



## Role of AI and blockchain in patient health care

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### Abstract

Patient data is a crucial asset in the healthcare sector, encompassing medical history, diagnoses, treatments, outcomes, and personal demographic details. This data is essential for improving healthcare services, conducting clinical research, developing new therapies, and enhancing public health. However, challenges such as data fragmentation, breaches, misuse, quality issues, and privacy concerns threaten the security, trustworthiness, and accessibility of patient data, impacting patient well-being. Blockchain and artificial intelligence (AI) are promising technologies poised to revolutionize patient data management. Blockchain ensures secure, transparent data transfer and storage, while AI enables machines to perform complex tasks requiring human intelligence. Together, they offer a decentralized solution to address current data challenges and risks. Blockchain provides a secure foundation for managing patient data, making it tamper-proof and accessible only to authorized parties, thus supporting the development of robust AI algorithms. By ensuring high-quality, standardized, and interoperable data, Blockchain enhances AI model accuracy and reliability. Additionally, blockchain's secure data sharing improves data quality for AI applications and addresses privacy, security, and accountability concerns, ensuring AI models are transparent, explainable, and fair.

**Keywords:** Blockchain, AI, integrity, decision making, patient data

### Introduction

Patient data is one of the most valuable and sensitive assets in the healthcare sector. It includes information about medical history, diagnoses, treatments, outcomes, and personal and demographic details of patients. This data can be utilized to enhance the quality and efficiency of healthcare services, conduct clinical research, develop new drugs and therapies, and improve public health and safety. However, patient data faces numerous challenges and risks, such as fragmentation, breaches, misuse, quality issues, and privacy concerns. These issues can undermine the trustworthiness, security, and accessibility of patient data, ultimately affecting patient health and well-being.

Blockchain and artificial intelligence (AI) are two emerging technologies with the potential to revolutionize patient data management in healthcare. Blockchain is a distributed ledger technology that enables secure and transparent data transfer and storage without intermediaries or central authorities. AI is a field of computer science that allows machines to perform tasks requiring human intelligence, such as learning, reasoning, decision-making, and problem-solving. Together, Blockchain and AI offer a digital and decentralized solution for managing patient data, addressing current challenges and risks while unlocking new opportunities and benefits for healthcare.

Blockchain is considered a foundational step for integrating AI into healthcare because it provides a secure and transparent framework for managing and sharing patient data. By leveraging blockchain technology, healthcare organizations can ensure that patient data is tamper-proof, immutable, and accessible only to authorized parties. This creates a robust data ecosystem that supports the development and deployment of AI algorithms.

AI algorithms require large volumes of high-quality data to train and enhance their performance. Using blockchain to store patient data ensures that the data is high quality, standardized, and interoperable, which is crucial for

developing accurate and reliable AI models. Additionally, blockchain facilitates the secure and transparent sharing of patient data among various healthcare providers and stakeholders, further improving the data's quality and usefulness for AI applications.

Moreover, blockchain technology can help address key challenges and risks associated with AI in healthcare, such as data privacy, security, and accountability. By using blockchain to manage patient data, healthcare organizations can protect data from unauthorized access and misuse, ensuring that AI models are transparent, explainable, and fair.

### Importance of Blockchain and AI in Patient Data Management

#### Keys to Patient Data Management

##### 1. Data Integrity and Trust

**Blockchain's Role:** Blockchain provides a secure, immutable ledger for storing data. Each transaction is encrypted and linked to the previous one, ensuring data integrity and trustworthiness.

**AI's Role:** AI relies on large datasets for training models. When this data is stored on a Blockchain, AI can trust the data's authenticity and integrity, leading to more reliable outcomes.

##### 2. Data Privacy and Security

**Blockchain's Role:** Blockchain enables secure and transparent data sharing by allowing access only to authorized parties. It can also anonymize data through techniques like encryption and hashing.

**AI's Role:** AI can implement advanced privacy-preserving techniques such as differential privacy and federated learning, which protect sensitive information during data processing and analysis.

**Combined Benefit:** AI models can securely access and analyze data on the blockchain without compromising privacy, enhancing security in data-driven applications.

### 3. Decentralized AI Models

**Blockchain's Role:** Blockchain supports the creation of decentralized applications (dApps), where control is distributed across the network without a central authority.

**AI's Role:** AI can be used to enhance these dApps by providing intelligent decision-making capabilities, enabling autonomous operations and improving efficiency.

**Combined Benefit:** Decentralized AI models can be deployed on blockchain platforms, ensuring transparency, security, and resistance to tampering.

### 4. Improved Data Quality

**Blockchain's Role:** Blockchain ensures that data is consistent, accurate, and reliable by maintaining a single source of truth across all nodes in the network.

**AI's Role:** AI algorithms require high-quality data for effective training and performance. By accessing blockchain-stored data, AI models can leverage clean and verified datasets.

**Combined Benefit:** The synergy between AI and blockchain leads to better data quality, resulting in more accurate and trustworthy AI predictions and insights.

### 5. Enhanced Transparency and Accountability

**Blockchain's Role:** Blockchain records all transactions in a transparent and traceable manner, providing an audit trail for data usage and access.

**AI's Role:** AI can analyze this audit trail to monitor and enforce compliance, detect anomalies, and ensure accountability in automated processes.

**Combined Benefit:** This combination enhances the transparency and accountability of AI systems, making them more trustworthy and ethical.

### 6. Efficient Data Sharing and Collaboration

**Blockchain's Role:** Blockchain facilitates secure and efficient data sharing among different parties by establishing trust and eliminating the need for intermediaries.

**AI's Role:** AI can analyze and derive insights from shared data, improving collaborative efforts in areas like research, healthcare, and finance.

By integrating AI with blockchain, organizations can unlock new levels of security, transparency, and efficiency in data management and processing. This synergy has the potential to revolutionize industries such as healthcare, finance, supply chain management, and beyond.

## Challenges

Integrating blockchain with AI presents several challenges, despite the significant potential benefits. These challenges include:

### 1. Scalability

**Blockchain:** Blockchain networks, especially those with proof-of-work consensus mechanisms like Bitcoin, can be slow and have limited throughput.  
**AI:** AI applications often require processing large volumes of data quickly, which can be hampered by blockchain's scalability limitations.

### 2. Data Privacy and Security

**Blockchain:** While blockchain ensures data integrity and transparency, it does not inherently provide privacy. Public blockchains expose transaction data to all participants.

**AI:** AI applications require access to vast amounts of data, raising concerns about how sensitive information can be securely processed and stored on a blockchain without compromising privacy.

### 3. Data Quality and Interoperability

**Blockchain:** Data stored on a blockchain must be accurate and high-quality, as errors are immutable and can lead to significant issues.

**AI:** AI models require standardized, high-quality data for effective training and operation. Ensuring interoperability between different data formats and systems on the blockchain can be challenging.

### 4. Complexity and Integration

**Blockchain:** Implementing blockchain solutions requires significant technical expertise and can be complex to integrate with existing systems.

**AI:** Integrating AI with blockchain adds another layer of complexity, requiring expertise in both technologies to create seamless, functional solutions.

### 5. Computational Resources

**Blockchain:** Consensus mechanisms like proof-of-work require substantial computational power, which can be resource-intensive and costly.

**AI:** AI training and inference processes also demand significant computational resources. Combining these with blockchain's requirements can strain infrastructure and increase costs.

### 6. Latency and Real-Time Processing

**Blockchain:** Transactions on a blockchain can take time to be confirmed, which is not ideal for applications requiring real-time data processing.

**AI:** Many AI applications, especially those in critical sectors like healthcare or finance, need real-time data access and processing, which blockchain's inherent latency can hinder.

**7. Regulatory and Legal Challenges**

**Blockchain:** The regulatory landscape for blockchain technology is still evolving, with varying legal requirements across jurisdictions.

**AI:** AI faces its own regulatory challenges, particularly concerning data privacy and ethical considerations. Integrating the two technologies must navigate these complex legal landscapes.

**8. Energy Consumption**

**Blockchain:** Blockchain networks, especially those using proof-of-work, are known for their high energy consumption.

**AI:** AI computations also consume significant energy, and the combined energy demand can be substantial, raising sustainability concerns.

**9. Consensus Mechanisms**

**Blockchain:** Different blockchain networks use various consensus mechanisms, each with its own advantages

and drawbacks. Choosing the right mechanism for integrating AI can be challenging.

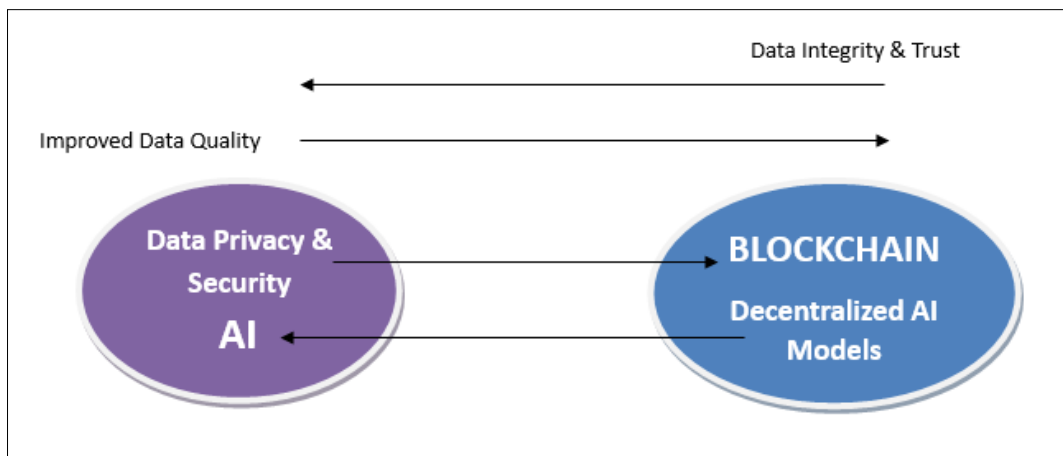
**AI:** Ensuring that AI processes align with the chosen consensus mechanism and do not introduce vulnerabilities or inefficiencies is crucial.

**10. Skill Gap and Expertise**

**Blockchain:** There is a limited pool of experts proficient in blockchain technology.

**AI:** AI expertise is also specialized, and finding professionals with knowledge in both fields is challenging, slowing down the integration process.

Addressing these challenges requires a concerted effort from researchers, developers, and industry stakeholders to create solutions that leverage the strengths of both technologies while mitigating their respective limitations.



**Fig 1:** Integration between AI and Block chain

**Conclusion**

In conclusion, the integration of blockchain and artificial intelligence (AI) presents a transformative opportunity for patient data management in the healthcare sector. By leveraging blockchain's secure, immutable ledger and AI's advanced analytical capabilities, healthcare organizations can significantly enhance data integrity, privacy, and quality. Blockchain ensures that patient data remains tamper-proof and accessible only to authorized parties, fostering a secure environment for data storage and transfer. Simultaneously, AI models can utilize this high-quality, standardized data to improve decision-making processes and outcomes. The synergy between blockchain and AI addresses numerous challenges currently plaguing patient data management, such as data fragmentation, breaches, and quality issues. Blockchain's decentralized nature and transparency improve data sharing and accountability, while AI's ability to process large datasets enhances the accuracy and reliability of healthcare solutions. However, integrating these technologies is not without its hurdles. Challenges such as scalability, data privacy, and the need for substantial computational resources must be carefully managed. To fully realize the potential of blockchain and AI in healthcare, collaborative efforts from researchers, developers, and industry stakeholders are essential.

Overcoming technical complexities and regulatory hurdles will pave the way for robust, efficient, and ethical patient data management systems. Ultimately, the combined strengths of blockchain and AI can revolutionize healthcare, leading to better patient outcomes, more efficient research, and a higher standard of care.

**References**

1. Kuo TT, Kim HE, Ohno Machado L. Blockchain distributed ledger technologies for biomedical and health care applications. *J Am Med Inform Assoc*,2017;24(6):1211-1220. doi:10.1093/jamia/ocx068.
2. Jiang S, Cao J, Wu H, Yang Y, Ma M. Blochie: A blockchain-based platform for healthcare information exchange,2018 *IEEE Int Conf Smart Comput SMARTCOMP*,2018, 49-56. doi:10.1109/SMARTCOMP.2018.00080.
3. Engelhardt MA. Hitching healthcare to the chain: An introduction to blockchain technology in the healthcare sector. *Technol Innov Manag Rev*,2017;7(10):22-34. doi:10.22215/timreview/1111.
4. Wang H, Song Y. Secure cloud-based EHR system using attribute-based cryptosystem and blockchain.

- Journal of Medical Systems,2018:42(8):152. doi:10.1007/s10916-018-1005-0.
5. Nguyen DC, Ding M, Pathirana PN, Seneviratne A. Blockchain and AI-based solutions to combat coronavirus (COVID-19)-like epidemics: A survey. *IEEE Access*,2020:9:95730-95753. doi:10.1109/ACCESS.2020.2992341.
  6. Azaria A, Ekblaw A, Vieira T, Lippman A. MedRec: Using blockchain for medical data access and permission management,2016 2nd Int Conf Open Big Data OBD, 2016, 25-30. doi:10.1109/OBD.2016.11.
  7. Radenkovic M, Dehlinger J. Integration of blockchain and AI for secure data exchange in healthcare: A state-of-the-art review. *Proc 17th Int Conf Priv Secur Trust PST*, 2018, 1-9. doi:10.1109/PST.2019.8806838.
  8. Sharma A, Sharma P. Blockchain and its integration with AI: A review. *International Journal Computer Applications*,2019:182(39):1-7. doi:10.5120/ijca2019918564.
  9. Sadiku MNO, Eze T, Musa SM. Blockchain technology in healthcare. *Int J Adv Sci Res Eng*,2018:4(1):70-75. doi:10.31695/IJASRE.2018.32829.
  10. Roehrs A, da Costa CA, da Rosa Righi R, de Oliveira KSF. Personal health records: A systematic literature review. *Journal Medical Internet Research*, 2017, 19(1). doi:10.2196/jmir.5876.
  11. Yue X, Wang H, Jin D, Li M, Jiang W. Healthcare data gateways: Found healthcare intelligence on blockchain with novel privacy risk control. *Journal Medical Systems*,2016:40(10):218. doi:10.1007/s10916-016-0574-6.
  12. Dubovitskaya A, Xu Z, Ryu S, Schumacher M, Wang F. Secure and trustable electronic medical records sharing using blockchain. *AMIA Annu Symp Proc*, 2018, 650-659. PMID: 30815109.
  13. Patil K, Seshadri R. Data management using blockchain and AI in healthcare. *International Journal of Recent Technology and Engineering (IJRTE)*,2019:8(1):3128-3131. doi:10.35940/ijrte.A1308.078119.
  14. Shuaib M, Saleem J, Ullah F, Saleem H. The role of blockchain and artificial intelligence in healthcare and medicine. *Journal of Advances in Computer Research*,2020:11(1):97-109. doi:10.22044/JACR.2020.8194.1480.
  15. Jain R, Kumar R. Securing healthcare data using blockchain and AI. *Journal of Ambient Intelligence and Humanized Computing*,2021:12(8):9375-9384. doi:10.1007/s12652-020-02655-5.
  16. Hussien HM, Yasin SM, Udzir NI, Zaidan AA, Zaidan BB. A systematic review for enabling healthcare with collaborative blockchain networks. *Journal of Biomedical Informatics*,2019:100:103304. doi:10.1016/j.jbi.2019.103304.
  17. Chen Y, Ding S, Xu Z, Zheng H, Yang S. Blockchain-based medical records secure storage and medical service framework. *Journal of Medical Systems*,2020:43(1):5. doi:10.1007/s10916-018-1121-x.
  18. McGhin T, Choo K-KR, Liu CZ, He D. Blockchain in healthcare applications: Research challenges and opportunities. *Journal of Network and Computer Applications*,2019:135:62-75. doi:10.1016/j.jnca.2019.02.027.
  19. Dwivedi AD, Srivastava G, Dhar S, Singh R. A decentralized privacy-preserving healthcare blockchain for IoT. *Sensors*,2019:19(2):326. doi:10.3390/s19020326.
  20. Vora J, Nayyar A, Tanwar S, Tyagi S. A review on healthcare and the Internet of Things: Opportunities and challenges. *International Journal of Computer Applications*,2018:182(8):27-35. doi:10.5120/ijca2018917896.