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Electronic Health Record Using Blockchain with Data Security Approach

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ABSTRACT:
Electronic health records (EHRs) have revolutioni zed healthcare by enabling patient information to be stored and managed digitally. This project expl ores the important role of electronic medical recor ds in health research and evidence-
based clinical practice.

Blockchain technology is one of the most important developments and innovations in the information technology sector. It has an important place in the digital age we live in and has made a great impact on people's lives. Additionally, blockchain technology is expected to improve existing IT infrastructure in many areas in the coming years. Recent technological developments have led to significant advances in healthcare. When sharing private health information, information security and accessibility are critical to integrating and communicating with electronic health records (EHR). In this context, choosing the best blockchain model for secure and reliable EHRs in healthcare requires an accurate method to evaluate the impact of different blockchain models on their work. This study uses empirical studies to evaluate the impact of blockchain technology and provides new ideas and methods for future researchers. This research study collected feedback from 56 experts in healthcare management to evaluate the impact of different blockchain models. In addition to many ideas of these experts, a decision-making model is used in the study to eliminate confusion arising from external studies and organize information regarding the content of the chosen blockchain model. Fuzzy analytical network analysis (F-ANP) is used to calculate the weight of the model, and the same method as fuzzy preference sequence (TOPSIS)medical ideal is used to evaluate the results of other methods. problem solving. Additionally, the results from this empirical research will serve as a tool in selecting the most appropriate blockchain model to maintain the absence of EHR breaches.

Keywords: Integration, Blockchain, Data Security, Cryptographic Security, Healthcare

1. INTRODUCTION

Today, some countries are facing a growing numb er of health problems, even as access to junior doc tors or doctors makes it difficult for patients. Cons idering the word “blockchain”, it becomes clear th at this technology is not only important, but also i mportant in the age of the World Wide Web [1]. I n general terms, blockchain is considered a databa se that stores or distributes information regarding all transactions or electronic products made and e xchanged between participants. Blockchain contai ns a clear record and proof of every transaction m ade [2], [3]. Trading can be done as a transaction management system using blockchain technology. Thus, blockchain can reduce costs and increase ef ficiency [4].

Modern innovation based on Blockchain technology has revolutionized almost every field, such as energy [5],[6], e-commerce [7], banking [8], government administration [9], medical services [10],[11], education [12], agricultural development
[13] nd many other businesses. Gartner, well- known research and marketing company, that predicts the value of investments decisions in blockchain technology will reach $3.1 trillion by 2030[14]. Fig 1 below shows Gartner’s forecast for blockchain investment growth. The transformative potential of blockchain technology is rapidly being recognized by leading companies, and the technology is seen as a game changer in many business use cases, including the healthcare industry. Since the commercials use of blockchain

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technology is huge, a lot of work is being done in this area. According to HPAA Magazine's report, there were 3,054 data breaches affecting more than 500 documents in the healthcare industry between 2009 and 2019. These breaches resulted in the destruction, theft, disclosure, or unauthorized publication of 230,954,151 records in the medical industry. This equates more than 69.78% of the American population. In 2019, Medical data breach cases were 1.4 cases per day.

The healthcare industry alone has recently begun t o show more interest in blockchain-
enabled applications [15]– [20]
Blockchain is an emerging technology currently g enerating significant interest in healthcare. Howev er, 40% of healthcare executives rank blockchain among their top 5 priorities. Additionally, global a doption of blockchain technology in healthcare is expected to reach $5.61 billion by 2025, accordin g to a study by BIS Research. According to the re port, by 2025, the use of blockchain technology could save up to $10-150 billions in annual costs, including data loss, it costs, operating costs, service fees and ad, as well as fraud and fraud in business products. Medical industry [21]. Adoption of EM Rs (electronic medical records) is now viewed as a key step in improving health information, efficie ncy, user experience, products, and associated cos ts. Kemkar et al. It is estimated that EMR program s can save thousands of dollars annually [22]. Co mmunicating health information will provide us w ith more information; for example, better understa nding of behavior in the health and disease comm unity to ensure effective treatment again [23] and good implementation of physician recommendatio ns [24]. However, it is also susceptible to various security and privacy risks due to its functionality a nd design [25], [27]. A major challenge in advanc ed medical information is how to capture, manage
, and interpret patient medical information without violating privacy [26].

Blockchain technology can combine patient medic al and medication information from different webs ites and data providers to create a single, up-to- date medical record that doctors can share when tr eating patients. There are also significant barriers t o blockchain adoption in healthcare [29], [30]. Th erefore, evaluating the impact of different blockch ain technology models on the protection of web- based medical information is an important and dif ficult task. It is important to evaluate the impact of blockchain technology on the growth of the healt hcare sector because it is a prerequisite for the im plementation of effective healthcare policies. In th is research paper, we model the impact of differen t blockchain models on healthcare applications ba sed on multidimensional decision making (MCD M) technology.

There are many MCDM methods that can be used to solve these problems [31]. Moreover, the main challenge is to determine the impact of blockchain technology in healthcare. In this work, researchers used the Anomalous Networking Process (ANP) and preference Ranking by Similarity to Good Structure (TOPSIS) method [32]. AHP focuses on hierarchical models, while ANP focuses on network models. Although many authors have used AHP-TOPSIS for such evaluations, ANP is another Analytical Process (AHP) tool widely used in MCDM-based problems [33]. Many authors have presented their work on fuzzy ANP-TOPSIS multiple decision making such choices. However, no one has conducted research to evaluate the impact of blockchain technology in protecting medical information in web-based electronics with the help of fuzzy-based decision-making.

2. LITERATURE SURVEY

Bates et al. (2003) laid the foundation for understa nding the potential of EHRs in clinical decision su pport. Their research highlighted the integration o f clinical decision support systems within EHRs a s a powerful tool to enhance healthcare providers' decision-making processes. By providing real- time information and recommendations, these syst ems help reduce errors and improve patient care q uality. Amarasingham et al. (2009) investigated the impact of the use of electronic health records on healthcare and patient outcomes. Their findings showed that hospitals with electronic medical records made significant improvements. Reduced mortality rates and shorter length of stay indicate that electronic medical records make a significant

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contribution to improving the quality of overall medical care. Sittig and Singh (2011) emphasized the importance of addressing privacy and security issues in electronic health records. Their research underscores the need for effective security and ethical procedures to protect patient information. Establishing and maintaining trust in the EHR system is important to ensuring the confidentiality and integrity of patient information. Interoperability challenges in EHR systems are addressed by Dixon et al. (2016). They cited challenges in sharing data between EHR systems. Lack of appropriate data structures and communication processes can lead to inadequate care and delays in treatment. Dixon et al. underlines the urgent need for industry-wide standards and coordination to address these issues.

Hripcsak and Albers (2013) provide an in-depth study of the potential of EHRs for longitudinal analysis. This approach involves monitoring the patient's health over time, providing information about disease progression and effective treatment. EHRs are an important resource for clinical research and evidence-based medicine, allowing doctors to better understand and manage chronic diseases. Kass et al. (2016) explored ethical issues in EHR use. Their research highlights the importance of consent and ethical responsibilities in handling patient information. EHRs contain large amounts of personal and health information; It requires clear guidelines to protect patient privacy and promote ethical standards in healthcare. The transformative power of data analysis in EHRs is the focus of Topol's (2015) research. He examined how comprehensive data analysis can uncover hidden patterns and insights in EHR data. The vast amount of information captured by EHRs can be leveraged to advance healthcare through predictive analytics, personalized medicine, and best practice identification. Adler-Milstein and Jha (2017) addressed the legal and regulatory challenges associated with EHRs. They highlighted issues related to data ownership and the complex landscape of healthcare regulations. Navigating these legal and regulatory aspects is crucial to ensure responsible and compliant EHR usage. Gheorghiu et al. (2020) emphasized EHRs' role in patient empowerment. They highlighted how EHRs enable patients to access their health information and participate in decision-making. This shift toward patient-centered care fosters collaboration between patients and healthcare providers, ultimately improving the overall healthcare experience. Greenhalgh et al. (2018) explores the challenges that arise when using electronic medical records. Issues such as preventing change and disrupting business processes were discussed. The transition from paper to electronic medical records can be a hurdle and a temporary inconvenience. Effective change management and careful planning are crucial to overcoming these challenges.

3. DIFFERENT BLOCKCHAIN MODELS

The different blockchain models in this group include: private blockchains, public blockchains, hybrid blockchains, permissioned blockchains, participatory chains, and decentralized applications; these are discussed in detail in the following subsections.

3.1 Private Blockchain

A private blockchain is a decentralized ledger that operates as a closed, secure repository based on cryptographic standards. It is a blockchain with restrictions or permissions that only works in a closed network. Private blockchains are mostly used by businesses or companies where users are only selected participants in the blockchain network. Write permissions are tracked in a completely private directory via the root vector of the decision, while read permissions can be public or restricted [35]. It allows only certain individuals or organizations to access the directory, access and view information. In this case, some people will check most users' accounts before making transactions. One version of private blockchain is the concept of a decentralized system or collaboration in which the blockchain operates under community control. This type of blockchain is a private network that stores public records of transactions that can only be accessed by

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authorized individuals [36]. Each of the two participants can be anonymous or completely anonymous; for example, in the previous exchange participants of the exchange could not do this. they know each other [37].

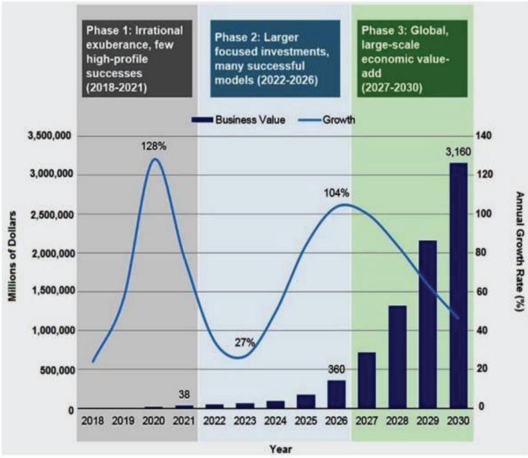

Fig:1 Blockchain investment growth rate forecast (2018-2030).

3.2 Public Blockchain

Public blockchains allow anyone to participate. It is a truly decentralized, borderless and permissioned ledger platform. Anyone with an internet connection can log in to the blockchain platform and reach consensus, thus becoming an integral part of the blockchain technology network. Nodes or users that are members of the public blockchain can view current and old data, check for changes or verify transactions and mine operations for future chains. Public blockchain technology allows anyone to communicate with other participants in the transaction. It keeps the transaction history unchanged. Anyone can post a job by following the established process and joining the network. The identity of the two participants may be anonymous or completely anonymous, meaning that the participants of the exchange may not have known each other before the exchange [37].

3.3 Hybrid Blockchain

Hybrid blockchain is based on the combination of private blockchain and public blockchain. This includes the operation of both blockchains; that is, it can have a network that relies on private permission or a network that does not require public approval. In this decentralized network, users can monitor who has access to information held by the blockchain. Additionally, a selected portion of blockchain data or information can be made public while the remaining data can be kept as private as possible on a private network. Blockchain hybrid networks are versatile and allow users to access multiple public blockchains as well as private blockchains. Business and government regulations may support hybrid blockchains. It provides consistency and flexibility, including what information is kept private or shared in a public directory. Many applications of hybrid blockchains exist in the real world. For example, XinFin is a hybrid blockchain consisting of Ethereum (public blockchain) and Quorum (private blockchain). XinFin has successfully completed many pilots by providing chain logistics, transportation, foreign trade agreements and financial services [38]. Hybrid blockchains are also being used as a way to maintain security while providing better performance. It usually takes the form of a public keychain that connects the keychain to a private or authorized external chain [39].

3.4 Permissioned Blockchain

Other parties involved in business analysis or accessing network data must be authorized by the central authority. This is a real advantage for businesses, financial institutions and organizations that are confident in complying with most restrictions and diligent about data protection management [34]. Blockchain permission can be viewed as an advanced blockchain protection mechanism as it maintains an authentication process that only allows certain transactions to be executed by certain interested parties. Permissioned blockchains work differently between private and public blockchains. It is designed to reap the benefits of blockchain without compromising the regulatory authority of the central authority. Ripple is a good example of permissioned blockchain.

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3.5 Consortium Blockchain

The organization's chain is based on a semi-decentralized model where the blockchain network consists of many businesses. This is not compatible with a private directory managed by a single organization. In this type of blockchain, many businesses can become nodes and share information or mine. Alliance chains combine elements of private and public chains. Once the point of agreement is reached, the most important differences between the two systems can be identified. The chain is not an open platform where anyone can control blocks, nor is it a closed platform where only one party can choose the block sender, but powerful organizations that serve as proofs have a similar process [40, 56-57].

3.6 Decentralized Blockchain

Decentralized applications (dApps) are software applications or systems that are not influenced by any organization and operate on blockchains and P2P database networks rather than on a single device. BitTorrent, Popcorn Time, and Tor are examples of software applications that run on different computers that are members of P2P networks that have many members on both sides, some downloading files, papers, others providing information and perhaps even facility information. while other members perform both functions simultaneously. dApps run and run on blockchain platforms in a public, open-source, decentralized ecosystem in cryptocurrency decision-making and are independent of the control and influence of a single authority [41]. DApps provide serverless features that can be used for clients and through blockchain-based decentralization.

TABLE 1. Different criteria to evaluate the blockchain models impact on healthcare services.

Criteria	Description
Patient Identity (T1)	In a blockchain based healthcare setting patients may control their public keys, maybe with the help of mobile or wearable devices and also use the public key infrastructure (PKI) to create their unique identity to access their medical data from the blockchain system, and also attach new relevant information. PKI helps to ensure professionals and organizations can believe the data is being created by the specific patient. It ensures proper authentication and authorization features.
Data Security (T2)	Patients receive the option by which they can share their keys essentially puts them in charge of what their health records can do, including different access privileges. In a blockchain setting, integrating keys with smart contracts prohibits illegitimate participants from attaching data to records of a patient, particularly outsiders trying to exploit data for objectives of fraudulent or any other personal reasons. This criterion ensures patient's personal information privacy, proper data management and effective authorization.
Data Monitoring (T3)	The ledger keeps tracking data each step along the way in a healthcare blockchain system, such as who managed it as well as where it was, until it hits the appropriate user. For efficient data monitoring, every patient data is properly controlled and synchronized in a real-time manner to all concerned parties.
Immutability (T4)	Medical data is spread safely throughout various sectors, maintaining confidentiality, reducing the risk of failure, and providing a proper audit trail in the situation of malicious actors. Blockchain model assures full clinical presentation of all professionals with secure access to confidential information with proper implementation of cryptography and hashing functions.
Consensus (T5)	Blockchain technology with its consensus process and decentralized architecture that protects against hacking or abuse eliminates the possibility of data theft in the healthcare system. Electronic healthcare records on the blockchain can be granted proof or evidence and verification of authentication. In blockchain setting several nodes find consensus on Proof-of-Stake and Proof-of-Work.
Value (T6)	Blockchain technology could emerge as a big platform for the healthcare professionals with the potential to deliver significant value in the industry. The value of blockchain technology can be measured by assessing the performance, convenience and demand in healthcare setting.

4. DESIGN AND ANALYSIS

The research methodology included in this analysis was designed to evaluate the impact of blockchain technology on the preservation of electronic web-based medical records. Figure 2 shows the hierarchy of challenges for assessing the impact of blockchain technology on the security of web- based medical information.

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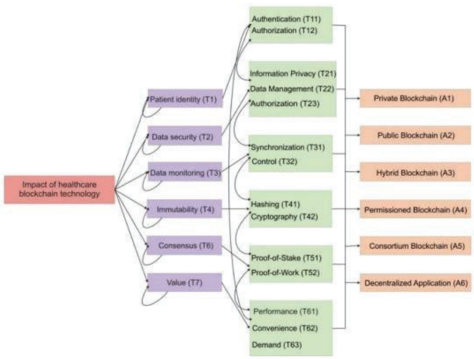

Fig: 2 ANP Structure for the evaluation of healthcare blockchain technology models.

It aims to analyze the impact of different blockchain models on different digital medical services and use MCDM technology in a fuzzy environment to choose the best solution. To achieve the stated goals, the researchers of this study used Fuzzy-ANP to calculate the weight of the factors and their interactions. We also use the TOPSIS method to evaluate other methods. The following subsections provide a general description of this process.

4.1 Fuzzy Analytics Network Process

Saaty [43] introduced ANP as a cross-variable decision method. Saaty [44] created the name Analytic Hierarchy Process (AHP) due to its advantages over the previous method in analyzing various tasks. This study chose ANP to solve this problem. AHP evaluates the relationship between different decision levels but does not consider the interaction between models or other methods; whereas ANP uses network connectivity to evaluate the interaction between models involving decision-making levels. In some cases, ANP has also been recognized. ANP also uses circles to represent interactions and feedback between elements of the same group and with other groups in the same network [23], [45]. Fuzzy ANP method is the combination of fuzzy logic and ANP method used to manage data errors, thus helping to increase reliability and consistency.

4.2 Fuzzy Topsis

Yoon and Hwang [46] originally proposed the TOPSIS method. They developed TOPSIS with the idea that the choice should be the shortest choice between the best solution and the longest choice between the worst solution. The TOPSIS system is one of the most popular decision-making techniques for solving complex problems in the world. It supports Zelany's [47] permutational ideal solution concept [48]. This is one of the most powerful MCDM methods for solving the regression problem where the variables change when a negative option is used. This approach is often used in some existing projects. Additionally, the TOPSIS method was developed to solve the fuzzy MCDM problem [32].

In this work, researchers used a combination of fuzzy ANP and TOPSIS to evaluate the impact of blockchain-focused technologies on the preservation of web-based electronic medical records. According to Figure 3, the weight and importance determination order with the help of fuzzy ANP-TOPSIS is defined as follows:

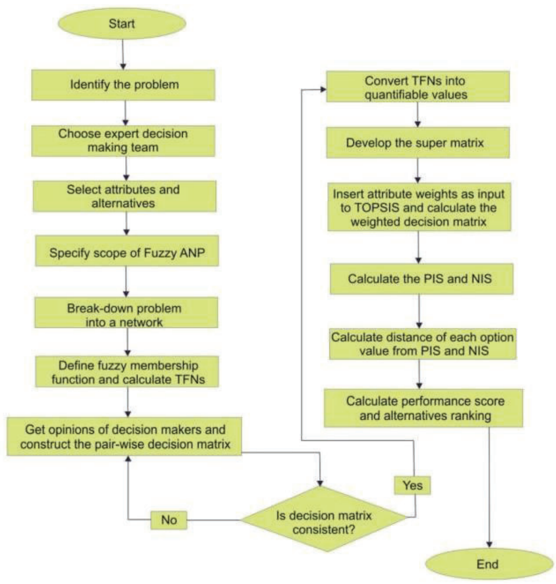

Fig 3: flowchart diagram of architecture

Step 1: English words are first converted directly into numerical values and then into three fuzzy numbers (TFN). In this study, TFN can be defined as (c1, c2, c3), where (c1 c2 = c3) and c1, c2, c3 are variables representing the minimum, average and maximum in TFN. Let's assume that A is a number that can be expressed as equation (1-2), which can be found in [48].

$$\mu_A(x) = F \to [0, 1] \quad (1)$$

$$\mu_A(x) = \begin{cases} \frac{x - c1}{c2 - c1}, & c1 \le x \le c2 \\ \frac{c3 - x}{c3 - c2}, & c2 \le x \le c3 \\ 0, & x > c3 Otherwise \end{cases} \quad (2)$$

First, 56 academics and blockchain industry experts presented different opinions as well as different blockchain development and research knowledge for each character and related information. Experts are asked to write and analyze their thoughts in a virtual meeting environment and gain insight into various aspects of group-wide behavior and the impact of messages.

Then, with the help of the collected data, the researchers obtained a network model to evaluate the severity of certain features of the impact of blockchain technology. Experts and experts in the field of Blockchain R&D arrived at the answer by evaluating the observable characteristics associated with each other on the scale shown in Table 2. The figure is derived with the help of three-dimensional fuzzy number (TFN), real equation. numbers are calculated using equations (3-6) and a system represented as (c1ij, c2ij, c3ij); where c1ij represents the low value, c2ij represents the medium value, and c3ij represents the high value. For comparison, the concept of TFN[ηij] is as follows:

$$\eta_{ij} = (c1_{ij}, c2_{ij}, c3_{ij}) \quad (3)$$

where, $c1_{ij} \le c2_{ij} \le c3_{ij}$

$$c1_{ij} = min\left(J_{ijd}\right) \quad (4)$$

TABLE 2. Saaty Scale with corresponding TFNs.

Saaty Scale Definition	Fuzzy Triangle Scale	
1	Equally important	(1 ,1, 1)
3	Weakly important	(2 ,3, 4)
5	Fairly important	(4 ,5, 6)
7	Strongly important	(6 ,7, 8)
9	Absolutely important	(9 ,9, 9)
2		(1 ,2, 3)
4	Intermittent values between two adjacent scales	(3 ,4, 5)
6		(5 ,6, 7)
8		(7 ,8, 9)

$$c2_{ij} = (J_{ij1}, J_{ij2}, J_{ij3})^{\frac{1}{x}} \quad (5)$$

$$and \ \ c3_{ij} = max\left(J_{ijd}\right) \quad (6)$$

Jijk explains the relative impact of the importance of the two factors listed in the above equation; and provided according to expert opinion. Among them, i and j represent a pair of features determined by experts. TFN (ηij) is calculated as a geometric measure of expert opinion for a given comparison. Therefore, equations 7 through 9 allow combinations of TFN values. The two TFNs are A1 and A2, A1 = (c11, c21, c31), A2 = (c12, c22, c32).

Working models are as follows

$$(c1_1, c2_1, c3_1) + (c1_2, c2_2, c3_2) = (c1_1 + c1_2, c2_1 + c2_2, c3_1 + c3_2) \quad (7)$$

$$(c1_1, c2_1, c3_1) \times (c1_2, c2_2, c3_2) = (c1_1 * c1_2, c2_1 * c2_2, c3_1 * c3_2) \quad (8)$$

$$(c1_1, c2_1, c3_1)^{-1} = \left(\frac{1}{c3_1}, \frac{1}{c2_1}, \frac{1}{c1_1}\right) \quad (9)$$

Step 2: A comparison matrix was created with the help of feedback from decision makers. Perform a correlation coefficient (CI) analysis as follows using the formula in Equation 10

$$CI = (\gamma_{max} - t)/(t - 1) \quad (10)$$

Among them, CI represents the consistency index and t represents the number of samples. Then the rate ratio (CR) of the index rate (RI) is calculated below.

$$CR = CI/RI \quad (11)$$

If CR < 0.1, the result matrix is similar. Of these, RI determines the stochastic index from the Saaty stochastic index [49]. Step 3: After a very good matrix is obtained with the help of the defuzzification process, the TFN value is converted into a value index. The defuzzification method

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used in this research is taken from [50] as shown in Equation (12-14) and is often called alpha cut. μα,β(ηij) = [β·ηα(c1ij) + (1 − β)·ηα(c3ij)] (12) where 0 ≤ α ≤ 1 and 0 ≤ β ≤ 1 i.e.

$$\eta\alpha(c1_{ij}) = (c2_{ij} - c3_{ij})\alpha + c1_{ij} \tag{13}$$

$$\eta\alpha(c3_{ij}) = c3_{ij} - (c3_{ij} - c2_{ij}).\alpha \tag{14}$$

In the mathematical model previously selected by registered experts, α and β were used, and α and β are also different from 0 and 1. Step 4: Deploy ANP's dependency management system into the crowd and install half of the crowd. The purpose of this step is to identify the target, factor, sub-factor, etc. created by the preference vectors. is to create a super matrix by comparing groups. Step 5: Evaluating the outputs of others according to the TOPSIS problem should have this equation to model the entire decision matrix.

$$X_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \tag{15}$$

In this equation i = 1, 2,. . . and j = 1,2, .. . noun Now calculate the normalized weighted decision matrix

$$M_{ij} = w_i X_{ij} \tag{16}$$

These include i = 1, 2, .. .m and j = 1,2, .. . Name Step 6: Predict the best solution of matrix I+ and the worst solution of matrix I

$$I^+ = z_1^+, z_2^+, z_3^+ \ldots\ldots z_n^+$$

$$I^- = z_1^-, z_2^-, z_3^- \ldots\ldots z_n^- \tag{17}$$

In this equation, if j is better, z + j is Max zij; If j is a value z + j Max is zij; if j is the best then z − j Min zij; If j is the cost factor, is z − j Min zij? Step 7: The next step is to determine how each value differs from the good solution and the bad solution: good solution:

$$D_i^+ = \sqrt{\sum_{j=1}^{m} (z_i^+ - z_{ij})^2};\ i = 1, 2, 3 \ldots .m \tag{18}$$

The Negative-ideal solution

$$D_i^- = \sqrt{\sum_{j=1}^{m} (z_{ij} - z_i^-)^2};\ where,\ i = 1, 2, 3 \ldots .m \tag{19}$$

where DC j defines the best solution distance according to choose i and D − i is the distance to the ideal, non-ideal path. Calculate the critical output (Pi) of each option

$$P = \frac{D_i^-}{D_i^- - D_i^+} \tag{20}$$

The interim evaluation process described above will be conducted using the Fuzzy-ANP TOPSIS system and a proprietary option to evaluate the impact of blockchain technology on EHRs. The next section presents a case study that provides a suitable model for the implementation of the blockchain technology concept. The written record identifying large files stored in free storage facilities must identify the location of storage and include the appropriate number. It should be clearly stated that if the access code is not received during the application, the access code will be reviewed. The same will be available before release. Experiments involving animals or humans and other studies requiring ethical approval must be submitted to the authority with a statement of acceptance.

TABLE 3. Aggregated Fuzzy Pair Wise Comparison Matrix at Level 1.

	T1	T2	T3	T4	T5	T6
T1	1.00000, 1.00000, 1.00000	1.75600, 2.35000, 3.03400	1.48300, 1.95800, 2.52900	1.12800, 1.55400, 1.98800	0.22150, 0.28710, 0.41520	0.31460, 0.46100, 0.87050
T2	-	1.00000, 1.00000, 1.00000	0.57000, 0.78600, 1.15600	0.57000, 0.72000, 0.97000	0.26790, 0.35210, 0.51760	0.16630, 0.19690, 0.25310
T3	-	-	1.00000, 1.00000, 1.00000	0.62700, 0.81200, 1.07200	0.30090, 0.43520, 0.80270	0.80270, 0.87050, 1.00000
T4	-	-	-	.00000, 1.00000, 1.00000	0.53860, 0.91430, 1.58360	0.60830, 1.05920, 1.68290
T5	-	-	-	-	1.00000, 1.00000, 1.00000	0.41520, 0.63720, 1.17910
T6	-	-	-	-	-	1.00000, 1.00000, 1.00000

5. DATA ANALYSIS AND RESULT:

It is a good measure to objectively measure the impact of blockchain technology. For the purpose of analysis, the six aspects of the first level of blockchain technology are; They are determined as T1, T2, T3, T4, T5 and T6, including patient identity, data security, data monitoring, immutability, approval and value. Regarding the analysis of the impact of blockchain technology on secondary electronic medical records: the characteristics of the patient's identity are recognition and consent, represented as T11 and

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T12, respectively. The characteristics of data security are data privacy, data management, and authorization, represented by T21, T22, and T23, respectively. The attributes of data management are synchronization and control, represented by T31 and T32 respectively. The products of immutability are cryptography and hashing, represented as T41 and T42, respectively. The features of the agreement are Proof-of-Stake and Proof-of-Work, represented by T51 and T52 respectively. The useful character is practical, easy and desirable, represented by T61, T62 and T63 respectively as shown in the table below. Evaluation of the security of electronic medical records using blockchain technology with the help of fuzzy ANP-TOPSIS is evaluated using equations (1)-(20) as shown below: Additionally use the Saaty formula shown in Table 1. We transform the word content into multivalued using equation (1)-(9) and then collect the triangular fuzzy number (TFN) values. Then, the consistency index and stochastic index are determined using equations (10) and (11). The random index of the pairwise comparison matrix is less than 0.1, which means our matrix is consistent across binary matrices. Then proceed to determine the correlation matrix of Level-1 parameters. With the help of Equations (12)– (14), the pairwise comparison matrix is defuzzied using the alpha cut method, so that the integration of all sub-attributes with the defuzzied local part weight is shown in Table 4 respectively. The methods used in the hierarchy are followed exactly and the ratio of the matrices and local weights are measured accordingly.

TABLE 4. Defuzzified Pair-Wise Comparison Matrix and Local Weight of Attributes at Level 1.

	T1	T2	T3	T4	T5	T6	Weights
T1	1.0000	2.3723	1.9819	1.5564	0.3027	0.5268	0.16032
T2	0.4215	1.0000	0.8243	0.7447	0.3724	0.2033	0.07817
T3	0.5046	1.2132	1.0000	0.8309	0.4935	0.8520	0.11743
T4	0.6425	1.3428	1.2035	1.0000	0.9636	1.1024	0.15778
T5	1.8982	4.9188	1.1737	0.9071	1.0000	0.7172	0.24368
T6	0.8554	1.5397	0.5445	0.7401	1.3943	1.0000	0.24263
CR= 0.064104							

TABLE 5. Weighted Super Matrix.

	Goal	T1	T2	T3	T4	T5	T6	T11	T12	T21	T22
Goal	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T1	0.16032	1.00000	2.57230	1.92190	1.53640	0.25270	0.50680	0.00000	0.00000	0.00000	0.00000
T2	0.07817	0.41050	1.00000	0.85430	0.69470	0.35240	0.18330	0.00000	0.00000	0.00000	0.00000
T3	0.11743	0.48460	1.31320	1.00000	0.83090	0.49350	0.85200	0.00000	0.00000	0.00000	0.00000
T4	0.15778	0.62250	1.14280	1.25350	1.00000	0.96360	1.10240	0.00000	0.00000	0.00000	0.00000
T5	0.24368	1.78820	4.81880	1.17370	0.85710	1.00000	0.71720	0.00000	0.00000	0.00000	0.00000
T6	0.24263	0.80540	1.85970	0.54450	0.74010	1.35430	1.00000	0.00000	0.00000	0.00000	0.00000
T11	0.00000	0.31234	0.00000	0.00000	0.00000	0.00000	0.00000	0.17300	0.19000	0.19200	0.21000
T12	0.00000	0.62766	0.00000	0.00000	0.00000	0.00000	0.00000	0.16900	0.18700	0.18200	0.18400
T21	0.00000	0.00000	0.32986	0.00000	0.00000	0.00000	0.00000	0.13900	0.15800	0.14100	0.16300
T22	0.00000	0.00000	0.17553	0.00000	0.00000	0.00000	0.00000	0.16300	0.17000	0.15300	0.21300
T23	0.00000	0.00000	0.49461	0.00000	0.00000	0.00000	0.00000	0.17300	0.14200	0.19600	0.19200
T31	0.00000	0.00000	0.00000	0.47523	0.00000	0.00000	0.00000	0.19900	0.17700	0.19400	0.22800
T32	0.00000	0.00000	0.00000	0.52477	0.00000	0.00000	0.00000	0.17300	0.19800	0.17400	0.20400
T41	0.00000	0.00000	0.00000	0.00000	0.31323	0.00000	0.00000	0.15200	0.16000	0.18700	0.19300
T42	0.00000	0.00000	0.00000	0.00000	0.68677	0.00000	0.00000	0.19700	0.19000	0.17600	0.16800
T51	0.00000	0.00000	0.00000	0.00000	0.00000	0.23495	0.00000	0.18400	0.19600	0.18200	0.19200
T52	0.00000	0.00000	0.00000	0.00000	0.00000	0.76505	0.00000	0.17300	0.19000	0.19200	0.21000
T61	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.23546	0.16900	0.18700	0.18200	0.18400
T62	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.37517	0.13900	0.15800	0.14100	0.16300
T63	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.38937	0.16300	0.17000	0.15300	0.21300

	T23	T31	T32	T41	T42	T51	T52	T61	T62	T63
Goal	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
T11	0.16800	0.16800	0.16800	0.17300	0.13300	0.16800	0.17300	0.19000	0.19200	0.21000
T12	0.17700	0.14900	0.14900	0.16900	0.16800	0.14900	0.16900	0.18700	0.18200	0.18400
T21	0.15900	0.14900	0.14900	0.13900	0.12300	0.14900	0.13900	0.15800	0.14100	0.16300
T22	0.16400	0.16900	0.16900	0.16300	0.15300	0.16900	0.16300	0.17000	0.15300	0.21300
T23	0.20600	0.20000	0.20000	0.17300	0.13200	0.20000	0.17300	0.14200	0.19600	0.19200
T31	0.22900	0.19600	0.19600	0.19900	0.16200	0.19600	0.19900	0.17700	0.19400	0.22800
T32	0.20000	0.17600	0.17600	0.17300	0.14000	0.17600	0.17300	0.19800	0.17400	0.20400
T41	0.20800	0.15500	0.15500	0.15200	0.14000	0.15500	0.15200	0.16000	0.18700	0.19300
T42	0.17800	0.18900	0.18900	0.19700	0.13100	0.18900	0.19700	0.19000	0.17600	0.16800
T51	0.17000	0.20100	0.20100	0.18400	0.17800	0.20100	0.18400	0.19600	0.18200	0.19200
T52	0.16800	0.16800	0.16800	0.17300	0.13300	0.16800	0.17300	0.19000	0.19200	0.21000
T61	0.17700	0.14900	0.14900	0.16900	0.16800	0.14900	0.16900	0.18700	0.18200	0.18400
T62	0.15900	0.14900	0.14900	0.13900	0.12300	0.14900	0.13900	0.15800	0.14100	0.16300
T63	0.16400	0.16900	0.16900	0.16300	0.15300	0.16900	0.16300	0.17000	0.15300	0.21300

TABLE 6. Global Weights through the Hierarchy.

Second Level Attributes	Global Weights	Percentage	Ranks
T11	0.09820	9.82 %	1
T12	0.06480	6.48 %	10
T21	0.04510	4.51 %	14
T22	0.05320	5.32 %	12
T23	0.05540	5.54 %	11
T31	0.06540	6.54 %	9
T32	0.07210	7.21 %	8
T41	0.04520	4.52 %	13
T42	0.08740	8.74 %	3
T51	0.07540	7.54 %	7
T52	0.09250	9.25 %	2
T61	0.07850	7.85 %	6
T62	0.08530	8.53 %	4
T63	0.08150	8.15 %	5

Values from multiple comparisons are used to obtain the unweighted super matrix. After the initial estimation of the weight super matrix (shown in Table 5), the constraint super matrix is also estimated. Using the local weight, weight super matrix, and limit super matrix, the global weight and ranking of attributes are calculated hierarchically as shown in Table 6. The researchers used the opinions of 56 professors enrolled in six elective courses. These options include: private blockchains, public blockchains, hybrid blockchains, permissioned blockchains, shared blockchains, and business applications, denoted as A1, A2, A3, A4, A5, and A6, respectively [54]. The Fuzzy-TOPSIS method is to provide as input the global weights of different conditions created by the fuzzy ANP to create a priority for each option. The results obtained with the help of Fuzzy-

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ANP-TOPSIS are analyzed using Equations (15)-(20) as follows: With the help of Equations (1)-(9) and Equation (15). For this purpose, equation (16) was used and a hierarchical decision matrix was created. Then the decision matrix unit score of each model (also called the performance value of the model) is derived from the weight of each measurement, and the fuzzy weighted standardized decision matrix is produced by Equation 16 and can be seen in Table 7. The solution (FPIS) and the worst solution (FNIS) are calculated by completing the product (17). The distance between each value selected by FPIS and FNIS is then calculated by Equations (18) and (19) and can be found in columns D+I and D-I in Table 8-9. Then the output value of each parameter is determined by mathematical equation (20). Other measures were taken according to the evaluation results shown in Table 10. The six blockchain technology changes define the results as A1, A4, A2, A5, A3, and A6. According to the research results, A1 (private chain model) are blockchains that are at risk of being exposed to more serious changes compared to other blockchain models that demonstrate their performance in the public sector, hybrid blockchains, permissioned blockchains, chain participation and distributed applications. It is designed to provide safe and effective EHR services to healthcare organizations.

TABLE 7. Subjective Cognition Results of Evaluators in Linguistic Terms.

	A_1	A_2	A_3	A_4	A_5	A_6
T11	4.27000, 6.27000, 8.27000	2.36000, 4.27000, 6.18000	1.45000, 3.00000, 4.91000	1.18000, 2.82000, 4.82000	4.27000, 6.27000, 8.27000	2.45000, 4.45000, 6.45000
T12	2.45000, 4.45000, 6.45000	3.18000, 5.18000, 7.18000	1.64000, 3.55000, 5.55000	0.82000, 2.27000, 4.27000	2.45000, 4.45000, 6.45000	3.55000, 5.55000, 7.45000
T21	2.64000, 4.64000, 6.64000	2.82000, 4.82000, 6.82000	2.55000, 4.45000, 6.45000	2.45000, 4.27000, 6.27000	2.64000, 4.64000, 6.64000	2.90000, 4.80000, 6.70000
T22	2.45000, 4.45000, 6.45000	3.55000, 5.55000, 7.36000	1.36000, 3.36000, 5.36000	1.91000, 3.73000, 5.73000	2.45000, 4.45000, 6.45000	2.36000, 4.27000, 6.27000
T23	3.18000, 5.18000, 7.18000	5.73000, 7.73000, 9.27000	1.64000, 3.55000, 5.55000	1.64000, 3.55000, 5.55000	3.18000, 5.18000, 7.18000	3.55000, 5.55000, 7.27000
T31	2.82000, 4.82000, 6.82000	4.09000, 6.09000, 8.09000	1.18000, 3.00000, 5.00000	1.45000, 3.36000, 5.30006	2.82000, 4.82000, 6.82000	2.09000, 4.09000, 6.09000
T32	3.55000, 5.55000, 7.36000	3.73000, 5.55000, 7.27000	2.82000, 4.82000, 6.73000	1.64000, 3.55000, 5.55000	3.55000, 5.55000, 7.36000	3.09000, 5.00000, 6.82000
T41	4.45000, 6.45000, 8.18000	2.36000, 4.27000, 6.27000	1.20000, 3.00000, 5.00000	1.36000, 3.36000, 5.36000	4.45000, 6.45000, 8.18000	2.45000, 4.45000, 6.45000
T42	4.45000, 6.45000, 8.27000	4.82000, 6.82000, 8.55000	1.09000, 2.82000, 4.82000	0.82000, 2.64000, 4.64000	4.45000, 6.45000, 8.27000	2.36000, 4.27000, 6.18000
T51	5.73000, 7.73000, 9.27000	5.55000, 7.50005, 9.27000	1.82000, 3.73000, 5.73000	1.64000, 3.55000, 5.55000	5.73000, 7.73000, 9.27000	3.18000, 5.18000, 7.18000
T52	5.18000, 7.18000, 8.82000	4.27000, 6.27000, 8.18000	1.73000, 3.55000, 5.55000	1.18000, 3.00000, 5.00000	5.18000, 7.18000, 8.82000	2.82000, 4.82000, 6.82000
T61	4.45000, 6.45000, 8.18000	4.27000, 6.27000, 8.09000	2.91000, 4.82000, 6.73000	2.82000, 4.82000, 6.73000	4.45000, 6.45000, 8.18000	3.55000, 5.55000, 7.36000
T62	6.27000, 8.27000, 9.45000	5.73000, 7.73000, 9.00000	1.64000, 3.36000, 5.36000	1.45000, 3.36000, 5.36000	6.27000, 8.27000, 9.45000	3.91000, 5.91000, 7.55000
T63	4.18000, 6.09000, 7.64000	5.73000, 7.73000, 9.00000	0.82000, 2.45000, 4.45000	1.64000, 3.55000, 5.55000	4.18000, 6.09000, 7.64000	2.82000, 4.82000, 6.64000

5.1 SENSITIVE ANALYSIS:

A sensitivity test is performed by adjusting variables to determine the accuracy of the results obtained [51]. During the evaluation of these data, sensitivity analysis of the result weights (variables) was performed. Throughout this study, 15 variables were used to test sensitivity with the help of 14 experiments in the final stage (second). In each experiment, the high level (CC-i) was determined by adjusting the weight of each factor, while the weight of other factors was kept constant by the Fuzzy-ANP-TOPSIS method. Table 11 and Figure 4 show impact estimates. According to the actual performance, the other (A1) has a satisfactory level of satisfaction (CC-i). Fifteen attempts were made. The results show that alternative 1 (A1) still maintains a high level of satisfaction (CC-i) across 15 trials. In the other 13 experiments, the lowest change in two different experiments was A3 and

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A6. Comparison of performance with Table 9. Weighted normalized fuzzy decision matrix. Each indicates the weighting of the scores of the options.

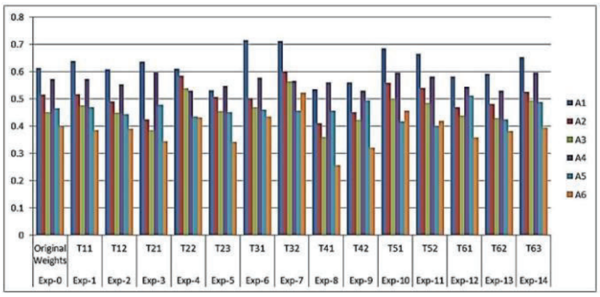

Fig 4 : Bar graph of sensitive analysis

TABLE 8. The Normalized Fuzzy-Decision Matrix.

	A_1	A_2	A_3	A_4	A_5	A_6
T11	0.46000, 0.67000, 0.86000	0.42000, 0.69000, 0.99000	0.54000, 0.75000, 0.94000	0.35000, 0.61000, 0.88000	0.57000, 0.78000, 0.96000	0.35000, 0.58000, 0.81000
T12	0.54000, 0.75000, 0.92000	0.38000, 0.60000, 0.80000	0.50000, 0.72000, 0.92000	0.31000, 0.57000, 0.82000	0.47000, 0.68000, 0.88000	0.46000, 0.67000, 0.86000
T21	0.39000, 0.59000, 0.79000	0.52000, 0.74000, 0.94000	0.46000, 0.68000, 0.88000	0.33000, 0.59000, 0.86000	0.32000, 0.53000, 0.74000	0.50000, 0.71000, 0.89000
T22	0.46000, 0.67000, 0.86000	0.38000, 0.60000, 0.80000	0.38000, 0.60000, 0.80000	0.57000, 0.78000, 0.96000	0.54000, 0.75000, 0.94000	0.46000, 0.67000, 0.86000
T23	0.50000, 0.71000, 0.89000	0.52000, 0.74000, 0.94000	0.52000, 0.74000, 0.94000	0.51000, 0.72000, 0.90000	0.46000, 0.68000, 0.87000	0.50000, 0.71000, 0.89000
T31	0.46000, 0.67000, 0.86000	0.52000, 0.74000, 0.93000	0.42000, 0.69000, 0.99000	0.47000, 0.68000, 0.87000	0.38000, 0.66000, 0.96000	0.54000, 0.75000, 0.92000
T32	0.50000, 0.71000, 0.89000	0.52000, 0.74000, 0.92000	0.20000, 0.47000, 0.77000	0.47000, 0.68000, 0.88000	0.20000, 0.50000, 0.80000	0.54000, 0.75000, 0.92000
T41	0.54000, 0.75000, 0.92000	0.60000, 0.81000, 1.00000	0.42000, 0.69000, 0.99000	0.61000, 0.82000, 0.98000	0.38000, 0.66000, 0.96000	0.59000, 0.80000, 0.97000
T42	0.54000, 0.75000, 0.92000	0.46000, 0.68000, 0.88000	0.20000, 0.47000, 0.77000	0.55000, 0.76000, 0.93000	0.20000, 0.50000, 0.80000	0.59000, 0.80000, 0.96000
T51	0.59000, 0.80000, 0.97000	0.46000, 0.68000, 0.87000	0.18000, 0.45000, 0.74000	0.47000, 0.68000, 0.87000	0.20000, 0.50000, 0.80000	0.54000, 0.75000, 0.93000
T52	0.59000, 0.80000, 0.96000	0.26000, 0.53000, 0.82000	0.16000, 0.42000, 0.72000	0.43000, 0.64000, 0.86000	0.12000, 0.39000, 0.69000	0.30000, 0.57000, 0.83000
T61	0.54000, 0.75000, 0.93000	0.43000, 0.72000, 1.00000	0.27000, 0.55000, 0.85000	0.39000, 0.61000, 0.81000	0.24000, 0.53000, 0.82000	0.33000, 0.59000, 0.86000
T62	0.46000, 0.67000, 0.86000	0.38000, 0.60000, 0.80000	0.38000, 0.60000, 0.80000	0.57000, 0.78000, 0.96000	0.54000, 0.75000, 0.94000	0.46000, 0.67000, 0.86000
T63	0.50000, 0.71000, 0.89000	0.52000, 0.74000, 0.94000	0.52000, 0.74000, 0.94000	0.51000, 0.72000, 0.90000	0.46000, 0.68000, 0.87000	0.50000, 0.71000, 0.89000

TABLE 9. The Weighted Normalized Fuzzy-Decision Matrix.

	A_1	A_2	A_3	A_4	A_5	A_6
T11	0.00010, 0.00060, 0.00190	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00100, 0.00400, 0.01700	0.00100, 0.00500, 0.01800
T12	0.00020, 0.00080, 0.00270	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00000, 0.00400, 0.01700	0.00200, 0.00700, 0.02500
T21	0.00010, 0.00050, 0.00180	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00000, 0.00200, 0.00900	0.00100, 0.00500, 0.01800
T22	0.00010, 0.00060, 0.00190	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00100, 0.00400, 0.01700	0.00100, 0.00500, 0.01800
T23	0.00020, 0.00080, 0.00270	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00000, 0.00400, 0.01700	0.00200, 0.00700, 0.02500
T31	0.00010, 0.00050, 0.00180	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00000, 0.00200, 0.00900	0.00100, 0.00500, 0.01800
T32	0.00030, 0.00110, 0.00360	0.00200, 0.00900, 0.03000	0.00200, 0.00900, 0.03000	0.00200, 0.00900, 0.03000	0.00200, 0.00900, 0.03400	0.00300, 0.01100, 0.03600
T41	0.00010, 0.00060, 0.00190	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00100, 0.00400, 0.01700	0.00100, 0.00500, 0.01800
T42	0.00020, 0.00080, 0.00270	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00000, 0.00400, 0.01700	0.00200, 0.00700, 0.02500
T51	0.00010, 0.00050, 0.00180	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00000, 0.00200, 0.00900	0.00100, 0.00500, 0.01800
T52	0.00010, 0.00060, 0.00190	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00200, 0.00600, 0.02000	0.00100, 0.00400, 0.01700	0.00100, 0.00500, 0.01800
T61	0.00020, 0.00080, 0.02070	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00200, 0.00800, 0.02500	0.00000, 0.00400, 0.01700	0.00200, 0.00700, 0.02500
T62	0.00010, 0.00050, 0.00180	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00200, 0.00700, 0.02200	0.00000, 0.00200, 0.00900	0.00100, 0.00500, 0.01800
T63	0.00030, 0.00110, 0.00360	0.00020, 0.00090, 0.00300	0.00020, 0.00090, 0.03000	0.00200, 0.00090, 0.03000	0.00200, 0.00900, 0.03400	0.00300, 0.01100, 0.03600

TABLE 10. Closeness Coefficients to the Aspired Level among the Different Alternatives.

Alternatives		d^{+i}	d^{-i}	Gap Degree of CC^{+i}	Satisfaction Degree of CC^{-i}
Alternative 1	A1	0.04400	0.02700	0.37900	0.61200
Alternative 2	A2	0.03700	0.03600	0.49700	0.51400
Alternative 3	A3	0.03500	0.04100	0.53900	0.45100
Alternative 4	A4	0.03500	0.02700	0.43900	0.57200
Alternative 5	A5	0.03800	0.04600	0.54500	0.46500
Alternative 6	A6	0.03200	0.04800	0.62500	0.39800

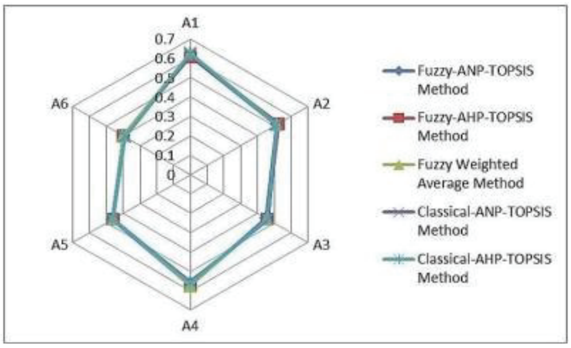

Fig 5: Radar chart representation of comparision of result

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5.2 Comparison of the result:

In this work, we used several different methods to test the accuracy of our results. Researchers used the Fuzzy ANP-TOPSIS method to analyze the accuracy of this research. The data collection and evaluation process for this data in Fuzzy ANP- TOPSIS is very similar to the classical ANP- TOPSIS approach. Therefore, blurring and defuzzification are required for Fuzzy-ANP-TOPSIS. Therefore, the data of fuzzy ANP- TOPSIS are written in their original numerical form and then converted into fuzzy numbers. The difference between fuzzy and classical ANP- TOPSIS results is shown in Figure 5. The results of this research are unique, but the point is the same. In this empirical study, the Pearson correlation method was used to measure the correlation between results. Coefficient correlation shows the effect of pairwise correlation. Scale from -1 to +1 [52]. A value close to -1 indicates a low correlation between values, while a value close to +1 indicates a strong correlation between values. The Pearson correlation between fuzzy ANP results and classical ANP results is 0.89176, showing a clear similarity between the results. As can be seen in Table 15, results were produced for different blockchain technology models for the same data, and all these results show the relationship between fuzzy ANP results and classical strong ANP results. The results of our analysis also show that the identified variables and their relationship with the security system are important aspects of security policy. Khan et al. [53] particularly adopted the fuzzy ANP-TOPSIS method in their study. This is because the ANP method is different from the AHP method because the ANP method has more linear models than tree models. Therefore, in this study, researchers adopted design as the first stage of being included in the network, which is the main point of production.

There is no way to evaluate software security in the context of design strategy with the help of the fuzzy ANP-TOPSIS process.

6. Conclusion and Future works:

The proposed work uses an integrated fuzzy-ANPTOPSIS to find the effect of blockchain technology to get secured electronic healthcare records. The hybrid fuzzy-ANP-TOPSIS method offers an effective way to analyze any MCDM issue with various variables and alternatives, such as blockchain technology assessment. Different factors for the blockchain models impact evaluation are estimated, their weights are measured, alternative rankings are determined and the overall impact of blockchain models for securing EHR is assessed. It has been concluded that alternative- Private Blockchain model is the most acceptable means for offering effective and robust service in healthcare blockchain technology. Private Blockchain technology would offer more secure platforms for sharing health data in the healthcare sector by protecting the data over a distributed peer-to-peer infrastructure, thus transforming the way in which the EHRs of patients are exchanged and maintained. This research study will serve as a model or motivation for future research as well as projects of blockchain technology in healthcare settings. Our discussed methodological approaches and categorization will lead to an infrastructure or model's proposal which solves the issues addressed in healthcare blockchain technology. Therefore, a potential path for future research is to assess the implementation of healthcare blockchain technology-based services prioritized on their impact to achieve positive improvements in the healthcare sector.

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