Annals of Case Reports
Almatrooshi SI, et al. Ann Case Rep: 9: 101703
www.doi.org/10.29011/2574-7754.101703
www.gavinpublishers.com

Review Article

Transformative Role of Cryptocurrency in the Healthcare System of UAE

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Citation: Almatrooshi SI, Gopakumar A, Mathur V (2024) Transformative Role of Cryptocurrency in the Healthcare System of UAE. Ann Case Report 9: 1703. DOI: 10.29011/2574-7754.101703

Received: 10 March 2024; **Accepted:** 14 March 2024; **Published:** 18 March 2024

Abstract

Key objectives: This review paper aims to highlight the importance of implementing crypto billing in the healthcare sector, with a specific focus on the Emirates Health Services (EHS) operating across the northern emirates of the UAE. The primary objective is to demonstrate how blockchain technology and smart contracts can enhance data security, privacy, and integrity in managing extensive electronic patient records. **Methods**: To achieve the objectives, a comprehensive review of literature and existing practices in healthcare billing and blockchain technology was conducted. The review focused on understanding the potential benefits of crypto billing, particularly in the context of the EHS. Additionally, insights from experts in blockchain technology and healthcare administration were gathered to inform the discussion on the implementation strategies. **Results**: The review underscores the potential of crypto billing, enabled by blockchain technology, to revolutionize healthcare billing processes. By automating and streamlining the billing process, crypto billing reduces administrative overhead and ensures greater transparency and accuracy in financial transactions. Moreover, the use of dynamic smart contracts allows for real-time, cryptocurrency-based payments, thereby facilitating decentralized decision-making and operational control with continuous system functionality. **Conclusions**: The review highlights the pressing necessity for adopting crypto billing within the healthcare sector. To realize the full potential of crypto billing, future efforts should focus on training healthcare professionals on utilizing smart contracts and decentralized payment gateways to optimize the efficiency of healthcare transactions and improve overall patient care.

Keywords: Cryptocurrency; Billing and Payments; Healthcare System; United Arab Emirates

Introduction

The widespread creation of extensive electronic patient records, placing significant demands on the protection of healthcare data during utilization and sharing across the healthcare system. The emergence of blockchain technology, recognized for its responsible and transparent data storage and distribution. It is opening avenues to address critical challenges related to data privacy, security, and integrity within the healthcare sector. Blockchain's cryptographic features provide enhanced security, making it suitable for handling sensitive healthcare data, including billing information. It facilitates the use of smart contracts, which are contracts that self-perform with the terms explicitly coded into the system.

In healthcare crypto billing, smart contracts could automate and streamline the billing process by automatically executing payment terms when predefined conditions are met, reducing administrative overhead. The patient data and billing records can be stored in a secure and decentralized manner, minimizing the likelihood of unauthorized/illegal access and ensuring data integrity. Crypto billing facilitates the distribution of authority, or control across multiple facilities of the same entity rather than

being concentrated in a single central authority. In the context of crypto billing, it involves spreading decision-making and operational control among multiple nodes. If one node or part of the network goes down, the system can still function as other nodes maintain the network. Within the realm of blockchain and digital currencies, decentralization is achieved by employing distributed ledger technology, which registers transactions across a network of computers. Each node in the network has a copy of the entire blockchain, and a consensus mechanism is used to validate and agree on the state of the ledger.

In an extensive healthcare systems like EHS, the information will be widely scattered across various non-integrated data storage solutions, hindering the availability of comprehensive data for supporting care processes and decision-making. This fragmentation arises from the isolated and centralized management of health information by individual medical centers. Consequently, Healthcare professionals frequently encounter challenges with limited access to comprehensive patient data, leading to potential errors across various aspects of patient care. Insufficient access to patient information may contribute to errors in diagnosis, treatment decisions, billing processes and other administrative aspects of healthcare management. Moreover, the centralization of information poses numerous risks to data security and integrity. Establishing mechanisms to foster interoperability among the information systems supporting healthcare processes is imperative [1-2]. The use of blockchain can enhance the efficiency and integrity of healthcare operations, providing a trustworthy framework for storing, sharing, and accessing patient information. The integration of a blockchain system into the healthcare sector closely parallels the functionalities of major payment processors. Blockchain technology in healthcare offers a secure, transparent, and decentralized platform for managing transactions and sensitive data. It is evolving significantly, holds the promise of transforming various information-driven sectors. In its first generation, it enhances monetary systems through cryptocurrency usage in finance sector, while the second generation maintains the algorithm but introduces decentralized applications and executes smart contracts. Moving into the third generation, the technology finding applications in healthcare, as well as other sectors. The influence and impact of blockchain technology extends beyond its origins in cryptocurrency, introducing a new paradigm for governing and organizing various aspects of medical services domain. However, cryptocurrency has been a catalyst for innovation and has transformed the landscape of medical services [3].

Numerous studies explore the global factors influencing the adoption of cryptocurrency infrastructure and its future trajectory. The expanding market of payment systems and financial technologies serves as a key benchmark for the development of crypto assets which is driven by the increasing prevalence of non-cash payments [4]. Though there are less empirical studies on the factors driving their adoption, there are vital theoretical discussions on the reasons of embracing cryptocurrencies and its outcomes [5-6]. Using statistical concepts, influence of social factors, and support conditions on the attitude toward the cryptocurrency financial system have been identified in literature, listed key social factors that significantly impact its implementation [7]. Other scholars explored the real-time transaction speed of the cryptocurrency system, quantified in transactions per second. It is essential for assessing the efficiency, scalability, and overall performance of a cryptocurrency system, ultimately contributing to a better understanding of its capabilities and limitations [8].

Another study discusses the use of blockchain technology where the Smart health-care services underscore the consideration of how these advancements are reaching and being embraced by diverse ethnic communities, likely involving the use of technology, data analytics, and innovative solutions to enhance healthcare delivery. The study employs structural equation modeling to explore the preparedness of ethnic minority groups in adopting e-healthcare services based on blockchain technology. They claim that the validated framework will assist regulatory bodies and marketers in formulating supportive mechanisms for healthcare services tailored to ethnic minority groups, addressing concerns related to security and privacy specific to these communities [9]. However, the healthcare sector of UAE has seen limited implementation of projects based on blockchain technology. Therefore, one of the research projects adopts a qualitative approach to investigate the viewpoints of physicians on the advantages, apprehensions, and obstacles associated with the adoption of blockchain in Health Information Exchange (HIE) initiatives. They utilized 'Promoting Action on Research Implementation in Health Services (PARIHS) framework' to enhance our comprehension of underlying causes, current challenges, perceived risks, perceived benefits, and recommendations. The research identified primary advantages, which are classified into three themes as innovative technological features, collaborative ecosystem, and system performance. Conversely, the main apprehensions and risks are classified into four themes such as individual, organizational, technological, and market-related issues.

In the above context, the EHS entity considered the advantages of employing crypto billing in its healthcare system and the current paper proposes the implementation strategy, as it oversees 136 facilities operating across six emirates of the UAE. The paper explored the need for implementing crypto billing in the healthcare sector of UAE and encourages the entities including EHS to set up smart contracts within the payment system to instantly direct patients and give indications. These smart contracts would automate the payment process by providing real-time instructions to patients, which are dynamic, fluctuating based

on the current prices of cryptocurrencies at the time a payment request is initiated. This should also ensure all cashiers and finance operation managers are able to access a decentralized form of payment gateway and trained to be able to guide customers on how to pay. As part of implementing crypto billing option at all EHS facilities under the EHS' management, a planned training and awareness to nurses and physicians is the future scope to know on how to send and manage information shared on smart contracts. The purpose of this current paper is to shed light on the integration of crypto billing within the healthcare system of EHS and propose a plan for implementation.

Use Cases

Cryptocurrency and blockchain technology have the potential to bring several benefits to the healthcare industry. Here are some potential use cases.

- Secure and Interoperable Health Records: Blockchain is used to create a secure and tamper-proof record of patient data to meet data integrity and Interoperability. Each entry in the blockchain is time-stamped and linked to the previous one, ensuring the integrity of the data. It can facilitate interoperability by providing a standardized and secure way for different healthcare providers to access and share patient data with the patient's consent.
- Supply Chain Management: Blockchain helps for Drug Traceability track the entire supply chain of pharmaceuticals, ensuring the authenticity and integrity of drugs from manufacturers to distributors and ultimately to hospitals. This help in reducing fake drugs.
- Billing and Payments: Cryptocurrencies and smart contracts can automate and streamline billing and payment processes within the healthcare system. This reduces administrative overhead and improves efficiency.
- Clinical Trials and Research: Blockchain enables secure and transparent sharing of clinical trial data among researchers and institutions. This enhances collaboration, data accuracy, and the overall efficiency of the research process.
- Identity Management: Blockchain used for Patient Identity Verification by secure and decentralized patient identity management. Patients can have control over their own identity, and healthcare providers can access verified information without relying on a centralized database.
- Telemedicine and Remote Patient Monitoring: Cryptocurrencies facilitates secure Data Transmission and traceable transactions for telemedicine services. Additionally, blockchain ensures the security and integrity of data transmitted from remote monitoring devices.
- Medical Device Tracking: Blockchain employed to track the manufacturing, distribution, and maintenance of medical devices. This supply chain for devices ensures the authenticity and reliability of these devices, reducing the risk of counterfeit or faulty products.
- Health Insurance: Smart contracts on a blockchain can automate the claims process in health insurance, ensuring that claims are processed transparently and efficiently.

Since the paper aims to leverage the benefits of smart contracts and cryptocurrency price points to facilitate instantaneous and flexible payments within the healthcare system, It is important to note that while the potential benefits are substantial, there are challenges and considerations, such as regulatory compliance, data privacy, and the need for industry-wide adoption. The integration of blockchain and cryptocurrency into healthcare requires careful planning and collaboration among stakeholders to realize the full potential of these technologies.

Methods for implementation

The primary objective of the paper is to delve into the practical aspects and potential benefits of incorporating cryptocurrency features into the realm of patient payments and billing within the healthcare sector of EHS. This exploration likely includes examining how cryptocurrencies can be integrated into the billing systems used. The main focus was on investigating the method of its implementation and the aspects such as the security, efficiency, and transparency of using cryptocurrencies in patient transactions, as well as the impact on the overall patient experience. This study is intended to provide insights into the feasibility and implications of leveraging cryptocurrency technology to enhance patient payment processes within the healthcare industry. Setting up a cryptocurrency payment chain via smart contracts in our healthcare system (EHS) involves several steps and requires specific infrastructure. Below is an outline proposed.

- Choosing Blockchain Platform - Choose a suitable blockchain platform for implementing smart contracts. Ethereum is a popular choice due to its robust smart contract capabilities, but other platform options available are Binance Smart Chain, Cardano, or Solana. Hyperledger Fabric, hosted by the Linux Foundation, is an open-source blockchain platform designed for enterprise use. It provides a permissioned blockchain infrastructure, making it suitable for applications requiring privacy and confidentiality. Hyperledger Fabric has been utilized in various healthcare projects globally.
- Wallet Integration - Integrate cryptocurrency wallets into the payment system. Users will need wallets to send and receive cryptocurrency payments. Wallet integration ensures a secure and user-friendly experience.

- Development of Smart Contracts - Develop smart contracts that handle the payment process. Smart contracts are self-executing contracts with the terms directly written into code. They can automate and enforce the rules of a payment transaction, ensuring transparency and security.
- Create a Frontend - Create a frontend for users to interact with smart contracts. This can be a web-based interface or a mobile app, commonly referred to as a decentralized application (DApp). The DApp allows users to initiate and manage cryptocurrency payments through smart contracts. Further integration can be done if real-world data is needed for the smart contract's execution, for enhancing their functionality and enabling more complex payment scenarios.
- Security measures - Ensure the overall security of the infrastructure. Cryptocurrency transactions involve valuable assets, and security measures such as encryption, secure key management, and communication protocols.
- Testing and deployment - Thoroughly test the smart contract and payment chain in a test environment to identify and fix any issues before deploying to the production blockchain. Once finalized, deploy the smart contract and associated infrastructure to the chosen blockchain. This step involves interacting with the blockchain network and deploying the smart contract code.
- Assessment and sustainability - Implement monitoring tools to track the performance and security of the payment chain. Using statistical approach, the actual transaction speed can be measured in transactions per second and annual speeds can be compared. The continuous assessment must reveal the adoption of the best crypto billing system driven by factors such as practicality, convenience, efficient transaction time, faster payments, and simplicity in the payment process etc. this step includes regularly update and maintain the system to address any issues or incorporate new features.
- User awareness programs - Provide users with clear instructions on how to use the payment system. Educate them on creating wallets, initiating payments, and understanding the smart contract's behavior.

Cryptocurrency best practices for healthcare and proposed plan

In an era where extensive electronic patient records demand robust protection and seamless sharing across healthcare systems, the emergence of blockchain technology with cryptocurrency practices offers a beacon of innovation. The integration of cryptocurrency into the healthcare sector represents a transformative surge in managing financial transactions and patient data. The following areas where its key best practices are observed.

- Strengthening anti-money laundering procedures at healthcare institutions-Healthcare institutions focus their anti-money laundering efforts on their interface function through transactions between healthcare institutions and major cryptocurrency exchanges, allowing for improved differentiation between ordinary client conduct from potential money laundering activities.
- Monitoring transactions-Algorithmic systems have been devised for traditional fiat currency to detect behaviors and patterns indicative of money laundering, and these are applicable to cryptocurrencies and virtual assets as well.
- Improving regulation-Enforcing more rigorous global standards for issuing e-wallets and overseeing cryptocurrency exchanges fosters consensus among major stakeholders and encourages complementary regulations within the healthcare sector.
- Placing third-party ID providers under state supervision – this enhances accountability, especially in addressing incidents related to data and identity theft.
- Using blockchain as a solution-The inherent characteristics of blockchain could facilitate enhanced supervision by enabling more in-depth anti-money laundering risk analysis, along with the integration of alert and reporting mechanisms into the cryptocurrency system.

Setting up a cryptocurrency payment chain via smart contracts requires a combination of blockchain expertise, smart contract development skills, and a user-friendly frontend to create a seamless experience for users interacting with the payment system. Furthermore, the paper would like to explore the challenges, regulatory considerations, and potential innovations associated with introducing crypto features into the healthcare payment landscape.

Challenges in implementation

Cryptocurrency regulations vary globally, and the lack of clear regulatory frameworks in the healthcare sector poses challenges for compliance and legal considerations. The implementation of cryptocurrencies in the healthcare system of the UAE presents specific challenges unique to the region. One significant hurdle lies in navigating the regulatory landscape, as the UAE has many jurisdictions, is actively shaping its view on cryptocurrency usage. Establishing clear guidelines and compliance measures within the healthcare sector is crucial to ensure that the integration of cryptocurrencies aligns with local regulations and meets the standards set by health authorities in the UAE.

Moreover, concerns about the security of patient data and financial transactions become particularly pronounced in the context of the UAE's commitment to prioritizing privacy and data protection. The decentralized nature of cryptocurrencies may clash with the stringent data protection measures in place. Integrating cryptocurrency payments with existing healthcare systems can be complex. Balancing the innovative potential of cryptocurrency integration with the imperative to safeguard patient confidentiality will be a delicate task. Healthcare organizations often use inherit systems and adapting them to accommodate cryptocurrency transactions may require significant technical adjustments.

Additionally, the healthcare industry needs robust measures to prevent fraud, scams, and other illicit activities associated with crypto payments. Fostering user trust and understanding among patients and healthcare providers in the UAE about the benefits and risks of cryptocurrency transactions is essential for successful implementation. Educating stakeholders on the details of cryptocurrency use and addressing concerns related to the technology's volatility and potential misuse will be vital steps in overcoming these challenges and ensuring a smooth adoption process in the healthcare system of the UAE.

Regulatory considerations

The implementation of cryptocurrency in the health sector involves navigating a dynamic regulatory environment, both domestically and internationally. In the UAE, regulatory considerations are paramount, with agencies such as the Abu Dhabi Global Market (ADGM) and the Dubai Financial Services Authority (DFSA) overseeing financial activities, including those related to cryptocurrencies [10-11]. Cryptocurrency businesses operating in the health sector must adhere to licensing and registration requirements set forth by these regulatory bodies. Compliance with Anti-Money Laundering (AML) and Counter Financing of Terrorism (CFT) regulations is particularly crucial to ensure the integrity of financial transactions within the healthcare industry. The primary financial regulators at the federal level in the UAE consist of the UAE Central Bank and the Securities and Commodities Authority (SCA) [12-13]. Alongside the federal jurisdiction, each of the Emirates has the option to opt for its independent local courts, addressing issues not exclusively reserved for federal jurisdiction as outlined in the Constitution.

On the international front, the OECD has been actively involved in studying and analyzing the implications of blockchain technology. The organization has conducted research, organized workshops, and produced reports on various aspects of blockchain, including its potential benefits, challenges, and policy considerations [14]. The UAE's engagement in the global financial community requires alignment with international standards set by entities like the Financial Action Task Force (FATF) [15]. Given the cross-border nature of cryptocurrency transactions in the health sector, compliance with regulations from major financial hubs and health-centric regulatory bodies is essential. The details of data protection and patient confidentiality further underscore the importance of adherence to international privacy regulations, including the European Union's General Data Protection Regulation (GDPR), to ensure the secure handling of sensitive health information in a global context. Navigating this complex regulatory landscape necessitates a proactive approach, with health organizations in the UAE staying up-to-date of evolving regulations and seeking legal counsel to ensure compliance and mitigate risks associated with the implementation of cryptocurrencies in the health sector.

Conclusion

In conclusion, the findings of this review emphasize the urgent need for implementing crypto billing in the healthcare sector. This article presents an approach for integrating cryptocurrency into the healthcare system of EHS and looks forward to employing an optimal method that has repeatability in other healthcare industries of UAE. Therefore, the subsequent research will focus on implementing the most effective crypto billing system and formulating an appropriate framework to evaluate the digital system, aiming to enhance crypto billing capabilities throughout the entity.

Acknowledgments: The authors acknowledge the support of Emirates Health Services for approval.

Funding: Not applicable.

Ethical considerations: Not applicable.

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this review article.

Author's contribution: The primary author conceived the idea, and all authors contributed to writing the paper.

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