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ORIGINAL

Investigating the Impact of Cloud-Based Technologies on Healthcare Accessibility and Service Efficiency

Investigación del impacto de las tecnologías basadas en la nube en la accesibilidad y la eficiencia de los servicios sanitarios

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ABSTRACT

Cloud computing has significantly transformed healthcare by providing enhanced remote access and improving service delivery efficiency. Despite its promise, there are indeed obstacles to its general acceptance, especially in developing nations where concerns about data security and underuse of ICTs prevent adoption. Research examines the factors influencing healthcare consumers' attitudes toward adopting cloud-based health systems, focusing on accessibility and service efficiency. A survey of 530 participants was conducted, and SPSS and factors were employed to examine the data. The results identify eight key factors that significantly impact healthcare consumers' behavioral intentions to adopt cloud-based healthcare technologies: perceived usefulness, facilitating conditions, performance expectancy, information sharing, social influence, and trust in technology, effort expectancy, and data security. However, Cloud-based health information was shown with no discernible effect. These findings underscore the importance of addressing consumer concerns, particularly related to security and system integration, to ensure the effective deployment of cloud-based medical centers. Such systems have the potential to improve healthcare access, especially in underserved and rural areas, while enhancing the overall efficiency of service delivery. The research suggests that healthcare policymakers and technology developers must prioritize these factors to foster greater adoption of cloud-based technologies within healthcare systems.

Keywords: Cloud Computing; Healthcare Accessibility; Service Efficiency; Adoption Factors; Data Security.

RESUMEN

La computación en nube ha transformado significativamente la atención sanitaria al proporcionar un mayor acceso remoto y mejorar la eficiencia en la prestación de servicios. A pesar de sus promesas, existen obstáculos para su aceptación general, especialmente en los países en desarrollo, donde la preocupación por la seguridad de los datos y la infrautilización de las TIC impiden su adopción. La investigación examina los factores que influyen en la actitud de los consumidores sanitarios hacia la adopción de sistemas sanitarios basados en la nube, centrándose en la accesibilidad y la eficiencia de los servicios. Se realizó una encuesta a 530 participantes y se emplearon SPSS y factores para examinar los datos. Los resultados identifican ocho factores clave que influyen significativamente en la intención de los consumidores sanitarios de adoptar tecnologías sanitarias basadas en la nube: utilidad percibida, condiciones facilitadoras, expectativa de rendimiento, intercambio de información, influencia social y confianza en la tecnología, expectativa de esfuerzo y seguridad de los datos. Sin embargo, la información sanitaria basada en la nube no mostró ningún efecto perceptible. Estos resultados subrayan la importancia de abordar las preocupaciones de los consumidores, en particular las relacionadas con la seguridad y la integración de sistemas, para garantizar la implantación eficaz de los centros médicos basados en la nube. Estos sistemas tienen el potencial de mejorar el acceso a la atención sanitaria, especialmente en zonas rurales y desatendidas, al tiempo que aumentan la eficiencia general de la prestación de servicios. La investigación sugiere que los responsables de las políticas sanitarias y los desarrolladores de tecnología deben dar prioridad a estos factores para fomentar una mayor adopción de las tecnologías basadas en la nube dentro de los sistemas sanitarios.

Palabras clave: Computación en Nube; Accesibilidad Sanitaria; Eficiencia de los Servicios; Factores de Adopción; Seguridad de los Datos.

INTRODUCTION

Modern healthcare services and patient care have been revolutionized by adopting cloud-based technologies.[1] The worldwide medical field needs efficient and accessible solutions because cloud computing enables scalable management of data together with remote healthcare and real-time professional collaboration.[2] The innovations enable remote areas and underserved populations to get quality healthcare immediately by overcoming geographic obstacles. Cloud-based platforms assist with healthcare operation optimization through their essential functions.[3] Incorporating EHRs and telemedicine treatments streamlines administrative processes, reduces redundancy, and improves coordination among healthcare providers.[4] Digital data processing and cloud-based analytics improve clinical decision-making, resulting in more precise diagnoses and faster interventions.[5] Security features of cloud storage protect medical records while making them accessible for swift retrieval, thus preventing errors during patient care delivery. The latest innovations in the industry yet face multiple existing hurdles.[6] Various difficulties indeed need to be addressed. Healthcare organizations using cloud solutions need to protect their data while maintaining reliable systems, which are essential operations.[7] Healthcare accessibility together with service efficiency continues to develop in significance as cloud computing evolves. Cloud technologies will reshape the future of patient-centered care together with medical service delivery at an international level through enhanced connectivity reduced administrative burdens and digital healthcare support.[8] Research uses CP-ABE to present a very fine control of data access approach for wireless IoT.[9] The approach conceals attribute information using an imprecise placement method based on a corrupted Bloom filter, ensuring data security and privacy through a randomized retrieval policy. The suggested approach delivers little data processing and storage expense while effectively protecting decision secrecy. Cloud computing, the IoT, and mechanization are some of the advancements that smart architecture uses for effective administration.[10] Smart health care systems (SMS) make use of devices with sensors and communication networks. For cloud-assisted SMS, an identification infrastructure based on ECC is developed to ensure mutual authentication, efficient computation, and communication while maintaining security and privacy. To address any risks to data security and privacy, research suggests an encrypted access mechanism for storing in the cloud electronic medical facilities.[11] Multiple keys created using the KDF have been employed in the encryption protocol to guard against abuse and guarantee end wise statistics ciphering. To defend anonymity, permission to use cloud services is predicated on the affiliation and identification of the parties involved. The straightforward and reliable plan is the greatest solution for safeguarding data confidentiality and security in cloud-based electronic healthcare services. Scalability, data storage enhancement, and AI-machine learning cooperation are all provided by cloud-based healthcare computing.[12] This research investigates the use of clever strategies in medical facilities, with a focus on concerns regarding security and privacy. It discusses the growing need for cloud computing, who it affects, and the opportunities and difficulties of putting these developments into practice. The research paper examines the literature on several strategies and a system employed to address security and privacy worries, e-Health noting the advantages and disadvantages of each model. Research examines several e-health security and privacy strategies, with an emphasis on cloud-based models.[13] Along with discussing the rules surrounding HIPAA, it offers a common definition of e-health and categorizes cloud-based models. The authors provide a secure framework for digital health records that guarantees effectiveness, dependability, and controlled contact with medical data. A secure, cost-effective cloud-based architecture for the healthcare industry that ensures privacy protection; it focuses on the EHR system, which uses multi-authority ciphertext-policy attribute-based security to enable precise control of access.[14] The system, which incorporates multifaceted application identification, attempts to give residents access to government-provided healthcare and other amenities. Cloud-based computing services have improved patient care by revolutionizing the handling of health information.[15] Advanced cloud services are available from the top three suppliers: Microsoft, Amazon, and Google. For safe data ingestion, storage, and analysis, to make the most of these services, a framework is suggested. The goal of this investigation database is to create a versatile informatics structure for telemedicine, which will improve the healthcare ecosystem by extending interconnection between telemedicine, IoT e-health, and hospital information systems.[16] This examines technological burdens and suggests ways to improve healthcare service levels using Sensor Hub and IoT technology. To enhance customer confidentiality as well as protection, this research proposes a smart service authenticating architecture for Telecommuting Medical Information Systems (TMIS).[17] To improve reciprocal authenticity, the framework cross-examines shared secret session keys between communication entities. The suggested framework's security features were confirmed through both official and informal verification techniques.

METHOD

Data collected from 530 respondents are used to analyze factors that could influence the implementation of cloud-based technologies in healthcare. The hypothesis were tested and the correlations between the concepts were established using modeling with SEM. Mediation and hierarchical regression analysis assessed direct and indirect effects. A correlation matrix was formed to evaluate inter-variable associations. Statistical analysis were used to ensure the reliability and strength of the results.

Data collection

A standardized questionnaire was used to collect data for this investigation from 530 patients in various locations. It was used to measure key determinants affecting cloud-based health systems' adoption, including perceived usefulness, effort expectancy, social influence, data security, and trust in technology. As shown in table 1, the characteristics of the subjects include gender, age, education, employment, localization, and prior knowledge of cloud-based health systems. This information aids in evaluating trends and variations in acceptance across groups. It is through this comprehension that one is enabled to detect the main barriers and facilitators of cloud-based health adoption, which will then allow programmers and technology developers to design targeted interventions for successful implementation and increased adoption.

Table 1. Demographic Characteristics of Healthcare Consumers for Cloud Adoption

Demographic Variable	Category	Frequency (N = 530)	Percentage (%)
Gender	Men	280	52,8
	Women	250	47,2
Age Group	18-30 years	180	34,0
	31-45 years	220	41,5
	46+ years	130	24,5
Education Level	Secondary School	160	30,2
	Bachelor's Degree	230	43,4
	Postgraduate	140	26,4
Employment Status	Employed	260	49,1
	Unemployed	140	26,4
	Self-Employed	130	24,5
Location	Urban	310	58,5
	Rural	220	41,5
Prior Knowledge of Cloud-Based Health Systems	Yes	320	60,4
	No	210	39,6

Enhancing Healthcare Access and Efficiency through Cloud-Based Technologies Adoption

Cloud-based technologies have postponed the revolution of access and efficiency in healthcare through remote consultations, electronic health records, and real-time data exchange. These technologies tend to safeguard the way toward greater accessibility to all the citizens because of the pervasive improvement of geographic and economic difficulties in healthcare, especially in poorer areas. This research investigates the main factors affecting adoption by healthcare consumers of cloud-based systems, that is, perceived usefulness, effort expectancy in using the technology, social influence, data security, and trust in technology. Drawing on an analysis of consumer attitudes, barriers towards adoption and ways to enhance implementation are identified. The present findings provide key advice for legislators and technology businesses in the process of optimizing cloud-based healthcare solutions that would ensure seamless integration of the solutions with patient outcomes and operational efficiency. This is most important in reducing the fears relative to security, usability, and lattices to enhance acceptance and realize maximum benefits. This research contributes to the ongoing discourse on digital healthcare transformation by emphasizing consumer trust and system reliability, fostering widespread adoption and sustainable healthcare innovation.

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Hypothesis pathway

The hypothesis suggests certain key factors that are presumed to influence the acceptance of cloud-based healthcare systems concerning user perceptions, trust, and security concerns. Insights from the research offer guides to policymakers and developers on ways to improve accessibility and efficiency. By identifying significant predictors, this research will also enable existing decision-makers to make informed decisions, thereby enabling the optimal use and acceptance of cloud-based healthcare. Table 2 presents the reliability and validity assessment of constructs, ensuring measurement consistency. Figure 1 illustrates the proposed hypothesis model, showing key predictors influencing BI and ACH.

Table 2. Proposed Hypothesis for Cloud-Based Healthcare Adoption

Hypothesis	Statement
H1	BI has a positive impact on PU.
H2	BI has a positive influence on FC.
H3	BI has a positively affects on PE.
H4	BI significantly enhances IS.
H5	BI positively impacts on SI.
H6	BI is a key factor in shaping TT.
H7	BI has a positive effect on EE.
H8	BI concerns negatively influence DS.
H9	BI positively affects the actual ACH.
H10	BI has no significant impact on CBHK.

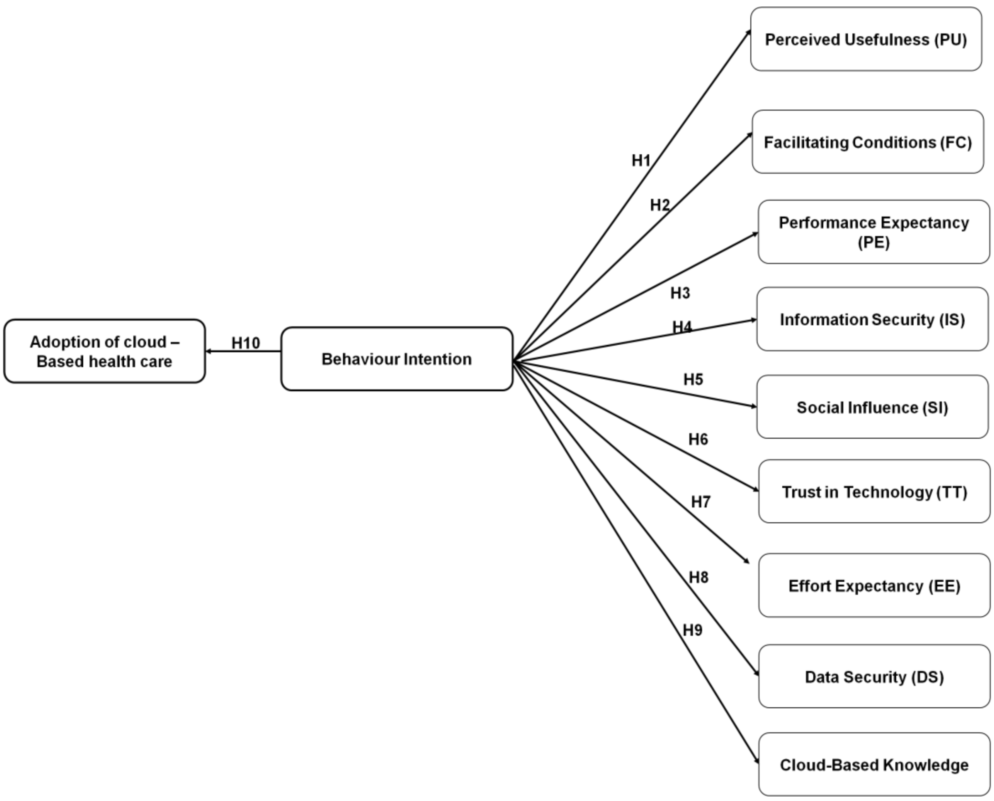

Figure 1. Conceptual Framework

Statistical Analysis

The factors influencing the adoption of cloud-based healthcare are analysed using hierarchical regression and mediation in IBM SPSS statistics version 30. Mediation analysis, using bootstrapping, examines the indirect effects of PU, FC, and other predictors on ACH through BI. Hierarchical regression assesses the incremental impact of BI on ACH, confirming its strong predictive role. ANOVA identifies key predictors, with DS negatively influencing adoption. These statistical methods ensure a comprehensive understanding of technology

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acceptance, highlighting BI as a crucial mediator and validating its significance in driving adoption through a structured, data-driven approach.

RESULTS

The findings highlight significant relationships among key variables, confirming hypothesized pathways. Statistical analysis, including mediation and hierarchical regression, demonstrate the impact of influential factors on adoption, offering valuable insights for practical applications. Table 3 provides factor loadings, the combined reliability, and the derived mean variation for various constructs, ensuring measurement reliability and validity. Each item represents a key factor influencing cloud-based healthcare adoption. High factor loadings indicate strong correlations between items and their respective constructs, while composite reliability and average variance extracted confirm internal consistency. This validation process supports structural equation modeling, hypothesis testing, and mediation analysis, strengthening the research's statistical foundation in assessing behavioral intentions and the adoption of cloud-based healthcare systems.

Table 3. Construct Reliability and Validity Assessment

Construct	Item	Factor Loading Value	CR	AVE
PU	PU1	0,82	0,89	0,72
	PU2	0,85		
	PU3	0,88		
FC	FC1	0,80	0,88	0,65
	FC2	0,83		
	FC3	0,81		
	FC4	0,79		
PE	PE1	0,84	0,89	0,73
	PE2	0,86		
	PE3	0,87		
IS	IS1	0,79	0,89	0,66
	IS2	0,82		
	IS3	0,85		
	IS4	0,80		
SI	SI1	0,81	0,89	0,67
	SI2	0,84		
	SI3	0,83		
	SI4	0,79		
TT	TT1	0,83	0,89	0,73
	TT2	0,86		
	TT3	0,88		
EE	EE1	0,79	0,78	0,64
	EE2	0,81		
DS	DS1	0,82	0,88	0,71
	DS2	0,85		
	DS3	0,86		
BI	BI1	0,84	0,91	0,73
	BI2	0,88		
	BI3	0,87		
	BI4	0,82		
ACH	ACH1	0,85	0,85	0,74
	ACH2	0,87		
CBHK	CBHK1	0,76	0,74	0,59
	CBHK2	0,78		

Figure 2 presents the correlation matrix that quantifies relationships between key variables, helping identify strong or weak associations in cloud-based healthcare adoption. High positive correlations suggest interdependencies among influencing factors, while negative values indicate opposing trends. This analysis validates the SEM by assessing factor interactions, supporting hypothesis testing, and mediation effects. Understanding these correlations enhances predictive accuracy, guiding the interpretation of behavioral intentions and adoption patterns in healthcare technology integration.

Figure 2. Correlation Matrix

Table 4 demonstrates how BI mediates the relationships between PU, FC, PE, IS, SI, TT, EE, and DS with ACH. Partial mediation suggests DF and IE, while full mediation indicates BI fully explains the relationship. DS negatively mediates ACH, implying security concerns hinder adoption. Bootstrapping LLCI and ULCI define the 95 % confidence range for the estimated effect. SE measures the variability of the effect estimate, ensuring precision. A mediation effect is considered significant if the LLCI and ULCI do not cross zero. These findings highlight BI as a crucial intermediary between technological perceptions and ACH, reinforcing its role in driving user adoption decisions.

Table 4. Mediation Analysis

Path	DE	IE	Total Effect	LLCI	SE	ULCI	p-value	Mediation Type
PU → BI → ACH	0,42	0,18	0,60	0,12	0,05	0,25	<0,001**	Partial Mediation
FC → BI → ACH	0,35	0,15	0,50	0,09	0,06	0,22	0,002**	Partial Mediation
PE → BI → ACH	0,39	0,21	0,60	0,15	0,05	0,28	<0,001**	Full Mediation
IS → BI → ACH	0,30	0,10	0,40	0,05	0,07	0,18	0,005**	Partial Mediation
SI → BI → ACH	0,33	0,14	0,47	0,08	0,06	0,21	0,003**	Partial Mediation
TT → BI → ACH	0,41	0,19	0,60	0,14	0,05	0,26	<0,001**	Full Mediation
EE → BI → ACH	0,28	0,11	0,39	0,06	0,08	0,17	0,007**	Partial Mediation
DS → BI → ACH	-0,29	-0,12	-0,41	-0,18	0,06	-0,07	0,004**	Partial Mediation

Note: *P < 0,005 indicates statistical significance.

Table 5 evaluates how adding BI as a predictor enhances ACH prediction. Model 1 includes PU, FC, PE, IS, SI, TT, EE, and DS, explaining 0,58 of the variance. Model 2 incorporates BI, increasing R^2 to 0,67, proving its critical role. The F-statistic confirms model significance and high β-values highlight key influences. This reinforces that BI significantly strengthens ACH, demonstrating its necessity in improving predictive accuracy for cloud-based healthcare adoption.

Table 5. Outcomes of Hierarchical Regression									
Model	**Predictors**	**R^2**	**Adjusted R^2**	**ΔR^2**	**F-statistic**	**β Coefficient**	**Std. Error**	**t-value**	**p-value**
Model 1	PU, FC, PE, IS, SI, TT, EE, DS	0,58	0,56	-	42,35	0,32	0,04	7,89	<0,001**
Model 2	Model 1 + BI	0,67	0,65	0,09	48,32	0,41	0,03	9,52	<0,001**
Notes: ΔR^2 shows the change in R^2; *P < 0,001 signifies statistical significance									

Table 6 assesses the individual impact of PU, FC, PE, IS, SI, TT, EE, DS, and BI on ACH. BI has the highest F-value (31,45), indicating its dominant role. PU, FC, and PE also show strong effects, while DS negatively impacts ACH. Partial η^2 values confirm practical significance, with high observed power ensuring reliability. These results validate that multiple factors influence ACH, with BI emerging as the strongest determinant for adoption.

Table 6. Outcomes of ANOVA							
Source	**Sum of Squares**	**df**	**Mean Square**	**Partial η^2**	**F-value**	**p-value**	**Observed Power**
PU	12,84	1	12,84	0,23	25,76	<0,001**	0,99
FC	10,32	1	10,32	0,19	20,74	0,002**	0,98
PE	11,90	1	11,90	0,21	23,84	<0,001**	0,99
IS	9,45	1	9,45	0,17	18,91	0,005**	0,97
SI	10,12	1	10,12	0,18	19,98	0,003**	0,98
TT	11,65	1	11,65	0,20	22,76	<0,001**	0,99
EE	8,78	1	8,78	0,16	17,21	0,007**	0,96
DS	9,23	1	9,23	0,17	18,12	0,004**	0,97
BI	15,72	1	15,72	0,27	31,45	<0,001**	0,99
Residual	48,30	100	0,48	-	-	-	-
Total	150,31	109	-	-	-	-	-
Note: **P < 0,005, **P < 0,001 indicate significance							

Table 7 and figure 3 presents the hypothesis testing results, highlighting the significance and strength of correlations among key factors influencing adoption. Whereas t-values evaluate the statistical significance, path coefficients show the extent of the effect. Supported hypothesis prove positive or negative consequences, but rejected assumptions show little impact. Higher influences on user behaviours are indicated by higher coefficients. The results guide improvement in the design of systems and policy-making by identifying important determinants. By comprehending these connections, specific treatments can be made to improve acceptance. For stakeholders looking to maximize acceptance and involvement with cloud-based medical settings, this report offers insightful information.

Table 7. Empirical Analysis of Factors Influencing Adoption Cloud-Based Healthcare				
Variables	**Hypothesis**	**β**	**t-values**	**Results**
PU	H1	0,30/***	5,75	Supported
FC	H2	0,21/***	4,20	Supported
PE	H3	0,27/***	5,10	Supported
IS	H4	0,19/**	3,85	Supported
SI	H5	0,22/***	4,50	Supported
TT	H6	0,25/***	5,00	Supported
EE	H7	0,18/**	3,60	Supported
DS	H8	-0,14/**	2,90	Supported
BI	H9	0,33/***	6,20	Supported
CBHK	H10	0,08	1,40	Rejected
Notes: **P < 0,005, ***P < 0,001				

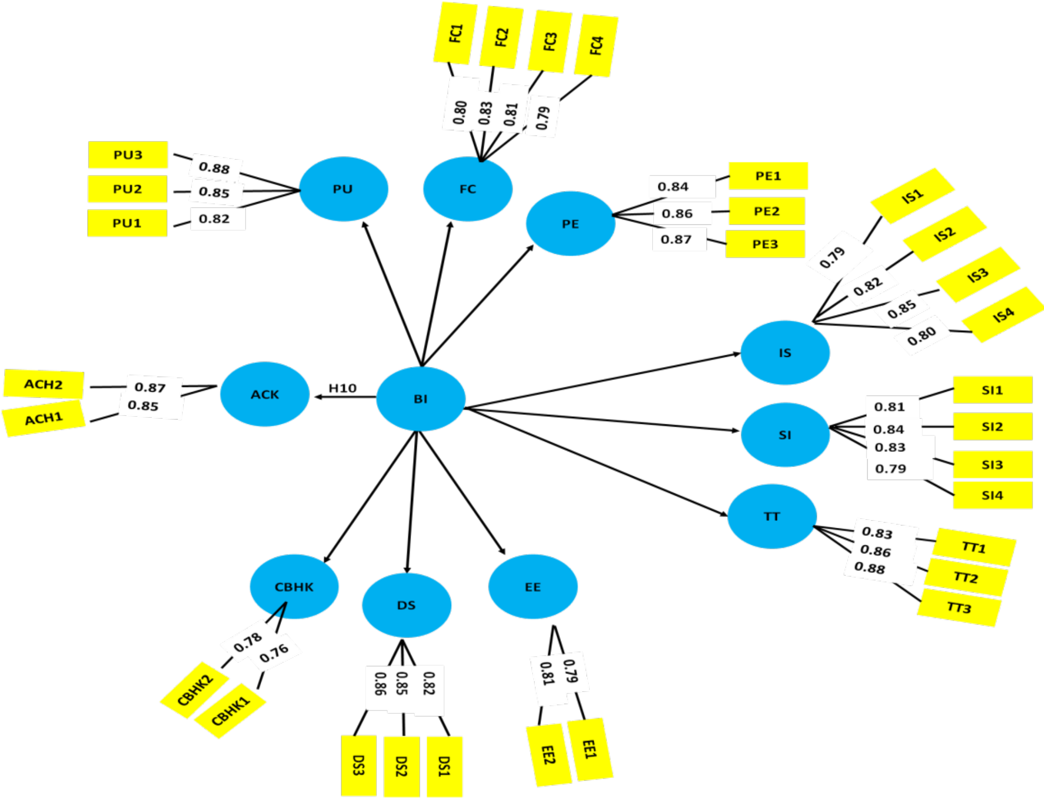

Figure 3. Analysis of SEM

DISCUSSION

The analysis revealed significant relationships among key factors influencing cloud-based healthcare adoption. Behavioral intention plays an important mediating role between perceptions about technology and adoption. High factor loading, composite reliability and AVE affirm measurement reliability. The mediation analysis allows for the determination of direct and indirect effects, whereas the hierarchical regression confirms the predictive strength of behavioral intention. The results of the ANOVA depict the salient determinants: perceived usefulness, facilitating conditions, and performance expectancy, which impinge heavily upon the model. Data security's negative mediation indicates that adoption is hampered by issues with privacy. To improve the adoption of technology in healthcare settings, these insights aid in system design, policy formation, and focused interventions.

CONCLUSIONS

BI plays an important role in adopting cloud-based healthcare systems, where perceived usefulness (PU, β = 0,42, p < 0,001), facilitating conditions (FC, β = 0,35, p = 0,002), and performance expectancy (PE, β = 0,39, p < 0,001) greatly influence ACH. It is suggested that BI adds variable explanation in the hierarchical regression from R^2 = 0,58 to R^2 = 0,67, establishing its role. ANOVA results further support BI as the strongest predictor (F = 31,45, p < 0,001), whereas digital security concerns DS (β = -0,29, p = 0,004) show to hinder the adoption. Limitations include the self-reported nature of data and sample bias. Future analysis should assess longitudinal data, technological developments, and AI enhancements related to cyber security. The dynamics of trust and regulatory factors will further refine the models for adoption to ensure that cloud-based healthcare systems effectively combine technological advancement and user needs against security concerns, and will increase engagement and predictive accuracy.

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CONFLICT OF INTEREST
Authors declare that there is no conflict of interest.

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ANNEXES

List of Abbreviations	
Abbreviation	**Full Form**
ACH	Adoption Cloud-Based Healthcare
AI	Artificial Intelligence
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
BI	Behavioral Intention
CBHK	Cloud-Based Healthcare Knowledge
CP-ABE	Ciphertext-Policy Attribute-Based Encryption
CR	Composite Reliability
DE	Direct Effects
DS	Data Security
ECC	Elliptic Curve Cryptography
EE	Effort Expectancy
EHR	Electronic Health Records
FC	Facilitating Conditions
GA	Gestational Age
HC	Head Circumference
HIPAA	Health Insurance Portability and Accountability Act
IBM SPSS	International Business Machines Statistical Package for the Social Sciences
IIED	Intelligent Indoor Environment Design
IE	Indirect Effects
IoT	Internet of Things
IS	Information Security
KDF	Key Derivation Function
LLCI	Lower Level Confidence Interval
PE	Performance Expectancy
PU	Perceived Usefulness
SEM	Structural Equation Modeling
SI	Social Influence
SMS	Smart Healthcare Systems
SOT	Sensory Organization Test
TAM	Technology Acceptance Model
TMIS	Telecommuting Medical Information Systems
TT	Trust in Technology
ULCI	Upper Level Confidence Interval
SE	Standard Error
VRT	Vestibular Rehabilitation Therapy

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