

A big data of rehabilitation process management based on block chain

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Abstract. This article uses block chain and big data technology to design a process management, and proposes a medical data sharing scheme based on block chain, which can effectively solve the problem that rehabilitation data may be tampered or deleted and improve work efficiency. Uses the chain block in the chain alliance technology, we design a rehabilitation information data storage management scheme, this scheme will be stored module is divided into two parts, one is the recovery operation data storage module, the module using relational data store inventory data, data read operations related to the rehabilitation treatment all can still read the database; The other is the audit log word storage module, which uses key-value database word storage to store the user's operation contents of the business data, and any modification of the business data will be written to the data module. The blockchain-based rehabilitation big data process management model proposed in this article not only well meets the regulatory audit requirements of the rehabilitation treatment management system, but also forms a real alliance among the health administration departments, hospitals and recovered patients. Conclusions: Through rehabilitation big data sharing system, medical personnel through case information to rehabilitation plan provides more valuable reference, and carries on the reasonable use of these information, so as to enhance the level of rehabilitation treatment and effective information will be fully in the medical data mining, medical personnel can strengthen communication and cooperation with information technology personnel, so as to create more convenient, applicable platform for the rehabilitation.

1. Background

At present, big data has been integrated into our main life and living environment, bringing a lot of convenience to our daily life. In the future, big data technology will also be widely used in various industries, with regard to the application of big data in the medical field [1]. The sharing of medical big data is of great significance for improving the level of medical and health services and reducing the cost of patients' medical treatment.

But there are still some safety problems in medical data sharing, chain block is a kind of distributed books technology, using its data tamper-proof, traceable characteristics can effectively solve the medical problems that may have been tampered with or removed, at the same time block chain can not rely on a third party to achieve reliable value delivery, help to reduce transaction costs and improve



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the efficiency of transactions, to encourage users to share the medical data provides a good platform. In recent years, some medical data sharing schemes based on blockchain have been proposed by the academic community, but most of the existing schemes have shortcomings such as low access control efficiency and privacy leakage of users' transaction information[2].

2. Features of blockchain

Block chain is an emerging technology with consensus algorithm as the core and block chain is extremely basic. According to the different degree of node openness, it can be divided into public chain, alliance chain and private chain, just as the names of these three chains describe: public chain is open to everyone, and everyone has the right to join it in the form of node. Alliance chain allows the participation of designated organizations to form an alliance, whose authorization design will be more complex and credibility will be higher; Private chains are only open to individual individuals or entities, and use scenarios are limited where data can be manipulated. The generation of each block in the block chain is the consensus established by the participants on the sequence of events and the current state of the transaction record of the entire system, without the control of the central node. Each participant can have the backup of the entire block chain data, and each participant can participate in the recording of data and word storage. Under the distributed peer-to-peer network without the central control node, a P2P self-organizing network is established by using the algorithm of distributed collective operation. Therefore, blockchain technology has many advantages such as decentralization, distribution, data tampering and traceability [3].

3. Characteristics and development trend of rehabilitation treatment

Rehabilitation treatment is a special medical field. The business process of a rehabilitation application involves the participation of disabled patients, medical institutions and the rehabilitation working group [4,5]. At present, various medical institutions are actively recommending the fine management of disease rehabilitation[6].

For the common clinical patients are divided into clinical treatment and rehabilitation treatment, and separate special management[7]. However, the existing clinical medical HIS system lacks specific rehabilitation therapy in patients with application, assessment, treatment, rehabilitation evaluation, mobile client orders to implement query and patients, medical and health management department important functions such as real-time monitoring module, the system of each hospital website only attach importance to the patient's clinical treatment, rehabilitation of the patients with functional evaluation is relatively single, and not with the medical and health management department store patient data to achieve effective sharing, leading to the current in the process of the patient's rehabilitation process runs most of the work of examination and approval is still in phase, the article can't meet the demand[8,9]. Especially in the field of medical surgery, reducing the average hospital stay, maximizing the use of limited medical resources and reducing medical expenses are important measures to meet the health needs of the general public. With the development of economy, medicine and science and technology, the emergence of new rehabilitation theories and techniques, rehabilitation medicine has also achieved considerable development. In order to implement the development direction of rehabilitation, which takes treatment advance as the starting point, interdisciplinary crossing as the link, and "super early recovery, full cycle recovery" as the general tone. A large number of clinical practices have found that it is effective to prevent complications, accelerate functional recovery, and reduce readmission risk and disability rate. Accelerated rehabilitation surgery refers to the adoption of a series of optimal treatment measures in the perioperative period confirmed by evidence-based medical evidence in order to accelerate the postoperative recovery efficiency of patients. The specific objectives are: to reduce patients' psychological and physical traumatic stress response, to reduce surgical complications and stress response, to prevent organ dysfunction, and to accelerate patients' postoperative recovery, to improve prognosis, and to reduce the risk of readmission and death. In the end, patients can enjoy better medical results while reducing their medical costs. In short, the following problems in the rehabilitation field need to be addressed[10].

4. Problems in the development of rehabilitation treatment

At present, the development of rehabilitation treatment faces several problems to be solved. One is transparency: more detailed management is needed for the acquisition of data of rehabilitation service objects, assessment of rehabilitation institutions, rehabilitation assessment and post-rehabilitation process, and effective behaviors of rehabilitation. Second, sharing: the recovery process is complex, the materials are numerous, the lack of centralized data storage and real-time change mechanism, a large number of text work makes the word in the time delay, high error rate, high labor costs. Third, privacy: it is difficult to guarantee the privacy of the patient's original medical records and treatment plans. Therefore, this article proposes a rehabilitation treatment process management model based on block chain to realize the safe storage, sharing and protection of data and ensure the openness and transparency of the assessment, treatment and rehabilitation process.

5. Rehabilitation big data storage management scheme based on block chain

This article designs a storage management scheme of rehabilitation information data, which divides the storage module into two parts. The first is the data storage module of rehabilitation operation. The other is the audit log word storage module, which USES key-value database word storage to store the user's operation contents of the business data, and any modification of the business data will be written to the data module. This article proposes a big data process management model for rehabilitation based on block chain, which not only well meets the demand for supervision and audit of rehabilitation treatment management system, but also makes a real alliance among health administrative departments, hospitals and patients. In the league, there is no has absolute control of the entity to the data, any tampering with the business data is recorded on the block chain, can largely prevent false data in the business process and circulation, better safeguard the interest, the data security word store exchange and sharing, and privacy protection. We design and implement a medical data sharing platform based on blockchain. As for the problems in medical data sharing, such as patients' reluctance to share medical data for fear of their privacy being compromised, and scientific research institutions' concern that the data they download from the cloud server will be tampered and spend a lot of time on data verification[11]. The platform will provide a decentralized medical data sharing service, can guarantee the confidentiality of medical data and tamper-resistant sex, at the same time in order to improve the patients share their enthusiasm of medical data, using smart contracts can provide a safe trading way to protect the privacy of both parties, can promote the development of medical technique data sharing.

6. The components of the data system and the realization of the objectives.

At the data management system, the rehabilitation service object is the patient who is the owner of the data and is responsible for providing his own rehabilitation treatment data. The doctor is required to sign the corresponding medical data to ensure that the information provided by the patient is true and reliable[12].

Rehabilitation staff: physical therapists, occupational therapists, psychotherapists, recreational therapists, music therapists, social workers, etc. Block chain network: consists of authentication center, preprocessing node, sorting node and confirmation node. Blockchain guarantees the tamperability of medical data through its own tamperability, and protects the privacy of user information in the service process.

Scientific research institution: scientific research institution is a data demander, and it needs to be authorized by the patient to use the patient's medical data for relevant research. Cloud servers: cloud servers are used to store users' encrypted medical data, ensuring that only authorized scientific institutions can access it. The medical data sharing system based on blockchain designed in this paper will achieve the following goals: using the blockchain network and cloud server to realize the sharing and storage of medical data. The main idea is to encrypt the patient's medical data and store it on the cloud server, and store it in the block chain network, so as to realize the safe storage and non-tampering of medical data. In order to improve the enthusiasm of patients to share medical data, the intelligent contract provides transaction means, which can ensure that only the relevant parties can get

the detailed data of the transaction, while the irrelevant parties can only verify the correctness of the transaction, but cannot get the detailed information of the transaction.

7. Specific modules and operations of the medical data sharing system.

The medical data sharing system based on blockchain mainly consists of three modules, as shown in figure 1.

System configuration module, data sharing module, operation review module. The system configuration module is divided into setting parameters and distributing certificates. The data sharing module includes the functions of data upload, data request and data download. The operations review block includes the functions of initiating operations, querying records, reencrypting records and supervising reviews. After the rehabilitation service object provides and submits its own data information, the system sets the module, automatically sets the parameters, provides the rehabilitation needs, and issues the certificate or license to the corresponding rehabilitation treatment personnel. Through the functions of data request, download and data upload, the rehabilitation staff can obtain the needs and real-time confidence of the rehabilitation service objects. After the completion of the treatment, they can make new assessment and upload the information of the new rehabilitation service objects. Then through the operation review module, real-time operation service is provided for the rehabilitation object, and the corresponding operation record is automatically generated, and the record book is encrypted and saved in the system, so as to better supervise and review by the third party institutions, and extract data from the scientific research institutions for relevant scientific research experiments.

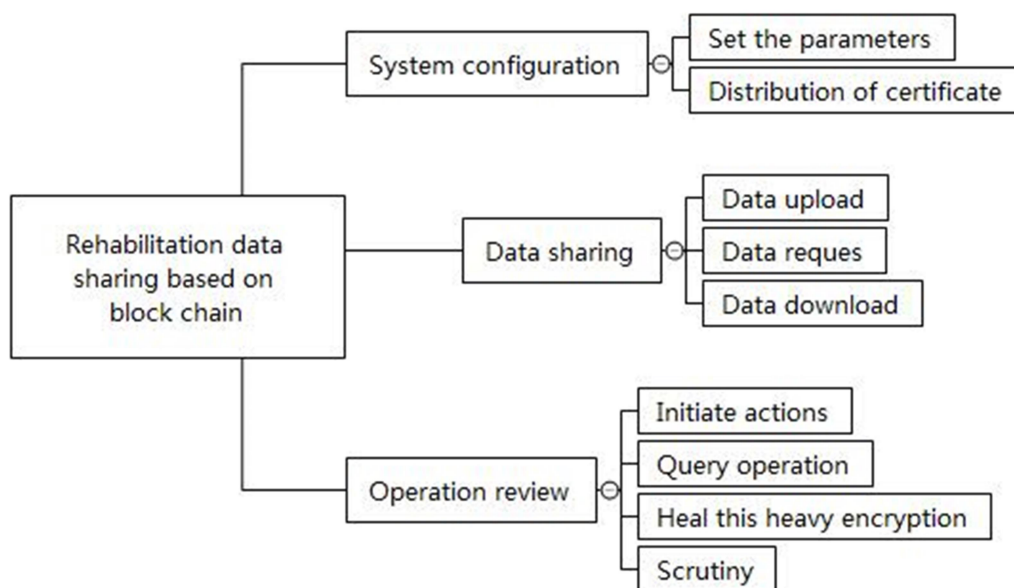


Figure 1. Medical data sharing system based on blockchain

8. Development advantages of blockchain-based rehabilitation treatment.

8.1. Digitalization of rehabilitation treatment information.

Rehabilitation information is an important reference for tracking and updating the patient's condition. In the era of big data, the continuous progress of data mining technology can effectively mine the diagnostic information of recovered patients, and make a data comparison among other similar recovered patients, which is helpful for doctors to work out more accurate recovery plans. Based on the data analysis of patients' archives, and the use of data mining technology to enhance the overall efficiency of drug research and development, so as to establish a new model of rehabilitation treatment services[13]. By focusing on patients and making detailed records of their health status, and then using

data warehouse to share medical data, the goal of serving patients can be realized and the accuracy and efficiency of doctors' diagnosis can be improved[14].

8.2. Cost reduction of rehabilitation treatment.

Rehabilitation treatment is a cyclical process, and too long rehabilitation treatment will also cause serious burden on the patient's family. In the era of big data, patients can be tracked and monitored remotely for a long time, and medical personnel can also conduct rehabilitation counseling for patients with the help of the network, which greatly reduces the cost of rehabilitation treatment for patients. In addition, as the medical data becomes more and more digital and standardized, the storage cost of data is also greatly reduced. When the data is run in commercial hardware, it is gradually widely used in the medical industry and can better serve the medical and health industry[15-17]. For example, big data makes it easy to book doctor appointments online, conduct remote guidance and simple rehabilitation treatments. In this way, not only can the time cost of medical treatment be shortened, but also the medical expenses of patients can be reduced, especially for patients in some remote areas or patients with limited mobility[18].

8.3. Rapid development of rehabilitation treatment technology.

In the era of big data, an important feature of data is to realize free dissemination. In the medical field, medical experience is very important, even in the field of rehabilitation treatment, and the role of experience is becoming more and more obvious[19]. In the era of big data, medical experience can be spread and Shared, which is very helpful for the improvement of rehabilitation treatment technology. Through the big data sharing system of rehabilitation treatment, medical personnel can provide more valuable reference for the rehabilitation treatment plan through case information. How to make rational use of this information to improve the level of rehabilitation treatment is a concern of people. At present, the development status of rehabilitation treatment in China is not optimistic. With the help of big data mining technology, the author believes that effective information in medical data will be fully mined, and medical personnel can strengthen communication and cooperation with it personnel, so as to create a more convenient and applicable rehabilitation treatment platform.

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10. References

- [1] Daniel IM 2020 *British J Anaesthesia*
- [2] Olumide M, Danda R and Moses G 2020 *Applied Network Science* **11**
- [3] Mitsutake S, Ishizaki T, Tsuchiya-Ito R, Uda K, Teramoto C, Shimizu S and Ito H 2020 *Archives of Physical Medicine Rehabilitation*
- [4] Tong Z, Xiaofeng L and He Z 2019 *Int. J. of Computer Applications in Technology* **3**
- [5] Kristen WC 2019 *Big Data and Cognitive Computing* **3**
- [6] Nawari ON and Shriram R 2019 *Buildings* **6**
- [7] Daniela AS, Claudio ASL, Luiz HC, Samara CS, Leticia Y, Jose COJ, Isaias ST, Gildarcio SG, Breslei MRF, Alexandre N, Johnny CM, Luiz AVD, Adilson MC, Paulo MT, Thais TT, Marcel S, Pedro CGC, Linamara RB 2019 *Decentralizing Rehabilitation: Using Blockchain to Store Exoskeletons' Movement* (Springer International Publishing)
- [8] Alexander B, Shlomi D and Tal H 2019 *Self-stabilizing Byzantine Consensus for Blockchain* (Springer International Publishing)
- [9] Ottenbacher KJ, Graham JE, Fisher SR 2019 *Physical Medicine Rehabilitation Clinics North America* **2**
- [10] Kenneth JO, James EG and Steve RF 2019 *Physical Medicine Rehabilitation Clinics North America* **2**

- [11] Sundaresan P and Lunesu LG 2019 *System and Method for Generating a Recovery Key and Managing Credentials Using A Smart Blockchain Contract* (Patent No. US2019036692)
- [12] Muhammad M, Qiang Q and Bulat N 2019 *Future Generation Computer Systems* **90**
- [13] Fletcher J and Bartolucci S 2018 Computer-Implemented System and Method Providing A Decentralised Protocol For The Recovery of Cryptographic Assets (Patent No. WO2018229608)
- [14] Jae ML, Yong SH, Jae CP and Min CC 2018 *American J Physical Medicine Rehabilitation*
- [15] Zhenjia C, Yonghui Z and Xia G 2018 *The Application of Distributed Database on Spectrum Big Data* (Springer International Publishing)
- [16] Nicolas C, Guangyan S and Ryan C 2016 *Tatra Mountains Mathematical Publications* **1**
- [17] Miyuru D, Prabhash A, Srinath P and Malith J 2017 *Solution Recommender for System Failure Recovery via Log Event Pattern Matching on a Knowledge Graph* (Distributed and Event-based Systems)
- [18] En C and Tzren-Ru C 2019 *Spectral reflectance recovery of various materials based on linear interpolation with nonparametric metameric spectra of extreme points* (Cryptography, Security and Privacy)
- [19] Marcus F 2017 *The promise of blockchain technology for interaction design* (Computer-Human Interaction)

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