion Criteria

Inclusion

- This study was written in English, the main scientific language, and covered AI adoption topics in full.
- This study investigated open-access and subscription publications, emphasizing open-access for accessibility.
- It presented empirical studies on healthcare AI adoption factors to inform AI integration.
- This study included papers published from 2019 to 2024 academic journals.
- To understand AI's diverse impact on healthcare management, examined

Inclusion Criteria

computer science, social sciences, business management, economics, econometrics, and finance.

Exclusion Criteria

- This study excluded those articles that did not meet these standards.
- This methodology was desired to guarantee the incorporation of substantial and pertinent contributions, restricting the scope to high-quality and accessible sources to deliver a thorough and detailed analysis of AI's influence on healthcare administration.

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Screening and Selection

A methodical strategy was used to identify and eliminate duplicates. Orange 3.36.2 was used to remove exact duplicates, focusing on the title and author. This was succeeded by manually examining the remaining articles to guarantee that no duplicates were missed. Articles that passed this examination were reviewed in full text using specified inclusion and exclusion criteria.
Applying the inclusion criteria and eliminating duplicates, all five authors independently reviewed the texts of the chosen papers. The evaluations were addressed at the following group sessions, and any inconsistencies were reconciled through a consensus approach. This approach ensured that interpretations and findings represented the team's judgment, improving article rating consistency and transparency.

Data Extraction and Analysis

Data extraction involved capturing key information on AI use in healthcare management, adoption factors, effectiveness, and study outcomes. Recurring themes and patterns were categorized into five main topics. The PRISMA guidelines ensured the rigor and reliability of the review process.

Results

The studies employed a variety of methodologies to address their objectives. Qualitative and quantitative analysis ([9], [20], [21], [27], [28], [32]) were common for evaluating attitudes, behaviors, and perceptions. Literature reviews ([10], [12], [15], [25], [43], [45], [48], [51], [53], [71]) dominated exploratory studies, highlighting knowledge gaps and offering conceptual frameworks. Systematic reviews ([11], [13], [14], [16], [18], [39], [74]) provided in-depth insights into specific domains like explainable AI or algorithm performance. Studies employing data analysis and statistical techniques ([26], [31], [58], [59], [70], [72], [73], [75], [77], [84]) focused on empirical validations and predictive modelling. AI-based approaches ([19], [36], [40], [42], [44], [52], [60], [62], [63], [65], [66], [67], [78], [80], [81], [83], [87]) were pivotal in advancing technological solutions. Experimental studies ([22], [23], [55]) and emerging technologies ([33], [34], [35], [50], [54], [68], [69], [82], [85], [86]) emphasized innovation. Combination methods ([38], [46], [47], [49], [76]) integrated diverse techniques, illustrating multidimensional problem-solving approaches (Table 1).

Table 1: Methodologies implemented in the included studies

Methodology	Studies
Qualitative and Quantitative Analysis	[9], [20], [21], [27], [28], [32]
Literature Review	[10], [12], [15], [25], [43], [45], [48], [51], [53], [71]
Systematic Review	[11], [13], [14], [16], [18], [39], [74]
Data Analysis and Statistical Techniques	[26], [31], [58], [59], [70], [72], [73], [75], [77], [84]
Use of Artificial Intelligence (AI) models	[19], [36], [40], [42], [44], [52], [60], [62], [63], [65], [66], [67], [78], [80], [81], [83], [87]
Experimental and Case Study Research	[22], [23], [55]
Meta-Analysis	[24]
Use of Emerging Technologies	[33], [34], [35], [50], [54], [68], [69], [82], [85], [86]
Combination Methods	[38], [46], [47], [49], [76]

The studies demonstrated diverse findings in AI applications and challenges. For instance, [9] revealed positive attitudes towards AI but raised concerns about privacy and doctor-patient relationships. Studies such as [12] and [13] underscored the potential of AI to enhance diagnostic precision while highlighting ethical and monitoring challenges. Meanwhile, [14] and [16] identified AI's role as a support tool in clinical decisions but emphasized the need for diverse perspectives. Stakeholder involvement ([17]) and workflow optimization

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([19], [26]) showcased AI's organizational benefits but stressed integration issues. Additionally, [20] and [29] discussed AI's implications for risk management and diagnostic accuracy, noting privacy and technical limitations. Across these studies, the findings underline AI's transformative potential while exposing significant ethical, technical, and infrastructural challenges (Table 2).

Table 2: Findings and Challenges of Studies on AI for quality assurance, stakeholder engagement and Healthcare response

Findings/Results	Challenges	Studies
Positive attitude towards AI, concerns about data and personal contact	Concerns about privacy and impact on doctor-patient relationship	[9]
Importance of quality control measures and accountability	Challenges in implementation and maintaining quality	[10]
Challenges and solutions for diversity and inclusion in AI	Issues of diversity and inclusion in design and development	[11]
Potential of AI to improve diagnostic precision	Ethical and practical issues in integrating AI	[12]
Importance of continuous monitoring of AI algorithms	Challenges in monitoring and updating algorithms	[13]
AI as a support tool in clinical decisions	Need to consider multiple perspectives	[14], [16]
Effectiveness of SGUS in diagnosis and monitoring	Importance of adding AI to improve accuracy	[15]
Need for involvement of various stakeholders	Importance of an ethical and sustainable approach	[17]
AI assists in diagnosis and management of IBS	Specificity and accuracy of certain algorithms	[18]
Workflow optimization	Integration with existing practices	[19], [26]
Risk management awareness	Data privacy and security	[20]
Technology adoption in various sectors	Access equity	[21]
Reduction of contamination risk	Economic and psychological considerations	[22], [32]
Improved diagnostic precision	Technical and ethical limits	[23]
Innovations in pharmacological therapies	Data complexity and interpretation	[24]
Potential in mental health management	Accessibility and privacy	[25]
Improved technological awareness	Risk classification	[27]
Acceleration of technology adoption	Ethical and legal implications	[28]
Improved diagnostic accuracy	Data privacy issues	[29]
Improved efficiency in remote care	Connectivity and access issues	[30]
Effective epidemic monitoring	Data security issues	[31]
Efficiency in surgical procedures	Economic and psychological considerations	[32]

AI's applications in technological innovations were observed in areas such as skill enhancement ([33], [34]) and efficient frameworks ([38], [50]). While significant progress was noted, challenges emerged in integrating and validating technologies in real-world settings. Enhanced disease management ([35], [51], [52], [67]) faced hurdles related to data privacy and model complexity. Studies on AI models ([46], [47], [62], [66]) stressed the need for interpretability and adaptation to healthcare contexts. Meanwhile, [39], [44], and [58] highlighted improved predictions and resource optimization but encountered integration and stakeholder issues. Emerging technologies like blockchain and IoMT

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(Internet of Medical Things) ([43], [64], [65]) offered secure solutions yet posed scalability and deployment challenges. Collectively, the studies showed advancements in AI yet identified significant regulatory, technical, and ethical obstacles (Table 3).

Table 3: Findings and Challenges of Studies on AI for technological innovations, AI in enhancing healthcare and Security and Intelligent Platforms

Findings/Results	Challenges	Studies
Improvement in skills, frameworks, and efficiency	Integration and validation of frameworks, technologies, and processes	[33], [34], [38], [50]
Enhanced disease management and diagnosis	Data privacy, technology integration, and model complexity	[35], [51], [52], [53], [54], [67]
Efficient use of AI and digital technologies	Addressing algorithmic bias, privacy, and system interoperability	[36], [37], [40], [41], [42], [63], [68]
Development of healthcare-specific AI models	Ensuring accuracy, interpretability, and adapting models to real-world challenges	[46], [47], [62], [66], [69]
Improved prediction, optimization, and resource allocation	Challenges with data integration, regulatory issues, and stakeholder collaboration	[39], [44], [45], [58], [59]
Integration of emerging technologies like blockchain and IoMT	Data security, effective deployment, and scalability	[43], [55], [56], [64], [65]
Improvements in clinical management and telemedicine	Stakeholder collaboration, data integration, and post-pandemic adjustments	[49], [53], [60], [61], [70]
Development of privacy-preserving systems for sensitive data	Addressing encryption challenges and compliance with ethical standards	[68], [69], [67]
Mapping and reviewing trends in healthcare AI research	Identifying gaps, evolving techniques, and addressing implementation challenges	[64], [71]

The findings from studies on AI for resource management spanned several categories. Data-driven healthcare studies ([72], [84], [86]) focused on intelligent decision-making systems, resource optimization, and ontology development, showcasing AI's ability to streamline complex processes. AI applications ([74], [76], [77], [78], [85]) demonstrated improved efficiency, pattern recognition, and predictive capabilities but also revealed diverse use cases and public perceptions. Studies on healthcare management ([79], [81], [82], [87]) illustrated the importance of frameworks for digitalization, federated learning, and enhanced security. Additionally, elderly care ([80]) and healthcare efficiency ([73], [75]) highlighted the potential of IoHT and AI in improving performance and resource allocation. These findings illustrate AI's transformative role while showcasing its broad applicability (Table 4).

Table 4: Findings of included studies on AI and resource management in healthcare

Category	Findings	Studies

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Data-Driven Healthcare	Intelligent decision-making systems developed	[72]
	Data-based decision making for resource management	[84]
	Development of a common integrated ontology	[86]
AI Applications	Use of XAI methods in various healthcare contexts	[74]
	Improved efficiency and patient outcomes	[76]
	Performance projections and provider attitudes	[77]
	Pattern recognition in presence and absence classes	[78]
	Positive AI expectations and concerns	[85]
Healthcare Management	Proposal for digitalization plans	[79], [87]
	FL approaches improving privacy and security	[81]
	Healthcare 5.0 security framework proposed	[82]
Elderly Care	Development of IoHT-CLS system for elderly care management	[80]
Healthcare Efficiency	Provider performance and social influences	[73]
	Technical efficiency assessment	[75]

The challenges identified in the studies span multiple categories. In data-driven healthcare ([72], [84], [86]), inconsistencies in healthcare needs, data management, and security emerged as critical barriers. AI applications ([74], [76], [77], [78], [85]) faced challenges related to diversity in applications, privacy, and interpretability, reflecting the complexities of integrating AI into healthcare systems. Healthcare management ([79], [81], [87]) revealed issues with technology adoption and standardization, particularly in implementing federated learning and digitalization frameworks. Elderly care ([80]) faced integration hurdles with IoHT technologies, while healthcare efficiency ([75]) struggled to balance cost-effectiveness and resource allocation. These challenges underscore the multifaceted barriers to leveraging AI for resource management and emphasize the need for comprehensive strategies to overcome them (Table 5).

Table 5: Challenges of included studies on AI and resource management in healthcare

Category	Challenges	Studies
Data-Driven Healthcare	Inconsistency of healthcare needs and resources	[72]
	Implementation in complex healthcare contexts	[84]
	Data management and security threats	[86]
AI Applications	Diversity of applications and interpretation of XAI results	[74]
	AI integration, privacy, and ethics	[76]
	Provider support and AI infrastructure	[73], [77]
	Enhancing CVD detection using AIDSS-CDDC	[78]
	Involvement of patients and public opinions	[85]
Healthcare Management	Adoption and integration of new technologies	[79], [87]
	Communication and standardization for FL implementation	[81]
Elderly Care	Integration of IoHT technologies	[80]
Healthcare Efficiency	Balancing cost-efficiency and resource management	[75]

Discussion

With its promise to improve precision, effectiveness, and creativity in a variety of fields, artificial intelligence (AI) has become a

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game-changer in clinical research and healthcare. To optimize its advantages while lowering its risks, its broad use also brings up important issues and moral dilemmas that need to be resolved [8].

An innovative transformation is seen in healthcare services with the use of AI, although its application in clinical practice is not known. A cross-sectional study was conducted to examine the trials related to AI in ClinicalTrails.gov which intends to investigate the characteristics of trial and developmental status of AI [8-10]. To construct the graph of AI application to achieve the analysis and visual representation visualization technology and Neo4j graph was used. The number of clinical trial registrations has exponentially increased since 2016. Data-driven technologies are the most used AI applications recently. There are still numerous obstacles to overcome before AI technology can be widely used in healthcare, and more excellent prospective clinical validation is needed [9].

The development of effective and safe drugs is through conducting clinical trials. Artificial Intelligence (AI) solutions are used by business as it facilitates rapid and efficient clinical research, given the changing personalized and data-driven treatment approach in healthcare. In a study, they assessed the challenges, opportunities, and potential implications of AI in clinical trials. They stated that the use of AI in clinical trials is in its infancy although it is fast evolving field. They expect the range of applications to expand and the implementations to rise quickly as regulators offer more guidelines to accept AI in particular domains [10].

AI has transformed the healthcare systems to enhance the quality of life and patient care. Healthcare can be revolutionized with rapid advancements in AI. A current state of AI and a comprehensive overview were analyzed in a review. They stated that AI can be used in the diagnosis of disease, and the development of personalized treatment plans, and it also assists the clinicians in the decision-making process. AI creates technology that can improve patient care in a various healthcare context, not only automating jobs. However, for AI to be used in healthcare in a responsible and efficient manner, problems with bias, data privacy, and the need of human knowledge must be solved [11].

There is a growing trend in the application of AI in healthcare including diagnosis, treatment, and risk assessment. A systematic review was done to assess the applications of AI that are implemented in real-life practice. They concluded that the clinical application of AI is at an early stage despite its great potential in healthcare [12].

AI has the potential to dramatically change clinical practice, but certain problems must be fixed before it can realize its full potential. One of these problems is the lack of high-quality medical data, which might lead to incorrect findings. Data availability, privacy, and security are other potential limitations on the use of AI in clinical practice. Finding relevant clinical measures and employing the appropriate methods are also essential to achieving the desired outcomes. The adoption of AI has ethical ramifications that go beyond technological issues. Accountability concerns are still unresolved, especially when AI makes poor decisions. Determining who is liable—the developer, the healthcare practitioner, or the institution—is a difficult and constantly changing task [13].

The capacity of AI to process enormous volumes of data with previously unheard-of speed and accuracy is one of its most important contributions to healthcare. AI-driven diagnostic systems, such those that use computer vision and machine learning algorithms, have demonstrated proficiency in recognizing diseases like diabetes mellitus, cancer, and cardiovascular disorders from medical images. By lowering diagnostic errors and facilitating early interventions, these systems frequently match or surpass the diagnosis accuracy of skilled doctors [14].

Conclusion

The systematic review highlights the significant advancements and challenges in the application of artificial intelligence (AI) and emerging technologies in healthcare. It demonstrates AI's transformative potential across various domains, including resource management, quality assurance, stakeholder engagement, technological innovation, and security frameworks. AI models and data-driven systems were shown to improve diagnostic precision, efficiency, and decision-making, while digitalization and IoHT systems advanced patient care, particularly for elderly populations. However, critical challenges such as privacy concerns, ethical dilemmas, integration complexities, and scalability issues persist, requiring robust frameworks and interdisciplinary collaboration. The findings underscore the importance of global efforts to bridge technological, infrastructural, and regulatory gaps, paving the way for sustainable and equitable AI implementation in healthcare.

References

1. Chopra, H., Shin, D. K., Munjal, K., Dhama, K., & Emran, T. B. (2023). Revolutionizing clinical trials: The role of AI in accelerating medical breakthroughs. *International Journal of Surgery (London, England)*, *109*(12), 4211. https://doi.org/10.1097/JS9.0000000000000705
2. Gautam, R. K., Kamal, M. A., Chopra, H., & Baig, A. A. (2022). Application of Artificial Intelligence in Drug Discovery. *Current Pharmaceutical Design*, *28*(33), 2690–2703. https://doi.org/10.2174/1381612828666220608141049
3. Bohr, A., & Memarzadeh, K. (2020). The rise of artificial intelligence in healthcare applications. In *Artificial Intelligence in healthcare* (pp. 25-60). Academic Press.
4. Malamateniou, C., McFadden, S., McQuinlan, Y., England, A., Woznitza, N., Goldsworthy, S., Currie, C., Skelton, E., Chu, K.-Y. ., Alware, N., Matthews, P., Hawkesford, R., Tucker, R., Town, W., Matthew, J., Kalinka, C., & O'Regan, T. (2021). Artificial Intelligence: Guidance for clinical imaging and therapeutic radiography professionals, a summary by the Society of Radiographers AI working group. *Radiography*, *27*(4), 1192–1202. https://doi.org/10.1016/j.radi.2021.07.028
5. Aung, Y. Y. M., Wong, D. C. S., & Ting, D. S. W. (2021). The promise of artificial intelligence: a review of the opportunities and challenges of artificial intelligence in healthcare. *British Medical Bulletin*, *139*(1), 4–15. https://doi.org/10.1093/bmb/ldab016
6. Askin, S., Burkhalter, D., Calado, G., & Samar El Dakrouni. (2023). Artificial Intelligence Applied to clinical trials: opportunities and challenges. *Artificial Intelligence Applied to Clinical Trials: Opportunities and Challenges*, *13*(2). https://doi.org/10.1007/s12553-023-00738-2
7. Bindra, S., & Jain, R. (2024). Artificial intelligence in medical science: a review. *Irish Journal of Medical Science (1971-)*, *193*(3), 1419-1429.
8. Van Hartskamp, M., Consoli, S., Verhaegh, W., Petkovic, M., & Van de Stolpe, A. (2019). Artificial intelligence in clinical health care applications. *Interactive journal of medical research*, *8*(2), e12100.
9. Moldt, J.-A., Festl-Wietek, T., Madany Mamlouk, A., Nieselt, K., Fuhl, W., and

Herrmann-Werner, A., "Chatbots for future docs: Exploring medical students' attitudes and knowledge towards artificial intelligence and medical chatbots," *Med. Educ. Online*, vol. 28, 2023, Art. no. 2182659. [CrossRef] [PubMed]

10. R. Bartels, J. Dudink, S. Haitjema, D. Oberski, and A. van 't Veen, "A Perspective on a Quality Management System for AI/ML-Based Clinical Decision Support in Hospital Care," *Front. Digit. Health*, vol. 4, 2022, Art. no. 942588. [CrossRef] [PubMed]
11. R. A. Shams, D. Zowghi, and M. Bano, "AI and the quest for diversity and inclusion: A systematic literature review," *AI Ethics*, 2023. [CrossRef]
12. I. Thomassin-Naggara, C. Balleyguier, L. Ceugnart, P. Heid, G. Lenczner, A. Maire, B. Séradour, L. Verzaux, P. Taourel, and Conseil, "Artificial intelligence and breast screening: French Radiology Community position paper," *Diagn. Interv. Imaging*, vol. 100, pp. 553–566, 2019. [CrossRef]
13. J. Feng, R. V. Phillips, I. Malenica, A. Bishara, A. E. Hubbard, L. A. Celi, and R. Pirracchio, "Clinical artificial intelligence quality improvement: Towards continual monitoring and updating of AI algorithms in healthcare," *npj Digit. Med.*, vol. 5, 2022, Art. no. 66. [CrossRef]
14. A. Boonstra and M. Laven, "Influence of artificial intelligence on the work design of emergency department clinicians: A systematic literature review," *BMC Health Serv. Res.*, vol. 22, 2022, Art. no. 669. [CrossRef] [PubMed]
15. M. Lorenzon, E. Spina, F. T. D. Franco, I. Giovannini, S. D. Vita, and A. Zabotti, "Salivary Gland Ultrasound in Primary Sjögren's Syndrome: Current and Future Perspectives," *Open Access Rheumatol. Res. Rev.*, vol. 14, pp. 147–160, 2022. [CrossRef]
16. H. D. J. Hogg, M. Al-Zubaidy, J. Talks, A. K. Denniston, C. J. Kelly, J. Malawana, C. Papoutsi, M. D. Teare, P. A. Keane, F. R. Beyer, et al., "Stakeholder Perspectives of Clinical Artificial Intelligence Implementation: Systematic Review of Qualitative Evidence," *J. Med. Internet Res.*, vol. 25, 2023, Art. no. 39742. [CrossRef]
17. G. J. Miller, "Stakeholder roles in artificial intelligence projects," *Proj. Leadersh. Soc.*, vol. 3, 2022, Art. no. 100068. [CrossRef]
18. M. Kordi, M. J. Dehghan, A. A. Shayesteh, and A. Azizi, "The impact of artificial intelligence algorithms on management of patients with irritable bowel syndrome: A systematic review," *Inform. Med. Unlocked*, vol. 29, 2022, Art. no. 100891.
19. R. Murri, C. Masciocchi, J. Lenkowicz, M. Fantoni, A. Damiani, A. Marchetti, P. D. A. Sergi, G. Arcuri, A. Cesario, S. Patarnello, et al., "A real-time integrated framework to support clinical decision making for COVID-19 patients," *Comput. Methods Programs Biomed.*, vol. 217, 2022, Art. no. 106655. [CrossRef] [PubMed]
20. A. A. Enughwure and I. C. Febaide, "Applications of Artificial Intelligence in Combating COVID-19: A Systematic Review," *Open Access Libr. J.*, vol. 7, 2020, Art. no. 8. [CrossRef]
21. M. Ortiz-Barrios, S. Arias-Fonseca, A. Ishizaka, M. Barbati, B. Avendaño-Collante, and E. Navarro-Jiménez, "Artificial intelligence and discrete-event simulation for capacity management of intensive care units during the COVID-19 pandemic: A case study," *J. Bus. Res.*, vol. 160, 2023, Art. no. 113806. [CrossRef]
22. M. L. Chee, M. E. H. Ong, F. J. Siddiqui, Z. Zhang, S. L. Lim, A. F. W. Ho, and N. Liu, "Artificial intelligence applications for COVID-19 in intensive care and emergency settings: A systematic review," *Int. J. Environ. Res. Public Health*, vol. 18, 2021, Art. no. 4749. [CrossRef]

ISSN: 2583-6129
DOI: 10.55041/ISJEM01962

23. Z. Xu, C. Su, Y. Xiao, and F. Wang, "Artificial intelligence for COVID-19: Battling the pandemic with computational intelligence," *Intell. Med.*, vol. 2, pp. 13–29, 2022. [CrossRef] [PubMed]
24. T. U. Zaman, E. K. Alharbi, A. S. Bawazeer, G. A. Algethami, L. A. Almehmadi, T. M. Alshareef, Y. A. Alotaibi, and H. M. O. Karar, "Artificial intelligence: The major role it played in the management of healthcare during COVID-19 pandemic," *IAES Int. J. Artif. Intell.*, vol. 12, pp. 505–513, 2023. [CrossRef]
25. L. Ismail and H. Materwala, "Blockchain paradigm for healthcare: Performance evaluation," *Symmetry*, vol. 12, 2020, Art. no. 1200. [CrossRef]
26. A. Aravazhi, B. I. Helgheim, and P. Aadahl, "Decision-Making Based on Predictive Process Monitoring of Patient Treatment Processes: A Case Study of Emergency Patients," *Adv. Oper. Res.*, vol. 2023, 2023, Art. no. 8867057. [CrossRef]
27. L. L. Văduva, A.-M. Nedelcu, D. Stancu, C. Bălan, I.-M. Purcărea, M. Gurău, and D. A. Cristian, "Digital Technologies for Public Health Services after the COVID-19 Pandemic: A Risk Management Analysis," *Sustainability*, vol. 15, 2023, Art. no. 3146. [CrossRef]
28. C. W.-L. Ho, K. Caals, and H. Zhang, "Heralding the Digitalization of Life in Post-Pandemic East Asian Societies," *J. Bioethical Inq.*, vol. 17, pp. 657–661, 2020. [CrossRef] [PubMed]
29. Y. J. Chen, L.-C. Lin, S.-T. Yang, K.-S. Hwang, C.-T. Liao, and W.-H. Ho, "High-Reliability Non-Contact Photoplethysmography Imaging for Newborn Care by a Generative Artificial Intelligence," *IEEE Access*, vol. 11, pp. 90801–90810, 2023. [CrossRef]
30. A. M. B. Suhaimy and T. Anwar, "Intelligent healthcare on hydrocephalus management using artificial neural network algorithm," *Int. J. Eng. Adv. Technol.*, vol. 9, pp. 6108–6115, 2019. [CrossRef]
31. M. A. Ortíz-Barrios, D. M. Coba-Blanco, J.-J. Alfaro-Saíz, and D. Stand-González, "Process improvement approaches for increasing the response of emergency departments against the COVID-19 pandemic: A systematic review," *Int. J. Environ. Res. Public Health*, vol. 18, 2021, Art. no. 8814. [CrossRef]
32. A. Zemmar, A. M. Lozano, and B. J. Nelson, "The rise of robots in surgical environments during COVID-19," *Nat. Mach. Intell.*, vol. 2, pp. 566–572, 2020. [CrossRef]
33. I. K. Nti, A. F. Adekoya, B. A. Weyori, and F. Keyeremeh, "A bibliometric analysis of technology in sustainable healthcare: Emerging trends and future directions," *Decis. Anal. J.*, vol. 8, 2023, Art. no. 100292. [CrossRef]
34. R. C. Free, D. Lozano Rojas, M. Richardson, J. Skeemer, L. Small, P. Haldar, and G. Woltmann, "A data-driven framework for clinical decision support applied to pneumonia management," *Front. Digit. Health*, vol. 5, 2023, Art. no. 1237146. [CrossRef] [PubMed]
35. F. Khalique, S. A. Khan, and I. Nosheen, "A Framework for Public Health Monitoring, Analytics and Research," *IEEE Access*, vol. 7, pp. 101309–101326, 2019. [CrossRef]
36. S. Atek, F. Bianchini, C. De Vito, V. Cardinale, S. Novelli, C. Pesaresi, M. Eugeni, M. Mecella, A. Rescio, L. Petronzio, et al., "A predictive decision support system for coronavirus disease 2019 response management and medical logistic planning," *Digital Health*, vol. 9, 2023, Art. no. 20552076231185475. [CrossRef]
37. E. Sulis, P. Terna, A. Di Leva, G. Boella, and A. Boccuzzi, "Agent-oriented Decision Support System for Business

Processes Management with Genetic Algorithm Optimization: An Application in Healthcare," *J. Med. Syst.*, vol. 44, 2020, Art. no. 157. [CrossRef]
38. M. Cho, M. Song, S. Yoo, and H. A. Reijers, "An Evidence-Based Decision Support Framework for Clinician Medical Scheduling," *IEEE Access*, vol. 7, pp. 15239–15249, 2019. [CrossRef]
39. W. Tam, M. Alajlani, and A. Abd-Alrazaq, "An Exploration of Wearable Device Features Used in UK Hospital Parkinson Disease Care: Scoping Review," *J. Med. Internet Res.*, vol. 25, 2023, Art. no. 42950. [CrossRef] [PubMed]
40. H. Huang, P.-C. Shih, Y. Zhu, and W. Gao, "An integrated model for medical expense system optimization during diagnosis process based on artificial intelligence algorithm," *J. Comb. Optim.*, vol. 44, pp. 2515–2532, 2022. [CrossRef] [PubMed]
41. F. F. Alruwaili, "Artificial intelligence and multi agent based distributed ledger system for better privacy and security of electronic healthcare records," *PeerJ Comput. Sci.*, vol. 6, 2020, Art. no. e323. [CrossRef]
42. E. Iadanza, G. Benincasa, I. Ventisette, and M. Gherardelli, "Automatic Classification of Hospital Settings through Artificial Intelligence," *Electronics*, vol. 11, 2022, Art. no. 1697. [CrossRef]
43. H. Fatoum, S. Hanna, J. D. Halamka, D. C. Sicker, P. Spangenberg, and S. K. Hashmi, "Blockchain integration with digital technology and the future of health care ecosystems: Systematic review," *J. Med. Internet Res.*, vol. 23, 2021, Art. no. 19846. [CrossRef]
44. I. Y. Chen, P. Szolovits, and M. Ghassemi, "Can AI help reduce disparities in general medical and mental health care?" *AMA J. Ethics*, vol. 21, pp. 167–179, 2019. [CrossRef]
45. M. N. K. Anudjo, C. Vitale, W. Elshami, A. Hancock, A. Adeleke, J. M. Franklin, and T. N. Akudjedu, "Considerations for environmental sustainability in clinical radiology and radiotherapy practice: A systematic literature review and recommendations for a greener practice," *Radiography*, vol. 29, pp. 1077–1092, 2023. [CrossRef]
46. B. S. Raja and S. Asghar, "Disease classification in health care systems with game theory approach," *IEEE Access*, vol. 8, pp. 83298–83311, 2020. [CrossRef]
47. Y. Shang, Y. Tian, M. Zhou, T. Zhou, K. Lyu, Z. Wang, R. Xin, T. Liang, S. Zhu, and J. Li, "EHR-Oriented Knowledge Graph System: Toward Efficient Utilization of Non-Used Information Buried in Routine Clinical Practice," *IEEE J. Biomed. Health Inform.*, vol. 25, pp. 2463–2475, 2021. [CrossRef]
48. S. García-Ponsoda, J. García-Carrasco, M. A. Teruel, A. Maté, and J. Trujillo, "Feature engineering of EEG applied to mental disorders: A systematic mapping study," *Appl. Intell.*, vol. 53, pp. 23203–23243, 2023. [CrossRef]
49. A. Celesti, I. De Falco, L. Pecchia, and G. Sannino, "Guest Editorial Enabling Technologies for Next Generation Telehealthcare," *IEEE J. Biomed. Health Inform.*, vol. 25, pp. 4240–4242, 2021. [CrossRef]
50. K. Zhai, N. A. Masoodi, L. Zhang, M. S. Yousef, and M. W. Qoronfleh, "Healthcare Fusion: An Innovative Framework for Health Information Management," *Electron. J. Knowl. Manag.*, vol. 20, pp. 179–192, 2022. [CrossRef]
51. D.-E.-M. Nisar, R. Amin, N.-U.-H. Shah, M. A. A. Ghamdi, S. H. Almotiri, and M. Alruily, "Healthcare Techniques through Deep Learning: Issues, Challenges and Opportunities," *IEEE Access*, vol. 9, pp. 98523–98541, 2021. [CrossRef]
52. G. Yu, M. Tabatabaei, J. Mezei, Q. Zhong, S. Chen, Z. Li, J. Li, L. Shu, and Q. Shu,

ISSN: 2583-6129
DOI: 10.55041/ISJEM01962

"Improving chronic disease management for children with knowledge graphs and artificial intelligence," *Expert Syst. Appl.*, vol. 201, 2022, Art. no. 117026. [CrossRef]

53. V. B. Vargas, J. De Oliveira Gomes, P. C. Fernandes, R. V. Vallejos, and J. V. De Carvalho, "Influential Factors for Hospital Management Maturity Models in a post-COVID-19 scenario—Systematic Literature Review," *J. Inf. Syst. Eng. Manag.*, vol. 8, 2023, Art. no. 12868. [CrossRef]
54. D. K. Murala, S. K. Panda, and S. P. Dash, "MedMetaverse: Medical Care of Chronic Disease Patients and Managing Data Using Artificial Intelligence, Blockchain, and Wearable Devices State-of-the-Art Methodology," *IEEE Access*, vol. 11, pp. 138954–138985, 2023. [CrossRef]
55. M. Soellner and J. Koenigstorfer, "Motive perception pathways to the release of personal information to healthcare organizations," *BMC Med. Inform. Decis. Mak.*, vol. 22, 2022, Art. no. 240. [CrossRef]
56. F. Alanazi, V. Gay, and R. Alturki, "Poor Compliance of Diabetic Patients with AI-Enabled E-Health Self-Care Management in Saudi Arabia," *Information*, vol. 13, 2022, Art. no. 509. [CrossRef]
57. S. Ramchand, G. Tsang, D. Cole, and X. Xie, "RetainEXT: Enhancing Rare Event Detection and Improving Interpretability of Health Records using Temporal Neural Networks," in *Proc. 2022 IEEE-EMBS Int. Conf. Biomed. Health Inform.* (BHI), Ioannina, Greece, Sep. 2022. [CrossRef]
58. N. Yang, "Financial Big Data Management and Control and Artificial Intelligence Analysis Method Based on Data Mining Technology," *Wirel. Commun. Mob. Comput.*, vol. 2022, 2022, Art. no. 7596094. [CrossRef]
59. Y. Chen, W. Huang, X. Jiang, T. Zhang, Y. Wang, B. Yan, Z. Wang, Q. Chen, Y. Xing, D. Li, et al., "UbiMeta: A Ubiquitous Operating System Model for Metaverse," *Int. J. Crowd Sci.*, vol. 7, pp. 180–189, 2023. [CrossRef]
60. F. López-Martínez, E. R. Núñez-Valdez, V. García-Díaz, and Z. Bursac, "A case study for a big data and machine learning platform to improve medical decision support in population health management," *Algorithms*, vol. 13, 2020, Art. no. 102. [CrossRef]
61. A.-C. Phan, T.-C. Phan, and T.-N. Trieu, "A Systematic Approach to Healthcare Knowledge Management Systems in the Era of Big Data and Artificial Intelligence," *Appl. Sci.*, vol. 12, 2022, Art. no. 4455. [CrossRef]
62. K. Liu, Z. Chen, J. Wu, Y. Tan, L. Wang, Y. Yan, H. Zhang, and J. Long, "Big Medical Data Decision-Making Intelligent System Exploiting Fuzzy Inference Logic for Prostate Cancer in Developing Countries," *IEEE Access*, vol. 7, pp. 2348–2363, 2019. [CrossRef]
63. S. K. Rana, S. K. Rana, K. Nisar, A. A. Ag Ibrahim, A. K. Rana, N. Goyal, and P. Chawla, "Blockchain Technology and Artificial Intelligence Based Decentralized Access Control Model to Enable Secure Interoperability for Healthcare," *Sustainability*, vol. 14, 2022, Art. no. 9471. [CrossRef]
64. J. Kedra, T. Radstake, A. Pandit, X. Baraliakos, F. Berenbaum, A. Finckh, B. Fautrel, T. A. Stamm, D. Gomez-Cabrero, C. Pristipino, et al., "Current status of use of big data and artificial intelligence in RMDs: A systematic literature review informing EULAR recommendations," *RMD Open*, vol. 5, 2019, Art. no. e001004. [CrossRef] [PubMed]
65. D. Hermawan, N. M. D. Kansa Putri, and L. Kartanto, "Cyber Physical System Based Smart Healthcare System with Federated Deep Learning Architectures with Data Analytics," *Int. J. Commun.*

Netw. Inf. Secur., vol. 14, pp. 222–233, 2022. [CrossRef]

66. B. Camajori Tedeschini, S. Savazzi, R. Stoklasa, L. Barbieri, I. Stathopoulos, M. Nicoli, and L. Serio, "Decentralized Federated Learning for Healthcare Networks: A Case Study on Tumor Segmentation," *IEEE Access*, vol. 10, pp. 8693–8708, 2022. [CrossRef]
67. S. Ahmad, S. Khan, M. F. AlAjmi, A. K. Dutta, L. M. Dang, G. P. Joshi, and H. Moon, "Deep Learning Enabled Disease Diagnosis for Secure Internet of Medical Things," *Comput. Mater. Contin.*, vol. 73, pp. 965–979, 2022. [CrossRef]
68. J. Kim and M. Kim, "Deepblockshield: Blockchain agent-based secured clinical data management model from the deep web environment," *Mathematics*, vol. 9, 2021, Art. no. 1069. [CrossRef]
69. A. Almalawi, A. I. Khan, F. Alsolami, Y. B. Abushark, and A. S. Alfakeeh, "Managing Security of Healthcare Data for a Modern Healthcare System," *Sensors*, vol. 23, 2023, Art. no. 3612. [CrossRef]
70. Y. Zhai, R. Li, and Z. Yan, "Research on Application of Meticulous Nursing Scheduling Management Based on Data-Driven Intelligent Optimization Technology," *Comput. Intell. Neurosci.*, vol. 2022, 2022, Art. no. 3293806. [CrossRef]
71. N. Mehta, A. Pandit, and S. Shukla, "Transforming healthcare with big data analytics and artificial intelligence: A systematic mapping study," *J. Biomed. Inform.*, vol. 100, 2019, Art. no. 103311. [CrossRef]
72. Q. Cai, H. Wang, Z. Li, and X. Liu, "A Survey on Multimodal Data-Driven Smart Healthcare Systems: Approaches and Applications," *IEEE Access*, vol. 7, pp. 133583–133599, 2019. [CrossRef]
73. A. Almalawi, A. I. Khan, F. Alsolami, Y. B. Abushark, A. S. Alfakeeh, and W. D. Mekuriyaw, "Analysis of the Exploration of Security and Privacy for Healthcare Management Using Artificial Intelligence: Saudi Hospitals," *Comput. Intell. Neurosci.*, vol. 2022, 2022, Art. no. 4048197. [CrossRef]
74. H. W. Loh, C. P. Ooi, S. Seoni, P. D. Barua, F. Molinari, and U. R. Acharya, "Application of explainable artificial intelligence for healthcare: A systematic review of the last decade (2011–2022)," *Comput. Methods Programs Biomed.*, vol. 226, 2022, Art. no. 107161. [CrossRef] [PubMed]
75. J.-S. Wu, "Applying frontier approach to measure the financial efficiency of hospitals," *Digit. Health*, vol. 9, 2023, Art. no. 20552076231162987. [CrossRef]
76. T. Nazir, M. Mushhood Ur Rehman, M. R. Asghar, and J. S. Kalia, "Artificial intelligence assisted acute patient journey," *Front. Artif. Intell.*, vol. 5, 2022, Art. no. 962165. [CrossRef]
77. J. Yang, B. Luo, C. Zhao, and H. Zhang, "Artificial intelligence healthcare service resources adoption by medical institutions based on TOE framework," *Digit. Health*, vol. 8, 2022, Art. no. 20552076221126034. [CrossRef] [PubMed]
78. H. A. Mengash, L. A. Alharbi, S. S. Alotaibi, S. AlMuhaideb, N. Nemri, M. M. Alnfiai, R. Marzouk, A. S. Salama, and M. A. Duhayyim, "Deep Learning Enabled Intelligent Healthcare Management System in Smart Cities Environment," *Comput. Mater. Contin.*, vol. 74, pp. 4483–4500, 2023. [CrossRef]
79. O. Maki, M. Alshaikhli, M. Gunduz, K. K. Naji, and M. Abdulwahed, "Development of Digitalization Road Map for Healthcare Facility Management," *IEEE Access*, vol. 10, pp. 14450–14462, 2022. [CrossRef]
80. H. C. Wan and K. S. Chin, "Exploring internet of healthcare things for establishing an integrated care link system in the healthcare industry," *Int. J. Eng. Bus.*

ISSN: 2583-6129
DOI: 10.55041/ISJEM01962

Manag., vol. 13, 2021, Art. no. 18479790211019526. [CrossRef]

81. D. C. Nguyen, Q.-V. Pham, P. N. Pathirana, M. Ding, A. Seneviratne, Z. Lin, O. Dobre, and W.-J. Hwang, "Federated learning for smart healthcare: A survey," *ACM Comput. Surv. (Csur)*, vol. 55, pp. 1–37, 2022. [CrossRef]
82. M. Wazid, A. K. Das, N. Mohd, and Y. Park, "Healthcare 5.0 Security Framework: Applications, Issues and Future Research Directions," *IEEE Access*, vol. 10, pp. 129429–129442, 2022. [CrossRef]
83. J. Cavanagh, P. Pariona-Cabrera, and B. Halvorsen, "In what ways are HR analytics and artificial intelligence transforming the healthcare sector?" *Asia Pac. J. Hum. Resour.*, vol. 61, pp. 785–793, 2023. [CrossRef]
84. C.-H. Huang and F. A. Batarseh, "Measuring Outcomes in Healthcare Economics using Artificial Intelligence: With Application to Resource Allocation," in *Proc. Int. Florida Artif. Intell. Res. Soc. Conf.* (FLAIRS), Miami, FL, USA, May 2021, vol. 34. [CrossRef]
85. A. Katirai, B. A. Yamamoto, A. Kogetsu, and K. Kato, "Perspectives on artificial intelligence in healthcare from a Patient and Public Involvement Panel in Japan: An exploratory study," *Front. Digit. Health*, vol. 5, 2023, Art. no. 1229308. [CrossRef] [PubMed]
86. A. Luschi, C. Petraccone, G. Fico, L. Pecchia, and E. Iadanza, "Semantic Ontologies for Complex Healthcare Structures: A Scoping Review," *IEEE Access*, vol. 11, pp. 19228–19246, 2023. [CrossRef]
87. K. Jordon, P.-E. Dossou, and J. C. Junior, "Using lean manufacturing and machine learning for improving medicines procurement and dispatching in a hospital," *Procedia Manuf.*, vol. 38, pp. 1034–1041, 2019.
88. Wang, A., Xiu, X., Liu, S., Qian, Q., & Wu, S. (2022). Characteristics of artificial intelligence clinical trials in the field of healthcare: A cross-sectional study on clinicaltrials. gov. *International Journal of Environmental Research and Public Health*, *19*(20), 13691.
89. Askin, S., Burkhalter, D., Calado, G., & El Dakrouni, S. (2023). Artificial intelligence applied to clinical trials: opportunities and challenges. *Health and technology*, *13*(2), 203-213.
90. Alowais, S. A., Alghamdi, S. S., Alsuhebany, N., Alqahtani, T., Alshaya, A. I., Almohareb, S. N., ... & Albekairy, A. M. (2023). Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC medical education*, *23*(1), 689.
91. Yin, J., Ngiam, K. Y., & Teo, H. H. (2021). Role of artificial intelligence applications in real-life clinical practice: systematic review. *Journal of medical Internet research*, *23*(4), e25759.
92. Alowais, S. A., Alghamdi, S. S., Alsuhebany, N., Alqahtani, T., Alshaya, A., Almohareb, S. N., Aldairem, A., Alrashed, M., Saleh, K. B., Badreldin, H. A., Yami, A., Harbi, S. A., & Albekairy, A. M. (2023). Revolutionizing Healthcare: The Role Of Artificial Intelligence In Clinical Practice. *BMC Medical Education*, *23*(1). https://doi.org/10.1186/s12909-023-04698-z
93. Undru, T. R., Utkarsha, U. D. A. Y., Lakshmi, J. T., Kaliappan, A., Mallamgunta, S., Nikhat, S. S., ... & Archana, G. A. U. R. (2022). Integrating Artificial Intelligence for Clinical and Laboratory Diagnosis–a Review. *Maedica*, *17*(2), 420.