World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Blockchain disruption in healthcare industry: Case studies, challenges and way forward

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World Journal of Advanced Research and Reviews, 2023, 20(03), 511–518

Publication history: Received on 27 October 2023; revised on 04 December 2023; accepted on 06 December 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.20.3.2501

Abstract

Blockchain technology has emerged as a transformative force in various industries, and healthcare is no exception. The health care industry can unlock possibilities that were never even seen before since blockchain revolutionized the way this industry operates, offering unparalleled advancements in its procurement, patient services, research, and medical diagnosis. This white paper explores the potential of blockchain to disrupt and revolutionize the healthcare sector, focusing on its impact on data security, interoperability, supply chain management, and patient empowerment. Furthermore, it embarks on an in-depth study of the use cases and benefits of implementing blockchain in the healthcare industry and seeks to understand its adoption through different real world case studies. As Blockchain becomes increasingly popular today it becomes important to analyze its benefits and enable it to permeate the health care industry sustainably. The transformative journey into Blockchain has not been tapped fully and comes with a plethora of implementation and adoption challenges. This research paper also identifies the challenges faced in implementing this technology and seeks to find a way forward for this disruptive technology. Ultimately, this research paper concludes that the benefits that accrue from blockchain outweigh the challenges and encourages greater adoption of blockchain technology in healthcare due to the innumerous benefits it offers.

Keywords: Blockchain; Digital Disruption; Healthcare; Blockchain Challenges

1. Introduction

The healthcare industry confronts a multitude of challenges that span both systemic and operational realms. Access to quality healthcare remains a global concern, with disparities in healthcare infrastructure and resources across different regions. Rising healthcare costs strain both individuals and systems, limiting affordability and accessibility. Interoperability issues persist, hindering the seamless exchange of patient information between healthcare providers and systems. Additionally, data security and privacy concerns loom large as the industry grapples with the digitization of health records. The aging population poses another challenge, placing increased demands on healthcare services and resources. Moreover, the rapid pace of technological advancements introduces the need for continuous adaptation and integration, often causing a lag in implementation. Addressing these challenges requires a holistic and innovative approach, leveraging technology, policy changes, and collaborative efforts to create a more resilient and patient-centric healthcare ecosystem. By leveraging decentralized and transparent ledger systems, blockchain has the potential to address some of these critical challenges in healthcare, ultimately leading to more efficient, secure, and patient-centric healthcare ecosystems. Smart contracts embedded in blockchain can automate and streamline administrative processes, cutting down on inefficiencies and reducing operational costs. In essence, blockchain emerges as a potent solution, ushering in a new era of trust, transparency, and efficiency in the healthcare landscape.

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1.1. Objectives

This paper aims to explore how blockchain can disrupt the healthcare industry, emphasizing its potential benefits in terms of providing data integrity, interoperability, supply chain management, and patient engagement. Using case studies from well-known healthcare companies it seeks to identify the adoption of blockchain in the current world. Furthermore, it identifies the challenges in blockchain adoption and seeks to identify an alternative solution for adopting this disruptive technology.

2. Methodology

This paper studies blockchain in the healthcare sector, with an emphasis on the comprehensive benefits it offers in this industry. This section outlines the research methods, data sources, and analytical tools employed to conduct this study.

2.1. Research Design

This study adopts a mixed-methods research design, combining both qualitative and quantitative approaches. Qualitative methods are employed for a comprehensive review of the literature, case studies, and regulatory analysis. Quantitative methods are utilized to analyze and interpret data relevant to blockchain adoption in healthcare.

2.2. Data Collection

2.2.1. Literature Review

The literature review draws from academic journals, reports, and books, focusing on publications from the fields of blockchain, digital healthcare and disruptive technologies. A systematic search strategy was implemented, including keyword searches in academic databases and hand-searching of relevant journals and conference proceedings. A bibliographic search was carried out from 2020 to 2023. Key concepts include blockchain, disruptive technologies and their application in the healthcare industry.

2.2.2. Case Studies

A selection of real-world case studies in the US healthcare sector is examined to understand the adoption of blockchain and the challenges that were faced. These case studies are sourced from internet news sources, regulatory documentation, and scholarly publications.

2.3. Data Analysis

2.3.1. Qualitative Analysis

Qualitative data obtained from the literature review and case studies are analyzed thematically. Common benefits, challenges, and best practices related to blockchain in healthcare are categorized and analyzed.

2.3.2. Quantitative Analysis

The quantitative aspect of the research involves the analysis of relevant data sets related to the issues in the healthcare industry. This includes data on medical record errors, drug tracing, patient data security breaches, patient demographics, digital maturity of healthcare companies and technology implementation costs. Data analysis techniques, such as statistical tests, maturity assessments and data visualization, are employed to identify patterns and potential biases.

3. Literature Review

3.1. Basics of Blockchain

Blockchain is a revolutionary decentralized technology that functions as a secure and transparent digital ledger. Consisting of a chain of blocks, each containing a record of transactions, blockchain eliminates the need for a central authority by distributing the ledger across a network of participants. Immutability ensures that once information is recorded, it cannot be altered, fostering trust and integrity. Cryptographic techniques secure transactions, and consensus mechanisms validate the accuracy of the ledger. Notable for its transparency, blockchain enables all authorized participants to view the same data, enhancing accountability. Smart contracts, self-executing scripts, automated processes based on predefined conditions. Whether used for cryptocurrencies, supply chain management,

or healthcare, blockchain's principles of decentralization, transparency, and security have transformative implications across various industries.

3.2. Blockchain in Healthcare

The following sections provide an overview of how blockchain can be applied to different areas of healthcare, highlighting its potential to enhance security, transparency, and efficiency. Blockchain in this industry becomes significant since health care and life sciences plan the most aggressive deployments of blockchain across all industries. A survey by Deloitte showed 35 percent of respondents saying that their company plans to deploy it in 2017 which was when blockchain was in a fledgling phase [16].

3.2.1. Current Interoperability Issues and Blockchain Solutions

In the current healthcare system, the patients' health records are fragmented and spread out across multiple hospitals, networks, and institutions where they have the interaction point with the patient in the form of blood tests, imaging, and clinic letters. The patient's quality of care suffers because of this. Other institutions are not aware of a patient's complete history and in turn, this could lead to incorrect decision making, delays, and unnecessary costs for the patient or health institution. In the worst case, these medical errors can be fatal. Research at the American Johns Hopkins Hospital by Makary et al, 2019 concluded that medical errors are the third leading cause of death in the United States [11] and that "most errors represent systemic problems, including poorly coordinated care." Data silos and interoperability gaps within healthcare systems are significant challenges that impede the seamless exchange of information and hinder the efficiency of healthcare delivery. These silos result in fragmented data, where patient information is dispersed and not easily accessible across the entire healthcare ecosystem. Interoperability gaps further exacerbate this issue by preventing different healthcare systems from effectively communicating and sharing data with one another. This lack of interoperability hinders the ability to create a comprehensive and real-time view of a patient's medical history, leading to inefficiencies in care coordination, increased likelihood of medical errors, and challenges in implementing data-driven initiatives. Moreover, most of the electronic health records are stored in centralized systems that results in trust in a single authority which is risky. Such data is also prone to security threats.

Interoperability, a major concern in healthcare, can be improved through blockchain's ability to establish a standardized and secure protocol for data exchange between different systems. By creating a transparent and shared ledger accessible to authorized parties, [15] blockchain fosters trust among stakeholders, including patients, healthcare providers, and regulators. As the healthcare industry continues to grapple with these challenges, blockchain technology stands out as a transformative solution capable of elevating data security, promoting interoperability, and rebuilding trust in healthcare systems. Blockchain provides all the data on a decentralized platform where parties do not have to trust some unknown standalone platform.

3.2.2. Challenges in Healthcare Supply Chain and Blockchain Solution

The healthcare supply chain faces a myriad of challenges, including issues of traceability, counterfeit drugs, inefficiencies, and lack of transparency. One of the critical challenges is the difficulty in tracking and verifying the authenticity of pharmaceutical products as they move through the supply chain. Counterfeit drugs pose a significant risk to patient safety and undermine the integrity of the healthcare system.

Blockchain technology emerges as a powerful solution to address these challenges. By implementing blockchain in the healthcare supply chain, [1] a transparent and tamper-resistant ledger is created. Each transaction, from the manufacturing of pharmaceuticals to their distribution and delivery, is recorded in a secure and decentralized manner. This ensures an immutable and verifiable history of each product's journey through the supply chain.

Blockchain's smart contracts can automate and enforce agreements between different entities in the supply chain, reducing delays and errors. This automation not only streamlines processes but also enhances overall efficiency. Additionally, real-time visibility into the movement of products allows for quicker response to issues such as recalls or shortages.

Furthermore, blockchain promotes trust among stakeholders in the supply chain. With a decentralized and consensus-based system, information becomes more reliable, reducing the likelihood of fraud or errors. The implementation of blockchain in the healthcare supply chain represents a transformative step towards a more secure, transparent, and efficient system, ultimately safeguarding patient well-being and the integrity of the pharmaceutical industry.

3.2.3. Patient Health Records on Blockchain

For patients and professionals, the present healthcare registration system is incredibly slow, inflexible, and woefully opaque. These problems are equally visible throughout the claims process. When a patient needs services (from a provider such as a general practice, a pharmacy or nursing home), health plans are used to determine how much of the cost they will pay. To determine this cost, the health plan must validate services received from the provider against the agreement the patient and health plan have, and then share their findings with the provider. This only occurs if the provider is in-network with a health plan. For a provider to be considered in-network, a complex agreement needs to be negotiated which adds a significant expense to the provider's administration costs. A part of these costs are billing and insurance related costs which include activities such as maintaining benefits databases and keeping records of services delivered. These costs up to 3.8 hours for the average physician to navigate [3]. On average, this whole process takes between one to two weeks if done electronically and takes three to five weeks on paper. Moreover, this process is rife with places for miscommunication and misunderstanding to occur. For care to take place, multiple people need to check multiple archaic agreements against multiple records. The result is an inefficient and opaque process that leaves stakeholders and, ultimately, patients feeling confused and skeptical.

Blockchain helps in securing the patient's historical health data including the usage statistics and upkeep logs enhancing patient safety and lowering the likelihood of faults. This would result in lower repeat diagnostics and decreased risk of errors associated with inaccurate medical records. When the patient forgets the medical reports or loses them, they can access this secure data on the blockchain and send it to the doctors resulting in less travel time. This also reduces the appointment cancellations resulting in better revenues for the hospitals and savings in lost administrative time and effort. Having this data on an immutable platform like blockchain helps in accessing the data at any time with trust between the different parties. Blockchain can provide patients with all of this data in an organized format on a decentralized platform thus providing them with greater control over their health records and empowering them in their decision-making process.

3.2.4. New Digital Healthcare Modes and Blockchain Solution

Digital health solutions such as Telemedicine will be critical for driving efficiency and reducing costs. The scope of Telemedicine covers referrals, second opinions, education, follow-up care, monitoring, diagnostics, and treatments across numerous specialties. Unfortunately, most modern Telehealth systems are not integrated with the core financial and clinical systems used by healthcare organizations. Data remains within the Telehealth application and requires manual entry later into health records. Digitization promises much potential, but adding an additional silo without incorporating the information does not add value. To succeed, systems, devices, and data need to be seamlessly integrated. Privacy and security law issues must consider the management of data in non-traditional formats (for example, audio and video) and the sharing of data responsibilities encountered. To minimize the privacy and security risk of Telehealth encounters, providers require reliable methods for verifying and authenticating the identities of the patient and practitioners. Blockchain solutions are a great tool to overcome these issues. Telemedicine data like video consultations and electronics prescriptions can be safely stored and shared through blockchain.

Furthermore, the wearables industry has been rapidly innovating to expand the frontier of the data that is collectable. We already have remarkable access to anatomic, biological, environmental, genomic, phenomic and physiological data. New ideas and technologies will only move this frontier further. Blockchain can connect these disparate data sources and then caregivers and researchers can have unprecedented insight into patient's lives.

3.2.5. Blockchain Solutions in other Healthcare related industries

Blockchain can increase transparency in clinical trials by offering a transparent and immutable trial data record. The drug development process can be made more secure enabling all the participants to share trustworthy data to collaborate and work more efficiently. Researcher agencies can access patient data on the platform to glean valuable future insights.

Blockchain's transparency and traceability features can help combat fraud within the healthcare insurance sector. Health insurance agents can use the patient's blockchain data to process claims. It reduces a lot of time in their man-hours spent in analyzing the trustworthiness of the data and also leads to quicker and more accurate payments. This benefit can furthermore be passed onto the patients in terms of lower insurance premiums.

4. Case Studies

4.1. MediLedger Project

The MediLedger Project aimed to leverage blockchain technology to create a secure, transparent, and interoperable network for the [2] pharmaceutical supply chain. The primary focus was on meeting the requirements of the Drug Supply Chain Security Act (DSCSA) in the United States. Chronicled, a technology company, collaborated with major pharmaceutical companies, including Pfizer, Genentech (Roche), and others, to develop and implement the blockchain-based solution.

As part of the implementation, each drug product was assigned a unique identifier (serial number) that was recorded on the blockchain. This allowed stakeholders, including manufacturers, wholesalers, and pharmacies, to trace the entire lifecycle of a drug product, from manufacturing to distribution to the end consumer. Smart contracts were utilized to automate certain processes, such as verification and compliance checks. This streamlined the verification of drug products and ensured that they met regulatory requirements at each stage of the supply chain.

The implementation of the MediLedger Project showcased several positive outcomes. Blockchain technology significantly enhanced traceability by providing a tamper-proof and transparent record of the drug supply chain. This not only helped combat counterfeit drugs but also facilitated more efficient recalls when necessary. The solution addressed the requirements of the DSCSA, demonstrating that blockchain can be a valuable tool for ensuring compliance with healthcare regulations. The enhanced security and traceability features contributed to a reduction in counterfeit drugs entering the supply chain, thereby improving patient safety. The decentralized and interoperable nature of the blockchain network fostered collaboration among different stakeholders in the pharmaceutical supply chain. This collaboration led to increased transparency and efficiency.

While the project demonstrated significant success, it also faced challenges, including the need for widespread industry adoption, addressing technical complexities, and ensuring scalability as the network expands.

4.2. IBM and FDA Project

IBM and the FDA collaborated on [5,6] a project to explore how blockchain technology could be utilized to address challenges related to data sharing in medical research while ensuring patient privacy and data security.

The primary objectives of the collaboration were to improve data sharing to explore a secure and efficient way to share patient data for medical research among different stakeholders, including researchers, healthcare providers, and regulatory bodies and to develop a system that prioritizes patient privacy and allows patients to have control over their data, including who accesses it and for what purposes.

The project involved the development of a permissioned blockchain network to enable secure and transparent data sharing. Key features of the implementation included a permissioned blockchain that ensured that only authorized participants, such as healthcare providers, researchers, and regulators, had access to the data. Smart contracts were utilized to implement patient consent mechanisms. Patients had the ability to control who could access their data, for what duration, and for specific research purposes. All transactions and changes to the data were recorded on the blockchain, providing an immutable and transparent audit trail. This enhanced traceability and accountability in the data-sharing process. The blockchain network facilitated interoperability by providing a standardized framework for data exchange. Different healthcare entities could securely share and access patient data in a standardized format.

The collaboration between IBM and the FDA resulted in several benefits. The use of blockchain technology provided a secure and efficient platform for sharing patient data for medical research, promoting collaboration among stakeholders. Blockchain-based smart contracts enabled patients to have greater control over their data, ensuring that their privacy was prioritized and that they could provide explicit consent for data sharing. The immutability and transparency of the blockchain ensured the integrity of the data and provided a clear and traceable history of all data transactions. The blockchain network streamlined regulatory oversight, allowing regulators like the FDA to have real-time visibility into data transactions while maintaining data security and patient privacy.

Despite the success of the collaboration, there were challenges in regulatory compliance, standardization of data formats, and the need for broader industry adoption.

4.3. Challenges and Risks in Blockchain Implementation

4.3.1. Regulatory Compliance

Healthcare is heavily regulated, [4] and compliance with existing regulations is a significant hurdle for blockchain adoption. Ensuring that blockchain solutions comply with privacy laws (such as HIPAA in the United States) and other healthcare regulations is crucial.

4.3.2. Interoperability and Integration

Achieving interoperability between existing healthcare systems and new blockchain solutions is a substantial challenge. The healthcare industry has diverse and often siloed systems, making seamless data exchange difficult. Standardizing data formats and ensuring compatibility is a complex task.

4.3.3. Lack of Data Standardization

The lack of standardized data formats across different healthcare providers and systems poses a challenge for blockchain integration. Without standardized data, achieving meaningful interoperability and data consistency becomes challenging.

4.3.4. Scalability Issues

Blockchain networks, particularly public ones, face scalability issues. As the volume of healthcare data is vast, ensuring that the blockchain infrastructure can handle the scale without compromising performance is a persistent challenge.

4.3.5. Integration with Legacy Systems

Many healthcare organizations operate with legacy systems that may not be easily compatible with blockchain technology. Integrating blockchain solutions with these existing systems without disrupting operations requires careful planning and execution.

4.3.6. Data Security Concerns

While blockchain is praised [4] for its security features, there are still concerns related to the security of endpoints (where data enters or exits the blockchain). The security of data before it enters the blockchain and after it leaves needs to be addressed comprehensively.

4.3.7. Costs and Resource Allocation

Implementing blockchain solutions involves significant upfront costs, including technology infrastructure, training, and development. Healthcare organizations may be hesitant to allocate resources and budget for such investments, especially when the benefits may not be immediately realized.

4.3.8. Education and Skill Gaps

Blockchain is a relatively new technology, and there is a shortage of skilled professionals with expertise in both blockchain and healthcare. Training existing staff or hiring new talent with the required skills can be a time-consuming and challenging process. A survey by Deloitte showed 39% of the respondents showing little or no knowledge of this technology [16].

4.3.9. Patient Adoption and Trust

Patients may be hesitant to adopt new technologies, especially when it comes to the security and privacy of their health data. Building trust in blockchain solutions and ensuring transparent communication about the benefits and security measures is crucial for patient acceptance.

4.3.10. Resistance to Change

The healthcare industry has historically been slow to adopt new technologies due to a variety of factors, including risk aversion, established workflows, and a conservative approach. Overcoming resistance to change and fostering a culture of innovation is a significant challenge.

4.4. Way Forward in Blockchain Implementation

Addressing the Blockchain implementation challenges requires a collaborative effort involving healthcare organizations, technology providers, regulatory bodies, and other stakeholders. It necessitates a strategic and phased approach to implementation, considering the unique nuances of the healthcare ecosystem.

Though all the challenges in blockchain implementation cannot be overcome immediately due to the rigid healthcare structure that we have currently, an alternative approach can be followed. Medical representatives, patients and policy makers can use the following alternative solutions while implementing blockchain technology in healthcare.

Blockchain-enabled solutions should be considered in relation to existing systems and technologies. Blockchain should complement and leverage existing systems and be tested incrementally in a controlled environment before large-scale implementation. Blockchain-based solutions must have features that must be evaluated in terms of compliance with laws, regulations, and data governance frameworks. Furthermore, blockchain should be evaluated on its merits and applied where it is the best application for the problem at hand, after comparing it to alternative solutions in terms of costs and benefits it offers. Blockchain requires a new way of thinking about data and information. Users of this technology, including patients and the public, must be educated, and prepared to use the features of this technology and the implications of its use for data ownership, access and privacy.

4.5. Opportunities for Further Research

Blockchain integration benefits with various other healthcare related sectors like insurance, fitness centers, pharmacies, health data research agencies, regulatory agencies can be explored. Blockchain's benefits in integration with a wide variety of other technologies and medical devices can be explored. This would help in unlocking and sharing the data in ways that were not possible earlier without this technology. Future studies can also be around how to tackle the implementation challenges and ethical issues that may come up in future from the use of this technology.

5. Results

This paper summarizes the key findings and emphasizes the transformative potential of blockchain in revolutionizing the healthcare industry.

6. Conclusion

The conclusion drawn from this research is that the benefits accrued by implementation of blockchain in healthcare far outweigh the challenges and this technology must be leveraged to overcome the innumerous challenges in the healthcare industry. It is a call to action for stakeholders to explore and adopt blockchain solutions for a more secure, interoperable, and patient-centric healthcare ecosystem.

References

[1] Guneer Kaur, 9 promising blockchain use cases in healthcare industry, Feb 20, 2023, Available from https://cointelegraph.com/news/9-promising-blockchain-use-cases-in-healthcare-industry

[2] MediLedger's Blockchain Pilot to Assist Drug Supply Chain Stakeholders in Developing an Interoperable Track & Trace System for the US DSCSA Regulations Has Kicked Off; Jun 18, 2019, San Francisco, Available from https://www.prnewswire.com/news-releases/mediledgers-blockchain-pilot-to-assist-drug-supply-chain-stakeholders-in-developing-an-interoperable-track--trace-system-for-the-us-dscsa-regulations-has-kicked-off-300869903.html

[3] Medicalchain Whitepaper, 2018, Available from https://medicalchain.com/en/whitepaper/

[4] Challenges of Blockchain in Healthcare, 22 Jul 2022, Available from https://www.geeksforgeeks.org/challenges-of-blockchain-in-healthcare/

[5] Mark Treshock, How the FDA is piloting blockchain for the pharmaceutical supply chain, May 4, 2020, Available from https://www.ibm.com/blog/how-the-fda-is-piloting-blockchain-for-the-pharmaceutical-supply-chain/

[6] BM and the FDA collaborate on blockchain health data, Jun 2019, Available from https://www.scientific-computing.com/news/ibm-and-fda-collaborate-blockchain-health-data

[7] Alison McCauley, Why Big Pharma Is Betting on Blockchain, 29 May 2020, Available from https://hbr.org/2020/05/why-big-pharma-is-betting-on-blockchain

[8] Mediledger Live Solutions, Available from Mediledger.com

[9] Chet Stagnaro, Freed Associates, Innovative Blockchain Uses in Health Care, Available from https://s3.amazonaws.com/arena-attachments/1649918/a272c30523a39678dadcddc272d53a24.pdf?1516914525.

[10] US Department of Health, and Human Services, Blockchain for Healthcare, HHS Cybersecurity Program, Office of Information Security, Oct 7, 2021, Available from https://www.hhs.gov/sites/default/files/blockchain-for-healthcare-tlpwhite.pdf

[11] AHRQ Patient Saf Network, Koppel R. Patient safety and health information technology: learning from our mistakes perspective, 2012;(4):5-8, accessed April 18, 2020; Available from https://psnet.ahrq.gov/perspective/patient-safety-and-health-information-technology-learning-our-mistakes.

[12] Sigall K. Bell, MD1,2; Tom Delbanco, MD1,2; Joann G. Elmore, MD, MPH3; et al, Frequency and Types of Patient-Reported Errors in Electronic Health Record Ambulatory Care Notes, Jun 9, 2020, Available from https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2766834

[13] Sue Bowman, Impact of Electronic Health Record Systems on Information Integrity: Quality and Safety Implications, Oct 1, 2023, Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3797550/

[14] Aitizaz Ali, Bander Ali Saleh Al-rimy, Ting Tin Tin, Saad Nasser Altamimi, Sultan Noman Qasem, and Faisal Saeed, Empowering Precision Medicine: Unlocking Revolutionary Insights through Blockchain-Enabled Federated Learning and Electronic Medical Records, Sep 2023 Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10490801/

[15] Blockchain in Healthcare: Transforming Data Security and Interoperability, Cloud 7 IT Services, https://www.linkedin.com/pulse/blockchain-healthcare-transforming-data-security/

[16] Meg Bryant, Blockchain: Healthcare has 'most aggressive deployment plans of any industry', Dec 15, 2016, https://www.healthcaredive.com/news/blockchain-healthcare-has-most-aggressive-deployment-plans-of-any-industr/432403/