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

(REVIEW ARTICLE)

Check for updates

Applying blockchain technology to healthcare: The cases of Ethereum and Cardano

Zhexiu Tu *

Department of Mathematics and Computer Science, University of the South.

World Journal of Advanced Research and Reviews, 2025, 26(03), 2684-2688

Publication history: Received on 19 May 2025; revised on 25 June 2025; accepted on 28 June 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.26.3.2496

Abstract

In this paper, we consider how the introduction of blockchain technology into the healthcare system can address the many challenges the healthcare industry is facing. After outlining the evolution of blockchain technology since 2015, we focus on two representative blockchains, Ethereum and Cardano. We scrutinize their similarities and differences in light of their potential applications in the healthcare industry.

Keywords: Blockchain; Healthcare; Ethereum; Cardano

1. Introduction

The invention of blockchain technology resolved two major tensions within the World Wide Web. The first tension pitted decentralization against tamper resistance, and second one set transparency against privacy. Blockchain technology first appeared with the conception of Bitcoin by Satoshi Nakamoto in 2008. Yet the maturation of blockchain technology has more recently been synchronized with the growth of the Ethereum platform, which launched in 2015.

Ethereum was the first decentralized blockchain where smart contracts were deployed and executed. The introduction of smart contracts made blockchain more tamper-proof and private, addressing two potential downsides that Bitcoin had not been able to completely resolve. In blockchain technology, global decentralization need not affect local tamper resistance, while macroscopic transparency need not curb microscopic privacy.

Indeed, Brian Burke, who formerly worked for the research firm Gartner, pointed out that using a public blockchain can remove the need for the central authorities that are usually essential for guaranteeing trust among different sides.[1] Instead, trust is built into the framework through immutable records on a distributed ledger where every transaction between two anonymous addresses is broadcasted to all members of the community.

Trust is a fundamental component of the healthcare system, of course. Healthcare revolves around a web of trust-based relationships—between providers and patients, between providers and financial institutions (e.g., insurers), between patients and financial institutions, between healthcare professionals themselves, and so on. Each of these relationships carries within it the very contradictions that blockchain technology has resolved: again, the tension between decentralization and tamper resistance, on the one hand, and transparency and privacy, on the other. Successful healthcare institutions and providers must be transparent about costs, risks, and potential outcomes while also respecting patients' privacy. While there should be no centralized authority that can interfere with the independent work of each healthcare provider (thus granting clinicians autonomy to make diagnoses and communicate care options), each provider's records should be as immutable as if they were, in fact, supervised by a central authority.

Today's healthcare system is not equipped to adequately meet these standards. For this reason, the gradual adoption of blockchain technology into the healthcare system in the near future is a logical next step for this industry.

* Corresponding author: Zhexiu Tu

2. Blockchain Applications in Healthcare

The features of blockchain and the workings of the healthcare industry can complement each other in ways beyond the ones mentioned above. Take the preservation of patient data, for example. Patient data is always the top priority of the healthcare industry with regard to data privacy, data security, and data efficiency. Patients want to know that neither a clinician nor an outside actor can tamper with their health records. Yet they also need prompt access to updated data like test results or prescription adjustments. The healthcare providers, meanwhile, have to weigh the cost of data storage.

Smart contracts can address all of those priorities: the immutability of records, accessibility of data, and reduction of data storage costs. Smart contracts are a special feature of blockchains, pioneered by Ethereum, that provide both a chain structure and a distributed ledger. Within a decentralized framework, every member maintains a copy of the entire blockchain wherein each transaction is verified by everyone else; costs are lower, and so is risk of forgery.

Sustainability presents another technological problem when it comes to the preservation of health records. The frequency of mergers and corporate reorganizations within the healthcare industry works against the need to maintain health records across time. Even within fully digitized Web 2.0 systems, the loss of patient records is common when healthcare providers expand, shrink, or relocate their business.

A concomitant problem frequently associated with sustainability is scalability, and this problem applies to the preservation of health records as well. The merger and reconstruction of healthcare databases cost the provider much time and effort with no guarantees against lost or misallocated information. Indeed, the scalability of databases usually poses an even larger challenge than sustainability. Using blockchain in healthcare applications, in addition to being more time- and cost-efficient [2], can significantly enhance the sustainability and scalability of health information.

Another unsolved problem in the healthcare industry that blockchain can help resolve is interoperability. Among multiple healthcare providers and their Web 2.0 systems, there usually are no intermediaries at all. Such siloing can cause huge problems for both patients and healthcare providers when healthcare records are transferred or migrated. Lost data, leaked information, and even tampering become unavoidable when healthcare systems are separated by the technological distance of their platforms or even by the physical distance of their servers. The hiring of intermediaries to achieve interoperability can be expensive and time-consuming. And the presence of any intermediary actually exposes data security and data privacy to further compromise. Here, too, the application of blockchain in the healthcare industry can resolve problems that heretofore seemed unavoidable.

3. Blockchain Moves beyond Bitcoin

Sustainability, scalability, and interoperability all were improved by the use of smart contracts, which, after being introduced by Ethereum in 2015, have also been employed by newer blockchains like Solana or Cardano. Allowing developers to build smart contracts on Ethereum was a turning point in the history of blockchain, marking its first successful application beyond Bitcoin. Ethereum cofounder Vitalik Buterin had argued to the developers of Bitcoin Core that blockchain technology could be beneficial to nonfinancial applications as well.[3] With smart contracts and decentralized applications, more Web 3.0 activities can be deployed on the Ethereum network, which is currently the largest and most mature open-ended decentralized platform.

Naturally, Ethereum is more appealing than Bitcoin to developers of healthcare systems and platforms. However, just like how Ethereum was invented out of the concept of Bitcoin, additional blockchains were developed as offshoots of Ethereum. Some of the other early founders of Ethereum left the community after disagreeing with Vitalik Buterin about core issues of development. One of them, Charles Hoskinson, founded IOHK, a blockchain company that immediately became a rival to Ethereum (IOHK is now known as Cardano, in honor of the Renaissance Italian polymath Gerolamo Cardano).

While Ethereum and Cardano sometimes receive attention in tandem, they differ in important ways. Thus, their prospective applications to the healthcare industry also diverge. In the following sections, we will delve into the ecosystems of both companies, elucidating their similarities and differences as they pertain to healthcare.

4. Similarities between Ethereum and Cardano

The most striking similarity between the two platforms concerns their mechanism for consensus: proof-of-stake, commonly abbreviated PoS. It is notable that Ethereum changed from proof-of-work (or PoW, the mechanism employed by Bitcoin) to proof-of-stake when Ethereum 2.0 was launched in 2021. Ethereum's previous PoW mechanism was one of the main factors behind the exit of Hoskinson and others from Ethereum. Cardano has used PoS from its founding in 2017.

The adoption of PoS has notable advantages in the areas of energy efficiency and scalability. Community members can pledge a portion of their crypto holdings as collateral to help validate and verify transactions. Those who do so are known as "stakers" or "validators." Compared to the Bitcoin network, the participation of stakers in Ethereum and Cardano is more eco- and community-friendly. Staking in both platforms is convenient. Cardano also allows on-chain staking through hardware wallets, a unique feature designed for those concerned about asset security.

From their founding, both platforms have admitted Layer 1 blockchain technology, providing space for developers to bring to life self-executing smart contracts and cultivate decentralized applications. Thus, both platforms have addressed the decentralization–tamper resistance and transparency–privacy tensions more systematically than has the Bitcoin network.

These qualities make both Ethereum and Cardano broadly applicable to the healthcare industry. For example, the micropayments common in the healthcare system can be greatly facilitated by either platform, since smart contracts are smart enough to self-execute all such payment transactions in a precise manner. The only divergence in their approaches to smart contracts is that each company uses a different coding language. Ethereum's language is Turing complete, which allows it to process anything given enough resources. Cardano uses a Haskell-based script called Plutus, which is designed for higher assurance, thus making its smart contracts more reliable.

5. Differences between Ethereum and Cardano

Their overall similarities aside, Ethereum and Cardano have notable philosophical difference that have profoundly affected their respective evolutions. Ethereum was constructed much earlier than Cardano and has maintained a much larger community from the outset of their coexistence. To respond to the growing needs and challenges in blockchain technology, the Ethereum Foundation has had to make rapid and even radical decisions. The development of Ethereum can be described as adaptable but occasionally rocky. It has responded quickly to the newest trends in blockchain technology, a dynamic that sometimes has caused division within the Ethereum Foundation.

In contrast, Cardano's development has been more steady, rigorous, and systematic. Every update of Cardano's platform undergoes extensive peer review, ensuring robustness and long-term stability. As a result, Cardano is rooted in academic research and is favored by sizeable institutions, including some in the healthcare industry. Accordingly, a potential downside of Cardano for its long-term application to healthcare is its comparatively slow pace of development. This guarantees stability. However, in the face of a constantly changing healthcare industry, Cardano may not offer the timely responses needed for an organization to keep pace.

Another factor that drags down Cardano's speed of development is its system of community governance, which also sets it apart from Ethereum. Due to the large number of Ethereum users, Ethereum Improvement Proposals often are evaluated (using a consensus process) by core developers, not by the entire community. While the governance of the Ethereum community is more elitist, that of the Cardano community is more democratic (if also, in some respects, more homogenous), using a structured system called Project Catalyst. Because nonprofit or academic organizations often embrace a collaborative or deliberative approach to setting policy, they may prefer Cardano. At the same time, new startups or promising businesses, which usually prioritize nimbleness and quick decisions, may choose Ethereum as their Web 3.0 platform. For the same reason, municipal or charitable hospitals may adopt Cardano, while private clinics may apply Ethereum in their medical systems.

It is also critical to scrutinize the financial aspects of both platforms. Liquidity—in this case, the ability of a given digital currency to effectively be used as cash—is especially important. There is more liquidity in the Ethereum network than in Cardano. US Coin (USDC) operates in Ethereum as an ERC-20 token, while no major USD stablecoin has been built on Cardano. The circulation of a stablecoin like USDC or USDT (Tether) is critical for assuring the financial sturdiness of blockchains.

Closely related to liquidity is the inflation index of both blockchains. Quite contrary to public expectations, Ethereum's native coin, Ether, has been deflationary over the years due to its variable transaction fees, better known as "gas fees," which have remained fairly high. In general, though, Ether has no maximum limit on supply, which means it may face inflationary pressures someday if the gas fees fail to keep the supply in check. Cardano's transaction fees are more predictable and are calculated based on the size of and computation involved in each transaction. There is a cap on the total amount of ADA, the native coin of Cardano, that can enter circulation on a yearly basis, with a lifetime maximum of forty-five billion tokens produced. Thus, ADA is generally considered a deflationary currency.

The circulation of stablecoin on Ethereum has made it more popular for business application than Cardano. However, since Cardano is more deflationary, and since the deployment of USD stablecoins on Cardano has been under consideration for a while now, there might be a day when Cardano is adopted as widely as Ethereum in competitive businesses, including profitable healthcare organizations.

As of 2025, both platforms have already engaged in a large number of healthcare-related partnerships. Ethereum stands out for its scalability and sustainability: Its applications within healthcare include combating prescription drug fraud and enhancing supply chains. Cardano stands out for its interoperability and steadiness. Porting between different blockchain platforms usually requires adaptations due to differences in smart contract languages and other technical aspects. Cardano currently is working on solutions and tools to make this transition smoother for developers. Thus, Cardano surpasses Ethereum in applications related to health information exchanges, patient-centric data sharing, and health insurance processing

6. Conclusion

Blockchain has the potential to offer long-term benefits to organizations of all types. These benefits include improved cash flow, lower transaction costs, and reduced settlement times. The application of blockchain technology began in finance but is set to expand to government, wholesalers, supply chains, and healthcare. In the future, blockchain could lead to radical changes in even more industries, thus impacting the whole economy. Using a blockchain can remove the need for central authorities when making transactions. Trust is built into the decentralized framework through immutable records on a distributed ledger where all members contribute to the integrity of the database. This framework addresses the risks posed by a common database that caregivers can access from any electronic medical system. Blockchain also eliminates the need to use intermediaries to store, transport, or protect data.

Still, blockchain technology is not immune to challenges, one of the largest being the threat of what is known as a "51% attack." This could occur to any blockchain, including Ethereum and Cardano, when there are fewer honest participants (or validators, in the case of Ethereum) than malicious ones on the network. While this risk is particularly serious during the adolescence of any blockchain, it means that the initial application of blockchain in a security-sensitive field like healthcare must be undertaken with extraordinary care.

But the potential ways that blockchain can be positively applied to healthcare are seemingly boundless. Mark Engelhardt has outlined four existing issues that blockchains can address in healthcare: (1) putting the patient at the center of care; (2) privacy and access; (3) completeness of information; and (4) costs.[4] There are even more promising applications for healthcare, however, and these include exchanging health information, combating prescription drug fraud, sharing patient data, and administering health insurance. The potential of this technology to transform economic interactions in healthcare has drawn interest from the providers themselves, not just from economists. Furthermore, blockchain has strong potential to enhance healthcare research, particularly in the areas of genomics and big data.

Ethereum's aggressive development and first-mover advantage have earned it a vast community and ecosystem in business. In contrast, Cardano's meticulous, research-driven approach might appeal to those who value rigorous testing and methodical evolution. Each thus might prove valuable to different aspects of the healthcare industry. For private hospitals or clinics, if a project requires rapid deployment with a vast array of existing tools, Ethereum might be preferable. For projects in public healthcare institutions that prioritize high assurance and security, Cardano's ecosystem could be a better fit.

References

[1] Cearley DW, Burke B, Searle S, Walker MJ. Top 10 strategic technology trends for 2018 [Internet]. Stamford, CT: Gartner. 2017 [cited 2025 March 31]. Available from: https://www.gartner.com/ngw/globalassets/en/information-technology/documents/top-10-strategic-technology-trends-for-2018.pdf.

[2] Lucas M. The difference between Bitcoin and blockchain for business [Internet]. Columbus, OH: The Risk Institute (The Ohio State University). 2017 [cited 2025 March 31]. Available from: https://u.osu.edu/riskinstitute/2017/08/28/the-difference-between-bitcoin-and-blockchain-for-business/.

[3] Tapscott D, Tapscott A. The Blockchain revolution: how the technology behind Bitcoin is changing money, business, and the world. New York: Portfolio; 2014.

[4] Engelhardt MA. Hitching healthcare to the chain: an introduction to Blockchain technology in the healthcare sector [Internet]. Technology Innovation Management Review. 2017 October [cited 2025 March 31];7(10): 2 - 34. Available from: https://doi.org/10.22215/timreview/1111