

Research Article

# A study of Blockchain Framework for Healthcare based System in Kanpur City

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Received 01 Sept 2023, Accepted 20 Sept 2023, Available online 26 Sept 2023, Vol.13, No.5 (Sept/Oct 2023)

## Abstract

Healthcare data can be created, copied and modified faster than ever before and if data is the fuel behind most efficient care, Blockchain may be vehicle to get us there. Today the Healthcare System is losing \$300 billion each year in poor data integration. In its purest form Blockchain used after a safe and secure system to share data more efficiently. The potential is great. But Blockchain is an intricate system used to package data in a way you can trust. It can only be modified by certain users. Once data is created, its broadcast and verified on a peer to peer network and then block of information is formed. Only people with correct key access and change it and every time if data is modified, a new data block is verified and added to the chain. If someone is try to temper with the transaction or block in the chain, permissioned members and validation tool work together to confirm or reject the new data. This process ensures the Blockchain remains a safe, secure and trusted source. For Healthcare, Blockchain can optimize real data through vast connectivity, providing a new way of sharing, analyzing and verifying the information. This could lead to accelerated Research and Development (R & D) and more coordinated care for hospital system. For patients and providers, it could having mean the information they need when the need it most. We believe, Blockchain can play important role in the future of healthcare.

**Keywords:** Blockchain, EMR, Smart Contract, SHA256 Algorithm, Tokenization, Public Private Patnrship (PPP)

## 1. Introduction

The healthcare system is shifting its focus to a newer model - value-based care, a complete overhaul from the traditional volume-based care system. While the traditional model focuses on charging patients based on the services provided irrespective of their medical significance, value-based healthcare focuses on more customized patient-centric services. Two major transformational changes include affordable treatment and superior healthcare services, using big data. Industry revolution 4.0 relies on big data and so does the healthcare system - clinical trials, drug testing, patient data management, patient engagement, remote patient monitoring, etc. However, huge costs are being incurred for storing and processing of such big data. Additionally, the mishandling of the health records and data breaches has raised a lot of data privacy concerns and led to erosion of trust in the current health regulatory practices. A country's expenditure on healthcare as a proportion of GDP is considered as one of the important indicators for the overall population health.

India's current spending on healthcare is <4% of the total GDP, compared to the top 10 countries (of OECD), which spends on an average >10%. Electronic Health Record, which plays a crucial role in processing and analyzing patients' medical records to provide better quality care, in India, specifically, is practiced in an unstandardized manner.

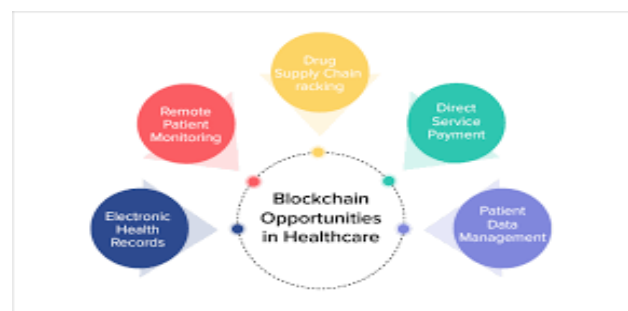


Figure1. Blockchain Opportunities in Healthcare

Healthcare providers face challenges in terms of maintaining data immutability and privacy, with respect to data sharing with relevant stakeholders. Different healthcare institutions use different models and their own set of codes, which also makes it hard to achieve interoperability. This issue is further escalated

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DOI: <https://doi.org/10.14741/ijcet/v.13.5.1>

when patients change their service providers due to unforeseen reasons. Patients' are forced to redo their medical tests and treatment processes, which adds to the overhead costs and also to their frustration. This can be addressed to a major extent through the use of Blockchain technology.

### 1.1 Blockchain

Blockchain is a method of recording information that makes it impossible or difficult for the system to be changed, hacked, or manipulated. A blockchain is a distributed ledger that duplicates and distributes transactions across the network of computers participating in the blockchain. Blockchain technology is a structure that stores transactional records, also known as the block, of the public in several databases, known as the "chain," in a network connected through peer-to-peer nodes. Typically, this storage is referred to as a 'digital ledger.' Every transaction in this ledger is authorized by the digital signature of the owner, which authenticates the transaction and safeguards it from tampering. Hence, the information the digital ledger contains is highly secure. In simpler words, the digital ledger is like a Google spreadsheet shared among numerous computers in a network, in which, the transactional records are stored based on actual purchases. The fascinating angle is that anybody can see the data, but they can't corrupt it.



Figure2. Features of Blockchain

### 1.2 Smart Contracts in Healthcare

Smart contracts and blockchain technology are ideal ways to automate and improve health data storage and management. As these technologies continue to evolve, so do their use cases. Healthcare applications are an important way smart contracts can be used to improve people's lives. Smart contracts offer a frictionless way for health care providers, insurance companies, researchers, drug manufacturers, and nearly every other entity in the healthcare industry to communicate. These on-chain programs can automate aspects of healthcare systems, freeing up time and resources for the professionals involved. When considering how to incorporate a smart contract system into your healthcare business, it's essential to look for a ledger with security, fast transaction processing, and predictable fees. Smart contracts offer a faster, more secure way for insurance providers, hospitals, and

other healthcare services to share patient information. If a patient's insurance policy was stored on-chain, it could be viewed by their healthcare provider when needed. Likewise, hospitals could easily add the patient's treatments to the distributed ledger to be viewed by their insurance provider, and insurance payments could be automated.

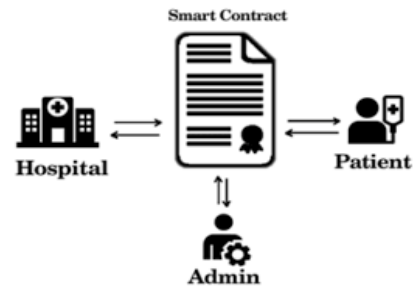


Figure3. Smart Contract in Healthcare

### 1.3 Hashing Algorithm

Cryptographic hashes are one-way functions that take input of data and generate the result into a size of fixed length called a digest—also called checksum. Hash functions are not able to decrypt as they are one-way functions; hence, they cannot be encrypted back to form the original message. Many algorithms are available to generate a hash, such as MD5 (message-digest algorithm), SHA1 (Secure Hash Algorithm 1), and SHA2 (Secure Hash Algorithm 2). This proposed model gives a modified hashing algorithm i.e. SHA256 to generate a hash.



Figure4. Hashing Algorithm(SHA256)

### 1.4 Tokenization in Healthcare

The healthcare industry is one of the most data-intensive in the world. Daily generation and storage of electronic health records (EHRs), clinical trial data, medical research, and billing information make managing and securing this sensitive data increasingly difficult. Tokenization has emerged as a popular solution for this issue, enhancing healthcare data management and privacy.

Tokenization is the process of replacing sensitive data with non-sensitive data known as tokens, which have no meaning or value outside of the application or system's context. The tokens may be substituted for

the original data for data analysis, processing, and storage. The original data is then stored securely, making it less susceptible to unauthorized access.



Figure 5. Tokenization in Healthcare

## 2. Initiatives taken by government of India in Healthcare System

In India, the government of India has drafted a National Health Policy (NHP) in 2017, with the goal of providing well-being for all Indian citizens, and universal access to good quality health care services without any financial constraint. Among many of its aims, NHP envisages creating a digital health technology environment. Data collection, storage, and sharing will be key to its establishment and so will be the protection of user data and privacy rights. In this regard, the Digital Information Security in Healthcare Act (DISHA) was drafted in 2017, to protect the patient's privacy and security of health data. In the future, DISHA is expected to streamline the electronic health records of individuals with ease of access, by standardizing and controlling the overall data retrieving process and protecting users' rights. In this regard, a federated permissioned Blockchain network integrated with the health information exchange (HIE) model, could address the gap between the formation of law and regulations and implementing the law in practice.

Using Estonia's case, a central repository of patient's healthcare data could be established which can be accessed anywhere, anytime. However, before implementing such Blockchain-based healthcare systems, India needs a major transformation in its technology infrastructure. As a developing nation, India is still an energy deficit country compared to its counterparts. The USA consumes about 12 units, Japan about 7.3 units, Estonia about 6.5 units, China about 4.5 units and India about 1.2 units of energy as of 2017 (Units are defined as kWh per person per annual consumption). Blockchain technology requires high computing and processing power to keep the exchanged information secured, which requires multiple servers across different geographies. Government and private players can work in public-private partnership mode to overcome this deficiency which can help to accelerate Blockchain implementation across healthcare and other sectors as

well. India has taken a few preliminary steps in this direction. CallHealth, a Hyderabad based start-up, which provides healthcare platform, has partnered with ThynkBlynk, to use its proprietary Blockchain technology, ChainTrail, which enables different healthcare service providers to integrate and securely share their data on the network. In terms of cyber-security, India ranks the least, among the global economies. It was listed among the top 5 nations to be affected by cybercrime in 2017-18, by 'Symantec Corp'. The top ranker was the USA, followed by China. However, Estonia was ranked among one of the safest cyber-secured countries across Europe. We could adopt some of the best practices from Estonia and view our current weakness of vulnerability to cyber-attacks not as a threat but as an opportunity to leap to Blockchain technology, especially in healthcare.

## 3. Healthcare Bodies in Uttar Pradesh

The state of Uttar Pradesh is geographically vast and occupies a great portion of the northern part of the country. With changes taking place and considerable investments having been made in the healthcare infrastructure of the state in the last couple of decades, there is significant improvement in the public and private healthcare sectors. The state government runs government medical colleges at Agra, Allahabad, Gorakhpur, Jhansi, Kanpur and Meerut besides a medical university as well as a super-specialty hospital at Lucknow; plans are afoot to develop four more super-specialty hospitals in various locations. The state's combined distribution of healthcare bodies are Nearly 60 District Hospitals, Over 20 combined hospitals, Around 850 Public Health Centres, 2850 additional Public Health Centres, Around 21000 sub Public Health Centres. However, the numbers may not do full justice to meet the demands of the vast population.

In the private sector, there are five private medical colleges and hospitals, twenty dental colleges besides a vast network of over 4750 nursing homes. Other hospitals providing methods of alternative treatment and healing techniques such as Ayurveda, Homeopathy and Unani number around 3000 altogether.

Almost half of the districts in Uttar Pradesh are covered by Public-Private Partnership (PPP) programs implemented by non-profit organizations supported ably by state agencies and USAID. These projects are based on the social franchisee method, the aim being to create sustainable PPP models that can reach out to the marginalized populations through a network of franchised hospitals that offer quality medical services across all areas. The structure of these networks comprises of a 'hub' and 'spoke' referral system that begins at the village level and goes all the way up to district level. The key strategies that are evolved include complementing public health system by leveraging existing private healthcare service infrastructure using an innovative and integrated

approach in service providing – use of ICT to increase system efficiency, standardize services by ensuring uniformity in operational procedures and clinical protocols across the franchise, conduct regular capacity team-building sessions and medical audits to ensure Quality Assurance, affordable service framework especially for maternal health and child care services, educating the public on the need and choices for family planning, ensuring backend linkages with government healthcare schemes and this service model has proved to be financially sustainable and therefore the potential for scalability especially for low-cost and resource public health care systems is very high.

#### 4. Inauguration of Health ATM @ Health Center, IIT, Kanpur jointly by Director, IIT Kanpur & Director, SGPGI Lucknow

The benefit of Telemedicine in giving access to healthcare services across geographical barriers or circumstances causing lack of physical contact with care providers has been realized by one and all during the recent Covid-19 Pandemic. One such telemedicine platform A Health ATM or Telemedicine Kiosk was jointly inaugurated by Prof Abhay Karandikar, Director, IIT Kanpur and Prof R K Dhiman, Director, SGPGI Lucknow, which is an integrated Computer, Biomedical diagnostics, Point of Care laboratory tests and videoconferencing system connected to Internet based network connecting Telehealth clinic with Doctors at a distance. The inauguration event was also attended by Prof Ganesh, Deputy Director, IITK, Prof Harish, DORD, IITK, Head, EE and Dr Mamta Vyas, CMO, Health center, IITK among others. This health ATM has been set up as a collaborative venture between Indian Institute of Technology, Kanpur and SGPGI, Lucknow. Prof Laxmidhar Behera and Prof SK Mishra made a presentation about the health ATM and its use in preventive personalized health care for IITK residents. India lives in its villages so said by our Father of the Nation, so we should ensure all the public services of the government should reach our fellow citizens living in far flung areas. Health services no exception. With rapid advancement of telecommunication technology and it's deployment in particular the wireless based Internet offer an unique opportunity to deliver healthcare services using such kind of portable low cost integrated platform. Government of India in it's mission of promoting digital technologies for public good has commissioned National Health Authority, one of it's objective is to offer digital health care for all its citizens and ensure they have a personal health record in electronic form which can be transported across the healthcare providers, institutions cutting down all kinds of geographical and manmade barriers. The system when operational in the campus of IIT Kanpur will ensure creation of electronic Personal Health Record (PHR) not only for it's own employee and their families but other dependent on the institution. Besides creation of PHR , the research on the health

data so generated using machine learning technologies and tools can open new avenues of health data analytics to offer predictive and personalized medicine. One of our focus on research would be analysis of health data of all patients during the recovery from Covid-19 infection to study its effects on Respiratory, Cardiovascular and other body systems to identify at-risk cases and intervene at an appropriate time to prevent disastrous consequences. The result of our study in collaboration with medical doctors of SGPGI will lead to possibility of deployment in Smart City Projects where smart health technologies like Internet of Medical Things using cloud computing are one of the deliverables and also Tele-ICU projects where Remote Monitoring of Patients (RPM) are possible applications. We are looking forward to venture into these new areas as soon the Health ATM is operational and wish to thank SGPGI and Government of Uttar Pradesh for its support.



Figure 6. Inauguration of Health ATM @ Health Center, IIT, Kanpur

#### 5. The Tripura state government using Blockchain in their Healthcare System

The Tripura state government has teamed up with the NIC Blockchain Centre of Excellence in Bengaluru for the initiative and is using the latter's APIs. Tripura is using the blockchain-based beneficiary management system to secure approved beneficiary lists, transaction requests, and details of successful transactions. Tripura has joined a growing list of Indian states and government agencies using blockchain initiatives across a variety of use cases. The Tripura government has started using blockchain technology to secure the data on the state's beneficiary management system. The APIs will allow the state government to store state beneficiary data sets on the blockchain, safeguarding the records and avoiding data manipulation. Tripura is using the blockchain-based beneficiary management system to secure scheme-wise approved beneficiary lists, approved transaction requests, and scheme-wise details of successful transactions. The move is in line with the state government's mission to promote 'Digital Tripura'. It

has also introduced schemes such as the IT/ITeS Startup Scheme, Data Centre Policy, ITeS Policy and IT incentive scheme as part of its digital push. In a statement, Dr Naresh Babu, director of IT in the Tripura government, said he is keen on exploring blockchain for issuing government-to-business certificates such as licences. He also expressed interest in exploring the Web3 Sandbox offered by the India Blockchain Forum to build and test use cases aimed at citizen and public services and enabling startups to build innovative use cases.

**6. How has Rajasthan state government used Blockchain technology for managing electronic health records**

The base fabric of Blockchain has been built in a manner that all different applications and services can be moved to Blockchain fabric with complete ease. The platform fully leverages Bhamashah – the state resident data hub for Rajasthan, ensuring that the system adheres and complies to JAM Trinity, integrates with the state identity and can map any benefit being given on the nodes of Blockchain platform itself. The electronic health records are mapped to the Bhamashah ID primarily, and it has been ensured that complete privacy guidelines are complied with. All electronic records, health summary, vitals, reports, prescriptions etc are mapped and are kept on Blockchain fabric, and can be accessed only after due consent of the patient. The system is fully secure, integrated and non-repudiated in nature ensuring genuineness of data.

**7. Blockchain in Healthcare startup in India**

There are 27 Blockchain in Healthcare startups in India. Here is a list of the 10 most exciting ones



**Vitraya Technologies**  
 Provider of blockchain-based health insurance claim management solutions

Provider of blockchain-based health insurance claim management solutions. It offers solutions for claim processing and claim settlement between hospitals, healthcare providers, and insurers. It uses smart contracts and blockchain-based technology for claim settlement, payouts, and fraud detection.



**Fitmint**  
 Reward-based application for tracking fitness activities

Reward-based application for tracking fitness activities. The platform enables users to earn rewards in cryptocurrency and NFTs by walking, running, or

working out. Users can share workouts with fitness buddies across the globe and challenge each other.



**Cuztomise**  
 Cloud based collaboration tool for field service management

Cuztomise is a cloud-based solution for enterprises currently serving digital marketing agencies and field service companies. It provides features for scheduling, invoicing, employee time sheets on mobile, document repository, tracking of the field job, business reporting and other such business process operations on the mobile platform. Includes an inbuilt communication platform allows engagement of agents and experts over a unified channel which is then used to build a knowledge base. Also added enterprise email integration with the product. Part of GSF Global Accelerator, batch 3. Part of TAVenture investment portfolio. It provides a SaaS-based platform for pharma management.



**Schröcken**  
 Provider of platform to help enterprises outsource manufacturing for pharma companies

Provider of platform to help enterprises outsource manufacturing for pharma companies. Utilizes enterprise-grade blockchain and smart contracts technology to establish trusted and private communications within ecosystem partners.



**Shivom**  
 Provider of blockchain-based genomics and data discovery platform

Provider of blockchain-based genomics and data discovery platform. The company is building a genomic and health data hub by combining blockchain, genomic DNA sequencing, artificial intelligence, and cryptography. Will allow people to store their genome after sequencing, and the resulting marketplace will enable the app and service providers to offer customized services.



**Pranacare**  
 Blockchain and AI-powered collaboration platform for doctors

Blockchain and AI-powered collaboration platform for doctors. It provides solutions for dieticians,

diabetologists, and cardiac experts to manage clients and data. It also provides a decentralized ledger, manages, traces, and records patient data. The AI-based platform provides patients' profile and risk scores on the basis of patients' records, predictive analysis for health risks, profile mapping, chatbot for interacting, recommendations on the insurance policy and healthy products, and medical reports parsing and analytics.



**MeFy** AI-based platform for health screening, diagnosis, and monitoring

AI-based platform for health screening, diagnosis, and monitoring. The platform leverages big data, AI diagnosis, diagnostic devices, grassroots innovation, advances in mainstream and alternative medicine. It provides healthcare data to everyone for research and finds new cures for different human-related diseases. The platform also uses blockchain technology. The company has developed Point Of Care Diagnostic device for testing modalities in a single system.



**HECOD**

Provider of cloud based personal health record management solutions

HECOD is a provider of cloud-based personal health record management solutions. It organizes the health records of patients, which can be accessed and share with the health care providers. The platform is cloud-based and with secure blockchain technology.



**Glosys Health**

AI and cloud-based business analysis and patient health management tool for providers

AI and cloud-based business analysis and patient health management tool for providers. The company has developed software like ' glosys HealthcarePlus ', ' glosys HospitalAssetSuite ', and ' glosys Cure '. that assists with analytical processing activities. It has features for data analysis, cyber security, blockchain technology, and more.



**Plenum Data**

Blockchain-based data security for healthcare solution

Plenum Data provides data security, data integration and data management solution based on blockchain,

AI, cloud, IoT, big data, and quantum computing. The company is building Plenum Data platform that records healthcare data through the integration of patient-reported data from mobile devices and wearable sensors. Provides algorithms to track patients activities for their wellness goals.

**8. Market Challenges**

A blockchain network's inherent structure defies any set form or norm, so adopting a blockchain system for healthcare could clash with data protection rules. Determining the role of a data fiduciary or a data controller in a blockchain-based network where each system serves several purposes as a node, or a miner may prove challenging. Poor penetration of technology and digital infrastructure in rural areas is also impeding the growth of digital healthcare in the country.

**9. Impact of COVID-19**

During the pandemic period, the patients' detail from around the world should be available at a shared commonplace to enable the research work by the researchers. Blockchain technology facilitates serving better home-quarantined patients by supplying medicine on time. Some patients do not get hospitalized but are isolated and treated at home. Even after the patient recovers, the data stored permanently in the blockchain help to check for after-effects.

**Conclusion**

There are innovative applications of Blockchain in healthcare due to inherent encryption and decentralization. It enhances the security of patients electronic medical records, promotes the monetization of health information, improves interoperability among healthcare organisations, and helps counterfeit combat medicines. Different healthcare fields in Kanpur City can change with Blockchain technology, areas like healthcare, digital agreements allowed by intelligent contracts constitute one of Blockchain's most critical applications. By removing intermediaries from the payment chain, intelligent contracts will minimise costs. The Blockchain potential in healthcare system in Kanpur City depends significantly on the adoption of associated advanced technologies in the ecosystem. It includes system tracking, healthcare insurance, medicines tracing, and clinical trials. Hospitals in Kanpur City can chart their services using a Blockchain framework, even over the entire life cycle, using device tracking. Blockchain technology can well be used to improve patient history management, especially tracking and the insurance mediation process, thereby accelerate clinical actions in Kanpur City with optimised data maintenance. Overall, this technology would significantly enhance and eventually revolutionise how patients and physicians treat and

use clinical records and improve healthcare services in Kanpur City.

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