

Exploring The Added Value Of Adopting Blockchain Technology In Marketing Organ Transplant Services In The United Arab Emirates

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Abstract:

Background: The adoption of any new technology is driven by the aim to generate value, whether for the customer or the organization itself. Blockchain technology has recently revolutionized the digital world, offering a new perspective on transparency and system efficiency, especially in sectors involving multiple stakeholders like healthcare. In this context, managing organ donation groups is of utmost importance, considering the requirements of donor-recipient data availability and compatibility.

Objective: This study aimed to explore the added value brought about by blockchain technology in the marketing system of organ donation and transplantation services in the United Arab Emirates.

Research Methods: We conducted a bibliographic review of literature published between 2012 and 2023, focusing on the role of blockchain technology in creating savings and value in the UAE healthcare sector. We relied on databases and official websites for data collection.

Results: The analysis, based on a review of 34 previous studies, presented the initial conceptual framework development consisting of three main themes to identify the added

value of blockchain technology in healthcare in general, upon which we studied its role in the field of organ transplantation.

Conclusions: The review indicated that the UAE's adoption of blockchain technology in marketing organ transplantation services led to saving over 20 million dollars annually in kidney dialysis costs. Citizens benefited from reduced time and economic costs by avoiding visits to registration centers. Blockchain technology also had significant impacts, especially in emergency patient acceptance cases, contributing to saving lives. Moreover, previous research highlighted the role of technology in harnessing scattered data, particularly in the organ transplantation ecosystem, which includes data from global donors. All of these aspects contribute to enhancing the safety and trust of citizens in the public healthcare sector.

Introduction

One of the prominent challenges faced by healthcare organizations is reshaping their operations to maintain a continuous balance between quality improvement and cost reduction. The interplay between financial revenues and the provision of high-quality services constitutes a complex nexus. In light of global demand surpassing the capacity to cover healthcare costs, the World Health Organization (WHO) report highlights healthcare as a diverse and escalating cost driver (Bittroff & Sandner, 2020, p. 02). This places significant pressure on governments and organizations to innovate ways of efficiently marketing healthcare services. In this context, healthcare systems strive to realign their processes to sustain an ongoing equilibrium between quality enhancement and cost reduction. Digital transformation offers valuable research opportunities from this perspective. Within this framework, pioneers of blockchain technology have emphasized its potential to provide utmost privacy, enabling distributed ledgers to cut costs and enhance information accessibility without intermediaries, leading to superior outcomes at reduced expenses (Nicolai, 2021).

Organ donation is deemed one of the noblest endeavors necessitating a revolution. The urgency and desperation an individual experiences when a family member requires an organ to continue living are beyond imagination. For decades, living donors have been the sole source of solid organs, and a supply-demand gap led to the establishment of deceased brain donation systems. According to the WHO, approximately 70,000 patients are registered on kidney transplant waiting lists, while living donors contribute around 20,000 kidneys to the total supply. At times, patients resort to illegal means to acquire organs, fostering illicit organ trade, with more than 50% being trafficked on the black market (Shinde, Mahalle, Bendre, & Castillo, 2022). On the other hand, the growing

demand for organs has been accompanied by the emergence of transplant tourism, often raising issues of compatibility and ethical constraints (Maskari & Al Senaidi, 2020). The absence of an effective management system jeopardizes life-saving organ transplantation (Attaran, 2022). Therefore, there is a necessity to adopt a comprehensive organ and tissue donation and transplantation management system to ensure a fair and efficient process, enhancing patient experience and trust (Hawashin, et al., 2022).

Many countries in the Middle East, such as Saudi Arabia, the United Arab Emirates, and Qatar, are placing greater emphasis on Blockchain technology. This move aligns with the current technological resurgence, resulting in blockchain projects in these countries (Chandrasekaran, Simon, Mathew, & Shekhar, 2022, p. 6229). The United Arab Emirates has demonstrated the application of Blockchain in the healthcare sector as part of its efforts to establish better healthcare conditions for its citizens. In 2003, more than 23 Emirati citizens underwent kidney transplants abroad (Maskari & Al Senaidi, 2020). To address these gaps and expand the benefits of donation, the government introduced a deceased donation program, resulting in a total of 107 kidney transplants in the country, with 105 from living donors and the remaining two from deceased donors (Maskari & Al Senaidi, 2020).

The adoption of any new technology is driven by the aim to generate value, whether for the customer or the organization itself. Blockchain technology has recently revolutionized the digital world, offering a new perspective on transparency and system efficiency, especially in sectors involving multiple stakeholders like healthcare. In this context, managing organ donation groups is of utmost importance, considering the requirements of availability, compatibility, and precise management of the donor and recipient lists. Real-world examples of applying blockchain technology in the healthcare sector illustrate significant benefits and reflect real challenges. The United Arab Emirates has already established a comprehensive blockchain-based healthcare ecosystem. So, **what is the added value that Blockchain technology has brought to the organ donation and transplantation system in the United Arab Emirates?**

1. Methodology

Previous research has shed light on how various institutions leverage the value created by adopting Blockchain. However, we note the limited experimental work conducted to assess the potential of this technology for value creation in healthcare in general, and discussions have largely omitted organ donation and transplantation services. Furthermore, studies investigating the added value of adopting blockchain technology in the medical organ transplantation sector in the United Arab Emirates are lacking, despite

being the first country in the world to employ Blockchain for organ transplantation (Attaran, 2022, p. 07). Consequently, a systematic literature review was conducted to explore sources of value creation in healthcare through the use of Blockchain technology. Established databases and official websites of the UAE government were utilized for this purpose. The keywords "Blockchain value-added" were employed to identify the initial list. Initially, all studies on Blockchain in healthcare were identified. After removing duplicates and narrowing down studies to those published in the fields of business management and commerce, the list was refined to literature focusing on value generation in healthcare. The review presented the initial conceptual framework development to create an assessment framework for the added value of Blockchain technology in healthcare in general, upon which we studied its role in the field of organ transplantation.

2. Results

The demand for organ transplantation has rapidly increased on a global scale due to a rise in organ-related illnesses and higher success rates of transplantation procedures. However, the availability of organs for transplantation remains scarce (Srivastava, Mahara, & Yadav, 2021, p. 173). This has led to the stimulation of international organ trade and trafficking (Shinde, Mahalle, Bendre, & Castillo, 2022). Managing organ groups is of paramount importance and necessitates addressing issues of medical compatibility and personal preferences (Srivastava, Mahara, & Yadav, 2021, p. 173).

Blockchain technology provides a reliable platform for storing and exchanging information related to organ availability and matching between donors and recipients, with hospitals acting as intermediaries between them (Jat & Grønli, 2022). No participant can individually control or manipulate the data. All interactions occur between peer contracts, which store and forward information to all neighboring contracts due to the absence of a central node for communication management (Chalissery & Asha, 2020). Blockchain stores donor details, such as their medical information and the type of organs they wish to donate, contributing to a more efficient matching mechanism for transplantation (Jat & Grønli, 2022). This is further enhanced by integrating artificial intelligence techniques to verify and match donors with encrypted patient data in smart contracts (Attaran, 2022). Data is stored in a single point, enabling a transition to a distributed system that allows for complete tracking of the donation process and enhances security (Ranjan, Srivastava, Gupta, Tapaswi, & Kumar, 2019).

2. Value Assessment Framework for Blockchain Technology in Healthcare

Scientific literature attributes various benefits of Blockchain technology in the field of healthcare, either related to patients or institutions. The COVID-19 pandemic demonstrated how the technology aids in building shared value between institutions and patients, as most solutions failed to enhance trust among citizens or facilitate data sharing ([Spanò & Massaro, 2021, pp. 03-04](#)). Based on an analysis of previous data, three main themes have emerged, illustrating the channels through which the impact of technology creates value in the healthcare sector.

2.1.1 Impact on Cost Driver Sources

The low costs generated by removing intermediaries' role are distributed among all stakeholders within the Blockchain. Transactions can be conducted faster and at lower costs, redistributing the intermediaries' share among stakeholders ([Abdollahi, Sadeghvaziri, & Rejeb, 2023, p. 439](#)). In this context, a Blockchain-based organ transplantation system reduces the transplant process duration by five times compared to traditional methods. Studies indicated that the duration of a Blockchain-based transplant process is 14 hours, whereas the traditional transplant process takes approximately 60 hours ([Chalissery & Asha, 2020](#)). Furthermore, empowering individuals to choose how they access healthcare reduces the burden on public health services ([Spanò & Massaro, 2021, p. 05](#)). Within the framework of the United Nations Sustainable Development Goals and achieving global universal healthcare coverage, a global system for chronic disease management can be established using Blockchain-based smart contracts, leading to further savings in healthcare services ([Ofiaz, 2019, p. 440](#)). On another note, studies have indicated the technology's potential to reduce waste and associated costs, alongside improving resource utilization and reducing wastage costs, especially those resulting from poor transportation practices within supply chains ([Abdollahi, Sadeghvaziri, & Rejeb, 2023, p. 439](#)). More efficient outputs can be obtained in the healthcare sector through the integration of Blockchain technology with the Internet of Things (IoT) and Artificial Intelligence (AI) ([Ofiaz, 2019, p. 440](#)). Additionally, it contributes to reducing the costs of healthcare waste, which poses a significant burden on the ecosystem ([Abdollahi, Sadeghvaziri, & Rejeb, 2023, p. 439](#)). Moreover, Blockchain technology reduces errors that may be related to transactions or medical records ([Spanò & Massaro, 2021, p. 05](#)). Finally, the impact extends to market data costs, where the new governance mechanisms brought by the technology consider customers as contributors or even decision-makers ([Abdollahi, Sadeghvaziri, & Rejeb, 2023, p. 440](#)).

2.1.2 Enhancing Stakeholder Interaction

This interaction results in the secure and efficient sharing of data and resources, facilitated by transaction tracking, privacy protection, increased compliance, and integrity. The objective is to develop healthcare performance that can be enhanced through the feedback expressed by other stakeholders in the chain (Russo-Spena, et al., 2023, p. 07). Moreover, this interaction contributes to expanding access to new resources, whether financial or intellectual, and continuously maintaining them. It also introduces new stakeholders, such as clients or strategic partners, who might not be available to traditional companies due to technical and financial limitations (Abdollahi, Sadeghvaziri, & Rejeb, 2023, pp. 437-439). Furthermore, studies have indicated that the application of Blockchain solutions in healthcare systems improves communication between healthcare information systems and maintains system security at a reasonable cost (Matlebjane & Ndayizigamiye, 2022, p. 05). They not only help enhance administrative and operational aspects but also support clinical aspects, such as reducing the risk of infection or similar issues (Spanò & Massaro, 2021, p. 05). They also enable clinical research organizations to leverage available patient files across the platform, including genetic material, benefiting anyone seeking genomic data aligned with their scientific projects (Russo-Spena, et al., 2023, p. 08). On the other hand, smart contracts integrated within Blockchain technology enable startups to access popular resource automation, thereby streamlining the resource collection process. This positively affects transaction costs and efficiency, especially in developing countries facing significant challenges in the healthcare sector (Abdollahi, Sadeghvaziri, & Rejeb, 2023, p. 438).

2.1.3 Transparency in the Healthcare Ecosystem

Transparency within the ecosystem is the third domain in which Blockchain technology encourages the creation of shared value. This technology enables secure data verification by storing tamper-proof information. This feature also allows for a comprehensive view of the system, making it easier to identify inefficiencies, clarify responsibilities, and thereby activate a cycle of trust among stakeholders (Russo-Spena, et al., 2023, p. 09). Furthermore, transparency helps reduce errors and ensures the quality control of medical certifications, while preventing unfair practices. This empowers patients to receive adequate and specialized medical care (Russo-Spena, et al., 2023, p. 09). In the context of clinical research, the technology has the capacity to build trust relationships among active parties, such as patients having confidence in ensuring the necessary protection of their data for research and development purposes (Spanò & Massaro, 2021, p. 05).

In a broader context, another value is created through Blockchain technology that is not related to the stakeholder business model within the ecosystem, but rather concerns the way we come together as a community, especially in the field of organ donation. This value is generated through supporting charities, fostering development in developing countries, and enhancing individual health (Spanò & Massaro, 2021, p. 06). In this context, the literature highlights the role of technology in harnessing scattered data to develop the required knowledge, particularly within the organ transplantation ecosystem, which includes data from global donors (Alrahbi, et al., 2022, p. 16).

Many reviewed studies demonstrate how Blockchain technology can support interactions and enhance stakeholder engagement in the value creation process. This is achieved by involving patients in their healthcare journey, tracking their data usage, enabling doctors to convert patient records into digital versions, scheduling screenings and treatments, and establishing transparency and trust among active parties.

2.2 Added Value of Adopting Blockchain Technology in the Medical Organ Transplantation Sector in the United Arab Emirates (UAE)

Government support and people's willingness to embrace modern technologies have propelled the UAE towards a vision of becoming a fully Blockchain-enabled nation by 2030, surpassing other Gulf Cooperation Council countries in implementing this technology in healthcare (Chandrasekaran, Simon, Mathew, & Shekhar, 2022, p. 6229). Blockchain technology is utilized to enhance and secure organ donation processes. The Ministry of Health and Prevention in the UAE (MOHAP) has adopted the "Hayat" application in collaboration with Dhonor Health Tech. The smart card contains 12 fields to store health data, documenting the cardholder's consent for organ donation, blood type, chronic and infectious diseases, disabilities and congenital deformities, surgical procedures undergone, surgical interventions, essential and secondary vaccinations, long-term medication, and implanted devices or supports, along with the last update date (MOHAP, 2023a). Moreover, the Cleveland Clinic Hospital ranks first in clinical and medical innovation, and the Sheikh Khalifa Medical City (SKMC) is home to the first organ transplant center in the UAE (Arredondo, et al., 2022).

2.2.1 The Role of Blockchain Technology in Reducing Organ Transplantation Costs in the UAE

The UAE's blockchain strategy aims to process 50% of government transactions through the Blockchain platform, resulting in approximately 11 billion dirhams saved from these transactions. This also equates to saving 77 million work hours annually (Al Barghuthi, Ncube, & Said, 2019, p. 05). This system facilitates access to organ donation offers and

accelerates transplantation processes, contributing to ease of access and process efficiency (Baroudi & Benghida, 2022, p. 267). In this context, each deceased donor can save the lives of eight people. The "HAYAT" program has played a role in saving the lives of more than 500 individuals to date. These solutions have saved the Ministry of Health and Prevention over 20 million dollars annually in kidney dialysis costs (Muhairi, Termanowski, Balovnev, & Hewett, 2020, p. 22). Furthermore, studies indicate that the adoption of medical technology facilitates rapid recovery and reduces patient service costs due to strategic governance (Alrahbi, et al., 2022, p. 16). Citizens also benefit from reduced time and lower economic costs associated with visiting registration centers. Additionally, this system aids authorities in curbing medical organ trade (Chandrasekaran, Simon, Mathew, & Shekhar, 2022, p. 6229).

Results from a study on the evolution of organ donation processes in the UAE indicate a significant increase in organ transplant procedures, surpassing a 420% growth compared to the activity in 2020 (Arredondo, et al., 2022).

Table1: UAE deceased organ donation and transportation activity, 2017-2021

Year	Actual donors number	Actual deceased number (pmp)	Organ transplanted
2017	3	3.7	11
2018	8	3.3	26
2019	10	3.7	37
2020	9	3.9	35
2021	39	3.8	147

Source: (Arredondo, et al., 2022)

The "Hayat" application based on blockchain technology is witnessing a growing interest among members of the community, with a significant increase in donation procedures, exceeding 433% compared to the activity in 2020 (Arredondo, et al., 2022). However, the pace of growth slowed down during the year 2022, as donation cases increased by only 41% compared to the year 2021 (MoHAP, 2023).

2.2.2 Value of Stakeholder Interaction in the Organ Transplant Ecosystem

Blockchain technology has had significant impacts, especially in cases of emergency admissions for patients in various hospitals. Physicians can easily access patient records, contributing to life-saving efforts (Chandrasekaran, Simon, Mathew, & Shekhar, 2022, p. 6229). Since the initial launch of the project, hospitals authorized to perform transplant procedures, including waitlists and allocation platforms, have been part of the blockchain-based "Hayat" application (Muhairi, Termanowski, Balovnev, & Hewett,

2020, p. 22). The implementation of "Hayat" on the blockchain has garnered a substantial response and interaction from citizens since its inception. As depicted in Table 2 statistics (MOHAP, 2023b).

Table 2: Hayat Organ Donation Programin numbers

Individuals registered in Hayat up to date	N° of transplants from 2017 till date	N° of organ donors from 2017 till date	Patients Waiting for Donors	N° of Organs Transplanted in 2023
14602	460+	160+	4000+	111

Source: (MOHAP, 2023b)

The organ donation and transplant process encompasses both living and deceased donors, as well as recipients, from 48 nationalities (MoHAP, 2023). The application of blockchain technology extends beyond managing patient records; it also includes licensing healthcare professionals (Chandrasekaran, Simon, Mathew, & Shekhar, 2022, p. 6229). Blockchain technology assists healthcare practitioners in determining various licensing requirements and participating processes (Baroudi & Benghida, 2022, p. 267). In this context, most specialists have benefited from training and educational courses at the Donor Tissue Institute (DTI) in Spain. This has contributed to enhancing the organ transplant system in the country, with over 390 doctors and nurses trained and 159 organs transplanted since September 2021 (DTI, 2022).

2.2.3 Transparency and Trust Indicators in the Organ Donation and Transplant System

The post-mortem donation program proved to be the most suitable solution due to the scarcity of viable organs for transplantation in the United Arab Emirates (UAE) (Maskari & Al Senaidi, 2020). The UAE Ministry of Health and Prevention issued Decree No. 550 regarding Organ Donation after Death (ODD) in 2017, covering brain death diagnosis (Arredondo, et al., 2022). Smart contracts were developed as a technology for identity verification and integration with conditions and requirements (Muhairi, Termanowski, Balovnev, & Hewett, 2020, p. 22). The "Hayat" program allows individuals above 21 years of age to express their willingness to donate organs after brain death. (MOHAP, 2023a, p. 3). It is a legal requirement to have the person's will as a binding agreement for donors in the legal digital contract record. Other stakeholders, such as family members, are involved in enforcing the agreement. This has led to the need for multiple signatures to allow family members to act as witnesses to the donor's will (Muhairi, Termanowski, Balovnev, & Hewett, 2020, p. 22). Overall, these measures aim to establish a safer environment for organ donation (Attaran, 2022).

In this context, studies indicate that the program has a positive impact on both donors and recipients, offering a sustainable solution for many patients and giving them new hope in life (MOHAP, 2023a, p. 03). Data is stored in a single point, allowing a transition to a distributed system that enables tracking of every stage of donation and transplantation. This effectively eliminates opportunities for organ trafficking, as transplantation occurs exclusively through this application (Ranjan, Srivastava, Gupta, Tapaswi, & Kumar, 2019). Furthermore, organ verification is achieved through DNA exchanges for the stored donor within the blockchain contract, enhancing security and transparency (Srivastava, Mahara, & Yadav, 2021). Any updates to the information in the healthcare database, such as appointment scheduling, are time-stamped and cryptographically signed within a block (Angraal, Krumholz, & Schulz, 2017, p. 02). This ensures the security and audibility of any modifications to healthcare records, addressing concerns about fraud in appointment scheduling and risks of organ tampering. The project has the potential to achieve its goal of raising awareness about the safety of stored patient data, enabling officials to identify breaches and take timely action to mitigate harm.

3. Discussion

The achieved results in marketing organ transplantation services are supported by the readiness levels demonstrated by the United Arab Emirates (UAE) to adopt this technology. Preparedness is particularly crucial, especially among stakeholders representing a Blockchain network (Nicolai, 2021, p. 91). This is evident through initiatives such as Dubai Health Authority and Abu Dhabi's strategic healthcare plan (Awamleh, Stephens, & Salem, 2022). Moreover, the UAE ranks first globally in government purchases of advanced technology products and first in the Arab world (29th globally) in terms of network readiness (Dutta & Lanvin, 2020, p. 24). It also stands as the largest spender in the healthcare sector (Balasubramanian, Shukla, Singh, & Islam, 2020, p. 08). In this context, it was found that government support is a significant incentive for technology adoption practices, including strategic, financial, and medical legislative support (Alrahbi, et al., 2022, p. 10) similar to the organ donation law that criminalizes organ trafficking (MOHAP, 2023a, p. 03). However, the prohibition of receiving compensation for the donation process could deter citizens from supporting the project. Despite the ban's intention to curb organ trafficking, regulation within an open trade context has often proven effective. Iran, for example, is among the few countries with abundant organs due to allowing organ sales regardless of qualified healthcare facilities (Rachana, Patil, Gupta, & Bannore, 2023). Therefore, the adoption of blockchain technology could regulate and incentivize the donation process.

On the other hand, obtaining suitable technical support and resources is of utmost importance in motivating doctors. The efficiency of the organ transplantation system in the UAE through blockchain technology is contingent on balancing healthcare infrastructure and coverage challenges, complex health policies, and the shortage of trained professionals (Arredondo, et al., 2022). There remains a need for a soft infrastructure, reflected in the legal and regulatory framework that assists entrepreneurs in establishing and managing startups (Langendorf, 2020, p. 19). Studies have shown doctors benefiting from using blockchain technology in managing waiting lists, resulting in increased expected performance rates (AlQudah & Shaalan, 2021, p. 977). However, blockchain role in primary care management should not overshadow its use in emergency care. The UAE's brain-death donation program may lead to a sustainable increase in donation rates (Maskari & Al Senaidi, 2020). Yet, the timing of brain-death declaration, a crucial variable in protecting the donor's organs, depends on efficient management of the donation process. Many hospitals missed the chance to utilize organs due to mismanagement, underscoring the need for high competence in emergency process management (Rachana, Patil, Gupta, & Bannore, 2023). In this context, studies examining leading experiences, like Estonia's, have demonstrated that technology enhances primary care efficiency, reducing unnecessary hospital visits and positively impacting waiting queues. However, significant disparities in healthcare access remain due to unmet needs resulting from waiting times, particularly for emergency cases, where blockchain technology may not fully address clinical requirements (OECD, 2021, p. 13). Finally, cultural alignment and comprehensive societal agreement on organ donation are crucial. Despite organ donation being recommended in all major religions for life-saving purposes, practical realities may vary among different segments (Rachana, Patil, Gupta, & Bannore, 2023). Low engagement due to religious and cultural beliefs and insufficient awareness represent key challenges for the organ and tissue transplantation project in the UAE (Arredondo, et al., 2022). To achieve best practices, establishing a sustainable blockchain program for organ transplantation should involve at least cooperation between GCC countries, especially considering the presence of advanced nations in this field, such as Saudi Arabia, within a regional solidarity vision to support patients with organ failure in the region.

4. Conclusion

The organ transplantation system based on Blockchain contributes to harnessing scattered data in an encrypted and reliable manner to develop essential knowledge, especially within an ecosystem that includes data from global donors. In addition to the ability to

trace the entire donation process, this assists in combating organ trafficking. Considering the study's subject matter and related concepts, the study recommends conducting investigations to test the proposed research hypotheses and the defined conceptual model for sources of value creation in Blockchain technology for organ transplantation, to obtain stronger and more credible results. Furthermore, research assumptions should include an analysis of the impact of community readiness levels and cultural consensus on organ donation in enhancing system efficiency. Alongside this, research into the requirements for establishing a collaborative regional and international solidarity approach based on Blockchain technology is necessary, contributing to the care of patients with organ failure, as the donation process remains a humanitarian act that should not be constrained by regional or ethnic boundaries.

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