*Seminars in Medical Writing and Education*. 2023; 2:136
doi: 10.56294/mw2023136

ORIGINAL

# Investigating Healthcare Professionals' Acceptance of Cloud Health Technologies in Rural Healthcare Centers

## Investigación de la aceptación de las tecnologías sanitarias en nube por parte de los profesionales sanitarios en centros sanitarios rurales

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**Cite as**: Rastogi S, Sekhar Patra S, Borah N. Investigating Healthcare Professionals' Acceptance of Cloud Health Technologies in Rural Healthcare Centers. Seminars in Medical Writing and Education. 2023; 2:136. https://doi.org/10.56294/mw2023136

**Submitted:** 15-09-2022 **Revised:** 27-12-2022 **Accepted:** 01-03-2023 **Published:** 02-03-2023

**Editor:** PhD. Prof. Estela Morales Peralta

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**ABSTRACT**

Cloud health technologies have the potential to enhance healthcare accessibility and service efficiency, particularly in rural areas where medical resources are limited. These technologies enable remote consultations, digital patient records, and real-time data exchange, improving decision-making and patient outcomes. It investigates healthcare professionals' acceptance of cloud health technologies in rural healthcare centers by examining key determinants influencing adoption. A cross-sectional survey was conducted among 320 healthcare professionals selected from various rural hospitals. A structured questionnaire, adapted from established technology acceptance models, was used for data collection. It employs a theoretical framework that integrates technological readiness, perceived usefulness, organizational support, and individual adaptability, analyzed using structural equation modeling. The application of cloud health technologies in rural healthcare involves integrating cloud-based platforms for patient management, medical collaboration, and secure health information exchange. The adoption process depends on factors, such as rural healthcare centers, secure health information exchange, privacy and security concerns, cloud-based patient management, medical collaboration support, and secure patient access and control. Statistical analyses, including path analysis, reliability testing, and multiple regression modeling, were used to assess relationships among key variables. The findings provide actionable insights for healthcare policymakers and administrators, emphasizing the need for capacity-building programs and infrastructure development to ensure sustainable adoption in rural healthcare settings.

**Keywords:** Cloud Health Technologies; Healthcare Adoption; Rural Healthcare Centers; Digital Health Solutions; Medical Technology Acceptance; Healthcare Professionals' Perception.

**RESUMEN**

Las tecnologías sanitarias en la nube tienen el potencial de mejorar la accesibilidad y la eficiencia de los servicios sanitarios, sobre todo en zonas rurales donde los recursos médicos son limitados. Estas tecnologías permiten las consultas a distancia, los historiales digitales de los pacientes y el intercambio de datos en tiempo real, mejorando la toma de decisiones y los resultados de los pacientes. Se investiga la aceptación por parte de los profesionales sanitarios de las tecnologías sanitarias en la nube en centros sanitarios rurales examinando los determinantes clave que influyen en su adopción. Se realizó una encuesta transversal entre 320 profesionales sanitarios seleccionados de varios hospitales rurales. Para la recogida de datos se utilizó un cuestionario estructurado, adaptado a partir de modelos establecidos de aceptación de tecnologías.

Se emplea un marco teórico que integra la preparación tecnológica, la utilidad percibida, el apoyo organizativo y la adaptabilidad individual, analizados mediante un modelo de ecuaciones estructurales. La aplicación de tecnologías sanitarias en la nube en la sanidad rural implica integrar plataformas basadas en la nube para la gestión de pacientes, la colaboración médica y el intercambio seguro de información sanitaria. El proceso de adopción depende de factores como los centros sanitarios rurales, el intercambio seguro de información sanitaria, los problemas de privacidad y seguridad, la gestión de pacientes basada en la nube, el apoyo a la colaboración médica y el acceso y control seguros de los pacientes. Para evaluar las relaciones entre las variables clave se utilizaron análisis estadísticos, como análisis de trayectorias, pruebas de fiabilidad y modelos de regresión múltiple. Los resultados aportan ideas útiles para los responsables de la formulación de políticas sanitarias y los administradores, y subrayan la necesidad de programas de capacitación y desarrollo de infraestructuras para garantizar una adopción sostenible en entornos sanitarios rurales.

**Palabras clave:** Tecnologías Sanitarias en la Nube; Adopción Sanitaria; Centros Sanitarios Rurales; Soluciones Sanitarias Digitales; Aceptación de la Tecnología Médica; Percepción de los Profesionales Sanitarios.

## INTRODUCTION

Cloud computing technology could significantly improve the quality and accessibility of healthcare services, especially in rural locations.[1] However, these developments in rural healthcare institutions, where resources are a challenge and access to advanced medical technology is limited, are largely predicated on the extent to which healthcare providers use cloud-based health solutions.[2] In such conditions, cloud health technologies, telemedicine services, electronic health records (EHRs), and data analytics systems can aid in reducing the gap between rural communities and healthcare providers. These can lead to better service delivery, improved patient care management, and the interaction between professionals.[3]

Potential benefits of cloud technologies exist, but healthcare practitioners' willingness to use such technologies, especially in rural areas, depends on several factors. The elements included in these factors are perceived value, simplicity of use, financial considerations, technological preparedness, privacy, and data security issues.[4] Poor training, lack of technical assistance, and limited infrastructure are common problems for healthcare workers in rural areas and might slow down the implementation of new technology. With conventional procedures, it will be resistant to change and healthcare workers might doubt the efficacy and reliability of cloud technology.[5]

The effectiveness of cloud health technologies in rural healthcare institutions depends on the acceptance of the technologies by the healthcare practitioners. Understanding the factors that influence healthcare professionals' choice of cloud technologies should guide legislators, healthcare organizations, and technology developers.[6] Through the identification of these factors, specific interventions, such as improving internet connectivity, offering sufficient training, ensuring strong data security measures, and highlighting the observable advantages of these technologies in enhancing healthcare delivery, can be developed to encourage the adoption of cloud health technologies.[7] Regional differences in infrastructure, possible biases in self-reported data, and the difficulty to generalize results to all rural healthcare facilities because of varying resource availability and technology readiness are some of the limitations.

The elements that influence healthcare customers' attitudes regarding the deployment of cloud-based health centers were examined.[8] The findings indicated that the behavioral intention of healthcare customers was significantly influenced by performance expectation, effort expectancy, social influence, enabling conditions, security of data, and data sharing. A model was provided by identifying the important success elements that affect doctors' behavioral regulation and confirmation of using cloud health information technology in Iraqi hospitals that were presented.[9] The findings demonstrated that physicians' verification and behavioral regulation were significantly impacted by system reliability, complexity of the system, safety, and privacy. Determined the concepts from previous investigations that have an impact on cloud computing adoption from the viewpoint of the prosperous country.[10] The results showed that the dependent variable, the utilization of cloud computing in the healthcare industry, was influenced by the anticipated factors under technology, management, environment, and morals, which increases effectiveness.

Employing the common word and knowledge map evaluation, the emergence and progression of examination ideas in cloud health care (CHC) explained.[11] The emergence and progress of cloud-based medical services were explained. The field of CHC has been expanding quickly on worldwide levels, and the technologies employed in their field were evolving and becoming more intelligent. A comprehensive initial set of privacy and safety needs using a methodical requirements engineering methodology focused on methodical inquiry was produced.[12] The findings indicate that the most important needs were the safety and confidentiality of healthcare information, which were followed by patient confidentiality, control over data usage and alterations, and patient control over access rights. To support the assertion that their approach offered adequate safety while preserving accessibility, discussion of their suggested methodology for the system was conducted, along with an informal assessment investigation.(13) The outcomes demonstrated the effectiveness of their suggested approach in terms of computing and transmission costs for safe cloud storage of medical data based on smart cards.

The cloud-assisted telecare medical information system's (TMIS) identification methodology while protecting privacy was improved.(14) Their improved protocol preserved the benefits of all desired security standards and preserved the effectiveness in terms of computing costs for cloud-assisted TMIS, as compared to other conventional protocols. To investigate whether ecological, human, administrative, and technological factors as a sources of doctors' opinions could affect their satisfaction and desire to continue using the cloud-based hospital information system (HIS), a combined approach based on the technology acceptance model (TAM) and expectation-confirmation model (ECM) was proposed.(15) The findings provided excellent support for the investigation's approach since all expected linkages were significant and control factors do not affect physicians' desire to continue using the cloud-based HIS. The important factors that influence healthcare professionals' adoption of cloud health technology in rural healthcare facilities were investigated.

### Hypothesis development

H1: Technological readiness has a significant impact on Health Care Professionals' Acceptance of Cloud Health Technologies (HCP-ACT).

H2: Perceived usefulness has a significant impact on HCP-ACT.

H3: Organizational support has a significant impact on HCP-ACT.

H4: Individual adaptability has a significant impact on HCP-ACT.

## METHOD

The significant factors of cloud health technology adoption by medical professionals in rural healthcare settings were examined. Health professionals in rural areas utilized the dependent variable HCP-ACT and the independent variables, such as technological readiness, perceived usefulness, organizational support, and individual support to assess the adoption of cloud health technologies. Figure 1 displays the conceptual diagram.

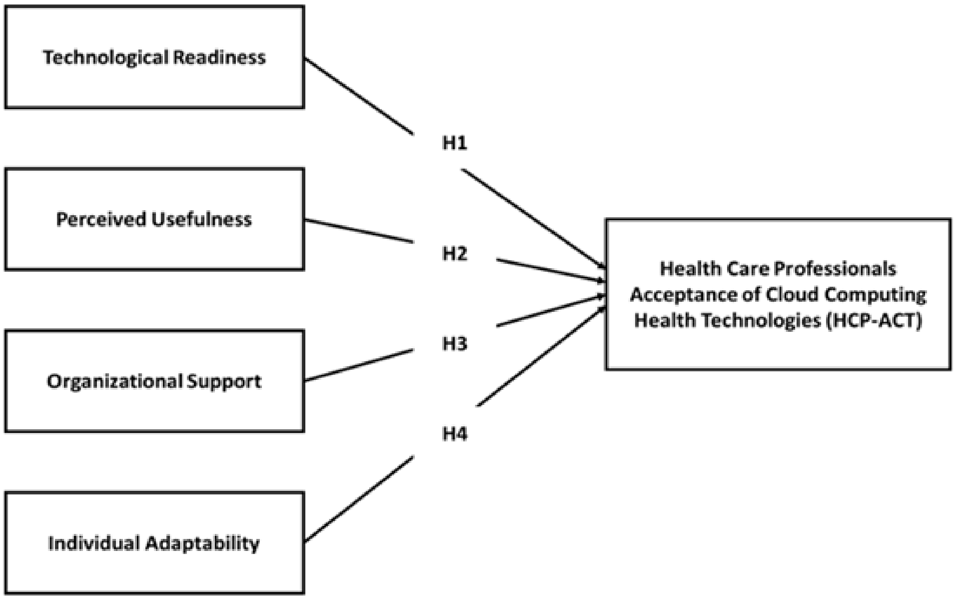


**Figure 1.** Conceptual diagram

### HCP-ACT

The adoption of cloud health technology by healthcare professionals in rural healthcare facilities is critical for enhancing healthcare delivery. These technologies address infrastructure issues in remote locations by enabling smooth connectivity, real-time monitoring of patients, and effective data storage. However, several factors, including perceived simplicity of use, confidence in data security, and the perceived value of technology in enhancing patient care, influence medical personnel's readiness to utilize cloud solutions. Understanding these elements could influence the creation and deployment of cloud-based health approaches, ultimately improving access to high-quality medical care in rural areas that are neglected. The architecture of HCP-ACT is shown in figure 2.

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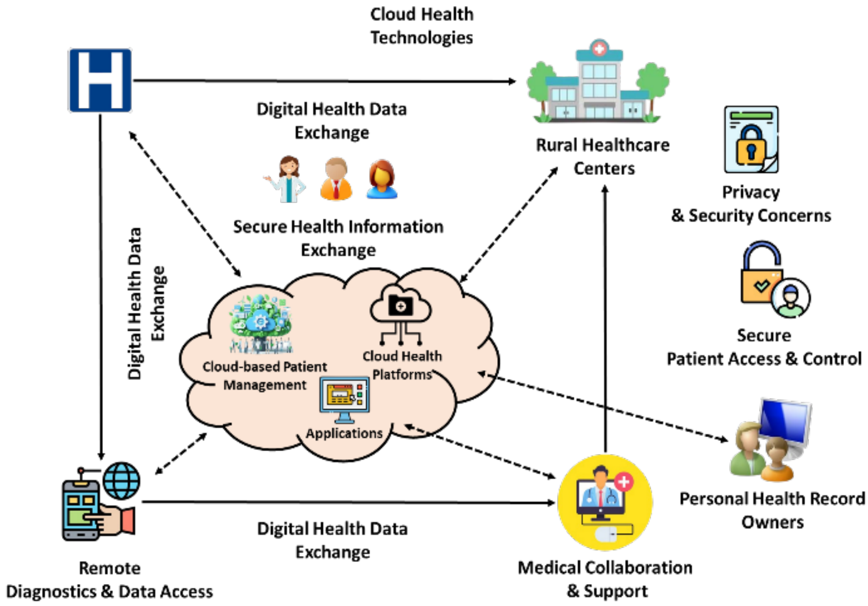


**Figure 2.** Framework of HCP-ACT

## Data collection

**Table 1.** Demographic characteristics of participants

| Variable | Categories | Frequency (n=320) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 180 | 56,3 |
| | Female | 140 | 43,7 |
| Age (years) | 21-30 | 70 | 21,9 |
| | 31-40 | 100 | 31,3 |
| | 41-50 | 90 | 28,1 |
| | 51+ | 60 | 18,7 |
| Education Level | Diploma | 70 | 21,9 |
| | Bachelor's Degree | 160 | 50 |
| | Master's Degree | 90 | 28,1 |
| Experience (years) | 1-5 | 80 | 25 |
| | 6-10 | 100 | 31,3 |
| | 11-15 | 90 | 28,1 |
| | 16+ | 50 | 15,6 |
| Job Role | General Practitioner | 110 | 34,4 |
| | Specialist/Consultant | 80 | 25 |
| | Nurse | 70 | 21,9 |
| | IT Staff | 60 | 18,7 |
| Work Schedule | Full-time | 260 | 81,3 |
| | Part-time | 40 | 12,5 |
| | Contract/Temporary | 20 | 6,2 |

The data was gathered through a structured questionnaire based on accepted models of technology adoption, and it includes the responses of 320 medical professionals employed by rural hospitals. It comprises demographic factors, including years of experience, job role, education level, age, work schedule, and gender, as shown in table 1. A 5-point Likert scale is used to assess the following important variables, such as technological readiness, perceived usefulness, organizational support, and individual adaptability. The dataset also contains qualitative responses about the perceived advantages and difficulties of implementing cloud health technologies and categorical information on the types of healthcare services provided. Figure 3 displays the demographic variables of a) gender and b) age.

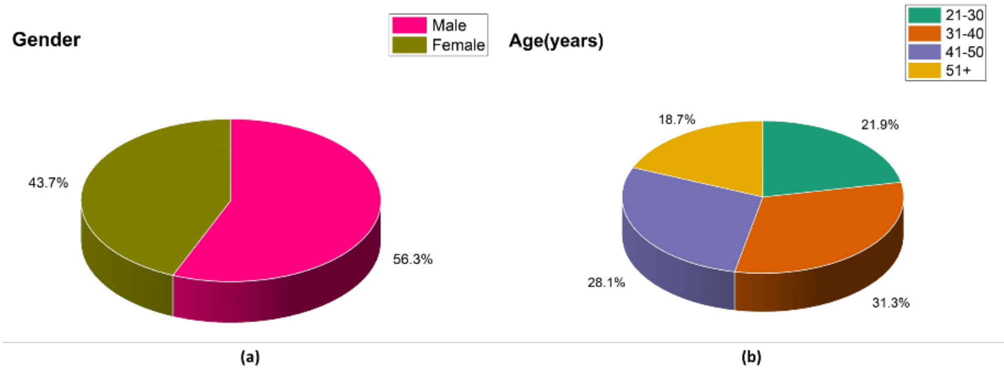


**Figure 3.** Demographic variables of a) gender and b) age

### Survey Questions

The standardized questionnaire was used to gather data from the 320 medical professionals work in rural hospitals. For example, the questionnaire includes two questions for each variable under investigation, ensuring consistency and reliability in data collection are shown below.

*Technological Readiness*

1. How comfortable are you with using cloud-based health technologies in your daily work?
2. Do you have the necessary technical skills to operate cloud-based healthcare systems efficiently?

*Perceived Usefulness*

1. How helpful do you find cloud systems in streamlining medical record management?
2. Do cloud-based technologies enhance collaboration with other healthcare professionals?

*Organizational Support*

1. Does your organization provide sufficient training for cloud health technology adoption?
2. Do you receive organizational encouragement to use cloud health technologies in patient care?

*Individual Adaptability*

1. How easily do you adapt to new healthcare technologies?
2. How do you perceive your ability to overcome challenges related to new digital health technologies?

### Statistical Assessment

The IBM SPSS version 25 tool is used to examine healthcare professionals' adoption of cloud health innovations in rural healthcare facilities. Multiple regression analysis (MRA) may be used to determine the elements that affect acceptance, including perceived utility, usability, and dependability. The reliability testing ensures the accuracy of the scales utilized for the analysis. Assessing the model's fit and determining the correlations between variables could be performed through path analysis using structural equation modeling (SEM) analysis.

## RESULTS

The path analysis, reliability testing, and MRA are used to examine how effectively healthcare workers in rural healthcare institutions embrace cloud health technology. Reliability testing guarantees data consistency, whereas MRA determines the factors affecting acceptability. To improve the efficiency and delivery of healthcare services in remote areas, path analysis assesses the correlations between factors and offers a thorough model of healthcare workers' attitudes and behavioral intentions toward implementing cloud technology.

### Multiple Regression analysis (MRA)

An MRA was used to evaluate the parameters influencing healthcare professionals' adoption of cloud health technology. The findings show that the Standardized Coefficient (β) reflects relative relevance, whereas the Unstandardized Coefficient (B) indicates the level of influence. A t-value > 1,96 and a p-value < 0,05 indicate that the association is significant. Significant predictors indicate a considerable effect on acceptance, directing future adoption efforts. The outcomes of MRA are displayed in table 2. The calculation reliability testing was shown below in equation (1).

$$HCP - ACT = \beta_0 + \beta_1 TR + \beta_2 PU + \beta_3 OS + \beta_4 IA + \epsilon \quad (1)$$

Where HCP-ACT is the dependent variable, TR, PU, OS and IA indicate the independent variables, $ß_0$ indicates the intercept, $\epsilon$ represents the error term, and $ß_1$, $ß_2$, $ß_3$ and $ß_4$ represent the coefficients of dependent variables.

**Table 2.** Outcomes of Multiple Regression Analysis

| Hypothesis | B | ß | t-value | p-value |
|---|---|---|---|---|
| H1 | 0,28 | 0,30 | 5,80 | p < 0,001 |
| H2 | 0,37 | 0,39 | 8,75 | p < 0,001 |
| H3 | 0,26 | 0,27 | 5,40 | p < 0,001 |
| H4 | 0,31 | 0,32 | 6,50 | p < 0,001 |

The prediction ability of important adoption determinants on healthcare professionals' acceptability of cloud health technologies is evaluated using MRA. H2 had the largest influence (B = 0,37, $\beta = 0,39$, t = 8,75 and p < 0,001), supporting the concept that usefulness promotes adoption. Another important factor is individual adaptability (B = 0,31, $\beta = 0,32$, t = 6,50 and p < 0,001), which suggests that professionals regarded as more flexible are more likely to employ cloud technology. Organizational support (B = 0,26, $\beta = 0,27$, t = 5,40 and p < 0,001) and H1 (B = 0,28 $\beta = 0,30$ t = 5,80 and p < 0,001) are also significant factors. Statistical significance is usually indicated by a p-value of less than 0,05, and all variables have p < 0,001, indicating extremely significant impacts are displayed in Figure 4. According to these findings, healthcare organizations should concentrate on enhancing H2 and H4 through policy support, infrastructure development, and training to guarantee the long-term use of cloud technology.

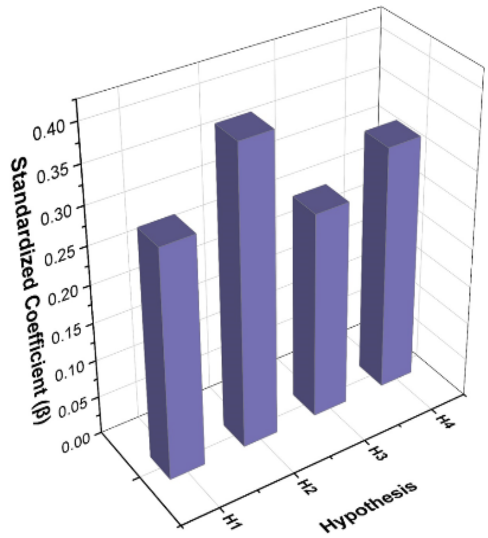


**Figure 4.** Graphical representation of the result of MRA's Standardized Coefficient

**Reliability testing**

The consistency in assessing healthcare professionals' use of cloud health technologies was ensured by reliability analysis, which evaluated internal consistency by employing connections to validate measurement stability. Composite Reliability (CR) and Cronbach's Alpha (CA) were utilized to assess the accuracy of healthcare professionals' adoption of cloud health technologies. When the CA score is ≥0,70 and the CR is ≥ 0,70, the internal consistency is considered excellent. These standards guarantee the validity and reliability of the scale, ensuring that the measurements reliably record medical professionals' use of cloud health technology for research purposes. Table 3 displays the result of reliability testing. The calculation reliability testing was shown in equations (2-3).

$$\propto = \frac{N}{N-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right) \quad (2)$$

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum \theta_i} \quad (3)$$

https://doi.org/10.56294/mw2023136

Where N signifies the number of items in the scale, $\sigma_i^2$ indicates the modification of each term, $\sigma_t^2$ signifies the overall modification of the scale, $\theta_i$ indicates the error modification of item i, and $\lambda_i$ represents the factor loading of item i.

**Table 3.** Result of Reliability testing

| Variable | CA | CR |
|---|---|---|
| H1 | 0,85 | 0,88 |
| H2 | 0,83 | 0,86 |
| H3 | 0,84 | 0,87 |
| H4 | 0,80 | 0,84 |

The CR values, which fall between 0,84 and 0,88, demonstrate the substantial level of consistency and low measurement error of each component. Strong dependability is also shown by H3 and H1, with corresponding α values of 0,84 and 0,85. CA indicates effective reliability and internal consistency values that are above the 0,70 standards for every variable. CR surpasses the 0,70 standard for all factors, with H1 having the highest CR of 0,88 was shown in figure 5. This guarantees that responses appropriately represent the perspectives of medical professionals about the use of cloud health technologies.

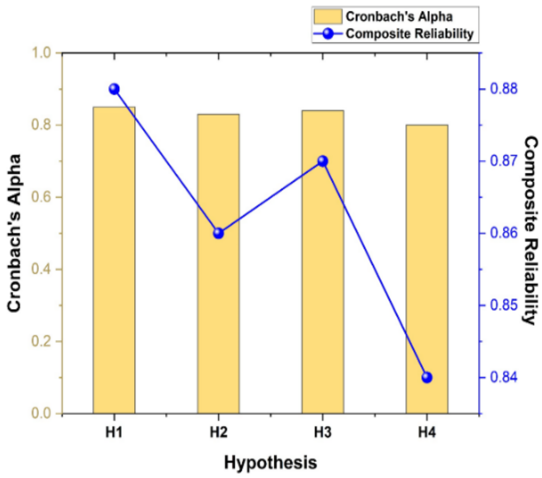


**Figure 5.** Graphical representation of the result of reliability testing's CA and CR

**Structural Equation Modeling**

The acceptability of cloud health technologies by healthcare professionals was analyzed using the SEM with path analysis standard errors (SE), path coefficients (β), p-values, and t-values. The significance level was determined at $p < 0,05$. Stronger connections were indicated by higher β, and significance was validated by t-values > 1,96. Table 4 displays the result of the SEM analysis. The calculation reliability testing was shown below in equation (4).

$$Y = \beta X + \epsilon \qquad (4)$$

Where X indicates the independent variables, Y represents the dependent variable, $\epsilon$ indicates the error term, and β represents the path coefficient.

**Table 4.** Result of Structural Equation Modeling Analysis

| Hypothesis | Path Coefficient (β) | Standard Error (SE) | t-value | p-value |
|---|---|---|---|---|
| Technological Readiness → HCP-ACT | 0,32 | 0,05 | 6,40 | p < 0,001 |
| Perceived Usefulness → HCP-ACT | 0,41 | 0,04 | 9,25 | p < 0,001 |
| Organizational Support → HCP-ACT | 0,28 | 0,06 | 5,70 | p < 0,001 |
| Individual Adaptability → HCP-ACT | 0,35 | 0,05 | 7,00 | p < 0,001 |

The HCP-ACT and independent factors are examined using path analysis. The path coefficients (ß) represent the degree of correlations. A strong connection between technology readiness and healthcare professional behavior is demonstrated by the technology readiness → HCP-ACT path, which has a path coefficient of 0,32. The connection's strong significance is shown by the t-value of 6,40, SE of 0,05, and p-value of less than 0,001. A t-value of 9,25, SE of 0,04, p-value<0,001, and a greater path coefficient of 0,41 for perceived usefulness → HCP-ACT further suggest its significant beneficial effect on HCP-ACT. A statistically significant impact is shown by a p-value of less than 0,001, SE of 0,06, and a path coefficient of 0,28 with a t-value of 5,70, which exceeds the critical threshold for organizational support → HCP-ACT. With a t-value of 7,00. SE of 0,05 and a path coefficient of 0,35, individual adaptability → HCP-ACT indicates a significant positive effect on healthcare professional behavior as displayed in figure 6. The statistical significance is indicated by the p-value less than 0,001. Policymakers can benefit from path outcomes, which indicate that institutional support and training investments can increase the use of cloud health technologies.

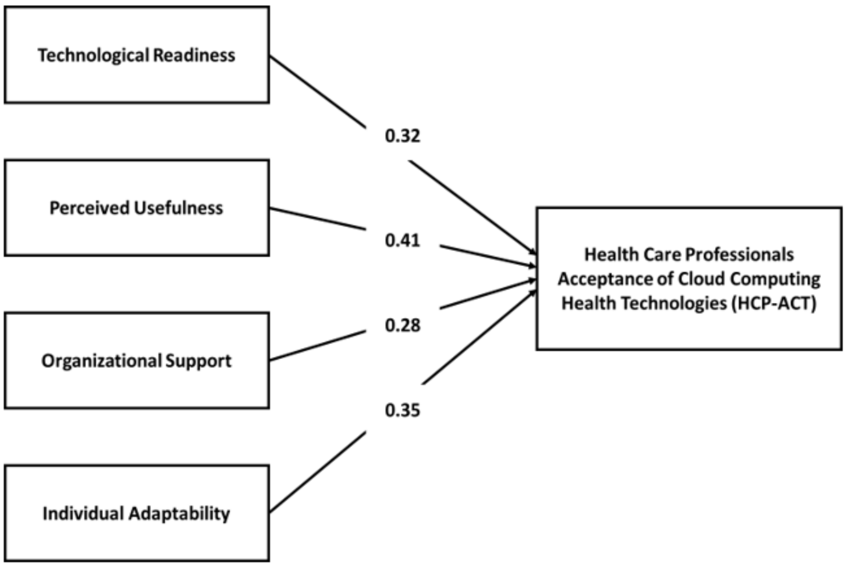


**Figure 6.** Graphical representation of path coefficient result

## DISCUSSION

The findings of the MRA show that the best predictor of cloud health technology adoption by healthcare professionals is H2 (B = 0,37, β = 0,39, t = 8,75, p < 0,001). This highlights the need to show the technology's effectiveness in medical environments. Another important factor is H4 (B = 0,31, β = 0,32, t = 6,50, p < 0,001), which implies that more adaptable healthcare personnel are more likely to use new technology. To facilitate adoption, both H1 (B = 0,28, β = 0,30, p < 0,001), t = 5,80 and H3 (B = 0,26, β = 0,27, t = 5,40, p < 0,001) are essential, highlighting the significance of institutional support and architecture. The high level of reliability in the evaluation measures is indicated by the reliability study, which shows CA values ranging from 0,80 to 0,85, above the suggested standard of ≥0,70. The reliability and low measurement error across variables are further confirmed by CR values, which range from 0,84 to 0,88 with the highest value of 0,88 for H1 ensuring that the scale accurately reflects the perspectives of medical experts about the deployment of cloud health technologies. The substantial correlations are further supported by the path analysis, which shows statistically significant (p < 0,001) path coefficients of 0,35 for individual adaptability and 0,41 for perceived usefulness. These results indicate that increasing cloud health technologies' perceived usefulness and individual adaptability, along with robust organizational support, might greatly increase healthcare professionals' adoption.

## CONCLUSIONS

Rapid advances in cloud health technology have significantly revolutionized healthcare delivery, providing promising responses to persistent difficulties experienced by healthcare systems, particularly in rural areas. The results of the MRA showed that the best indicators of healthcare staff's adoption of cloud health technologies are H2 (B = 0,37, ß = 0,39, t = 8,75 and p < 0,001) and H4 (B = 0,31, ß = 0,32, t = 6,50 and p < 0,001). The reliability analysis indicated strong internal consistency, with CR values ranging from 0,84 to 0,88, the highest was 0,88 for H1. Path analysis demonstrated that these characteristics had a beneficial impact on adoption behavior, with p < 0,001 of a path coefficient of 0,35 for individual adaptability and 0,41 for perceived usefulness, highlighting the significance of perceived usefulness and individual adaptability in encouraging healthcare professionals to embrace cloud technology. Limitations that hinder the successful deployment of cloud health solutions in remote areas include restricted internet connection, insufficient facilities, resistance to change,

https://doi.org/10.56294/mw2023136

lack of technical expertise, security concerns, high prices, and inadequate training. Future scope includes extending cloud technology integration, upgrading data security measures, offering specialized training for healthcare professionals, improving internet infrastructure, and encouraging collaboration with tech providers to improve the quality and accessibility of healthcare in remote areas.

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## FINANCING
None.

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

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