MEDICAL INSURANCE CLAIM USING BLOCKCHAIN

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

MEDICAL INSURANCE CLAIM USING BLOCKCHAIN

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UNDER THE GUIDANCE OF

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COMPUTER SCIENCE & ENGINEERING

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Approval Certificate

This is to certify that the project report entitled "**Medical Insurance Claim Using Blockchain**" submitted by **Kundan Kumar (12023002026001) and Prithwiraj Das (12023002026007)** in partial fulfilment of the requirements of the degree of **Bachelor of Technology in Computer Science & Engineering** from **University of Engineering and Management, Jaipur** was carried out in a systematic and procedural manner to the best of our knowledge. It is a bona fide work of the candidate and was carried out under our supervision and guidance during the academic session of 2023- 2024.

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ABSTRACT

During Medical Emergencies Health Insurance plays an extremely important role in providing us the coverage against medical expenses. But Preventing Data Breach and Fraudulent activities of data related to health care is the biggest challenge in this sector. Blockchain Technology provides transparency which is the biggest issue in health sector. In this paper, we design the insurance claim model in which Blockchain will help our system maintaining transparency between the insurer and the company. This proposed model replaces the agent and offers the direct contact between the insurer, hospital and the company. IPFS is the distributed file storage system where one can share large files in secured manner. our papers concentrates on using and combining both blockchain and IPFS where the patient's private data is stored in this distributed file storage named IPFS and the cryptographic address of the files gets store in the blockchain technology. This project aims to analysis a dataset regarding Titanic Survival and predicts whether a person has survived or not in the titanic accident. It involves various steps such as data pre-processing, exploratory data analysis, feature selection, and model selection. The code visualizes the data, checks for missing values, replaces missing values with median values and replaces categorical variables with numerical values using encoding technique. Further, it uses a Logistic Regression algorithm to predict the no of people survived after the accident. The final score obtained from the model is used to evaluate the model's accuracy.

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1. CHAPTER

INTRODUCTION

1.1 Project Overview

Medical insurance is a vital part of today's world. With the increase in the number of health issues, not everyone can afford all kinds of treatment required and the time wasted in claims. The introduction of blockchain technology is proving to be of great benefit to lower and middle-class people. Different types of blockchain are being used to provide maximum benefitsto society. Permissioned and advanced blockchain provides security and transparency to sensitive information. The attribute-based signature (MA-ABS) scheme with multiple authorities is used to provide privacy to patient's data. Smart Contracts for Ethereum Blockchain are being used to automate the process of insurance claims and payments to patients. Hyperledger Fabric is used for the implementation so that restful APIs can be usedfor easy access of data on the blockchain. The healthcare insurance system implementation onblockchain will eliminate the intermediaries, causing delay, fraud, high cost, etc., and bring about a faster process of claims and treatment while maintaining the security and privacy of allmedical records such as EHRs and EMRs.

1.2 A Overview of Blockchain Technology

Blockchain was invented by Satoshi Nakamoto" the pseudonym of an unknown person or persons "in 2008 to serve as the public transaction ledger of the cryptocurrency bitcoin [which] made it the first digital currency to solve the double-spending problem without the need of a trusted authority or central server." A blockchain is a decentralized, distributed and public digital ledger that is used to record transactions across many computers so that the record cannot be altered retroactively without the alteration of all subsequent blocks and the consensus of the network

1.3 Applications of Blockchain in healthcare

There are two main types of participants within a blockchain network: users and validators. Users are individuals or entities that use a blockchain to transact on the decentralized network. Validators, on the other hand, protect the network from becoming centralized and are in certified to append newly created blocks to the chain consistently. All material in this website is intended for illustrative purposes and general information only. It does not constitute financial advice nor does it take into account your investment objectives, financial situation or particular needs. You should consider the information in light of your objectives, financial situation and needs before making any decision about whether to acquire or dispose of any digital asset. Investments in digital assets can be risky and you

may lose your investment. Past performance is no indication of future performance. A blockchain system shouldbe able to defend itself from an attack. A blockchain will generally implement security using financial incentives that originate in game theory, ensuring that it is more expensive to exploit the blockchain than the total value earned through the exploitation itself.

1.4 Remix-IDE

Remix is an open-source web-based Integrated Development Environment (IDE) for developing smart contracts using the Solidity programming language. It provides a user- friendly interface for writing, testing, debugging, and deploying smart contracts on various blockchain networks such as Ethereum, Binance Smart Chain, and more. Remix has a built-in compiler and debugger, making it straightforward for developers to write efficient and secure smart contracts. It also supports a wide range of plugins and extensions, allowing users to customize their development environment according to their needs. No surprises then, that Remix is widely used by blockchain developers worldwide and has become an essential tool in the Ethereum development ecosystem.

The Remix IDE has a clean and intuitive interface designed to make it easy for developers to write, test, and deploy smart contracts. The layout consists of several key elements, including:

- **Icon Panel**

The Icon Panel is located on the left side of the IDE and contains various icons for accessing different features of Remix. These icons include the file explorer, compiler, debugger, and settings.

- **Terminal**

The Terminal is located at the bottom of the IDE and displays the compiler output and other processes. It can also be used for running scripts and other commands.

- **Side Panel**

The Side Panel is located on the right side of the IDE. It contains various panels for accessing different features, such as the Solidity compiler, the debugger, the plugin manager, and more.

1.5 Technology Stack Used (Programming languages)

Solidity is a statically typed programming language designed for developing smart contracts that run on the Ethereum Virtual Machine (EVM) or compatible virtual machines. Solidity uses ECMAScript-like syntax which makes it familiar for existing web developers; however unlike ECMAScript it has static typing and variadic returntypes. Solidity is different from other EVM-targeting languages such as Serpent and Mutans in some important ways. It

supports complex member variables for smart contracts, including arbitrarily hierarchical mappings and structs. Solidity smart contract support inheritance, including multiple inheritance with C3linearization. Solidity introduces an application binary interface (ABI) that facilitates multiple type-safe functions within a single smart contract (this was also later supported by Serpent). The Solidity proposal also includes "Natural Language Specification", a documentation system for specifying user-centric descriptions of the ramificationsof method-calls.

1.6 Objective of the Project

Blockchain can help digital health by making it easier to share data securely, with patient consent, across very fragmented healthcare systems. Before diving into the use cases, it's important to be clear on what blockchain is for and what business benefits it is delivering to enterprises today

1.7 Scope of the Project

A Blockchain network is used in the healthcare system to preserve and exchange patient data through hospitals, diagnostic laboratories, pharmacy firms, and physicians. Blockchain applications can accurately identify severe mistakes and even dangerous ones in the medical field. Blockchain technology will bring about significant efficiency gains, cost savings, transparency, faster payouts, and fraud mitigation while allowing for data to be shared in real-time between various parties in a trusted and traceable manner. Blockchains can also enable new insurance practices to build better products and markets. Insurance companies operate in a highly competitive environment in which both retail and corporate customers expect the best value for money and a superior online experience. Blockchain technology represents an occasion for positive change and growth in the insurance industry. Blockchain can be applied throughout the insurance industry and across many lines of business, including:

- Registries of high-value items and warranties
- Parametric (index-based) products
- Reinsurance practices
- Peer-to-peer (P2P) models
- Distribution methods

2. CHAPTER

LITERATURE REVIEW

The interest in applying blockchain technology to medical insurance claims lies in its reliable benefits of increasing transparency, security and reducing redundancies within the processes. The medical insurance claim submission cycle is characterized by shortcomings such as lengthy processes, fraudulent practices and expensive administrative expenses. All these shortcomings are obviated by blockchains since it is a decentralized and distributed ledger. The literature in the reports suggest that a unique trusted network or can remove the need for multiple parties by reducing the time between contract initiation and completion. Smart contracts are fundamental features on a blockchain which makes it possible for the entire process on verification of claims, transactions and settlements to be automated. Blockchains' cryptographic security and transparency makes them indispensable according to Patel et al (2023) as it minimizes contestations between policyholders and insurers and provides privacy for the health records of patients. Moreover, there are projects on blockchain technology enhancing healthcare data systems and therefore solving the data interoperability challenges. The weaknesses of redundant data storing are solved by making it possible that all the stakeholders, insurance companies, patients, and hospitals can easily share information using blockchains. Fraud prevention through authentication validation is highlighted by some pilot projects in blockchains, Medi Ledger and Guard time for example.

3. CHAPTER

METHODOLOGY

3.1 Data encryption and decryption mechanisms

Data encryption is a method of protecting data by encoding it in such a way that itcan only be decrypted or accessed by an individual who holds the correct encryption key. When a person or entity accesses encrypted data without permission, it appears scrambled or unreadable. Data encryption is the process of converting data from a readable format to a scrambled piece of information. This is done to prevent prying eyes from reading confidential data in transit. Encryptioncan be applied to documents, files, messages, or any other form of communication over a network. In order to preserve the integrity of our data, encryption is a vital tool whose value cannot be overstated. Almost everything we see on the internet has passed through some layer of encryption, be it websites or applications.

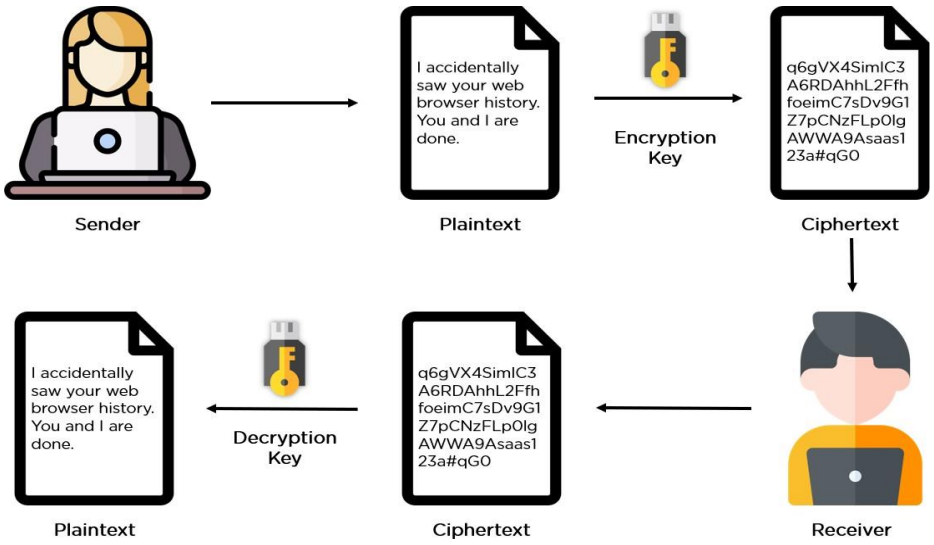

Figure 3.1 - Encryption-Decryption Technique

Decryption is the transformation of data that has been encrypted and rendered unreadable back to its unencrypted form. The garbled data is extracted by the system and converted and transformed into texts and images that are easily understandable by the reader as well as the system. Simply

put, decryption is essentially the reverse of encryption, which requires coding data to make it unreadable, but the matching decryption keys can make it readable. The recipients must have the right decryption or decoding tools to access the original details. Decryption is performed using the best decryption software, unique keys, codes, or passwords. The original file can be in the form of text files, images, e-mail messages, user data, and directories. The original format is called plaintext while the unreadable format is referred to as ciphertext. Parties use an encryption scheme called an algorithm and keys for encryption and decryption of messages in a private conversation. The decryption algorithm is also known as a cipher

3.2 Privacy considerations in healthcare data

Many issues in healthcare have been identified as possible candidates for blockchain technology solutions, including enhancing the security and privacy of patient data .Since medical records include sensitive information that needs to be kept private, privacy is a crucial issue in the healthcare industry. Patients may suffer as a result of unauthorized access to such data, and healthcare professionals may face legal repercussions. Blockchain technology offers certain advantages that make it a desirablechoice for boosting healthcare privacy. It is a decentralized and distributed ledger, which means that data are spread among several network nodes. As a result, there is less chance of a centralized point of failure or attack target. Second, blockchain technology enables the development of smart contracts that can automate data sharingand enforce privacy laws. The ability to encrypt and pseudonymize data stored ona blockchain allows for the protection of personal information while still enabling authorized parties to access the essential data. Blockchain technology has the potentialto enhance patient privacy, but some issues need to be resolved. The interoperability ofvarious blockchain platforms is one of the biggest issues since healthcare providers maybe utilizing dissimilar systems that cannot connect .Another difficulty is the complexity of putting blockchain technology into practice, which calls for resources and technological know-how that may not be accessible in all healthcare settings. Blockchain technology combines several privacy-enhancing technologies to bolster thesecurity of sensitive patient data. Healthcare data may be sent and stored securely thanks to encryption, with access limited to those with the necessary decryption keys who are permitted to do so. Smart contracts' consent management allows patients to choose exactly who may access their data, aligning healthcare data governance with patient preferences .

3.3 Access control and permission management

As blockchain-based access control continues to grow, several emerging trends are worth noting.73% of organizations are planning to invest in blockchain-based access control in the next two years. Source – Organizations planning to invest in blockchain-based access control . One of the most significant trends is the potential for integrating other technologies, such as artificial intelligence (AI) and the Internet of Things (IoT). The global market for blockchain-based access control is expected to reach $10.5 billion by 2027, with a compound annual growth rate

4. CHAPTER

4.1 System Design

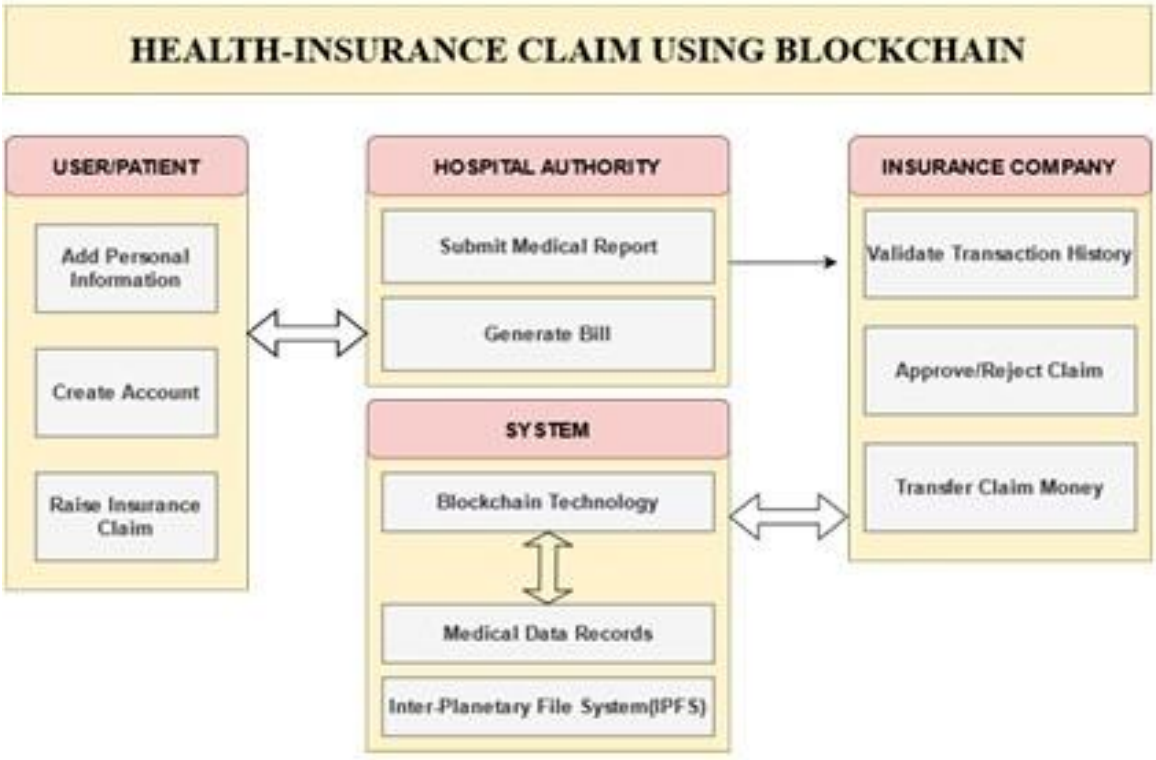

Figure 4.1: System Architecture

Within the architecture design displayed in Figure 2 is the representation of the healthcare institutions, their peer clients, Insurance company, IPFS and the Blockchain. Each person accesses the blockchain in accordance to their roles. Each node holds the same copy of the immutable blockchain and the insurance claim. There are three different types of entries in the Blockchain: (i) patient healthcare records, (ii) insurance claim records, and (iii) The Bill amount. Entries in the Blockchain cannot be updated, forcing a new entry will create a new Block. A patient can view all the entries related to the medical report and payments. The process starts when the insurer issues the policy of the patient in Blockchain. The medical reports uploaded by the hospital authorities gets store in the IPFS and their transaction gets store in the Blocks. IPFS uses a P2P (Peer to-Peer) network model for sharing a file in a decentralized and distributed manner across nodes. Files are stored across a network of nodes after they are broken in parts and hashed. When the parts are assembled together, based on their hash value, it recreates the original file.

5. CHAPTER

5.1 Comparison With Traditional Insurance Claim Systems

The current legacy system used in processing health insurance claims causes a huge amount of financial loss every year due to fraud claims. It is also highly prone to privacy and security threats due to the use of traditional methods. Health insurance claims for prescription drugs are one such claim that is highly prone to being tampered with. Also, there is a lack of linkage in the prescription data between the medical care provider and the pharmacy, which also leads to miscommunication and the use of false prescriptions. In this paper, we propose processing health insurance claims for drug prescriptions using blockchain technology that manages the processing of prescription drugs in a private, secure, trustworthy, and decentralized manner. The proposed system utilizes a private Ethereum blockchain. The system includes two smart contracts: registration and approval smart contracts, which provide traceability and trustworthiness to the system. The system was integrated with off-chain storage (IPFS) and a fronted decentralized applications (DApps), which improves the accessibility of centralized patient information by authorized parties. To maintain the privacy of the data, a gateway is used to filter the data that can be viewed by the participants. We present the system architecture, sequence diagrams, entity-relationship diagram, and algorithms to demonstrate the working principles of the proposed process for processing health insurance claims for prescription drugs using blockchain

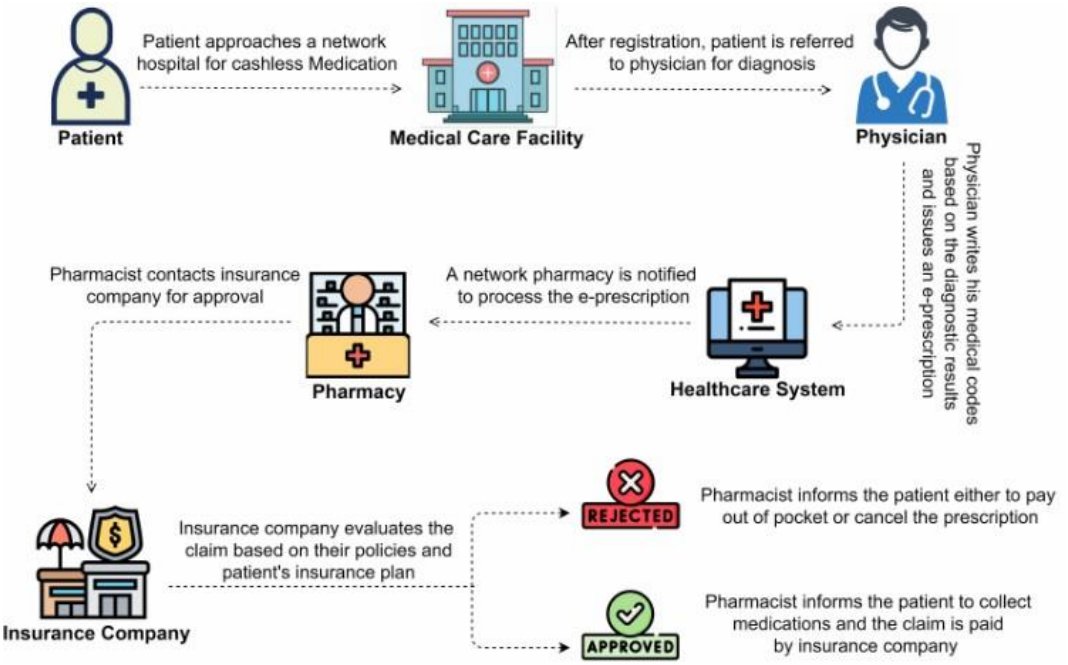

Figure 5.1: Typical process flow for processing health insurance claim for prescription drug.

6.CHAPTER

RESULTS & DISCUSSION

Evaluation of the system's performance

For deploying, you need to have a contract compiled. To check that there is a compiled contract, find the CONTRACT select box (which is under the VALUE input field), you can use this module.

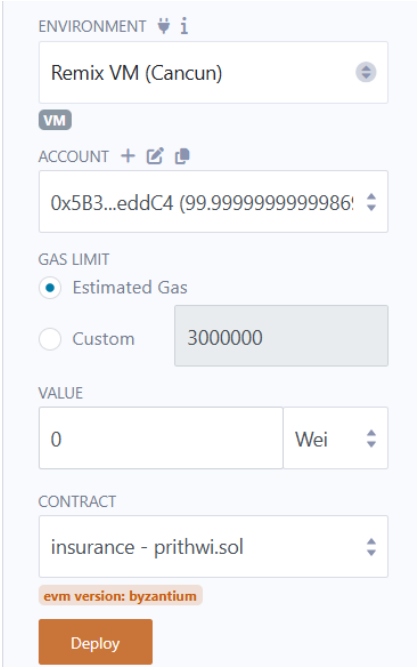

Figure 6.1 : Deploy Remix-IDE

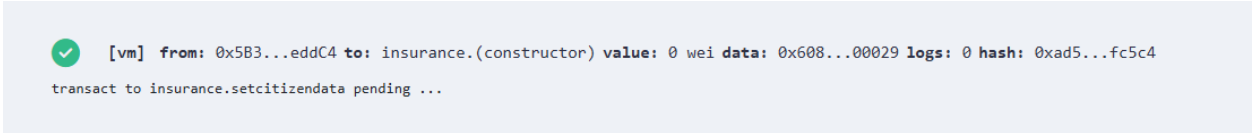

Figure 6.2 : Debug in Remix-IDE

The Remix Project is a rich toolset that can be used for the entire journey of contract development by users of any knowledge level, and as a learning lab for teaching and experimenting with Ethereum. Once you click in the tab, hit in the MetaMask notification window to approve and pay for the contract deployment transaction

7. CHAPTER

CONCLUSION

Blockchain has shown its potential for transforming the traditional industry with its key characteristics such as decentralization, persistency, anonymity, and auditability. The proposed system provides reliable and secure healthcare scheme using blockchain that works in decentralized environment by removing the cost of resources such as cost, time to manage the healthcare data records. The system is able to maintain the privacy and provide top level security to healthcare data records as it contains some private information related to health. The key characteristics, potential advantages, and applications of blockchain technology in the healthcare sector have been highlighted during the past five years through a critical review of its development and difficulties. Blockchain holds promise for changing healthcare by enabling safe data management, interoperability, and patient-centric treatment thanks to its decentralized, unchangeable, and transparent nature. The system has a wide range of possible uses, including improving supply chain management, avoiding fraud, and managing clinical trials and medical data. The assessment of increased efficacy and efficiency has demonstrated appreciable advancement, showing improved data protection, streamlined procedures, and possible cost savings in healthcare operations. To fully realize the potential of blockchain, however, issues including interoperability, regulatory issues, scalability, and standards must be resolved. Collaboration between healthcare professionals, policymakers, technologists, and patients is necessary for successful integration. Blockchain technology has the potential to lead to a revolutionary change in healthcare, ushering in a period of enhanced data security, interoperability, and ultimately better patient care.

8. CHAPTER

FUTURE SCOPE

The future scope of blockchain technology in healthcare is vast and holds great promise for transforming the industry in numerous ways. Here are some key areas where blockchain is expected to have a significant impact:

1.Interoperability:One of the biggest challenges in healthcare is the lack of interoperability among different systems and institutions. Blockchain can facilitate seamless data exchange between healthcare providers, insurers, researchers, and patients, leading to improved coordination of care and better health outcomes.

2. Medical Records Management: Blockchain can streamline the management of electronic health records (EHRs) by providing a tamper-proof and transparent system for recording and accessing patient data. This can reduce administrative burdens, eliminate duplicate records, and improve data accuracy.

3. Supply Chain Management: Blockchain technology can be used to track and trace pharmaceuticals, medical devices, and supplies throughout the supply chain. This can help prevent counterfeit drugs, ensure product quality, and improve transparency in procurement and distribution processes.

4. Clinical Trials and Research: Blockchain can enhance the integrity and transparency of clinical trials by recording trial data in a secure and auditable manner. It can also facilitate data sharing among researchers while maintaining patient privacy, which can accelerate medical research and innovation.

5. Healthcare Payments and Billing: Blockchain-based smart contracts can automate and streamline healthcare payments, reducing billing errors, fraud, and administrative costs. Smart contracts can also enforce payment terms automatically based on predefined conditions, enhancing transparency and trust in financial transactions.

6. Patient Empowerment: Blockchain enables patients to have greater control over their health data and how it is shared. Patients can grant permission to healthcare providers, researchers, or other entities to access their data, ensuring transparency and informed consent.

7. Compliance and Regulation: Blockchain can help healthcare organizations comply with data protection regulations such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States or the General Data Protection

Regulation (GDPR) in the European Union. The immutable nature of blockchain records can facilitate auditing and regulatory compliance efforts.

Overall, the future of blockchain in healthcare looks promising, with potential benefits ranging from improved data security and interoperability to enhanced patient outcomes and innovation in healthcare delivery and research. However, challenges such as scalability, regulatory concerns,

9. CHAPTER

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