

EXAMINING CHALLENGES IN THE ADOPTION OF BIG DATA IN HEALTH CARE INSTITUTIONS AND ITS IMPACT ON PATIENTS' SATISFACTION: AN EMPIRICAL STUDY IN DELHI, INDIA

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ABSTRACT

The study aims to investigate the obstacles and factors influencing the adoption of big data in healthcare organizations, and its subsequent impact on patient satisfaction. Big Data in healthcare refers to the collecting, analysis, and use of clinical data from patients that is too massive or complex to be grasped by standard data processing methods. Adopting big data in health care will enable managers to render services to patient and customer satisfaction. However, in the health care sector, firms must overcome several hurdles and problems by adopting new technology.

A detailed literature review was undertaken to examine many obstacles associated with the use of Big Data. A well-structured questionnaire was prepared in Likert scale to find the elements that influence big data adoption and its impact on patient satisfaction. To evaluate factors, exploratory factor analysis using SPSS 21 was performed, and Structural Equation Modelling (SEM) was performed to assess key significant factors that impact patient satisfaction. The data was gathered from employees associated with the hospitals.

The survey received responses from 212 participants. Following the analysis of the data, it was found that five challenging factors influence big data adoption. These are data integration, data understanding, technology and infrastructure, lack of expert and regulation barrier. These factors explained 70.36% of variance. Whereas SEM analysis indicated that both data integration, data understanding and lack of expertise significantly affect big data adoption. Furthermore, big data adoption in hospitals will help in improving patient satisfaction.

"This paper was selected from the Global Conference on Emerging Technologies, Business, Sustainable Innovative Business Practice, and Social Well-being on 10th and 11th December 2022 in India organized by Confab 360 Degree."

KEYWORDS

healthcare, big data, patient satisfaction

INTRODUCTION

The healthcare business in India has experienced remarkable growth in terms of employment opportunities and revenue generation. This growth can be attributed to improved services, expanded coverage, and increased investments by both public and private institutions. Furthermore, the integration of cutting-edge technologies like Big Data (BD) is playing a pivotal role in transforming the Indian healthcare system towards a patient-centric approach [1]. The efficacy of medical outcomes, the productivity of healthcare professionals, and ultimately patient satisfaction can be significantly impacted by BD, which entails the analysis of vast and complex datasets [2].

In today's rapidly evolving healthcare landscape, hospitals are faced with the challenge of streamlining care-delivery processes and developing sustainable business models to cope with escalating healthcare costs while meeting the expectations of increasingly informed and engaged patients. Alongside advancements in patient care, hospitals are investing efforts in deploying and leveraging their information technology (IT) infrastructure, resources, and organizational capabilities to improve the quality of care-delivery [3].

In addition to streamlining care-delivery and improving operational efficiency, hospitals are faced with the challenges of addressing the convergence of unexpected and market dynamics. This includes adapting to regulatory changes, evolving reimbursement models, and shifting patient expectations. To navigate these complexities, healthcare professionals, including doctors, office workers, and other staff, can benefit from leveraging cutting-edge IT solutions and harnessing the massive volumes of patient-generated data that are readily accessible. By consolidating patient information, such as medical history, into a single, practical location, hospitals can enhance the quality of care-delivery, improve clinical decision-making, and promote seamless coordination among healthcare providers [4].

Looking ahead, hospitals are expected to encounter a myriad of significant organizational, political, and technological challenges as they strive to fully leverage digital technology. The integration of BD and advanced analytics presents opportunities for hospitals to re-define their position within the broader healthcare ecosystem. By harnessing the power of data-driven insights, hospitals can

enhance their ability to deliver personalized and value-based care, leading to improved patient outcomes and experiences [5]. Furthermore, the adoption of BD has the potential to drive significant societal advantages by optimizing the quality and efficiency of healthcare services [6].

Despite substantial investments in the adoption of BD to meet patients' demands and expectations, the healthcare industry continues to face hurdles and obstacles. These challenges range from technical complexities, such as data integration and infrastructure limitations, to organizational barriers, including a lack of expertise and resistance to change. Additionally, regulatory and privacy concerns pose significant challenges for healthcare organizations seeking to leverage BD for improved patient care [7]. Therefore, this paper aims to address the issues and limitations that healthcare organizations confront in providing excellent care and value to patients, with a specific focus on maximizing patient satisfaction. By examining the challenges associated with the adoption of BD in healthcare institutions, this study aims to provide valuable insights and recommendations for overcoming these obstacles and harnessing the full potential of data-driven healthcare.

LITERATURE REVIEW

The adoption of BD is defined as a technique that allows an invention to modify an organization's infrastructure [8]. The adoption of BD comprises cutting-edge information processing technologies and decision-making tools [9].

BIG DATA IN HEALTH CARE INDUSTRY (HCI)

BD in health care contains vast volumes of information that may be used significantly. Because of the tremendous potential that exists in it, it has been a topic of special attention for industry and academics during the last decade. Every organization dealing with BD has to deal with 3V's- Velocity, Volume, and Variety. BD has grown in importance in healthcare due to three main trends in the industry: the large quantity of data accessible, rising healthcare costs, and an emphasis on patient satisfaction. To improve services and patient satisfaction, several clinics, healthcare hospitals and institutions produce, store and analyse BD. Some significant data sources in the healthcare sector include hospital records, patient medical records, test results, and internet of things-enabled devices. Effective administration and analysis are required to generate usable information from this data. Otherwise,

reviewing vast amounts of data to find a solution quickly, may become a mammoth task like hunting for a needle in a haystack. Each stage of extensive data management has unique challenges. Some of the significant obstacles to its acceptance are as follows:

1) Lack of Experts – As professionals understand data, the healthcare institution must look for learned professionals to manage BD. These people include data analysts, data engineers, and scientists who have worked with technology and can make sense of vast amounts of data. To bridge this gap, specific actions must be taken.[10]. Similarly [11], studied the shortage of skilled professionals in the field of BD analytics is a widespread challenge across industries, including healthcare. The rapid growth of data and technological advancements have outpaced the development of a qualified workforce to effectively manage and derive insights from large datasets. Also, [12], emphasized the critical role of data scientists in healthcare organizations for successful implementation of BD initiatives. They highlighted that data scientists possess the necessary skills to handle complex data integration challenges, apply advanced analytics techniques, and communicate actionable insights to support evidence-based decision-making.

2) Technological and infrastructure Barrier - Technological and infrastructure Barrier - BD has emerged as a crucial top-line business problem that organizations must address to be competitive and relevant in today's increasingly data-driven world. For this reason, technological and infrastructure needs are critical to ensuring the early completion of progress execution. BD investment is increasing across the board. Still, the cost will continue to be one of the most significant barriers to technology adoption and infrastructure development when launching BD projects [13]. In addition to the cost barrier, other authors have also identified various technological and infrastructure challenges in the adoption of BD in healthcare. For instance, [14], highlighted the need for scalable and robust IT infrastructure to handle the large volume, velocity, and variety of healthcare data. They emphasized the importance of investing in powerful servers, storage systems, and networking capabilities to support efficient data processing and analysis. Furthermore, [15] emphasized the importance of data security and privacy in the context of BD infrastructure. They discussed the challenges of safeguarding

sensitive patient information and complying with regulatory requirements while leveraging BD technologies. Implementing robust security measures, such as encryption and access controls, is crucial to protect patient data and maintain trust in healthcare organizations' data-driven initiatives.

3) Data Integration - Social networking sites, customer logs, financial reports, ERP software, emails, presentations, and staff reports are just a few data sources used in businesses. Businesses typically ignore this region. It takes much work to compile this information into reports. On the other hand, data integration must be faultless because it is essential for analysis, reporting, and business intelligence [16]. In addition [17] emphasized the need for a robust data integration strategy that enables seamless collection and integration of heterogeneous data sources in healthcare organizations. They stressed the importance of developing standardized data formats, protocols, and interfaces to facilitate interoperability and efficient data integration.

Moreover, [18] discussed the complexities associated with integrating structured and unstructured healthcare data from various sources, such as electronic health records, medical devices, wearable sensors, and patient-generated data. They emphasized the need for advanced data integration techniques, such as data cleansing, transformation, and mapping, to ensure the accuracy, consistency, and reliability of integrated data for meaningful analysis and decision-making.

4) Regulation barriers- Different structures might have guidelines, but in any case, one of these guidelines applies to most organizations. Organizational rules may be divided into four main categories: government rules, asset-imposing business model rules, asset-guideline-imposing industry rules, and brand-guideline-imposing industry rules. The strategy and exploitation of Big clinical data have yet to be clearly and efficiently specified, even though it is challenging to create Big clinical data without the restriction of regulations. [19]. Further, [20] discussed the complex legal and regulatory landscape surrounding the collection, storage, and use of healthcare data, which often creates challenges for healthcare organizations aiming to leverage BD. They emphasized the need for clear guidelines and policies regarding data privacy, consent, security, and compliance to ensure ethical

and responsible use of BD in healthcare. [21] addressed the regulatory challenges related to data sharing and interoperability in healthcare. They emphasized the importance of addressing regulatory barriers to enable seamless data exchange and collaboration among different healthcare entities. They highlighted the need for standardized data formats, protocols, and consent frameworks to overcome regulatory hurdles and facilitate secure data sharing for improved patient care and research.

5) Lack of understanding and securing data- - The failure of businesses' efforts to use significant data results from ignorance. Staff members may need to learn about data definitions, sources, processing, and storage. Data experts could understand what's happening, but others might need help understanding. Keeping these enormous data sets secure is one of the most challenging parts of BD. Businesses typically put data security off since they focus on comprehending, storing, and analyzing their data sets. However, this is a bad idea since vulnerable data repositories might serve as a haven for hostile hackers, slowing the procedure [22].

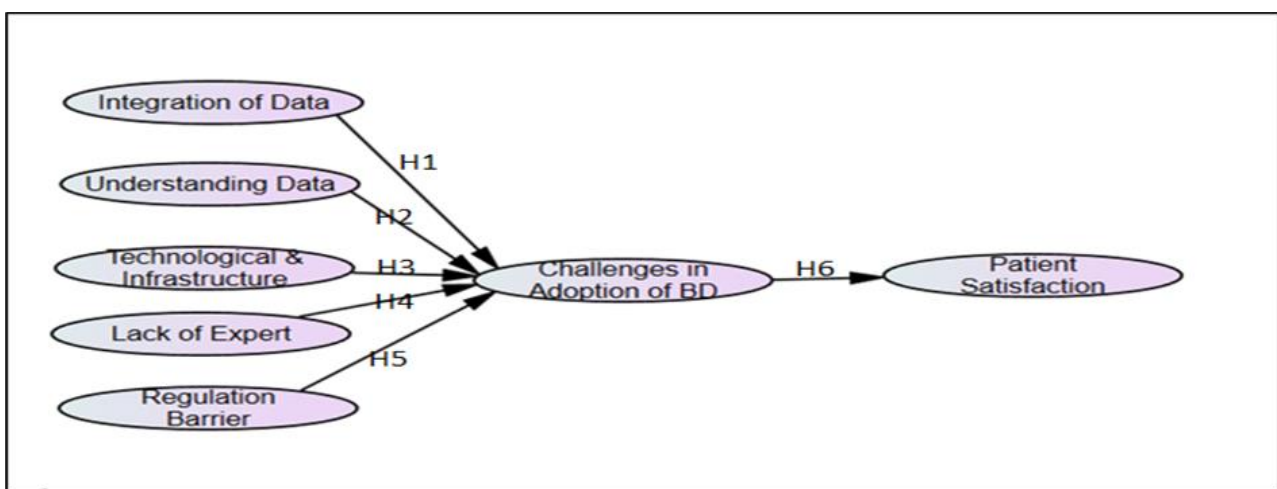
In addition to the challenges mentioned above, other authors have also emphasized the significance of understanding and securing data in the adoption of BD in healthcare. [23] discussed the importance of data literacy and education among healthcare professionals to enhance their understanding of data concepts and promote data-driven decision-making.

They emphasized the need for training programs and resources that equip healthcare personnel with the necessary knowledge and skills to effectively utilize and interpret BD. Furthermore, [24] highlighted the criticality of data security and privacy in the context of BD in healthcare. They discussed the risks associated with unauthorized access, data breaches, and misuse of sensitive healthcare information. They emphasized the need for robust data security measures, such as encryption, access controls, and monitoring systems, to safeguard patient privacy and maintain data integrity in the era of BD.

6) Patient Satisfaction - BD may empower people to manage their health by informing, educating, and inspiring them. Extensive data analysis knowledge provides medical professionals with clinical insights that enable them to provide improved client satisfaction. Additionally, it removes the guesswork frequently present in treatment, allowing clinicians to prescribe medications and accurately make clinical judgments. This lowers costs and improves patient satisfaction. Utilizing financial and clinical data may demonstrate treatment plans' effectiveness and efficiency. Beyond this, the billing systems can be enhanced, diagnosis and procedure codes can be cleared, patients can be given unique patient identification, and data can be synced with other verticals for future use [25].

Based on the literature study and the challenges encountered in adopting BD in Health Sector, a conceptual framework is being tested with the following hypothesis.

FIGURE1: CONCEPTUAL FRAMEWORK AND HYPOTHESIS



Source: Authors Compilation

OBJECTIVE OF THE STUDY

The research attempts to clarify the basic influences on hospitals' use of big data technology and how this technology contributes to patients' higher satisfaction levels.

HYPOTHESIS OF THE PRESENT STUDY

- H1.** Integrating Data by staff and executives significantly affects the adoption of big data in Health Care Institutions.
- H2.** Understanding data by staff & executives significantly affects the adoption of big data in Health Care Institutions.
- H3.** Technological and Infrastructure challenges significantly affect the adoption of big data in Health Care Institutions.
- H4.** The need for more experts significantly affects the adoption of big data in Health Care Institutions.
- H5.** Regulation Barrier significantly affects the adoption of big data in Health Care institutions.
- H6.** Challenges in adopting big data have a positive effect on patient satisfaction.

RESEARCH METHODOLOGY-

The ethics clearance has been waived for this research by Graphic Era Deemed to be University, India.

The research intends to investigate Delhi's Health Care Industry (HCI) challenges in using big data. To comprehend the obstacles and challenges associated with the implementation of BD in HCI as well as its impact on patient satisfaction, a well-structured questionnaire was developed. A simple Random Sampling method was adapted to collect a sample from every tier of employees because the study's huge population allowed for substantial congruency from the subpopulation. A 5.0 Likert scale was administered to assess the respondents' responses, ranging from "strongly agree" to "strongly disagree." The questionnaire was delivered to the respondents using Google Forms, and responses were requested via their email addresses. Data were gathered from 250 respondents from five hospitals and four clinics located in Delhi. Hence, the scope of the study is limited to the Delhi region. Out of the total sample size of 250 participants, a total of 212 respondents provided complete and filled responses, while the remaining participants provided incomplete responses. Due to the incomplete nature of these responses, they were not included in the analysis for the present study.

TABLE1: DEMOGRAPHIC PROFILE OF HEALTH CARE EXECUTIVES

Characteristics of Respondents	Group	Frequency	Percentage
Age	<35	58	27.36
	36-45	55	25.94
	46-55	51	24.06
	>55	48	22.64
Gender	Female	77	36.32
	Male	135	63.68
Education	Technical	55	25.94
	Graduate	77	36.32
	Post-Graduate	67	31.60
	Others	13	6.13
Front-Line Executive (Admin Staff)		67	31.61
Back-End Executive (Admin Staff)		97	45.75
IT Staff & Executives		48	22.64

Source: Authors Compilation

DATA ANALYSIS AND INTERPRETATION

RELIABILITY ANALYSIS

The reliability analysis is a calculation-based study that also provides information on the correlations between the scale's items and several widely used scale reliability indicators. Using the Cronbach alpha technique, internal consistency and reliability of data were assessed. All values were above a threshold level of 0.7 [26]. Additionally, as stated by Hu et al [27], all dependent constructs had CR values larger than 0.7. The variables investigated were connected and sufficient for testing the hypothesis because the factor loading values fell within the range of 0.68 to 0.91.

EXPLORATORY AND CONFIRMATORY FACTOR ANALYSIS:

Exploratory factor analysis (EFA), a conventional formal measuring paradigm, is used when both observable and latent variables are thought to be examined at the interval level. The study variable must pass the KMO test to investigate the factors. Our study's Kaiser-Meyer-Olkin (KMO) value was 0.867, above the threshold level. High values near 1.0 show that the factor analysis is practical when applied to the data [28]. Using the principal component method with eigenvalues greater than 1, Five-factors were extracted, accounting for 70.36% of the variance. Data integration (23.24%), lack of expertise (17.31%), technology and infrastructure (9.15%), data understanding (12.45%), and regulation barrier (8.21%) are these factors. CFA uses SEM to validate the construct and evaluate its impact on endogenous construct [29].

TABLE2: DESCRIPTION OF INDICATOR

Construct	Item Code	Description of variables	F. Loading	C - Alpha	CR	AVE
Data Integration	DI1	Combining of Data affects the adoption	0.83	0.82	0.87	0.74
	DI2	Gathering of Data from several sources	0.87			
	DI3	Transferring Data to requisite sources	0.79			
Lack of Expertise	LE1	Employees lack the technical know-how to use technology, hence fear to adapt new things	0.91	0.83	0.91	0.78
	LE2	The organization has a smaller number of technical experts who can assist other employees	0.88			
	LE3	Employees have difficulty applying technology in real-time due to a lack of experience	0.87			
Technology & Infrastructure	TI1	The cost of buying technology is high	0.87	0.85	0.87	0.68
	TI2	The complexity of technology affects the adoption	0.83			
	TI3	Acquiring infrastructure is costly as an organization does not have adequate resources	0.79			
Data Understanding	DU1	Employees do not have adequate knowledge	0.84	0.83	0.9	0.77
	DU2	Employees lack understanding of data and its linkage	0.91			
	DU3	Employees need proper training to understand	0.88			
Regulation Barrier	RB1	Government rules and regulation	0.82	0.86	0.84	0.64
	RB2	Organizational rules and policies are rigorous to adapt to new technology	0.81			
	RB3	Industry guidelines affect the adoption	0.78			

Adoption of Big Data	ABD1	The value of technology is not known	0.77	0.87	0.88	0.65
	ABD2	Applying technology not known	0.73			
	ABD3	The usage of technology is not known.	0.84			
	ABD4	High cost of technology	0.89			
Patient Satisfaction	PSAT1	Delays in bill Processing affect patient satisfaction	0.81	0.84	0.9	0.7
	PSAT2	Syncing of patient data affects satisfaction	0.84			
	PSAT3	Coding of patient data and linking	0.83			
	PSAT4	Bringing financial and clinical data to one place	0.87			

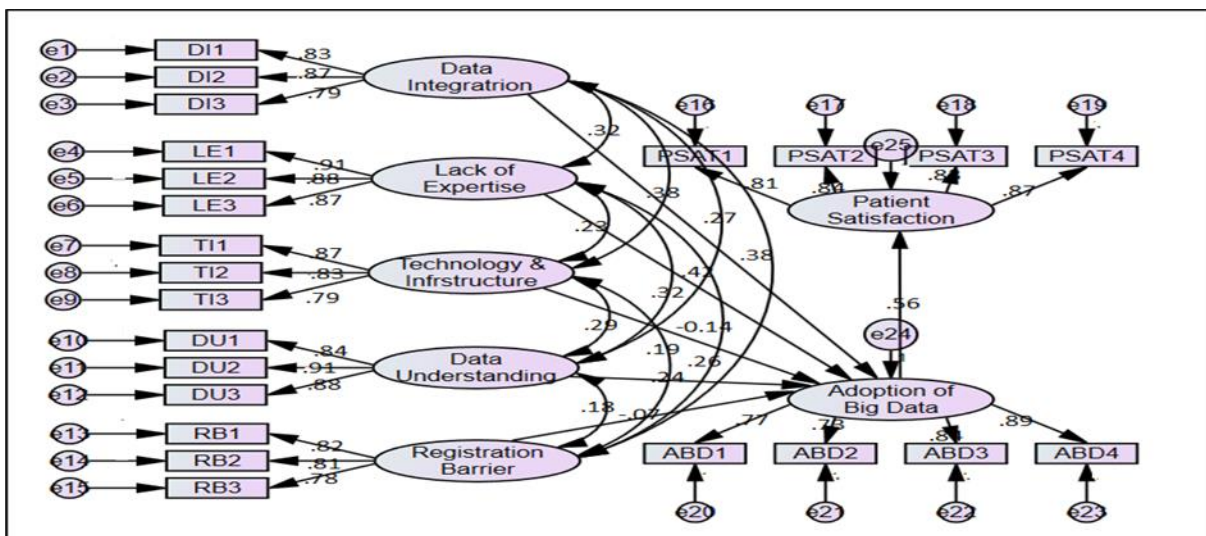
Source: Authors Compilation

TABLE 3: DISCRIMINANT VALIDITY

Discriminant validity	Data Integrity	Lack of Expertise	Technology & Infrastructure	Data Understanding	Regulation Barrier	Adoption of Big Data	Patient Satisfaction
Data Integrity	0.86						
Lack of Expertise	0.32	0.88					
Technology & Infrastructure	0.38	0.23	0.82				
Data Understanding	0.27	0.32	0.29	0.87			
Regulation Barrier	0.14	0.26	0.19	0.18	0.8		
Adoption of Big Data	0.38	.42	-0.14	0.23	-0.07	0.8	
Patient Satisfaction	0.36	0.36	0.18	0.33	0.17	0.55	0.83

Source: Authors Compilation

FIGURE2: ESTIMATE PATH ANALYSIS



Source: Authors Compilation

Convergent and discriminant validity meets the requirement of internal consistency from the assessment of the measurement model [30]. The findings of the validity study are displayed in Tables 2 and 3.

STRUCTURAL MODEL AND HYPOTHESIS TESTING

A connection between the endogenous and exogenous variables was made to achieve a model fit using SEM. The final model's parameters were as follows: AGFI = 0.911, CMIN/df = 2.83, GFI = 0.921, and RMSEA = 0.046 [31]. Evaluating the impact of the dependent construct on the independent construct is therefore essential in determining the validity of the hypothesis. Table 4 contains the outcomes of the hypothesis, and Figure 2 displays the path coefficient.

The estimate path coefficient analysis indicates that the biggest apprehension in the adoption of technologies as BD in healthcare organizations are data integration at ($\beta=0.38$, $P=***$), a lack of experience at ($\beta = 0.42$, $P=***$), and data comprehension at ($\beta = 0.24$, $P=***$). Therefore, the suppositions H1, H2, and H4 are accepted. When adopting BD, employees did not place much weight on technology, organizational structure, or regulatory issues. As a result, hypotheses H3 and H5 were disapproved. Additionally, the use of BD significantly impacted patient satisfaction. Therefore, at ($\beta = 0.56$, $P = ***$), the hypothesis H6 is likewise

supported. From the data, it can be concluded that patients are more likely to be satisfied if technologies are effectively integrated and used by the HCI to help patients anytime by extracting patient health-related data anywhere.

The findings of this study have important managerial implications for healthcare leaders. Firstly, addressing the challenge of data integration is crucial. Robust data integration strategies and technologies must be developed to aggregate and analyse diverse data sources effectively. This will enable organizations to leverage the full potential of BD in improving healthcare outcomes. Secondly, the lack of expertise in working with BD emerges as a significant barrier. Investments in training and development programs can enhance the data analytics skills of employees, empowering them to utilize BD for informed decision-making and ultimately enhance patient satisfaction. Thirdly, data comprehension plays a critical role. Healthcare professionals need to understand how to interpret and analyse data effectively. Providing resources and support to enhance data literacy among staff is vital for leveraging the wealth of available data. By addressing these challenges, healthcare organizations can unlock the transformative power of BD, leading to improved patient care and satisfaction.

TABLE 4: HYPOTHESIS RESULTS

Hypothesis	Proposed Relationship	Effect	Path Coefficient	Result
H1	Data Integration -----> Adoption of BD	Direct	0.38***	Accepted
H2	Lack of Expert -----> Adoption of BD	Direct	0.42***	Accepted
H3	T & I -----> Adoption of BD	Direct	-0.14NS	Rejected
H4	Data Understanding -----> Adoption of BD	Direct	0.24***	Accepted
H5	Regulation Barrier ----->Adoption of BD	Direct	-0.07NS	Rejected
H6	Adoption of BD -----> Patient Satisfaction	Direct	0.56***	Accepted

Source: Authors' result analysis

CONCLUSION AND SUGGESTION

BD is a rapidly developing technology that connects various sources to provide vast data and information to satisfy customers. The adoption of BD in healthcare too had several challenges. Our study identified five key factors that impact adoption, including: data integration, data understanding, infrastructure and technology, a shortage of experts, and regulatory barriers. These factors account

for a significant portion of the challenges faced. Patients often encounter issues with billing, patient identity, medical records, and doctor evaluation, which can affect their satisfaction. To address these issues, hospitals should prioritize measures such as integrating data effectively and leveraging the expertise of professionals. The study also confirmed that adopting BD can significantly impact patient satisfaction by enabling departments and doctors to analyze patient histories and provide better care. Organizations must invest in infrastructure, training, and

hiring experts to optimize data usage and enhance their marketability. These findings present opportunities for healthcare providers to improve patient satisfaction by aligning their strategies accordingly.

This study is relevant as it addresses the challenges faced by healthcare organizations in adopting BD technologies and highlights the impact on patient satisfaction. By identifying the key factors hindering adoption, the study provides valuable insights for healthcare leaders to make informed decisions and improve patient care delivery. However, one major limitation of this study is the reliance on self-reported data, which may be subject to response biases or inaccuracies. Additionally, the study focused on healthcare organizations within a specific region, which may limit the generalizability of the findings to other settings or countries. Further research with larger and more diverse samples is needed to validate the findings and ensure broader applicability.

Further research could explore the specific strategies and approaches that healthcare organizations can adopt to overcome the identified challenges in adopting BD. Additionally, investigating the long-term effects of implementing BD technologies on patient outcomes and healthcare system efficiency would contribute to the existing knowledge in the field. Furthermore, studying the ethical and privacy implications of using BD in healthcare would be essential for developing guidelines and policies that ensure data security and patient confidentiality.

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