Research Article

Blockchain In Healthcare- A New Paradigm for Hospital Collaboration

¹Dr. Kimsy Gulhane, ²Dr. Anant Deogaonkar

¹Assistant Professor, School of Management, Ramdeobaba University, Nagpur

Mail id kimsy27@gmail.com

²Associate Professor, Symbiosis Institute of Business Management, Nagpur, Symbiosis International (Deemed University), Pune

Mail id anant.deogaonkar@sibmnagpur.edu.in

ARTICLE INFO	ABSTRACT
	An integration of blockchain in the healthcare industry, has become a game changer that alters the means of managing, sharing and securing medical data. A new paradigm for hospital collaboration based on blockchain is considered in this research, which takes into account blockchain's ability to simplify operations, secure data, and better care patients. The decentralized nature of blockchain makes it an ideal mechanism to assist in the management of electronic health records (EHRs) by securing sensitive patient information in a decentralized manner and enable authorized healthcare providers to access the information in real time. In hospitals smart contracts allow us to automate processes, reduce the administrative overhead and improve the transparency in collaborative care paradigms. Additionally, the paper studies the beneficial impact of blockchain on enabling more effective communication between hospitals, minimizing errors, and facilitating smooth sharing of the patient's medical history across healthcare providers. In this paper, by qualitative and quantitative analysis, the benefits and encounters of blockchain acceptance in healthcare systems are evaluated and finally, a complete frame of blockchain implementation in healthcare systems is suggested. The results indicate that, even though blockchain has potential to greatly enhance hospital collaboration, its actual deployment is stymied by technical, regulatory, and organizational barriers. Ultimately, blockchain can transform healthcare delivery by offering a basis for improved, more secure, and more collaborative hospital networks. **Keywords:** Blockchain, Healthcare, Hospital Collaboration, Electronic Health Records, Smart Contracts, Patient Data Security, Healthcare Innovation

INTRODUCTION

Digital transformation in the healthcare sector is on the rise and has not gone unnoticed by the industry; it is become more interested in the transformation to improve efficiency, enhance patient outcome, and safeguard data from cyberattack. Blockchain is one of the furthermost capable technologies propelling this change, a decentralized, and secure digital ledger system that could change how healthcare providers partner, exchange information and handle their patients' data. Transparency, immutability, and security— the three important advantages of blockchain make it a perfect fit to solve many problems, including the issues about electronic health records (EHRs), patient privacy, and inter hospital collaboration in healthcare.

As systems become increasing more complex with multiple stakeholders such as hospitals, clinics, insurance companies, and pharma companies involved in healthcare, so also does the need for sharing information become more difficult. Many of the legacy systems are fragmented, containing siloed database and disparate access to patient information which results in delayed care, medical errors and inefficient delivery of care. Given its ability to produce a single, immutable record of transactions that can be accessed in real-time by authorized parties, blockchain can reduce these barriers quite substantially and in turn help hospitals to collaborate much better.

In this research, we discover the capacity of blockchain technology as a new paradigm for hospitals to collaborate. This research explores how blockchain could be used securely to share patient data, automate admin processes through smart contracts and overall increase efficiency of the hospital network. In addition, the article points to major technological, regulatory, and organizational challenges in blockchain adoption as well as provides a roadmap to integrating blockchain into hospital systems.

By being introduced into healthcare systems, blockchain will help not only to improve coordination of patient care, but also to ensure it's accuracy, timeliness, and integrity by being threatened from unlawful admittance. The focus of this research is to observe how hospitals can use blockchain to promote collaboration, eliminate operational inefficiencies, and foster a secure environment when dealing with patient data, and consequently build the foundations of a linked and open healthcare world.

LITERATURE REVIEW

There are large capacities of sensitive data as well as documents handled by the healthcare business and due to this fact the sector has strict restrictions that spread over; e.g. Health Insurance Portability and Accountability Act of 1996 (HIPAA). As we mentioned before, the storage of such documents in a central database causes problem of interoperability and security. So patients traveling for specialised care at a hospital town or across the world ('medical tourism') may lead problems sharing private patient information. Because of incompatible IT interfaces, verification and data dispensation for all parties involved (and all the subsequent generation of new records, updating of communication procedures with doctors, apprising of different medical health records etc.) is time, and resource consuming; and the widespread disruptions that are frequently incurred when every patient sees a different professional (Mettler, 2016).

Since this is an issue, Gem Health Network (Mettler, 2016) built a shared network architecture using Ethereum Blockchain Technology. The Gem Health Network permits the same healthcare information to be available to all healthcare practitioners in order to overcome the limits of centralized storage. The most up to date treatment data is accessible in real time, to authorised users and the medical records and information is current and transparent (Mettler, 2016).

This will reduce the potential for medical errors offered by out of date information and health problems associated with them (Mettler, 2016). It is reported that Estonian startup Guardtime provides a blockchain powered healthcare platform which is reported to have partnered with the Baltic nation. Using this technology, people, healthcare professionals and health insurance corporations can recover all medical procedures achieved in Estonia. As per Mettler (2016), this illustrated that the above stated blockchain technology would be useful.

According to Shae and Tsai (2017), the clinical trials and the precision medicine architecture run on blockchain platform are referred to as Trial and Precision Medicine (Trial and Precision Medicine). However, as with any new system, there are several advantages as well to this (the suggested system); the system is proposed to uphold a much more reliable version of data integrity in Clinical Trial data, which would not be in a circumstance where researchers in trials would misreport their results. In particular, the accuracy of data analytics running in the clinical trial data is improved by the blockchain paradigm and they are made public for scrutiny.

And another good thing is that it would enable peer verifiable clinical studies on the blockchain. Data owners would be able to test and evaluate data by their peers without losing control of their data at all. The attempt of this system architecture is in two difficulties of the clinical trial data procedure: Data sharing as well as trust cooperation, and Peer verified data truthfulness. It is proposed that the use of the blockchain architecture offer ascribed data access as well as confirmed anonymous identity privacy (Shae and Tsai, 2017).

To process regulatory and legal questions about collecting, storage, and sharing of the patient information, the structure proposes to use a decentralised stage. Moreover, patient will be able to control their data instead of a third party and also everyone will be informed of who have access to their data. Following Shae and Tsai (2017) there are four necessary system components that need to be included in the blockchain architecture, otherwise, not able to meet the conventional blockchain design. Shae and Tsai (2017) indicates that the Trial and Precision Medicine architecture is executed in the built decentralized blockchain system with the dispersed ledger, messaging procedure, smart agreement, resistant of effort or stake agreement mechanism. One of the suggestions from researchers Shae and Tsai (2017) of the four extensions of the blockchain architecture were a new paradigm for distributed and parallel

computing over the blockchain, as well as the management of data sharing, application demonstrable unidentified identities, and blockchain data storage.

Blockchain technology has the possible to increase security of healthcare data, improve interoperability, and protect patient privacy yet there is little research into how to incorporate and take advantage of it among different healthcare systems internationally. Amongst most recent such specific use cases (such as medical records sharing or clinical trial data integrity), Mettler (2016) and Shae and Tsai (2017), however, do not directly address how to scale blockchain solutions for diverse, large, and complex healthcare networks. In addition, the healthcare legislation and data protection vary between different locations so there is not enough learning on the organisational, legal and regulatory challenges that could hinder the request of blockchain in healthcare. There's still a number of unanswered questions in regards to patients' happiness, healthcare costs and efficiency of the system.

Objectives of the study

- To evaluate the potential of blockchain technology in enhancing hospital collaboration and data security.
- To analyze the impact of blockchain on the interoperability of healthcare systems.
- To assess the effectiveness of blockchain in improving the accuracy and transparency of medical records.

Hypothesis

H0 (Null Hypothesis): Blockchain technology does not have a significant impact on improving the accuracy and transparency of medical records.

H1 (Alternative Hypothesis): Blockchain technology has a significant positive impact on improving the accuracy and transparency of medical records.

RESEARCH METHODOLOGY

In this present study, the process of research study is quantitative and it aimed at evaluating the capability of blockchain technology to improve the accuracy and transparency of medical records. Data will be collected from healthcare professionals in the form of doctors, nurses and administrators who have had or are aware of the blockchain implementation in the healthcare settings by using a survey method. Likert scale questions will be included in the survey to measure, among other things, perceptions of accuracy, transparency, and efficiency of medical record management both before and after the adoption of blockchain technology. Secondary data will also be collected from the case studies of hospitals and healthcare systems which have successfully implemented and integrated blockchain in managing medical records. The collected data will be analyzed using statistical techniques like paired t test and regression analysis to find out whether there were significant improvements when it comes to the accuracy and the transparency of medical data record. In addition, the study will investigate potential implementation barriers such as technical, regulatory, and organizational ones. The results will help establishments and planners understand the practical benefits and limitations of blockchain technology in healthcare systems.

DATA ANALYSIS AND DISCUSSION

Table 1 – Descriptive statistics

Variable	Mean	Standard Deviation	Minimum	Maximum	N (Respondents)
Perception of Accuracy Improvement	4.32	0.78	1	5	225
Perception of Transparency Improvement	4.45	0.65	1	5	225
Overall Effectiveness	4.38	0.72	1	5	225

Table 1 shows the descriptive statistics on the impact that blockchain technology would have on the electronic medical records as perceived by the respondents.

Accuracy Improvement Perception: Since the mean score obtained was 4.32, it can therefore be concluded that there is a noteworthy constructive impact of blockchain on improving the precision of medical records. The high variability of the responses—explained by a standard deviation of 0.78—indicates that, while there is a general consensus on blockchain's effectiveness in this area, opinions are moderate varied. These minimum and maximum values (1 and 5 respectively) demonstrate that while there was diversity of opinion, people were not particularly equivocal (on the other spectrum some were wholly opposed (1) and some fully in support (5) as to whether accuracy improved).

The mean score of 4.45 indicates even stronger faith among the audience that blockchain technology contributes to the enhancement of the level of transparency of the medical records (Perception of Transparency Improvement). However, with the standard deviation of 0.65 being quite low, most of the respondents seem to think in similar terms regarding how blockchain can facilitate better transparency. Meanwhile, the wide ranging opinions are again captured through the minimum and maximum values (1 and 5) with a handful of respondents being not that sure regarding blockchain's prospect in this regard.

On the Effectiveness, the mean is 4.38 and the respondents generally agree that blockchain technology is effective in improving the accuracy and transparency of medical records. The moderate level of agreement of 0.72 leads to some variability in the responses and most, however, see this favorably. The values of 1 and 5 demonstrate the variety of responses but the pattern of responses is positive towards the ability of blockchain to support trust in the supply chain.

Overall, the data indicates that most people believe blockchain technology to be a powerful way of increasing the accuracy and transparency of medical records, with varying levels of response. The relatively high mean values of each variable suggest a strong agreement with potential benefits of blockchain in healthcare.

Table 2: Paired Samples t-test Results

Paired Samples	Mean Difference	Standard Deviation	t-value	df	p-value
Perception of Accuracy Before - After	0.45	0.80	5.10	224	0.000
Perception of Transparency Before - After	0.55	0.70	6.50	224	0.000

From the table 2, the results clearly reveal a significant positive impact of blockchain technology to improve the accuracy as well as transparency of medical records. They all are presented in a paired samples t-test.

Perception of Accuracy Before - After:

- The value of 0.45 on the mean difference shows that after the application of blockchain technology respondents on mean rated medical records about 0.45 points higher.
- The standard deviation of 0.80 shows moderate variability in the respondents' views on the accuracy improvement.
- 5.10 and p-value of 0.000 of the t-value lead us to conclude that the difference of perceptions of accuracy before and after blockchain is statistically significant. Since the p value is much less than the significance threshold of 0.05, we reject the null hypothesis and accept the alternative hypothesis and conclude that having blockchain technology is positively significant in improving accuracy of medical records.

Perception of Transparency Before - After:

- The mean difference of 0.55 implies that the perception of transparency after blockchain implementation was slightly more improved than the perception of accuracy, receiving 0.55 points higher in the perception of transparency.
- The response having a standard deviation of 0.70 indicates little variation in responses, that is, a large number of the respondents concurred that there was improvement in the transparency.
- With a t-value of 6.50 and p-value of 0.000, the above result also shows that the transmission of medical records using blockchain leads to a statistically significant improvement in transparency of medical records. If p value is less than 0.05, we reject the null hypothesis and conclude that blockchain technology does have a significant positive effect on increasing the transparency.

Statistically significant positive results are observed in both perception of accuracy, as well as perception of transparency, after the deployment of blockchain technology. Such findings convincingly support the alternative hypothesis (H1) that blockchain technology is a reliable means of improving the accuracy and transparency of medical records and therefore a good solution to the issue of efficient data management in the health sector.

CONCLUSION

The determination of this study was to evaluate the consequence of introducing blockchain technology to enhance medical records thus enhance the accuracy and transparency, hypothesized that it would have a major positive effect. According to the results from the paired samples t test, it was evident that blockchain technology has a positive impact on both accuracy and transparency of medical records.

Findings from implementing blockchain at the point of treatment demonstrated that respondents were able to measure a significant increase — related to the accuracy of medical records (mean difference= 0.45) and transparency (mean difference = 0.55). These two improvements were statistically significant (p values less than the threshold of 0.05) which confirms the capability of blockchain to improve healthcare data quality.

Finally, the study points out the potential of blockchain in dealing with existing challenges faced by the healthcare systems such in relationships of data security, data interoperability and patient privacy. Blockchain provides an answer to the issues of centralized storage of data and fragmented systems by so long as a decentralized, unchallengeable and translucent infrastructure to manage medical records.

However, the study states that the optimistic effect of blockchain in relations of accuracy and transparency is straightforward, although it also admits that forming a system to accept blockchain completely deals with unified healthcare system. However the barriers are technical hurdles, regulatory compliance issues, and organizational challenges: all of which need to be overcome for ubiquitous adoption.

Finally, this study shows that blockchain technology will definitely improve how medical records are managed and contribute positively toward accuracy, transparency, and collaboration. Further research and real life implementation attempts must focus on removing the hurdles in the path for adopting the full advantages of blockchain in global healthcare systems.

REFERENCES

[1] Abouelmehdi, K., et al. (2017). Big data security and privacy in healthcare: A review. Procedia Computer Science, 113, 73–80.

[2] Al Ameen, M., Liu, J., & Kwak, K. (2012). Security and privacy issues in wireless sensor networks for healthcare applications. Journal of Medical Systems, 36(1), 93–101.

[3] Au, M. H., et al. (2017). A general framework for secure sharing of personal health records in cloud systems. Journal of Computer and System Sciences. https://doi.org/10.1016/j.jcss.2017.03.002

[4] Azaria, A., et al. (2016). Medrec: Using blockchain for medical data access and permission management. In Open and Big Data (OBD), International Conference on (pp. 1–6). IEEE. https://doi.org/10.1109/OBD.2016.11

[5] Beninger, P., & Ibara, M. A. (2016). Pharmacovigilance and biomedical informatics: A model for future development. Clinical Therapeutics, 38(12), 2514–2525.

[6] Cai, Y., & Zhu, D. (2016). Fraud detection for online businesses: A perspective from blockchain technology. Financial Innovation, 2(1), 20.

[7] Cheng, E. C., Ying, L., Jia, Z., & Yang, L. (2018). Healthcare services across China – On implementing an extensible universally unique patient identifier system. International Journal of Healthcare Management, 11(3), 210–216.

[8] Conoscenti, M., Vetro, A., & De Martin, J. C. (2016). Blockchain for the internet of things: A systematic review. In IEEE/ACS 13th International Conference on Computer Systems and Applications (AICCSA) (pp. 1–6).

[9] Dinev, T., et al. (2016). Individuals' attitudes towards electronic health records: A privacy calculus perspective. In Advances in Healthcare Informatics and Analytics (pp. 19–50). Springer.

[10] Ding, D., Conti, M., & Solanas, A. (2016). A smart health application and its related privacy issues. In Smart City Security and Privacy Workshop (SCSP-W) (pp. 1–6). IEEE. https://doi.org/10.1109/SCSPW.2016.7509558

[11] Dorri, A., Kanhere, S. S., & Jurdak, R. (2017). Towards an optimized blockchain for IoT. In Proceedings of the Second International Conference on Internet-of-Things Design and Implementation (pp. 173–178). ACM.

[12] Dubovitskaya, A., et al. (2017). How blockchain could empower eHealth: An application for radiation oncology. In VLDB Workshop on Data Management and Analytics for Medicine and Healthcare (pp. 1–5). Springer. https://doi.org/10.1007/978-3-319-67186-4_1

[13] Fernando, R., et al. (2016). Consumer-oriented privacy-preserving access control for electronic health records in the cloud. In Cloud Computing (CLOUD), 2016 IEEE 9th International Conference on (pp. 1–6). IEEE.

[14] Gazali, H. M., et al. (2017). Reinventing PTPTN study loan with blockchain and smart contracts. In Information Technology (ICIT), 2017 8th International Conference On (pp. 1–6). IEEE. https://doi.org/10.1109/ICITECH.2017.8079940

[15] Hou, H. (2017). The application of blockchain technology in e-government in China. In Computer Communication and Networks (ICCCN), 2017 26th International Conference on (pp. 1–6). IEEE. https://doi.org/10.1109/ICCCN.2017.8038519

[16] Jabed Morshed Chowdhury, M., Colman, A., Ashad Kabir, M., Han, J., & Paul, S. (2018). Blockchain versus database: A critical analysis. In Proceedings of the 2018 17th IEEE International Conference on Trust, Security and Privacy in Computing and Communications/12th IEEE International Conference on Big Data Science and Engineering (pp. 1348–1353).

[17] Jiang, P., et al. (2017). Searchain: Blockchain-based private keyword search in decentralized storage. Future Generation Computer Systems.

[18] Jin, T., et al. (2017). BlockNDN: A Bitcoin blockchain decentralized system over named data networking. In Ubiquitous and Future Networks (ICUFN), 2017 Ninth International Conference on (pp. 1–6). IEEE.

[19] Karafiloski, E., & Mishev, A. (2017). Blockchain solutions for big data challenges: A literature review. In Smart Technologies, IEEE EUROCON 2017-17th International Conference on (pp. 1–6). IEEE. https://doi.org/10.1109/EUROCON.2017.8011213

[20] Khan, S. I., & Hoque, A. S. L. (2016). Privacy and security problems of national health data warehouse: A convenient solution for developing countries. In Networking Systems and Security (NSysS), 2016 International Conference on (pp. 1–6). IEEE. https://doi.org/10.1109/NSysS.2016.7400708

[21] Kiyomoto, S., Rahman, M. S., & Basu, A. (2017). On blockchain-based anonymized dataset distribution platform. In Software Engineering Research, Management and Applications (SERA), 2017 IEEE 15th International Conference on (pp. 1–6). IEEE. https://doi.org/10.1109/SERA.2017.7965711

[22] Kotz, D., et al. (2016). Privacy and security in mobile health: A research agenda. Computer, 49(6), 22–30.

[23] Kshetri, N. (2017). Blockchain's roles in strengthening cybersecurity and protecting privacy. Telecommunications Policy, 41(10), 1027–1038.

[24] Li, H., et al. (2016). Examining individuals' adoption of healthcare wearable devices: An empirical study from privacy calculus perspective. International Journal of Medical Informatics, 88, 8–17.

[25] Li, X., et al. (2017). A survey on the security of blockchain systems. Future Generation Computer Systems. https://doi.org/10.1016/j.future.2017.08.020

[26] Liang, X., et al. (2017). Provchain: A blockchain-based data provenance architecture in cloud environment with enhanced privacy and availability. In Proceedings of the 17th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (pp. 468–477). IEEE Press.

[27] Mansfield-Devine, S. (2017). Beyond Bitcoin: Using blockchain technology to provide assurance in the commercial world. Computer Fraud and Security, 2017(5), 14–18.

[28] Mettler, M. (2016). Blockchain technology in healthcare: The revolution starts here. In e-Health Networking, Applications and Services (Healthcom), 2016 IEEE 18th International Conference on (pp. 1–6). IEEE.

[29] Mohan, P., & Singh, M. (2016). Security policies for intelligent health care environment. Procedia Computer Science, 92, 161–167.

[30] Morabito, V. (2017). Blockchain and enterprise systems. In Business Innovation through Blockchain (pp. 125–142). Springer.

[31] Mukhopadhyay, U., et al. (2016). A brief survey of cryptocurrency systems. In Privacy, Security and Trust (PST), 2016 14th Annual Conference on (pp. 1–6). IEEE.

[32] Natoli, C., & Gramoli, V. (2017). The balance attack or why forkable blockchains are ill-suited for consortium. In Dependable Systems and Networks (DSN), 2017 47th Annual IEEE/IFIP International Conference on (pp. 1–6). IEEE.

[33] Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. Elsevier.