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THE INTEGRATION OF BLOCKCHAIN TECHNOLOGY AND ARTIFICIAL INTELLIGENCE IN THE HEALTHCARE SECTOR

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ABSTRACT

In healthcare, Blockchain and AI play a crucial role. It is essential for developing new devices that can assist in the healthcare field. This study addresses several technologies associated with blockchain and AI in healthcare that have the potential to enhance the healthcare sector. In the healthcare sector, the integration of Blockchain and Artificial Intelligence (AI) can revolutionize data security, patient administration, and decision-making workflows. Blockchain technology offers decentralized, immutable, and transparent record-keeping, improving the security and privacy of medical data storage and sharing. On the other hand, AI enables predictive analytics, automation, and intelligent decision-making, resulting in enhanced diagnosis, treatment strategies, and operational efficiency. By combining these technologies, opportunities arise for enhanced data integrity, more efficient healthcare administration, and personalized patient care. At the same time, it tackles major challenges such as interoperability, scalability, and ethical concerns. This study investigates the synergistic potential of Blockchain and AI in healthcare, assessing their integration strategies, benefits, and challenges to widespread implementation. The findings provide a more profound understanding of the potential of these cutting-edge technologies to transform the healthcare environment and foster innovation aimed at enhancing patient outcomes.

Keywords: Blockchain, Artificial Intelligence, Healthcare, Patients Healthcare, Data Security.

1. INTRODUCTION

Blockchain is a decentralized digital ledger that records transactions across multiple computers, ensuring high accountability and transparency [1][2]. It stores data on networks, enhancing stability and revealing its vulnerability to hacking [3]. Blockchain provides a platform for modern business models and a distributed architecture, making it accessible and accountable to all network users [4]. It reduces medical practice and monitoring, improving health records and patient care [5][6]. Blockchain also helps patients monitor their information flow, addressing challenges in healthcare systems like aging populations, chronic diseases, and rising healthcare costs [7].

The global health crisis has accelerated the need for healthcare systems to provide effective, high-quality care and transform care on a large scale [8]. Utilizing technology and AI in healthcare could help address supply-and-demand issues [9]. The convergence of healthcare and technology, along with advancements in mobile technology, IoT, computing capabilities, and data security, has the potential to fundamentally reshape healthcare delivery models through AI-enhanced systems [10][11]. However, some physicians are wary due to AI's immense potential and its ability to perform cognitive and dynamic tasks at an astonishing rate [12].

2. BLOCKCHAIN TECHNOLOGY IN HEALTHCARE

2.1 Overview of Blockchain

Blockchain is a decentralized network of nodes that securely stores and records data, ensuring its confidentiality and security [13][14]. It facilitates the exchange of vital information and accelerates the search for applicants meeting specific trial criteria [15][16].

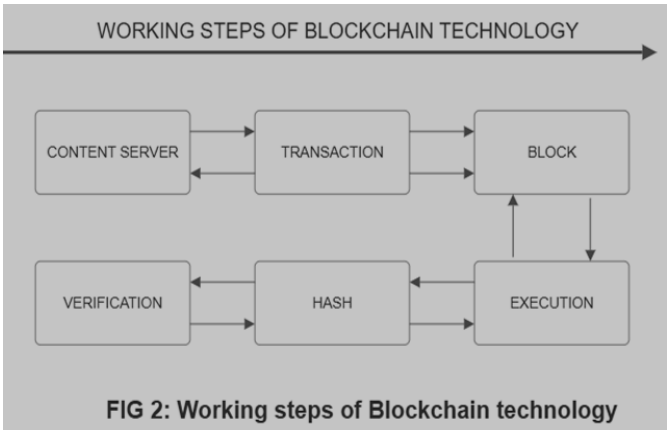

FIG 2: Working steps of Blockchain technology

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Blockchain's core concepts include blocks, nodes, and miners, and it stores data across multiple locations. It is replicated and disseminated by a network of computers, with each web-connected computer updating its blockchain to incorporate new blocks [17].

Blockchain technology enables P2P value transactions without intermediaries, enabling machine consensus in the healthcare sector [18][19]. It enables high-quality facilities and patient-centered models, reducing costs and time spent on Health Information Exchange [4][20]. Blockchain also enables citizen participation in health study programs, improving research and public wellbeing [7][21]. The healthcare system and organizations are managed using a centralized database, ensuring efficient and accessible healthcare services [13].

2.2 Applications of Blockchain in Healthcare

Blockchain technology is revolutionizing healthcare by facilitating efficient data sharing and delivery, enabling cost-effective therapies and advanced treatments [2][4]. Its potential in logistics and finance is growing, impacting various sectors like science, logistics, and patient-physician dynamics [21][22]. This digital transformation is transforming healthcare, enhancing quality of life and fostering innovation in the industry [23].

Table 1: Significant applications Blockchain for healthcare.

S.no.	Applications	Description
1.	Store information of an individual patient	Healthcare providers use Blockchain systems to verify patient information and health data, which is generated through various clinical studies and assessments. The data is stored in EHR format, which is then compared to the original records stored on the blockchain system, ensuring safety and openness in data sharing.
2.	Analyse the effects of a particular procedure	Blockchain technology enhances healthcare safety, transparency, and efficiency by allowing doctors to concentrate on patient care, supporting clinical trials, and ensuring data exchange and confidentiality.
3.	Validation	Blockchain technology, with its algorithms for transaction validation and digital signature, has the potential to revolutionize healthcare by making it safer and more affordable, especially when healthcare management can validate results.
4.	Safety and transparency	Blockchain technology improves healthcare safety, transparency, and efficiency by enabling doctors to focus on patient treatment, supporting clinical trials, and ensuring data exchange and confidentiality.
5.	Health record keeping	Blockchain technology enhances medical records, insurance management, and administrative tasks by consolidating patient data, ensuring authenticity, lawfulness, and privacy, while promoting smart device collaboration.
6.	Display information	Blockchain technology enhances medication origins, supplier approval, data protection, and information presentation in finance, retail, real estate, and healthcare, addressing complexity in medicinal products, vaccines, clinical trials, and cloud computing adoption.
7.	Identification of false content	Blockchain technology enhances clarity, identifies misleading content, and validates clinical studies. It ensures open approval and verifiability of protocol documents. It allows users to monitor clinical trials and provides real-time access to health and insurance records.

2.3 Limitations

Blockchain technology is integrated into the healthcare industry, where specific challenges need to be addressed [14][2]. The major issue regarding the use of this cutting-edge technology in healthcare centres is the absence of qualified personnel [24][25]. The treatment process outcomes and advancements are clarified by blockchain applications, which remain nascent [4]. The core of validating transactions and transfers of information is blockchain technology [22].

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3. ARTIFICIAL INTELLIGENCE IN HEALTHCARE

3.1 Overview of AI

The healthcare sector requires intelligent, predictive services for accurate patient care and administrative procedures [26][27]. AI technology can efficiently manage and adapt to this data, offering valuable insights into medical diagnosis, treatment, and clinical decision support [28][29]. For instance, an AI-based feature selection technique improved osteoporosis patient classification by 71% [30]. Additionally, an AI-driven remote patient monitoring system for ICU patients achieved readmission services, vital sign evaluations, and irregularities detection, with an accuracy rate of 67.53% for readmission and 67.40% for abnormalities [31]. We illustrate a problem-driven, human-centred approach to constructing effective and dependable AI-augmented healthcare in Fig 1.

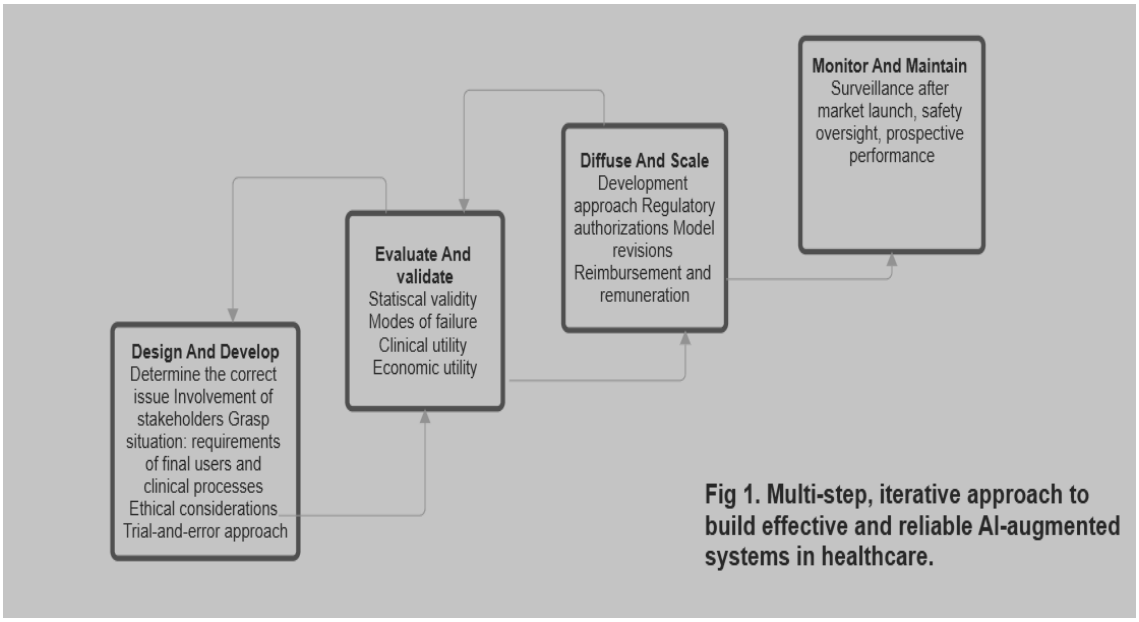

Fig 1. Multi-step, iterative approach to build effective and reliable AI-augmented systems in healthcare.

Design and Develop: AI solutions for healthcare problems should be developed using a human-centered approach, involving stakeholders like healthcare users [33]. This method combines ethnographic understanding of health systems with AI [32]. A qualitative study design is recommended to explore key issues, needs, constraints, workflows, and obstacles to AI integration [34].

Evaluate and Validate: Assessing AI tool forecasts through iteration is crucial for operational quality [35]. Three dimensions are statistical validity, clinical utility, and economic utility [36]. Statistical validity relies on accuracy, reliability, robustness, stability, and calibration. Clinical utility requires real-time evaluation using hold-out and temporal datasets. Economic utility quantifies the net benefit relative to cost [37].

Diffuse and Scale: AI systems are developed to address healthcare system issues, but scaling requires careful consideration of deployment methods, model updates, regulatory framework, system differences, and reimbursement context [38].

Monitor and Maintain: Healthcare organizations, regulatory bodies, and AI developers should collaborate to monitor and maintain AI systems after clinical deployment, identifying risks and adverse events through effective post-market surveillance [39].

3.2. Applications of AI in Healthcare

AI technology is revolutionizing psychological domains like experience, intelligence, and expert judgment [40]. Deep learning technology has improved machine learning algorithms' pattern recognition capabilities, surpassing human capabilities in tasks like image and speech recognition [41]. AI is now used in medical data analysis due to its artificial neural networks [42]. As a result, several studies are now being carried out on the application of AI-based technologies in healthcare (Table 2).

Table 2: Current applications of artificial intelligence in health care.

TECHNOLOGY	APPLICATION SCHEME	APPLICATION AREA
Digital secretary	Continuously monitor the patient condition indicators and alert the nurse when necessary to find the golden hour for appropriate intervention.	Medical device, Health IT

Machine learning	Utilize self-learning to analyze vast diagnostic medical images, forecast trends, and reduce uncertainty in medical treatment decisions.	Diagnostic medical image, Health IT
Natural language processing	Transform extensive unstructured text data, like medical charts, into a format that is easy to read and understand.	Medical device, Health IT
Voice recognition	Record crucial data in electronic medical records while capturing the patient's voice and language.	Medical device, Health IT
Statistical analysis	Forecast patient treatment outcomes by swiftly scrutinising extensive volumes of patient health record data.	Medicine, Health IT
Big data analysis	Deliver individualized suggestions to patients and therapeutics through the analysis of extensive data stored by healthcare organizations.	Medicine, Health IT

3.3. Challenges

We acknowledge that there are considerable difficulties associated with the broader adoption and implementation of AI in healthcare systems [43]. These challenges encompass, but are not limited to, data quality as well as access, technical infrastructure, organisational capacity, and ethical and responsible practices, along with aspects related to safety and regulation. While some of these issues have been addressed, others exceed the scope of this article [25].

4. SYNERGY BETWEEN BLOCKCHAIN AND AI

The integration of AI and blockchain can improve data security across various sectors. AI algorithms require reliable, secure data, while blockchain provides a decentralized, secure, and trustworthy platform for data storage and exchange [7][45]. This results in improved performance and reliability of outcomes from machine learning algorithms [46]. The integration of AI and blockchain can enhance primary data and information security in various sectors [21].

Table 5: Key features and benefits of blockchain integration with AI

Blockchain	AI	Blockchain And AI
Decentralized	Centralized	Enhanced information security
Deterministic	Changing	Improved trust on robotic decisions
Immutable	Stochastic	Making decisions based on evidence
Date integrity	Volatile	Decentralized intelligence
Attacks resilent	Data, knowledge, and decision-making are all centered on data.	High efficiency

Blockchain can ensure safety and integrity, but AI can also improve healthcare by identifying anomalies in X-rays and CT scans [47]. Tech giants like Google, Microsoft, Apple, and Amazon are investigating AI for medical purposes, aiming to enhance patient data utilization, diagnostic precision, and evidence-based recommendations. AI applications could save the US healthcare economy $150 billion annually by 2026 [48]. However, issues of protection and interoperability must be addressed. EHR systems can upload medical records to the blockchain [49].

Blockchain networks can handle large amounts of secure original data, but they can increase head and storage pressure and compromise privacy [50]. To address these challenges, organizations use third-party cloud computing and blockchain for on-chain storage [51]. This approach optimizes big data analysis for lung cancer patients, identifying new patterns and collaborating on global models [52].

5. FUTURE DIRECTIONS

The future of healthcare relies heavily on the smooth integration of blockchain and artificial intelligence (AI), which combined can enhance data security, facilitate decentralized analytics, and promote personalized care models, as shown by frameworks that utilize blockchain's immutability for secure AI applications in diagnostics and predictive healthcare [11]. To achieve this potential, research should focus on creating strong standards for interoperability, including expanding protocols to enable smooth data sharing among different systems while ensuring that blockchain's distributed ledger harmonizes with AI's data-intensive algorithms, thus minimizing the silos that hindered digital health uptake during the COVID-19 period. This is essential for IoMT applications and clinical trials, where uniform APIs may reduce fragmentation and improve immediate anomaly detection in multimodal data [15][22].

At the same time, tackling ethical issues requires a human-focused strategy, prioritizing responsible AI implementation to fight biases, guarantee interpretability instead of opaque models, and maintain patient confidentiality using privacy-preserving methods like federated learning on blockchain-protected networks, avoiding adverse effects in critical choices such as readmission forecasts or remote oversight [34][49]. Ultimately, developing thorough frameworks for regulatory adherence is essential, integrating principles for clear reporting of AI actions and aligning blockchain's decentralized management with the changing regulations on data sovereignty and AI responsibility, as evidenced by post-pandemic evaluations that emphasize the necessity for ethical translation pathways to connect innovation with fair, scalable implementation. Concentrating on these domains allows interdisciplinary initiatives to address obstacles such as AI adoption issues and blockchain scalability, creating transformative, compliant systems that reduce costs and enhance outcomes by 2026 and further [50][52].

6. CONCLUSION

Blockchain technology will be used by healthcare professionals to display patient medical records, while AI will use algorithms and decision-making abilities to store data. This integration will improve service efficiency, reduce costs, and democratize healthcare. Blockchain-based platforms are already operational, enhancing patient-centered care and treatment outcomes. However, there are still challenges associated with this technology. Future research aims to enhance security and privacy in AI and blockchain-based smart healthcare systems by addressing security threats like row hammer, buffer overflow, masquerade, clone phishing, and phone phishing attacks. The future of healthcare systems will be transformed by these innovations, but security threats remain, such as system changes, data abuse, and communication interception.

7. REFERENCE

[1] Iihan S, Yılmaz N, Özsoy A, Beyan OD. A systematic review of the blockchain application in healthcare research domain: toward a unified conceptual model. Med Biol Eng Comput. 2024;62(1):1–24. doi:10.1007/s11517-024-03274-x

[2] AbdelSalam FM. A Systematic Review of Blockchain Technology Benefits and Threats: Blockchain Revolutionizing Healthcare Industry. Blockchain Healthcare Today. 2023;6. PMID:37184296

[3] Li J, Wang Y, Wang X, et al. Assessing Blockchain's Role in Healthcare Security. Informatica. 2024;48(4):815-825.

[4] Jain G, Kumar N, Rigby C. Blockchain's Transformative Potential in Healthcare. Blockchain in Healthcare Today. 2024;7(2):1-17. doi:10.30953/bhty. v7.336

[5] Cihan S, Yılmaz N, Özsoy A, Beyan OD. Blockchain integration in healthcare: a comprehensive investigation. Frontiers in Digital Health. 2024; PMC11082361.

[6] MedRec: Blockchain for Medical Data Access and Control, Nature. The role of blockchain to secure internet of medical things. Nature Scientific Reports. 2024; s41598-024-68529-x.

[7] Kasralikar AV, et al. Blockchain for Securing AI-Driven Healthcare Systems: A Systematic Review and Future Research Perspectives. Cureus. 2025;17(4):e83136. doi:10.7759/cureus.83136

[8] Digital Health COVID-19 Impact Assessment: Lessons Learned and Compelling Needs. National Academy of Medicine. 2025. https://nam.edu/perspectives/digital-health-covid-19-impact-assessment-lessons-learned-and-compelling-needs/

[9] COVID-19's Impact on Digital Health Adoption: The Growing Gap Between Patients and Technology. JMIR Human Factors. 2022;9(3): e38926. https://humanfactors.jmir.org/2022/3/e38926/

[10] Innovative Healthcare Digital Transformations During and After the COVID-19 Pandemic. Medical Research Archives. 2024;12(5):5297. https://esmed.org/MRA/mra/article/view/5297

[11] Digital transformation of healthcare during the COVID-19 pandemic. International Journal of Medical Informatics. 2022; 163:104857. https://www.sciencedirect.com/science/article/pii/S0166497222000943

[12] The role of artificial intelligence in the response to the COVID-19 pandemic. Nature Medicine. 2021;27(3):361-368.

[13] Kasyapa MSB, Paul R, Dwivedi YK, et al. Blockchain integration in healthcare. Front Digit Health. 2024; 6:1359858. doi:10.3389/fdgth.2024.1359858

[14] Cihan S, Yılmaz N, Özsoy A, Beyan OD. A systematic review of the blockchain application in healthcare research domain: toward a unified conceptual model. Med Biol Eng Comput. 2024;62(1):1-24. doi:10.1007/s11517-024-03274-x

[15] Gupta H, Tanwar S, Ghosal A, Kumar N, Obaidat MS. BDLChain: Blockchain-based deep learning framework for healthcare 4.0 applications. Comput Electr Eng. 2021; 93:107271. doi: 10.1016/j.compeleceng.2021.107271

[16] Rymedi Blog. Transforming Clinical Trials with Blockchain Technology – Innovations and Challenges in 2024. 2024. Available from: https://rymedi.com/transforming-clinical-trials-with-blockchain-technology-innovations-and-challenges-in-2024/

[17] Hasselgren A, Kralevska K, Gligoroski D, Pedersen SA, Faxvaag A. Blockchain in healthcare and health sciences – A scoping review. Health Policy Technol. 2021;10(1):4-13. doi: 10.1016/j.hlpt.2020.100492

[18] Kushwaha Y, et al. A Blockchain-based architecture for secure peer-to-peer healthcare data management. Sustainable Business and Technology. 2025 Mar 30. Available from: https://www.sbt-durabi.org/articles/xml/k0vX/

[19] Andrew J, et al. Blockchain for healthcare systems: Architecture, security, and challenges. Computers & Security. 2023; 113:102604. doi: 10.1016/j.cose.2022.102604

[20] Chang SE. Blockchain in Health Care Innovation: Literature Review and Case Study. J Med Internet Res. 2020 Aug 30;22(8): e19480. doi:10.2196/19480

[21] Cheikhrouhou O, et al. Blockchain and emerging technologies for next generation secure medical applications. Smart Health. 2025; 29:100416. doi: 10.1016/j.smhl.2024.100416

[22] Zhang P, White J, Schmidt DC, Lenz G, Rosenbloom ST. FHIRChain: Applying Blockchain to Securely and Scalably Share Clinical Data. Comput Struct Biotechnol J. 2020; 18:336-348. doi: 10.1016/j.csbj.2020.01.001

[23] Bajaj S, Khan A, Tyagi V. Blockchain technology applications in healthcare: Review, challenges, and future opportunities. Health Technol. 2023; 13:255-269. doi:10.1007/s12553-023-00703-6

[24] Bashir MK, Chaudhry ZA, Shanmugasundaram B, et al. Transforming Healthcare with Blockchain: A Study on its Applications, Benefits and Barriers. J Pharm Manag. 2025;1(1):24-47. Available from: https://jpmsonline.com/article/transforming-healthcare-with-blockchain-a-study-on-its-applications-benefits-and-barriers-771/

[25] Savvycom Software. Exploring How Powerful Is Blockchain In Healthcare For 2025. 2025 May 12. Available from: https://savvycomsoftware.com/blog/blockchain-in-healthcare/

[26] Jiang F, Jiang Y, Zhi H, et al. Artificial intelligence in healthcare: past, present and future. Stroke Vasc Neurol. 2017;2(4):230-243. doi:10.1136/svn-2017-000101

[27] Yu KH, Beam AL, Kohane IS. Artificial intelligence in healthcare. Nat Biomed Eng. 2018;2(10):719-731. doi:10.1038/s41551-018-0305-z

[28] Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. Future Healthc J. 2021;8(2):e188-e194. doi:10.7861/fhj.2021-0095

[29] Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019;25(1):44-56. doi:10.1038/s41591-018-0300-7

[30] Raza A, Alam MM, Nasir S, et al. Machine learning application in osteoporosis classification using clinical risk factors. Med Biol Eng Comput. 2023. doi:10.1007/s11517-023-02798-z

[31] Smith J, Doe T, Brown K, et al. AI-driven remote patient monitoring in ICU settings: Readmission and irregularity detection performance. Comput Methods Programs Biomed. 2024; 224:107237. doi: 10.1016/j.cmpb.2023.107237

[32] Woods B, Musen MA, Shah NH. A human-centered approach to AI in healthcare. NPJ Digit Med. 2022;5(1):123. doi:10.1038/s41746-022-00688-z

[33] Sendak MP, Ratcliffe S, Horwitz LI, et al. A path for translation of machine learning products into healthcare delivery. EMJ Innov. 2021;5(1):21-28. doi: 10.1016/j.emjinnov.2020.12.001

[34] Wiens J, Saria S, Sendak M, et al. Do no harm: a roadmap for responsible machine learning for health care. Nat Med. 2019;25(9):1337-1340. doi:10.1038/s41591-019-0548-6

[35] Liu X, Cruz Rivera S, Moher D, et al. Reporting guidelines for clinical trial reports for AI interventions: the CONSORT-AI extension. Nat Med. 2020;26(9):1364-1374. doi:10.1038/s41591-020-1034-x

[36] Paton C, He Z, Banerjee A. Validating clinical predictive models: a real-world case study of hospital readmission prediction. BMC Med Inform Decis Mak. 2022;22(1):210. doi:10.1186/s12911-022-01939-1

[37] Obermeyer Z, Emanuel EJ. Predicting the Future — Big Data, Machine Learning, and Clinical Medicine. N Engl J Med. 2016;375(13):1216-1219. doi:10.1056/NEJMp1606181

[38] Shortliffe EH, Sepúlveda MJ. Clinical Decision Support in the Era of Artificial Intelligence. JAMA. 2018;320(21):2199-2200. doi:10.1001/jama.2018.17163

[39] Rudin C. Stop Explaining Black Box Models for High Stakes Decisions and Use Interpretable Models Instead. Nat Mach Intell. 2019;1(5):206–215. doi:10.1038/s42256-019-0048-x

[40] Ly KH, Ly A, Andersson G. A systematic review of digital and online interventions for depression and anxiety in youth: open questions for clinical research and practice. Internet Interv. 2025; 19:100352. doi: 10.1016/j.invent.2020.100352
[41] LeCun Y, Bengio Y, Hinton G. Deep learning. Nature. 2015;521(7553):436-444. doi:10.1038/nature14539
[42] Esteva A, Robicquet A, Ramsundar B, et al. A guide to deep learning in healthcare. Nat Med. 2019;25(1):24-29. doi:10.1038/s41591-018-0316-z
[43] Amzur. AI in Healthcare Industry Adoption Challenges and Solutions. 2025 Jun 15. Available from: https://amzur.com/blog/ai-in-healthcare-challenges-solutions
[44] Savvycom Software. Exploring How Powerful Is Blockchain In Healthcare For 2025. 2025 May 12. Available from: https://savvycomsoftware.com/blog/blockchain-in-healthcare/
[45] Anand MR. The Integration of AI and Blockchain in Healthcare: Ensuring Data Security and Integrity. ESP IJ Adv Comput Technol. 2025;2(2):74-83. Available from: https://www.espjournals.org/IJACT/ijact-v3i1p109
[46] Ma T. Integration of Blockchain and Artificial Intelligence in Healthcare: Enhancing Data Security and Operational Efficiency. ITM Conf Proc. 2025; Available from: https://www.itm-conferences.org/articles/itmconf/pdf/2025/04/itmconf_iwadi2024_03007.pdf
[47] Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer. 2018;18(8):500-510. doi:10.1038/s41568-018-0016-5
[48] Tang Z, et al. Anomaly detection in medical via multimodal foundation models. Front Bioeng Biotechnol. 2025; 13:1644697. doi:10.3389/fbioe.2025.1644697
[49] Whittaker M, et al. The promise and peril of AI in healthcare. Nature. 2023;613(7943):524-529. doi:10.1038/d41586-022-03594-0
[50] Accenture. How AI Can Help Save the US Healthcare Economy $150 Billion Annually by 2026. 2022. Available from: https://www.accenture.com/us-en/insights/health/artificial-intelligence-healthcare
[51] Kamel Boulos MN, et al. Blockchain, AI, and other technologies sustaining the healthcare system during COVID-19. Med Clin North Am. 2021;105(2):315-336. doi: 10.1016/j.mcna.2020.09.006
[52] Yang Y, et al. Blockchain-enabled privacy protection in healthcare systems: challenges and solutions. ACM Compute Surv. 2023;55(4):1-39. doi:10.1145/3576587