Blockchain-based technology in the healthcare industry and trend analysis

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Abstract. To sort out the current research status and trend analysis of blockchain technology in medical development. Logistic regression techniques are applied in this article to sort out the research and application trends of blockchain technology in the medical industry by using data cleaning and feature engineering, and by collecting domestic and international literature for analysis. At present, the application of blockchain technology in the medical industry is still in the early experimental stage. The medical industry should seize the development opportunities and strengthen technical research and R&D innovation so that blockchain technology can really play a role in reshaping the future information technology of the medical industry.

Keywords: Blockchain, Medical Industry, Research Progress, WEB3.0, Trend Analysis

1. Introduction

In the past stage, we have built relevant medical information databases in order to solve the regulatory problems in the medical process, and the digitisation of medical prescriptions can cure the database of third-party regulatory authorities to find the information on record. Combined with some of the current advanced open source blockchain technologies[1], a blockchain application solution suitable for the current medical scenario has been developed, which can protect patients' medical data while sharing private health data in a more secure and faster way across the network. This study analyses the principles and characteristics of blockchain technology, compares the current status of blockchain technology applications and research in the healthcare industry[2], and explores the prospects for innovation and development of this technology in the industry.

2. Definition, technical principles and characteristics of blockchain

2.1. Definition of a blockchain

A blockchain, is a chain of one block after another. In each block a certain amount of information is stored and they are connected in a chain in the order of the time in which they were created. This chain is stored in all servers and the whole blockchain is secure as long as one server in the whole system is working. These servers are called nodes in the blockchain system and they provide storage space and arithmetic support for the entire blockchain system. This technology helps to achieve full lifecycle management of the identity of network entities, providing a tamper-evident and traceable security foundation for the registration and use of identity information.

2.2. Technical features of blockchain technology in the healthcare industry

2.2.1. Traceability
Blockchain is tamper-evident, traceable and overall efficient in storing medical data to protect the interests of both doctors and patients , it can guarantee the transparency of the medical process of medication use through the traceability of medical information and simplify the regulatory process. The core innovation behind the programming blockchain is that it can support the decentralisation of technology by providing a permissionless, trustless and verifiable ecosystem[2].

2.2.2. Security
The security of medical data is ensured by the encryption method of the blockchain. RSA encryption algorithm is a non-symmetric encryption algorithm. RSA is widely used in public key encryption and in electronic commerce. The more difficult it is to factor a very large integer, the more reliable RSA is. To date, there is no reliable way to attack the RSA algorithm in the world.

2.2.3. Graded adjustability
Smart contracts are set up to have effective guaranteed access to graded permissions. A smart contract is a computer protocol designed to disseminate, validate or enforce contracts in an informative manner. Smart contracts allow trusted transactions to be made without a third party, which are traceable and irreversible.

3. The evolution of blockchain technology
In November 2008, against the backdrop of the global financial crisis, Satoshi Nakamoto published his seminal paper "Bitcoin: A Peer-to-Peer Electronic Cash System", proposing to change the current centralised financial and monetary system and design a completely decentralised peer-to-peer electronic cash system with a blockchain as the underlying architecture. Since then, the development of blockchain technology has gone through roughly 3 stages. In the early stages, an open, transparent, decentralised and tamper-proof ledger system was constructed. The second stage is typified by the Ether system. The third stage is the Internet of Value stage, where blockchain technology and 5G networks and other technologies gradually reconfigure the future development ecology of the Internet[3].

4. Blockchain applications in the healthcare industry at home and abroad

4.1. Case study of blockchain in foreign medical industry
In September 2017, the MediLedger blockchain platform is a joint project of Teck and Pfizer Pharmaceuticals to launch the MediLedger blockchain drug tracking project and start applying it to relevant fields as a pilot, expecting to achieve the drug information recorded on the blockchain from pharmaceutical manufacturers to wholesalers to hospitals on the supply of drugs It is expected to achieve the authenticity of drug information recorded on the blockchain from pharmaceutical manufacturers to wholesalers to hospitals to ensure the safety of patients' medication[4].

4.2. Case study of blockchain in the domestic healthcare industry
In August 2017, AliHealth announced a pilot blockchain project in cooperation with Changzhou Medical Association, aiming to put emerging blockchain technology should achieve secure and controlled data interconnection between local healthcare institutions and solve the information security problem of healthcare institutions in a safe and effective way. Through protocols and certificates, the access and operation rights of up and down hospitals and government management are agreed[4].

5. WEB technology building in the healthcare industry

5.1. In the early stage of development of the medical industry

WEB 1.0: Static page is the first stage of the development of the World Wide Web, the media form is dominated by portals, certain specific groups or enterprises will be one-way information released to the network, solving the need for users to obtain information and read it, in this process, users can only passively receive undifferentiated information released by the website, but cannot upload their own feedback[5]. Medical digitisation 1.0: Digitisation of medical equipment. The digitisation of medical equipment has taken shape, and various digital medical devices have already played a huge role in the diagnosis and treatment process, such as B ultrasound, CT, da Vinci surgical robots, etc.

5.2. In the middle of the development of the medical industry

WEB 2.0: readable and writable, interactive Internet. At this point, the user is both the recipient and the publisher of information on the Internet, and people can communicate in both directions and in multiple directions through the Internet. From web portals to personal portals, from online information to online users, a human-centred approach to communication and interaction has been formed, which has also contributed to the rise of social networks. The digitisation of the medical system is mainly reflected in the digitisation of the industry, i.e. the comprehensive completion of the information technology infrastructure and information technology application systems that support the operation of the entire medical system, such as in-hospital local area networks, wireless networks and hospital information systems, etc. The operation of any organisation and the implementation of business processes cannot be achieved without the support of information technology infrastructure and information technology application systems[6].

5.3. In the medical industry

WEB 3.0 is a new form of Internet developed in combination with blockchain technology, the core of which lies in decentralization - "giving users the ability to truly own the Internet". The data and information in the Internet is identified from the moment it is published, and there is no need to worry about theft or deletion of data if the database is lost. Medical digitalisation 3.0: decentralised medical data storage Using blockchain technology, the Tridonic Medical Data Public Chain uses technologies such as Atomic swaps and data warehouse construction to store collected data in a traceable manner, fuse (Relays) and (Liquidity network) to build a powerful medical data system platform that supports cross-layer and cross-chain data access[6]. Data access, internal and external information sharing, and breaking down information barriers. Promote medical informatization and statistical informatization, improve the efficiency of the utilization of medical and health information systems, and enhance the digitization of the medical and health industry.

6. Analysis of current blockchain in research

Table 1. Analysis of high frequency terms in blockchain technology + healthcare research

Keyword	Frequency	Centrality
Blockchain	38	0.75
Blockchain Technology	15	0.25
Artificial Intelligence	7	0.19
Big Data	6	0.18
Medical	5	0.16
Aging population	2	0.05
Health Awareness	2	0.05
Medical Equipment	2	0.03

Table 1. (continued).

"Internet+"	2	0.12
Telemedicine	2	0.11
Decentralization	2	0.15
Medical Big Data	2	0.05
Ai Medical Applications	1	0.04
5G Technology	1	0.03
Homomorphic encryption	1	0.05
Cross-validation	1	0.01
Biotechnology	1	0.04
Medical Services	1	0.01
Distributed	1	0.05
Data Security	1	0.04
Machine-learning	1	0.03
Opportunity	1	0.01
Medical Cluster	1	0.03
Traceability	1	0.01
Medical Records	1	0.01
Patients	1	0.02
Information Security	1	0.03
p2p	1	0.05

Table 2. Current applications and literature on blockchain healthcare in China

Type	No. of articles	Percentage
Academic Journals	5804	70.69%
Master's Thesis	1584	18.11%
Other i.e. conferences, newspaper articles, etc.	830	10.44%
Subject content (as of June 2022)	**No. of articles**	**Percentage**
Blockchain, blockchain technology	9869	48.30%
Electronic medical records	6244	30.56%
Other Articles	4319	21.14%
Year (data source zhiwang.com)	**Number**	
2016		448
2017		1040
2018		2503
2019		2925
2020		4664
2021		3985
Until 2022-6		1575

Table 3. Blockchain + healthcare in foreign language database literature

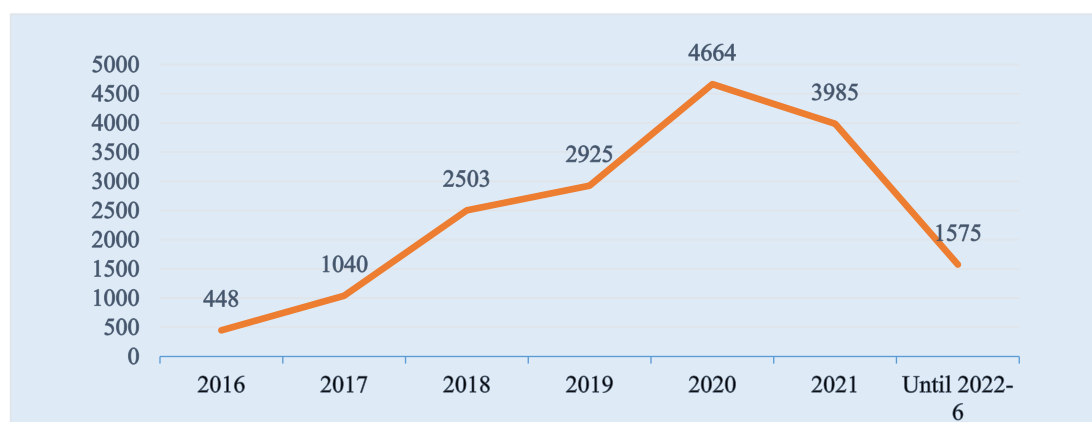| keywords	Number	
blockchain		533
blockchain / medical		119
blockchain / health		259
blockchain / healthcare		190
blockchain / hospital		67
blockchain / technology		415
Year (data source MedPub.com)	**Number**	
2016		7
2017		17
2018		57
2019		104
2020		208
2021		395
Until 2022-6		360

Figure 1. Trends in domestic blockchain technology based medical literature inclusion over the last 6 years Collinear graph
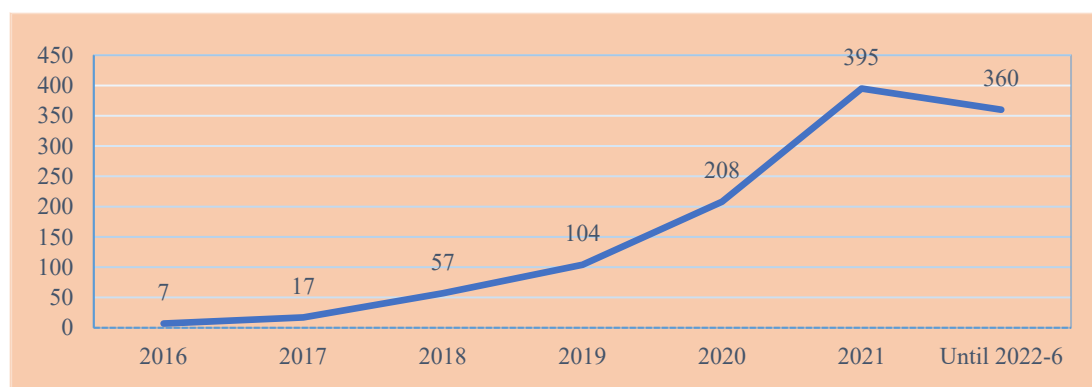

Figure 2. Trends in the increase of healthcare and blockchain keywords worldwide over the last 6 years Collinear graph

7. Analysis of blockchain in domestic and international healthcare industry literature

7.1. Research frontier and development trend

Table 1 Through the combined analysis of literature, keywords and word cloud chart of blockchain in the medical field, we can firstly find that the keywords blockchain+medical are mainly focused on the topics of blockchain technology, p2p, biotechnology, medical association and so on[3]. The frequency of such keywords as "information security", "medical record" and "patient" is relatively low, which means that the relevant research results are still relatively few, but the country attaches great importance to the development of the combination of blockchain technology and the medical entity industry. To sum up, the trend of blockchain technology application research in the medical field will be the development of targeted research in the large field of medical care that will clarify the current pain points.

7.2. Analysis of the application of blockchain in domestic medical industry literature

Table 2 explores the inclusion types of relevant blockchain+medical field literature at home and abroad through online data statistics, and finds that 70.69% of the relevant literature types in China belong to academic papers, blockchain technology realizes comprehensive application of multiple scenarios in the medical field, and the keywords contain keywords such as electronic medical records and smart contracts, etc[7]. The percentage of literature 30.56%, which means that on-chain healthcare focuses more on meticulous and specific technical level research, and China leads in the number of innovations and applications in the blockchain field, but involves few core technologies.

7.3. Analysis of the application of blockchain in foreign medical industry literature

Table 3 has a certain degree of foresight through the inclusion of relevant literature in foreign websites. "In the past 6 years, the literature related to blockchain technology outside of China has shown a significant growth overall, but in the period from 2021 to In the past 6 years, the overall literature related to blockchain technology outside of China has shown a significant growth, but in the period from 2021 to June 2022, it is generally flat, reflecting that the exploration of the application of blockchain technology in the medical field abroad is at the forefront of the world, but to a certain extent, it really needs a period of time to settle down before conducting in-depth research.

8. Pain points facing the development of blockchain in the healthcare industry

8.1. Insufficient blockchain transaction processing performance In the decentralized structure of blockchain technology

Each node is an independently existing ledger, and the whole transaction can only be confirmed after every node in the whole network has completed and reached consensus, so it leads to low transaction processing performance, and it is difficult to realize real-time data query access for tertiary hospitals with daily data flow of millions.

8.2. Technical development needs to be matured

The underlying technology needs to be further matured and effective cryptographic algorithms shall be designed to protect privacy issues; improve potential transaction throughput, transaction speed, storage capacity and other issues, these technical difficulties are also related to the landing of blockchain in the medical industry[8]. Only by overcoming the core technical difficulties can the advantages and potential of blockchain technology be truly exploited and the research of related technologies be better promoted in the clinical setting.

9. Conclusion

It can be concluded that the development of medical data based on blockchain technology is currently in its infancy, but a combination of the data from the above derived charts and overviews shows that

blockchain technology can break the current information barriers and can lead the medical industry to a better stage of development.The above study, in accordance with a certain analysis logic, completes the analysis of blockchain technology characteristics, the literature inclusion of blockchain technology combined with the medical field, the understanding and application of blockchain technology in major tertiary hospitals, and concludes that medical data based on blockchain technology has an important role in the current application scenario. It provides practical technical support to reshape the process of hospital management. It is foreseeable that blockchain technology will reshape the future of information technology in the global medical industry[3].Strengthen the independent research and development and innovation of blockchain technology in the medical industry, develop the application potential of blockchain technology in depth, and truly realize the new information technology for the development of the medical industry. In the future, our "blockchain + medical" will be better for the benefit of mankind.

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