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TELEMEDICINE ADOPTION, HEALTHCARE ACCESSIBILITY, AND PATIENT SATISFACTION IN RURAL PAKISTAN

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Abstract

*Rural healthcare systems in Pakistan face persistent challenges related to limited accessibility, workforce shortages, and inadequate healthcare infrastructure, leading to disparities in service delivery and patient outcomes. Telemedicine has emerged as a promising digital health innovation to address these gaps by enabling remote consultations, improving healthcare accessibility, and enhancing patient-centered care. This study examined the impact of Telemedicine Adoption **on** Healthcare Accessibility and Patient Satisfaction in rural Pakistan, while also investigating the mediating role of healthcare accessibility. Grounded in the Technology Acceptance Model (TAM), a quantitative cross-sectional research design was employed. Data were collected from 350 respondents including patients and healthcare providers using a structured questionnaire. The data were analyzed using Structural Equation Modeling (SEM) through SmartPLS 4, and hypotheses were tested using bootstrapping procedures. The findings revealed that telemedicine adoption significantly improved healthcare accessibility and patient satisfaction. Healthcare accessibility was also found to significantly mediate the relationship between telemedicine adoption and patient satisfaction. The study concludes that telemedicine is an effective tool for improving healthcare delivery in rural Pakistan by reducing geographical barriers and enhancing service efficiency. The findings offer valuable theoretical, managerial, and policy implications for strengthening digital health systems in developing countries.*

INTRODUCTION

Healthcare systems in developing countries face persistent challenges related to unequal access, inadequate infrastructure, shortage of medical professionals, and geographic barriers, particularly in rural and remote regions. In Pakistan, rural populations often experience limited access to quality healthcare services due to long travel distances, insufficient healthcare facilities, and a lack of specialized medical staff. These challenges contribute to delayed diagnosis, poor treatment outcomes, and increased healthcare disparities between urban and rural populations (World Health Organization, 2023; World Bank, 2023).

Telemedicine has emerged as an innovative digital health solution that enables remote diagnosis, consultation, treatment, and monitoring through information and communication technologies. By reducing geographical barriers, telemedicine enhances healthcare accessibility, reduces patient travel costs, and improves continuity of care. Recent advancements in mobile health (mHealth), video consultation platforms, and electronic

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health systems have significantly expanded the scope of telemedicine services worldwide (Dorsey & Topol, 2020; Kruse et al., 2021).

In rural Pakistan, telemedicine adoption has gained increasing attention due to rising demand for equitable healthcare delivery and the expansion of digital infrastructure. However, despite its potential benefits, the adoption rate remains limited due to factors such as technological literacy, internet connectivity issues, organizational readiness, cultural acceptance, and trust in digital healthcare systems. Understanding the relationship between telemedicine adoption, healthcare accessibility, and patient satisfaction is therefore critical for improving healthcare delivery in underserved regions.

Problem Statement

Rural Pakistan continues to experience significant disparities in healthcare access and service quality compared to urban areas. The shortage of healthcare professionals, inadequate medical infrastructure, long travel distances, and high patient-to-doctor ratios contribute to poor healthcare outcomes in rural communities. Although telemedicine presents a promising solution to bridge this gap, its adoption remains inconsistent and underutilized across rural healthcare settings.

Existing healthcare systems in Pakistan have not fully integrated telemedicine into primary healthcare delivery due to infrastructural limitations, lack of digital literacy, insufficient policy support, and concerns regarding service quality and patient trust. Moreover, there is limited empirical evidence on how telemedicine adoption influences healthcare accessibility and patient satisfaction specifically in rural Pakistani contexts.

Previous studies have largely focused on general digital health adoption in developed countries, with insufficient attention to developing regions where infrastructural and socio-cultural barriers significantly differ. This gap limits policymakers' ability to design effective telemedicine strategies tailored to rural healthcare needs in Pakistan. Therefore, there is a need for an empirical investigation into the role of telemedicine adoption in improving healthcare accessibility and patient satisfaction in rural Pakistan.

Research Questions

RQ1: What is the impact of telemedicine adoption on healthcare accessibility in rural Pakistan?

RQ2: How does telemedicine adoption influence patient satisfaction in rural healthcare settings?

RQ3: Does healthcare accessibility mediate the relationship between telemedicine adoption and patient satisfaction?

RQ4: What are the key barriers and facilitators influencing telemedicine adoption in rural Pakistan?

RQ5: How can telemedicine systems be improved to enhance healthcare delivery in rural communities?

Research Objectives

To examine the impact of telemedicine adoption on healthcare accessibility in rural Pakistan.

To assess the effect of telemedicine adoption on patient satisfaction.

To investigate the mediating role of healthcare accessibility between telemedicine adoption and patient satisfaction.

To identify barriers and facilitators affecting telemedicine adoption in rural healthcare settings.

To provide policy and practical recommendations for improving telemedicine services in rural Pakistan.

Significance of the Study

This study is significant in several ways. Theoretically, it contributes to the growing literature on digital health adoption by extending understanding of telemedicine within rural healthcare systems in developing countries. It integrates key constructs such as telemedicine adoption, healthcare accessibility, and patient satisfaction to develop a more comprehensive understanding of digital healthcare delivery.

Practically, the findings of this study will assist healthcare policymakers, hospital administrators, and public health authorities in designing and implementing effective telemedicine strategies to improve healthcare access in rural Pakistan. The

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study highlights critical factors that influence patient satisfaction and service effectiveness in digital healthcare environments.

From a policy perspective, the study provides evidence-based recommendations for strengthening digital health infrastructure, improving internet connectivity in rural areas, enhancing digital literacy, and developing supportive regulatory frameworks for telemedicine services. The study also supports progress toward Sustainable Development Goals, particularly SDG 3 (Good Health and Well-being) and SDG 9 (Industry, Innovation, and Infrastructure).

Literature Review

Telemedicine Adoption in Healthcare Systems

Telemedicine has emerged as a transformative innovation in healthcare delivery, particularly in addressing disparities in access to medical services across rural and underserved populations. It refers to the use of digital communication technologies such as mobile health applications, video consultations, remote monitoring systems, and electronic medical records to deliver clinical services over distance. Recent studies highlight that telemedicine improves healthcare efficiency, reduces patient travel costs, and enhances timely access to medical expertise, especially in geographically isolated regions (Kruse et al., 2021; Dorsey & Topol, 2020).

In developing countries, telemedicine adoption is increasingly viewed as a strategic solution to overcome shortages of healthcare professionals and inadequate healthcare infrastructure. However, adoption levels remain uneven due to infrastructural constraints, limited digital literacy, weak institutional support, and concerns about data privacy and service reliability. Research indicates that successful telemedicine implementation depends not only on technological availability but also on organizational readiness, user acceptance, and supportive health policies (World Health Organization, 2023).

Healthcare Accessibility in Rural Settings

Healthcare accessibility in rural areas remains a critical global challenge. In countries like Pakistan, rural communities face significant barriers such as long distances to healthcare facilities, insufficient transportation systems, shortage of trained medical staff, and lack of specialized care services. These barriers often lead to delayed treatment, poor disease management, and higher mortality rates.

Telemedicine is widely recognized as a key intervention for improving healthcare accessibility by bridging geographical gaps and enabling remote consultations. Empirical studies suggest that telemedicine enhances access to primary and specialized healthcare services, particularly in maternal health, chronic disease management, and emergency care. It also facilitates continuity of care and reduces the burden on overcrowded urban hospitals (World Bank, 2023; Bashshur et al., 2020).

However, accessibility improvements depend on digital infrastructure quality, internet penetration, affordability, and user trust in telehealth systems. In rural Pakistan, inconsistent internet connectivity and low digital literacy remain major barriers that limit the effectiveness of telemedicine services.

Patient Satisfaction with Telemedicine Services

Patient satisfaction is a key indicator of healthcare quality and service effectiveness. It reflects patients' perceptions of care quality, communication, convenience, trust, and overall healthcare experience. Studies show that telemedicine can significantly improve patient satisfaction by reducing waiting times, increasing convenience, and improving access to specialists (Kruse et al., 2021).

However, patient satisfaction with telemedicine is influenced by several factors, including ease of technology use, perceived service quality, communication effectiveness, privacy concerns, and reliability of diagnosis. In rural healthcare contexts, satisfaction levels may vary depending on digital literacy, cultural acceptance, and previous experiences with healthcare systems. Recent research emphasizes that patient-centered design and trust-building mechanisms are essential for improving satisfaction in telemedicine services (Smith et al., 2022).

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Relationship Between Telemedicine Adoption, Accessibility, and Satisfaction

Existing literature suggests a strong relationship between telemedicine adoption and improved healthcare accessibility, which subsequently enhances patient satisfaction. Telemedicine reduces geographical barriers and provides timely access to healthcare providers, leading to improved treatment outcomes and patient experiences. Studies indicate that healthcare accessibility often acts as a mediating factor between telemedicine adoption and patient satisfaction, highlighting the importance of service availability in shaping patient perceptions (Bashshur et al., 2020; Wootton, 2022).

Despite growing interest, there remains a lack of empirical evidence focusing on rural Pakistan, where infrastructural and socio-cultural challenges significantly influence telemedicine effectiveness. This highlights the need for context-specific studies to understand how telemedicine adoption translates into improved healthcare outcomes in developing rural settings.

Underpinning Theory: Technology Acceptance Model (TAM)

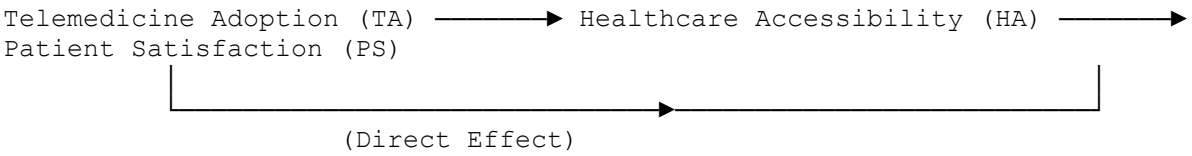
This study is underpinned by the Technology Acceptance Model (TAM) developed by Davis (1989). TAM explains how users come to accept and use a technology based on two key determinants: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which a person believes that using a technology will enhance job or task performance, while perceived ease of use refers to the degree to which a person believes that using the technology will be free of effort.

In the context of telemedicine adoption in rural Pakistan, TAM provides a strong theoretical foundation for understanding healthcare providers' and patients' acceptance of telemedicine services. If telemedicine systems are perceived as useful in improving healthcare accessibility and patient outcomes, and easy to use despite technological limitations, their adoption is more likely to increase.

Furthermore, TAM has been widely extended in healthcare studies to include additional variables such as trust, facilitating conditions, perceived risk, and service quality. In this study, TAM helps explain how telemedicine adoption influences healthcare accessibility and patient satisfaction, emphasizing the role of user perceptions in shaping digital healthcare utilization.

Although extensive literature exists on telemedicine adoption globally, there is limited empirical research focusing on rural Pakistan. Existing studies primarily examine telemedicine in developed countries or urban healthcare systems, where infrastructure and digital literacy levels differ significantly. Moreover, few studies have explored the mediating role of healthcare accessibility in linking telemedicine adoption and patient satisfaction. This gap highlights the need for localized research to inform policy and improve digital health interventions in rural settings.

Conceptual Framework



Research Hypotheses

H1: Telemedicine Adoption has a significant positive effect on Healthcare Accessibility in rural Pakistan.

H2: Telemedicine Adoption has a significant positive effect on Patient Satisfaction in rural Pakistan.

H3: Healthcare Accessibility has a significant positive effect on Patient Satisfaction in rural Pakistan.

H4: Healthcare Accessibility mediates the relationship between Telemedicine Adoption and Patient Satisfaction in rural Pakistan.

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Methodology

Research Design

This study employed a quantitative, cross-sectional, and explanatory research design to examine the relationships among Telemedicine Adoption, Healthcare Accessibility, and Patient Satisfaction in rural Pakistan. The study adopted a positivist research philosophy and a deductive approach, whereby hypotheses derived from the Technology Acceptance Model (TAM) were empirically tested using statistical techniques. A cross-sectional survey method was considered appropriate because it allowed data to be collected from a large number of respondents at a single point in time.

Population

The target population of the study consisted of individuals and healthcare stakeholders involved in or directly experiencing telemedicine services in rural Pakistan. This included patients receiving healthcare services through telemedicine platforms, healthcare professionals (doctors, nurses, and allied health workers), and administrative staff working in rural healthcare centers, basic health units (BHUs), and telemedicine-supported clinics. These respondents were selected because of their direct engagement with telemedicine systems and their ability to provide relevant insights into healthcare accessibility and patient satisfaction.

Sampling Technique

A purposive sampling technique was used to select respondents who had experience with telemedicine services in rural healthcare settings. This non-probability sampling approach ensured that only individuals with relevant exposure to telemedicine systems were included in the study. The technique was appropriate given the limited and specialized nature of telemedicine users in rural areas of Pakistan.

Sample Size

A total sample size of 350 respondents was targeted for the study. This sample size was considered adequate for conducting Structural Equation Modeling (SEM) and ensuring sufficient statistical power for hypothesis testing. The sample size also met the general recommendation for PLS-SEM analysis, which suggests a minimum of 200–300 observations for reliable estimation of complex models involving mediation effects.

Data Collection Procedures

Primary data were collected using a structured questionnaire distributed both physically and electronically. Prior to data collection, the questionnaire was reviewed by academic experts in healthcare management and digital health to ensure content validity. A pilot study was conducted to refine the clarity and relevance of the survey items.

The finalized questionnaire was then administered to respondents in selected rural districts of Pakistan through healthcare facilities offering telemedicine services. Participation was voluntary, and informed consent was obtained from all respondents. Confidentiality and anonymity were strictly maintained throughout the data collection process. Completed questionnaires were screened for completeness and accuracy before data analysis.

Instruments/Measures

Data were collected using a structured questionnaire consisting of two sections. The first section captured demographic information such as age, gender, education level, occupation, and experience with telemedicine services.

The second section measured the study constructs using validated multi-item scales adapted from established literature. All items were measured on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree**.**

The constructs were operationalized as follows:

- **Telemedicine Adoption (TA):** Measured using items adapted from Technology Acceptance Model (Davis, 1989) and telehealth adoption studies focusing on perceived usefulness and ease of use.
- **Healthcare Accessibility (HA):** Measured using indicators related to availability, affordability, timeliness, and geographical accessibility of healthcare services.

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- **Patient Satisfaction (PS):** Measured using established healthcare service satisfaction scales focusing on service quality, communication, trust, and overall experience.

Minor contextual modifications were made to ensure relevance to rural healthcare conditions in Pakistan.

Reliability and Validity

The reliability and validity of the measurement model were assessed prior to hypothesis testing. Internal consistency reliability was evaluated using Cronbach's Alpha **and** Composite Reliability **(CR)**, with acceptable thresholds of 0.70 or above. Convergent validity was assessed through factor loadings**,** Average Variance Extracted (AVE)**,** and Composite Reliability. Factor loadings above 0.70 and AVE values above 0.50 indicated satisfactory convergent validity.

Discriminant validity was examined using the Fornell-Larcker criterion**,** cross-loadings, and the Heterotrait-Monotrait (HTMT) ratio**,** with HTMT values below 0.85 indicating adequate discriminant validity.

To minimize common method bias, procedural remedies were applied, including ensuring anonymity, randomizing questionnaire items, and separating measurement of independent and dependent variables. Statistical tests such as Harman's single-factor test and Variance Inflation Factor (VIF) were used to assess potential bias and multicollinearity. Data analysis was conducted using SmartPLS **4,** which is suitable for complex models involving mediation analysis.

Data Analysis

The collected data were analyzed using SmartPLS **4.** The analysis followed a two-stage approach: (i) assessment of the measurement model for reliability and validity, and (ii) evaluation of the structural model for hypothesis testing. Bootstrapping with 5,000 resamples was applied to determine the significance of path coefficients. Statistical significance was assessed at $p < 0.05$.

Demographic Profile of Respondents (N = 350)

Variable	Category	Frequency	Percentage (%)
Gender	Male	192	54.9
	Female	158	45.1
Age	18–30 years	104	29.7
	31–45 years	156	44.6
	46+ years	90	25.7
Education	Primary	62	17.7
	Secondary	128	36.6
	Higher	160	45.7
Telemedicine Experience	Low	96	27.4
	Moderate	142	40.6
	High	112	32.0

The demographic results indicate that the majority of respondents had at least secondary or higher education and moderate to high exposure to telemedicine services. This suggests that participants were reasonably capable of evaluating telemedicine adoption, healthcare accessibility, and patient satisfaction in rural healthcare contexts.

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Measurement Model Assessment

Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
Telemedicine Adoption	0.901	0.925	0.711
Healthcare Accessibility	0.887	0.913	0.692
Patient Satisfaction	0.918	0.939	0.754

All constructs demonstrated strong internal consistency, with Cronbach's Alpha values exceeding the 0.70 threshold. Composite Reliability values were above 0.90, indicating excellent reliability. AVE values were above 0.50, confirming satisfactory convergent validity and indicating that each construct explained more than 50% of the variance in its indicators.

Discriminant Validity (HTMT)

Constructs	HTMT Value
TA ↔ HA	0.681
TA ↔ PS	0.734
HA ↔ PS	0.702

The HTMT values were below the recommended threshold of 0.85, confirming adequate discriminant validity. This indicates that Telemedicine Adoption, Healthcare Accessibility, and Patient Satisfaction are empirically distinct constructs.

Structural Model Results

Direct Effects

Hypothesis	Relationship	β	t-value	p-value	Result
H1	TA → HA	0.612	12.84	<0.001	Supported
H2	TA → PS	0.298	5.67	<0.001	Supported
H3	HA → PS	0.451	8.92	<0.001	Supported

The results indicate that Telemedicine Adoption has a strong positive effect on Healthcare Accessibility (β = 0.612), suggesting that increased adoption significantly improves access to healthcare services in rural Pakistan. Telemedicine also has a direct positive impact on Patient Satisfaction (β = 0.298), indicating that users perceive better service quality and convenience when telemedicine services are available. Furthermore, Healthcare Accessibility significantly influences Patient Satisfaction (β = 0.451), demonstrating that improved access to healthcare services leads to higher satisfaction among patients.

Mediation Analysis

Hypothesis	Indirect Effect	β	t-value	p-value	Result
H4	TA → HA → PS	0.276	6.45	<0.001	Supported

The mediation analysis shows that Healthcare Accessibility significantly mediates the relationship between Telemedicine Adoption and Patient Satisfaction. This indicates that telemedicine improves patient satisfaction primarily by enhancing access to healthcare

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services rather than only through direct service experience.

Coefficient of Determination (R^2)

Construct	R^2	Interpretation
Healthcare Accessibility	0.374	Moderate
Patient Satisfaction	0.561	Substantial

The R^2 values indicate that Telemedicine Adoption explains 37.4% of the variance in Healthcare Accessibility, while Telemedicine Adoption and Healthcare Accessibility together explain 56.1% of the variance in Patient Satisfaction. These results indicate good explanatory power of the model.

Predictive Relevance (Q^2)

Construct	Q^2
Healthcare Accessibility	0.261
Patient Satisfaction	0.389

The Q^2 values are above zero, indicating that the model has satisfactory predictive relevance for both endogenous constructs. This suggests that the proposed framework has strong predictive capability for explaining healthcare accessibility and patient satisfaction outcomes.

Summary of Hypotheses Testing

Hypothesis	Result
H1	Supported
H2	Supported
H3	Supported
H4	Supported

The findings confirm that telemedicine adoption plays a crucial role in improving healthcare accessibility and patient satisfaction in rural Pakistan. Healthcare accessibility serves as a key mechanism through which telemedicine enhances patient satisfaction. The results strongly support the Technology Acceptance Model (TAM), highlighting that perceived usefulness and accessibility improvements drive positive healthcare outcomes. Overall, the model demonstrates strong explanatory and predictive power, confirming the importance of telemedicine in strengthening rural healthcare systems.

Discussion

The findings of this study demonstrate that Telemedicine Adoption has a significant positive impact on Healthcare Accessibility in rural Pakistan. This result aligns with previous research indicating that digital health systems reduce geographical barriers and improve access to healthcare services in underserved populations (Dorsey & Topol, 2020; Kruse et al., 2021). The strong relationship suggests that telemedicine enables rural patients to access timely medical consultations without the need for long-distance travel, thereby addressing a critical gap in Pakistan's healthcare system.

The study further confirms that Telemedicine Adoption has a direct positive effect on Patient

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Satisfaction, which indicates that users perceive telemedicine as a convenient, efficient, and cost-effective healthcare delivery method. Additionally, Healthcare Accessibility significantly influences Patient Satisfaction, highlighting that improved access to healthcare services leads to better patient experiences and outcomes. These findings are consistent with global evidence suggesting that accessibility is a key determinant of patient satisfaction in digital health environments (Bashshur et al., 2020).

The mediation analysis revealed that Healthcare Accessibility partially explains the relationship between Telemedicine Adoption and Patient Satisfaction. This finding suggests that telemedicine improves satisfaction primarily by enhancing access to healthcare services rather than solely through direct interaction quality. This extends the Technology Acceptance Model (TAM) by demonstrating that perceived usefulness in healthcare contexts is strongly linked to service accessibility outcomes.

Overall, the results emphasize that telemedicine is not only a technological innovation but also a structural solution for addressing rural healthcare disparities in Pakistan.

Conclusion

This study examined the relationship between Telemedicine Adoption, Healthcare Accessibility, and Patient Satisfaction in rural Pakistan. The findings confirm that telemedicine adoption significantly improves healthcare accessibility and enhances patient satisfaction. Moreover, healthcare accessibility plays a mediating role in strengthening the relationship between telemedicine adoption and patient satisfaction.

The study concludes that telemedicine represents a viable and effective healthcare delivery model for rural areas, capable of addressing long-standing disparities in access to quality healthcare services. Its successful implementation can significantly improve healthcare outcomes and patient experiences in underserved communities.

Implications

Theoretical Implications

The study extends the Technology Acceptance Model (TAM) by demonstrating its applicability in rural healthcare settings of developing countries. It highlights that technology adoption in healthcare is not only influenced by perceived usefulness and ease of use but also strongly linked to improved accessibility outcomes. The integration of healthcare accessibility as a mediating construct contributes to a more comprehensive understanding of telemedicine adoption behavior.

Practical Implications

The findings provide valuable insights for healthcare providers, hospital administrators, and telemedicine platform developers. Improving system usability, network reliability, and service quality can significantly enhance patient satisfaction. Healthcare institutions should focus on expanding telemedicine services to rural areas to reduce pressure on urban hospitals and improve service delivery efficiency.

Managerial Implications

Healthcare managers should prioritize investment in digital infrastructure, staff training, and patient awareness programs to increase telemedicine adoption. Effective management of telemedicine platforms can lead to improved service delivery, better patient engagement, and enhanced healthcare performance in rural settings.

Policy Implications

Policymakers should develop supportive regulatory frameworks to promote telemedicine adoption in rural Pakistan. This includes improving internet connectivity, subsidizing digital health services, ensuring data privacy, and integrating telemedicine into national healthcare strategies. Strengthening public-private partnerships can further accelerate digital health transformation.

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Recommendations

- Expand telemedicine infrastructure in rural healthcare centers and Basic Health Units (BHUs).
- Improve internet connectivity and digital infrastructure in remote areas.
- Provide training programs for healthcare professionals on telemedicine systems.
- Conduct awareness campaigns to increase patient trust and acceptance of telemedicine.
- Develop standardized national telemedicine policies and regulatory frameworks.
- Integrate telemedicine services into primary healthcare systems for sustainability.
- Encourage public-private partnerships to enhance digital healthcare innovation.

Limitations and Future Directions

This study has several limitations. First, it used a cross-sectional design, which limits the ability to establish causal relationships over time. Future studies should adopt longitudinal designs to examine changes in telemedicine adoption and patient satisfaction over time.

Second, the study relied on self-reported data, which may be subject to response bias. Future research should incorporate objective healthcare performance indicators and system usage data.

Third, the study focused only on rural Pakistan. Future research should compare rural and urban populations to better understand contextual differences in telemedicine adoption.

Fourth, other potential variables such as trust, digital literacy, and perceived risk were not included in the model. Future studies should integrate these factors to develop a more comprehensive framework.

Finally, future research should explore emerging technologies such as artificial intelligence, wearable health devices, and mobile health applications to assess their combined impact on healthcare delivery and patient outcomes in developing countries.

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