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Readiness Level Assessment for Blockchain Practices in the Healthcare Sector Using Fuzzy Logic Approach: A Case Study in Bangladesh

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Abstract

In recent years, the adoption of blockchain technology has attracted attention in various industries, including healthcare, for its potential to transform data management and improve operational efficiency. This paper explores the readiness of healthcare organizations in Bangladesh in adopting blockchain practices. The conceptual framework has been developed based on a review of the relevant literature in details, as well as consultation with health-care experts. The model construct based on various influential factors of blockchain adoption. The paper uses a fuzzy logic approach to assess the current state of blockchain technology in hospital. This approach provides successful interventions by clearly demonstrating current capabilities and highlighting areas for improvement. Based on expert data from renowned hospital in Bangladesh, the study provides a comprehensive picture of their readiness level with weaker attributes need to be addressed. The result shows that preparedness of the hospital. Hospital appears moderate ready to adopt blockchain technology due to some weaker attributes. The results highlight specific areas by identifying five important attributes that need to be addressed in both hospitals to achieve emphasis, and provide a clear roadmap for healthcare organizations aiming to successfully integrate blockchain technology. This study contributes to the growing awareness of blockchain in healthcare by providing a framework that high-level healthcare professional and policymakers can use to prioritize interventions and also by analyzing readiness condition and addressing critical attributes, blockchain exercises have the potential to increase security, transparency and operational efficiency, and ultimately improve patient care at Bangladesh.

Keywords

Readiness Assessment, Level of Readiness, Blockchain Practices, Fuzzy Approach, Healthcare sector

1. Introduction

Hospital is not an exception to various industries which Blockchain technology is transforming. The potential of storing, managing and securely sharing data across decentralized networks in a way that improves operations in the healthcare is high especially in managing patient data, ensuring supply chain transparency, and improving data interoperability (Balasubramanian et al. 2021). Increasing demographics, costs and the like diseases such as diabetes and cancer pose increased challenges to healthcare organizations. Such challenges demand creative answers that meet the high standard of quality care with delivering them at a cost effective price. There is a need for a new strategic approach to address accessibility of healthcare services of different populations and corresponding disparities across socioeconomic strata and geographic locations (Nicolai et al. 2023). As a promising tool, blockchain technology is able to strengthen the security, transparency and efficiency of various healthcare operations, including management of patient data, supply chain transparency and data interoperability (Sanda et al. 2022)

And while this promise holds promise for this would be a significant step toward digitization, blockchain technology's successful adoption in healthcare organizations ultimately comes down to the readiness of the institution to begin the journey of adopting disruptive technology. In the case of blockchain in healthcare, the readiness of the organization to implement it will determine its success (Sanda et al. 2022) . Readiness means the ability of the organizations to incorporate new technologies into their existing models in a seamless and ultimately effective manner. In the context of blockchain adoption, ability and willingness of healthcare institutions to adopt blockchain in an effective way represent readiness to do so . Readiness is a dimension that gets at how ready an organization is for technology and practice change, including in the healthcare sector. It describes the attitudes, behavior of the people who will be touched by tactical changes, and assesses implementation feasibility of the proposed changes (Nicolai et al. 2023). Readiness is instrumental when adopting blockchain technology and it can indicate the organization's readiness for new systems, readiness for change and how change can be enhanced to serve patients better (Balasubramanian et al. 2021). Several key factors dictate how ready and able health care institutions are to adopt blockchain. Managerial commitment is another factor that is key for this purpose in order to drive the adoption process and align organizational goals to the technological advancements.

With weak leadership and a lack of clear vision; blockchain projects might struggle to gain traction. Another vital factor to the success of anything involving blockchain is employee engagement — meaning the staff must be willing and able to adapt its enduring workflows and procedures associated with the new systems of blockchain technology (Balasubramanian et al. 2021). Their competence and confidence in using blockchain will be improved only if they are adequately trained and instructed. It also needs technological infrastructure readiness that implies that current healthcare institutions' systems are strong enough to sustain blockchain integration and support data interoperability and security without disruptions. These organizations that have a culture of innovation and flexibility are more likely to introduce the new environment such as the blockchain. Strong culture is supportive of trust, collaboration, and openness for new things that are integral to the adaptation of blockchain practices in healthcare. Finally, regulatory and legal readiness is critical to working with compliance on health data regulations, and to make sure blockchain solutions achieve the rigour now needed in healthcare regarding privacy and security (Sanda et al. 2022). Collectively these factors determine how ready an organization is to integrate blockchain and potential areas to concentrate on in order to close weaknesses and maximize readiness for technology adoption.

However, many healthcare institutions lack preparedness in the long term since readiness tends to be neglected while only the technical tools and techniques are paid much attention (Hira et al. 2022). However, before jumping into blockchain in healthcare, the first and foremost activity to be performed is assessment of the institution to see if it's ready for such a transformation or not. Therefore, this research introduces a theoretical framework using fuzzy logic approach to assess the level of readiness in healthcare institutions in Bangladesh to adopt blockchain. As such, fuzzy logic is particularly well suited to this type of analysis as it enables the representation of uncertainty and ambiguity which are inherent characteristics of complex healthcare environments (Sanda et al. 2022). In particular, this paper shows a comprehensive framework that evaluates blockchain technology readiness levels, determines potential environmental barriers, and outlines actional recommendations to promote blockchain technology adoption in the healthcare context through fuzzy logic. A case study of healthcare institutions in Bangladesh is explored, where a number of unique challenges and factors that help or hinder readiness in blockchain practices are explored (Hira et al. 2022). By means of a fuzzy logic methodology, this study contributes to understanding the important factors for blockchain readiness and the impact of organizational culture and technological infrastructure in blockchain adoption (Zadeh, 2023).

Previous studies investigated readiness for technology adoption based on fuzzy models in different healthcare settings (Balasubramanian et al.2021), (Hira et al.2022), (Anzum & Kibria, 2024) ; however, a gap exists in the literature for a comprehensive model designed to evaluate the level of readiness for adopting blockchain practices in hospitals in Bangladesh. This research attempts to fill that gap by proposing a novel model to assess the readiness of healthcare institutes in Bangladesh for Blockchain technology at multiple levels of the analysis. The goal of the model is then to pinpoint weaknesses and strengths in these institutions, providing insights both qualitative and quantitative that are immediately translatable back to the local healthcare setting. To finish, the goal is to offer actionable methods which show that blockchain adoption can likewise improve healthcare infrastructures in Bangladesh.

1.1 Objectives

The specific objectives of this research are:

To develop a conceptual model for assessing the readiness of healthcare institution in Bangladesh for blockchain adoption
To identify and analyze critical factors that drives the readiness of these institutions for blockchain practices.

2. Methodology

This research utilizes a Fuzzy Logic-based model, the Blockchain Readiness Assessment in Healthcare Institutions (BRAHI), to address the condition of readiness of in Bangladeshi hospital for blockchain adoption. Developed through extensive literature review and expert consultation, the BRAHI model addresses local challenges and incorporates 8 criteria with 16 attributes focusing on key enablers such as managerial commitment, employee engagement, technological infrastructure, and regulatory compliance. The model was tested on three healthcare institutions with varying technological capacities, providing a comprehensive assessment of their blockchain readiness.

2.1 Representation of the Blockchain Readiness Assessment Model (BPRAHI)

The Blockchain Practice Readiness Assessment in Healthcare Institution (BPRAHI) framework evaluates the readiness of Bangladeshi healthcare institutions for blockchain adoption through three layers: four enablers, 8 criteria, and 16 attributes. These layers assess readiness at the management, employee, and organizational levels, focusing on Technological Infrastructure, Regulatory Compliance, Employee Engagement, Management Commitment, and Blockchain Implementation Strategy. These enablers collectively determine an institution's preparedness for integrating blockchain into healthcare processes. Table 1 summarizes the key enablers, criteria, and attribute relevant to health care block chain readiness.

Table 1. BPRAHI Evaluation Model Indicators

Enabler	Criteria	Attribute	References
Technological Infrastructure (B1)	Blockchain Infrastructure (B11)	Data storage capacity(B111)	(Balasubramanian et al., 2021)
		Server readiness(B112)	(Akbar et al., 2022)
	IT System Integration (B12)	Compatibility with current IT systems (B121)	(Sanda et al., 2022).
		Availability of necessary blockchain software tools (B122)	(Holm & Goduscheit, 2020)
Regulatory Compliance (B2)	Data Privacy Laws (B21)	Compliance with local and international privacy laws (B211)	(Holm & Goduscheit, 2020)
		Understanding of blockchain regulations(B212)	(Balasubramanian et al., 2021)
	Data Governance and Management (B22)	Implementation of robust access controls (B221)	(Deng, 2004)
		Data integrity validation(B222)	Expert Opinion
Employee Engagement (B3)	Training and Awareness (B31)	Blockchain education for staff (B311)	(Balasubramanian et al., 2021)
		Feedback and Communication (B312)	(Anzum & Kibria, 2024)
	Adoption Willingness (B32)	Employees' readiness to embrace blockchain technology (B321)	(Akbar et al., 2022)
		Collaborative Culture(B322)	(Holm & Goduscheit, 2020)
Management Commitment (B4)	Strategic Planning (B41)	Blockchain integration in long-term strategies(B411)	(Akbar et al., 2022)
		Statement of purpose (B412)	(Balasubramanian et al., 2021)

	Leadership Support (B42)	Organization's goal and the BP purpose (B421)	(Anzum & Kibria, 2024)
		Resource allocation for blockchain projects(B422)	Expert Opinion

The (BPRAHI) framework follows a structured seven-step process:

Step 1: Identifying Attributes, Criteria, and Enablers
The study begins by identifying important enablers, criteria, and qualities for measuring blockchain adoption in healthcare institutions. Adoption of blockchain technology has various benefits, including improved data security, patient record management, and transparency. Table 1 summarizes the identified enablers and their associated features.
Step 2: Linguistic Scale for Rating Performance and Importance
A predefined linguistic scale is used to rate the performance and importance of each attribute, based on prior research.

Step 3: Expert Opinion for Weightings and Ratings
Five experts, including healthcare professionals and IT specialists with blockchain knowledge, rate each factor's performance (scale: 0-10) and importance (scale: 0-1) through a survey. These ratings are used to assess the blockchain readiness of the institution.

Step 4: Linguistic Terms to Fuzzy Sets Conversion
The collected data, represented in linguistic terms, is converted into fuzzy sets for more accurate measurement, following previous research (Timans et al., 2012). Table 2 shows the numerical numbers used to calculate Blockchain Practices Readiness Assessment Health Index ratings.

Table 2. Identifying variants and their linguistic equivalents is critical for importance weighting and performance evaluation

Performance Score (M_{ijk})		Importance weighing (N_{ijk})	
Variants	Numerical value	Variants	Numerical value
Worst (W)	(0,0.5,1.5)	Very Low (VL)	(0,0.05,0.15)
Very Poor (VP)	(1,2,3)	Low (L)	(0.1,0.2,0.3)
Poor (P)	(2,3,5,5)	Fairly Low (FL)	(0.2,0.35,0.5)
Fair (F)	(3,5,7)	Medium (M)	(0.3,0.5,0.7)
Good (G)	(5,6.5,8)	Fairly High (FH)	(0.5,0.65,0.8)
Very Good (VG)	(7,8,9)	High (H)	(0.7,0.8,0.9)
Excellent (E)	(8.5,9.5,10)	Very High (VH)	(0.85,0.95,1)

Step 5: Fuzzy Scores as well as Weight Combinations
Fuzzy mathematical formulae are utilized to aggregate the fuzzy performance ratings and weights, yielding a Blockchain Practice Readiness Index (BPRI) for every enabler.Equation (1) describes how the variables' performance ratings are translated into criterion ratings (Timans et al., 2012). The criterion ratings are then transformed into enabler ratings using equation (2).

$$BP_i = \frac{\sum_{j=1}^{i} (B_{ij} * N_i)}{\sum_{j=1}^{i} X_{ij}} \ldots\ldots\ldots (1)$$

$$BP_{ij} = \frac{\sum_{k=1}^{k} (B_{ijk} * N_{ijk})}{\sum_{k=1}^{k} N_{ijk}} \ldots\ldots\ldots (2)$$

In the next phase, equation (3) will be used to determine the FRBPHI

$$FRBPRI_i = \frac{\sum_{j=1}^{i} (B_i * N_i)}{\sum_{j=1}^{i} N_i} \ldots\ldots\ldots\ldots (3)$$

Step 6: Blockchain Readiness Levels

The BPRI is determined using the Euclidean distance method and compared to specified readiness levels, as indicated in Table 3. Table 3 shows the fuzzy point that correlates to degrees of readiness for performing blockchain.

Table 3. Fuzzy points and degrees of readiness

Degrees of readiness	**Fuzzy points**
Prepared (P)	(7, 8.5, 10)
Close to Prepared (CP)	(5.5, 7, 8.5)
Average Prepared (AP)	(3.5, 5, 6.5)
Low Prepared (LP)	(1.5, 3, 4.5)
Not Prepared (NP)	(0, 1.5, 3.)

Equation (4) is used to evaluate the Euclidean distance (E), as shown below.

$$E(\text{BPRI}, \text{IILi}) = \sqrt{\sum(fBPRI(x) - fRIB_i(x))^2} \ldots\ldots\ldots\ldots (4)$$

Step 7: Identification of Key Blockchain Readiness Challenges
Using the Blockchain Readiness and Importance Index (BRII), lower-performing or less-important attributes are identified, revealing gaps in infrastructure, training, and other areas needing improvement.

This methodology, through the Blockchain Readiness Assessment and Health Index (BRAHI), provides a structured evaluation of healthcare institutions' preparedness for blockchain adoption. It supports healthcare managers and policymakers in identifying strengths, weaknesses, and necessary steps for successful implementation. This comprehensive approach helps healthcare institutions evaluate their readiness for blockchain integration and develop actionable strategies for successful adoption.

2.2 Data Collection Procedure
The present study aims to assess the condition of preparation of hospital organizations to implement blockchain practices by employing expert opinions and a fuzzy logic-based framework. The research engages a panel of ten experts representing various healthcare domains, including medical doctors, surgeons, nurses, pharmacists, and academicians, all with experience spanning 2 to 15 years. Their insights form the basis of assessing blockchain practice indicators. In order to evaluate the proposed framework, data were collected by from single hospital in Bangladesh, anonymized as Hospital A in adherence to confidentiality agreements.

3. CASE STUDIES
The BPRAHI evaluation technique was tested in one Bangladeshi hospital. However, due to confidentiality agreements, we will not provide any details of the institutions in this study and will refer to them as Hospital A throughout the text.

3.1 Hospital A
The evaluation of blockchain practices is conducted within a hospital in Khulna, Bangladesh, to assess the adoption and readiness of blockchain practice in the hospital. The hospital is well-established with a team of highly skilled and experienced professionals who specialize in various medical fields. However, the hospital confronts a number of issues, including the need to improve data management, strengthen security protocols, reduce fraud, and increase accessibility to medical records and supply chain management. This study intends to assist hospital administrators by utilizing the blockchain assessment methodology to identify major areas for development and determine the institution's readiness to utilize blockchain technology. Table 4 give assigns priority ratings to enablers critical for healthcare blockchain practice preparation. Table 5 gives rates the importance of criteria influencing healthcare preparation for blockchain practice. Table 6 provides important performance scores and importance weights for

attributes impacting hospital blockchain preparedness. The data provided by the experts from the hospital is summarized as follows:

Table 4. Important ratings for healthcare preparation for blockchain practice enablers

Enabler (BP_i)	Important ratings (N_i)		
	S1	S2	S3
BP_1	VH	H	VH
BP_2	H	VH	VH
BP_3	H	H	H
BP_4	H	H	VH

Table 5. Important ratings for healthcare preparation for blockchain practice criteria

Criteria (BP_{ij})	Importance weight (N_{ij})			BP_{ij}	N_{ij}		
	S_1	S_2	S_3		S_1	S_2	S_3
BP_{11}	H	H	FH	BP_{41}	H	H	H
BP_{12}	H	FH	FH	BP_{42}	H	H	H
BP_{31}	FH	FH	H				
BP_{32}	FH	H	FH				

Table 6. Performance Score and importance weighting for attributes related to healthcare blockchain readiness

BP_{ijk}	Performance Score (M_{ijk})			Importance weighing (N_{ijk})		
	S_1	S_2	S_3	S_1	S_2	S_3
BP_{111}	FH	H	MH	G	F	F
BP_{112}	H	H	H	P	VP	VP
BP_{121}	M	M	M	F	P	P
BP_{122}	VH	VH	FH	G	P	F
BP_{131}	FH	FH	M	P	G	FP
BP_{132}	H	FH	FH	G	VG	G

Table 7 summarizes the weighted significance of qualities and the overall performance rating. Table 8 summarizes the combined important rankings for the various criteria and enablers.

Table 7. Fuzzy Rating of Healthcare Preparedness for Blockchain Practices in Criteria Evaluation

Blockchain Criteria	Blockchain Attribute	Performance Score (M_{ijk})	Importance weighing (N_{ijk})	Criteria rating value(VP_{ij})
BP_{11}	BP_{111}	(3,5,7)	(0.5, 0.65, 0.8)	(3.06,4.73,6.62)
	BP_{112}	(2.3,4.3,5.5)	(0.72,0.83,0.56)	
BP_{12}	BP_{121}	(3.5,5,6.7)	(0.46,0.62,0.78)	(4.4,5.33,6.63)
	BP_{122}	(5.5,5,6)	(0.61,0.74,0.68)	
BP_{21}	BP_{211}	(3.4,5,6.5)	(0.65,0.77,0.54)	(2.67,4.45,6.51)
	BP_{212}	(3.4,4.2,6.4)	(0.65,0.77,0.54)	
BP_{22}	BP_{221}	(2.5,3.6,5.3)	(0.46,0.62,0.78)	(2.34,4.34,6.23)
	BP_{222}	(2.4,4.3,5.7)	(0.46,0.62,0.78)	

BP_{31}	BP_{311}	(3.7,5.7,7)	(0.62,0.74,0.86)	(2.23,4.34,6.32)
	BP_{312}	(2.4,4.4,6.6)	(0.43,0.71,0.66)	
BP_{32}	BP_{321}	(3.6,4.8,6.4)	(0.57,0.71,0.78)	(2.34,4.6,6.4)
	BP_{322}	(2.4,4.2,5.6)	(0.45,0.53,0.54)	
BP_{41}	BP_{411}	(2.3,4.3,5.4)	(0.57,0.71,0.78)	(2.23,4.0,5.32)
	BP_{412}	(3,4.3 ,6.4)	(0.75,0.83,0.74)	
BP_{42}	BP_{421}	(2.2,3.5,5.4)	(0.26,0.44,0.62)	(3.23,4.23,6.4)
	BP_{422}	(3.3,5.4,7.7)	(0.46,0.62,0.78)	

Table 8. Fuzzy Rating of Hospital Preparedness for Blockchain Practices using Enabler Assessment and FBPRI

Enabler	Criteria	Criteria Score (M_{ij})	Criteria Weighting (N_{ij})	Blockchain Enabler Score (BP_i)	Enabler Weights value (N_i)	blockchain Index
BP_1	BP_{11}	(3.06,4.73,6.62)	(0.66,0.77,0.88)	(3.42,4.93,6.3)	(0.52,0.63,0.7)	(2.66,4.28,6.4)
	BP_{12}	(4.4,5.33,6.63)	(0.62,0.74,0.86)			
BP_2	BP_{21}	(2.34,4.34,6.23)	(0.66,0.77,0.88)	(2.74,4.53,6.3)	(0.63,0.73,0.84)	
	BP_{22}	(2.23,4.34,6.32)	(0.46,0.62,0.78)			
BP_3	BP_{31}	(2.23,4.0,5.32)	(0.66,0.77,0.88)	(2.63,4.42,6.3)	(0.52,0.63,0.81)	
	BP_{32}	(3.23,4.23,6.4)	(0.62,0.74,0.86)			
BP_4	BP_{41}	(2.24,4.5,5.31)	(0.66,0.77,0.88)	(2.4,4.9,6.3)	(0.5,0.60,0.8)	
	BP_{42}	(3.4,4.5,6.5)	(0.62,0.74,0.86)			

3.1.1 Determine the Euclidean Distance

The Euclidean distance (E) for the ready label is derived using equation (4), as shown below:

E (BPRI, Prepared) = $[(2.66-7)^2+ (4.28-8.5)^2+ (6.44-8.5)^2]^{1/2} = 6.39$
E (BPRI, Close to Prepared) = $[(2.66-5.5)^2+ (4.28-7)^2+ (6.44-8.5)^2]^{1/2} = 4.43$
E (BPRI, Average Prepared) = $[(2.66-3.5)^2+ (4.28-5)^2+ (6.44-6.5)^2]^{1/2} = 1.10$
E (BPRI, Low Prepared) = $[(2.66-1.5)^2+ (4.28-3)^2+ (6.44-4.5)]^{1/2} = 2.59$
E (BPRI, Not Prepared) = $[(2.66-0)^2+ (4.28-1.5)^2+ (6.44-3)^2]^{1/2} = 5.16$

Assessing Preparedness Labels The linguistic label is coupled with the shortest E value using Euclidean distance calculation, demonstrating that the institution's preparedness for the blockchain index is "average prepared." This information is depicted in Figure 1.

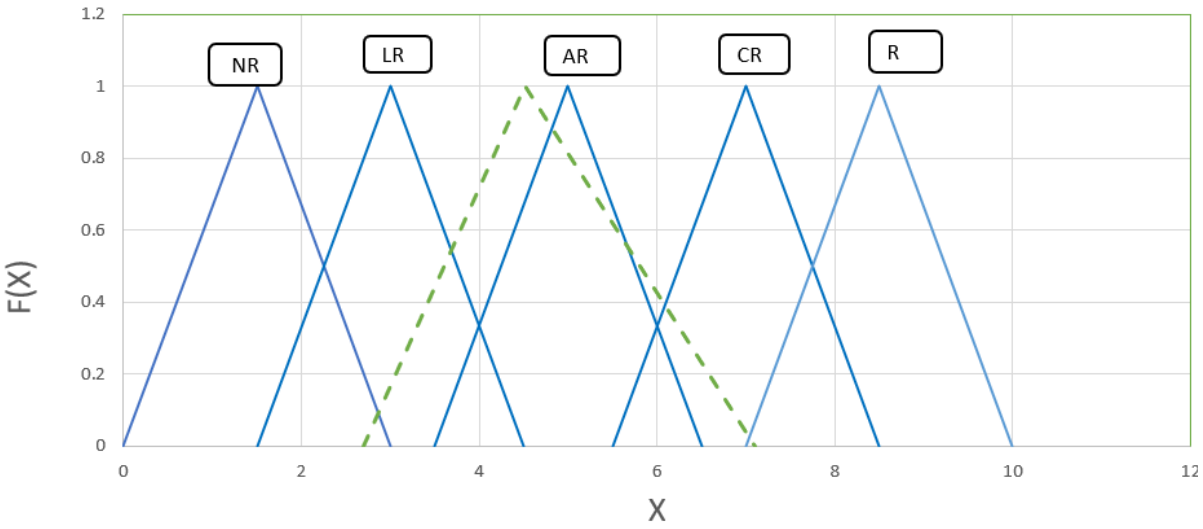

Figure-1. Linguistic levels to fulfill fuzzy readiness for blockchain procedures in hospital

3.1.2 Determining Key Attributes using the Blockchain Performance Importance Index

The BPII is a two-step procedure for identifying weaker characteristics. First, the BPII is calculated using equation (5). Second, equation (6) assigns a rating to each element. Table 9 reveals that each attribute has been assigned an average rating, and the administration has set a threshold of 1.3, implying that any feature that falls below this value indicates an opportunity for enhancement or improvement within the hospital's operating framework. Hospital A has shortcomings. Table 11 lists the following areas. Based to the Pareto concept, twenty percent of the attributes with the lowest scores should be improved to increase overall readiness for lean performance.

Table 9. The Fuzzy blockchain Practices Importance Index (BPII) measures hospital preparedness for block chain practices

Block chain attributes	Importance weighing (N_{ijk})	$B_{ijk} = (1, 1, 1) – N_{ijk.}$	BPII	Rank value
BP_{111}	(0.5, 0.65, 0.8)	(0.5 ,0.35,0.2)	(1.28,1.35,1.01)	1.34
BP_{112}	(0.72,0.83,0.56)	(0.28,0.17,0.44)	(0.76,0.82,2.6)	**1.07***
BP_{121}	(0.46,0.62,0.78)	(0.54,0.38,0.32)	(1.36,0.8,2.80)	**1.28***
BP_{122}	(0.61,0.74,0.68)	(0.39,0.26,0.42)	(1.27,1.32,2.1)	1.47
BP_{211}	(0.65,0.77,0.54)	(0.35,0.33,0.46)	(1.48,1.52,2.23)	1.67
BP_{212}	(0.65,0.77,0.54)	(0.35,0.23.0.46)	(1.05,1.08,2.94)	**1.17***
BP_{221}	(0.46,0.62,0.78)	(0.54,0.35,0.22)	(1.18,1.33,1.18)	1.38
BP_{222}	(0.46,0.62,0.78)	(0.54,0.38,0.22)	(1.18,1.38,1.18)	1.42
BP_{311}	(0.62,0.74,0.86)	(0.38,0.26,0.14)	(1.14,1.3,0.95)	**1.22***
BP_{312}	(0.43,0.71,0.66)	(0.57,0.29,0.44)	(1.6,1.28,2.64)	1.56

BP_{321}	(0.57,0.71,0.78)	(0.43,0.29,0.22)	(0.72,0.8,1.62)	**0.91***
BP_{322}	(0.45,0.53,0.54)	(0.33,0.29,0.22)	(0.72,0.83,1.62)	**0.94***
BP_{411}	(0.57,0.71,0.78)	(0.55,0.47,0.46)	(1.7,1.78,1.45)	1.57
BP_{412}	(0.75,0.83,0.74)	(0.33,0.29,0.22)	(1.03,1.51,1.89)	1.48
BP_{421}	(0.26,0.44,0.62)	(0.74,0.56.0.38)	(1.23,1.4,1.6)	1.33
BP_{422}	(0.46,0.62,0.78)	(0.54,0.38,0.22)	(1.18,1.38,1.62)	1.35

Table 10. Listings of Poor attributes

Blockchain attributes	Poor attributes
BP_{112}	Server readiness
BP_{121}	Compatibility with current IT systems
BP_{212}	Understanding of blockchain regulations
BP_{311}	Blockchain education for staff
BP_{321}	Employees' readiness to embrace blockchain technology
BP_{322}	Collaborative Culture

4. Results and Discussion:

Bangladeshi hospitals today face challenges related to data management inefficiencies, outdated infrastructure, evolving customers' expectations. In this manner, these challenges underscore the requirement for creative answers like blockchain technology to improve data transparency, improve security, and help improve the conveyance of healthcare service delivery. The model provides structured evaluation of blockchain practices in healthcare, using fuzzy logic based inputs to assess blockchain readiness level across three hospitals. In Table 1, the assessments model was developed through the identification of blockchain enablers, criteria and attributes which were related specifically to healthcare sector. Successful blockchain implementation needs to integrate technology, manage patient data, ensure data security, and hold managerial accountability. We assessed performance and importance ratings using expert inputs with the centroid method via fuzzy logic. Surveys and interviews from experts such as hospital managers and IT professionals were used from whom we got insights. The numerical values measuring the Blockchain Practices Readiness Index (BPRI) were obtained by transforming linguistic terms and fuzzy membership functions into numerical values. Hospital A were categorised as "close to ready" with BPRI values of (2.77; 4.35; 6.07) which mean that Hospital A have a moderate readiness level for blockchain adoption, but do not have infrastructure and resource allocation ready enough to adopt blockchain yet.

Among the weaknesses detected commonly to the hospitals are server readiness, Employees' readiness to embrace blockchain technology and Collaborative Culture. The Blockchain Practices Importance Index (BPII) was to identify these weakness, including barriers like investments in technological infrastructure or data security measures. Hospitals need to work on upgrading their IT systems, whereby educating their staff on blockchain technologies and getting leadership support for the new technological implementation to improve readiness. This study finds a comprehensive roadmap for leading healthcare administrators who are trying to improve their readiness to blockchain, enhance data security and ultimately improve healthcare outcome. When we compare our current readiness assessment results with those from other sectors (Anzum & Kibria 2024). we look for similar barriers: resistance for technological changes and lack of training are different industry's blockages for mobile software adoption. Once addressed, these challenges will pave way to the hospital's migration to blockchain based systems, improve the management of hospital operations, and patient data.

5. Conclusions and Agenda for Future Research

The purpose of this study is to examine the state of readiness of the healthcare institutions in Bangladesh for adopting blockchain practices which intend to improve data transparency, security and will be much more efficient. Based on the results of Readiness Level Assessment for Blockchain Practices in the Healthcare Sector, the research reveals hospitals in various readiness levels and identifies their weaknesses and required improvements. A major finding is

that hospital administrators need to pay more attention to the gaps in technological infrastructure and employee training, as well as leadership support, if the blockchain is to be implemented successfully. The study emphasizes the same importance of knowledge sharing about blockchain technology, developing the clarity of communication channels among the parties involved and the constant appraisal and improving of the adoption process. Hospitals must invest in ensuring IT systems are able to work, and also work to create a culture where technological change is supported. This study is limited, however, in scope, to considerations of a single country and thus restricts the applicability of findings to a broader context. Finally, the sample size of only a small number of hospitals may prevent the generalizability of results and self reported data may subject the study to biases. Additionally, a study of blockchain readiness provides a snapshot of readiness without measuring progress over time and regional characteristics that potentially affect an organization's level of blockchain readiness were not correctly considered. Even with these caveats, this research presents useful lessons about sizing the blockchain constraints, the challenges and opportunities in setting up a blockchain network, and the challenges of determining who the intended users, participants, and auditors of the blockchain should be. More future research is needed to expand across different healthcare settings, correlate the ranking of readiness attributes, and compare with the findings of different regions. This understanding of blockchain readiness will be deepened by longitudinal studies and a more inclusive stakeholder engagement, and how to effectively implement blockchain will be practicalized.

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