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An Empirical Investigation in Measuring the Role of Blockchain in Enhancing Innovation in the Health Care Industry for Sustainable Business Perspective

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ABSTRACT
Blockchain technology uses time stamping and cryptography to decentralise the transaction process of financial aspects. The recent study has managed to understand that it can also be implemented in other sectors like healthcare and governmental projects. This paper shows the relevance of blockchain technology in making fruitful contributions to the healthcare system. In this context, a brief history of blockchain technology and its evolution has been illustrated in this research paper. The continuous increase of this technology in sorting several issues of the healthcare system is also discussed here. In this regard, the issues like clinical trials and their privacy maintenance, drug tracking, managing the electronic health records of patients have been portrayed here. Primary survey-based research has been carried with random healthcare sector staff. It was conducted among fifty respondents and the primary data were analysed in Microsoft Excel. After that, the primary data were discussed using recently available journal articles. Besides, reviews from different articles and sources have also been presented here. The total findings and concepts are depicted in the discussion and findings segment. Findings showed that, blockchain technology is able to bring sustainability in the healthcare sectors in terms of business administration.
Keywords: blockchain technology, healthcare, Electronic Health Record, sustainability

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INTRODUCTION

A study regarding the market prospect of blockchain technology shows that it is capable of generating approximately 42 million values in the healthcare sector by the end of 2023. Moreover, the compound rate of blockchain growth can reach up to 71.8% in a financial year by this time [1]. The above two data illustrate the enormity of the contribution of blockchain technology in the healthcare sector. The main aspect of launching this technology is to reduce the authority over data and information of a particular person or a specific institution. Indeed, decentralization of power in the context of data fetching and using can be implemented by the introduction of this technology. To summarise, blockchain technology is synonymous with ledger systems that use time encoded blocks to manage and sort data. This technology was first proposed by *Satoshi Nakamoto* in the year 1991 [2]. However, the popularity of blockchain technology has increased after the groundbreaking launching of *Bitcoin* in 2009.The technology has recently gained more admiration due to its publicity in social media forums and the heavy investments of industrialists in it. Though the technology was mainly developed for the up-gradation of the *fintech (Financial technology)* area, its wide potential areas have been found to make contributions in the field of healthcare, governmental tasks and supply chain. The versatile aspects of this technology can minimise the cost and complexity of transactions in the upcoming days. Moreover, blockchain technology can help to enhance the security, transparency and regulatory system in these fields.

There are several issues of the modern healthcare system; such as the security of information, the standard of care, privacy and encryption of data that need major attention for further improvement [3]. Blockchain technology can address all these gaps and make it an immensely critical factor for integrating

into the healthcare system. In the present circumstances, this technology is proving to be beneficial for helping the delivery and caring segments of healthcare. Moreover, in the upcoming days, it will help to manage the data-related issues in the healthcare system. The fact of making over 1 million USD investments by 55 % of senior executives of the US shows its future prominence in the healthcare system [4]. In this research paper, an illustration of the relevance of blockchain technology has been discussed to improve the healthcare system in the future. The decentralisation feature of blockchain technology allows individual people and organisations to make a contribution to data and information segments. As a consequence, the speed of workflow, revenue earning and rigidity of security is going to be enhanced. On the other hand, this technology is also accountable for reducing the risk and cost of the work process. Blockchain technology uses a*peer-to-peer* networking system to generate and keep multiple copies of data in various computing devices situated in different provinces [5]. Resultantly, the authority of central agencies diminishes as an individual can access the data by the allowance of a peer. One prominent aspect of blockchain technology in the context of the healthcare system is the usage of *smart contract software*. This aspect is much capable for self-execution of various critical instructions (figure 1, 4).Resultantly, the cost regarding making payments, monitoring and contracting are reduced by a significant amount.This feature of blockchain technology can obsolete the contribution of coordinating agencies in various fields, including the healthcare sector.

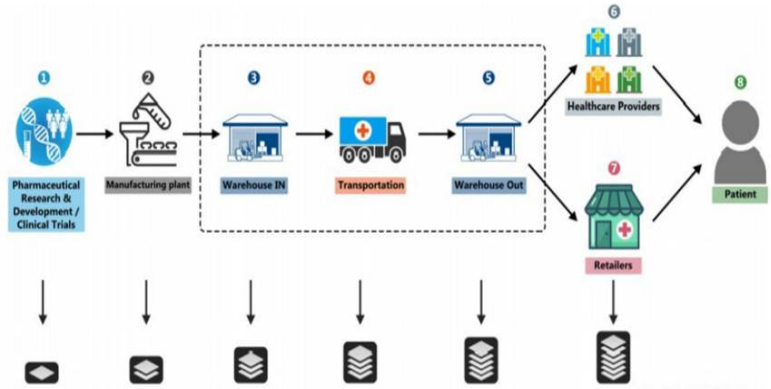

Figure 1: Different stages of blockchain management in healthcare setup[5]

Factor and Avaneer Health are the two organisations in the field of healthcare that have integrated this technology to bring sustainability to their business. These organisations are cutting down the role of intermediary coordination in the healthcare system to increase their revenue and develop sustainability. Blockchain technology can bring everlasting benefits to the healthcare system through its transparency, dicentric trait and openness. The segments of healthcare systems like wearable and medical research can be hugely improved by the integration of blockchain [6].It is much evident that the healthcare system itself is questioning the contribution of blockchain technology. A recent survey conducted by Deloitte in 2018 showed the apparent contribution of blockchain.According to the survey of this organisation, almost 11% of enterprises are using this technology in their business procedure and 75 % of enterprises are focusing on their research for blockchain development [7]. The study also suggests the demands of incorporating this technology in the healthcare sector.

Figure 2: The cycle of process in managing electronic health record of a patient by using blockchain technology[7]

The data and information which are once put down in a block cannot be changed afterwards. This aspect of the immutability of blockchain technology makes it a prominent contributor in the healthcare sector to manage data and information (figure 2). As a consequence, the health sector can secure its records about clinical trials, data and information of its patients and similar sorts of things by the usage of blockchain management. Besides, the feature of blockchain to assist in the process of monitoring patients in real-time is also immensely helpful for taking care of the patients (remotely as well; figure 3). It can also act as a tool to intervene in the medical treatment processes of a patient [8]. This attribute is helpful to secure the record as well as to provide access to the record to the respective patient. According to the ***HIPAA (Health Insurance Portability and Accountability Act)*** providing the respective patients and clinicians access to the relevant data and information is necessary at the moment.

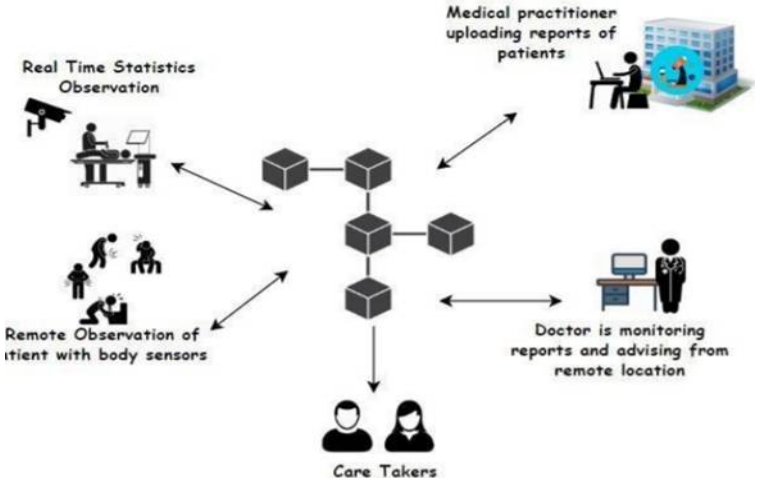

Figure 3: Remote patient monitoring by using IoT and blockchain technology[8]

In parallel to it, blockchain technology can help to organise the supply chain system of a pharmacy. Moreover, this technology can identify fake drugs and chemicals, which is of paramount importance to demolish the chance of business loss. Thus, blockchain technology can bring sustainability to the business process of healthcare institutions in the upcoming days. Besides, an organisation can reduce its cost expenditure for making new drugs by using this technology [9].

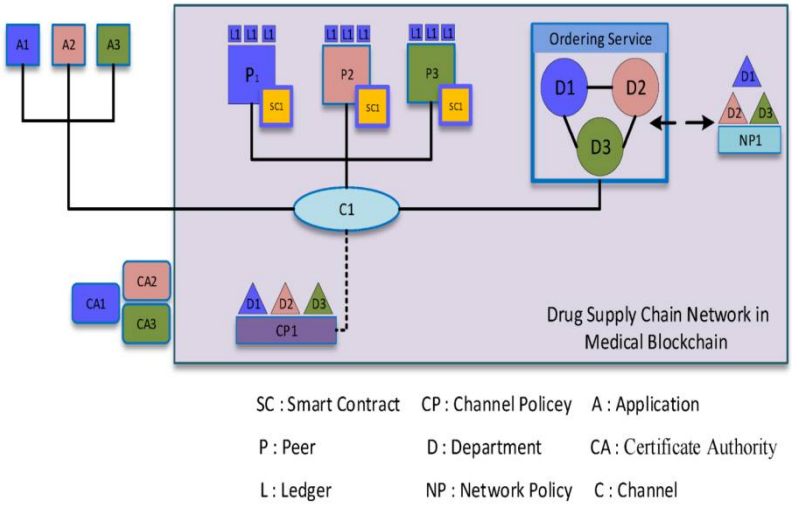

Figure 4. Medical Blockchain model[9]

The contribution of smart contacts can manage the safety and efficiency prospects in the context of making a new drug. Besides, it is worth mentioning here that blockchain technology provides the advantage to manage the identity of a patient. Ensuring privacy regarding personal medical information and records is another feature of blockchain which makes it a major tool for making further improvements in the healthcare system. Verification of the credentials of medical employees can also be done by using blockchain technology. Moreover, it aids to manage the security of the Internet of Things

(IoT) when accessed remotely [10]. All these above-mentioned features of this technology make it an indispensable mechanism to become integrated and nurtured in the future of the healthcare system.

MATERIAL AND METHODS

A systematic method has been taken to get a deep insight into the relevance of blockchain technology for enhancing innovation in the healthcare industry as well as to bringing sustainable business.To get an overview of this topic and to conduct this research, several articles were accessed belonging to 2018-2021. To retain authenticity as well as to complete the project within a given deadline, the researcher has used the open-source *Google scholar* for accessing the publications and articles. The researcher has also taken necessary data and information through surveys of various organisations including Deloitte [11]. The research paper also consists of *analysis and interpretation* of blockchain management of various governmental institutes. It is worth mentioning that there were an extremely small number of research publications on this topic before 2016.For further analysis of the relevance of the growing demand for blockchain technology, a constructive comparison between all the accessed research publications has been performed. This ensured the reliability as well as the credibility of the resources which were accessed to conduct this research. The researcher has also gone through several audio-visual based study materials to get an idea about all the recent research on this field.Besides the secondary research method, the researcher has also performed primary research for understating the ground reality of blockchain technology and its impact. For this context, three fundamental questions were asked and opinions of people of different sectors were collected regarding those questions. Generally, questions were constructed on a close end basis to ensure that people remain binary in their opinion. This is a prolific method to understand the biases of people in a particular aspect. However, some people remained reluctant to express their thoughts in a binary way and they provided an open-ended opinion on some of the questions. The opinions were collected predominantly from the people who are related to the healthcare system by some means. However, the opinions from the young generation were also taken into consideration for conducting this research project.

In parallel to it, those three fundamental questions were also raised on social media platforms to receive a larger perspective about people's ideas on this topic. However, the response remained extremely negligible in this regard. As a consequence, the researcher has not elaborated on that part in this research paper. Therefore, the research has mainly focused on getting ideas from accessed research articles and the data which were gathered from primary research. Throughout the research conduction, a significant amount of care has been taken to minimise the irrelevant data and its use in the purpose of conducting this research.

RESULTS

Survey Questions

Q1: Do you think that blockchain technology *(BCT)* can address all the issues regarding data management in the healthcare system?

TABLE I. ADDRESSING ISSUES OF DATA MANAGEMENT IN HEALTHCARE BY BCT

Options Given	Total Participants	Response collected	Percentage
Strongly Agree	50	20	40
Agree	50	10	20
Neutral	50	10	20
Disagree	50	10	20
Strongly Disagree	50	5	10

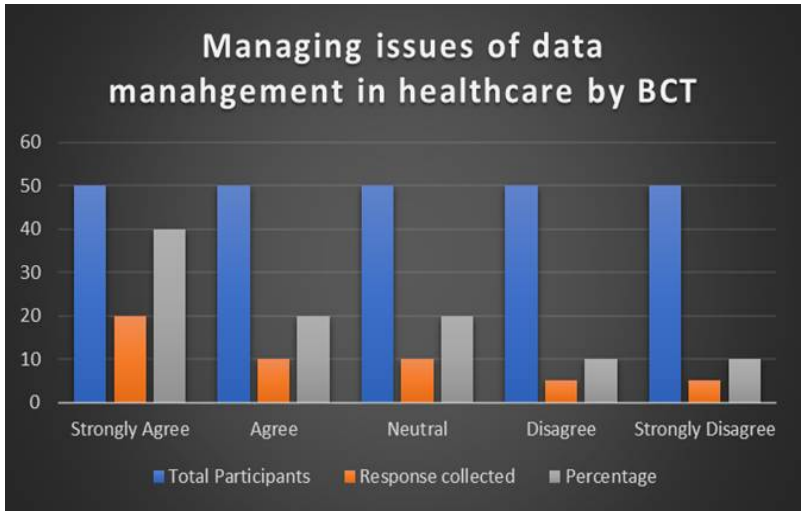

Figure 5. Addressing Issues of Data Management In Healthcare By BCT

The above table as well as the illustration shows that there are twice as many people who think the integration of blockchain technology can address all the issues regarding data management in the healthcare system (Table I, Figure 5). However, there is a significant amount of people who have not opined any positive or negative feedback in this regard. A small segment of people is a firm believer of the fact while 10% of people possess strong disbelief in this topic.The people were selected from different sectors to get an overall overview in this regard.

Q2: Can blockchain technology sustain the business perspective of the healthcare system?

TABLE II. IMPACT OF BCT FOR SUSTAINING THE BUSINESS PERSPECTIVE OF THE HEALTHCARE SYSTEM

Options Given	Total Participants	Response collected	Percentage
Strongly Agree	50	25	50
Agree	50	10	20
Neutral	50	10	20
Disagree	50	3	6
Strongly Disagree	50	2	4

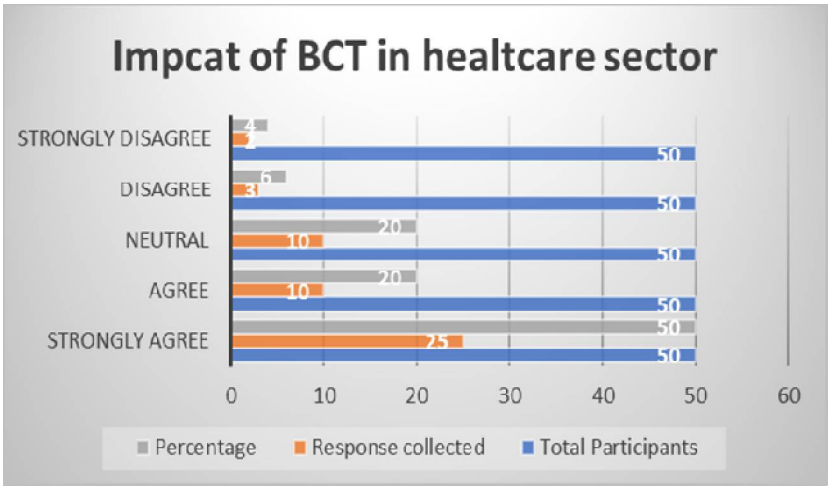

Figure 6. Impact of BCT

The second table (Table II) as well as the illustration (figure 6) shows that half of the opinion possessor believes that blockchain technology can bring sustainability from the business perspective. However, there were a small number of people who thought in this line very firmly. The number of people in contrast to this opinion is also quite significant.

Q3: Do you think blockchain technology is the only substitute in this aspect for the upcoming days?

TABLE III: OTHER SUBSTITUTION OF BLOCKCHAIN TECHNOLOGY FOR THE HEALTHCARE SYSTEM

Options Given	Total Participants	Response collected	Percentage
Strongly Agree	50	20	40
Agree	50	10	20
Neutral	50	10	20
Disagree	50	10	20
Strongly Disagree	50	5	10

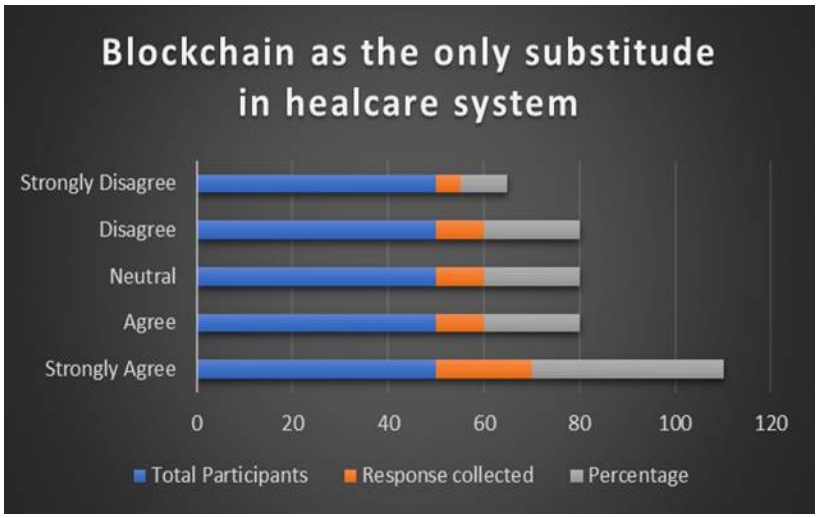

Figure 7. Availability of other substitution of blockchain

It was noticeable that people were not sure about other tools for managing data in the healthcare system. They were not all in favour of using blockchain technology in the healthcare system also. Almost 4 out of 10 people opined that blockchain technology is the only substitute for the healthcare system in the upcoming days. In contrast to that, a fairly noticeable number of people opposed this opinion. Although, one out of every ten people was a firm believer that only blockchain can bring sustainability in managing data in the healthcare system (Table III, figure 7).Fifty people from different sectors were chosen for conducting this survey. There was a fair amount of misconception regarding the usage of blockchain technology and its effect on the healthcare system among people. However, a large chunk of people was familiar with the term blockchain technology and its current growth in the financial technology sector. Moreover, they were not that familiar with the incorporation of this technology in the health sector.

DISCUSSION

The above survey and its interpretation show that people were not that familiar with the current aspects of blockchain technology in managing different issues of the healthcare system. They were concerned about the fact that this technology will become an integrable part of it [12]. The primary research also provides an idea that people are quite diverse about their views regarding this topic. On the other hand, it is also worth mentioning here that a small number of people firmly believe that at some point in time the healthcare system will only be left with blockchain technology for managing its data-related issues. The secondary research however illustrates another part of the coin by giving an estimation of the impact of

blockchain technology in minimising different issues of the healthcare system. The study suggests that this technology can sort out the issue regarding false results and data removal in the arena of clinical trials. It is estimated that the pharmaceutical sector can save approximately 200 billion USD by incorporating blockchain technology [13].Several sectors within the umbrella of the healthcare system can be hugely benefited by the emergence of trustworthy records and reports after using blockchain technology [14]. There are four major parts of the medical industry that can extract immense assistance from the introduction of blockchain technology in the future. Following are the four major parts of the medical industry.

Clinical trials

The accountability, reliability and transparency of clinical trials can increase in a significant amount if blockchain technology is used in this segment at its fullest potential [15]. The immutability of each block used in blockchain technology is a major factor that can minimise the issues related to data manipulation. This is of utmost importance as the healthcare sector is largely affected by the fraudulent clinical reports at the present time [16]. Furthermore, the reliability of using smart contracts to prevent any type of error in encryption of patient's data is also proven crucial in the field of clinical reports management. The smart contract brings the aspect of taking permission or a key code from the patient in regards to going through it, which seems to be very helpful to reduce data piracy [17].

Drug sharing

As the involvement of third-party users is increasing day by day in managing health records and clinical data, the privacy of data of patients is at more risk in proportion to it [18]. Despite all the advantages and smooth services of Google, it is evident that the giant search engine is providing its glimpse at every corner of the daily lives of an individual. The health issues of an individual are also getting noticed similarly. In parallel to it, IBM is using its supercomputing gadget namely ***Watson*** to investigate the sleeping pattern of people [19]. These IT giants are claiming to increase the health facility in this context by assessing these data. However, there must be a certain limit up to which a third-party service provider can make its penetration in electronic health records of an individual. Blockchain management can address this concern in an organised manner. Besides, studies suggest that almost 21 minutes of the daily service of a nurse goes behind the scenes to address issues like searching medical devices, managing misplaced beds and similar sorts of things [20]. The study also suggests that organisations who are using blockchain technology can reduce the expenditure of almost 400,000 Euro in a financial year [21].

Patient records

Blockchain technology can address the issue of the centralisation of data in clinical trials of healthcare institutions. The decentralisation aspect of this technology provides access to medical reports to its respective patients [22, 23]. The *MedRec* is one such healthcare institution that has incorporated blockchain technology to provide its patients and doctors an immutable health log [24]. The large scale data can only be managed efficiently by incorporating this tool. Estimation shows, there will be almost 26 to 44 Petabytes of data by the end of 2023 and handling this large volume is itself a big task for the healthcare sector in the upcoming days [25, 26]. Organising approximately 9 million electronic health records can only be managed by proper implementation of blockchain technology [27].

Drug tracking

According to a report by WHO (World Health Organisation), 10 % of the total pharmaceutical shops are found to be fake and fraudulent [28]. To sort out this problem, an organisation such as ***Chronicle*** is using blockchain technology which can mention the manufactured place of a drug [29]. Besides, they are also providing the assistance of tracking the location of a specific drug for a while [30]. As mentioned above, the proper implication of this technological aspect can provide benefits in manufacturing drugs as well as demolishing the fraudulent related to drugs [31].Besides all the above-mentioned segments, blockchain technology can also help to track various medical devices as well [32, 33]. Almost 60 % of medical stakeholders are in favour of integrating this technology to organise medical devices efficiently [34].

CONCLUSION

It is concluded that blockchain technology and its relevance is increasing day by day in the healthcare system for managing data and clinical reports. However, it is also evident that this technology is not the last word in this context as many gaps need to be sorted out quickly. The further improvement of this technology is dependent on the enthusiasm of the health sector to make it an integral part of their working procedure. A fair amount of research is also critical in the present scenario, and for that, a large amount of investment is also required. The future of blockchain technology can also become feeble due to government policies. The overall research paper illustrates an elaborative discussion about why blockchain technology is important, what issues need to be sorted out and what is the future of this technology in the context of healthcare management.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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