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# THE ROLE OF BLOCKCHAIN IN DEVELOPING A SECURE DIGITAL PROFILE

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## Abstract

The article examines the peculiarities of the formation and operation of blockchain technology, which appeared as a way to conduct transactions, spread to other areas of social life. The paper aims to prove the high security of blockchain and its ability to store large databases of distributed data, digital assets, personal information based on the study of the peculiarities of blockchain construction. To this end, the work examined in detail the standard blockchain and the relationship between the blocks, showing the links between the participants in the chain, their collegial responsibility for any changes made to the chain, the transparency of making new transactions. Thanks to this approach to blockchain formation, blockchain provides maximum protection of its assets from external unauthorized changes. The example of the unified state health information system shows how the mechanism works in a digital environment and accumulates personal information. The work uses methods of systematization, analogy, generalization, visualization, analytical review, modeling and new knowledge generation. Based on the results of the analysis of blockchain technology, conclusions were made about their promising application in other industries for the guaranteed storage of valuable information.



*Keywords:* Blockchain, data, profile, patient, security

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## 1. Introduction

Blockchain technology (hereinafter BT), which first appeared in 2008 as a tool to optimize complex transactions between transaction participants, has been interpreted and applied in the subsequent periods of development of the digital world. Today there is already a certain accumulated experience of BT application in various sectors of the national economy, which has proved that the principle of distributed responsibility and user accessibility underlying blockchain operation allows successful storage and resistance to hacker attacks. The constant updating of data, the chronology of the sequence of entries does not allow for adaptation and assignment of the work of the chain. The principle of non-predictability of blockchain platform operation allows to keep their high reliability and stability in conditions of financial instability. In fact, this is a constantly replenished database, the safety of which is ensured by its distribution or dispersion among users, who simultaneously act as guarantors of the authenticity of transactions and form blocks of records. Thus, changes occur simultaneously throughout the chain, and all actors have information in full access, which leaves no room for data distortion or falsification.

The mechanism of blockchain technology is the application of algorithms of mathematical calculation, which allow the simultaneous control of the entire blockchain by its participants. BT completely eliminates the possibility of retrospective adjustment of already existing records without breaking the links between the chains, so the chain of records remains unchanged and public. Miners generating digital currencies operate on this principle. But the ability of BT to build distributed chains of records and data, as well as to store them securely, allows its application in the areas of public management to generate BigData and arrays of information about homogeneous processes.

The main areas of application of BT are generation and translation of cryptocurrencies, generation and management of contracts, creation of blockchain services for social and public administration spheres. These technologies are developing in three main directions, but they are most widely used and of national economic importance in the construction of electronic services for public services and storage of information about homogeneous processes.

## 2. Problem Statement

The expanding scope of blockchain technology entails new challenges in adapting it to different conditions of use. The direction that will be considered in this article is the formation of distributed arrays, data within the provision of medical services. To this end, it is necessary to develop and build a clear architecture of interaction between the participants of the processes, which will exclude duplication and unauthorized access to the archives.

## 3. Research Questions

The following questions were posed in this study to find an answer to them:

i. What is blockchain technology?
ii. Why does blockchain technology have the highest degree of protection?

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iii. How can blockchain technology be applied to health care?

iv. What is the future of blockchain technology?

## 4. Purpose of the Study

The purpose of the research was to study the features of the construction and operation of blockchain technology, to identify the basic principles of the secure construction of the chain of data storage and to assess the future prospects for the application of this technology in other social and economic sectors.

## 5. Research Methods

Security in the digital sphere today is a big issue and high risk services that need to provide guarantees to their users. Initially, the system must be built on the principle of maximizing the system of data protection, which blockchain technology allows. To this end, the paper studied the feature of blockchain formation in BT on the basis of content analysis and visual analysis of the mechanism of formation and attachment of new blocks to the common chain. The conclusions obtained from the analysis of the BT mechanism allowed to clearly formulate the basic principles of chain generation and identify its strengths using the methods of systematization, logic and analogy.

To determine the capabilities of BT in the formation of USHIS (Unified State Health Information System) a systematic approach was used, which allowed a comprehensive presentation of the mechanism of electronic interaction in the health system. Using the methods of abstraction, generalization and description, the mechanism of USHIS was studied, its features were identified and weak points were identified. By means of deduction method the principles of digital profile formation and its safe operation in digital environment were defined, the role of blockchain technologies in building the base of safe interaction between users was highlighted.

Information sources for the study were the works of Russian and foreign scientists studying the problems of digitalization in medicine, in particular (Davidovich & Kugach, 2018; Davydov, 2018; Gilbert et al., 2008; Goldberg et al., 2012; Galsgaard et al., 2022; Karpov et al., 2016; Kartskhiya, 2021; Plowman et al., 2018; Shandora, 2020). The works of the following scholars dealing with the implementation of artificial intelligence and blockchain technologies in the digital data exchange system, (Essen et al., 2018; Hoy, 2017; Heer, 2019; Knezevic, 2018; Morozova, 2020; Pachidi et al., 2021; Strohm et al., 2020; Topol, 2019; Verghese et al., 2018).

## 6. Findings

The evolution of blockchain technology (BT) and its extension far beyond cryptocurrency generation is quite problematic, as there are no clear protocols for its application in other areas of management. Approbation of BT in the cryptocurrency market and the emergence of smart contracts between its participants helped to understand the algorithm of this system and offer a wider scope for its application. Thus, today online file storages of information or personal personal data are developing, i.e. the technology is moving to a new level of implementation. The high degree of reliability of information

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and difficulty of access to it from the outside allow to provide a guarantee of safety from hacking and theft of information. Strict chronological sequence of operations and close interconnection between the blocks allows the system to function as a whole and to react instantly to the slightest change in any block. A unique encryption key, generated by each node or block, independently excludes unauthorized use of data. Each change in any block is pre-checked for validity, requiring cryptographic confirmation of the transaction or data transfer.

Let us represent structurally the BT system itself (Figure 1). As we can see from the diagram of BT fragment the whole chain is substituted by independent blocks, which go in distinct regular sequence, have unique ciphers and codes. In the chain there is interconnection only between consecutive blocks, it is impossible to jump over the previous block, which eliminates a certain variability in the chain. But it is this mechanism that provides order and a high degree of protection, since it is not possible to wedge oneself between the consecutive blocks.

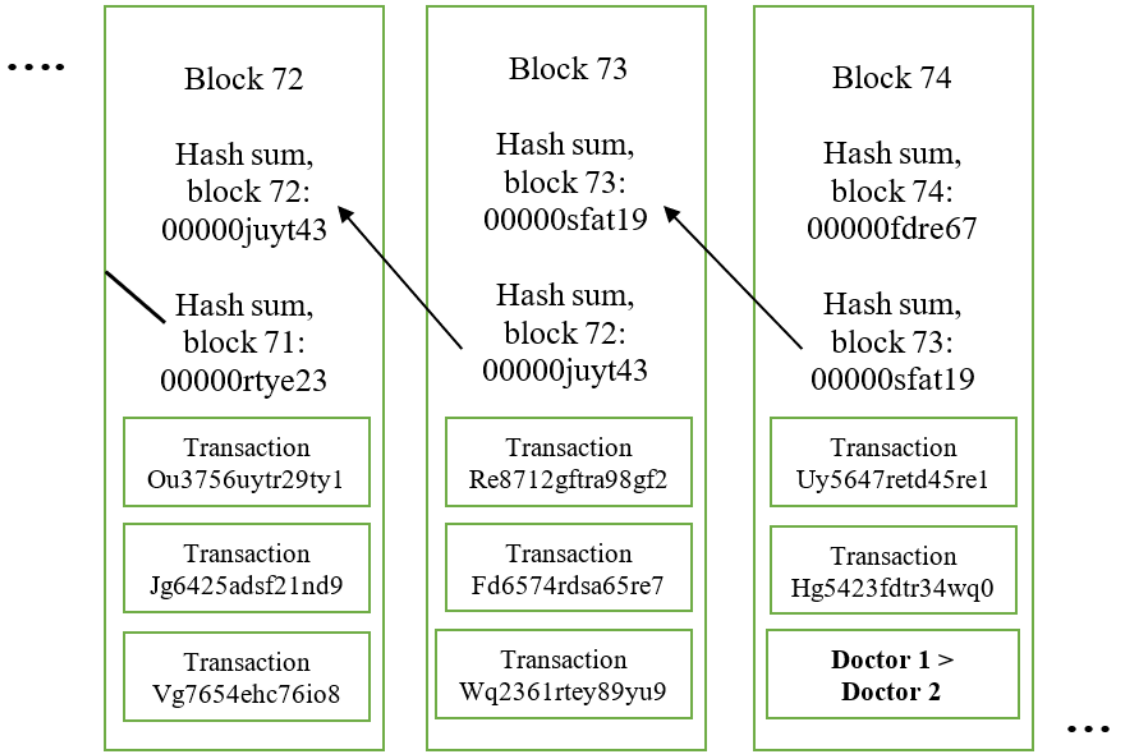


**Figure 1.** Standard scheme of information exchange in BT

It is only possible to attach a new block at the end of a chain after passing a certain procedure of verification and approval by the network participants. If any of the participants tries to violate this rule, his actions will not be approved by the other participants and the data received from him will not be saved. Such collective management allows not to break the principle of formation and provides integrity of all array from improper influence.

In Figure 1 we have presented the mechanism of work of BT in the process of data exchange and formation of new blocks of data for joining to already available arrays. Undoubtedly, this technology has

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a high degree of self-protection against external unauthorized interference, which gives grounds for its application in other social spheres as a storage of valuable information.

For example, in the health care system, there is the problem of maintaining medical confidentiality and preserving patient history data. Personal data on patients and their illnesses are stored in the archives of medical institutions, which are often represented by outdated paper warehouses and disconnected files in the computer system of the individual institution. A major problem arises when a patient needs to transfer to another specialized medical institution to continue treatment. The lack of a complete picture of the doctors' anamnesis makes it impossible to promptly continue treatment and requires repeated diagnosis and identification of pathologies. Having complete data on previous appointments and test results would greatly simplify the treatment procedure and its speed, but this is not possible today due to the lack of access to their medical data by both the patient and the treating physician at the other institution.

In this regard, the reform of the entire healthcare system is still ongoing at the state level and the Unified State Health Information System (hereinafter, the USHIS) has been built, which includes 13 groups of various information subsystems aimed at information support, information interaction, information counseling, informing the population, and providing access to medical services. It should be noted that USHIS is still in its formation stage, which does not allow for a comprehensive assessment of the work of this information environment. We can only provide a schematic representation of the main USHIS services. (Figure 2).

Figure 2 shows the mechanism of the USHIS operation in relation to an individual medical institution and a patient. The system is presented at all levels of management (federal, regional, municipal), and through electronic signals and information exchange it builds a single digital space in which the doctor, medical institution, pharmacies and the patient receive medical services work. The smooth operation of this system requires prompt response of all participants and access to electronic patient records. For this purpose, Data Processing Centers (federal, regional) have been created to act as repositories of personal information of patients.

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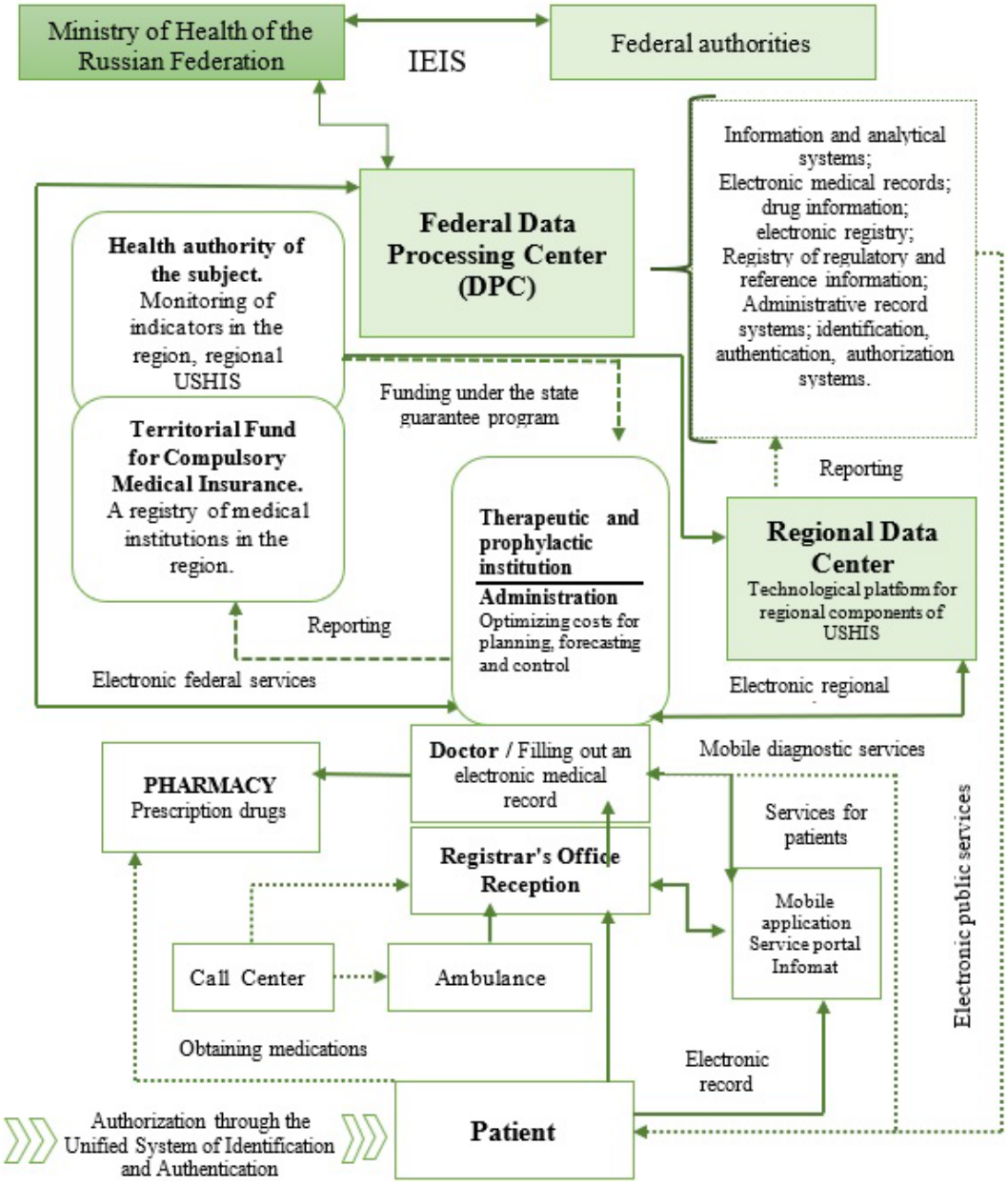


**Figure 2.** USHIS operation mechanism

In fact, at each stage of the patient information flow there is a local information accumulator that accumulates primary data, captures it and sends it to the next level until it reaches the doctor, who moderates the whole process and makes decisions based on the incoming data, enters it into the database, gives signals for subsequent actions and manipulations with the patient. Full information about the patient's health status is available to several users of this distributed network (doctor, DPC administrators, medical facility administrators, etc.). The only disadvantage in this chain we can consider the lack of access of the patient himself to his electronic medical record, which excludes its removal and copying or replication. This restriction was introduced for security purposes and to preserve medical secrecy in order to prevent individuals from accessing the databases of medical institutions.

Today, the USHIS actually works as a data bank of medical institutions, suppliers of medical equipment, and an electronic help desk for patients and doctors. If all medical institutions with their

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electronic databases are connected, the system will operate as a "digital" twin of the healthcare system. The accumulation of personal and commercially sensitive information requires compliance with digital security principles, which will increase both medical institutions' and patients' confidence in the system. From this perspective, blockchain technology will form a secure, distributed chain of communication and data storage in an online environment.

## 7. Conclusion

Summarizing this study, we can conclude that blockchain technology expands the prospects of its application in other areas of socio-economic development of society. Let us emphasize the main advantages of these technologies:

i. the feature of the distributed principle of storing information at each network administrator allows to maximize the system of secure connection and intrusion by third parties;

ii. the existing system of individual encryption allows the user to be guaranteed to keep his data on a shared network and not take up space on personal media. In addition, the use of his individual encryption in other areas of remote access will actually replace the passwords and logins that digital services require;

iii. digital identification systems allow not only storage of data, but also their registration and verification, supporting the facts with a digital signature. This approach makes it possible to store important information in a digitized format, to have access to it at any time and from anywhere on the planet, without keeping original documents. Digital registration will also make it possible to keep counterparties as informed as possible about the facts and to automatically document them;

iv. automatic provision of information and access to verified network users with certain access rights from any workplace;

v. the information created in the blockchain network is unique and impossible to repeat or duplicate, which makes it impossible to doubt its authenticity.

Thus, the enumerated characteristics of blockchain technology allow the development of its scope of application in other sectors of the economy. In the healthcare system, the prospects of BT are based on its ability to generate and store huge amounts of data, which will replace the archives of medical institutions, reduce the time to obtain a complete anamnesis on patients and doctors to quickly exchange data in the process of complex treatment or diagnosis.

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